

**RESEARCH AND DEVELOPMENT CENTER  
OF SHERBROOKE**

Major renovation of the hydraulic heating and  
cooling network – Phase 2 –Electromechanical  
sections – PWGSC: R.078727.001.

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**TOME 1: SPECIFICATIONS – MECHANICAL**

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**RESEARCH AND DEVELOPMENT CENTER OF SHERBROOKE**  
**2000, COLLEGE STREET**  
**SHERBROOKE (QUÉBEC)**  
**J1M 0C8**

**MAJOR RENOVATION OF THE HYDRAULIC HEATING**  
**AND COOLING NETWORK – PHASE 2 –**  
**ELECTROMECHANICAL SECTIONS – PWGSC: R.078727.001.**

**DIVISIONS 01, 02 AND 23**



**For tender**  
**April 1<sup>st</sup>, 2016**

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**Part 1            Generalities**

**1.1               RELATED REQUIREMENTS**

- .1       All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               PROJECT PLANNING AND MANAGEMENT**

- .1       The current project at the research and development center of Sherbrooke (RDCS) is realized with two (2) sets of complementary tender documents.
- .2       The general contractor will be responsible for the control contractor who will become is sub-trade and therefore be responsible for the tender documents and drawings of phase 1 (annex 2). For all other sub-trades, tender documents and drawings of phase 2 will be applicable.
- .3       Keeping in mind the realisation period for the project, it is of the primary importance that the Contractor follows a strict schedule in order to respect the allowed realisation period. The following milestone (non-exhaustive list) can be optimized or modified upon preliminary agreement with the Departmental Representative.
- .4       Any delay in the project realisation upon realisation period will be of the Contractor's responsibility who will, at his own cost, do all necessary work/action to avoid any prejudice to the Owner. This will include the temporary leasing of appropriate cooling/heating equipment to assure thermal comfort inside the building, no matter the season, and all workmanship and material necessary for the temporary work.
- .5       Phase 2.1 : Summer 2016 (May 2016 to September 2016)
  - .1       The completion of all the work in the heating network:
    - .1       Dismantling of all heating equipment as shown on plans.
    - .2       Installation of the new boilers (water & steam).
    - .3       Installation of the preheating coil.
    - .4       Installation of pumps and heat exchangers in regards to heating work.
    - .5       Installation of chemical treatment.
  - .2       Replacement of energy recovery wheel.
  - .3       Architecture work necessary to the phase 2.1 work.
  - .4       Structure installation on the roof for the air cooled condenser (by structure).
  - .5       Structural reinforcement (by structure).
  - .6       Dismantling of the underground tanks (by civil).
  - .7       Temporary modifications of the discharge piping of the PB-1 pump in order to assure appropriate operation of the existing chillers (REF-1 & REF-2) with the existing cooling towers (T-2& T-3). This will free the NPS 5 existing piping necessary in the new heating network.
  - .8       Test, startup, commissioning, cleaning, etc.

- .9 Phase 2.2 (autumn 2016-winter 2017) preliminary work.
- .10 Any other work that doesn't cause prejudice to the building operation and project schedule.
- .6 Phase 2.2 : Autumn 2016 – Winter 2017 (October 2016 to March 2017)
  - .1 The completion of all the work in the cooling network, in phase:
    - .1 Dismantling of all cooling equipment as per indications on plans, while respecting the temporary work schedule in order to assure proper working of all equipment.
    - .2 In order to assure proper operation of the heat pumps, U-3 and U-4 cooling coils and building fan-coils, provide for temporary piping to condensing unit CU-3 and CU-4 with the cooling tower T-1. Plan the rental of an inline pump for the cold glycol supply to all equipment. Proceed with piping modifications as shown on the drawing (temporary work). Provide balancing valves.
      - .1 Pump of 3.8 l/s, 50' of head, 1750 rpm, 2 HP, 600/3/60.
    - .3 Installation of the chillers.
    - .4 Installation of the air cooled condensers.
    - .5 Installation of pumps and heat exchangers in regards to cooling work.
    - .6 Installation of chemical treatment.
    - .7 Following the completion of the installation of the main equipment (items nos. 3 to 6), proceed with the transfer of the equipment supplied by condensing units (CU-3 and CU-4) toward the REF-3 chiller and cooling tower T-4. Proceed with the dismantling of the temporary work and complete the installation of every equipment.
  - .2 Architecture work necessary to the phase 2.1 work.
  - .3 Test, start-up, commissioning, cleaning, etc.

### **1.3 SCHEDULE OF WORK**

- .1 Unless noted, the Contractor must respect the opening hours of the RDCS for the execution of the project, which are from 8 h to 17 h, Monday to Friday. If the Contractor wishes to have extended hours or even work on weekends, he shall make a formal request to the Owner and the Departmental Representative. It is also important to take in consideration that any service interruption, loud work or any type of work that may bother the personnel must be executed outside of the opening hours of the RDCS, with the Owner and Departmental Representative approbation.

### **1.4 VERIFICATION OF THE DRAWINGS AND SPECIFICATIONS**

- .1 Only drawings and specifications marked "for tender" should be used for the calculation of bids.
- .2 Check that the copy of the documents is complete: number of drawings, specifications' number of pages.



- .3 Specialties mentioned in the titles of the drawings are to facilitate the work of each section and should not be regarded as restrictive.
- .4 Drawings indicate the approximate placements of equipment. Each section must check the exact emplacements before any installation.
- .5 During bids, each section must study the mechanical and electrical drawings and specifications and compare them with architectural and structural drawings and specifications and notify the architect or engineer at least five working days before submission of his tender of any contradictions, errors or omissions that can be observed.
- .6 During the execution of the works, notify the architect or engineer of any inconsistency, error or omission discovered before starting the work.
- .7 The engineer reserves the right to interpret the contents of mechanical and electrical drawings and specifications.
- .8 No indemnity or compensation will be given for the displacement of ducts, pipes, etc., deemed necessary because of the architecture, the structure or any other normal consideration.

#### **1.5 IMPORTANT NOTE: PROVIDE AND INSTALL**

- .1 Provide and install all materials and equipment described in this specification and/or shown in the drawings, regardless if the expression "provide and install" is used or not. See also the article "MINOR WORKS".

#### **1.6 LAWS, REGULATIONS AND PERMITS**

- .1 All laws and regulations issued by the authorities having jurisdiction relating to the works described herein apply. Each section is required to comply with them without additional compensation.
- .2 Each section must obtain, at its expense, all necessary permits and certificates, pay all costs for drawing approvals and for inspections required by organisms having jurisdiction.
- .3 Provide a copy of the drawings bearing the seal of approval of the relevant inspection services.
- .4 Upon completion of the works, provide the owner with a copy of all the permits and approval certificates from the different offices and departments that have jurisdiction over this building. Submit a copy of the transmittal to the Departmental Representative.

#### **1.7 MINOR WORKS**

- .1 Every section must provide all required components and must do all of the minor works that are necessary for the equipment or system to work properly, even if not specified in the specifications guide.

## **1.8 TOOLS AND SCAFFOLDING**

- .1 On the construction site, provide a full range of tools for the proper execution of the work. Furthermore, provide, erect and remove the scaffoldings required to perform the work.

## **1.9 COOPERATION WITH OTHER TRADES**

- .1 Each section must:
  - .1 Cooperate with the other trades working on the same building or project.
  - .2 Stay informed of the additional drawings issued to other trades.
  - .3 Verify if these drawings are in conflict with its work.
  - .4 Organize its work to not to interfere with the other works being executed in the building.
  - .5 Collaborate with the other sections to determine the location of access doors in walls and ceilings.
- .2 During the works, if necessary, the relevant section must remove and replace the tiles or access doors to reach its equipment and repair, at its own expense, all the damage it has caused. Protect the furniture and restore the premises to a clean condition when the work is completed.

## **1.10 MATERIALS**

- .1 Unless otherwise stated, use new materials, clear of imperfections or defects, of the specified quality, bearing the approval labels of CSA, ULC, FM, AMCA, ARI or any other in accordance with the particular specialities.

## **1.11 PROTECTION OF WORKS AND MATERIALS**

- .1 Each section must protect its installations against all damage, from any cause, during the execution of works until the work is accepted in a definitive manner.
- .2 All equipment and materials stored on-site must be adequately protected, sheltered from bad weather, or any other possible damage.
- .3 At the end of each work day, seal with a screw cap or a suitable metal cap all openings in conduits of any kind.

## **1.12 SHOP DRAWINGS**

- .1 Before the fabrication of any equipment, submit for verification in PDF format the shop drawings, a copy annotated by the Departmental Representative will then be returned as a PDF by e-mail. The drawings will need to show the dimensions, the weight, the number of attachment points, where the centre of gravity is, the seismic classification, the wiring diagrams, the capacities, the control diagrams, the performance curves, the space needed for maintenance and any other relevant data. If needed, clearly indicate, for each equipment, the dimensions and the location of required plumbing, heating and electrical connections. Each drawing must be verified, coordinated, signed and dated by the concerned trade before being submitted for verification.
- .2 Shop drawings must be relevant to the proposed equipment. The sheets from general catalogs are not accepted as shop drawings. Each drawing must be identified with the name of the project, the Departmental Representative's name, the date and designation of the equipment shown in the drawings and specifications. Drawings must be prepared and signed by the supplier. Drawings pulled from the supplier's website are not accepted.
- .3 The verification of shop drawings is general and has the main purpose of avoiding as many errors as possible in manufacturing. This verification does not relieve the relevant section of its liability for errors, omissions, information, dimensions, quantity of equipment, etc., appearing in his drawings.
- .4 The drawings must be in French.
- .5 The contractor must make the necessary copies of the reviewed and / or updated shop drawings to include them in the instruction manuals to be provided at the end of the work. See the article "OPERATION AND MAINTENANCE MANUAL".

### **1.13 COORDINATION DRAWINGS**

- .1 Generalities:
  - .1 Coordination drawings, also called composite drawing, are required in all cases where interference between different trades' works need such drawings to illustrate that the work is realizable.
  - .2 Coordination drawings must show clearly and precisely, all the works involved, those of the relevant section and those done by others.
  - .3 Communicate with the Departmental Representative to procure architectural basemap.
- .2 Description:
  - .1 Coordination drawings consist of dimensioned plans, to scale, indicating the position of the equipment, ducting, piping, valves and other accessories with cuts and details required, complete with piping and duct dimensions, locations of ducts, openings, anchorages and supports, relative positions with structure, architectural works and other mechanical and electrical work.
  - .2 Provide drawings at a 1/30 scale (3/8") on paper.
- .3 Preparation:

- .1 Each relevant section should make its coordination drawings and coordinate them with other disciplines.
  - .2 The Division 23 (see "HEATING, VENTILATING AND AIR CONDITIONING") is responsible for the coordination with all mechanical and electrical trades for its coordination drawings. These sections must provide all the data, schematics, drawings and, diagrams necessary for this coordination work.
  - .3 The Division 23 (see "HEATING, VENTILATING AND AIR CONDITIONING") must prepare a drawing of its own work with all the necessary data and dimensions and incorporate all information provided by other trades into it.
  - .4 All drawings without exception must be coordinated by the Division 23 (section "HEATING, VENTILATING AND AIR CONDITIONING") with the collaboration of all mechanical and electrical Divisions.
  - .5 All coordination drawings for a given sector must all be submitted together for verification.
- .4 Collaboration:
- .1 Close collaboration must exist between the all businesses responsible for the work to determine the location of their respective work and avoid incompatibilities.
- .5 Distribution of coordination drawings:
- .1 Submit to the Departmental Representative for review, a PDF copy of the coordination drawings, approved by the contractor and signed by all sections.
  - .2 Once commented on, the drawings will be corrected by the relevant section, and if required, resubmitted.
- .6 Responsibility:
- .1 Each section is directly responsible for the emplacement and exact dimensions of openings, perforations and sleeves, location of the equipment, pipes and ducting, whether the structural, architectural or engineering drawings are listed or not.
  - .2 The Division 23 (section "HEATING, VENTILATING AND AIR CONDITIONING") must ensure the full coordination of its work with the coordination drawings.
  - .3 No compensation will be given for the modifications imposed on the work, for the purpose of coordination and integration of the electromechanical systems amongst them.
  - .4 Notwithstanding the responsibility of coordinating the integration, work cannot be implemented without prior verification of the coordination drawings. Each section must redo, at its expense, all work nonconforming to the coordination drawings without any compensation based on a misinterpretation of the scope and limitations of its work. Such misinterpretations do not relieve the relevant section of its responsibilities and obligations to provide complete and duly proven, ready to operate systems in perfect condition and fully integrated.
  - .5 Verification of coordination drawings by the engineer is limited to ensuring that the technical requirements seem to be met (fire dampers, grids, insulation, etc.). The engineer does not check the quality of the coordination carried out by the contractors.

- .7 Pre-existing work:
  - .1 Coordination drawings should take into account existing mechanical, electrical, structural and architectural installations as well as planned work.
- .8 Coordination drawings are required for:
  - .1 The placement of sleeves, openings and perforations expected in the walls, floors, beams and columns.
  - .2 All heating, ventilating & air conditioning.
  - .3 All mechanical shaft supports.
  - .4 All mechanical and electrical work in mechanical rooms.
  - .5 All mechanical and electrical work in all places where space is particularly restricted
  - .6 Places described in sections of the Divisions 23 and 26.
  - .7 This clause is not restrictive. Coordination drawings may be demanded in places deemed necessary.
  - .8 Coordination drawings of the boiler room, cooling towers, etc., are the responsibility of the Division 23 (section "HEATING - CHILLED WATER").
- .9 Collaboration drawing originals:
  - .1 Upon completion of the works, a USB flash drive of each guidebook and two hard copies of the drawings of the work, as executed, must be given to the owner at no cost, by each mechanical and electrical section.

#### **1.14 CONCRETE WORKS**

- .1 Concrete works required for mechanical and electrical include the formwork, the rebar, meshing, the concrete, casting, and concrete finishing.
- .2 These works include concrete bases and foundations necessary for equipment and piping, such as pumps, fans, chillers, boilers, transformers, generators, buffer tanks, electrical conduits, lamp posts, electrical power distribution stations, furniture, etc.
- .3 Install all equipment, inertia bases, integral bases, electrical equipment, etc., on a concrete leveling base.
- .4 Anchor leveling bases to the structural slab. Unless otherwise specified, it must have a minimum thickness of 75 mm above the finished floor. The perimeter must extend at least 100 mm above the base of the equipment. The surface must be clean, smooth and level, and with 20 mm x 20 mm bevelled edges on the perimeter. These bases must be reinforced by a metal mesh.
- .5 The other bases should include, in addition to wire mesh, steel reinforcement bars (rebar).
- .6 The concrete must have a minimum strength of 25 MPa after twenty-eight days.
- .7 Affix the equipment to the bases by means of anchor bolts and expansion shields (by the section providing the equipment). Use chemical anchors if required.

- .8 Each relevant mechanical and electrical section should provide the details of its bases on its cooperation drawings.
- .9 For details on the bases, see the description of all equipment in the specifications or in the drawings.
- .10 Concrete works are the responsibility of the general contractor with the coordination of requirements by each relevant section.

#### **1.15 UP TO DATE DRAWINGS**

- .1 Each section must, at its expense, clearly indicate all changes, additions, etc., on a separate copy of the drawings and specifications, so as to have a complete and accurate copy of the work as executed and materials installed when the contract is completed. In particular, any displacement, even minor, of underground piping must be indicated with precision.
- .2 This copy of the drawings must be kept up to date and be available on site.
- .3 Deliver these plans to the owner at the end of the works.

#### **1.16 OPERATION AND EQUIPMENT MAINTENANCE INSTRUCTION MANUALS**

- .1 Each section must provide the owner with four copies of manuals with detailed instructions for the operation and maintenance of all equipment and appliances included in his contract. Also provide a USB flash drive.
- .2 These manual must contain:
  - .1 A list and illustration of all equipment components: pumps, fans, filters, controls, burners, alarm panels, lighting fixtures, transformer stations, generators, fire alarms, etc.
  - .2 A copy of the approved shop drawings, and as executed.
  - .3 The instructions for lubrication published by the manufacturers with the specifications of the oils and greases to be used and the frequency of lubrication.
  - .4 A diagram indicating the identification numbers of each valve, the normal operating position, the location, and flow direction for each of the piping systems.
  - .5 Prepare a properly attached glossary containing the number, location, and function of each valve. This glossary should contain a separate chapter for all shut down (or emergency) valves and main valves. The numbering code must be approved.
  - .6 A diagram of the controls with explanatory text.
  - .7 A list identifying access points to fire shutters and controls in the walls and ceilings.
  - .8 A list of legends of the piping, the piping identification codes, and ventilation systems.
  - .9 A list of the systems' final calibration values, as approved.
  - .10 A list of the different subcontractors with names, addresses, and phone numbers.
  - .11 A list of representatives and / or manufacturers of the installed equipment with names, addresses, and phone numbers.

- .12 These instructions must contain all the graphics, curves, capacities and other data provided by the manufacturers concerning the operation and details of all mechanical and electrical equipment installed in the building.
- .13 The fan graphics must clearly indicate the specified operating point and the required horsepower. These graphics should also indicate the serial number, fan model, and the operating speed.
- .3 The entirety must be written in English.
- .4 Divide each manual in the sections using blank sheets which have colored tabs with the necessary identification. For example: "CENTRAL SYSTEM FAN". At the beginning of the manual, insert a table of contents with the title of each section and identification of the corresponding tab.
- .5 Each manual is covered with a black cardboard, allowing the binding of loose sheets with 215 mm x 275 mm binding strips.
- .6 Submit a copy to the engineer for comments and then deliver three copies of the manuals to the owner and one to the engineer.
- .7 These manuals should be submitted before final trials. Provide an empty section to later add calibration and commissioning reports.

#### **1.17 CONCEALED WORK**

- .1 Do not conceal any work, material, such as pipes, boxes, etc. before the installation has been verified.
- .2 If a section does not comply with this requirement, it will have to pay the cost of all work required to proceed to the examination of the works.
- .3 Unless otherwise indicated, all piping and ducts must be concealed in partitions, walls, between floors, in ceilings, etc. The cost of all necessary wall covering shall be borne by the contractor.
- .4 Reread the articles "COOPERATION WITH OTHER TRADES" and "TESTING".

#### **1.18 PLACEMENT OF PIPING AND DUCTS**

- .1 No pipe must not be in contact with another. Allow a clearance of at least 15 mm ( $\frac{1}{2}$  ") between them. No piping may be in contact with any part of the building. Take special care in the case of piping through a steel beam.
- .2 Take particular care to conserve space in vital areas, including in the case of piping rising along columns.
- .3 Any piping or ducting that may possibly be covered by insulation must be installed at a sufficient distance from walls, ceilings, columns or other piping , ducts, and equipment to facilitate the insulation of the pipe or duct.

- .4 Any piping or ducting placed horizontally must be installed to maximize the ceiling height. This is of particular importance in rooms where ceilings are suspended, such as in parking lots and warehouses.
- .5 Exposed piping should be straight and generally, parallel to the framework.
- .6 Consider the symmetry with respect to the piping of the apparent equipment. Consult the architect or the engineer if necessary.
- .7 Before installing a pipe or duct, make note of the location of the other mechanical, electrical, architectural and structural work to avoid interference, otherwise the relevant section will be required to move the pipe or duct at its expense.
- .8 When uninsulated piping passes through a wall or a poured concrete floor, install rigid insulation on the pipe before casting, after the installation of the pipe, so that the concrete does not come into contact with the pipe.

#### **1.19 MANUFACTURERS' INSTRUCTIONS**

- .1 Install the various pieces of prefabricated materials and equipment, in accordance with the manufacturer's instructions. Obtain all relevant instructions.
- .2 Ensure the presence of the manufacturers' representative to attest the conformity of the installation.

#### **1.20 LAYOUT AND ACCESS TO THE EQUIPMENT**

- .1 Install the equipment so that they are easily accessible for maintenance, disassembly, repair, and moving.
- .2 Pay particular attention to the motors, belts, bushings, heat exchangers and boiler tubes, fittings, valves, controls, rotating shafts, etc.
- .3 If necessary, install access doors and accessories, such as extensions for the lubrication of bushings, etc.
- .4 Installation of equipment:
  - .1 Ensure that maintenance and disassembly can be done without having to move the connecting elements of the piping and ducts, by the use of union fittings, flanges or valves, and without the building structural members or other installations being obstacles. Dismantling must be possible without emptying networks and / or stopping the power supply to other equipment.
  - .2 The manufacturer's nameplate and stamp or label of the standardization and approval bodies must be visible and readable once the equipment has been installed.
  - .3 Provide fasteners and metal accessories of the same texture, color and finish as the support metal to which they are attached. Use non-corrosive fasteners, anchors, and shims to secure the external and internal work.
  - .4 Ensure that the floors or tiles on which the equipment will be installed are level.



- .5 Check fittings done at the factory and retighten them if necessary to ensure the integrity of the installation.
- .6 Provide a means to lubricate the equipment, including Lifetime lubricated shaft housings.
- .7 Connect the equipment's drainage piping to the drains.
- .8 Align the edges of the equipment/device to the building walls.
- .5 Disposition for the future:
  - .1 In any place where a space was left free for future use, ensure that this space remains free and install materials and equipment related to the work so that future connections of the added equipment can be done without needing to redo the floor, walls or ceiling, or even, a portion of the mechanical or electrical facilities.

## **1.21 PAINTING**

- .1 Apply a base coat of mordant on any non-galvanized metal equipment or equipment supports. Before leaving the premises, touch up the base coat of all the damaged areas after removing any rust.
- .2 The base coat is a sandable grey colored water based acrylic, this product can be used as a base layer and to paint cut or perforated sections of galvanized apparatus, equipment or equipment supports.
  - .1 Such as the Sierra Performance S30 Griptec from Rust-Oleum, or Sierra Performance S71 as an aerosol.
- .3 Unless otherwise indicated, do not apply a layer of mordant on the uninsulated pipe, except when subjected to weather.
- .4 On insulated pipes, no additional painting is required to that required by the insulation terms.
- .5 Ensure that access doors of all kinds, including the opening convector panels, electrical panels, etc. are painted in the open position to ensure freedom of movement.
- .6 See Section 23 05 53.01 – Identification of networks and mechanical equipment.

## **1.22 FRAMES, SUPPORTS, AND CONSOLES**

- .1 Each relevant section must provide and erect all frames and consoles required for the equipment it installs: reservoir tanks, panels, motors, starters, key switches, etc.
- .2 Install equipment at the height shown in the drawings, but never less than 75 mm above the floor.
- .3 Build the supports and brackets out of welded and grinded steel. If necessary, install hooks, rails, eyelets, etc., to facilitate installation and removal of equipment.

## **1.23 NEW OPENINGS, DRILLING IN WALLS, FLOORS, BEAMS, AND COLUMNS**

.1 Generalities:

- .1 Unless otherwise indicated, the openings necessary for the piping and ventilation ducts, in the form of sleeves to install or drilling, are the responsibility of each relevant mechanical and electrical section.
- .2 Each relevant section is responsible for all damages and breaks due to its drilling.
- .3 Openings must be shown and located on the coordination drawings, located and identified on the site in a manner accepted by the contractor and the structural engineer before drilling.
- .4 The openings must be sufficiently large to permit the laying of ducts and thermal and acoustic insulation.
- .5 Any drilling in the structure must be approved by the structural engineer.
- .6 Piercing holes with pneumatic or electric hammers by vibratory action as well as hand drilling and any other process by mechanical impacts are prohibited.
- .7 In the concrete, drill the holes using a rotary water drill or any other equipment accepted by the structural engineer.
- .8 In the steel deck, drill and reinforce openings, according to the guidelines of the structural engineer.
- .9 It is not allowed to drill in column projections or strips without special permission from the structural engineer who will decide how to proceed.

.2 Round, square and rectangular openings in concrete:

- .1 All new round openings required for ventilation work and all new square or rectangular openings required for mechanical and electrical works in the concrete must be done by the contractor of the relevant section, following the structural engineer's guidelines, and at their expense.

.3 Openings in concrete block walls and drywall:

- .1 Openings to be drilled by the contractor. Sealing of openings by the contractor. In the case of openings in piping of temperatures higher than 38°C, the relevant mechanical section must install a 20 gauge galvanized steel sleeve, according to the article "SLEEVES" in this section.

.4 Concrete beams and columns:

- .1 The drilling of new openings in the concrete beams and columns is prohibited.

.5 Steel beams and columns:

- .1 The drilling of new openings in the steel beams and columns is prohibited.

.6 Steel deck:

- .1 All new openings required through the steel deck for mechanical and electrical work and reinforcements required for this bridging must be done by the general contractor. However, each mechanical section should locate and give the dimensions of the openings on the site, in a manner acceptable by the contractor and the structural engineer.

.7 Floor drains and funnel drains:

- .1 All new vertical openings to be drilled in the concrete for the laying of new floor drains and funnel drains should be performed as follows: in the upper part of the slab, with a diameter sufficient to lay the drain body, and in the lower part, with a sufficiently smaller diameter to lay the drainage pipe. The drain body part must be made watertight using of epoxy.

.8 Vertical openings in concrete for piping:

- .1 All new vertical openings to be drilled in concrete with integrated finish or already cast finish, for the laying of pipes, must be performed as follows : In the upper part of the slab, with a sufficient diameter to affix the sealing plate of the sleeve, and in the lower part, with a sufficiently smaller diameter to accommodate the steel sleeve.
- .2 In the case of concrete slab whose finish is not yet cast, the opening in the concrete must be drilled to accommodate the steel sleeve only. Make the sealing plate resting on the raw slab watertight with epoxy before pouring the concrete and / or finish.

**1.24 SUPERVISOR**

- .1 Each section must retain and pay for the services of a competent and permanent supervisor or superintendent who must remain on site until the works are accepted, and, having full authority to represent the section. All communications, orders, etc. supplied by the Departmental Representative or the contractor are considered as given directly to the company responsible for the work of the section.
- .2 Submit for approval the name, qualifications, and experience of the supervisor or superintendent.
- .3 This supervisor cannot be removed from the work site without a valid reason and prior written approval.
- .4 Facilitate site inspections for the owner and the engineer at any time. During these visits, the supervisor must be available to them.

**1.25 INSPECTIONS**

- .1 It is absolutely necessary before any inspection request to the Departmental Representative, that the testing were previously conducted and successful.

**1.26 TESTING**

- .1 Each section must cooperate with the other sections, so as to enable them to complete their tests within the time delay required by the contractor.
- .2 Once the test is finished, readjust all the equipment used for this test, to permit their proper operation.
- .3 General requirements:

- .1 All tests must be performed in the presence of the Departmental Representative and to his satisfaction.
- .2 The Departmental Representative may require a test of installations and equipment before accepting them.
- .3 For temporary trials, obtain written permission to operate and test installations and permanent equipment before being accepted by the Departmental Representative.
- .4 Give a written 48 hour notice to the Departmental Representative before the date of the test.
- .5 Provide equipment, meters, material and staff required to run tests during the project until the acceptance of installations by the Departmental Representative and pay all fees.
- .6 If a piece of equipment or device does not meet the manufacturer's data or the specified performance during a test, immediately replace the defective unit or part and pay all expenses incurred by the replacement. Make adjustments to the system to achieve the desired performance. Cover all costs, including those of new tests and repair.
- .7 Prevent dust, dirt, and other foreign matter from entering the openings of installations and equipment during testing.
- .8 Provide to the Departmental Representative a certificate or letter from the manufacturer confirming that each section of the installation was implemented to their satisfaction.
- .9 Submit the written test results to the Departmental Representative.
- .10 The tests must be performed and accepted prior to the installation of the thermal insulation.
- .11 Do not conceal or embed piping, conduits, or equipment before the tests are completed and accepted.
- .12 By submitting the pipe or conduits to the test pressures required in each of the respective sections, take the necessary precautions to prevent the deterioration of equipment and accessories that cannot withstand such pressures.
- .13 If it is impossible to test the entire installation in a single trial, it can be divided into several zones, each of which will be tested individually. The installation must be tested in several stages.
- .14 Provide hydraulic pumps, air compressors, fans and other equipment necessary to perform all tests and related temporary work.
- .15 Correct any leak detected. The defective part must be removed, repaired and the test is redone until the results are satisfactory.
- .16 Whenever tests are conducted with water, place the pressure gauge at the highest point of the installation.
- .17 Whenever tests are conducted with compressed air, use soap and water on the piping and apparatus to detect air leaks. The air temperature must be the same in the pressure readings. Install a thermometer for this purpose.
- .18 For joints with caulking, it is not permitted to repair cracks using other materials.
- .19 Provide two copies of a written report for each of the tests performed.

- .4 Special requirements:
  - .1 For details about the tests to perform, see the other sections of this specification.
  - .2 The presence of a section can be required in a test conducted by another section.
- .5 Factory tests:
  - .1 The Departmental Representative and the owner reserve the right to examine the equipment in the factory and attend factory trials described in this specification.
  - .2 Notify the Departmental Representative and the owner at least one week in advance of the date, time and place where the factory testing will take place.
  - .3 Submit two certified copies of the factory test reports to the Departmental Representative.

## **1.27 FINAL TESTING**

- .1 Each section must include all costs of final testing to the overall price in its tender. When the work is fully completed and settings, calibrations, and preliminary tests are successfully performed, run the final tests. Notify the Departmental Representative early enough to allow him to attend any of the tests judged necessary.
- .2 In order to demonstrate that the work is complete and executed satisfactorily, each piece of equipment must run for a minimum period of fifteen days and that, prior to acceptance "with reservation". During this period, all equipment must operate simultaneously and not consecutively. The operation must be in automatic mode and as per the controls planned in the operating sequences
- .3 During this period, prior to acceptance "with reservation", each relevant section will need to conduct normal maintenance, in accordance with the instruction manuals provided by the contractor during the maintenance. The maintenance for the period between the provisional and final acceptance will be covered by the owner if all information necessary for maintenance is provided and the training was completed. Otherwise, the contractor will need to undertake the maintenance.

## **1.28 EQUIPMENT CALIBRATION AND OPERATION**

- .1 Generalities:
  - .1 Vibration tests are required to ensure that:
    - .1 The equipment operates within acceptable levels of vibration.
    - .2 That vibration or noise is not transmitted to the building structure.
  - .2 The company in charge of the work of each relevant section must use the services of a firm specialized in vibration analysis to conduct verifications and the work required by this article.
  - .3 Before proceeding to any work, have the selection of the specialized firm, which must be retained to perform the analyses, approved. Submit the qualifications of the firm and the methodology to be used to perform the work.
  - .4 The work must be performed by a qualified engineer or technician.

- .5 Provide a list of personnel who will be assigned to the project and a list of equipment and devices that will be used to perform the analyses.
- .2 Analyses:
  - .1 Fans with a 1 HP or stronger motor must be analyzed.
  - .2 Pumps with a 3 HP or stronger motor must be analyzed.
  - .3 All systems modulated by a variable frequency speed controller must be analyzed over the entire range of operating frequencies.
  - .4 ANSI S3.29 and ISO 2631-2 standards must be followed for occupant comfort.
  - .5 If the acceptable values of vibrations are not available from the manufacturer of the equipment, use the RMS (IRD 1988).
  - .6 Also refer to the chapter "Sound and Vibration Control" from ASHRAE.
  - .7 Minimum criteria to be met:
    - .1 The amplitude parameter is the velocity (mm/sec.). The frequency range used must cover 600 cycles/min. (CPM) (10 Hz) to 600 000 cycles/min. (10 000 Hz).
      - .1 Overall value (unfiltered) for the entire frequency band of the device: maximum velocity of vibrations of 4 mm/sec.
      - .2 Filtered value (by frequency band): peak maximum velocity of 2 mm/sec.
- .3 General procedure:
  - .1 Generalities:
    - .1 All analyses should be performed only when the system is adjusted, calibrated, and functioning according to design requirements. The analyses can be performed during the adjustment period.
    - .2 Provide a coordinated schedule with the contractor's intervention and the owner's activities for the testing of each piece of equipment.
    - .3 During the execution of the works, prepare and present to the contractor and the engineer preliminary reports for later discussion about the tests.
  - .2 Complete a visual check of all equipment to detect any obvious installation error correctable on-site.
  - .3 Ensure the freedom of movement of vibration isolators and that there are no short circuits caused by any obstruction, whether between the equipment or the anti-vibration equipment base and the structure of the building.
  - .4 Operate the equipment and check by hearing for any apparent malfunction.
  - .5 Check the bearings with a stethoscope. Defective bearings must be replaced immediately to avoid damaging the shaft or any other component.
  - .6 Adjust and calibrate the equipment and the system so that the equipment vibration tests are performed at operating conditions.
  - .7 Perform vibration tests.
- .4 Vibration testing procedure:

- .1 The following steps must be followed to ensure that the tests are adequate.
  - .2 Determine the operating speed of the equipment. Using a tachometer or stroboscope, measure the rotational velocity of the driven equipment, as well as that of the motor.
  - .3 Determine and report the acceptable criterion in the report.
  - .4 Ensure the freedom of movement of vibration isolators.
  - .5 Operate the equipment and perform a visual and auditory verification to detect any apparent malfunctioning. Check bearings using a stethoscope. Defective, misaligned, and malfunctioning bearings must be corrected before continuing the test. If corrections are not made, the equipment will be considered unacceptable.
  - .6 Measure and record the bearing vibrations from the driven components as well as of the motors in horizontal, vertical and, if possible axial directions. There must be at least one axial measurement for each rotating equipment.
  - .7 Take a "Spike Energy" reading for each engine to determine its condition.
  - .8 Perform an analysis with respect to time on each engine to detect the probability of an electrical fault.
  - .9 Analyze the results and determine probable causes of the vibration.
  - .10 Proceed to the corrections required for operation within acceptable standards.
  - .11 Perform a new analysis to demonstrate that the equipment is operating within acceptable standards.
- .5 Analyses Reports:
- .1 Submit three copies of the final report.
  - .2 The report should contain, among other things, the following information:
    - .1 For each analyzed system, a diagram identifying the measurement points.
    - .2 The vibration curves generated by the analyzer, indicating the date on it, the measuring range, the multiplier, the filter used, the identification of the analyzed equipment, and the measurement point.
    - .3 A table showing the velocity measurements in inches / sec., As well as the "Spike Energy" for each of the reading points of the equipment.
    - .4 Conclusions from the data collected in relation to vibration criteria and the likely causes of the vibrations.
    - .5 Description of corrective actions done on each device.
- .6 Accepted companies:
- .1 Hydraulique R&O Services Inc.
  - .2 Paul Gilles Vibrations
  - .3 Services Techniques Vibal Enr.
  - .4 Vibra K Consultants
  - .5 Vibro Mec JPB

## 1.29 INSTRUCTIONS TO THE OWNER

- .1 Give to the representative of the owner all the details on the operation of the equipment specified and installed under this contract. Provide qualified personnel to operate this equipment until the owner's representative is adequately qualified to take charge of the operation and maintenance of said equipment.
- .2 This training can be combined with the final testing period provided that the owner's team is available.
- .3 It is understood that such tests are not an automatic acceptance of equipment by the owner.
- .4 The owner has the right to do this test as soon as the work is considered sufficiently complete by the relevant engineer's section, and considered in accordance with the drawings and specifications.

### **1.30 MAINTENANCE DURING THE CONSTRUCTION PERIOD**

- .1 This article applies only in cases where the equipment is used during the construction period.
- .2 In addition to the responsibilities and obligations of each section, as to the temporary or permanent use of its installations and the use of equipment by the owner or any other section during construction and before final acceptance of the work, the relevant section still remains as responsible for the operation, preventive maintenance, or other, of its equipment during the same period.
- .3 For these purposes, each relevant section should, in general manner, use its own labor and its own equipment and administer the direct supervision of these tasks.
- .4 However, the relevant section does not have the responsibility to provide the staff required for the equipment's operation during the construction period and before final acceptance of work. It still remains responsible for the equipment during testing, the adjustment period, calibration, and maintenance of this equipment.
- .5 Supply of spare parts, such as filters, pump belts, fans, compressors and others, as well as providing the energy required for the equipment's operation during the construction period, are the owner's responsibility.

### **1.31 TEMPORARY SERVICES**

- .1 From a mechanical and electrical point of view, temporary services include: electricity, telephone service, fire alarms, lighting, water supply, sanitation and drainage, heating, ventilation, controls, intercom systems, fire protection, refrigeration, and all the systems necessary for the completion of the works.
- .2 All temporary services, as well as energy costs, are the responsibility of the general contractor. Refer to general conditions of contract.
- .3 No device that is not part of the permanent installation will be used for temporary services before the building is deemed complete.



- .4 The temporary service period ends upon acceptance "with reservation".

## **1.32 RENOVATIONS**

### **.1 Continuous service:**

- .1 The following services are not to be interrupted without prior agreement with the owner: telephone, electricity, lighting, intercom, fire alarms, sprinklers, fire protection water, domestic water, sanitary plumbing, storm drainage, external drainage systems, ventilation and air conditioning, etc.
- .2 To ensure the continuity of services at during the hours required by the owner, each relevant section must do all temporary works required, including labor and equipment.
- .3 All major service cuts must be performed outside the occupancy hours of the building. For example: ventilation, heating-cooling, electricity, water, steam, etc.

### **.2 Demolition:**

- .1 All demolition work is the responsibility of each concerned section.

### **.3 Occupied rooms:**

- .1 The work is being done during the occupancy of rooms in the building, therefore, the work must be performed by stages in the rooms designated by the owner.
- .2 Perform work after prior agreement with the owner and establish an acceptable work schedule with the owner.
- .3 Before undertaking work in a given area, ensure the availability of all equipment, tools, and labor required to perform the work without interruption.
- .4 Follow the owner's instructions as to the delivery to the worksite of its personnel and equipment.
- .5 The owner will indicate which staircase can be used and within what limits it is permitted to circulate in the present corridors.
- .6 Take all necessary precautions to adequately protect existing installations in these areas.
- .7 At no time must the traffic and the functioning of the building services be impeded. Follow all of the owner's instructions.

### **.4 Noise:**

- .1 Because of the proximity of the occupied premises, take all necessary measures to reduce the noise from construction and demolition.

### **.5 Other restrictions:**

- .1 In order not to impair the function of the building that must remain in operation during construction:
  - .1 No vehicles other than trucks used to transport equipment has access to the site for the duration of the works.
  - .2 The use of all elevators will be allowed as long as all the Owners requirements are respected.

- .3 The interior circulation outside the boundaries of the services to be renovated must be minimized.
- .4 The access permitted to the various rooms, for demolition and construction purposes, must be determined by the owner.
- .2 Obey the owner's rules and directives about signs, announcements, advertisements, smoking, etc.
- .3 Limit yourself to the area delimited set by the owner for the storage of equipment. They must not congest the area. No part of the construction is to be burdened with a load of equipment that may be hazardous for it.
- .4 Follow the owner's sterility standards.
- .6 Dismantling of existing piping, materials, and equipment.
  - .1 Any removed pipe, fitting, or valve should not be reused.
  - .2 No equipment should be reused.
  - .3 The dismantling of pipes, materials and existing equipment is the responsibility of each concerned mechanical and electrical section unless indicated otherwise.
  - .4 All existing equipment and material removed and not re-used or not returned to the owner, as described below, belong to the respective mechanical or electrical section who are to dispose of them as quickly as possible off site.
  - .5 Every concerned section must anticipate the cost of transporting waste off site and bear all related costs to dispose of it.

### **1.33 EQUIPMENT TO BE HANDED OVER TO THE OWNER**

- .1 Provide the owner with the following items:
  - .1 Maintenance products and portable equipment indicated in the specification.
  - .2 The replacement materials indicated in the specification.
  - .3 The keys of all supplied equipment with locks.
- .2 Obtain receipts from the owner for each of the items mentioned above and give them to the engineer.

### **1.34 CERTIFICATION OF COMPLIANCE**

- .1 Upon completion of the works, each subcontractor must provide the engineer the certificate of compliance attesting that all work was performed according to drawings and specifications, and according to the applicable codes. See the example at the end of this section.
- .2 Submit the certificate to the Departmental Representative at the same time as the request for an attestation of successful work completion.
- .3 Have an administrator from the company sign this form and affix his seal to it.

### **1.35 CLEANLINESS OF THE SYSTEMS**

.1 Take every necessary measure and precaution to keep the inside of all of the ventilation systems' components and ducts clean.

.2 Duct cleanliness:

.1 All ducts and ventilation equipment should be regularly maintained for cleanliness.

### **1.36 CLEANING**

.1 Clean the work area as work progresses. At the end of each work day, or more often if the owner sees fit, remove the trash, carefully arrange the equipment to be used, and do the work site cleanup.

.2 Once the work is completed, remove the scaffolding, temporary protective equipment, and surplus materials. Repair any defects observed at this stage.

.3 Clean the areas used for the execution of works and put them in a state at least equivalent to that which existed before the work began; the cleaning must be approved by the owner.

## **Part 2 Products**

### **2.1 NOT APPLICABLE**

.1 Not applicable.

## **Part 3 Execution**

### **3.1 NOT APPLICABLE**

.1 Not applicable.

**CERTIFICATE DE COMPLIANCE**

Project : \_\_\_\_\_  
Project address : \_\_\_\_\_  
Discipline : \_\_\_\_\_  
Specification section : \_\_\_\_\_

We certify that all materials and equipment used, as well as all apparent or concealed work that we have completed or that we have ordered completed, are in all aspects, compliant with the plans, specification, addenda, and changes prepared by the Engineers of Bouthillette Parizeau inc., and with all applicable codes in effect.

Social reason : \_\_\_\_\_  
Address : \_\_\_\_\_  
Telephone number : \_\_\_\_\_  
Signatory name : \_\_\_\_\_  
Signature : \_\_\_\_\_  
Signatory title : \_\_\_\_\_

**COMPANY SEAL**

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets. Instruction must include product characteristics, performance criteria, physical size, finish and limitations.
- .2       Shop drawings:
  - .1       Drawings to show:
    - .1       Mounting arrangements.
    - .2       Operating and maintenance clearances.
  - .2       Drawings and product data accompanied by:
    - .1       Detailed drawings of bases, supports, and anchor bolts.
    - .2       Acoustical sound power data, where applicable.
    - .3       Points of operation on performance curves.
    - .4       Manufacturer to certify current model production.
    - .5       Certification of compliance to applicable codes.

**1.3               CLOSEOUT SUBMITTALS**

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

- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Use different colour waterproof ink for each service.
  - .3 Make available for reference purposes and inspection.
- .8 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

#### **1.4**

#### **MAINTENANCE MATERIAL SUBMITTALS**

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

- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.

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

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location, as per Owner approbation and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area. If Contractor is not ready to receive equipment upon delivery date arrival, Contractor shall assume all storage fees requested by manufacturer.
  - .2 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

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

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

- .2 Restore to new condition, finishes which have been damaged.

### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers.

### **3.4 CLEANING**

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

### **3.5 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        All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2                ADMINISTRATIVE**

- .1        Schedule project meetings throughout the progress of the work at the call of Departmental Representative.
- .2        Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.3                PRECONSTRUCTION MEETING**

- .1        Within 15 days after award of Contract, a meeting will be schedule for the parties in the contract to discuss and resolve administrative procedures and responsibilities.
- .2        Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3        Notify parties concerned minimum 5 days before meeting.
- .4        Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5        Non exhaustive list of item to be included to the agenda:
  - .1        Appointment of official representative of participants in the Work.
  - .2        Schedule of Work: in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
  - .3        Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .4        Delivery schedule of equipment.
  - .5        Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .6        Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
  - .7        Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
  - .8        Monthly progress claims, administrative procedures, photographs, hold backs.
  - .9        Appointment of inspection and testing agencies or firms.
  - .10      Insurances, transcript of policies.

**1.4                PROGRESS MEETINGS**

- .1        During course of Work, meeting will minimally take place every 2 weeks. Depending of the project progress, some might be done by conference call, at the discretion of the Departmental Representative.

- .2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.
- .3 Notify parties minimum 5 days prior to meetings.
- .4 Agenda to include the following, non-exhaustive list:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for affect on construction schedule and on completion date.
  - .12 Other business.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               DEFINITIONS**

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

**1.3               REQUIREMENTS**

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

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

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

- .1 Submit to Departmental Representative within 15 working days of the Award of Contract, the Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .2 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

#### **1.5 PROJECT MILESTONES**

- .1 Project milestones form interim targets for Project Schedule.
  - .1 All work in regards of the removal of the underground tank must be completed by September 2<sup>nd</sup>, 2016.
  - .2 All work in regards of the replacement of the heat recovery wheel must be completed by September 2<sup>nd</sup>, 2016.
  - .3 All work in regards of the replacement of the water boiler and steam work must be completed by September 30<sup>th</sup>, 2016.
  - .4 All work in regards of the addition of water cooled chiller must be completed by September 30<sup>th</sup>, 2016.
  - .5 All work in regards of the replacement of existing chillers by condenser less chiller must be completed by February 24<sup>th</sup>, 2017.
  - .6 All work in regards of the replacement of the pneumatic controls of Building no 1 must be completed by February 24<sup>th</sup>, 2017.

#### **1.6 MASTER PLAN**

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Departmental Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

#### **1.7 PROJECT SCHEDULE**

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.
  - .4 Mobilization.

- .5 Civil work (excavation, backfill, etc.).
- .6 Roofing.
- .7 Interior Architecture.
- .8 Plumbing.
- .9 Lighting.
- .10 Electrical.
- .11 Piping.
- .12 Controls.
- .13 Heating, Ventilating, and Air Conditioning.
- .14 Fire Systems.
- .15 Testing and Commissioning.
- .16 Supplied equipment long delivery items.

## **1.8 PROJECT SCHEDULE REPORTING**

- .1 Update Project Schedule on a 2-week basis reflecting activity changes and completions, as well as activities in progress.

## **1.9 PROJECT MEETINGS**

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

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2 ADMINISTRATIVE**

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

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 8 days for Departmental Representative's review of each submission.

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



- .11 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
  - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

**1.4 SAMPLES**

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to appropriate Departmental Representative's business address.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .6 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

**1.5 CERTIFICATES AND TRANSCRIPTS**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2            REFERENCES**

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of Quebec:
  - .1 An Act Respecting Occupational Health and Safety, R.S.Q., c.S-2.1 (may 2012).

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit site-specific Health and Safety Plan: within 10 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.
- .2 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports once every 2 weeks to Departmental Representative.
- .3 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .4 Submit copies of incident and accident reports.
- .5 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .6 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .7 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .8 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.
  - .1 None the less, inform the Facility Manager or call 911.
  - .2 In case of a toxic spill, leave the room and avoid contact with the fluids. Immediately inform the Facility Manager.

**1.4            FILING OF NOTICE**

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

- .2 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

## **1.5 SAFETY ASSESSMENT**

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

## **1.6 MEETINGS**

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

## **1.7 REGULATORY REQUIREMENTS**

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

## **1.8 PROJECT/SITE CONDITIONS**

- .1 Work at site will involve contact with: radioactivity and biodiversity.
- .2 All intervention must be coordinated with the Facility Manager. The Contractor must comply with the protocols in effect in order to gain access to every local.

## **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 Departmental Representative 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 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Contractor shall be the Principal Contractor as described in the Quebec Act Respecting Health and Safety code for the Construction for only their scope and areas of work as defined and described this project specification.
- .4 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 R.S.Q., c. S-2.1, an Act respecting Health and Safety, and c. S-2.1, r.4 Safety Code for the Construction Industry.
- .2 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 occur 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 Departmental Representative verbally and in writing.

**1.13 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 Departmental Representative.

**1.14 CORRECTION OF NON-COMPLIANCE**

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

**1.15 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 REQUIREMENTS**

- .1       All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               REFERENCES AND CODES**

- .1       Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2       Meet or exceed requirements of:
  - .1       Contract documents.
  - .2       Specified standards, codes and referenced documents.

**1.3               HAZARDOUS MATERIAL DISCOVERY**

- .1       Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.
- .2       PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.
- .3       Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.

**1.4               BUILDING SMOKING ENVIRONMENT**

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

**Part 2            Products**

**2.1               NOT USED**

- .1       Not Used.

**Part 3            Execution**

**3.1               NOT USED**

- .1       Not Used.

**END OF SECTION**





**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2                REFERENCES**

- .1        Canadian Standards Association (CSA International):
  - .1        CSA-A23.1/A23.2 (current edition), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2        CAN/CSA-S269.2 (current edition), Access Scaffolding for Construction Purposes.
  - .3        CAN/CSA-Z321 (current edition), Signs and Symbols for the Occupational Environment.
- .2        Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .3        U.S. Environmental Protection Agency (EPA) / Office of Water:
  - .1        EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.3                INSTALLATION AND REMOVAL**

- .1        Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2        Identify areas which have to be gravelled to prevent tracking of mud.
- .3        Indicate use of supplemental or other staging area.
- .4        Provide construction facilities in order to execute work expeditiously.
- .5        Remove from site all such work after use.

**1.4                SCAFFOLDING**

- .1        Scaffolding in accordance with CAN/CSA-S269.2.
- .2        Provide and maintain scaffolding, ramps, ladders, swing staging, platforms & temporary stairs.

**1.5                ELEVATORS**

- .1        Designated existing elevators can be used by construction personnel and for the transporting of materials. Co-ordinate use with Departmental Representative.
- .2        Provide protective coverings for finish surfaces of cars and entrances.

**1.6 SITE STORAGE/LOADING**

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

**1.7 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site provided it does not disrupt the building daily operations.
- .2 Provide and maintain adequate access to project site.

**1.8 SECURITY**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

**1.9 OFFICES**

- .1 Provide office heated to 22°C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

**1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

**1.11 SANITARY FACILITIES**

- .1 Contractor and employees are allowed to use the building sanitary facilities. At all time, employees must respect building hygiene and cleanliness rules.
- .2 If the hygiene or cleanliness rules are not followed, the Departmental Representative reserves the right to cancel the use of the sanitary facility of the building. From then on, the Contractor shall supply, in sufficient number, outdoor sanitary facility at his own expense.

**1.12 CONSTRUCTION SIGNAGE**

- .1 No other signs or advertisements, other than warning signs, are permitted on site.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of offsite on completion of project or earlier if directed by Departmental Representative.

**1.13 CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               REFERENCES**

- .1 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .2 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.3               QUALITY**

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

**1.4               AVAILABILITY**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify[Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

## **1.5 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 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .5 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

## **1.6 TRANSPORTATION**

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

## **1.7 MANUFACTURER'S INSTRUCTIONS**

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

## **1.8 QUALITY OF WORK**

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

## **1.9 CO-ORDINATION**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves, accessories and all other equipment mentioned in the tender and technical drawings.

**1.10 CONCEALMENT**

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

**1.11 REMEDIAL WORK**

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

**1.12 LOCATION OF FIXTURES**

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

**1.13 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.

**1.14 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.

**1.15 PROTECTION OF WORK IN PROGRESS**

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

**1.16 EXISTING UTILITIES**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2                PROJECT CLEANLINESS**

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

**1.3                FINAL CLEANING**

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean new mechanical and electrical equipment. Replace broken, scratched or disfigured glass.

- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2            ADMINISTRATIVE REQUIREMENTS**

- .1    Acceptance of Work Procedures:
  - .1    Contractor's Inspection: contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
    - .1    Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
    - .2    Request Departmental Representative inspection.
  - .2    Departmental Representative Inspection:
    - .1    Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
    - .2    Contractor to correct Work as directed.
  - .3    Completion Tasks: submit written certificates in French that tasks have been performed as follows:
    - .1    Work: completed and inspected for compliance with Contract Documents.
    - .2    Defects: corrected and deficiencies completed.
    - .3    Equipment and systems: tested, [adjusted] [balanced] and fully operational.
    - .4    Certificates required by Utility companies: submitted.
    - .5    Operation of systems: demonstrated to Owner's personnel.
    - .6    Commissioning of mechanical systems: completed in accordance with 01 91 13 - General Commissioning (Cx) Requirements, 01 91 31 - Commissioning (CX) Plan and 01 91 33 – Commissioning Form; and copies of final Commissioning Report submitted to Departmental Representative.
    - .7    Work: complete and ready for final inspection.
  - .4    Final Inspection:
    - .1    When completion tasks are done, request final inspection of Work by Departmental Representative and Contractor.
    - .2    When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.

- .5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- .6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .7 Final Payment:
  - .1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
  - .2 When Work deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

**1.3 FINAL CLEANING**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               ADMINISTRATIVE REQUIREMENTS**

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

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Three weeks prior to Substantial Performance of the Work, submit to the Departmental Representative a copy of the O&M manual for is review. After is approbation, submit three (3) final copies of operating and maintenance manuals in French.
- .2 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .3 Provide evidence, if requested, for type, source and quality of products supplied.

**1.4               FORMAT**

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

- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on USB flash drive.

## **1.5 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

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

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

- .5 Keep record documents and samples available for inspection by Departmental Representative.

## **1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Record information concurrently with construction progress.
  - .1 Do not conceal Work until required information is recorded.
- .2 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .2 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .3 Field changes of dimension and detail.
  - .4 Changes made by change orders.
  - .5 Details not on original Contract Drawings.
  - .6 References to related shop drawings and modifications.
- .3 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .4 Other Documents: maintain manufacturer's certifications, inspection certifications and field test records required by individual specifications sections.
- .5 Provide digital photos, if requested, for site records.

## **1.8 EQUIPMENT AND SYSTEMS**

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

- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Include test and balancing reports as specified in Section 01 91 13 - General Commissioning (Cx) Requirements.
- .14 Additional requirements: as specified in individual specification sections.

#### **1.9 MATERIALS AND FINISHES**

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

#### **1.10 DELIVERY, STORAGE AND HANDLING**

- .1 Store components subject to damage from weather in weatherproof enclosures.
- .2 Store paints and freezable materials in a heated and ventilated room.
- .3 Remove and replace damaged products at own expense and for review by Departmental Representative.

#### **1.11 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.



- .5 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .6 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .7 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .3 Procedure and status of tagging of equipment covered by extended warranties.
  - .4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

- .8 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .9 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

**1.12 WARRANTY TAGS**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Related Requirements
- .3 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.
- .4 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

**1.2 GENERAL**

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

### **1.3 COMMISSIONING OVERVIEW**

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

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

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

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

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.

- .5 Understand completely design criteria and intent and special features.
- .6 Submit complete start-up documentation to Departmental Representative.
- .7 Have Cx schedules up-to-date.
- .8 Ensure systems have been cleaned thoroughly.
- .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.6 CONFLICTS**

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

## **1.7 ACTION AND INFORMATIONAL SUBMITTALS**

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

## **1.8 COMMISSIONING DOCUMENTATION**

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

## **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.

- .2 Verification of reported results.
- .3 Repairs, retesting, re-commissioning, re-verification.
- .4 Training.

#### **1.10 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 75% of each completion stage. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Departmental Representative, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present as required and/or requested by Departmental Representative.

#### **1.11 STARTING AND TESTING**

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

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

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

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

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.
  - .4 Obtain written approval of test results and documentation from (Departmental Representative before delivery to site.

- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturers trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

#### **1.14 PROCEDURES**

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

- .2 Subject new equipment/systems to specified start-up procedures.

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

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

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

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

#### **1.17 TEST RESULTS**

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

#### **1.18 START OF COMMISSIONING**

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

#### **1.19 INSTRUMENTS / EQUIPMENT**

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



- .3 Equipment as required to complete work.

## **1.20 COMMISSIONING PERFORMANCE VERIFICATION**

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

## **1.21 WITNESSING COMMISSIONING**

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

## **1.22 AUTHORITIES HAVING JURISDICTION**

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

## **1.23 COMMISSIONING CONSTRAINTS**

- .1 It is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

## **1.24 EXTRAPOLATION OF RESULTS**

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

## **1.25 EXTENT OF VERIFICATION**

- .1 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .2 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .3 Perform additional commissioning until results are acceptable to Departmental Representative.

**1.26 REPEAT VERIFICATIONS**

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

**1.27 SUNDRY CHECKS AND ADJUSTMENTS**

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

**1.28 DEFICIENCIES, FAULTS, DEFECTS**

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

**1.29 COMPLETION OF COMMISSIONING**

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

**1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

**1.31 TRAINING**

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

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

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

**1.33 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.

- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

#### **1.34 PERFORMANCE VERIFICATION TOLERANCES**

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

#### **1.35 OWNER'S PERFORMANCE TESTING**

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

### **Part 2 Products**

#### **2.1 NOT USED**

- .1 Not Used.

### **Part 3 Execution**

#### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               SUMMARY**

- .1       Section includes:
  - .1       Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

**1.3               REFERENCES**

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

**1.4               GENERAL**

- .1       Provide a fully functional facility:
  - .1       Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .2       Facility user and O&M personnel have been fully trained in aspects of installed systems.
  - .3       Optimized life cycle costs.
  - .4       Complete documentation relating to installed equipment and systems.
- .2       Term "Cx" in this section means "Commissioning".
- .3       Use this Cx Plan as master planning document for Cx:
  - .1       Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2       Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3       Sets out deliverables relating to O&M, process and administration of Cx.

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

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

- .1 Cx Plan to be 100% completed within 8 weeks prior to Cx startup. Cx plan must be composed of the following:
  - .1 Approved shop drawings and product data.
  - .2 Approved changes to contract.
  - .3 Contractor's project schedule.
  - .4 Cx schedule.
  - .5 Contractors, sub-contractors, suppliers' requirements.
  - .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to Departmental Representative and obtain written approval.

## **1.6 REFINEMENT OF CX PLAN**

- .1 During construction phase, revise, refine and update Cx Plan to include:
  - .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
- .2 Revise, refine and update Cx plan and indicate revision number and date.

- .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

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

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:
  - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
  - .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
    - .1 Review of Cx documentation from operational perspective.
    - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
    - .3 Protection of health, safety and comfort of occupants and O M personnel.
    - .4 Monitoring of Cx activities, training and development of Cx documentation.
    - .5 Work closely with members of Cx Team.
  - .3 Departmental Representative is responsible for:
    - .1 Planning with the Contractor the organization of the Cx.
    - .2 Monitoring operations Cx activities.
    - .3 Witnessing, certifying accuracy of reported results.
    - .4 Witnessing and certifying TAB and other tests.
    - .5 Developing BMM.
    - .6 Ensuring implementation of final Cx Plan.
    - .7 Performing verification of performance of installed systems and equipment.
    - .8 Implementation of training plan.
  - .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
    - .1 Testing.
    - .2 TAB.
    - .3 Performance of Cx activities.
    - .4 Delivery of training and Cx documentation.
    - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.
  - .5 Contractor's Cx agent implements specified Cx activities including:
    - .1 Demonstrations.
    - .2 Training.

- .3 Testing.
- .4 Preparation, submission of test reports.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## **1.8 CX PARTICIPANTS**

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems except as noted.
  - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
    - .1 To include performance verification.
  - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
  - .4 Specialist Cx agency:
    - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
  - .5 Client: responsible for intrusion and access security systems.
  - .6 Ensure that Cx participant:
    - .1 Could complete work within scheduled time frame.
    - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O M personnel, including:
      - .1 Changes to heating or cooling loads beyond scope of EMCS.
      - .2 Changes to EMCS control strategies beyond level of training provided to O M personnel.
      - .3 Redistribution of electrical services.
  - .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 1 month prior to starting date of Cx for review and approval.

## **1.9 EXTENT OF CX**

- .1 Commission mechanical systems and associated equipment:
  - .1 Plumbing systems:
    - .1 Domestic CWS and HWS.
    - .2 Cooling tower water input.



- .2 HVAC:
  - .1 Energy recovery wheel, ventilation unit no URC.
  - .2 Steam distributor and accessories.
  - .3 Cooling tower and accessories.
  - .4 Chillers and accessories.
  - .5 Air-cooled condenser and accessories.
  - .6 Water cooled and accessories.
  - .7 Boilers (water and steam) and accessories.
  - .8 Pumps and accessories.
  - .9 Glycol pressurisation systems and accessories.
  - .10 Hydronic network.
- .2 Commission electrical systems and equipment:
  - .1 Low voltage below 750 V:
    - .1 Low voltage equipment.
    - .2 Low voltage distribution systems.

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

- .1 General requirements:
  - .1 Compile French documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.
  - .5 WHMIS information.
  - .6 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

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

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests.

- .3 Deliverables, provide:
  - .1 Cx Specifications.
  - .2 Start-up, pre-Cx activities and documentation for systems, and equipment.
  - .3 Completed installation checklists (ICL).
  - .4 Completed product information (PI) report forms.
  - .5 Completed performance verification (PV) report forms.
  - .6 Results of Performance Verification Tests and Inspections.
  - .7 Description of Cx activities and documentation.
  - .8 Description of Cx of integrated systems and documentation.
  - .9 Training Plans.
  - .10 Cx Reports.
  - .11 Prescribed activities during warranty period.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

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

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

- .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
- .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.
- .3 Pre-Cx activities - ELECTRICAL:
  - .1 Low voltage distribution systems under 750 V:
    - .1 Requires independent testing agency to perform pre- energization and post-energization tests.

#### **1.13 START-UP**

- .1 Start-up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
  - .1 Energy recovery wheel, ventilation unit no URC.
  - .2 Steam distributor and accessories.
  - .3 Cooling tower and accessories.
  - .4 Chillers and accessories.
  - .5 Air-cooled condenser and accessories.
  - .6 Water cooled and accessories.
  - .7 Boilers (water and steam) and accessories.
- .3 Departmental Representative to monitor some of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):
  - .1 Approved Cx Agent to perform.
    - .1 Repeat when necessary until results are acceptable to Departmental Representative.
  - .2 Use procedures modified generic procedures to suit project requirements.
  - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
  - .4 Departmental Representative to approve completed PV reports.
  - .5 Departmental Representative (reserves right to verify up to 30% of reported results at random.
  - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

#### **1.14 CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Perform Cx by specified Cx agency using procedures developed by Departmental Representative.
- .2 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .3 Departmental Representative to witness and certify reported results of Cx.

- .4 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

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

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

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

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

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

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

#### **1.18 CX SCHEDULES**

- .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 30 days before start of Cx.
    - .3 Cx agents' credentials: 45 days before start of Cx.
    - .4 Cx procedures: 30 days before start of Cx.
    - .5 Cx Report format: 30 days before start of Cx.
    - .6 Discussion of heating/cooling loads for Cx: 30 days before start-up.
    - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
    - .8 Notification of intention to start TAB: 14 days before start of TAB.
    - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
    - .10 Notification of intention to start Cx: 14 days before start of Cx.
    - .11 Identification of deferred Cx.
    - .12 Implementation of training plans.
    - .13 Cx reports: immediately upon successful completion of Cx.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Owner.
  - .3 Three months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

**1.19 CX REPORTS**

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

**1.20 ACTIVITIES DURING WARRANTY PERIOD**

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Fine tuning of HVAC systems.

**1.21 TRAINING PLANS**

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

**1.22 FINAL SETTINGS**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2            SUMMARY**

- .1    Section Includes:
  - .1    Commissioning forms to be completed for equipment, system and integrated system.

**1.3            INSTALLATION/START-UP CHECK LISTS**

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

**1.4            PRODUCT INFORMATION (PI) REPORT FORMS**

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

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

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

## **1.6 SAMPLES OF COMMISSIONING FORMS**

- .1 Contractor will develop and provide to Departmental Representative required project-specific Commissioning forms in electronic format complete with specification data for is verification.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

## **1.7 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for use:
  - .1 Contractor must provide project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Departmental Representative with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in O&M manual in accordance with Section 01 78 00 – Closeout submittal.

## **1.8 LANGUAGE**

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



**Part 2            Products**

**2.1                NOT USED**

.1            Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used.

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1 All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               SUMMARY**

- .1 Section Includes:
  - .1 This Section specifies roles and responsibilities of Commissioning Training.

**1.3               TRAINEES**

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

**1.4               INSTRUCTORS**

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

**1.5               TRAINING OBJECTIVES**

- .1 Training to be detailed and duration to ensure:
  - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
  - .2 Effective on-going inspection, measurements of system performance.
  - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
  - .4 Ability to update documentation.

- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

## **1.6 TRAINING MATERIALS**

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.
  - .2 Operating Manual.
  - .3 Maintenance Manual.
  - .4 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.

## **1.7 SCHEDULING**

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

## **1.8 RESPONSIBILITIES**

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

## **1.9 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 System philosophy, limitations of systems and emergency procedures.
  - .2 Review of system layout, equipment, components and controls.
  - .3 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
  - .4 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
  - .5 Maintenance and servicing.

- .6      Trouble-shooting diagnosis.
- .7      Inter-Action among systems during integrated operation.
- .8      Review of O M documentation.
- .3      Provide specialized training as specified in relevant Technical Sections of the construction specifications.

**Part 2            Products**

**2.1            NOT USED**

- .1      Not Used.

**Part 3            Execution**

**3.1            NOT USED**

- .1      Not Used.

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       All contract documents apply to Divisions 01, 02, 23, 26 and also Architecture, Civil work and Structure.

**1.2               REFERENCES**

- .1       Canadian Environmental Protection Act, 1999 (CEPA 1999).
- .2       Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1       Material Safety Data Sheets (MSDS).
- .3       National Fire Code of Canada, current edition.
- .4       Transportation of Dangerous Goods Act (TDGA), current edition, c. 34.
- .5       Transportation of Dangerous Goods Regulations (TDGR), T-19.01-SOR/2003-400.
- .6       Storage of PCB Material Regulations, SOR/92-507.
- .7       PCB Waste Export Regulations, 1996, SOR/97-109.
- .8       Ozone-Depleting Substances Regulations, SOR/99-07.
- .9       Environmental Code of Practice on Halons, July 1996.
- .10      Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems, March 1996.

**1.3               DEFINITIONS**

- .1       Toxic: substance is considered toxic if it is listed on Toxic Substances List found in Schedule 1 of CEPA.
- .2       List of Toxic Substances: found in Schedule 1 of CEPA, lists substances that have been assessed as toxic. Federal Government can make regulations with respect to a substance specified on List of Toxic Substances. Column II of this list identifies type of regulation applicable to each substance.
- .3       PCBs: includes chlorobiphenyls referred to in Column I of item 1 of the List of Toxic Substances in Schedule I of Canadian Environmental Protection Act.

**1.4               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data:
  - .1       Submit WHMIS MSDS - Material Safety Data.
  - .2       Submit photocopy of shipping documents and waste manifests to Departmental Representative when shipping toxic wastes off site.
  - .3       Maintain one copy of product data in readily accessible file on site.

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

- .1 Store and handle toxic wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
- .2 Store and handle flammable and combustible wastes in accordance with current National Fire Code of Canada requirements.
- .3 Co-ordinate storage of toxic wastes with Departmental Representative and follow internal requirements for labelling and storage of wastes.
- .4 Observe smoking regulations, smoking is prohibited in area where toxic wastes are stored, used, or handled.
- .5 Only certified persons who have successfully completed Environment Canada Environmental Awareness Course for Environmentally Safe Handling of Refrigerants are permitted to work on refrigeration and air conditioning systems.
- .6 Report spills or accidents involving toxic wastes immediately to Departmental Representative and to appropriate regulatory authorities. Take reasonable measures to contain the release while ensuring health and safety is protected.
- .7 Transport toxic wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
- .8 Use authorized/licensed carrier to transport toxic waste.
- .9 Co-ordinate transportation and disposal of toxic wastes with Departmental Representative.
- .10 Notify appropriate regulatory authorities and obtain required permits and approvals prior to exporting toxic waste.
- .11 Dispose of toxic wastes generated on site in accordance with applicable federal and provincial acts, regulations, and guidelines.
- .12 Ensure toxic waste is shipped to authorized/licensed treatment or disposal facility and that liability insurance requirements are met.
- .13 Minimize generation of toxic waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Sections 01.

**1.2 PROJECT PHASING - ELECTROMECHANICAL**

- .1 Keeping in mind the realisation period for the project, it is of the primary importance that the Contractor follows a strict schedule in order to respect the allowed realisation period. The following milestone (non-exhaustive list) can be optimized or modified upon preliminary agreement with the Departmental Representative.
- .2 Any delay in the project realisation upon realisation period will be of the Contractor's responsibility who will, at his own cost, do all necessary work/action to avoid any prejudice to the Owner. This will include the temporary leasing of appropriate equipment to assure thermal comfort inside the building, no matter the season, and all workmanship and material necessary to the temporary work.
- .3 Phase 2.1: Summer 2016 (May 2016 to September 2016)
  - .1 The completion of all the work in the heating network:
    - .1 Dismantling of all heating equipment as shown on plans.
    - .2 Installation of the new boilers (water and steam).
    - .3 Installation of the preheating coil.
    - .4 Installation of pumps and heat exchangers in regards to heating work.
    - .5 Installation of chemical treatment.
  - .2 Replacement of energy recovery wheel.
  - .3 Architecture work necessary to the phase 2.1 work.
  - .4 Structure installation on the roof for the air cooled condenser (by structure).
  - .5 Structural reinforcement (by structure).
  - .6 Dismantling of the underground tanks (by civil).
  - .7 Temporary modifications of the discharge piping of the PB-1 pump in order to assure appropriate operation of the existing chillers (REF-1 and REF-2) with the existing cooling towers (T-2 and T-3). This will free the NPS 5 existing piping necessary in the new heating network.
  - .8 Test, startup, commissioning, cleaning, etc.
  - .9 Phase 2.2 (autumn 2016-winter 2017) preliminary work.
  - .10 Any other work that doesn't cause prejudice to the building operation and project schedule.
- .4 Phase 2.2: Autumn 2016 – Winter 2017 (October 2016 to March 2017)
  - .1 The completion of all the work in the cooling network, in phase:
    - .1 Dismantling of all cooling equipment as per indications on plans, while respecting the temporary work schedule in order to assure proper working of all equipment.

- .2 In order to assure proper operation of the heat pumps, U-3 and U-4 cooling coils and building fan-coils, provide for temporary piping to condensing unit CU-3 and CU-4 with the cooling tower T-1. Plan the rental of an inline pump for the cold glycol supply to all equipment. Proceed with piping modifications as shown on the drawing (temporary work). Provide balancing valves.
  - .1 Pump of 3.8 l/s, 50' of head, 1750 rpm, 2 HP, 600/3/60.
- .3 Installation of the chillers.
- .4 Installation of the air cooled condensers.
- .5 Installation of pumps and heat exchangers in regards to cooling work.
- .6 Installation of chemical treatment.
- .7 Following the completion of the installation of the main equipment (item no 3 to 6), proceed with the transfer of the equipment supplied by condensing units (CU-3 and CU-4) toward the REF-3 chiller and cooling tower T-4. Proceed with the dismantling of the temporary work and complete the installation of every equipment.
- .2 Architecture work necessary to the phase 2.1 work.
- .3 Test, start-up, commissioning, cleaning, etc.

### **1.3 SPECIFIC CONDITIONS – HEATING – CHILLED WATER**

- .1 The specific requirements of the mechanical and electrical works, Divisions 01 and 23, apply to this section.
- .2 The following sections are included in the scope of the heating – chilled water work and complement each other to form a whole.
  - .1 23 05 00 – Common Work Results for HVAC.
  - .2 23 05 05 – Installation of Pipework.
  - .3 23 05 16 – Expansion fittings and loop for HVAC piping.
  - .4 23 05 17 – Pipe Welding.
  - .5 23 05 19.01 – Thermometers and Pressure Gauges - Piping Systems.
  - .6 23 05 23.02 – Valves – Cast iron.
  - .7 23 05 23.05 – Butterfly valves.
  - .8 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
  - .9 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
  - .10 23 05 53.01 – Mechanical Identification.
  - .11 23 05 93 – Testing, Adjusting and Balancing for HVAC.
  - .12 23 07 14 – Thermal Insulation for Equipment.
  - .13 23 07 15 – Thermal Insulation for Piping.
  - .14 23 08 01 – Performance verification mechanical piping system
  - .15 23 08 02 – Cleaning and star-up of mechanical piping system
  - .16 23 11 16 – Domestic water piping
  - .17 23 11 23 – Facility Natural Gas Piping.

- .18 23 21 13.02 – Hydronic systems : Steel.
  - .19 23 21 14 – Hydronic Specialties.
  - .20 23 21 23 – Hydronic Pumps.
  - .21 23 22 13 – Steam and Condensate Heating Piping.
  - .22 23 22 14 – Steam Specialties.
  - .23 23 23 00 – Refrigerant Piping.
  - .24 23 25 00 – HVAC Water Treatment Systems.
  - .25 23 52 00 – Heating Boilers
  - .26 23 57 00 – Heat Exchangers for HVAC
  - .27 23 64 26 – Water Chillers.
  - .28 23 65 10 – Condensers and Cooling Towers.
  - .29 23 73 12 – Coils.
- .3 Heating and chilled water – Scope of the work:
- .1 Included work:
    - .1 The work includes, in general, the labor, the delivery, and the installation of all materials and equipment necessary for the heating – chilled water work indicated on the drawings and specifications.
    - .2 This work includes, but is not limited to:
      - .1 All demolition shown on the drawings and necessary for the completion of the project, including pot-feeders and accessories for the dismantled pumps.
      - .2 All new domestic water piping (hot and cold) for existing and new equipment.
      - .3 The backflow preventers on the domestic cold water pipe supplying the soft water system.
      - .4 All new gas piping for the new equipment.
      - .5 The complete chilled water system with forced supply and return circulation.
      - .6 The complete hot water system with forced supply and return circulation.
      - .7 The complete close circuit cooling tower water system with forced supply and return circulation.
      - .8 All temporary work required for proper equipment operation, including test, balancing and insulation.
      - .9 The supply and installation of all required pumps, on concrete foundation.
      - .10 The supply and installation of the water chillers REF-1 and REF-2 with air-cooled condensers, chillers installed on new concrete foundation in mechanical room, condenser installed on the steel structure on the roof, under the supervision of the chillers' manufacturer, ready to be assembled, connected, and turned on.

- .11 The supply and installation of the water chillers REF-3, with heat recovery, chillers installed on new concrete foundation in mechanical room, under the supervision of the chillers' manufacturer, ready to be assembled, connected, and turned on.
- .12 The supply and network filling of all necessary refrigerant for the proper operation of the chillers REF-1, REF-2 and REF-3.
- .13 The supply and installation of hot water boilers CEC-1, CEC-2 and CEC-3, installed on modified concrete foundation in boiler room, under the supervision of the chillers' manufacturer, ready to be assembled, connected, and turned on.
- .14 The supply and installation of a steam boiler CVAP-1, installed on new concrete foundation in mechanical room, under the supervision of the chillers' manufacturer, ready to be assembled, connected, and turned on.
- .15 The complete hot propylene glycol force flow heating system, supply and return with hot water – glycol exchanger for the preheating coil of the ventilation unit U-2.
- .16 The supply and installation of a close circuit cooling tower no T-4, installed on structural support in mechanical room, under the supervision of the chillers' manufacturer, ready to be assembled, connected, and turned on.
- .17 The supply and installation of the heat exchangers, installed on new concrete foundations in mechanical room, ready to be assembled, connected, and turned on.
- .18 The supply and installation of a new energy recovery wheel, including the on-site support from the manufacturer for the measurement survey prior to the order, and the on-site support from the manufacturer for the installation of the new equipment by the contractor.
- .19 The complete chemical treatment system for the following systems: chilled water, hot water, steam and cooling tower.
- .20 The complete glycol pressurisation systems for the chilled water, hot water and cooling tower network.
- .21 The complete make-up water system for the chilled water, hot water and cooling towers water networks.
- .22 The steam network for the humidifiers, including all required accessories.
- .23 The pressure reducing stations on the steam system with safety valves and vents to the outside to supply the low pressure steam systems.
- .24 The low pressure steam systems with gravity condensate systems and low pressure supply for the steam heating coils, the humidifiers, and the other devices indicated in the drawings.
- .25 All special connections described in the specification and/or shown in the drawings.

- .26 Provide the capping of the underground piping following the excavation and dismantling by Civil. Piping must be capped inside of the boiler room and outside the building. Provide welded cap or combination flange-blank flange.
- .27 The supply, the storage, and the installation of springs, anti-vibration mounting pads, flexible hoses, and other noise dampening devices required for devices and systems supplied by heating – chilled water.
- .28 The supports and structural steel components required to support the pipework, the fittings, and the equipment.
- .29 The supply in sufficient quantity of all required propylene glycol necessary for the filling of all network.
- .30 Tests, start-up and commissioning.
- .31 Even with the commissioning planned on the chillers REF-1, REF-2 and REF-3 at the end of winter 2017, plan for a second commissioning on each chiller during the peak summer period, in order to validate proper operation. Plan for sufficient time to proceed with every verification as requested in sections 01.
- .32 All special connections.
- .33 Sealing of sleeves and openings.
- .34 The coordination of erection drawings from sections from the Divisions 23, 25, and 26, in accordance with the requirements of the Division 01 - General Instructions.
- .35 The insulation as described in sections 23 07 14 – Thermal Insulation for Equipment and 23 07 15 – Thermal Insulation for Piping.
- .36 The complete identification of all devices and accessories, in accordance with section 23 05 53.01 Mechanical Identification.
- .37 The seismic measures concerning heating – chilled water work, in accordance with Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- .3 Instrumentation openings:
  - .1 In the pipes and/or ducts, create the openings necessary for measuring instruments and temperature, pressure, flow, etc. control instruments, where required by the Division 25.
  - .2 Install wells in the piping for the thermometers and the temperature readings.
  - .3 Install access doors to the ventilation controls.
- .2 Work excluded:
  - .1 In general, the following work is excluded:
    - .1 Control work, except those specifically requested in this section.
    - .2 The electrical connections, except those specifically requested in this section.
    - .3 Flashing.

.4 The steel framework supporting the cooling towers.

.4 Special Connection:

- .1 In general, special connections include all required connections to devices, all piping, adapters, shut-off valves, bypasses, unions, flanges, screens, air vents, controls, test valves, drain valves, control valves, shock absorbers, buffer tanks, traps, ventilation ducts, flexible joints, and other accessories necessary to operate the devices.
- .2 When special connections are made by others for their devices, each relevant section should be monitoring these connections and is solely responsible for the proper functioning of its equipment.
- .3 Each section is responsible for any damage it may cause the devices to which it makes connections.
- .4 Part of the heating – chilled water work:
  - .1 All connections and all chilled water, hot water, cooling tower water, propylene glycol, and steam connection points for various devices shown in the drawings, as well as those described in the specifications.
  - .2 Controls:
    - .1 The installation and the connections of the piping for chilled water, ethylene glycol, hot water, heating water, tower cooling water and steam, and all control valves are provided by the Division 25.
    - .2 Install the control valves following the guidelines of the Division 25 and under their supervision.
    - .3 Obtain the necessary directives.
    - .4 The diameters of the control valves shown on the drawings are for reference only.
    - .5 When the control valves or other accessories are supplied by this section, but installed by others, this section remains directly responsible for the operation of its equipment.
    - .6 Provide the directives and the supervision required for the installation.
  - .3 Ventilation:
    - .1 All steam coil connections for steam, condensate, and steam vents.
    - .2 All steam humidifier connections for steam and condensate, including the piping and the accessories needed for the complete assembly of the various humidifier components.
    - .3 All ethylene glycol connections to the ventilation coils.
    - .4 All hot water heating coil connections to the hot water.
    - .5 All ventilation coil chilled water connections.
  - .4 Plumbing – Drainage:
    - .1 All connections for drainage, overflow, safety valve exhaust, etc. from all heating and refrigeration devices to the funnels.

- .2 These connections include, without being limited to, those from the cooling towers, the water chillers, the fan-coil units, the water softeners, the condensate pans, the hot water heating networks, the chilled water, the water towers, the steam and condensate, the backflow devices, etc.
- .3 Anchor the connections near the funnels.
- .4 Bevel to 45° and ream the end of the pipes flowing into the funnel.
- .5 Install the drain piping with the highest flow above the center of the funnel.
- .6 Determine the dimensions of the funnels according to the number and size of the indirect drains discharging into it.
- .7 The actual funnels are part of the plumbing work, as well as any piping from the funnels to the sanitary or storm drainage systems.
- .8 The drainage piping from the backflow devices' funnels to the drainage funnels are part of this section's work.
- .5 Plumbing – Domestic Cold Water:
  - .1 Supply and install all domestic cold water connections to the various heating and refrigeration devices. For this purpose, a shut-off valve is installed by this section at each connection point to the domestic cold water network.
- .6 Future connections – Steam, condensate, chilled water, and hot water:
  - .1 In the places shown in the drawings, provide connections with welded caps for future use on the high pressure steam piping, the low pressure steam piping, the condensate piping, the chilled water supply and return piping, and the hot water supply and return piping. View the details on the drawings.
- .7 Cleaning and degreasing of the hot water heating systems, the high temperature hot water, the chilled water, and the cooling tower water and ethylene glycol:
  - .1 In addition to the drains provided on different devices, provide NPS 1½ connectors with extra heavy cast iron screw caps (to allow connection of a drain hose) at the low points and all places where the pipe cannot be drained by gravity on hot water heating, chilled water, ethylene glycol, and tower water systems.
  - .2 If a check valve prevents the drainage, install an NPS 1½ connector on the side where drainage is otherwise impossible.
- .5 Documents to provide:
  - .1 Provide the following documents:
    - .1 The manufacturers' warranty certificates.
    - .2 The pressure vessel certificates.
    - .3 The certificates of approval from the concerned authorities.

- .4 The instruction manuals for the operation and the maintenance of the equipment, in accordance with Division 20.
- .5 The drawings kept up to date, in accordance with Division 20.
- .6 Erection (coordination) drawings, in accordance with Division 20.
- .7 A list of legends with piping identification, in accordance with Division 20.
- .8 A piping identification list.
- .9 A list indicating for each electric motor: the voltage, the current inscribed in amperes on the motor's plate, the motor service factor, the type of lubrication, the current at no load, at zero speed, and at normal load on each of the motor's phases, the normal operating voltage on each phase, the capacity of the thermal protection installed in the starter, and the adjustment of the thermal protection.
- .10 A list indicating for each pump: the following pressures measured with calibrated pressure gauges at the pump inlets and outlets, for normal flow and no flow.
- .11 List of the automatic flow rate controllers' flows.
- .12 List of the flow meters' flows.

#### **1.4 SPECIFIC CONDITIONS – VENTILATION**

- .1 The specific requirements of the mechanical and electrical works, Divisions 01 and 23, apply to this section.
- .2 The following sections are included in the scope of the ventilation work and complement each other to form a whole.
  - .1 23 05 00 – Common Work Results for HVAC.
  - .2 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
  - .3 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
  - .4 23 05 53.01 – Mechanical Identification
  - .5 23 05 93 – Testing, Adjusting and Balancing for HVAC
  - .6 23 05 94 – Pressure testing of air duct system
  - .7 23 07 13 – Duct Insulation
  - .8 23 31 13.01 – Metal Ducts - Low Pressure to 500 Pa
  - .9 23 33 00 – Air Duct Accessories.
  - .10 23 51 00 – Breeching, Chimneys and Stacks
  - .11 23 73 12 – Coils.
  - .12 23 84 13 – Humidifiers.
- .3 Scope of work:
  - .1 Work included:
    - .1 The work includes, in general, labor, supply, and installation of all materials and equipment necessary for ventilation – air conditioning work indicated on the drawings and in the specification.



- .2 This work includes, but is not limited to:
  - .1 All demolition shown on the drawings and necessary for the completion of the project.
  - .2 The supply and installation of a propylene glycol preheating coil in the ventilation unit U-2.
  - .3 The complete replacement of the energy recovery wheel in the ventilation unit no URC-1.
  - .4 The supply and installation of all new humidifier, complete with accessories.
  - .5 The supply and installation of all new chimney for the boilers exhaust. Provide fire proof sealant between the combined chimney and the existing floor openings.
  - .6 The insulation as described in sections 23 07 13 – Duct Insulation.
  - .7 All special connections and ducts.
  - .8 All supports and structural steel components required to support the ducts and the equipment.
  - .9 All access doors.
  - .10 The supply and the installation of springs, anti-vibration bases, acoustic plenums, silencers, and other equipment required for this section.
  - .11 The vandal-proof grates at the locations shown in the drawings.
  - .12 All demolition, relocation, and recalibration work for ducts, terminal units, and diffuser grilles, as shown in the drawings.
  - .13 Identification of the systems' ventilation ducts, the devices, and the other accessories, in accordance with section 23 05 53.01 - Mechanical Identification.
  - .14 Tests, start-up and commissioning.
  - .15 All work for the balancing and the adjustments of the air quantities.
  - .16 Paraseismic measures for ventilation – air conditioning work, according to section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .2 Work excluded:
  - .1 In general, the following work is excluded:
    - .1 The controls: the supply and the installation.
- .4 Special connections and related work:
  - .1 See Divisions 01 and 23.
  - .2 Part of this section's work:
    - .1 The complete ventilation connections of the various devices indicated on the drawings and/or specifications, whether these devices are part of this section or not. The dimensions of the ventilation ducts to the devices

- shown in the drawings are approximate and should be verified with the other involved sections before the pipes are manufactured.
- .2 The directives, the supervision, and the responsibility for the installation of the various devices provided by this section, but installed by another section.
  - .3 The welded or screwed connections for the ventilation devices and ducts prepared to receive the drain pipes.
  - .4 The openings and the access doors required for the control devices and the other instruments. The sealing of the pipes passing through the ventilation units.
- .5 Documents to provide
- .1 Provide the following documents:
    - .1 The certificates of approval from the concerned authorities.
    - .2 Shop drawings, device drawings, and erection drawings.
    - .3 A list of duct identification legends.
    - .4 Copies of the instruction manuals for the equipment operation and maintenance.
    - .5 The drawings, kept up to date.
    - .6 A list indicating for each electric motor: the current in amperes at zero load and at normal load, the capacity of the heater installed in the starter, and the value of the maximum current in amperes inscribed on the motor plate.
    - .7 A full report of the results requested in the article "VENTILATION SYSTEMS' TAB REPORT" from the section 23 05 93 - Testing, Adjusting and Balancing for HVAC

## **1.5 ELECTRICAL CONNECTIONS**

- .1 Each relevant mechanical section must provide and install the motors, the thermostats, the controllers, and the other devices specific to their own specialty shown on the drawings and/or requested in the specification.
- .2 Unless otherwise indicated, each relevant mechanical section must provide the starters and the transformers relating to their specialty. These starters and transformers are installed and connected by the Division 26.
- .3 According to the indications on the diagrams and the drawings, the Division 25 or 26 must provide and install the ducts, the cables, and the boxes with complete connections for all mechanical devices, under the supervision of the Division that provided the device.
- .4 However, each relevant mechanical section is solely responsible for the operation of their own equipment. They must check all the electrical control sequences and the protection of each device by checking all the overload relays.
- .5 Each relevant mechanical section is solely responsible for the selection of the overload relays.
- .6 All electrical connections must comply with the electrical specification requirements.

**Part 2            Product**

**2.1                NOT APPLICABLE**

.1            Not applicable.

**Part 3            Execution**

**3.1                NOT APPLICABLE**

.1            Not applicable.



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               REFERENCES**

- .1        Canadian General Standards Board (CGSB).
  - .1        CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2        Canadian Standards Association (CSA International).
  - .1        CSA B149.1-10, Installation Code for natural gas and propane.
- .3        National Fire Code of Canada (NFCC 2005).

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

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

**Part 2            Products**

**2.1               NOT USED**

- .1        Not Used.

**Part 3            Execution**

**3.1               APPLICATION**

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

### **3.2 CONNECTIONS TO EQUIPMENT**

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

### **3.3 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and applicable codes.
- .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 AIR VENTS**

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

### **3.6 DIELECTRIC COUPLINGS**

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

### **3.7 PIPEWORK INSTALLATION**

- .1 Install pipework to CSA B149.1.
- .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 Install all piping in order to avoid any tension or compression stress.
- .6 Do not bend piping in any way.
- .7 Identification marks must be visible at all time to facilitate inspections.
- .8 For every type of piping, elbows, reducing elbows, couplings and unions must be of the same manufacturer as the tees.
- .9 In general, use long radius elbows.
- .10 Assemble piping using fittings manufactured to ANSI standards.
- .11 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.
- .12 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .13 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .14 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .15 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .16 Group piping wherever possible and as indicated.
- .17 Ream pipes, remove scale and other foreign material before assembly.
- .18 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .19 Provide for thermal expansion as indicated.
- .20 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 Use ball or butterfly valves, depending on dimensions, at branch take-offs for isolating purposes except where specified.
  - .6 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .21 Check Valves:
  - .1 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.8 WELDING AND THREADING**

- .1 NPS 2 and smaller: unless indicated, threaded joint (standard thread) complete with union connection to equipment. Theaded joint must comply with ANSI B16.12.

- .2 NPS 2½ and higher: unless indicated, welded joint with flange connection to equipment.

### **3.9 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 All sealing must be done with fire retardant, waterproof non-hardening mastic.
  - .2 Ensure no contact between copper pipe or tube and sleeve.

### **3.10 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.

### **3.11 PREPARATION FOR FIRE STOPPING**

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.12 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.



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

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

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

### **3.14 EXISTING SYSTEMS**

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

### **3.15 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 01.

**1.2                REFERENCES**

- .1        ASTM International Inc.
  - .1        ASTM A53/A53M (current edition), Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2        ASTM A105/A105M (current edition), Standard Specification for Carbon Steel Forgings, for Piping Applications.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section (01 33 00 - Submittal Procedures).
- .2        Product Data:
  - .1        Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1        Manufacturer, model number, line contents, pressure and temperature rating.
    - .2        Movement handled, axial, lateral, angular and the amounts of each.
    - .3        Nominal size and dimensions including details of construction and assembly.

**1.4                CLOSEOUT SUBMITTALS**

- .1        Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.
  - .1        Data to include:
    - .1        Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

**1.5                DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1                BELLOWS TYPE EXPANSION JOINTS**

- .1        For axial, lateral or angular movements, as indicated.
- .2        Maximum operating pressure: 1034 kPa.
- .3        Maximum operating temperature: as indicated.
- .4        Type A: free flexing, factory tested to 1½ times maximum working pressure. Provide test certificates.
- .5        Bellows:
  - .1            Multiple bellows, hydraulically formed, single ply, austenitic stainless steel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.
- .6        Reinforcing or control rings:
  - .1            2 piece nickel iron.
- .7        Ends:
  - .1            Flanged to match pipe.
- .8        Liner:
  - .1            Austenitic stainless steel in direction of flow.
- .9        Shroud:
  - .1            Carbon steel, painted.

**2.2                FLEXIBLE CONNECTION**

- .1        Application: to suit motion as indicated.
- .2        Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.
- .3        Inner hose: stainless steel corrugated.
- .4        Braided wire mesh stainless steel outer jacket.
- .5        Diameter and type of end connection: as indicated.
- .6        Operating conditions:
  - .1            Working pressure: 1034 kPa.
  - .2            Working temperature: as indicated.
  - .3            To match system requirements.
- .7        Three flexible grooved couplings placed in close proximity to vibration source for vibration attenuation and stress relief.

## **2.3 ANCHORS AND GUIDES**

- .1 Anchors:
  - .1 Provide as indicated.
- .2 Alignment guides:
  - .1 Provide as indicated.
  - .2 To accommodate specified thickness of insulation.
  - .3 Vapour barriers, jackets to remain uninterrupted.

## **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 expansion joints with cold setting, as indicated. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.
- .4 Do welding in accordance with section 23 05 17 - Pipe Welding.

### **3.3 PIPE CLEANING AND START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **3.4 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

### **3.5 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               REFERENCES**

- .1        American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1        ANSI/ASME B31.1 (current edition), Power Piping.
  - .2        ANSI/ASME B31.3 (current edition), Process Piping.
  - .3        ANSI/ASME Boiler and Pressure Vessel Code (current edition):
    - .1        BPVC 2007 Section I: Power Boilers.
    - .2        BPVC 2007 Section V: Non-destructive Examination.
    - .3        BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2        American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1        ANSI/AWWA C206 (current edition), Field Welding of Steel Water Pipe.
- .3        American Welding Society (AWS)
  - .1        AWS C1.1M/C1.1 (current edition) Recommended Practices for Resistance Welding.
  - .2        AWS Z49.1 (current edition), Safety in Welding, Cutting and Allied Process.
  - .3        AWS W1 (current edition), Welding Inspection Handbook.
- .4        Canadian Standards Association (CSA International)
  - .1        CSA W48 (current edition), Filler Metals and Allied Materials for Metal Arc Welding.
  - .2        CSA B51 (current edition), Boiler, Pressure Vessel and Pressure Piping Code.
  - .3        CSA-W117.2 (current edition), Safety in Welding, Cutting and Allied Processes.
  - .4        CSA W178.1 (current edition), Certification of Welding Inspection Organizations.
  - .5        CSA W178.2 (current edition), Certification of Welding Inspectors.

**1.3               QUALITY ASSURANCE**

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

- .4 Each welder to possess identification symbol issued by authority having jurisdiction.
- .2 Inspectors:
  - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

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

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

### **Part 2 Products**

#### **2.1 ELECTRODES**

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

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 QUALITY OF WORK**

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

#### **3.3 INSTALLATION REQUIREMENTS**

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



- .2 Branch connections: install welding tees or forged branch outlet fittings.

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

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

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

- .1 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive magnetic particle (hereinafter referred to as "particle") tests.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld.
- .4 Failure of visual examinations:
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to ten supplementary welds, fees will be covered by Contractor.

### **3.6 DEFECTS CAUSING REJECTION**

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

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

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

### **3.8 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Section 01.

**1.2               REFERENCES**

- .1       American Society of Mechanical Engineers (ASME)
  - .1       ASME B40.100 (current edition), Pressure Gauges and Gauge Attachments.
  - .2       ASME B40.200 (current edition), Thermometers, Direct Reading and Remote Reading.
- .2       Canadian General Standards Board (CGSB)
  - .1       CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
  - .2       CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data, shop drawings:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for [thermometers and pressure gauges] and include product characteristics, performance criteria, physical size, finish and limitations.
- .2       Certificates:
  - .1       Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3       Test and Evaluation Reports:
  - .1       Submit certified test reports for [thermometers and pressure gauges] from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

**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: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

**Part 2            Products**

**2.1               GENERAL**

- .1       Design point to be at mid-point of scale or range.

- .2 Ranges: as indicated.

## **2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, liquid filled, 230 mm casing length: to CAN/CGSB-14.4.
  - .1 Resistance to shock and vibration.

## **2.3 THERMOMETER WELLS**

- .1 Steel pipe: stainless steel.

## **2.4 PRESSURE GAUGES**

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
  - .1 Siphon for steam service.
  - .2 Snubber for pulsating operation.
  - .3 Diaphragm assembly for corrosive service.
  - .4 Gasketed pressure relief back with solid front.
  - .5 Bronze stop cock.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 GENERAL**

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
- .2 Install between equipment and first fitting or valve.

### **3.3 THERMOMETERS**

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Heat exchangers.

- .2 Water heating and cooling coils.
- .3 Water boilers.
- .4 Chillers.
- .5 Cooling towers.
- .3 Use extensions where thermometers are installed through insulation.

### **3.4 PRESSURE GAUGES**

- .1 Install in locations as follows:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.
  - .3 Upstream and downstream of control valves.
  - .4 Inlet and outlet of coils.
  - .5 Inlet and outlet of liquid side of heat exchangers.
  - .6 Outlet of boilers.
  - .7 In other locations as indicated.
- .2 Use extensions where pressure gauges are installed through insulation.

### **3.5 NAMEPLATES**

- .1 Install engraved lamicoid nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, identifying medium.

### **3.6 CLEANING**

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

### **3.7 PROTECTION**

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

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               REFERENCES**

- .1        American Society of Mechanical Engineers (ASME)
  - .1        ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.
- .2        ASTM International Inc.
  - .1        ASTM A49-01(2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.
  - .2        ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .3        ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
  - .4        ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .5        ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6        ASTM B85/B85M-08, Standard Specification for Aluminum-Alloy Die Castings.
  - .7        ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3        Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1        MSS SP-61-03, Pressure Testing of Steel Valves.
  - .2        MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3        MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4        MSS SP-82-1992, Valve Pressure Testing Methods.
  - .5        MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Product Data, shop drawings:
  - .1        Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4               CLOSEOUT SUBMITTALS**

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

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

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

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size, minimum 1.
  - .3 Stem packing: one for every 10 valves, each size, minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Valves:
  - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
  - .1 Gate valves: MSS SP-70.
  - .2 Globe valves: MSS SP-85.
  - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
  - .1 Body, bonnet: ductile iron to ASTM A536 Grade 65-45-12.
  - .2 Connections: flanged ends with 2 mm raised face with serrated finish to ANSI B16.1.
  - .3 Inspection and pressure testing: to MSS SP-82.
  - .4 Bonnet gasket: non-asbestos.
  - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
  - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
  - .7 Gland packing: non-asbestos.



- .8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
- .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

## **2.2 GATE VALVES**

- .1 NPS 2 1/2-8, outside screw and yoke (OS Y), iron trim, solid wedge disc:
  - .1 Body and multiple-bolted bonnet: with full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
  - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
  - .3 Seat rings: renewable bronze screwed into body.
  - .4 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
  - .5 Seat rings: integral with body.
  - .6 Stem: nickel-plated steel.
  - .7 Pressure-lubricated operating mechanism.
  - .8 Operator: handwheel.

## **2.3 GLOBE VALVES**

- .1 NPS 2 1/2 - 10, OSY:
  - .1 Body: with multiple-bolted bonnet.
  - .2 WP: 860 kPa steam, 1.4 MPa CWP.
  - .3 Bonnet-yoke gasket: non-asbestos.
  - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
  - .5 Seat ring: renewable, regrindable, screwed into body.
  - .6 Stem: bronze to ASTM B62.
  - .7 Operator: handwheel.

## **2.4 PLUG VALVE**

- .1 NPS 2 1/2 - 10, OSY:
  - .1 Cast iron body.
  - .2 Class 125.
  - .3 Plug : EPDM covered ductile iron, epoxy covered seat.
  - .4 Position indicator and adjustable stop.
  - .5 Mechanical stop with adjustment key.
  - .6 Operator: handwheel.

## **2.5 CHECK VALVES**

- .1 Swing check valves, Class 125:
  - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
    - .1 Up to NPS 16: ductile iron ASTM A536 Grade 65-45-12.
  - .2 Ratings:
    - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
  - .3 Disc: rotating for extended life.
    - .1 Up to NPS 6: stainless steel type 316.
  - .4 Seat rings: renewable bronze to ASTM B62 screwed into body.
  - .5 Hinge pin, bushings: stainless steel.
  - .6 Disc: A126 Class B, secured to stem, rotating for extended life.
  - .7 Seat: cast iron, integral with body.
  - .8 Hinge pin: exelloy; bushings: malleable iron.
  - .9 Identification tag: fastened to cover.
  - .10 Hinge: stainless steel.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.

### **3.2 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
  - .2 ASME B16.1-05, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25,125 and 250.
  - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS through 24.
  - .4 ANSI/ASME B16.11-05, Forged Fittings, Socket-Welding and Threaded.
  - .5 ANSI/ASME B16.25-07, Buttwelding Ends.
  - .6 ANSI/ASME B16.34-04, Valves - Flanged, Threaded and Welding Ends.
- .2 ASTM International Inc.
  - .1 ASTM A126-04), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-67-02a, Butterfly Valves.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawings:
  - .1 Submit manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit data for valves specified in this section.

**1.4 CLOSEOUT SUBMITTALS**

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

**1.5 DELIVERY, STORAGE AND HANDLING**

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

- .2 Delivery and acceptance requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every ten valves each size, minimum one.
  - .2 Discs: one for every ten valves, each size, minimum one.
  - .3 Stem packing: one for every ten valves, each size, minimum one.
  - .4 Valve handles: one of each size.
  - .5 Gaskets for flanges: one for every ten flanged joints.
- .3 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Sustainable Requirements:
  - .1 [\_\_\_\_\_].

### **2.2 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG**

- .1 Except to specialty valves, to be of single manufacturer.
- .2 To be suitable for dead-end service.
- .3 CRN registration number required for products.
- .4 Sizes:
  - .1 Flange type: NPS 2 to 30.
  - .2 Grooved end type: NPS 2 to 12.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
  - .1 NPS 2 - 12: 200 psig.
- .6 Minimum seat temperature ratings to 121°C.
- .7 Application: on-off operation.
- .8 Operators:
  - .1 NPS 2 - 6: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.
- .9 Designed to comply with MSS SP-67 and API 609.

- .10 Compatible with ANSI Class 125/Class 150 flanges.
- .11 Construction:
  - .1 Body ductile iron.
  - .2 Disc: 316 SS.
  - .3 Seat: EPDM.
  - .4 Shaft: 316 stainless steel.
  - .5 Taper pin: 316 SS.
  - .6 Key: carbon steel.
  - .7 O-Ring: EPDM.
  - .8 Bushings: Teflon.

## **2.3 MOUNTING FLANGES**

- .1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Valve and mating flange preparation.
  - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
  - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
  - .3 Install butterfly valves with disc in almost closed position.
  - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

### **3.2 INSTALLATION OF VALVES**

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

**3.3 ACTUATOR INSTALLATION**

- .1 Installed by this section.
- .2 Supplied and electrically connected by Division 25.
- .3 Cycle valve operation from fully closed to fully open then back to fully closed.
- .4 At same time, check travel stop settings for proper disc alignment.

**3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Section 01.

**1.2               REFERENCES**

- .1       American Society of Mechanical Engineers (ASME):
  - .1       ASME B31.1-07, Power Piping.
- .2       ASTM International:
  - .1       ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2       ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3       ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3       Factory Mutual (FM).
- .4       Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
  - .1       MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2       MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3       MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5       Underwriter's Laboratories of Canada (ULC).

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

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

- .4 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

#### **1.4 CLOSEOUT SUBMITTALS**

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

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

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

### **Part 2 Products**

#### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements:
  - .1 Design supports, platforms, catwalks, hangers to withstand seismic events as specified Section 23 05 48 – Vibration and seismic controls for HVAC piping and equipment.

#### **2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

#### **2.3 PIPE HANGERS**

- .1 Finishes:
  - .1 Ensure steel hangers in contact with copper piping are epoxy coated.



- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut, carbon steel retaining clip.
    - .1 Rod: 9 mm UL listed.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed.
- .3 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .4 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies.
  - .2 Steel brackets.
  - .3 Sway braces for seismic restraint systems.
- .5 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .6 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel black.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with two nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: black.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## 2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.5 INSULATION PROTECTION SHIELDS**

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

## **2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.7 HOUSE-KEEPING PADS**

- .1 Refer to section 01 11 01 – General instructions.

## **2.8 PIPING ROOF SUPPORT**

- .1 UV stabilized polypropylene body. Interlock possibility for end to end mounting. 25 mm thick, 173 kPa, close cell structural foam. 1 lb per support.
- .2 5 years manufacturer warranty against defect.
- .3 Support such as Roof Top Blox model RTB-01, complete with all necessary anchoring items; threaded rods, bolts, Cantrust and proper clamps for multi-piping installation, etc.
- .4 Install 19 mm thick rubber mat, 300 mm x 300 mm, under each support.

## **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 on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:

- .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
- .2 Bolt-tightening torques to industry standards.
- .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

### 3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code.
- .2 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .5 Within 300 mm of each elbow.

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

- .6 Pipework greater than NPS 12: to MSS SP69.

### 3.4 HANGER INSTALLATION

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

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

### **3.5 HORIZONTAL MOVEMENT**

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

### **3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

### **3.7 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Vibration isolation materials and components, seismic control measures and their installation.

**1.3 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Building Code of Canada (NBC) – 2010.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 11 01 – General instructions.
  - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Quebec, Canada.
  - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
  - .3 Provide detailed drawings of seismic control measures for equipment and piping.

**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.

**1.7 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **Part 2            Products**

### **2.1                GENERAL**

- .1        The selection of the appropriate model is the responsibility of the manufacturer. Vibration equipment must be chosen to control lowest frequency capable of creating problems.
- .2        Maximum compression must not damage the spring. Equipment must be selected for a compression factor that will not exceed 2/3 of maximum compression.
- .3        Equipment must be able to control oscillation and lateral forces coming from all direction and be stable for a lateral displacement of 10 to 20% of spring height.
- .4        Static deflexion in mm is equal to weight divided by the rigidity constant of the isolator ( $f=F/K$ ). That deflexion must never be lower than indicated value in the base and isolator table.
- .5        When required deflexion is lower than 5 mm, anti-vibration pad can be use instead of spring mount equipment.
- .6        When used to support equipment with large amount of liquids, they must be limit stop.
- .7        When required to control lateral movement, install stabiliser.
- .8        Size and shape of bases type and performance of vibration isolation as recommended by manufacturers instruction and section 01 11 01 – General instructions.

### **2.2                ANTI-VIBRATION PADS**

- .1        Neoprene-steel-neoprene; 16 mm minimum thick neoprene bonded to 6.4 mm galvanised steel plate; 30 or 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 275 kPa.

### **2.3                SPRING MOUNT**

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

### **2.4                HANGERS**

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

- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut.

## 2.5 FLEXIBLE CONNECTORS

- .1 Sizing from pipe dimension and not from equipment connection diameter.
  - .1 NPS 2 and smaller: treaded connectors.
  - .2 NPS 2½ and bigger: flanged connections. Make sure the alignment of the piping does not exceed the alignment tolerance of the flexible connector.
- .2 For pipe NPS 2 and smaller:
  - .1 Flexible connector made of stainless steel mesh, MWP 1035 kPa (150 PSI), fatigue resistant, lateral movement of 13 mm with a 500 Hz amplitude, model TSN from Flexi-Tube.
  - .2 For copper piping, brass mesh, model CBH from Flexi-Tube.
- .3 For pipe NPS 2½ and bigger:
  - .1 Flexible connector built from stainless steel with multiple ring, steel flange with control rod, resistant to extension and axial compression of 13 mm minimum, and to a lateral movement of 7 mm minimum, working pressure of 1100 kPa at a temperature of 38°C, model TSF from Flexi-Tube.
- .4 For pipe size 2½ and bigger at the suction and discharge of pumps:
  - .1 Sphèrical expansion joint built from EPDM and polyester rope. All joint must be from 2 sphere with retaining ring in malleable steel with steel flange. Working pressure of 1475 kPa at 77°C. Burst and elongation safety factor of 3/1. When the pipe is not bolted down, use control rods. Model SFDEJ, SFDCR from Mason Industries. When flexible connector is also used as an elbow, use model MFNEC from Mason Industries.

## 2.6 STRUCTURAL BASES

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

- .3 Bases to clear housekeeping pads by 25 mm minimum.

## **2.7 INERTIA BASE**

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

## **2.8 SEISMIC CONTROL MEASURES**

- .1 General:
  - .1 Seismic risk level:
    - .1  $I_E : 1.0$
    - .2 Location category : E
  - .2 In the work to be completed in a building does not require any seismic measure, a sealed and signed letter from a seismic engineer is required to confirm the fact.
  - .3 Seismic control systems to work in every direction.
  - .4 Fasteners and attachment points to resist same maximum load as seismic restraint.
  - .5 Drilled or power driven anchors and fasteners not permitted.
  - .6 No equipment, equipment supports or mounts to fail before failure of structure.
  - .7 Supports of cast iron or threaded pipe not permitted.
  - .8 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:
      - .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 Piping systems:
  - .1 Fire protection systems: to NFPA 13.
  - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
  - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
  - .1 Approved by seismic 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 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to 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.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

### **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 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
  - .3 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification of vibration control:
  - .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 Air cooled condenser no 1.
    - .2 Chiller no 1.
    - .3 Air cooled condenser no 2.
    - .4 Chiller no 2.
    - .5 Cooling tower no 4.
  - .3 Provide Departmental Representative with notice 72 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.
- .3 Inspection and certification of seismic control:
  - .1 Following the installation of each seismic control measure, installation must be inspected and certified with an official letter signed and sealed from a seismic engineer and submitted to Departmental Representative.

### **3.4 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1            Section 01.

**1.2            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.

**1.3            REFERENCES**

- .1            Canadian Gas Association (CGA)
  - .1            CSA/CGA B149.1-2010, Natural Gas and Propane Installation Code.
- .2            Canadian General Standards Board (CGSB)
  - .1            CAN/CGSB-24.3-92, Identification of Piping Systems.

**1.4            ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Product data to include paint colour chips, other products specified in this section.

**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            Waste Management and Disposal:
  - .1            Dispose of unused paint and/or coating material at official hazardous material collections site.
  - .2            Do not dispose of unused paint or coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## **Part 2            Products**

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

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

Size no. 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 no. 5.
  - .2 Equipment in Mechanical Rooms: use size no. 9.

### **2.3            EXISTING IDENTIFICATION SYSTEMS**

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

- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

## **2.4 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Natural gas: to CSA/CGA B149.1.
  - .2 Sprinklers: to NFPA 13.

## **2.5 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive [plastic-coated cloth] [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 Departmental Representative.
  - .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
** Add design temperature		
++ Add design temperature and pressure		
Raw water	Green	RAW WATER
River water	Green	RIVER WATER
Sea water	Green	SEA WATER
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Brine	Green	BRINE
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Steam [_____]kPa	Yellow	[_____] kPa STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
Intermittent blow-off	Yellow	INT. BLOW-OFF
Continuous blow-off	Yellow	CONT. BLOW-OFF
Chilled drinking water	Green	CH. DRINK WTR
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Contaminated lab waste	Yellow	CONT. LAB WASTE
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	STORM
Sanitary	Green	SAN

Contents	Background colour marking	Legend
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
No. [ ] fuel oil suction	Yellow	# [ ] FUEL OIL
No. [ ] fuel oil return	Yellow	# [ ] FUEL OIL
Engine exhaust	Yellow	ENGINE EXHAUST
Lubricating oil	Yellow	LUB. OIL
Hydraulic oil	Yellow	HYDRAULIC OIL
Gasoline	Yellow	GASOLINE
Natural gas	to Codes	
Propane	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Chlorine	Yellow	CHLORINE
Nitrogen	Yellow	NITROGEN
Oxygen	Yellow	OXYGEN
Compressed air (	Green	COMP. AIR [ ] kPa
Compressed air (700kPa)	Yellow	COMP. AIR [ ] kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Carbon dioxide	Red	CO2
Instrument air	Green	INSTRUMENT AIR

## 2.6 IDENTIFICATION DUCTWORK SYSTEMS

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

## 2.7 VALVES, CONTROLLERS

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

## **2.8 CONTROLS COMPONENTS IDENTIFICATION**

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

## **2.9 LANGUAGE**

- .1 Identification in French.

## **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 Departmental Representative approbation.

### **3.3 INSTALLATION**

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

### **3.4 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
  - .1 Do not paint, insulate or cover.

### **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 VALVES, CONTROLLERS**

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

### **3.7 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               SUMMARY**

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

**1.3               QUALIFICATIONS OF TAB PERSONNEL**

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

#### **1.4 PURPOSE OF TAB**

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

#### **1.5 EXCEPTIONS**

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

#### **1.6 CO-ORDINATION**

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

#### **1.7 PRE-TAB REVIEW**

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

#### **1.8 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.

#### **1.9 OPERATION OF SYSTEMS DURING TAB**

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

#### **1.10 START OF TAB**

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Pressure, leakage, other tests specified elsewhere Division 23.

- .2 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 Liquid systems:
    - .1 Flushed, filled, vented.
    - .2 Correct pump rotation.
    - .3 Strainers in place, baskets clean.
    - .4 Isolating and balancing valves installed, open.
    - .5 Calibrated balancing valves installed, at factory settings.
    - .6 Chemical treatment systems complete, operational.

#### **1.11 APPLICATION TOLERANCES**

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

#### **1.12 ACCURACY TOLERANCES**

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

#### **1.13 INSTRUMENTS**

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

#### **1.14 ACTION AND INFORMATIONAL SUBMITTALS**

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

#### **1.15 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

**1.16 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit one copy of TAB Report to Departmental Representative for verification and approval, in French in D-ring binders, complete with index tabs. Submit five copies following approbation.

**1.17 VERIFICATION**

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

**1.18 SETTINGS**

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

**1.19 COMPLETION OF TAB**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

**1.3 REFERENCES**

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

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
  - .1 Submit proposed report form and test report format to Departmental Representative for approval at least one month before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
  - .2 Prepare report of results and submit to Departmental Representative within 72 hours of completion of tests. Include:
    - .1 Schematic of entire system.
    - .2 Schematic of section under test showing test site.
    - .3 Required and achieved static pressures.
    - .4 Orifice differential pressure at test sites.
    - .5 Permissible and actual leakage flow rate (L/s) for test sites.
    - .6 Witnessed certification of results.
  - .3 Include test reports in final TAB report.
  - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .5 Instructions: submit manufacturer's installation instructions.
  - .6 Manufacturer's field reports specified.

## **Part 2            Products**

### **2.1            TEST INSTRUMENTS**

- .1    Test apparatus to include:
  - .1      Fan capable of producing required static pressure.
  - .2      Duct section with calibrated orifice plate mounted and accurately located pressure taps.
  - .3      Flow measuring instrument compatible with the orifice plate.
  - .4      Calibration curves for orifice plates used.
  - .5      Flexible duct for connecting to ductwork under test.
  - .6      Smoke bombs for visual inspections.
- .2    Test apparatus: accurate to within +/- 3% of flow rate and pressure.
- .3    Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than two months before start of tests.
- .4    Re-calibrated every six months thereafter.

## **Part 3            Execution**

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

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

### **3.2            TEST PROCEDURES**

- .1    Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2    Section of duct to be tested to include:
  - .1      Fittings, branch ducts, tap-ins.
- .3    Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4    Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5    Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

### **3.3            SITE TOLERANCES**

- .1    System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2    Leakage tests on following systems not to exceed specified leakage rates.
  - .1      Small duct systems up to 250 Pa: leakage 2%.
  - .2      Large low pressure duct systems up to 500 Pa: leakage 2%.



- .3 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1%.

- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

### **3.4 TESTING**

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

### **3.5 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               REFERENCES**

- .1        Definitions:
  - .1        For purposes of this section:
    - .1        "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
    - .2        "EXPOSED" - means "not concealed" as previously defined.
    - .3        Insulation systems - insulation material, fasteners, jackets, and other accessories.
  - .2        TIAC Codes:
    - .1        CRD: Code Round Ductwork.
    - .2        CRF: Code Rectangular Finish.
- .2        Reference Standards:
  - .1        American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1        ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings except Low-Rise Residential Buildings.
  - .2        ASTM International Inc.
    - .1        ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2        ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3        ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4        ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5        ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6        ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7        ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8        ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3        Canadian General Standards Board (CGSB)
    - .1        CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

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

- .1 Product Data, shop drawings:
  - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
    - .2 Details of operation, servicing and maintenance.
    - .3 Recommended spare parts list.
- .2 Manufacturers' Instructions:
  - .1 Provide manufacture's written duct insulation jointing recommendations and special handling criteria, installation sequence & cleaning procedures.

### **1.4 QUALITY ASSURANCE**

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

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

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

## **Part 2 Products**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

## **2.3 JACKETS**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921. & ASTM-E84.
- .2 Lagging adhesive: compatible with insulation.
  - .1 Maximum VOC limit 250 g/L.

## **2.4 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
    - .1 Maximum VOC limit 200 g/L.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: setting on mineral wool, to ASTM C449.
- .4 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .6 Contact adhesive: quick-setting
  - .1 Maximum VOC limit 250 g/L.
- .7 Canvas adhesive: washable.
  - .1 Maximum VOC limit 250 g/L.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .10 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face of insulation.
- .11 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 PRE-INSTALLATION REQUIREMENTS**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum two rows each side.

### **3.4 DUCTWORK INSULATION SCHEDULE**

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

TIAC Code	Type	Vapor barrier	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	Yes	50
Round cold and dual temperature supply air ducts	C-2	Yes	50
Rectangular warm air ducts	C-1	No	25
Round warm air ducts	C-1	No	25

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

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

- .1 Finishes: conform to following table:

TIAC Code	Rectangular	Round
Indoor, concealed	None	None
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3

**3.5            CLEANING**

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

**END OF SECTION**





**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 01.

**1.2            REFERENCES**

- .1    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1    ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2    ASTM International Inc.
  - .1    ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2    ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .3    ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - .4    ASTM C547-07, Standard Specification for Mineral Fiber Pipe Insulation.
  - .5    ASTM C553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .6    ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .7    ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3    Canadian General Standards Board (CGSB)
  - .1    CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2    CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Material Safety Data Sheets (MSDS).
- .5    Thermal Insulation Association of Canada (TIAC)
  - .1    National Insulation Standards, 2005.
- .6    Underwriters Laboratories of Canada (ULC)
  - .1    CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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

- .1 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's Instructions:
  - .1 Include procedures to be used and installation standards to be achieved.
- .3 Qualifications:
  - .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

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

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.

## **Part 2 Products**

### **2.1 FIRE AND SMOKE RATING**

- .1 Fire and smoke ratings to CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 INSULATION**

- .1 TIAC Code A.6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52MA.
  - .3 Maximum "k" factor of 0.039 W/m.<sup>0</sup>C at 32<sup>0</sup>C.
  - .4 Certified by manufacturer free of potential stress corrosion cracking corrodents.

### **2.3 CEMENT**

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

## 2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type to CAN/CGSB 51.53 with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint.
  - .3 Minimum service temperatures: -20°C.
  - .4 Maximum service temperature: 65°C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness:
    - .1 Indoor : 0.50 mm.
    - .2 Outdoor : 0.76 mm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .8 Special requirements:
    - .1 Outdoor: UV rated material.
  - .9 Covering adhesive: compatible with insulation.
    - .1 Maximum VOC limit 250 g/L.
- .2 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: compatible with insulation.
    - .1 Maximum VOC limit 250 g/L.

## 2.5 INSULATION SECUREMENTS

- .1 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .2 Contact adhesive: quick setting.
  - .1 Maximum VOC limit 250 g/L.
- .3 Canvas adhesive: washable.
  - .1 Maximum VOC limit 250 g/L.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation with expanded metal lath on other face of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

**2.6 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.
  - .1 Maximum VOC limit 250 g/L.

**2.7 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

**2.8 OUTDOOR VAPOUR RETARDER MASTIC**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 PRE- INSTALLATION REQUIREMENTS**

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

**3.3 INSTALLATION**

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

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment, etc.
- .2 Installation to permit periodic removal and replacement without damage to adjacent insulation.

### **3.5 MECHANICAL EQUIPMENT INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 Hot Equipment:
  - .1 Plate heat exchanger
    - .1 On both faces and between plates while keeping free all bolts, as per manufacturer recommendation, ACIT A-6, 13 mm.
- .3 Cold equipment:
  - .1 Plate heat exchanger
    - .1 On both faces and between plates while keeping free all bolts, as per manufacturer recommendation, ACIT A-6, 13 mm.
    - .2 Chilled water pump
      - .1 ACIT A-6, 13 mm.
    - .3 Chillers
      - .1 Insulate all cold section or cold piping, ACIT A-6, 13 mm.
- .4 Finishes:
  - .1 Equipment in mechanical rooms: TIAC code CEF/2 with 13 mm cement and canvas jacket.

### **3.6 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 01.

**1.2            SUMMARY**

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

**1.3            REFERENCES**

- .1        American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1        ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2        American Society for Testing and Materials International (ASTM)
  - .1        ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
  - .2        ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3        ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4        ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5        ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6        ASTM C547-2003, Mineral Fiber Pipe Insulation.
  - .7        ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3        Canadian General Standards Board (CGSB)
  - .1        CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2        CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).
- .5        Manufacturer's Trade Associations
  - .1        Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

- .6 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
  - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

#### **1.4 DEFINITIONS**

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

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawing:
  - .1 Submit manufacturer's printed product literature, specifications and

#### **1.6 QUALITY ASSURANCE**

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

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.



- .3 Store at temperatures and conditions required by manufacturer.

## **Part 2 Products**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 INSULATION**

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702, ASTM C547.
- .5 TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1 Insulation: complies with CAN/CGSB-51.40.
  - .2 Vapor barrier: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor of 0.039 W/m.<sup>0</sup>C at 32°C.
  - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

### **2.3 INSULATION SECUREMENT**

- .1 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

### **2.4 CEMENT**

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

## **2.5 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

## **2.6 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

## **2.7 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m<sup>2</sup>.

## **2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint.
  - .3 Minimum service temperatures: -20°C.
  - .4 Maximum service temperature: 65°C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness:
    - .1 Indoor : 0.50 mm.
    - .2 Outdoor : 0.76 mm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .8 Special requirements:
    - .1 Outdoor: UV rated material.
- .2 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: compatible with insulation.

## **Part 3 Execution**

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

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

### **3.2 PRE-INSTALLATION REQUIREMENT**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: at expansion joints, valves, primary flow measuring elements, flanges and unions at equipment, etc.
- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: PVC.

### **3.5 INSTALLATION OF ELASTOMERIC INSULATION**

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

### **3.6 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1:
  - .1 Securements: Tape at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3:
  - .1 Securements: Tape at 300 mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.

- .4 TIAC Code: A-6:
- .1 Insulation securements: as per manufacturer recommendations.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: as per manufacturer recommendations.
- .5 Thickness of insulation as listed in following table.
- .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application Run out	Temperature °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)			
			to 1	1 1/4 to 2	2 1/2 to 4	5 to 6
Steam	up to 175	A-1	38	50	65	75
Steam, Saturated and Super heated	over 175	A-1	38	65	65	75
Condensate Return	60 - 94	A-1	25	38	38	38
Boiler Feed Water		A-1	25	25	25	25
Hot Water Heating	60 - 94	A-1	25	38	38	38
Hot Water Heating	up to 59	A-1	25	25	25	25
Glycol Heating	60 - 94	A-1	25	38	38	38
Glycol Heating	up to 59	A-1	25	25	25	25
Domestic HWS		A-1	25	25	25	38
Chilled Water	4 - 13	A-3	25	25	25	25
Domestic CWS		A-3	25	25	25	25
Refrigerant hot gas liquid suction	4 - 13	A-6	25	25	25	25

- .6 Finishes:
- .1 Exposed indoors: canvas jacket.
  - .2 Exposed in mechanical rooms: canvas jacket.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .5 Outdoors: PVC jacket.
  - .6 Finish attachments: as per manufacturer recommendation.
  - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

### 3.7 CLEANING

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 01.

**1.2                REFERENCES**

- .1        American Society for Testing and Materials International (ASTM):
  - .1        ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

**1.3                CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1        In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.4                HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1        Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2        When systems are operational, perform following tests:
  - .1        Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2        Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1        Pump operation.
    - .2        Boiler and/or chiller operation.
    - .3        Pressure bypass open/closed.
    - .4        Control pressure failure.
    - .5        Maximum heating demand.
    - .6        Maximum cooling demand.
    - .7        Boiler and/or chiller failure.
    - .8        Cooling tower (and/or industrial fluid cooler) fan failure.
    - .9        Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

**1.5                HYDRONIC SYSTEM CAPACITY TEST**

- .1        Perform hydronic system capacity tests after:
  - .1        TAB has been completed
  - .2        Verification of operating, limit, safety controls.
  - .3        Verification of primary and secondary pump flow rates.

- .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water (heating water, steam, cooling, cooling tower network) to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning off heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.
- .7 Chilled water system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Adding heat from building heating system or;
    - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater than OAT. RAT to be at least 23 degrees C minimum.
  - .2 Test procedures:
    - .1 Open fully cooling coil control valves.
    - .2 Set thermostats on associated AHU's for maximum cooling.
    - .3 Set AHU's for design maximum air flow rates.
    - .4 Set load or demand limiters on chillers to 100%.
    - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

## **1.6 CONDENSER WATER AND HUMIDIFICATION SYSTEMS**

- .1 In addition to procedures specified above, perform following:
  - .1 Add chemicals each week as required and following manufacturer instructions.
  - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
  - .4 Inject inhibitor into cooling tower sump.

## **1.7 GLYCOL SYSTEMS**

- .1 Test to prove concentration will prevent freezing to minus 34 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

## **1.8 STEAM SYSTEMS**

- .1 Performance verification:
  - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
  - .2 Verify operation of components of steam system including:
    - .1 Steam traps by:
      - .1 Measuring temperature of condensate return and/or
      - .2 Using audio-sensing devices.
      - .3 Use of other approved methods.
    - .2 Flash tanks.
    - .3 Thermostatic vents.
  - .3 Verify performance of condensation units, including:
    - .1 Pump capacity at design temperature.
    - .2 Controls.
  - .4 If applicable, verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
  - .5 Adjust piping system as required to eliminate water hammer.
- .2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

## **1.9 GASEOUS FUEL SYSTEMS**

- .1 Operation tests:
  - .1 Measure gas pressure at gas meter outlet and at burner manifold.
  - .2 Verify details of temperature and pressure compensation at meter.
  - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
  - .4 Check terminals of vents for gas pressure regulators.

**1.10 POTABLE WATER SYSTEMS**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
  - .2 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

**1.11 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

**1.12 TRAINING**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified herein.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 01.

**1.2            SUMMARY**

- .1        Section Includes:
  - .1        Procedures and cleaning solutions for cleaning mechanical piping systems.

**1.3            REFERENCES**

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

**1.4            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Product Data:
  - .1        Submit manufacturer's printed product literature, specifications and datasheet.
  - .2        Instructions: submit manufacturer's installation 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 manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

**Part 2           Products**

**2.1            CLEANING SOLUTIONS**

- .1        Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2        Sodium carbonate: 0.40 kg per 100 L water in system.
- .3        Low-foaming detergent: 0.01 kg per 100 L water in system.

**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                CLEANING HYDRONIC AND STEAM SYSTEMS**

- .1        Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2        Cleaning Agency:
  - .1        Retain qualified water treatment specialist to perform system cleaning.
- .3        Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist and inform Departmental Representative
- .4        Cleaning procedures:
  - .1        Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1        Cleaning procedures, flow rates, elapsed time.
    - .2        Chemicals and concentrations used.
    - .3        Inhibitors and concentrations.
    - .4        Specific requirements for completion of work.
    - .5        Special precautions for protecting piping system materials and components.
    - .6        Complete analysis of water used to ensure water will not damage systems or equipment.
- .5        Conditions at time of cleaning of systems:
  - .1        Systems: free from construction debris, dirt and other foreign material.
  - .2        Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3        Strainers: clean prior to initial fill.
  - .4        Install temporary filters on pumps not equipped with permanent filters.
  - .5        Install pressure gauges on strainers to detect plugging.
- .6        Report on Completion of Cleaning:
  - .1        When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7        Hydronic Systems:
  - .1        Fill system with water, ensure air is vented from system.
  - .2        Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

- .3 Use water metre to record volume of water in system to +/- 0.5%.
- .4 Add chemicals under direct supervision of chemical treatment supplier.
- .5 Closed loop systems: circulate system cleaner at 60°C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
- .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
- .7 Add chemical solution to system.
- .8 Establish circulation, raise temperature slowly to [maximum design] [82 degrees C minimum]. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .8 Glycol Systems:
  - .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 34°C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.
- .9 Steam Systems: in addition to general requirements as specified above, perform following:
  - .1 Remove internal components of steam traps until flushing and warm-up have been completed.
  - .2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.
  - .3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.
  - .4 Water hammer: determine source and eliminate cause.
- .10 Steam boilers:
  - .1 Isolate boilers from piping system.
  - .2 Fill to normal operating level. Add cleaner. Fire to 50% of design operating steam pressure. Maintain for 24 h, during which blow down boiler every 4 h including water columns, controls, skimmer lines and valves, test cocks, blowdown valves. Add water to return to operating level.
  - .3 Allow boiler to cool, then drain, flush and inspect.
  - .4 Reconnect to piping system.
  - .5 Refill boiler with clean softened water and immediately add chemical inhibitors.
  - .6 Apply heat slowly and raise to normal design operating steam pressure. Maintain for 4 h.

- .7 Discharge condensate from steam system to sewer for 96 h after initial operation. During this period continue chemical treatment of boilers with inhibitors to ensure complete removal of oils, grease and millscale from steam and condensate return piping steam.
- .8 Drain steam condensate until it is clean and free from suspended matter. Ensure proper operation of steam traps.
- .9 Allow boiler to cool, drain, open inspection ports and wash out with clean water.
- .10 If boiler is not used immediately, refill with softened water, add sodium sulphite, bring up to pressure. Test for residual sulphite.
- .11 After cleaning is completed and system is filled, perform relevant start-up procedures as specified for hydronic systems:

### 3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
  - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .8 Repeat with water at design temperature.
  - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .10 Bring system up to design temperature and pressure slowly.
  - .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .12 Adjust pipe supports, hangers, springs as necessary.
  - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .14 If bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
  - .15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
  - .16 Check operation of drain valves.
  - .17 Adjust valve stem packings as systems settle down.
  - .18 Fully open balancing valves (except those that are factory-set).
  - .19 Check operation of over-temperature protection devices on circulating pumps.

- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.4 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Sections 01.

**1.2                REFERENCES**

- .1        American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME):
  - .1        ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.
  - .2        ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3        ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4        ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2        ASTM International Inc.:
  - .1        ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2        ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
  - .3        ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).
- .3        American National Standards Institute/American Water Works Association (ANSI)/(AWWA):
  - .1        ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4        Canadian Standards Association (CSA International):
  - .1        CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5        Department of Justice Canada (JUS):
  - .1        Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6        Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1        Material Safety Data Sheets (MSDS).
- .7        Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
  - .1        MSS-SP-67-02a, Butterfly Valves.
  - .2        MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
  - .3        MSS-SP-71-05, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4        MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .8        National Research Council (NRC)/Institute for Research in Construction:
  - .1        NRCC 38728, National Plumbing Code of Canada (NPC) – current edition.

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

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

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

- .1 Store, manage and handle as per manufacturer recommendation.

## **Part 2 Products**

### **2.1 PIPING**

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

### **2.2 FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1½ and smaller: wrought copper to ANSI/ASME B16.22; suitable for operating pressure to 1380 kPa.

### **2.3 JOINTS**

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5.
- .4 Teflon tape: for threaded joints.
- .5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.



## **2.4 GATE VALVES**

- .1 NPS 2 and under, soldered:
  - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

## **2.5 GLOBE VALVES**

- .1 NPS 2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.

## **2.6 SWING CHECK VALVES**

- .1 NPS 2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

## **2.7 BALL VALVES**

- .1 NPS 2 and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150.
  - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

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

### **3.3 VALVES**

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

- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

### **3.4 PRESSURE TESTS**

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

### **3.5 FLUSHING AND CLEANING**

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

### **3.6 PRE-START-UP INSPECTIONS**

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

### **3.7 DISINFECTION**

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

### **3.8 START-UP**

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
  - .4 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

### **3.9 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
  - .4 Verify compliance with safety and health requirements.
  - .5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

### **3.10 OPERATION REQUIREMENTS**

- .1 Coordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

### **3.11 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               SUMMARY**

- .1        Section Includes:
  - .1        Materials and installation for piping, valves and fittings for gas fired equipment.

**1.3               REFERENCES**

- .1        American Society of Mechanical Engineers (ASME):
  - .1        ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .2        ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3        ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .4        ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2        American Society for Testing and Materials International (ASTM):
  - .1        ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  - .2        ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3        ASTM B75M-99, Standard Specification for Seamless Copper Tube.
  - .4        ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3        Canadian Standards Association (CSA International):
  - .1        CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4        Canadian Standards Association (CSA)/Canadian Gas Association (CGA):
  - .1        CAN/CSA B149.1 HB-00, Natural Gas and Propane Installation Code Handbook.
- .5        Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1        Material Safety Data Sheets (MSDS).

**1.4               ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Product Data:
  - .1        Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2        Indicate on manufacturers catalogue literature following.

- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **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.

## **Part 2 Products**

### **2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
  - .1 NPS 1/2 to 2, screwed.
  - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

### **2.2 JOINTING MATERIAL**

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: non-metallic flat.
- .4 Brazing: to ASTM B837.

### **2.3 FITTINGS**

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.
  - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
  - .3 Welding: butt-welding fittings.
  - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
  - .5 Bolts and nuts: to ASME B18.2.1.
  - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
  - .1 Cast copper fittings: to ASME B16.18.
  - .2 Wrought copper fittings: to ASME B16.22.

## **2.4 VALVES**

- .1 Provincial Code approved, lubricated ball type.

## **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 PIPING**

- .1 Install in accordance with Section 23 05 05 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149.1 and supplemented as specified.
- .2 Install drip points:
  - .1 At low points in piping system.
  - .2 At connections to equipment.
- .3 Paint all natural gas piping, yellow color, paint must be suitable for steel, 2 coats of paint minimum.

### **3.3 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Performance Verification:
  - .1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .3 PV procedures:
  - .1 Test performance of components.

### **3.5 ADJUSTING**

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
  - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

**3.6 CLEANING**

- .1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems, CAN/CSA B149.1, and supplemented as specified.
- .2 Perform cleaning operations as specified in Section 01 74 11 – Cleaning and in accordance with manufacturer's recommendations.
- .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01.

**1.2 REFERENCES**

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA):
  - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .2 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
  - .3 ASME B16.9-07, Factory-Made Wrought Buttwelding Fittings.
  - .4 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
  - .5 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International:
  - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International:
  - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):
  - .1 MSS-SP-67-2002a, Butterfly Valves.
  - .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

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

- .1 Product Data, shop drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
  - .1 Include special servicing requirements.

### **1.5 EXTRA STOCK MATERIALS**

- .1 Supply spare parts as follows:
  - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
  - .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
  - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
  - .4 Valve handles: 1 minimum of each size.
  - .5 Gaskets for flanges: 1 minimum for every ten flanges.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, category B, as follows:
  - .1 To NPS 6: Schedule 40.

### **2.2 PIPE JOINTS**

- .1 NPS 2 and under: screwed fittings with lead-free pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

- .3 Flanges: weld neck, raised face, to ANSI/AWWA C111/ A21.11.
- .4 Flange gaskets: to ANSI/AWWA C111/ A21.11.
- .5 Pipe thread: taper.
- .6 Bolts and nuts: to ASME B18.2.1, ASME B18.2.2.

## **2.3 FITTINGS**

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

## **2.4 VALVES**

- .1 Connections:
  - .1 NPS 2 and smaller: screwed ends.
  - .2 NPS 2-1/2 and larger: flanged ends.
- .2 Gate valves: to MSS-SP-70, application: isolating equipment, control valves, pipelines:
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem, wedge disc.
  - .2 NPS 2-1/2 and over:
    - .1 Mechanical Rooms: rising stem, wedge disc bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
    - .1 Operators: manual.
- .3 Butterfly valves: to MSS-SP-67, application: isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
  - .1 NPS 2-1/2 and over: lug type: as specified Section 23 05 17 - Pipe Welding.
- .4 Globe valves: to application: throttling, flow control, emergency bypass, MSS-SP-80:
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: with PTFE disc.
  - .2 NPS 2-1/2 and over:
    - .1 With bronze disc, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Balancing, for TAB:
  - .1 Sizes: calibrated balancing valves, as specified this section.
  - .2 NPS 2 and under:
    - .1 Bronze body, working pressure of 2069 kPa at 121<sup>0</sup>C, threaded joint, globe valve type. Used for flow measurement, network balancing and safe shutoff with memory stop for easy startup.

- .2 ¼" NPT drain, connections with integral check valve, one on each side of the seat, allowing the connection of the instrument measure. Micrometer type indicator for the open position of the valve.
- .3 NPS 2-1/2 and over:
  - .1 Bronze body, flanged, working pressure of 862 kPa, bronze spherical valve with TFE seat for NPS 2½ and NPS3, bronze seat and bronze replaceable disk with EPDM for NPS size over 3", working pressure of 1200 kPa at 121°C. Used for flow measurement, network balancing and safe shutoff with memory stop for easy startup.
  - .2 Connections with integral check valve, one on each side of the seat, allowing the connection of the instrument measure. Micrometer type indicator for the open position of the valve.
- .6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc.
- .7 Swing check valves: to MSS-SP-71.
  - .1 NPS 2 and under:
    - .1 Class 125, swing, with bronze disc.
  - .2 NPS 2-1/2 and over:
    - .1 Flanged ends: as specified Section 23 05 23.02 - Valves - Cast Iron.

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

#### **3.2 PIPING INSTALLATION**

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

#### **3.3 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove hand wheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

**3.4 CLEANING, FLUSHING AND START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

**3.5 BALANCING**

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

**3.6 GLYCOL CHARGING**

- .1 Include mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.

**3.7 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems.

**3.8 CLEANING**

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

**3.9 PROTECTION**

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

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1        Section 01.

**1.2            REFERENCES**

- .1        ASME:
  - .1        ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2        ASTM International:
  - .1        ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2        ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .3        ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
  - .4        ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3        CSA Group:
  - .1        CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Product Data, shop drawings:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4            CLOSEOUT SUBMITTALS**

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

**1.5            DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect hydronic specialties from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

## **Part 2            Products**

### **2.1                DIAPHRAGM TYPE EXPANSION TANK**

- .1    Vertical steel pressurized diaphragm type expansion tank.
- .2    Diaphragm sealed in ultra resistant butyle suitable for 115°C operating temperature.
- .3    Working pressure: 860 kPa with ASME stamp and certification.
- .4    Air precharged to 83 kPa.
- .5    Base mount for vertical installation.
- .6    Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .7    Replaceable diaphragm.
- .8    Identifications:
  - .1    RE-1 (low temperature heating) : Capacity of 416 l, 610 mm diameter, 1676 mm height, such as Amtrol model AX-200V or a replacement product approved by addendum as per tenderers instruction.
  - .2    RE-2 (glycol pre-heating) : Capacity of 30 l, 304 mm diameter, 508 mm height, such as Amtrol model AX-15V or a replacement product approved by addendum as per tenderers instruction.
  - .3    RE-3 (chilled water) : Capacity of 30 l, 304 mm diameter, 508 mm height, such as Amtrol model AX-15V or a replacement product approved by addendum as per tenderers instruction.
  - .4    RE-4 (REF condenser water) : Capacity of 30 l, 304 mm diameter, 508 mm height, such as Amtrol model AX-15V or a replacement product approved by addendum as per tenderers instruction.
  - .5    RE-5 (glycol, cooling tower) : Capacity of 30 l, 304 mm diameter, 508 mm height, such as Amtrol model AX-15V or a replacement product approved by addendum as per tenderers instruction.
  - .6    RE-6 (chilled glycol [U-3/U-4]) : Capacity of 30 l, 304 mm diameter, 508 mm height, such as Amtrol model AX-15V or a replacement product approved by addendum as per tenderers instruction.

### **2.2                AUTOMATIC AIR VENT**

- .1    Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

### **2.3                BACKFLOW PREVENTER**

- .1    Double check valve assembly, steel or brass body, brass and stainless steel mechanism, made of:
  - .1    Two isolating valves.
  - .2    Union coupling.
  - .3    Strainer in front of first isolating valve.



- .4 Double check valve assembly with discharge valve for reduced pressure assembly type.
- .5 Low risk: supply water for glycol pressurisation system.
  - .1 Such as Watts model no 007.
- .6 High risk: closed circuit network, make-up water for steam boiler, condensate cooler.
  - .1 Such as Watts model no 009.
- .7 Installed as per CSA-B64 standard.

## **2.4 PIPE LINE STRAINER**

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12: cast iron body to ASTM A278/A278M, Class 30, flanged connections.
- .3 Blowdown connection: NPS 1.
- .4 Screen: stainless steel with:
  - .1 Steam: 0.8 mm perforations.
  - .2 Water: 1.19 mm perforations.
- .5 Working pressure: 860 kPa.

## **2.5 SUCTION DIFFUSER**

- .1 Body: cast iron with flanged connections.
- .2 With no built-in strainer.
- .3 Full length straightening vanes.
- .4 Pressure gauge tapings.

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

### **3.2 APPLICATION**

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

### **3.3 GENERAL**

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

### **3.4 STRAINERS**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.

### **3.5 AIR VENTS**

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

### **3.6 BACKFLOW PREVENTER**

- .1 When applicable (depending on model), drain the backflow preventer to nearest floor drain and install drainage piping solidly and rigidly.
- .2 Contractor must be qualified to install and test as per CSA-B64 standards. Provide test results in appropriate manual to Departmental Representative.
- .3 Install backflow preventer on domestic cold water line as shown on drawings.

### **3.7 EXPANSION TANKS**

- .1 Adjust expansion tank pressure to suit design criteria of network.
- .2 Install valve at inlet to tank.

### **3.8 PRESSURE SAFETY RELIEF VALVES**

- .1 Run discharge pipe to terminate above nearest drain.

### **3.9 SUCTION DIFFUSERS**

- .1 Install on inlet to pumps having suction size greater than 50.

### **3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01.

**1.2               REFERENCES**

- .1        American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1        ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2        CSA Group
  - .1        CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
- .3        Electrical Equipment Manufacturers Association of Canada (EEMAC)
- .4        National Electrical Manufacturers' Association (NEMA)
  - .1        NEMA MG 1-2011, Motors and Generators.

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Product Data, shop drawings:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for pump, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

**1.4               CLOSEOUT SUBMITTALS**

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

**1.5               DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect hydronic pumps from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

## **Part 2            Products**

### **2.1                EQUIPMENT**

- .1        Size and select components to: CAN/CSA-B214.

### **2.2                GENERALITY**

- .1        Impeller must not exceed 85% of its maximum diameter size.
- .2        Flexible connection for the pump and motor group. Flexible joint must be selected in regards to the starting tork of the motor, plus a safety factor of 150% and for frequent start.
- .3        Flexible connection protected by a removable metal guard, rigid construction, compatible with the weight and rotational speed of the joint.
- .4        Perfectly aligned pump and free of any vibration.
- .5        Proceed with trials in order to determine the natural frequency of the pump-motor group. Proceed with the required corrections to eliminate any risk of resonance on all the speed range, particularly with variable speed pump.
- .6        For propylene glycol, use appropriate compatible mechanical joint.

### **2.3                VERTICAL IN-LINE CIRCULATORS**

- .1        Centrifugal type, vertical, as per working pressure mentioned below.
- .2        Volute: cast iron, radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .3        Impeller: bronze, statically and dynamically balanced, carbone steel shaft with bronze jacketing.
- .4        Radial gasket: split type, exterior mechanical seal, spacer and coupling.
- .5        Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .6        Bottom of pump supplied with drainage valve and flexible hose connector.
- .7        Coupling: flexible self-aligning.
- .8        Motor: vertical type motor with rigid shaft, P-type base, squirrel cage induction type, protected against dripping.
- .9        Design pressure: 1200 kPa.
- .10      Identifications:
  - .1        PB-1 : heating water, flow of 22 l/s, 95 ft of head, 1750 rpm, 20 HP motor, 575/3/60, Bell & Gossett model 80, no. 4 x 4 x 11 or a replacement product approved by addendum as per tenderers instruction.
  - .2        PER-1 : chilled water, flow of 19 l/s, 60 ft of head, 1750 rpm, 7.5 HP motor, 575/3/60, Bell & Gossett model 80, no. 3 x 3 x 9½ or a replacement product approved by addendum as per tenderers instruction.
  - .3        PER-2 : chilled water, flow of 19 l/s, 60 ft of head, 1750 rpm, 7.5 HP motor, 575/3/60, Bell & Gossett model 80, no. 3 x 3 x 9½ or a replacement product approved by addendum as per tenderers instruction.

- .4 PET-1 : cooling tower 50%PG, flow of 21 l/s, 100 ft of head, 1750 rpm, 20 HP motor, 575/3/60, Bell & Gossett model 80, no 4x4x11 or a replacement product approved by addendum as per tenderers instruction.
- .5 PGLC-1 : hot 50%PG, flow of 3.30 l/s, 60 ft of head, 1750 rpm, 3 HP motor, 575/3/60, Bell & Gossett model 80, no. 1½ x 1½ x 9½ or a replacement product approved by addendum as per tenderers instruction.
- .6 PGLF-1 : cold 50%PG, flow of 1.90 l/s, 50 ft of head, 1750 rpm, 1.5 HP motor, 575/3/60, Bell & Gossett model 80, no. 1½ x 1½ x 7B or a replacement product approved by addendum as per tenderers instruction.
- .7 PREC-1 : condenser water, flow of 6.25 l/s, 40 ft of head, 1750 rpm, 2 HP motor, 575/3/60, Bell & Gossett model 80, no. 2½ x 2½ x 7 or a replacement product approved by addendum as per tenderers instruction.

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

#### **3.2 APPLICATION**

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

#### **3.3 INSTALLATION**

- .1 Install hydronic pumps to: CAN/CSA-B214.
- .2 Base mounted type: supply templates for anchor bolt placement:
  - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
  - .2 Align coupling in accordance with manufacturer's recommended tolerance.
  - .3 Check oil level and lubricate. After run-in, tighten glands.
- .3 Ensure that pump body does not support piping or equipment.
  - .1 Provide stanchions or hangers for this purpose.
  - .2 Refer to manufacturer's installation instructions for details.
- .4 Install volute venting pet cock in accessible location.
- .5 Check rotation prior to start-up.

- .6 Install pressure gauge test cocks.

### **3.4 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements; supplemented as specified herein.
  - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Adjust alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
  - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
  - .15 Verify lubricating oil levels.

### **3.5 PERFORMANCE VERIFICATION (PV)**

- .1 General:
  - .1 Verify performance in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Verify that manufacturer's performance curves are accurate.
- .3 Ensure valves on pump suction and discharge provide tight shut-off.
- .4 Multiple Pump Installations - Series and Parallel:
  - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.



- .5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .6 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:
  - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
  - .2 Use Report Forms specified in Section 01 91 13 - General Commissioning (Cx) Requirements] Report Forms and Schematics.
  - .3 Pump performance curves (family of curves).

### **3.6 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
  - .2 ASME B16.25-07, Buttwelding Ends.
  - .3 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .4 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings: NPS through 24.
  - .5 ANSI/ASME B16.9-07, Factory-Made Wrought Steel Buttwelding Fittings.
  - .6 ANSI B18.2.1-96(R2005), Square and Hex Bolts and Screws (Inch Series).
  - .7 ANSI/ASME B18.2.2-87(R2005), Square and Hex Nuts (Inch Series).
- .2 American National Standards Institute (ANSI) / American Water Works Association (AWWA):
  - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 ASTM International Inc.:
  - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .4 Association canadienne de normalisation (CSA)/CSA International:
  - .1 CSA W48-F06, Matériaux d'apport et matériaux associés pour le soudage à l'arc.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.:
  - .1 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .2 MSS-SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
  - .4 MSS-SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawings:
  - .1 Provide manufacturer's printed product literature and datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:

**1.5 DELIVERY, STORAGE AND HANDLING**

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

**1.6 EXTRA MATERIALS**

- .1 Extra Stock Materials:
  - .1 Provide spare parts as follows:
    - .1 Valve seats: one for every ten valves, each size. Minimum one.
    - .2 Discs: one for every ten valves, each size. Minimum one.
    - .3 Stem packing: one for every ten valves, each size. Minimum one.
    - .4 Valve handles: 1 of each size.
    - .5 Gaskets for flanges: one for every ten flanges.

**Part 2 Products**

**2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

**2.2 PIPE JOINTS**

- .1 NPS 2 and under: screwed fittings with lead-free dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.
- .4 Pipe thread: taper.
- .5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1, ANSI/ASME B18.2.2.
- .6 Buttwelding ends: to ANSI/ASME B16.25.

**2.3 FITTINGS**

- .1 Pipe flanges: cast-iron to ASME B16.1, Class 125.
- .2 Screwed fittings: malleable iron to ASME B16.3, Class 150.
- .3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.
- .4 Buttwelding fittings: steel to ANSI/ASME B16.9.
- .5 Unions: malleable iron, to ASTM A47/A47M, ASME B16.3.

## **2.4 VALVES**

- .1 Connections:
  - .1 NPS 2 and smaller: screwed ends.
  - .2 NPS 2 1/2 and larger:
    - .1 Equipment: Flanged ends.
    - .2 Elsewhere: Flanged ends.
- .2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines.
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem, wedge.
  - .2 NPS 2 1/2 -8:
    - .1 Mechanical Rooms: Class 150, rising stem, wedge disc, cast iron, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: with PFTE disc.
  - .2 NPS 2 1/2 and over:
    - .1 With bronze disc, cast iron with bronze trim, to Section 23 05 23.02 - Valves - Cast Iron.
- .4 Gate valves: Application: gravity condensate return service, steam drip point assemblies.
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem, wedge disc.
  - .2 NPS 2 1/2 and over:
    - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, cast iron, bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc.
- .6 Lift check valves:
  - .1 NPS 2 and under: Class 125, lift, with composition disc.
  - .2 NPS 2 1/2 and over: as specified Section 23 05 23.02 - Valves - Cast Iron.

## **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 PIPING**

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified below.

- .2 Connect branch lines into top of mains.
- .3 Install piping in direction of flow with slopes as follows, unless indicated:
  - .1 Steam: 1:240.
  - .2 Condensate return: 1:70.
- .4 Make provision for thermal expansion.
- .5 Drip pocket: line size.

### **3.3 TESTING**

- .1 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

### **3.4 SYSTEM START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **3.5 PERFORMANCE VERIFICATION (PV)**

- .1 General:
  - .1 Verify performance in accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems supplemented as specified herein.
- .2 Timing, only after:
  - .1 Pressure tests successfully completed.
  - .2 Flushing as specified has been completed.
  - .3 Water treatment system has been commissioned.
- .3 PV Procedures:
  - .1 Verify complete drainage of condensate from steam coils.
  - .2 Verify proper operation of system components, including, but not limited to:
    - .1 Steam traps - verify no blow-by.
    - .2 Flash tanks.
    - .3 Thermostatic vents.
  - .3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.
    - .1 If bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .4 Humidifiers: for commissioning procedures, refer to Section 23 84 13 - Humidifiers.
- .5 Condensate pumping units: for commissioning procedures, refer to Section 01 91 13 - General Commissioning (Cx) Requirements.

**3.6 CLEANING**

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

**END OF SECTION**





**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Sections 01.

**1.2 REFERENCES**

- .1 American Society for Mechanical Engineers (ASME International).
- .2 ASTM International Inc.:
  - .1 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM A167-99(2004), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
  - .3 ASTM A216/A216M-07, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.
  - .4 ASTM A240/A240M-07e1, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .5 ASTM A276-06, Standard Specification for Stainless Steel Bars and Shapes.
  - .6 ASTM A351/A351M-06, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
  - .7 ASTM A564/A564M-04, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
  - .8 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawings:
  - .1 Provide manufacturer's printed product literature Canadian Registration Number (CRN), and datasheets for steam traps, vacuum breakers, pressure reducing valves, air vents, safety relief valves, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:

**1.4 DELIVERY, STORAGE AND HANDLING**

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

- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Cast steel: to ASTM A216/A216M.
- .2 Cast iron: to ASTM A278, Class 125.
- .3 Bronze: to ASTM B62.
- .4 Stainless steel: to ASTM A351/A351M.

### **2.2 INVERTED BUCKET STEAM TRAP 0-1000 KPA**

- .1 Application: for non-modulating steam services on end of line drips.
- .2 Materials: body - cast iron; valve - stainless steel; bucket-stainless steel, with bimetal air vent.
- .3 Capacity: as indicated.
- .4 Such as Armstrong model no 881.

### **2.3 SAFETY AND RELIEF VALVES**

- .1 Spring loaded type of bronze with high capacity and full nozzle and to ASME code.
- .2 Material: body -cast iron; valve - housing cast bronze; spring - steel, cadmium plated; bronze/brass trim.
- .3 Capacity: as indicated.

### **2.4 DRIP PAN ELBOWS**

- .1 Application: on discharge of steam safety relief valves.
- .2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.
- .3 Such as Anvil fig. 1538.

### **2.5 PIPE LINE STRAINERS UP TO NPS 2**

- .1 Application: ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.
- .2 Working pressure: 860 kPa.
- .3 Body: cast iron.
- .4 Connections: screwed.
- .5 Screen: stainless steel with 0.8 mm perforations.

**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.
- .2        Maintain proper clearance around equipment to permit maintenance.

**3.2                STRAINERS**

- .1        Install as indicated.
- .2        Ensure clearance for removal of basket.
- .3        Install valve blow-down as indicated.

**3.3                SAFETY RELIEF VALVE**

- .1        Pipe to atmosphere independent of other vents and in accordance with applicable code.
- .2        Support discharge pipe against reaction forces and to take up thermal movement.
- .3        Drain pipe from drip pan elbow to terminate over floor drain.

**3.4                STEAM TRAPS**

- .1        Install unions on inlet and outlet.

**3.5                PERFORMANCE VERIFICATION**

- .1        In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

**3.6                CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 01.

**1.2            REFERENCES**

- .1    ASME:
  - .1    ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2    ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
  - .3    ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4    ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.
- .2    ASTM International:
  - .1    ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2    ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3    Groupe CSA:
  - .1    CSA B52-05 (C2009), Collection B52, Code sur la réfrigération mécanique.
- .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.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Product Data, shop drawings:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .2    Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3    Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.4            CLOSEOUT SUBMITTALS**

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

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 TUBING**

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

### **2.2 FITTINGS**

- .1 Service: design pressure 2070 kPa and temperature 121°C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, 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.

### **2.3 PIPE SLEEVES**

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

### **2.4 VALVES**

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.3 GENERAL**

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

#### **3.4 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.

#### **3.5 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<sup>3</sup>/s at minimum load. Connect upstream of traps on large riser.

### **3.6 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 2 MPa and 1 MPa 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.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.
  - .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
  - .3 Use copper lines of largest practical size to reduce evacuation time.
  - .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
  - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
  - .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
    - .1 Twice to 14 Pa absolute and hold for 4 hours.
    - .2 Break vacuum with refrigerant to 14 kPa.
    - .3 Final to 5 Pa absolute and hold for at least 12 hours.
    - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
    - .5 Submit test results to Departmental Representative.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.



- .8 Checks:
  - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report measurements to Departmental Representative.

### **3.8 DEMONSTRATION**

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

### **3.9 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1       Sections 01.

**1.2            REFERENCES**

- .1       ASME:
  - .1       ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2       Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1       Material Safety Data Sheets (MSDS).

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data, shop drawings:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .2       Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.4            CLOSEOUT SUBMITTALS**

- .1       Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2       Operation and Maintenance Data: submit operation and maintenance data for HVAC water treatment systems for incorporation into manual.
- .3       Include following:
  - .1       Log sheets as recommended by manufacturer.

**1.5            DELIVERY, STORAGE AND HANDLING**

- .1       Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2       Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3       Storage and Handling Requirements:
  - .1       Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2       Store and protect HVAC water treatment systems from nicks, scratches, and blemishes.
  - .3       Replace defective or damaged materials with new.

## **1.6 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **Part 2 Products**

### **2.1 MANUFACTURER**

- .1 Equipment, chemicals, and service provided by one supplier.

### **2.2 POT FEEDER**

- .1 Welded steel 4 mm thick, epoxy finish, no joints, pressure rating 2068 kPa. Temperature rating: 93°C, 250 mm diameter, 18.9 l capacity, one high pressure 84 mm opening for chemical supply, 4 19 mm FNPT connection for network connection, 2 on top 2 on the bottom, threaded high pressure iron lid with epoxy finish and BUNA seal. Provide 100 mm funnel with manual valve for chemical injection. Such as Magnus PF5X4HP.

### **2.3 CLOSE CIRCUIT FILTRATION SYSTEM**

- .1 Derivation filtration system for each close circuit network. System must be able to filter 5% of the flow and be made of the following:
  - .1 Stainless steel body with nickel plated brass head.
  - .2 20 microns filtering cartridge of cotton wound with stainless steel core.
  - .3 Two pressure gauge.
  - .4 Two brass isolating valves.
  - .5 6 x replacement 20 microns cartridge.
  - .6 Welded copper pipe and fitting.
- .2 Close circuit filtration system must be completely factory preassemble and ready to install, such as Magnor model FCH-H-1.

### **2.4 CORROSION COUPON STATION**

- .1 Corrosion coupon station with 4 corrosion coupons, such as Magnor or Drew.

### **2.5 GLYCOL BYPASS FILTER**

- .1 Filter installed on the 50% propylene glycol heating network of the unit no U-2, in bypass of the pump.
- .2 Replaceable cartridge, 10 micron capacity.
- .3 Such as Drew model 9238-01-6.

### **2.6 GLYCOL PRESSURISATION SYSTEM (PAGL-1/2/3)**

- .1 100l tank, in HDPE, with removable lid for filling.

- .2 Positive displacement pump, ODP motor, 0.33 HP, 1725 rpm, flow of 3.91 l/s at 345 kPa with internal safety valve, and with the following:
  - .1 Adjustable pressure switch.
  - .2 Glycerine filled pressure gauge.
  - .3 Check-valve.
  - .4 Control panel:
    - .1 NEMA 1 housing.
    - .2 Three position selector for the pump.
    - .3 Two position selector for the alarm.
    - .4 10 A fuse.
    - .5 Alarm.
    - .6 DEL indicator for: voltage indicator, pump working, low level, pressure problem, alarm.
    - .7 Low level protection (stop).
    - .8 Alarm output for system integration.
    - .9 Fish type connecting cable, minimum 1524 mm.
  - .5 120/1/60.
  - .6 Agitation system in order to keep homogenous dilution.
  - .7 Copper type L piping and fitting.
- .3 System completely factory assemble and tested such as Magnus model PGM022B.

## **2.7 COOLING TOWER CHEMICAL TREATMENT**

- .1 Supply an automatic water treatment system for a 100 tons cooling tower. System is made of the following:
  - .1 Impulsion water meter.
  - .2 Copper piping with valve.
  - .3 Three electronic metering pump with adjustable flow. Pump must be fixed on the equipment with suction piping.
  - .4 Three low level switch.
  - .5 Complete suction and discharge piping with strainer at each pump.
  - .6 Injection coupling installed on cooling tower piping.
  - .7 Balancing valve for the drainage, solenoid valve for drainage, conductivity probe, preinstalled flow switch on the piping who will manage the system operation with cooling tower operation.
  - .8 Microprocessor conductivity equipment with NEMA 4X housing and with the following characteristics:
    - .1 Conductivity control.
    - .2 Indicating light for:
      - .1 High level conductivity.
      - .2 Low level conductivity.

- .3 Indicating light for state of control:
  - .1 Inhibitor injection.
  - .2 Algaecide injection no 1.
  - .3 Algaecide injection no 2.
  - .4 No flow in the monitor.
- .4 Variable mode for inhibitor injection:
  - .1 With the water meter.
  - .2 With the % of drainage.
  - .3 With the % of running time.
  - .4 Simultaneously with the drainage.
- .5 Possibility to shift the drainage following biocide injection.
- .6 Possibility to do a pre-drainage prior to a biocide injection in order to prevent the loss.
- .7 Water temperature indicator in the monitor.
- .8 Cumulated amount of flow following drainage.
- .2 Factory preassemble and tested, ready to be installed system, such as Magnor model Monotour VI-100 tons.
- .3 Provide following chemical:
  - .1 1 x 24 kg of Magnatrol 283A.
  - .2 1 x 21 kg of Magnatrol 450A.
  - .3 1 x 21 kg of Magnatrol 41 A.

## **2.8 CHEMICAL FEED PIPING**

- .1 Resistant to chemicals employed. Pressure rating: 860 kPa.

## **2.9 CHEMICAL FEED PUMPS**

- .1 Electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.

## **2.10 SHIPPING/FEEDING CHEMICAL CONTAINERS**

- .1 High density moulded polyethylene, with liquid level graduations, cover.

## **2.11 CONDUCTIVITY CONTROLLER**

- .1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 microhms.
- .2 Insensitive to phase angle shifts, capable of operating on 95-130 V without affecting accuracy, power, bleedoff status lights.

## **2.12 CONDUCTIVITY PROBES**

- .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

## **2.13 WATER SOFTENER**

- .1 General: two sodium zeolite exchangers with common brine tank with eductor and manifold.
- .2 Performance: to reduce effluent hardness to less than 1 ppm.
- .3 Control:
  - .1 Automatic feature to prevent regeneration of both exchangers at same time.
  - .2 Clock permitting regeneration as required. Provide for adjustment of brine/rinse and backwash cycles.
  - .3 Electrical – 120/1/60.
- .4 Such as Pentair model 9100, connection and meter size of 19 mm.

## **2.14 WATER TREATMENT FOR STEAM SYSTEMS**

- .1 Performance: to control sludge, scale, dissolved solids, provide corrosion protection to following criteria:
- .2 Chemical feed pump:
  - .1 One pump per boiler.
  - .2 Electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.
- .3 Chemical and container:
  - .1 F482, Liquid oxygen scavenger from State Industrial Product.
  - .2 Containers: as specified.
  - .3 Capacity: 75 L.
  - .4 Low water level cut-off and alarm.
- .4 Agitator:
  - .1 Sized to suit container.
  - .2 With stainless steel shaft, stain-less steel impeller.
  - .3 To suit installation.
- .5 Chemical feed pump control:
  - .1 Repeat cycle percentage timer. Feed time fully adjustable for 0-100% of repeated time cycle, 30 minute repeat.
  - .2 Electric interlock with make-up water controls.
  - .3 Electric interlock with steam boiler feed pump.
  - .4 Reset timer initiated by signal from contact head metre installed on water make-up line to feed tank.
- .6 Conductivity control, probe and blowdown motorized valve:
  - .1 Lockable NEMA 4 housing, minimum 3½" display, LED indicating status, easy adjustment, 115V/1/60, 2% accuracy, including probe. Such as State Industrial Product, Boiler Surface Blowdown Controller model no 113383.

- .2 Motorized bleed-off valve, spring return, 115 V/1/60, 19 mm diameter, full port, 125 PSI, brass body, Teflon seals. Such as State Industrial Product, model no 124665.

## **2.15 CHEMICALS**

- .1 Provide 1 year supply.
- .2 Obtain chemicals from manufacturer with existing valid contract with Owner.

## **2.16 TEST EQUIPMENT**

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

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

### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 INSTALLATION**

- .1 Install HVAC water treatment systems in accordance with ASME Boiler and Pressure Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

### **3.4 CHEMICAL FEED PIPING**

- .1 Install crosses at changes in direction. Install plugs in unused connections.



### **3.5 CLEANING OF MECHANICAL SYSTEM**

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative.
- .2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.
- .3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.
- .4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions approved by authority having jurisdiction.

### **3.6 WATER TREATMENT SERVICES**

- .1 Provide water treatment monitoring and consulting services for period of 1 year after system start-up. Service to include:
  - .1 Initial water analysis and treatment recommendations.
  - .2 System start-up assistance.
  - .3 Operating staff training.
  - .4 Visit plant every 30 days during period of operation and as required until system stabilizes, and advice on treatment system performance.
  - .5 Provide necessary recording charts and log sheets for 1 year operation.
  - .6 Provide necessary laboratory and technical assistance.
  - .7 Provide clear, concise, written instructions and advice to operating staff.

### **3.7 WATER SOFTENER**

- .1 Install in accordance with manufacturer's instructions.

### **3.8 FIELD QUALITY CONTROL**

- .1 Start-up:
  - .1 Start-up water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning:
  - .1 Commissioning Agency: to be installing water treatment sub-contractor.
  - .2 Timing:
    - .1 After start-up deficiencies rectified.
    - .2 After start-up and before TAB of connected systems.
  - .3 Pre-commissioning Inspections: verify:
    - .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
    - .2 Suitability of log book.
    - .3 Currency and accuracy of raw water analysis.

- .4 Required quality of treated water.
- .4 Commissioning procedures - applicable to Water Treatment Systems:
  - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
  - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
  - .3 Establish test intervals, regeneration intervals.
  - .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
  - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
  - .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
  - .7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.
- .5 Commissioning procedures - Water Softeners:
  - .1 Demonstrate compliance with specifications by chemical analyses of raw water and treated water.
  - .2 Determine, demonstrate actual softening capacity between regenerations.
  - .3 Establish regeneration intervals and procedures.
  - .4 Train O M personnel in regeneration procedures.
- .6 Commissioning procedures - Closed Circuit Hydronic Systems:
  - .1 Analyze water in system.
  - .2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.
  - .3 Record types, quantities of chemicals applied.
- .7 Training:
  - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O M personnel.
  - .2 Train O M personnel in softener regeneration procedures.
- .8 Certificates:
  - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .9 Commissioning Reports:
  - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.

- .10 Commissioning activities during Warranty Period:
  - .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

**3.9 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Sections 01.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International:
  - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
  - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012
  - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.

**1.3 DOCUMENTS/ÉCHANTILLONS À SOUMETTRE POUR ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Test and Evaluation Reports:
  - .1 Certification of Ratings:
    - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

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

## **Part 2 Products**

### **2.1 SEAL CLASSIFICATION**

- .1 Classification as follows:

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

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

### **2.2 SEALANT**

- .1 Sustainability Characteristics:
  - .1 Adhesives and sealants: VOC limit 250 g/L maximum.
- .2 Sealant: oil resistant, water borne, flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

### **2.3 TAPE**

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

### **2.4 DUCT LEAKAGE**

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

### **2.5 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: standard radius.

- .2 Round: smooth radius.
- .3 Mitred elbows, rectangular:
  - .1 To 400 mm: with double thickness turning vanes.
  - .2 Over 400 mm: with double thickness turning vanes.

## **2.6 FIRE STOPPING**

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

## **2.7 GALVANIZED STEEL**

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

## **2.8 STAINLESS STEEL**

- .1 To ASTM A480/A480M, Type 304.
- .2 Finish: number 4.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to be continuous inert gas welded.

## **2.9 HANGERS AND SUPPORTS**

- .1 Hangers and Supports: [in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum size duct supported by strap hanger: 500.
  - .2 Hanger configuration: to SMACNA.
  - .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA and following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.

- .2 For steel joist: manufactured joist clamp.
- .3 For steel beams: manufactured beam clamps:

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 GENERAL**

- .1 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .2 Install breakaway joints in ductwork on sides of fire separation.

#### **3.3 HANGERS**

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

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

#### **3.4 SEALING AND TAPING**

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

#### **3.5 LEAKAGE TESTS**

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.



- .5 Do not install additional ductwork until trial test has been passed.
- .6 Complete test before performance insulation or concealment Work.

### **3.6 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Sections 01.

**1.2                REFERENCES**

- .1        Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1            SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Product Data, shop drawings:
  - .1            Submit manufacturer's instructions, printed product literature and data sheets for energy recovery wheel and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1            Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2            Store and protect air duct accessories from nicks, scratches, and blemishes.
  - .3            Replace defective or damaged materials with new.

**1.5                ACCEPTED MATERIALS OR PRODUCTS**

- .1        When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

**1.6                WARRANTY**

- .1        A standard 10-year material and labor warranty covering all materials supplied and installed is included.

**Part 2            Products**

**2.1                ENERGY RECOVERY WHEEL**

- .1        Identification: RT-1.

- .2 Replace energy recovery wheel of ventilation unit no URC. Retrofit for a horizontal Wing wheel model WC-1400, approximate wheel diameter of 2007 mm.
  - .1 Dismantle existing wheel and control and dispose off-site.
  - .2 Replacement of the wheel must include. Rotor, MH type media, bearings, hub, VFD motor (1/4 RPM to 20 RPM), control panel and any other equipment and/or accessories recommended by manufacturer for appropriate operation.
  - .3 Horizontal installation.
  - .4 200 mm depth media, made of corrugated aluminium foil with high surface area and laminar flow to assure no fouling. Material supplied with desiccant coating for selective absorption of water vapor. All edges to be epoxy-coated for corrosion protection.
  - .5 Sectional installation.
  - .6 Flow of 3600 l/s.
  - .7 Air pressure loss:
    - .1 Supply: 0.55" water.
    - .2 Return: 0.55" water.
  - .8 Wheel diameter: 2007 mm.
  - .9 Weight: 296 kg.
  - .10 Motor: 0.33 HP, 120/1/60.
  - .11 Complete functional control panel, with 4 temperature probe, one per duct.
- .3 Capacities (DB – dry bulb; WB – wet bulb):
  - .1 Summer:
    - .1 Outdoor air: (BS): 30°C, (BH): 21°C.
    - .2 Supply air: (BS): 25°C, (BH): 18°C.
    - .3 Return air: (BS): 23°C, (BH): 17°C.
    - .4 Exhaust air: (BS): 28°C, (BH): 20°C.
    - .5 Recovered energy: 42.8 kW.
  - .2 Winter:
    - .1 Outdoor air: (BS): -34°C, (BH): -34°C.
    - .2 Supply air: (BS): 9°C, (BH): 6°C.
    - .3 Return air: (BS): 22°C, (BH): 18°C.
    - .4 Exhaust air: (BS): -18°C, (BH): -18°C.
    - .5 Recovered energy: 236.5 kW.
- .4 Equipment such as Thermotech (Aireau Quebec) model TR-144-14-MH3-4-1-XHV Thermowheel or a replacement product approved by addendum as per tenderers instruction.

## **2.2 ACCESS DOORS IN DUCTS**

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

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

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 INSTALLATION**

- .1 Contractor must plan and coordinate the replacement of the energy recovery wheel with the manufacturer.
  - .2 It is imperative that the contractor get the on-site technical support from the manufacturer for the replacement of the wheel.
  - .3 Contractor must work jointly with the technical staff of the manufacturer that will be on-site and apply requested requirements and recommendations.
  - .4 Plan sufficient period for the personal training with the new wheel, accessories and control panel.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 1219 mm x 610 mm for person size entry.
    - .2 508 mm x 508 mm for servicing entry.
    - .3 300 mm x 300 mm for viewing.
    - .4 As indicated.

- .2 Locations:
  - .1 Energy recovery wheel.
  - .2 Place where periodic maintenance is required (humidifiers).

### **3.3 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Sections 01.

**1.2               REFERENCES**

- .1       Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- .2       Underwriters' Laboratories of Canada (ULC):
  - .1       ULC S636 – Gas venting system.
  - .2       ULC C959 – Industrial chimneys

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for chimneys and stacks and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2       Indicate following:
    - .1       Methods of sealing sections.
    - .2       Methods of expansion.
    - .3       Details of thimbles.
    - .4       Bases/Foundations.
    - .5       Supports.
    - .6       Guy details.
    - .7       Rain caps.
- .2       Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.4               QUALITY ASSURANCE**

- .1       Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations.
- .2       Certifications:
  - .1       Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

**1.5               DELIVERY, STORAGE AND HANDLING**

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

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

## **1.6 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **Part 2 Products**

### **2.1 GAS VENT FOR CONDENSATION BOILER**

- .1 ULC S636 labelled, 288°C rating maximum, for gas equipment only. Built for maximum pressure rating of 6" and must have resisted a 35" water column pressure.
- .2 Sectional, prefabricated, double wall with 13 mm air space.
- .3 Stainless steel inner wall (AL29-4C) with minimal thickness of .0020" for sizes 100 mm to 300 mm and 0.024" for size 350 mm and over.
- .4 Stainless steel inner wall (441) with minimal thickness of .0020" for sizes 100 mm to 250 mm and 0.024" for size 300 mm and over.
- .5 Constructed with 3 welded reinforcing U pieces to assure the rigidity and supplied with appropriate couplings. Chimney must be continuous from the equipment to the exterior outlet and supplied by only one manufacturer. Starting equipment connection coupling must be supplied with the chimney.
- .6 Viton o-ring assure the seal between each section.
- .7 All component of the chimney (support, wall/roof penetration, coupling, drain, etc.) must UL listed and supplied by the manufacturer.
- .8 Installation must be done following the manufacturer instructions and applicable codes.
- .9 Fifteen years warranty on any fabrication defect and workmanship.
- .10 Chimney such as model Secure Seal SSD from Security Chimney International.

### **2.2 GAS VENT FOR STEAM BOILER**

- .1 ULC-103, ULC S604 and ULC-C959, labelled, 537°C rating maximum and must have resisted a 35" water column pressure.
- .2 Sectional, prefabricated, double wall with 50 mm high temperature insulation fiber.
- .3 Stainless steel inner wall (304) with minimal thickness of .0035".
- .4 Stainless steel inner wall (304) with minimal thickness of .0018".



- .5 Chimney must be continuous from the equipment to the exterior outlet and supplied by only one manufacturer. Starting equipment connection coupling must be supplied with the chimney.
- .6 Interior wall assembled by laser welding or plasma.
- .7 Auto-centering joint to align properly interior and exterior walls.
- .8 Security flange supplied with every section for connection and sealing purposes.
- .9 Chimney must compensate for thermal expansion.
- .10 All component of the chimney (support, wall/roof penetration, coupling, drain, etc.) must UL listed and supplied by the manufacturer.
- .11 Installation must be done following the manufacturer instructions and applicable codes.
- .12 Fifteen years warranty on any fabrication defect and workmanship.
- .13 Chimney such as model CIX 304-304 from Security Chimney International.

## **2.3 ACCESSORIES**

- .1 Hangers and supports: as per manufacturer recommendation.
- .2 Rain cap.
- .3 Expansion sleeves with heat resistant caulking, held in place as indicated.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION - GENERAL**

- .1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.
- .2 Support chimneys at bottom, roof and intermediate levels as indicated.
- .3 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.
- .4 Install flashings on chimneys penetrating roofs, as indicated.
- .5 Install rain caps and cleanouts, as indicated.

**3.3 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Sections 01.

**1.2               REFERENCES**

- .1       American Boiler Manufacturers Association (ABMA).
- .2       ASME:
  - .1       ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .3       Groupe CSA:
  - .1       CAN1-3.1-77(C2011), Chaudières à gaz industrielles et commerciales d'assemblage.
  - .2       CSA B51-F09, Code des chaudières, appareils et tuyauteries sous pression.
  - .3       CSA B149.1-F10, Code d'installation du gaz naturel et du propane.
  - .4       ANSI Z21.13-10/CSA 4.9-10, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .4       Electrical and Electronic Manufacturers Association of Canada (EEMAC).

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data, shop drawings:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2       Indicate on drawings:
    - .1       General arrangement showing terminal points, instrumentation test connections.
    - .2       Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
    - .3       Foundations with loadings, anchor bolt arrangements.
    - .4       Piping hook-ups.
    - .5       Equipment electrical drawings.
    - .6       Burners and controls.
    - .7       All miscellaneous equipment.
    - .8       Flame safety control system.
    - .9       Breeching and stack configuration.
  - .3       Engineering data to include:
    - .1       Boiler efficiency at 25%, 50%, 75% and 100% of design capacity.
    - .2       Radiant heat loss at 100% design capacity.

- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

#### **1.4 CLOSEOUT SUBMITTALS**

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

#### **1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Special tools for burners, access opening, handholes and Operation and Maintenance.
    - .2 Spare parts for 1 year of operation.
    - .3 Spare gaskets.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect boiler and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

#### **1.8 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

### **Part 2 Products**

#### **2.1 GENERAL**

- .1 Packaged boiler:
  - .1 Complete with burner and necessary accessories and controls.

- .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CAN1-3.1.
- .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
- .4 Designed and constructed to ASME Boiler and Pressure vessel Code.
- .5 CRN (Canadian Registration Number), to CSA B51.
- .6 Boiler/burner package to bear ACNOR and CGA label.
- .2 Single point electrical connection:
  - .1 Controls: 120V, 1 phase, 60 Hz.
  - .2 Electrical components: CSA approved.
- .3 Controls: factory wired. Enclosed in EEMAC 1 steel cabinet.
- .4 Jackets: heavy gauge metal, finished with heat resisting paint.
- .5 Mounting:
  - .1 Structural steel base, lifting lugs.
  - .2 Install boilers on supports as per manufacturer recommendations.
- .6 Anchor bolts and templates:
  - .1 Supply for installation by other Divisions. Anchor bolts to be sized to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .7 Start-up, instruction, on-site performance tests: three days per boiler.
- .8 Trial usage:
  - .1 Departmental Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
  - .2 Supply labour, materials and instruments required for tests.
- .9 Temporary use by contractor:
  - .1 Contractor may use boilers only after written approval from Departmental Representative.
  - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
  - .3 Refurbish to as-new condition before final inspection and acceptance.

## **2.2 FLEXIBLE TUBE HOT WATER STEAM BOILER**

- .1 Packaged, water tube design, with 4 flue gas passes separated with water wall tubes and two drums.
- .2 Boiler tubes: 25 mm diameter, 2.4 mm thick, 6 passes, flexible design coil, easily removed and replaced at attachment to drums without requiring welding or expanding.
- .3 Equip with large down/comers to ensure internal natural circulation and temperature equalization.
- .4 Water side interior of upper and lower drums accessible via front and rear openings.
- .5 Fire side interior accessible for service and inspection.

- .6 Heating surface: 13.8 m<sup>2</sup>.
- .7 Water content: 400 L.
- .8 Boiler frame and casing: 16 GA, rust resistant and painted, 62 mm glass fiber insulation.
- .9 All controls must be located in front of boiler.
- .10 Access to combustion chamber: 712 mm x 1270 mm.
- .11 Combustion chamber insulation:
  - .1 Access panel: 50 mm rigid mineral fiber and 50 mm high temperature ceramic fiber.
  - .2 Front and back panel: 100 mm rigid mineral fiber and 50 mm high temperature ceramic fiber.
- .12 Warranty: 25 year on the boiler chamber against thermal choc.
- .13 Control panel installed close to burner, with single connection point, electrical switch and starter.
- .14 Forced draft burner, full modulation, including security and operation controls from current codes.
  - .1 Such as Riello model RS-28M, capacity of 1044 MBH, modulating, ½ HP at 120/1/60 with flame supervision control from Siemens, model LFL.
  - .2 See also item 2.5 – Gas burner.
- .15 Accessories:
  - .1 Sight glass.
  - .2 Pressure transmitter.
  - .3 Pressure gauge.
  - .4 Electronic level control with electrodes.
  - .5 Electrode for low water level.
  - .6 High pressure protection.
  - .7 Safety valve set at 103 kPa.
  - .8 Solenoid valve for softened water with manual and bypass valve.
  - .9 Solenoid valve for surface flush down with manual, bypass and isolating valve.
  - .10 Blowdown valve with bypass and isolating valve.
  - .11 2 hand access for inspection and cleanup.
  - .12 Chemical feed connection.
  - .13 Buffer tank complete with pump and pre-installed suction piping with accessories (valves, strainer, drain), automatic steam injection for the make-up water pre-heating, tank automatic fill, control panel with electric switch, function indicating light, high and low level alarm, such as Hurst model Feedmiser-30 gallons, distributed by Service Énergétique RL. Provide strainer at pump inlet.
    - .1 Pump such as Goulds model 1SV2GA4F10, 0.5 HP, 208/3/60, 3 gpm, 40 ft head, 3600 rpm.
  - .14 Provide gas regulator to lower inlet pressure from 35 kPa to 14 kPa, body 19 mm x 31 mm, orifice 9.5 mm, Cadmium spring, such as Rockwell 143-80-2HP.

- .15 Blowdown tank in mechanical room no. 301, such as GF-2439, complete with temperature regulator and solenoid valve, maximum water outlet temperature at 65°C, distributed by Service Énergétique RL.
- .16 Condensate cooler in boiler room, local A-3, such as Armstrong model CC-5, preset temperature at 57°C.
- .17 Chemical injection, see section 23 25 00 – HVAC water treatment system.
- .18 Water softener, see section 23 25 00 – HVAC water treatment system.
- .19 Metering pump, see section 23 25 00 – HVAC water treatment system.
- .16 Performance:
  - .1 In accordance with ANSI Z21.13/CSA 4.9 (gas burning) testing procedures.
  - .2 Steam: 449 kg/h. Design steam pressure: 860 kPa. Operating pressure: 83 kPa, 82°C water supply.
  - .3 Natural gas, gas pressure of 14 kPa.
  - .4 Boiler efficiency: 80% minimum at 30% to 100% firing rates.
  - .5 Input: 352 kW, Output : 281 kW.
  - .6 Dimensions: 978 mm x 2160 mm x 1962 mm.
  - .7 Weight: 3050 lb (shipping), 3550 lb (operating).
- .17 Identification: CVAP-1:
  - .1 Steam boiler such as Bryan LLC model AB-120-S-150-30 or replacement product approved by addendum in accordance with the tenderers instructions.

### **2.3 MODULAR HOT WATER BOILER, NATURAL GAS PULSE FIRED, CONDENSING TYPE**

- .1 Boilers must be part of the Gaz Metro grant for the energy efficiency program. Contractor is responsible for the management of the grant for the Owner.
- .2 Heating boiler seasonal efficiency rating: 95%. Flue gas exhaust temperature of 75°C, when operating in condensing mode.
- .3 Flue gas: individually direct vented. Combustion air: individually drawn from boiler room as indicated and as recommended by manufacturer.
- .4 Provide gas regulator to lower inlet pressure from 35 kPa to 10 kPa, body 38 mm x 38 mm, orifice 19 mm, green/black spring, such as Rockwell 243-8-6.
- .5 Each boiler/burner group must be supplied as a prefabricated unit, assembled and wired in plant and ready to receive mechanical and electrical connection on site. Installed on a base with eyebolts and anchors for seismic measure.
- .6 Single point electric connection.
- .7 Smooth surface without fins, allowing auto-clean of the surface by condensate flow.
- .8 In respect with Quebec provincial codes, ACNOR B-51 and ASME section I and IV (1100 kPa at 121°C).
- .9 Motorized damper for common evacuation.

- .10 Condensate neutralisation system:
  - .1 Rechargeable unit with pellets, allowing the neutralisation of condensate over the 6.5 value and with a flow of 70 l/h.
  - .2 Such as Grunbeck model N-70 or replacement product approved by addendum in accordance with the tenderers instructions.
- .11 Heat exchanger:
  - .1 Water cooled combustion chamber and thermally insulated.
  - .2 Exchanger with oblique baffle in stainless steel grade SA 240-316-Ti.
  - .3 Flue gas in contact with return water thru heat exchanger.
- .12 Controls for each module to include:
  - .1 Solid state controller with auxiliary relay.
  - .2 Fan prove pressure switch and pressure sensing flame safeguard system.
  - .3 Provide combination gas control with:
    - .1 Two main shut off valve.
    - .2 System pressure controlled regulator.
    - .3 Automatic redundant shut off valves.
    - .4 Two pressure switch
    - .5 One vent.
    - .6 One manual shut-off valve.
    - .7 ASME approved pressure relief valve and temperature/pressure indicator.
- .13 Control panel:
  - .1 Boiler controller, Vitotronic 300 no GW6B with touch screen from Viessmann or replacement product approved by addendum in accordance with the tenderers instructions.
  - .2 LON communication module, Vitogate 300 for BACnet IP/MSTP integration, from Viessmann or replacement product approved by addendum in accordance with the tenderers instructions.
  - .3 Accessories:
    - .1 Viessamnn external module mode; EA1 to control water supply temperature.
    - .2 Adaptor for the fresh air damper input when an heating demand is sent. Adaptor must receive an opened confirmation from damper to allow boiler startup.
- .14 Performances:
  - .1 In accordance with ANSI Z21.13/CSA 4.9 gas burning testing procedures.
  - .2 Natural gas, pressure of 10".
  - .3 CEC-1 and CEC-2:
    - .1 Hot water flow of 11 l/s. max operating pressure: 517 kPa.



- .2 Operating temperature:
  - .1 Supply: 49°C
  - .2 Return: 38°C
- .4 CEC-3:
  - .1 Hot water flow of 4.75 l/s. max operating pressure: 517 kPa.
  - .2 Operating temperature:
    - .1 Supply: 85°C
    - .2 Return: 63°C
  - .5 Input: 423 kW, Output: 402 kW.
  - .6 Dimensions: 1078 mm x 2273 mm x 1428 mm
  - .7 Weight: 1495 lb shipping), 2000 lb (operating).
- .15 Identification: CEC-1 to CEC-3:
  - .1 Condensing boiler such as Viessmann CM2-400 or replacement product approved by addendum in accordance with the tenderers instructions.

## **2.4 AUXILIARIES**

- .1 Provide auxiliaries for each boiler and to meet ASME requirements.
- .2 Hot water boilers:
  - .1 Relief valves: ASME rated, set at 517 kPa, to release entire boiler capacity.
  - .2 Pressure gauge: 90 mm diameter complete with shut-off cock.
  - .3 Thermometer: 127 mm diameter range 10 to 125°C.
  - .4 Low water cut-off: with visual and audible alarms.
  - .5 Isolating gate valves: on supply and return connections.
  - .6 One set of cleaning tools.
- .3 Steam boilers:
  - .1 Safety valves: ASME rated, set at 103kPa, complete with drip pan elbow and vent pipe.
  - .2 Pressure gauge: 130 mm diameter range 0 to 200 kPa, complete with syphon and cock.
  - .3 Water column assembly: with tri-cocks, gauge glass, protective rods, blowdown valves operated from firing floor.
  - .4 High water level: audible alarm.
  - .5 Low water level: fuel cut-off with visual and audible alarms and feedwater pump control switch.
  - .6 Feedwater regulator on 3-valve bypass with drain valve, stop valve and check valve.
  - .7 Continuous blow-down stop valve.
  - .8 Auxiliary low water cut-off with separate cold water connection to boiler.
  - .9 Steam stop valve.
  - .10 Quick-opening blowdown valve and shut-off valve.

- .11 Stack thermometer: range 65 to 400°C.
- .12 Drain valve: NPS 2.
- .13 One set cleaning tools.
- .4 Pot type chemical feeder.

## 2.5 **GAS BURNERS**

- .1 General:
  - .1 Forced draft with:
    - .1 Built-in blower to supply combustion air, complete with motor, silencer and damper.
    - .2 High voltage ignition transformer.
    - .3 Flame observation port.
    - .4 Easy access to nozzles and electrodes.
  - .2 Gas pilot:
    - .1 To building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.
  - .3 Main gas train:
    - .1 To building code and provincial regulations including main shut-off valve, pressure regulator, motorized electric shut-off valve, downstream block-test valve with test connection and pressure gauge.
  - .4 Controls:
    - .1 Electronic combustion control relay with ultra-violet flame detector for combustion control and flame supervision.
    - .2 Control to shut off fuel within five seconds upon pilot flame or main flame failure or upon signal of safety interlock and to ensure, when restarted, in sequence:
      - .1 Pre-purge.
      - .2 Pilot ignition and supervision.
      - .3 Main gas valve opening.
      - .4 Pilot cut-off. Pilot-proving period not to exceed ten seconds.
      - .5 Burner operation.
      - .6 Post-purge burner shut-down.
    - .3 Static pressure interlock. To shut off burner upon loss of combustion air pressure.
    - .4 Fuel-air mixture: control through:
      - .1 Two-position motor with linkage to control fuel and air and with end switches to prove low-fire start and energize high fire solenoid valve for high-low fire operation.
    - .5 Immersion controllers:
      - .1 Operating: to start and stop burner, and operating between adjustable setpoints.

- .6 Visual and audible alarms: to indicate burner shutdown due to flame failure, low water level, high pressure, low air pressure, low gas pressure.
- .7 Selector switch: to permit manual and automatic firing at any rate between low and high fire.
- .8 Pilot lights: to indicate:
  - .1 Normal burner operation.

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

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.3 INSTALLATION**

- .1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Pipe hot water relief valves full size to nearest drain.
- .6 Pipe steam relief valve through roof with drip pan elbow piped to nearest drain.
- .7 Pipe blowdown/drain to blowdown tank/floor drain.
- .8 Natural gas fired installations: in accordance with CSA B149.1.

### **3.4 MOUNTINGS AND ACCESSORIES**

- .1 Safety valves and relief valves:
  - .1 Run separate discharge from each valve.
  - .2 Terminate discharge pipe as indicated.
  - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.
- .2 Blowdown valves:
  - .1 Run discharge to terminate as indicated.

### **3.5 FIELD QUALITY CONTROL**

- .1 Commissioning:
  - .1 Manufacturer to:
    - .1 Certify installation.
    - .2 Start up and commission installation.
    - .3 Carry out on-site performance verification tests.
    - .4 Demonstrate operation and maintenance.
  - .2 Provide Departmental Representative at least 48 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

### **3.6 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Sections 01.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME Boiler and Pressure Vessel Code, 2010.
- .2 CSA International:
  - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.
    - .1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Manufacturer's Instructions: submit manufacturer's installation instructions.

**1.4 CLOSEOUT SUBMITTALS**

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

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Stock Materials:
  - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

**1.6 DELIVERY, STORAGE AND HANDLING**

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

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

## **1.7 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Plate Heat Exchanger, ECH-1:
  - .1 Water to propylene glycol water:
    - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code. Section VIII and provincial pressure vessel regulations.
  - .2 Frames: carbon steel ICLF-150, with baked epoxy enamel paint, carbon steel side bolts and shroud baked epoxy paint.
  - .3 Plates: 316 stainless steel, type AT20P H.
  - .4 Gaskets: nitrile rubber (NBR).
  - .5 Nozzles: 1345 kPa, ASA rubber rated flange type.
  - .6 Supports: as indicated.
  - .7 Piping connections: flange.
  - .8 Capacity:
    - .1 Primary: chilled water: 1.68 L/s, 6.7°C to 15°C. Pressure drop: 20 kPa.
    - .2 Secondary: PG50%: 1.91 L/s, 16 degrees C to 8°C. Pressure drop: 32 kPa.
    - .3 Capacity: 56.6 kW.
    - .4 Connection size: DN 2½.
    - .5 Dimensions: 1270 mm (h), 419 mm (w) and 686 mm (l).
    - .6 Such as Mueller model Accu-therm or a replacement product approved by addendum as per tenderers instruction.

- .2 Plate Heat Exchanger, ECH-2:
  - .1 Water to propylene glycol water:
    - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code. Section VIII and provincial pressure vessel regulations.
  - .2 Frames: carbon steel ICLF-150, with baked epoxy enamel paint, carbon steel side bolts and shroud baked epoxy paint.
  - .3 Plates: 316 stainless steel, type AT20P H.
  - .4 Gaskets: nitrile rubber (NBR).
  - .5 Nozzles: 1345 kPa, ASA rubber rated flange type.
  - .6 Supports: as indicated.
  - .7 Piping connections: flange.
  - .8 Capacity:
    - .1 Primary: heating water: 2.92 L/s, 49°C to 16°C. Pressure drop: 24 kPa.
    - .2 Secondary: PG50%: 3.28 L/s, 10°C to 43°C. Pressure drop: 34.5 kPa.
    - .3 Capacity : 405 kW.
    - .4 Connection size : DN 2½ and DN3.
    - .5 Dimensions : Dimensions : 1270 mm (h), 419 mm (w) and 991 mm (l).
    - .6 Such as Mueller model Accu-therm or a replacement product approved by addendum as per tenderers instruction.
- .3 Plate Heat Exchanger, ECH-3:
  - .1 Water to propylene glycol water:
    - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code. Section VIII and provincial pressure vessel regulations.
  - .2 Frames: carbon steel ICLF-150, with baked epoxy enamel paint, carbon steel side bolts and shroud baked epoxy paint.
  - .3 Plates: 304 stainless steel, type AT40M H.
  - .4 Gaskets: nitrile rubber (NBR).
  - .5 Nozzles: 1345 kPa, ASA rubber rated flange type.
  - .6 Supports: as indicated.
  - .7 Piping connections: flange.
  - .8 Capacity:
    - .1 Primary: condenser water: 6.2 L/s, 38°C to 32°C. Pressure drop: 23 kPa.
    - .2 Secondary: PG50% : 6.95 L/s, 29°C to 35°C. Pressure drop: 34.5 kPa.
    - .3 Capacity: 143 kW.
    - .4 Connection size: DN 4.
    - .5 Dimensions: 1663 mm (h), 564 mm (w) and 515 mm (l).
    - .6 Such as Mueller model Accu-therm or a replacement product approved by addendum as per tenderers instruction.

- .4 Plate Heat Exchanger, ECH-4:
  - .1 Water to propylene glycol water:
    - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code. Section VIII and provincial pressure vessel regulations.
  - .2 Frames: carbon steel ICLF-150, with baked epoxy enamel paint, carbon steel side bolts and shroud baked epoxy paint.
  - .3 Plates: 304 stainless steel, type AT40M H.
  - .4 Gaskets: nitrile rubber (NBR).
  - .5 Nozzles: 1345 kPa, ASA rubber rated flange type.
  - .6 Supports: as indicated.
  - .7 Piping connections: flange.
  - .8 Capacity:
    - .1 Primary: condenser water: 11 L/s, 38°C to 32°C. Pressure drop: 21 kPa.
    - .2 Secondary: PG50%: 12.3 L/s, 29°C to 35°C. Pressure drop: 35 kPa.
    - .3 Capacity: 255 kW.
    - .4 Connection size: DN 4.
    - .5 Dimensions: Dimensions : 1663 mm (h), 564 mm (w) and 696 mm (l).
    - .6 Such as Mueller model Accu-therm or a replacement product approved by addendum as per tenderers instruction.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.



- .3 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.
- .4 Plate exchangers: install in accordance with manufacturer's recommendations.

### **3.3 APPURTENANCES**

- .1 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.
- .2 Install pressure gauge on primary and secondary side.

### **3.4 FIELD QUALITY CONTROL**

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

### **3.5 SYSTEM START-UP**

- .1 General: perform start-up operations in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
- .2 Check heater for cleanliness on primary and secondary sides.
- .3 Check water treatment system is complete, operational and correct treatment is being applied.
- .4 Check installation, settings, operation of relief valves and safety valves.
- .5 Check installation, location, settings and operation of operating, limit and safety controls.
- .6 Check supports, seismic restraint systems.
- .7 General: perform performance verification in accordance with Section [01 91 13 - General Commissioning (Cx) Requirements]: General Requirements, supplemented as specified.
- .8 Timing: only after TAB of hydronic systems have been successfully completed.
- .9 Primary side:
  - .1 Measure flow rate, pressure drop and temperature at heater inlet and outlet.
- .10 Secondary side:
  - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
  - .2 Calculate heat transfer from primary and secondary sides.
- .11 Simulate heating water temperature schedule and repeat above procedures.
- .12 Verify settings, operation of operating, limit and safety controls and alarms.
- .13 Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

**3.6 CLEANING**

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

**3.7 DEMONSTRATION**

- .1 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as follows:

**3.8 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Sections 01.

**1.2               REFERENCES**

- .1       Air-Conditioning, Heating and Refrigeration Institute (AHRI):
  - .1       AHRI-550/590, Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
- .2       CSA International:
  - .1       CSA B52, Mechanical Refrigeration Code.
- .3       Environment Canada, (EC)/Environmental Protection Services (EPS):
  - .1       EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data, shop drawings:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for water chillers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2       Indicate:
    - .1       Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
    - .2       Wiring as assembled and schematics.
    - .3       Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
    - .4       Type of refrigerant used.

**1.4               CLOSEOUT SUBMITTALS**

- .1       Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2       Operation and Maintenance Data: submit operation and maintenance data for water chillers for incorporation into manual.
- .3       Data to include:
  - .1       Description of equipment giving manufacturers name, model type and year, capacity and serial numbers.
  - .2       Provide part load performance curves.
  - .3       Details on operation, servicing and maintenance.
  - .4       Recommended spare parts list.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect water chillers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **1.6 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **1.7 EXTENDED WARRANTY**

- .1 For the work of this section, the 12-month warranty period prescribed in paragraph GC 3.13 of the General conditions « C » is extended to 60-months (total). The extended warranty shall cover parts and labor on the compressors as well as the refrigerant inside the period.

## **Part 2 Products**

### **2.1 GENERAL FOR CHILLERS REF-1 AND REF-2**

- .1 Identifications: REF-1/COND-1 and REF-2/COND-2.
- .2 Provide complete air cooled scroll type chiller package including: 4 compressors; 2 circuits (2 compressors / circuit); evaporator; condenser, motor and motor starter; controls; control centre; piping; wiring; relief valves, refrigeration and oil change; ready for connection to chilled water circuit, interlocks and electric power source, installed in welded steel frame with heavy gauge panels and access doors finished to manufacturers standard. Chiller must be factory tested and assembled.
- .3 Capacity:
  - .1 Certified ratings based on AHRI 550/590:
    - .1 324 kW (91.2 tons), when cooling 9.59 L/s of water from 14.7°C to 6.67°C.
    - .2 Air cooled condenser supplied with 35 degrees C entering air design ambient temperature and minimum ambient temperature of -18°C entering air.
    - .3 Power input, including electrical components: 108.4 kW.
    - .4 Fouling resistance coefficient: 0.000045 m<sup>2</sup>K/W.
  - .2 Refrigerant: R410A.

- .3 Unit power: 575/3/60.
- .4 Dimensions and weight:
  - .1 Length: 3480 mm
  - .2 Width: 864 mm
  - .3 Height: 1524 mm
  - .4 Weight: 2968 lb (shipping), 3050 lb (operation).
- .4 Acoustical:
  - .1 Sound pressure levels for the unit shall not exceed the following specified levels. The manufacturer shall provide the necessary sound treatment to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 575.

SOUND VALUES								
Sound Pressure (dB)								
63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Overall
50	54	66	76	80	78	75	65	84
Sound Power (dB)								
58	62	74	84	88	86	83	72	92

- .5 Compressor:
  - .1 The compressors shall be sealed hermetic scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads.
- .6 Compressor motor:
  - .1 Hermetic type with overload protection and manual restart: 575/3/60.
- .7 Evaporator:
  - .1 The evaporator shall be direct expansion type with stainless steel plates brazed together. It shall be insulated with 19 mm closed cell polyurethane insulation and have 4500 kPa water side working pressure.
  - .2 Fluid: 100% water.
  - .3 Type of connection and size: 75 mm, Victaulic. Contractor must provide couplings and transition from Victaulic piping to welded pipe.
  - .4 Fluid pressure loss: 17.2 kPa (5.8' of water).
  - .5 Provide cleanable strainer at the inlet of the evaporator, perforation no larger than 1.6 mm diameter. Installation as per manufacturer's recommendation.
- .8 Air cooled condenser:
  - .1 Condenser coil:
    - .1 The condenser shall be constructed of seamless copper tubes on a staggered tube pattern. Tubes shall be mechanically expanded into continuous, corrugated, rippled aluminum plate type fins for permanent metal-to-metal contact. The fins shall have full depth fin collars completely covering the copper tube.

- .2 The coil shall be "floating tube type" with refrigerant carrying tubes not touching the galvanized end plates. The coil shall be supported by non-refrigerant carrying copper tubes that are expanded into the coil.
- .3 Heavy wall copper headers shall have dimpled stub tubes from the coil and a beaded hole for the large connection tube, both items to assure good brazing surface and joint strength.
- .4 Headers to be field piped to prevent excessive vibration from discharge gas pulsations.
- .5 Coils shall have a working pressure of 2760 kPa. A field-supplied 2760 kPa relief device, one per circuit, is required on units up to two circuits.
- .6 Coils shall be factory leak tested, dehydrated and connection ends spun closed.
- .7 Unit shall be shipped under pressure with a dry air or nitrogen holding charge.
- .8 Unit must have two refrigeration circuits, four fans per coil.
- .9 Estimated refrigerant charge: 53 lb.
- .2 Cabinet:
  - .1 The cabinet shall be pre-painted beige G90 galvanized steel. Motors shall be supported by 11-gauge galvanized steel rail fastened to the coil center and end supports. Each fan section shall be in an individual compartment, separated from other fan sections by cabinetry. All legs and lifting brackets shall be 11-gauge galvanized steel.
- .3 Motor:
  - .1 575/3/60, 1140 rpm. Motors shall be open drip proof motor with internal overloads.
- .4 Fan and fan guard
  - .1 Fans shall have heavy gauge aluminum blades with painted steel spider. Fan guards shall be PVC-coated steel.
- .5 Electrical:
  - .1 Unit shall have weatherproof electric control panel with factory door-mounted, non-fused switch.
  - .2 Control voltage shall be 120 V with individual contactors and fuse protection for each motor.
- .6 Control:
  - .1 A controller must manage the different stages of the condenser ACH fans. Also, a VFD per circuit must be supplied. They will be controlled by pressure probe. Controls will be factory installed and wired to the weatherproof control panel.
- .7 Acoustical:
  - .1 Sound pressure levels for the unit shall not exceed the following specified levels. The manufacturer shall provide the necessary sound treatment to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 575.

SOUND VALUES								
Sound Pressure (dB)								
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Overall
65	70	67	66	63	62	56	56	68.8
Sound Power (dB)								
92	97	94	93	90	89	83	83	95.8

- .8 Dimensions and weight
  - .1 Length: 4191 mm
  - .2 Width: 2045 mm
  - .3 Height: 1248 mm
  - .4 Weight: 2140 lb (shipping), 2140 lb (operation).
- .9 Refrigeration circuit:
  - .1 Each refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.
- .10 Options and accessories:
  - .1 The following options are to be included:
    - .1 Hot gas bypass on all circuits.
    - .2 Chilled water switch to be installed on site on water line and connected to control panel.
    - .3 Disconnect switch, single or multi-point.
    - .4 MicroTech II controller.
    - .5 Acoustical kit on compressors.
    - .6 Anti-seismic spring (on-site installation per contractor).
- .11 Control centre:
  - .1 Control panel:
    - .1 MicroTech II: The control panel shall contain a microprocessor controller providing operating and equipment protection controls plus motor starting equipment, factory wired, operationally tested, and ready for operation. Standard components shall include a control transformer with primary and secondary fusing, microprocessor transformers with integral fusing, compressor contactors, circuit breakers, single-point wiring arrangement and switches for each circuit pumpdown and unit control power. The control panel shall have a hinged tool-locked door.
    - .2 The control system shall stage the compressors based on the leaving water temperature. Equipment protection devices controlled by the microprocessor include
      - .1 Oil pressure differential.
      - .2 Motor protection.
      - .3 High pressure.
      - .4 Loss of refrigerant.

- .5 Loss of water flow.
- .6 Freeze protection, low refrigerant pressure.
- .7 Controls shall include auto/stop switch.
- .8 Chilled water setpoint adjustment.
- .9 Anti-cycle timer.
- .10 Digital display with water temperature.
- .11 Setpoint, operating temperatures and pressures, and diagnostic messages.
- .3 The following features and functions shall be included:
  - .1 The LCD-type display shall have a minimum of twenty characters with all messages in plain English. Coded messages are not acceptable.
  - .2 Critical parameters shall have their own section of control and shall be password protected.
  - .3 Resetting chilled water temperature by a remote 4-20mA DC signal.
  - .4 A soft load function to prevent the system from operating at full load during the chilled water pulldown period.
  - .5 An electronic time clock to allow programming of a yearly schedule accommodating weekends and holidays.
  - .6 Auto restart after a power failure, not requiring external battery backup or auxiliary power for maintaining program memory.
  - .7 Shutdowns shall be date and time stamped with system temperatures and pressures recorded. A minimum of six previous occurrences shall be kept in a revolving memory.
  - .8 Start-to-start and stop-to-start timers to provide minimum compressor off-time with maximum motor protection.
  - .9 Capability of communication with a PC or remote monitoring through a twisted pair RS-232 interface.
  - .10 Lead/lag manually or automatically by compressor number of starts.
  - .11 Continuous diagnostic checks of unit to provide a pre-alarm signal in advance of a shutdown allowing time for remedial action to be taken.
- .2 The controller shall contain the following features as a minimum:
  - .1 Unit Enable Selection - Enables unit operation from local keypad, digital input, or BAS; Unit Mode Selection - Selects standard cooling, ice, glycol, or test operation mode.
  - .2 Shutdown Alarms:
    - .1 No evaporator water flow.
    - .2 Low evaporator pressure.
    - .3 High condenser pressure.
    - .4 Motor protection system.



- .5 Phase voltage protection (optional).
  - .6 Outside ambient temperature.
  - .7 Evaporator freeze protection.
  - .8 Sensor failures.
- .3 Limit alarms:
  - .1 Condenser pressure stage down, unloads unit at high discharge pressures.
  - .2 Low ambient lockout, shuts off unit at low ambient temperatures.
  - .3 Low evaporator pressure hold, holds stage no. 1 until pressure rises.
  - .4 Low evaporator pressure unload, shuts off one compressor.
- .4 Operating location:
  - .1 Allows the unit to be controlled from local computer, using digital inputs or BAS system.
- .5 Analog input:
  - .1 Analog Inputs - Reset of leaving water temperature, 4-20 mA.
- .6 Digital Inputs:
  - .1 Unit off switch.
  - .2 Remote start/stop.
  - .3 Flow switch.
  - .4 Motor protection.
- .7 Digital Outputs:
  - .1 Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared.
  - .2 Evaporator pump; field wired, starts pump when unit is set to start.
- .8 Optional Building Automation System (BAS) Interface:
  - .1 The unit shall be equipped with an optional factory-installed BAS communication module. Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® or LONMARKS ® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier: BACnet MS/TP master (Clause 9).
  - .2 The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
  - .3 All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

- .12 Equipment:
- .1 Scroll chiller such as Daikin Applied (Enviroair Industries) model no WGZ100DA with air-cooled condenser no ACH100AD or a replacement product approved by addendum as per tenderers instruction.
  - .2 Supply all necessary refrigerant to fill piping and assure appropriate operation.

## 2.2 GENERAL FOR CHILLERS REF-3

- .1 Identifications: REF-3.
- .2 Provide complete water cooled scroll type chiller package including: 4 compressors, two circuits (2 compressors / circuit); evaporator; condenser, relief valve, motor and motor starter; controls; control panel; piping; wiring; refrigeration and oil change; ready for connection to chilled water circuit, interlocks and electric power source, installed in welded steel frame with heavy gauge panels and access doors finished to manufacturers standard. Chiller must be factory tested and assembled.
- .3 Capacity:
  - .1 Certified ratings based on AHRI 550/590:
    - .1 115.35 kW (29.2 tons), when cooling 3.43 L/s of water from 14.72°C to 6.67°C.
    - .2 Water cooled condenser supplied with 6.21 L/s of water at 36.67°C, pressure drop not to exceed 23.7 kPa.
    - .3 Power input, including electrical components: 29.2 kW.
    - .4 Fouling resistance coefficient: 0.000045 m<sup>2</sup>K/W.
  - .2 Refrigerant: R410A.
  - .3 Unit power: 575/3/60.
  - .4 Chiller selection requires special high pressure switch. Coordinate the factory installed switch with the manufacturer.
  - .5 Dimensions and weight:
    - .1 Length: 3454 mm
    - .2 Width: 833 mm
    - .3 Height: 1610 mm
    - .4 Weight: 2488 lb (shipping), 2564 lb (operation).
- .4 Acoustical:
  - .1 Sound pressure levels for the unit shall not exceed the following specified levels. The manufacturer shall provide the necessary sound treatment to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 575.

SOUND VALUES								
Sound Pressure (dB)								
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Overall
64	58	63	71	63	71	62	48	74
Sound Power (dB)								
72	66	71	79	71	79	70	56	82

- .5 Compressor:
  - .1 The four compressors shall be sealed hermetic scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads.
- .6 Compressor motor:
  - .1 Hermetic type with overload protection and manual restart: 575/3/60.
- .7 Evaporator:
  - .1 The evaporator shall be direct expansion type with stainless steel plates brazed together. It shall be insulated with 19 mm closed cell polyurethane insulation and have 4500 kPa water side working pressure.
  - .2 Fluid: 100% water.
  - .3 Type of connection and size:
    - .1 Evaporator: 64 mm, Victaulic. Contractor must provide couplings and transition from Victaulic piping to welded pipe.
      - .1 Fluid pressure loss: 17.5 kPa (5.9' of water).
    - .2 Condenser: 100 mm, Victaulic. Contractor must provide coupling and transition from Victaulic piping to welded pipe.
      - .1 Fluid pressure loss: 23.7 kPa (8.0' of water).
  - .4 Provide cleanable strainer at the inlet of the evaporator, perforation no larger than 3.2 mm diameter. Installation as per manufacturer's recommendation.
- .8 Water cooled condenser:
  - .1 Horizontal shell and finned tube type with steel shell and integral finned copper tubes rolled into steel tube sheets. The chiller shall be equipped with intermediate tube supports. Construct condenser in accordance with the requirements of ASME Section VIII Unfired Pressure Vessel Code and ANSI B9.1 Safety Code. It shall be designed for 1599 kPa water side working pressure and 3104 kPa refrigerant side pressure and be provided with ASME, ANSI B9.1 pressure relief valves.
- .9 Refrigeration circuit:
  - .1 Each refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.
- .10 Options and accessories:
  - .1 The following options are to be included:
    - .1 Hot gas bypass on all circuits.
    - .2 Flow switch installed on evaporator and condenser.
    - .3 Disconnect switch, single or multi-point.
    - .4 Acoustical kit for compressor.
    - .5 Vibration insulator (installed on site by contractor).

.11 Control centre:

.1 Control panel:

.1 MicroTech II: The control panel shall contain a microprocessor controller providing operating and equipment protection controls plus motor starting equipment, factory wired, operationally tested, and ready for operation. Standard components shall include a control transformer with primary and secondary fusing, microprocessor transformers with integral fusing, compressor contactors, circuit breakers, single-point wiring arrangement and switches for each circuit pumpdown and unit control power. The control panel shall have a hinged tool-locked door.

.2 The control system shall stage the compressors based on the leaving water temperature. Equipment protection devices controlled by the microprocessor include.

.1 Oil pressure differential.

.2 Motor protection.

.3 High pressure.

.4 Loss of refrigerant.

.5 Loss of water flow.

.6 Freeze protection, low refrigerant pressure.

.7 Controls shall include auto/stop switch.

.8 Chilled water setpoint adjustment.

.9 Anti-cycle timer.

.10 Digital display with water temperature.

.11 Setpoint, operating temperatures and pressures, and diagnostic messages.

.3 The following features and functions shall be included:

.1 The LCD-type display shall have a minimum of twenty characters with all messages in plain English. Coded messages are not acceptable.

.2 Critical parameters shall have their own section of control and shall be password protected.

.3 Resetting chilled water temperature by a remote 4-20mA DC signal.

.4 A soft load function to prevent the system from operating at full load during the chilled water pulldown period.

.5 An electronic time clock to allow programming of a yearly schedule accommodating weekends and holidays.

.6 Auto restart after a power failure, not requiring external battery backup or auxiliary power for maintaining program memory.

.7 Shutdowns shall be date and time stamped with system temperatures and pressures recorded. A minimum of six previous occurrences shall be kept in a revolving memory.

.8 Start-to-start and stop-to-start timers to provide minimum compressor off-time with maximum motor protection.

- .9 Capability of communication with a PC or remote monitoring through a twisted pair RS-232 interface.
- .10 Lead/lag manually or automatically by compressor number of starts.
- .11 Continuous diagnostic checks of unit to provide a pre-alarm signal in advance of a shutdown allowing time for remedial action to be taken.
- .2 The controller shall contain the following features as a minimum:
  - .1 Unit Enable Selection - Enables unit operation from local keypad, digital input, or BAS; Unit Mode Selection - Selects standard cooling, ice, glycol, or test operation mode
  - .2 Shutdown Alarms:
    - .1 No evaporator water flow.
    - .2 Low evaporator pressure.
    - .3 High condenser pressure.
    - .4 Motor protection system.
    - .5 Phase voltage protection (optional).
    - .6 Outside ambient temperature.
    - .7 Evaporator freeze protection.
    - .8 Sensor failures.
  - .3 Limit Alarms:
    - .1 Condenser pressure stage down, unloads unit at high discharge pressures.
    - .2 Low ambient lockout, shuts off unit at low ambient temperatures.
    - .3 Low evaporator pressure hold, holds stage no. 1 until pressure rises.
    - .4 Low evaporator pressure unload, shuts off one compressor.
  - .4 Operating location:
    - .1 Allows the unit to be controlled from local computer, using digital inputs or BAS system.
  - .5 Analog input:
    - .1 Analog Inputs - Reset of leaving water temperature, 4-20 mA.
  - .6 Digital Inputs:
    - .1 Unit off switch.
    - .2 Remote start/stop.
    - .3 Flow switch.
    - .4 Motor protection.
  - .7 Digital Outputs:
    - .1 Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared.
    - .2 Evaporator pump; field wired, starts pump when unit is set to start.

- .8 Optional Building Automation System (BAS) Interface:
  - .1 The unit shall be equipped with an optional factory-installed BAS communication module. Factory mounted DDC controller(s) shall support operation on a BACnet®, Modbus® or LONMARKS ® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier: BACnet MS/TP master (Clause 9).
  - .2 The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
  - .3 All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.
- .12 Equipment:
  - .1 Scroll chiller such as Daikin Applied (Enviroair Industries) model no WZ035DW or a replacement product approved by addendum as per tenderers instruction.
  - .2 Supply all necessary refrigerant to fill piping and assure appropriate operation.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

#### **3.3 GENERAL**

- .1 Provide appropriate protection apparatus.

- .2 Install unit as indicated, to manufacturers recommendations, and in accordance with EPS 1/RA/2.
- .3 Ensure adequate clearances for servicing and maintenance.
- .4 Manufacturer to approve installation, to supervise startup and to instruct operators. Include two days per unit.

### **3.4 CLEANING**

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

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by rotary-screw water chiller installation.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Sections 01.

**1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION**

- .1 Anchor bolts: size anchor bolts to withstand seismic acceleration and velocity forces as defined in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

**1.3 REFERENCES**

- .1 ASTM International:
  - .1 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .3 ASTM B117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - .4 ASTM C67-12, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
  - .5 ASTM D520-00(2011), Standard Specification for Zinc Dust Pigment.
- .2 CSA Group:
  - .1 CSA B52-05, Mechanical Refrigeration Code.
- .3 Cooling Technology Institute (CTI):
  - .1 CTI-ATC-105-00, Acceptance Test Code.
  - .2 CTI-STD-201-11, Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.
- .4 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA MG 1-2011, Motors and Generators.
- .5 Underwriters Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data, shop drawings:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for close circuit cooling towers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

- .3 Indicate on drawings:
  - .1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
  - .2 Wiring as assembled and schematically.
  - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
  - .4 Vibration and seismic control measures.
  - .5 Manufacturers recommended clearances.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Test reports:
  - .1 Submit certified test reports for closed circuit coolers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Manufacturer's Field Reports:
  - .1 Submit manufacturer's field reports specified.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for close circuit cooling towers for incorporation into manual.
- .3 Include:
  - .1 Description of equipment giving manufacturers name, type, model year, capacity.
  - .2 Start-up and commissioning procedures.
  - .3 Details of operation, servicing and maintenance.
  - .4 Recommended spare parts list.

#### **1.6 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company or person specializing in closed circuit coolers installations with five year experience.
- .2 Regulatory Requirements: work to be performed in compliance with CEPA and applicable Provincial/Territorial regulations.

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

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

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

## **1.8 WARRANTY**

- .1 For the work of this section, the 12-month warranty period prescribed in paragraph GC 3.13 of the General conditions « C » is extended to 60-months (total).
- .2 Warranty includes the following:
  - .1 Support.
  - .2 Fans.
  - .3 Fan shafts.
  - .4 Bearings.
  - .5 Sheaves.
  - .6 Motor shafts.
  - .7 Fan motors.

## **1.9 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **Part 2 Products**

### **2.1 PERFORMANCE REQUIREMENTS**

- .1 Performance certified in accordance with CTI-STD-201.
- .2 Close circuit cooling tower:
  - .1 Capacity: 319 kW, 15.27 L/s of water from 35°C to 29°C with 15.5°C ambient wet bulb temperature.
  - .2 Fill system with water and add 50% glycol.
  - .3 Pressure drop: 51.7 kPa.
- .3 Oversized type motor fan: 15 HP
- .4 Air flow and static pressure: 8.17 m<sup>3</sup>/s, 48 Pa.
- .5 Pump motor: 0.75 HP.
- .6 Water flow: 7.25 L/s.
- .7 Power supply 575/3/60.
- .8 Variable frequency drive (VFD), see below.
- .9 Pan heater, see below.

## **2.2 GENERAL**

- .1 Identification: T-4.
- .2 Factory assembled forced draft counterflow vertical discharge closed circuit cooler.
- .3 Ensure major equipment including cooling towers, cooling tower gear drive assemblies, fans, and motors have manufacturer's name, address, style, model, serial number, catalogue number on plate secured to item of equipment.
- .4 Plates: durable and legible throughout equipment life and made of anodized aluminum.
- .5 Fix plates in prominent locations with nonferrous screws or bolts.
- .6 Passivation of the close circuit cooling tower must be completed.
- .7 Allow for delivery in multiple section for ease of manipulation and installation.

## **2.3 SIZE AND WEIGHT**

- .1 Dimensions: approximately 2737 mm x 1206 mm x 2991 mm maximum height.
- .2 Weight:
  - .1 Shipping: 4570 lb.
  - .2 Operating: 5970 lb.

## **2.4 MATERIALS**

- .1 Steel: components fabricated of zinc-coated steel not lighter than 1.5 mm thick steel, protected against corrosion by zinc coating.
  - .1 Zinc coating: to ASTM A153/A153M and ASTM A123/A123M, with extra heavy coating of not less than 0.76 kg per square meter of surface.
  - .2 Coat galvanized surfaces damaged due to welding with zinc rich coating conforming to ASTM D520, Type 1.
- .2 Fibre glass reinforced plastic, (FRP) components: inert, corrosion resistant, and fire-retardant with thickness of 3.66 kg/square meter.
- .3 Polyvinyl chloride, (PVC) with flame spread rating of 10, smoke developed of 25, to CAN/ULC-S102.2.

## **2.5 CASING AND FRAMEWORK**

- .1 Materials: galvanized steel sheet, angles and channels.
- .2 Access to spray nozzles.

## **2.6 COLD WATER BASIN**

- .1 Construct basin watertight from galvanized steel and protection against corrosion with the *BALTIBOND* system.
- .2 Construct and install basin to ensure that air will not entrained in outlets when operating and no water will overflow on shutdown.

- .3 Accessories will include circular access doors, wide surface strainer with opening smaller than nozzle size, anti-cavitation equipment to avoid air dragging, bronze water supply with plastic floating device of large diameter to ensure easy adjustment.
- .4 Equip basins with:
  - .1 Overflow and valve drain connections.
  - .2 Float-controlled, makeup water valve as indicated.
- .5 Makeup water: discharge not less than 50 mm or two pipe diameters, whichever is greater, above top of basin.

## **2.7 HOT WATER DISTRIBUTION**

- .1 Water shall be distributed evenly over the tower fill area by a water distribution system consisting of header and spray branches of Schedule 40 PVC pipe with plastic distribution nozzles having a minimum orifice of  $\frac{3}{4}$ " x  $\frac{5}{16}$ ". The branches and plastic spray nozzles shall be held in place by snap-in rubber grommets providing quick removal of individual nozzles or complete branches for cleaning or flushing. The header shall include provisions for measuring spray pressure externally. Screw-in nozzles will not be acceptable.

## **2.8 PUMP**

- .1 Centrifugal brass pump, with mechanical gasket, installed on the basin and completely connected at the suction of the basin of the water distribution system. Pump must be installed to allow complete drainage.

## **2.9 COIL SECTION**

- .1 The heat transfer casing sections shall be removable from the pan-fan section. Each section shall include serpentine, PVC wet deck surface below a spray-type water distribution system, all encased by hot-dip galvanized steel panels finished with the *BALTIBOND* corrosion protection System with removable sectional eliminators at top.
- .2 Coil will be executed from smooth first quality tubing at the manufacturer factory and completely galvanized after fabrication. Conceivable so fluid pressure drop is low. Tubes will have a slope in order to allow fluid flow toward manifold. Coil must resist to test pressure of 2585 kPa.

## **2.10 ELIMINATORS**

- .1 Eliminators shall be constructed of hot-dip galvanized steel finished with the Baltibond Corrosion Protection System and be removable in easily handled sections. They shall have a minimum of three changes in air direction with a hooked leaving edge, and shall direct discharge away from the fans and limit drift loss to 0.002% of the total water circulated. They shall have sufficient rigidity to support the weight of a person. PVC eliminators will not be acceptable.

## **2.11 FAN**

- .1 The fans and motors shall be factory installed at the base of the unit in the dry entering air stream to provide greater reliability and ease of maintenance. The forwardly curved centrifugal fans shall be heavy-duty centrifugal flow type, statically and dynamically balanced prior to shipment. Fan housing shall have curved inlet rings for efficient air entry and rectangular discharge cowls shall extend into the basin to increase fan efficiency and prevent water from splashing into the fans. Fans shall be mounted on a steel fan shaft supported by heavy-duty self-aligning; relubricatable bearings with cast iron housings. The fan wheels complete fan housings, the sloping fan panel, discharge cowls and the bearing supports are protected by Baltibond Corrosion Protection System.
- .2 Fan drive: V-belt designed for minimum 150% of motor nameplate ratings.
- .3 Each motor shall be premium efficiency of Totally Enclosed Fan Cooled (T.E.F.C.) ball bearing type, single winding with 1.15 service factor. Each motor shall be mounted on an easily adjusted heavy-duty motor base. V-belt fan drives shall be designed for not less than 150% of motor nameplate horsepower. Drives and all moving parts shall be protected by removable hot-dip galvanized steel screens and panels finished with the *BALTIBOND* corrosion protection
- .4 System drives, fans, and moving parts: protected by galvanized wire guards.

## **2.12 CONTROL PANEL**

- .1 Furnish and install a complete prewired control panel with VFD, ready for installation inside the building. The control panel shall include disconnect, starters, pilot lights, transformer, relays, controllers, switches, alarms, interlocks, etc.
  - .1 Control panel such as M7000 series from MGI Technologies (Aquavap) or a replacement product approved by addendum as per tenderers instruction.
  - .2 Variable frequency drive (VFD) from ABB Control, model ACH550 complete with:
    - .1 RL filter at input and RLC at output.
    - .2 BACnet communication protocol.
    - .3 On the panel door, include a microprocessor type operation station, Auto/Stop/Manual selector, Auto/Stop/Bypass selector, indicator light for start, fault, and bypass mode.
    - .4 Input/output: start off permission, modulation, and alarm.

## **2.13 ACCESSORIES**

- .1 The cooling tower shall be provided with an electric immersion pan heater package to prevent the pan water from freezing when the unit is inoperative. The heater package shall be sized to maintain the pan water temperature at 4.4°C when the ambient air temperature is -28.8°C. The heater package shall be tubular element construction and the contact terminals enclosed in a moisture proof terminal box.
- .2 A 110 V, moisture resistant temperature controller shall be included, dial calibrated from -18°C to 121°C. A low water level cut-out shall be provided to de-energize the heaters if the vent element is not fully submerged.

- .3 Extended lubrication lines shall be provided for ease of maintenance to the exterior of the tower.
- .4 The Cooling Tower manufacturer shall provide a tapered discharge hood. The hood shall be fabricated from heavy gauge hot-dip galvanized steel, finished with the *BALTIBOND* corrosion protection System. Full length water tight access doors shall be provided for access to the distribution system. Contractor shall supply extension of discharge hood if required to reach exterior of roof.

## **2.14 VIBRATION ISOLATORS**

- .1 Provide structural steel underneath unit as per manufacturer recommendations. Support must be of sufficient length so that the weight is transferred directly the beams underneath the floor, in line with the existing columns.
- .2 Provide vibration insulator as per manufacturer recommendation, such as Mason Industries model no SLRSO-C2-XXXX or a replacement product approved by addendum as per tenderers instruction.

## **2.15 EQUIPMENT**

- .1 Close circuit cooling tower such as Baltimore Aircoil Company (Aquavap) model VF1-027-41K or a replacement product approved by addendum as per tenderers instruction.

## **Part 3 Execution**

### **3.1 BALTIBOND CORROSION PROTECTION SYSTEM**

- .1 G-235 hot dip galvanized steel substrate.
- .2 Parts prepared in a four-step, (cleaned, pretreated, rinsed, dried), process.
- .3 Electrostatically applied thermosetting, hybrid polymer fuse-bonded to the substrate steel during a thermally activated curing stage.
- .4 All protected parts are to be coated prior to assembly.
- .5 Quality assurance inspection program including 23 steps through-out polymer application and unit fabrication.
- .6 Unit (parts) shall be assembled with phenolic-epoxy coated, cadmium-plated, washer head fasteners.
- .7 Protection system shall be tested by 6 000 hours of 5% salt spray per ASTM standard B117 without failure.
- .8 Protection system shall be tested by 6 000 hours of chemical attack at a pH4 and a pH11 at 35°C without failure.
- .9 Protection system shall not fracture or delaminate after 160" pounds direct impact from a 0.625" radius impact tool according to ASTM Method D2794.
- .10 Protection system shall not crack after exposure to 6 000 hours of continuous ultra-violet light, equivalent to 120 000 hours of normal sunlight radiation.
- .11 Protection system shall not show any signs of deterioration after a minimum of 200 thermal shock cycles conducted between -25°F. and 180°F.

- .12 Protection system shall not show any sign of erosion when exposed continuously for 6,000 hours to high pressure (414 kPa) water jet.
- .13 Or a replacement product approved by addendum as per tenderers instruction.

### **3.2 EXAMINATION**

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

### **3.3 GENERAL**

- .1 Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests:
  - .1 Test under actual operating conditions in accordance with CTI-ATC-105 to verify specified performance.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.5 ADJUSTING**

- .1 Lubricate bearings with oil or grease as recommended by manufacturer.
- .2 Tighten belts to manufacturer's specified tension.



**3.6            CLEANING**

- .1      Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1          Leave Work area clean at end of each day.
- .2      Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.
- .3      Maintain system in clean condition until final acceptance.
- .4      Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**



**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Sections 01.

**1.2            REFERENCES**

- .1    Definitions:
  - .1    Certified nominal specifications: technical data published or taken from the manufacturer's documentation, confirmed by tests that have been performed by the manufacturers, or on their behalf by independent laboratories, and certifying the compliance of the elements with the requirements of the codes and the standards in effect.
- .2    References:
  - .1    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
    - .1    ANSI/ASHRAE 90.1-2007 (I-P) – Energy Standard for Buildings except Low-Rise Residential Buildings.
    - .2    ANSI/ASHRAE 52.2-2007 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - .2    Air Conditioning and Refrigeration Institute (ARI):
    - .1    ARI 410-2001 – Forced Circulation Air Cooling and Air Heating Coils.
  - .3    American Society for Testing and Materials International (ASTM):
    - .1    ASTM A53/A53M-10 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .4    Canadian General Standards Board (CGSB):
    - .1    CAN/CGSB 1.181-99 – Ready-Mixed Organic Zinc-Rich Coating.

**1.3            ACCEPTED MATERIALS OR PRODUCTS**

- .1    When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

**Part 2           Products**

**2.1            COIL SPECIFICATIONS**

- .1    For specific characteristics, see the coil tables.

## **2.2 CHILLED WATER, HOT WATER, AND ETHYLENE GLYCOL COILS**

- .1 Manufacturing:
  - .1 Copper manifold with threaded brass fittings, drain plug, minimum NPS 2 fitting with a maximum velocity of 3.25 m/sec. See the tables.
  - .2 Copper tubes 16 mm in diameter and with a nominal thickness of .635 mm.
  - .3 Aluminum fins in corrugated sheets, well fixed to the tubes, evenly spaced, and with a nominal thickness of 191 mm.
  - .4 Circuits: Only full, half, and double circuit coils are accepted.
  - .5 Test pressure of 1725 kPa.
  - .6 Operating pressure of 1035 kPa.
- .2 Coil selection:
  - .1 As per selection in shown in coil table or a replacement product approved by addendum as per tenderers instruction.

## **Part 3 Execution**

### **3.1 COILS - GENERAL**

- .1 Install chilled water and glycol heat recovery coils entirely inside the unit, including the ends, in order to prevent any condensation on the outside of the unit.

### **3.2 COIL SUPPORTS**

- .1 Install coils on bases made from brackets, U-irons, I-beams, or WF-beams, welded according to the coil dimensions. Construct the supports so that the coils can be slid into place without dismantling the pipes.
- .2 Independently support each coil so as to be able to remove a coil without dismantling the adjacent coils. Seal the joints between the coils. Provide piping connections to allow easy disassembly.
- .3 Submit installation drawings.

GLYCOL COIL SPECIFICATIONS							
Identification			SERP-001				
Location			U-2				
Air	Flow (L/s)		9270				
	Velocity (m/s)		3.91				
	PDA (Pa)		0.14				
	T° inlet (°C)	DB	-20				
		WB	---				
	T° outlet (°C)	DB	51				
WB		---					
PG50% (Heating)	Flow (L/s)		3.28				
	PDW (kPa)		30				
	T° inlet (°C)		64				
	T° outlet (°C)		28				
Coil specifications	Type		5WH0904A				
	Rows		4				
	Fins		9				
	Number of circuits		Half				
	Height (mm)		1372				
	Length (mm)		1727				
	Quantity		1				
	Total surface (m²)		2.369				
	Instal- lation	Hor.					
Vert.		X					
Comments							
Legend :							
DB : dry bulb							
WB : wet bulb							
PDA : static pressure drop, air side							
PDW : static pressure drop, hot water side							
Comments :							
1 MAXIMUM FLUIDE PRESSURE DROP OF 35 KPA.							
2 MODEL NUMBER AS PER HEATCRAFT COMPANY.							

**END OF SECTION**



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Sections 01.

**1.2               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data, shop drawings:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for humidifiers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2       Submit shop drawings to indicate project layout, dimensions and extent of humidification system.
- .2       Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3       Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4       Manufacturer's Field Reports:
  - .1       Submit manufacturer's field reports specified.

**1.3               CLOSEOUT SUBMITTALS**

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

**1.4               MAINTENANCE MATERIAL SUBMITTALS**

- .1       Extra Materials:
  - .1       Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2       Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.
  - .3       Provide following: one complete set of renewable evaporator media.

**1.5               DELIVERY, STORAGE AND HANDLING**

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

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

## **1.6 ACCEPTED MATERIALS OR PRODUCTS**

- .1 When materials or products are described by their trademark, refer to the Instruction to bidders in order to know the procedure for the approval of the equipment or product submitted.

## **Part 2 Products**

### **2.1 DIRECT STEAM INJECTION TYPE**

- .1 The humidifier will be a direct injection type using a combination head made up of a valve integrated to a steam separator.
- .2 Humidifiers with a valve independent to the separator will not be considered equivalent.
- .3 The head of the humidifier will include a combination steam separator and control valve allowing the water droplet separation all while preheating the valve body through the act of steam jacketing. After exiting the orifice of the valve the steam will enter a drying chamber before being admitted into the dispersion tube.
- .4 The distributor will be a jacketed tube made entirely of stainless steel. Full pressure steam will enter the jacket portion of the tube before entering the head of the humidifier and in turn the inner portion of the tube for dispersion into the duct. This preheating in the jacket is done to reduce condensation in the inner portion. If multiple tubes are used it may be necessary to provide a separate steam supply to the manifold jacket from the one to the head of the humidifier.
- .5 The humidifier will receive full pressure steam and discharge atmospheric steam into the duct. The humidifier will be supplied with strainer and inverted bucket steam trap.
- .6 The separation chamber will be constructed in a way and with the correct volume to disengage and extract any water droplets or particles larger than 3 microns from the steam when the unit is in use.
- .7 The control valve portion of the head must be steam jacketed and include a parabolic plug providing truly linear control.
- .8 The valve will include a Belimo electric actuator.
- .9 The drying chamber will essentially only see atmospheric steam that has passed through the seat and stem of the valve and will also be steam jacketed.
- .10 Chamber will also provide sound attenuation and will be filled with stainless steel dampening media.



- .11 The distribution tube will provide a uniform jet of steam along its entire length and will be jacketed by a chamber filled with line pressure steam in order to provide the driest possible steam to the duct. It will also have an internal wire mesh in stainless steel to provide additional sound attenuation.
- .12 The humidifier will come equipped with a temperature switch to ensure proper drainage of the cold condensate before start-up.
- .13 Capacities, dimensions and selection as per indication below:
  - .1 HUM-1 (Unit U-1): 70 kg/h, pressure of 70 kPa, orifice of 13 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 92-M8. Equipment such as Armstrong BLEM-92 or a replacement product approved by addendum as per tenderers instruction.
  - .2 HUM-2 (Unit U-2): 130 kg/h, pressure of 70 kPa, orifice of 16 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 93-M8. Equipment such as Armstrong BLEM-93 or a replacement product approved by addendum as per tenderers instruction.
  - .3 HUM-3 (Unit U-3): 14 kg/h, pressure of 70 kPa, orifice of 5 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 91-M2. Equipment such as Armstrong BLEM-91 or a replacement product approved by addendum as per tenderers instruction.
  - .4 HUM-4 (Unit U-4): 14 kg/h, pressure of 70 kPa, orifice of 5 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 91-M2. Equipment such as Armstrong BLEM-91 or a replacement product approved by addendum as per tenderers instruction.
  - .5 HUM-5 (Unit U-1-Librairy): 25 kg/h, pressure of 70 kPa, orifice of 6 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 91-M1.5. Equipment such as Armstrong BLEM-91 or a replacement product approved by addendum as per tenderers instruction.
  - .6 HUM-6 (Unit U-1-Librairy): 25 kg/h, pressure of 70 kPa, orifice of 6 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 91-M1.5. Equipment such as Armstrong BLEM-91 or a replacement product approved by addendum as per tenderers instruction.
  - .7 HUM-7 (Computer room): 9.5 kg/h, pressure of 70 kPa, orifice of 4 mm, complete with steam trap and strainer, 24 V Belimo electric actuator, 4-20 mA and electric temperature switch. Distributor: 1 x 91-M1. Equipment such as Armstrong BLEM-91 or a replacement product approved by addendum as per tenderers instruction.

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

**3.2                INSTALLATION**

- .1      Install in accordance with manufacturers instructions.
- .2      Humidifier and evaporator media to be new and clean when project is accepted.
- .3      Water service overflow drain: to manufacturers' recommendation.
- .4      Install access doors or panels in adjacent ducting.
- .5      Install capped drain connection at low point in duct.

**3.3                FIELD QUALITY CONTROL**

- .1      Manufacturer's Field Services:
  - .1      Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2      Performance Verification (PV):
  - .1      General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
  - .2      Timing:
    - .1      After TAB of ducted air systems.
    - .2      At same time as PV of related air handling units.
- .3      Start-up:
  - .1      General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
  - .2      Verify:
    - .1      Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
    - .2      Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
    - .3      Visually check distribution manifold to ensure:

- .1 Even distribution of vapour.
    - .2 Freedom from water deposits.
- .4 Commissioning Reports:
  - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx)  
Requirements: reports, supplemented as specified. Include:
    - .1 PV results on approved PV Report Forms.
    - .2 Product Information Report Forms.

### **3.4 DEMONSTRATION**

- .1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx)  
Requirements: Training of O M Personnel.

### **3.5 CLEANING**

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

**END OF SECTION**



**RESEARCH AND DEVELOPMENT CENTER  
OF SHERBROOKE**

Major renovation of the hydraulic heating and  
cooling network – Phase 2 –Electromechanical  
sections – PWGSC: R.078727.001.

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**TOME 2: SPECIFICATIONS – ELECTRICAL**

2012-186-103-1

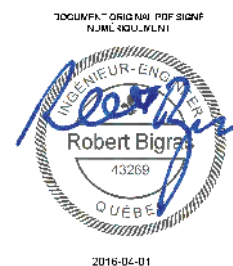
2016-04-01



**RESEARCH AND DEVELOPMENT CENTER OF SHERBROOKE**  
**2000, COLLEGE STREET**  
**SHERBROOKE (QUÉBEC)**  
**J1M 0C8**

**MAJOR RENOVATION OF THE HYDRAULIC HEATING**  
**AND COOLING NETWORK – PHASE 2 –**  
**ELECTROMECHANICAL SECTIONS – PWGSC: R.078727.001**

**DIVISION 26**



**For tenders**  
**April 1, 2016**

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**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 All contractual documents.
- .2 Obtain a copy of pertinent documents, read them attentively and determine requirements based on the scope of work.

**1.2 SCOPE OF WORK**

- .1 Work Includes:
  - .1 In general, work consists of the supply of all required materials, workforce, equipment and tools required to complete the electrical installations as described in writing, plans, and specifications. Most notably, work is comprised of:
    - .1 3 PH distribution network of 347/600 V, emergency.
    - .2 3 PH distribution network of 120/208 V, emergency.
    - .3 Electrical and mechanical grounding.
    - .4 Supply and connection of all motors and their controls.
    - .5 Modification of motor control centres.
    - .6 Supply and connection of electric heating appliances; supply only to the coils of the HVAC systems.
    - .7 Connection of other equipment as outlined in the plans.
    - .8 All steel structural supports for conductors, cables, devices, and equipment.
    - .9 All specified tests.
    - .10 Relocation of existing equipment.
    - .11 Demolition and removal of equipment deemed obsolete.
    - .12 Installation of temporary equipment to ensure continuity of service.

**1.3 MATERIALS**

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

**1.4 DOCUMENTS/SAMPLES TO SUBMIT FOR APPROVAL/INFORMATION**

- .1 Submit the documents and samples required in accordance with section 01 11 01 – General instructions.
- .2 Data Sheets:
  - .1 Submit the technical data sheets required in addition to the instructions and the Manufacturer's documentation concerning motor central control. Technical data sheets must indicate product information, nameplate, performance criteria, product dimensions, product limitations. Submit upon examination, wiring motor diagram with the control part.

- .2 Electrical distribution power: in the main local electrical room.
- .3 Workshop Drawings:
  - .1 Wiring diagrams and device installation details must indicate placement, proposed layout, control charts, accessories, piping, ducts, and all other elements which must be shown in order to achieve a coordinated construction effort.
  - .2 Wiring diagrams must indicate the terminal ends, internal wiring of each device and in addition interconnections between the different devices.
  - .3 Drawings must indicate necessary functioning disconnects for maintenance and replacement of devices.
  - .4 Submit to the consultant 1 samples of technical data sheets in numerical format.
  - .5 If changes are requested, the Ministry's Representative must be notified prior to making these changes.

## **1.5 DOCUMENTS/ITEMS TO SUBMIT UPON COMPLETION OF WORK**

- .1 Electrical contractor must submit to the owner six copies of the operating and maintenance manuals for each piece of equipment or device included in their contract.
- .2 The manuals must contain:
  - .1 An illustrated list of all device constituents: control, alarm panel, lighting devices, transformers, generators, and fire-alarm, etc.
  - .2 An approved and executed copy of drawings.
  - .3 List of subcontractors: name, address, telephone number.
  - .4 List of manufacturers of the equipment installed: name, address, telephone number.
  - .5 The instructions must contain all graphics, curves, operating capacity, and other information set forth by the manufacturer concerning the operating details of all the electrical equipment installed in the building.
- .3 All information must be assembled in French.
- .4 Divide each manual into sections using a blank coloured sheet bearing the correct identification of the section. Example: "GENERATORS". At the front of the manual, insert a table of contents with the title of each section and indicate where in the manual to find the section.
- .5 Cover each manual in a black carton stock paper, allowing for binding, the type assembled by Dominion Loose Leaf, Acco Press or approved equivalent, ensuring a size of 215 mm x 275 mm 8½" x 11"
- .6 Submit a copy to engineer for comments and deliver the five copies to the owner and engineer.
- .7 The manuals must be submitted prior to final review/tests. Leave sufficient space in the manual to add additional reports/information as required.
- .8 Upon completion of work, the electrical contractor must submit to the engineer a certificate of conformity which attests that the work has been completed as per the drawings and specifications and in accordance with the applicable codes and standards in place. See the example at the end of the present section.

- .9 Send this certificate to the engineer at the same time as the requested manuals.
- .10 Have this form signed by a company administrator and affix their seal to it.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

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

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

### **2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

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

### **2.4 WIRING TERMINATIONS**

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

### **2.5 EQUIPMENT PROTECTED BY SPRINKLERS**

- .1 Any electrical equipment which is enclosed in a perforated cover/box/container and that is installed in a sprinkler-protected area must be protected by a hood or non-combustible cover that is arranged in such a way that it does not impede the proper functioning of the sprinkler system.

### **2.7 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: lamicoid 1.5 mm thick plastic engraving sheet melamine, matt white finish face, black core, lettering accurately aligned and engraved into core, mechanically attached with self-tapping screws.

.2 Sizes as follows:

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

- .2 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .4 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .5 Terminal cabinets and pull boxes: indicate system and voltage.
- .6 Transformers: indicate capacity, primary and secondary voltages.
- .7 Devices:
  - .1 Identify all electrical equipment with visible safety labels on the device cover, the door of the device, or on the device frame.
  - .2 Use the same device code as indicated on drawings. The identification of equipment of water cooling tour no. 4 can be modified at the end of work. Coordinate its identification with the Division 23.
  - .3 Provide a list of all device identification for approval prior to the manufacturing.
  - .4 Assure that all device identifications are affixed to the equipment and that they are in French.
  - .5 List of equipment to identify:
    - .1 Motor central motor
    - .2 All specific elements identified in plans or in each section of the specifications.
    - .3 Starter.

## 2.8 WIRING IDENTIFICATION

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

- .1 Identify with letters of size 5 cm in height, each phase A, B, C, N, on the inside of each transformer entry point, each low-voltage switchboard, and each motor control centre on all live components.
- .2 Identify components and assigned phases using the colour codes outlined below:

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

- .3 Use coloured tape placed at a distance of 150 mm from each end of the conductors to identify drivers. Use coloured tape on each end of the conductors inside junction and pull boxes.
- .5 Drivers:
  - .1 Identify in each panel, in each pull and junction box each wire with the use of identification tags of the E-Z-Code brand, model WB from Thomas & Betts.
  - .2 Indicate on the tag: the circuit number, zone number, and function, in a way that each wire can be easily identified.

## 2.9 CONDUIT AND CABLE IDENTIFICATION

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

Prime	Auxiliary	
Up to 250 V	Yellow	
Up to 600 V	Orange	
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Blue	
Other communication systems	Green	Blue
Fire alarm	Red	
Other security systems	Purple	Yellow
Lighting	White	
Emergency	Black	
Used	Green	

- .4 Conduits:
  - .1 Colour code conduits, boxes and metallic sheathed cables.

- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Paint all junction and pull boxes.

## **2.10 CIRCUIT IDENTIFICATION**

- .1 Secondary panels at 120/208 V and 347/600 V:
  - .1 Identify in type all of the circuits in the secondary panel affected by the works on a protected plastic tab inserted in the panel box door. Use the same circuit number that appears in the plans. Be sure to describe succinctly the loading charge.

## **2.11 FINISHES**

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

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 no. 1 except where specified otherwise.

### **3.3 NAMEPLATES AND LABELS**

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

### **3.4 INSTALLATION OF CONDUITS AND CABLES**

- .1 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### **3.5 LOCATION OF OUTLETS**

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

### **3.6 LOCATION OF OUTLETS**

- .1 Place the outlets according to the plans and align them in a symmetrical fashion.
- .2 Install back-to-back outlets along a common wall leaving a horizontal gap of at least 300 mm between boxes.
- .3 At the engineer's request, the placement of outlets can be modified to 3000 mm without additional cost or credit if the change was advised prior to the installation.
- .4 Place lighting outlets and ceiling outlets suspended from the rafters going two ways, without harming the ceiling suspensions. Ensure that the outlets are accessible.
- .5 Make setting adjustments once the interior is complete.
- .6 Place lighting switches between 225 mm and 300 mm from single door frames on the door knob side and between 225 mm and 300 mm from the extremity of double doors.
- .7 The exact location of outlets should be coordinated using the architectural drawings prior to installation.

### **3.7 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .2 Ensure circuit protective devices in addition to overcurrent trips, relays and fuses match the required capacity values according to their labels.

### **3.8 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panel boards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panel boards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Circuits originating from branch distribution panels.
  - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

- .3 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.9 PERFORMANCE**

- .1 Electrical contractor to collaborate with other tradespeople in such a way that the performance of equipment can be tested in a timely fashion.
- .2 Once testing of equipment is complete, devices can be adjusted in such a way to obtain maximum efficiency.
- .3 General Requirements:
  - .1 All testing must be completed in the presence of the engineer and to their satisfaction.
  - .2 The engineer may require their own testing prior to accepting the results.
  - .3 For setting a temporary trial, obtain written permission to put in place a trial of the installations and permanent devices before they are accepted by the engineer.
  - .4 A written warning giving a notice of 48 hours to the engineer is required prior to testing.
  - .5 Provide the necessary devices, equipment, meters, materials, and personnel required for the execution of testing throughout the project until such a time as the engineer accepts the performance and all charges are settled.
  - .6 If a piece of equipment or a device does not operate as per the manufacturer's guarantee or the results of a test do not yield the desired results, the faulty piece of equipment must be replaced without delay and payment shall be deferred until the new piece of equipment is installed and desired operating results are obtained.
  - .7 Prevent dust, dirt, and other foreign materials from penetrating the openings in installations and devices during the testing phase.
  - .8 Provide the engineer with a certificate or a manufacturer's letter confirming that the power supply to the device has been installed to their satisfaction.
  - .9 Provide written confirmation of the results obtained from testing.



- .10 Testing trials must be completed and accepted prior to the installation of thermal insulation.
- .11 Do not hide or place in recess any outlets, accessories, or devices until testing is complete and results have been accepted.
- .4 Special Requirements:
  - .1 The presence of the electrical contractor may be required for a test conducted by another trades group.
- .5 Factory Testing:
  - .1 The owner and engineer reserve the right to examine equipment in use and to assist in the testing to ensure factory device requirements are met.
  - .2 Advise the engineer and owner at least one week in advance with the exact date and time that testing will occur.
  - .3 Provide two certified copies of testing reports to the engineer.

### **3.10 SYSTEM STARTUP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Provide these services for such period (minimum 8 hours), and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

### **3.11 CLEANING**

- .1 General Information:
  - .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .2 No not accumulate waste which may present a danger.
  - .3 It is the responsibility of the contractor to ensure the protection against dust and debris, taking into consideration that users will present outside the execution of work.
- .2 Cleaning During Construction:
  - .4 At least once a day, remove scrap material and debris.
  - .5 At the end of the working session, clean the work zone and ensure the air circulation is free of debris.
  - .6 The disposing of debris and scrap materials are the responsibility of the contractor.
  - .7 Plan cleaning work in such a way to minimize the possibility of dust and debris entering building systems.
- .2 Final Cleaning:
  - .1 Conduct final cleaning to prepare the site for issuance of the certificate of project completion.
  - .2 Sweep all hard surfaces.
  - .3 Remove all accessible debris and any surplus materials from hidden spaces.

- .2 Take all necessary precautions in order to keep the interior of panels, boxes, equipment, and others clean. Upon completion of work, ensure the interior of each system is in proper working order and clean.
- .3 Once work is completed, clean the inside of all installed equipment and re-apply primer or finish as required.

### **3.12 DEMOLITION**

- .1 Remove and transport off-site all equipment that is obsolete following the installation of new amenities, and complete a run-through of conduits, boxes, outlets, switches, lighting devices, power distribution devices, auxiliary systems, safety/warning communications systems, and all accessories comprising electrical installations.
- .2 Remove the wiring and conduits right up to the last panel or box retained in the network.
- .3 Seal all openings left in accordance with the requirements contained in article "IGNIFUGATION".
- .4 Restore supply circuits, controls, warning and communications systems, in the event that circuits are broken as a result of demolition of the current systems.

### **3.13 REMOVAL AND RE-INSTALLATION OF EXISTING EQUIPMENT**

- .1 Remove and install all electrical devices, ducts and required conductors to allow for the completion of architectural work and mechanical structures as outlined in the plans. Consult plans of other disciplines as required.

### **3.14 WORK IN AN EXISTING BUILDING**

- .1 Coordinate with the owner of the building work that is to be completed following the delimitation of certain areas indicated on the plans and drawings. In general, the work must be executed in more than section at a time per floor.
- .2 All work that requires the de-energizing of equipment or a partial halt in service of equipment in order to service or make changes should be undertaken during stop-periods as established by the owner(s) and authorized through advanced written consent.
- .3 Any request to halt work must be sent to stakeholders at least one week in advance.
- .4 Provide a schedule of work to be completed in coordination with the owner, staff, and other divisions to determine these stop periods.
- .5 Coordinate the receipt and handling of materials with the owner or a representative.
- .6 Reduce the inconvenience caused by noise and dust.
- .7 Comply at all times with the regulations and requirements of the owner regarding security measures and other rules.
- .8 All staff, including subcontractors, must wear a badge or identification card when on the premises.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1    CSA International:
  - .1        CAN/CSA-C22.2 18-F98(C2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2        CAN/CSA-C22.2 No.65-F03(C2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMJ-J-543-ANCE-03).
- .2    Electrical and Electronic Manufacturers' Association of Canada (EEMAC):
  - .1        EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3    National Electrical Manufacturers Association (NEMA)

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 11 01 – General instructions.
- .2    Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3                CLOSEOUT SUBMITTALS**

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

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1    Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3    Storage and Handling Requirements:
  - .1        Store materials off ground and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Pressure type wire connectors to: CAN/CSA-C22.2 no.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2        Fixture type splicing connectors to: CAN/CSA-C22.2 no.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3        Clamps or connectors for armoured cables, TECK cable and flexible conduit as required to: CAN/CSA-C22.2 No.18.

**2.2                CONDUCTOR SEALS**

- .1        Un-welded connectors of size 8 AWG or less, use 3M Scotchlock or Peggy by Thomas & Betts.
- .2        Un-welded copper-to-copper connectors of size 6 AWG or larger, use series type H from Thomas & Betts.
- .3        Un-welded copper-to-neutral connectors of size 6 AWG or larger, use APS type from Thomas & Betts.
- .4        Un-welded neutral-to-neutral connectors of size 6 AWG or larger, use HPS type from Thomas & Betts.

**2.3                CONNECTING BLOCKS**

- .1        All conductor seals in boxes and panels as part of the fire-alarm, low-voltage lighting, other low-voltage systems, etc., will be made on terminal blocks with sufficient quantities for each conductor.
- .2        Terminal blocks will be of Wieland brand, No. 9700B, 10 A, 300 V, complete with rail, end plates, identification, extremity of flanges and jumpers.

**2.4                ACCEPTABLE MANUFACTURERS**

- .1        Joints:
  - .1        3M
  - .2        Burndy
  - .3        Thomas & Betts
- .2        Connecting Blocks:
  - .1        Staffel
  - .2        Weidmüller
  - .3        Wieland

**Part 3            Execution**

**3.1                EXAMINATION**

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

**3.2                INSTALLATION**

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

**3.3                SEALS**

- .1      Tape connectors, not with their own jacket, use at least two rows of 3M tape No. 88 semi-overlapping.
- .2      The di-electric characteristics of wrapped seals must not be inferior to those of the isolating conductors.
- .3      Seals and connectors which do not have a smooth surface should be wrapped with 3M Scotchfil prior to being taped.

**3.4                CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1 Unless indicated otherwise, circuits at 15 A, 120 V will be of size as indicated in annex II of this section.

**1.2                PRODUCT DATA**

- .1 Provide product data in accordance with Section 01 11 01 – General instructions.

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1 Conductors: stranded for 8 AWG and larger. Minimum size: 12 AWG.
- .2 Unless indicated otherwise, copper conductors: Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE Non Jacketed.
- .3 Where 'AL' is specified in the plan, for size 1 AWG (100 A and greater), aluminum conductors (ACM): conductors: size as indicated, with thermoplastic insulation type RW90 XLPE, rated at 600 V.
- .4 Conductors in low-voltage system (25 V or less), of size 18 AWG minimum, integrated into multi-conductor cables, with PVC insulation.
- .5 Conductors and cables must bear the manufacturer's label, insulation type, size and voltage rating at regular intervals on the outer conductor or cable with permanent markings.

**2.2                TECK 90 CABLE**

- .1 Conductors:
  - .1 Grounding conductor: Unless stated otherwise copper, where AL is specified in the plan, aluminum alloy ACM.
  - .2 Circuit conductors: Unless stated otherwise copper, where AL is specified in the plan, stranded aluminum alloy ACM, size as indicated.
- .2 Insulation:
  - .1 Cross-linked polyethylene (RW90 XLPE).
  - .2 Voltage rating: 1000 V.
- .3 Tape: Mylar
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat, interlocking, aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

- .7 Fastenings:
  - .1 One hole, malleable iron, steel, aluminum, in humid areas, straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type U supports for two or more cables. Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.
- .9 Single-phase cable details:
  - .1 Concentric grounding cables.
- .10 Three-phase cable details:
  - .1 Class B stranded copper conductors.
  - .2 Class B stranded copper to ground.
  - .3 Filling with non-hygroscopic material.

### **Part 3 Execution**

#### **3.1 FIELD QUALITY CONTROL**

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

#### **3.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors – 0 – 1 000 V.
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.



- .8 Supply and install drivers and cables required for connecting all equipment and electrical devices to make them fully operational even in the event that the conductors or cables are not explicitly shown on the plans.
- .9 Install conductors or cables in conduits or metal sheaths as indicated in this section.
- .10 Install a neutral conductor bypass circuit at 120 V.
- .11 Use only lubricants approved by the manufacturer for cable pulling.
- .12 Install cables and leads continuously without joints from their point of origin to the powered device. If necessary, create joints in approved boxes.
- .13 Support conductors in vertical conduit with Type M carriers, manufactured by OZ Products. Space them as follows:
  - .1 Conductors of size 1/0 and smaller: supports every 30 m.
  - .2 Conductors of size 2/0 to 4/0: supports every 25 m.
  - .3 Conductors of size 250 to 350 MCM: support every 20 m.
  - .4 Conductors of size 350 to 500 MCM: supports every 15 m.
  - .5 Conductors of size 600 to 700 MCM: supports every 12 m.
- .14 Support vertically mounted armored cables or type TECK such as AC90, ACU90, RP90, RC90, or TECK90 according to the requirements outlined in Table 21, Chapter V – Electrical Construction Code of Québec or:
  - .1 Incorporate 90 degree bends in the vertical conduit at intervals not exceeding the distances outlined in Table 21, Chapter V – Electrical Construction Code of Québec.
  - .2 Use a cable specifically designed for vertical conduit.
- .15 Use Annex 1 to determine the maximum number of conductors/lines.

### **3.3 INSTALLATION OF BUILDING WIRES**

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

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

- .1 Group cables wherever possible on U channels.
- .2 Install exposed or concealed cable securely supported by staples, straps, hangers.
- .3 Installation of single-conductors:
  - .1 Splice drivers as recommended by the manufacturer.
  - .2 At the ends of the cables, attach the line forming the ground screen, link each to the ground terminal provided inside the cell cables in each position.
  - .3 Otherwise let float the wires of the ground green to the other end of the cables.

- .4 On top of the cells where the cables enter, provide for non-metallic metal plates (aluminum) at the starting point of the cables and insulation at the arrival point of the cables. Route all cables through the same opening in a metal frame.
- .5 Drill these plates and attach the fittings to the appropriate cables.
- .6 The fitting used to secure the cables to the plates are aluminum, screwed to the metal shell, and are of the type recommended by the manufacturer.
- .7 The metal shell of the cables must be connected to the metal plate at the base of the cables. This means that the PVC sheath cables must not be damaged in order to avoid contact between the metal casing and the metal support cables, and must establish a closed circuit between armored wires.
- .8 The order and the phase must be as it appears in the drawing.
- .9 Maintain an equal spacing of at least the largest diameter of the cable between each of the cables installed in open air or in the cable racks.

## ANNEX I

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

Note :  
For dimensions not listed, consult Chapter V of the Electrical Construction Codes of Québec.

**ANNEX II**

<b>MAXIMUM LENGTH (IN METERS) OF BYPASS CIRCUIT AT 120 V VERSUS VOLTAGE DROP</b>			
Conductor Size AWG	Rating in Amps (A)		
	15	20	30
12	20	15	---
10	30	25	15
8	50	40	25
6	90	65	40
Notes : <ul style="list-style-type: none"><li>– For non-specified loads, refer to Chapter V – Electricity Construction Code of Québec (Table No. D3)</li><li>– Distance calculated for copper conductors at a temperature of 60°C.</li></ul>			

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1       American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE):
  - .1       ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Submit in accordance with Section 01 11 01 – General instructions.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1       Insulated grounding conductors: green, copper conductors, size as indicated.
- .2       Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1       Grounding and bonding bushings.
  - .2       Protective type clamps.
  - .3       Bolted type conductor connectors.
  - .4       Thermite welded type conductor connectors.
  - .5       Bonding jumpers, straps.
  - .6       Pressure wire connectors.

**Part 3            Execution**

**3.1                EXAMINATION**

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

**3.2                INSTALLATION GENERAL**

- .1       Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories as outlined in Chapter V- Electrical Code of Construction of Québec.
- .2       Install connectors in accordance with manufacturer's instructions.
- .3       Protect exposed grounding conductors from mechanical injury.
- .4       Conduct by thermite welding, buried connections, connections to the electrodes and connections to conduct groundwater with good conductivity.

- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Flexible ducts, providing a bonding wire connected at each end to a ground terminal.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install a separate ground conductor leads in each of the arteries and branches serving care areas.
- .10 Ground metal structures on raised floors using all four support poles.
- .11 Ensure the grounding of all electrical equipment provided in another section, is fueled by that division.
- .12 Install grounding in all rigid PVC pipes.
- .13 Ground the steel frame of the building, and metal coating by welding copper to steel.
- .14 Arrange the grounding conductors in radial form and route all connections directly to a single common point grounding. Avoid loop connections

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.
- .2 Linking built engines or other devices transmitting vibrations with a separate conductor, green, to a grounding terminal in the junction box or connection placed between the rigid pipe and the flexible conduit connecting the device.

### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator during tests.

**END OF SECTION**

**Part 1            General**

**1.1                WASTE MANAGEMENT AND DISPOSAL**

- .1      Remove all packaging materials from the site and transport them to the appropriate recycling facilities.
- .2      Collect and separate for disposal for recycling in accordance with Waste Management Plan.
- .3      Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .4      Fold up metal banding, flatten and place in designated areas for recycling.

**Part 2            Products**

**2.1                SUPPORT CHANNELS**

- .1      U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted set in poured.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1      Secure equipment to poured concrete with expandable inserts.
- .2      Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3      Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .4      Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5      Suspended support systems:
  - .1      Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2      Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .6      Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .7      Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .8      Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .9 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .10 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .11 Painting the ends of the profiled steel with Galvicon to reduce rust.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-F06, Canadian Electrical Code, Part 1, 20th Edition.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 11 01 – General instructions.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 11 01 – General instructions.
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province.

**Part 2            Products**

**2.1                SPLITTER BOXES**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position, of calibre 14.
- .2 Terminations: main and branch lugs and connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

**2.2                JUNCTION AND PULL BOXES**

- .1 Construction: 16 gauge minimum steel, welded steel cans, painted with a coat of paint applied with an electrostatic process, dimensions as indicated.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.
- .4 Knockouts, factory made.
- .5 When apparent, TC type with frame, covered/concealed hinges, lock, no visible screws.
- .6 Boxes with large dimensions equipped with steel angle frame to form a rigid assembly, easily removable lids.

**Part 3            Execution**

**3.1                SPLITTER INSTALLATION**

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

**3.2                JUNCTION, PULL BOXES AND CABINET INSTALLATION**

- .1        Install pull boxes in inconspicuous but accessible locations.
- .2        Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3        Install terminal block as indicated in Type T cabinets.
- .4        Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.
- .5        Install all junction and pull boxes as indicated in the plans or where necessary.

**3.3                IDENTIFICATION**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 11 01 – General instructions.

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required, steel, 14 gauge minimum, with thickness of 40 mm, and dimensions outlined in the Canadian Electrical Code.
- .3 Gang boxes where wiring devices are grouped in the same area.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 All boxes protruding less than 2.4 m from the ground will be of the FS type.

**2.2 GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

**2.3 MOUNTING BOXES IN MASONRY OR GYPSUM BOARD**

- .1 Galvanized steel outlet boxes, simple, flush mounting into masonry walls, blocks or gypsum board.
- .2 Recessed box 101 mm x 101 mm, plaster to cover 12.5 mm or more.
- .3 Boxes in exterior walls with insulation and vapor barrier, Thomas & Betts No. BCR2000.
- .4 Box of projection type FS (a group), if for a single pipe, or 101 mm x 101 mm, if more than one channel.

**2.4 CONDUIT BOXES**

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

## **2.5 CEILING BOXES**

- .1 Octagonal box projecting from 101 mm diameter, serial number 54151, to the required depth.
- .2 Sunken octagonal box of 101 mm diameter, serial number 54521, to the required depth.

## **2.6 FITTINGS - GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 The openings in the box must be of dimensions corresponding to those fittings ducts, mineral insulated cables and armored cable. It is forbidden to use discount washers.
- .6 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .7 Identify systems for outlet boxes as required.
- .8 Group in one box: switches, sockets, and other similar devices, placed side by side. If there are more than two devices, with GSB boxes, a GBC plaster lid must be used.
- .9 Outlet boxes shown as back-to-back on the plans must ensure a minimum spacing of 300 mm.
- .10 In the gypsum walls, affix the boxes with metal studs, as shown in the plans.

**END OF SECTION**

## **Part 1           General**

### **1.1           REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18-F98(C2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45-FM1981(C2003), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-F04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-FM1985(C2003), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-FM1984(C2003), Rigid PVC (Un-plasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3-F05, Non-metallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

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

- .1 Provide submittals in accordance with Section 01 11 01 – General instructions.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.

## **Part 2           Products**

### **2.1           CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings, and expanded ends.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal steel aluminum.
- .6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.
- .8 The size required by Chapter V - Electricity of the Quebec Construction Code (Code d'Électricité du Québec), unless otherwise indicated, is a minimum of 21 mm diameter.
- .9 Galvanized steel, rigid, thin-walled, unless otherwise indicated.
- .11 Aluminum, rigid, installed, projecting outside.
- .12 Galvanized steel, flexible type, for primary and secondary connection of dry transformers between the ductwork and the transformer (maximum length of  $\pm 2$  m).

- .13 Galvanized steel, flexible waterproof kind, between the ductwork and the unit's connections box ( $\pm$  900 mm in length) for connecting motors and kitchen appliances.
- .15 Connectors and conduit fittings, thin-walled steel, screw compression type.

## **2.2 CONDUIT FASTENINGS**

- .1 One hole, steel straps to secure surface conduits where the diameter is equal to 50 mm or less.
  - .1 Two hole, steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Threaded rods, 6 mm diameter, to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells (L)" where 90 degrees bends for conduits 25 mm and larger.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## **2.4 FISH CORD**

- .1 Polypropylene.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.
- .3 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.
- .4 Use flexible metal conduit for connection to motors in dry areas.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .6 Use explosion proof flexible connection for connection to explosion proof motors.
- .7 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.

- .8 Minimum conduit size for lighting and power circuits: 19 mm.
- .9 Bend cold conduit:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Run 2- 25 mm spare conduits up to ceiling space and 2- 25 mm spare conduits down to ceiling space from each flush panel.
  - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete surface type box.
- .14 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .15 Dry conduits out before installing wire.
- .16 Unless otherwise indicated, all ducts are to be concealed in walls, floors, ceilings and suspended ceilings.
- .17 Install protruding ducts in parallel with structural lines and so as not to harm the equipment of other trades.
- .18 No drilling is to be done through the beams for the passage of conduits.
- .19 Maintaining the continuity of the grounding throughout the facility, taking care to make solid connections between the conduits and equipment. A green wire grounding must be added to each flexible conduit connecting a device capable of vibrating, such as, motors and all ducts are to be installed in concrete.
- .20 The inner radius of curvature of the ducts is at least six times the internal diameter of the pipe. When a group of ducts run side by side, the bending radii are concentric.
- .21 Connect the threaded conduit liners and devices using two nuts and a threaded sleeve, and insulated steel. Merge conduit with thin-walled steel type connectors compression.
- .22 Ream ends of threaded rigid conduit to remove metal burrs. Carefully cut fillets and coat gaskets or use an equivalent product to seal. Maintain the length of fillets to the minimum necessary for the connections to the boxes.
- .23 During construction, equip ducts with plugs to prevent foreign bodies from entering.
- .24 Leave a nylon cord at least 3 mm in diameter in each empty conduit where the installation of cables is part of another section.
- .25 Conduit raceways between two outputs, pull boxes or sliding sleeves must not have more than three 90 ° elbows or equivalent or be more than 60 m in length, except the external telephone network, where indicated in the plans.
- .26 Attach conduits as follows:
  - .1 Supply and install all the necessary supports galvanized steel for electrical work.

- .2 Conduits:
  - .1 When the insulated conduits are in contact with a surface of concrete or masonry, affix them using cast iron or steel straps.
  - .2 Where a group of passages (four or more) flows in parallel, affix them to the steel supports by anchoring them directly to the frame or by means of threaded rods or other supports.
  - .3 The size of the rods, supports, and spacing of supports are based on weight bearing as required by the code. When conduits of various sizes are grouped, the spacing of the supports is determined by the smallest conduit of the group.
- .3 Install cross braces spaced up to 12 m center-to-center and longitudinal braces on all horizontal runs of suspended conduits to 300 mm of the ceiling tile. This requirement may be omitted if the maximum diameter is less than 65 mm for a conduit or if conduits of an individual group has a total weight less than 15 lb/m.
- .27 Continuous **nets** are not allowed. In some cases it is impossible to install ordinary fittings, in these circumstances use Erikson type fittings.
- .28 Support conduits suspended using galvanized brackets, as described elsewhere in this book.
- .29 The spacing of supports and fasteners must be in accordance with the latest edition of the Electrical Code of Québec.
- .30 Support vertical conduits at floor level and use intermediate supports required by the code.
- .31 In suspended ceilings, support the metal sheath cables to the frame and not the ceiling structure.
- .32 The conduits should not touch the conduit insulation, mechanical equipment, or be buried in the insulation or fireproofing materials.
- .33 When a recessed panel is located in a room with a suspended ceiling, install three empty conduits of 21 mm diameter between the panel and the interior of the suspended ceiling and three upper pipes 21 mm between the panel and the suspended ceiling of the lower stage. These conduits must be easily accessible for future work/maintenance.

### 3.3 SURFACE CONDUITS

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



**3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 No conduit is to be installed in concrete slabs.

**3.5 CLEANING**

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

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCES**

- .1        Electrical Equipment Manufacturers Association of Canada (EEMAC)

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 11 01 – General instructions.
- .2        Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for motor control centres and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Shop Drawings:
  - .1        Indicate on drawings:
    - .1        Outline dimensions.
    - .2        Configuration of identified compartments.
    - .3        Floor anchoring method and dimensioned foundation template.
    - .4        Dimensioned position and size of busbars and details of provision for future extension.
    - .5        Schematic and wiring diagrams.
- .4        Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

**Part 2            Products**

**2.1                SUPPLY CHARACTERISTICS**

- .1        Electrical supply as indicated.

**2.2                GENERAL DESCRIPTION**

- .1        Wiring: Class I, Type B.
- .2        Cleaned metal parts, processed phosphate, electrostatically painted, standard colors of the manufacturer.
- .3        Terminal blocks size 4 for less installed near of the starters or contactors for the connection of power cable and for the connection of command's conductor.
- .4        Wiring motor diagram and control circuits affixed inside the door. Identification compatible with command's drawing.

**2.3                SILLS**

- .1        Continuous 38 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

## **2.4 MOTOR STARTERS AND DEVICES**

- .1 Combined starters:
  - .1 Starter with the capacity indicated on drawings, calibrated for resistive and inductive load, power cut-set as indicated values.
  - .2 Withdrawable type for the templates 4 and under, fixed for larger calibers.
  - .3 Combined with safety switch and breaker as indicated to paragraph "SAFETY SWITCH".
  - .4 Lights and control buttons installed in the door.
  - .5 Command transformer 600/120 V with fuse class J at secondary and grounding. Transformer of the needed capacity for planned commands.
  - .6 Provide two auxiliary contacts 600 V, 10A, NO (normally open) and two auxiliary contacts NC (normally close) connect to command's terminal block. If more than three auxiliaries contacts are needed on command's drawing, an auxiliary relay shall be include in the starter.
- .2 Safety Switch:
  - .1 Combined with starters or installed individually if there is no starter. Safety switch of the capacity indicated in the drawings.
- .3 Overload:
  - .1 Solid state type.
  - .2 Phase loss protection
  - .3 Manuel restart
  - .4 Adjustment of tripping current
  - .5 Select the overload's class according of motor's specification (minimum class 20).
  - .6 Thermistor type for all motors of 20 Hp and more.

## **2.5 STARTER UNIT COMPARTMENTS**

- .1 Units EEMAC size 5 and smaller, circuit breaker units 225 A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.
- .2 Unit mounting:
  - .1 Engaged position - unit stabbed into vertical bus.
  - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
  - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
  - .4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.
- .3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for three padlocks to lock operating handle in "off" position and lock door closed.

- .4 Hinge unit doors on same side.
- .5 Overload relays manually reset from front with door closed.
- .6 Pushbuttons [and indicating lights] mounted on door front.
- .7 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.
- .8 Removable MCC drawer for all non-reversing starter for size 4 or less. Units clamps on the back of the drawers, self-compensated type, with self-aligning. The envelope of unit's clamps must isolate power son from the connection point to the clips to the battery compartment. Starters orders son must also be removable.
- .9 Testing the MCC drawer.
- .10 Space not used, provide all accessories
- .11 Return to the owner all remove MCC drawer.

## **2.6 Manufacturer**

- .1 Existing to modify motor central control
  - .1 KLOCKNER-MOELLER (Eaton).
  - .2 Series 200 – NO CND-11-8044.
- .2 Contact:
  - .1 Kamil Kachich Industrial – MOEM Sales Representative
  - .2 514-943-7337
  - .3 KamilKachich@Eaton.com

## **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 motor control centres installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant 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 Consultant.

### **3.2 INSTALLATION**

- .1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.
- .2 Make field power and control connections as indicated.
- .3 Ensure correct overload heater elements are installed.

**3.3 FIELD QUALITY CONTROL**

- .1 Ensure moving and working parts are lubricated where required.
- .2 Operate starters in sequence to prove satisfactory performance of motor control centre during 1 hour period.

**END OF SECTION**

**Part 1            General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Product Data:
  - .1    Provide fuse performance data characteristics for each fuse type and size above 15 A. Performance data to include: average melting time-current characteristics.
- .2    Shop Drawings:
  - .1    Provide shop drawings in accordance with Section 01 11 01 - General Instructions.

**1.2            EXTRA MATERIALS**

- .1    Three spare fuses of each type and size installed above 600 A.
- .2    Six spare fuses of each type and size installed up to and including 600 A.

**Part 2           Products**

**2.1            FUSES - GENERAL**

- .1    Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2    Fuses: product of one manufacturer.

**2.2            FUSE TYPES**

- .1    Class L fuses.
  - .1    Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2    Type L2, fast acting.
- .2    Class J fuses.
  - .1    Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2    Type J2, fast acting.
- .3    Class R -R fuses.
  - .1    Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
  - .2    Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .3    Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4    Class C fuses.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install fuses in mounting devices immediately before energizing circuit.
- .2        Ensure correct fuses fitted to physically matched mounting devices.
  - .1        Install rejection clips for Class R fuses.
- .3        Ensure correct fuses fitted to assigned electrical circuit.
- .4        Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5        Install spare fuses in fuse storage cabinet.

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCES**

- .1        CSA International
  - .1        CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

**Part 2            Products**

**2.1                BREAKERS GENERAL**

- .1        Moulded-case circuit breakers: to CSA C22.2 No. 5.
- .2        Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .3        Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .4        Common-trip breakers: with single handle for multi-pole applications.
- .5        Circuit breakers with interchangeable trips as indicated.
- .6        Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated.

**2.2                THERMAL MAGNETIC BREAKERS**

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

**2.3                MAGNETIC BREAKERS**

- .1        Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.
  - .1        Co-ordination to result in interruption by breaker of fault-level currents up to interrupting capacity of breaker.
- .2        Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.
  - .1        Breakers applied following manufacturer's guidelines and accepted best practice.

**Part 3            Execution**

**3.1                EXAMINATION**

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

**3.2                INSTALLATION**

- .1      Install circuit breakers as indicated.

**END OF SECTION**

**V/PROJECT : TPSGC 12-186-103-1**

**N/PROJECT : 16-023**

**N/CLIENT : R.078721.001**

**01 April 2016**

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**TECHNICAL SPECIFICATIONS – TOME 3 ARCHITECTURE**

**FOR TENDER**





**Division 02 – Existing conditions**

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**Division 06 – Wood, plastics, and composites**

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**Division 07 – Thermal and moisture protection**

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**Division 09 - Finishes**

09 21 99	Partitions for minor works	04 pages
09 91 99	Painting for minor works	05 pages

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 CSA International
  - .1 CSA S350, Code of Practice for Safety in Demolition of Structures.
- .2 U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit documents and samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit demolition drawings:
  - .1 Submit for review and approval by the consultant shoring and underpinning drawings stamped and signed by professional engineer registered or licensed in the province of Quebec in Canada, showing proposed method.

**1.3 SITE CONDITIONS**

- .1 Review "Designated Substance Report" and take precautions to protect environment.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance [listed as hazardous] be encountered, stop work, take preventative measures, and notify consultant immediately.
  - .1 Proceed only after receipt of written instructions has been received from consultant.
- .3 Notify consultant before disrupting building access or services.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Inspect site with the consultant and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.

### 3.2 PREPARATION

- .1 Protection of In-Place Conditions:
  - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, landscaping features and parts of building to remain in place. Provide bracing and shoring required.
  - .2 Keep noise, dust, and inconvenience to occupants to minimum.
  - .3 Protect building systems, services and equipment.
  - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
  - .5 Do work in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Demolition/Removal:
  - .1 Remove items as indicated. Removal of Pavements, Curbs and Gutters:
    - .1 Protect adjacent joints and load transfer devices.
  - .2 Remove parts of existing building to permit new construction.
  - .3 Trim edges of partially demolished building elements to tolerances as defined by consultant to suit future use.

### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Refer to demolition drawings and specifications for items to be salvaged for reuse.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 13 52 Modified bituminous sheet waterproofing.
- .2 Section 07 52 00 Modified bituminous membrane roofing

**1.2 REFERENCES**

- .1 CSA International
  - .1 CSA B111, Wire Nails, Spikes and Staples.
  - .2 CSA O121, Douglas Fir Plywood.
  - .3 CAN/CSA-O141, Softwood Lumber.
  - .4 CSA O151, Canadian Softwood Plywood.
  - .5 CAN/CSA-O325.0, Construction Sheathing.
- .2 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.
  - .2 FSC-STD-20-002, Structure and Content of Forest Stewardship Standards V2-1.
  - .3 FSC Accredited Certified Bodies.
- .3 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber [2000].
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-[A2007], Architectural Coatings.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for rough carpentry work and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 MAINTENANCE MATERIALS SUBMITTALS**

- .1 Extra Stock Materials:
  - .1 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use [19] mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate

**1.5 QUALITY ASSURANCE**

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.  
Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wood from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Lumber: unless specified otherwise, softwood, S4S (dressed on four sides), moisture content 19% or less in accordance with following standards:
  - .1 CAN/CSA-O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
  - .3 FSC certified.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
  - .1 Board sizes: "Standard" or better grade. Dimension sizes: "Standard" light framing, "standard" or better grade.
  - .2 Post and timbers sizes (squares): "Standard" or better grade.
- .3 Panel Materials:
  - .1 Douglas fir plywood (DFP): to CSA O121, standard construction.
    - .1 Urea-formaldehyde free.
  - .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.
    - .1 Urea-formaldehyde free.
  - .3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.
    - .1 Urea-formaldehyde free.
- .4 Wood Preservative:
  - .1 Surface-applied wood preservative: [clear] [coloured], [copper naphthenate] or 5% pentachlorophenol solution, water repellent preservative.
  - .2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used,

- pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.
- .3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.
- .5 Fasteners: to CAN/CSA-G164, for exterior work, fire-retardant treated lumber.
- .6 Nails, spikes and staples: to CSA B111.
- .7 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .8 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, [explosive actuated fastening devices], recommended for purpose by manufacturer.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rough carpentry installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of consultant.
  - .2 Inform consultant 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 consultant.

### **3.2 PREPARATION**

- .1 Treat surfaces of material with wood preservative, before installation. Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.
- .2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

### **3.3 INSTALLATION**

- .1 Comply with requirements of NBC, supplemented by the following paragraphs.
- .2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.
- .7 Install sleepers as indicated.

- .8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.
- .9 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .10 Countersink bolts where necessary to provide clearance for other work.

### 3.4 **CLEANING**

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

END OF SECTION

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 21 13 Board insulation
- .2 Section 09 21 99 Partitions for minor works

**1.2 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  - .2 ASTM D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
  - .3 ASTM D6162, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
  - .4 ASTM D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
  - .5 ASTM D6164, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
  - .2 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .3 Canadian Standards Association (CSA) / CSA International
  - .1 CSA-A123.3, Asphalt Saturated Organic Roofing Felt.
- .4 Underwriters Laboratories' of Canada (ULC)
  - .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .2 CAN/ULC-S702.2, Standard for Mineral Fibre Thermal Insulation for Buildings.
  - .3 CAN/ULC-S706, Standard for Wood Fibre Thermal Insulation for Buildings.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .2 Product Data:
  - .1 Provide two (2) copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements, and indicate VOC content for:
    - .1 Primers.
    - .2 Asphalt.
    - .3 Sealers.
    - .4 Filter fabric.
- .3 Provide shop drawings and indicate:
  - .1 Flashing details.
- .4 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

#### 1.4 FIRE PROTECTION

- .1 Fire Extinguishers:
  - .1 Maintain one cartridge operated type or stored pressure rechargeable type with shut-off nozzle,
  - .2 ULC labelled for A, B and C class protection.
- .2 Maintain fire watch for one (1) hour after each day's waterproofing operations cease.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Provide and maintain dry, off-ground weatherproof storage.
- .2 Store rolls of felt and membrane in upright position.
  - .1 Store membrane rolls with salvage edge up.
- .3 Remove only in quantities required for same day use.
- .4 Place plywood runways over completed Work to enable movement of material and other traffic.
- .5 Store sealants at +5 degrees °C minimum.
- .6 Store insulation protected from daylight, weather and deleterious materials.
- .7 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.
- .8 Store and manage hazardous materials in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.6 FIELD CONDITIONS**

- .1 Ambient Conditions
  - .1 Do not install waterproofing when temperature remains below -18 degrees C for torch application, or when temperature is lower than manufacturers' recommendations for mop application.
  - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .2 Install waterproofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into waterproofing system.

**Part 2 Products**

**2.1 PERFORMANCE CRITERIA**

- .1 Compatibility between components of waterproofing system is essential. Provide written declaration to consultant stating that materials and components, as assembled in system, meet this requirement.

**2.2 VAPOUR RETARDER**

- .1 Base sheet vapour retarder: to CGSB 37-GP-56M, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, glass reinforcement.
- .2 Self adhesive air/vapour barrier with glass reinforcement and elastomeric bitumen (SBS), with the following properties:
  - .1 Thickness: 1,0 mm;
  - .2 Minimal application temperature: 5° C;
  - .3 Product reference: Bakor Inc. "Blueskin SA", equivalent accepted.
- .3 Self adhesive connecting membrane and intramural flashing, glass reinforcement and elastomeric bitumen (SBS), with the following properties:
  - .1 Thickness: 1,0 mm;
  - .2 Minimal application temperature: -4 ° C;
  - .3 Product reference: Bakor Inc. "Blueskin TWF", equivalent accepted.

## **2.3 ADHESIVE**

- .1 Self adhesive connecting membrane primer on masonry, concrete, wood, gypsum panels and metallic surfaces, with synthetic rubber, having the following properties:
  - .1 Solid content:  $\pm 35\%$ ;
  - .2 Application temperature: -5 to 40o C;
  - .3 Product reference: Bakor Inc. "Blueskin Primer", equivalent accepted.

## **Part 3 Execution**

### **3.1 EXAMINATION OF ROOF DECKS**

- .1 Verification of Conditions:
  - .1 Inspect with consultant deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
- .2 Evaluation and Assessment: prior to beginning of work ensure:
  - .1 Decks are firm, straight, smooth, dry, and free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
  - .2 Curbs have been built.
  - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
  - .4 Plywood and lumber nailed plates have been installed to deck, walls and parapets as indicated.
- .3 Do not install waterproofing materials during rain or snowfall.

### **3.2 PROTECTION OF IN-PLACE CONDITIONS**

- .1 Cover walls, walks, and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Protect roof from traffic and damage. Comply with precautions deemed necessary by consultant.
- .5 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .6 Metal connectors and decking will be treated with rust proofing or galvanization.



**3.3 PRIMING DECK**

- .1 Apply deck primer to deck, waterproofing substrate at the rate recommended by consultant.

**3.4 CLEANING**

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

**END OF SECTION**



**Part 1            General**

**1.1        RELATED SECTIONS**

- .1        Section 09 21 99            Partitions for minor works

**1.2        REFERENCES**

- .1        American Society for Testing and Materials International (ASTM)
  - .1        ASTM C208, Specification for Cellulosic Fiber Insulating Board.
  - .2        ASTM C591, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - .3        ASTM C612, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  - .4        ASTM C726, Standard Specification for Mineral Fiber Roof Insulation Board.
  - .5        ASTM C728, Standard Specification for Perlite Thermal Insulation Board.
  - .6        ASTM C1126, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
  - .7        ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .8        ASTM E96/E96M, Standard Test Methods for Water Vapour Transmission of Materials.
- .2        Canadian Gas Association (CGA)
  - .1        CAN/CGA-B149.1, Natural Gas and Propane Installation Code Handbook.
  - .2        CAN/CGA-B149.2, Propane Storage and Handling Code.
- .3        Canadian General Standards Board (CGSB)
  - .1        CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .4        Underwriters Laboratories of Canada (ULC)
  - .1        CAN/ULC-S604, Standard for Type A Chimneys.
  - .2        CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
  - .3        CAN/ULC-S702, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .5        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).

### **1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit two (2) copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's insulation products and adhesives.
- .2 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

### **1.4 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **Part 2 Products**

### **2.1 INSULATION**

- .1 Extruded polystyrene (XPS): to CAN/ULC-S701.
  - .1 Type: 2.
  - .2 Thickness: as indicated;
  - .3 Edges: Butt Edge and Shiplap.

### **2.2 ADHESIVE**

Adhesive (for polystyrene): to CGSB 71-GP-24.

## **2.3 ACCESSORIES**

- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

## **Part 3 Execution**

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

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 WORKMANSHIP**

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .5 Offset both vertical and horizontal joints in multiple layer applications.
- .6 Do not enclose insulation until it has been inspected and approved by consultant.

### **3.3 EXAMINATION**

- .1 Examine substrates and immediately inform consultant in writing of defects.
- .2 Prior to commencement of work ensure:
  - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

### **3.4 RIGID INSULATION INSTALLATION**

- .1 Apply adhesive to insulation board in accordance with manufacturer's recommendations.
- .2 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.
- .3 In addition to adhesive, install mineral fibre insulation boards with insulation clips and disk, two (2) per 600 x 1200 mm board minimum, fit boards tight, cut off fastener spindle 3 mm beyond disk.

- .4 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide and 0.15 mm thickness modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

### **3.5 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 07 21 13 Board insulation
- .2 Section 09 21 99 Partitions for minor works

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.33, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
  - .2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

**1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedure.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include:
    - .1 Product characteristics.
    - .2 Performance criteria.
    - .3 Limitations.
- .3 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .4 Quality assurance submittals:
  - .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 and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Mock-Ups:
  - .1 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.
  - .2 Mock-up will be used to judge workmanship, substrate preparation, and material application.
  - .3 Locate where indicated.

- .4 Allow 24 hours for inspection of mock-up by consultant before proceeding with vapour barrier work.
- .3 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

## **Part 2 Products**

### **2.1 SHEET VAPOUR BARRIER**

- .1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick.

### **2.2 ACCESSORIES**

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer. To Section 07 92 00 - Joint Sealing.
- .3 Staples: minimum 6 mm leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall assemblies prior to installation to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

### **3.2 EXTERIOR SURFACE OPENINGS**

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

### **3.3 PERIMETER SEALS**

- .1 Seal perimeter of sheet vapour barrier as follows:
  - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
  - .2 Lap sheet over sealant and press into sealant bead.



- .3 Install staples through lapped sheets at sealant bead into wood substrate.
- .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.4 LAP JOINT SEALS**

- .1 Seal lap joints of sheet vapour barrier as follows:
  - .1 Attach first sheet to substrate.
  - .2 Apply continuous bead of sealant over solid backing at joint.
  - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
  - .4 Install staples through lapped sheets at sealant bead into wood substrate.
  - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.5 CLEANING**

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

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Requirements for the installation of preformed metal cladding/siding.

**1.2 RELATED SECTIONS**

- .1 Section 07 13 52 Modified bituminous sheet waterproofing
- .2 Section 07 21 13 Board insulation

**1.3 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI B18.6.4, Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM D2369, Test Method for Volatile Content of Coatings.
  - .2 ASTM D2832, Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .3 ASTM D5116, Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .3 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-51.32, Sheathing, Membrane, Breather Type.
- .4 Canadian Standards Association (CSA International).
  - .1 CSA B111, Wire Nails, Spikes and Staples.
- .5 Environmental Choice Program (ECP).
  - .1 CCD-045, Sealants and Caulking Compounds.
- .6 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC-S706, Wood Fibre Thermal Insulation for Buildings.

**1.4 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

**Part 2 Products**

**2.1 ACCESSORIES**

- .1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, colour and gloss as cladding, with fastener holes pre-punched.

**2.2 FASTENERS**

- .1 Nails: CSA B111. Screws: ANSI B18.6.4. Purpose made stainless steel.

**2.3 CAULKING**

- .1 Sealants: see section 07 92 00 - Joints sealants

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

**3.2 INSTALLATION**

- .1 Install cladding in accordance with CGSB 93.5, and in accordance of existing conditions (Reinstallation like the existent).

**3.3 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 62 00 Sheet metal flashing and trim

**1.2 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM C726, Standard Specification for Mineral Fiber Roof Insulation Board.
  - .2 ASTM C728, Standard Specification for Perlite Thermal Insulation Board.
  - .3 ASTM C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .4 ASTM C1396/C1396M, Standard Specification for Gypsum Board.
  - .5 ASTM D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  - .6 ASTM D312, Standard Specification for Asphalt Used in Roofing.
  - .7 ASTM D448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
  - .8 ASTM D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
  - .9 ASTM D6162, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
  - .10 ASTM D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
  - .11 ASTM D6164, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
  - .12 ASTM D6222, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcement.
  - .13 ASTM D6223, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcement.
  - .14 ASTM D6509, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcement.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
  - .2 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
  - .3 CAN/CGSB-51.33, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .3 Canadian Standards Association (CSA International)

- .1 CSA A123.21, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- .2 CSA-A123.3, Asphalt Saturated Organic Roofing Felt.
- .3 CSA O121, Douglas Fir Plywood.
- .4 CSA O151, Canadian Softwood Plywood.
- .4 Factory Mutual (FM Global)
  - .1 FM Approvals - Roofing Products.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 Underwriters Laboratories' of Canada (ULC)
  - .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
  - .2 CAN/ULC-S702.2, Standard for Mineral Fibre Thermal Insulation for Buildings.
  - .3 CAN/ULC-S704, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
  - .4 CAN/ULC-S706, Standard for Wood Fibre Thermal Insulation for Buildings.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide two (2) copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements, and indicate VOC content for:
    - .1 Primers.
    - .2 Asphalt.
    - .3 Sealers.
    - .4 Filter fabric.
- .3 Provide shop drawings:
  - .1 Indicate flashing details.

### 1.4 QUALITY ASSURANCE

- .1 The roof is still under guarantee; the work must be done by the subcontractor who has executed the roof repair works.
  - .1 Coordinate: Couverture Victo 2000 inc., contact Michel Pouliot: 819.758.6776

### 1.5 FIRE PROTECTION

- .1 Fire Extinguishers:

- .1 Maintain one cartridge operated type or stored pressure rechargeable type with shut-off nozzle,
- .2 ULC labelled for A, B and C class protection.
- .2 Maintain fire watch for one (1) hour after each day's roofing operations cease.

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

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
  - .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
  - .2 Provide and maintain dry, off-ground weatherproof storage.
  - .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.
  - .4 Remove only in quantities required for same day use.
  - .5 Place plywood runways over completed Work to enable movement of material and other traffic.
  - .6 Store sealants at +5 degrees °C minimum.
  - .7 Store insulation protected from daylight, weather and deleterious materials.

#### **1.7 FIELD CONDITIONS**

- .1 Ambient Conditions
  - .1 Do not install roofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.
  - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

### **Part 2 Products**

#### **2.1 PERFORMANCE CRITERIA**

- .1 Compatibility between components of roofing system is essential. Provide written declaration to consultant stating that materials and components, as assembled in system, meet this requirement.
- .2 Roofing System: to CSA A123.21 for wind uplift resistance.

#### **2.2 PRODUCTS**

- .1 All used products have to be as existing.

**Part 3 Execution**

**3.1 QUALITY OF WORK**

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual, roofing cover workers/ entrepreneur in roofing.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 The interface of the walls and roof assemblies will be fitted with durable rigid material sheet metal or plywood providing connection point for continuity of air barrier.
- .4 Assembly, component and material connections will be made in consideration of appropriate design loads, with reversible mechanical attachments.

**3.2 EXAMINATION OF ROOF DECKS**

- .1 Evaluation and Assessment:
  - .1 Prior to beginning of work ensure:
    - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
    - .2 Curbs have been built.
    - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
    - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
  - .2 Do not install roofing materials during rain or snowfall.

**3.3 PROTECTION OF IN-PLACE CONDITIONS**

- .1 Cover walls, walks, and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by consultant.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Metal connectors and decking will be treated with rust proofing or galvanization.

**3.4 PREPARATION OF STEEL DECK (CHANNEL TYPE)**

- .1 Install sound absorbing insulation in flutes of acoustical steel roof deck in accordance.



- .2 Steel decking will be treated with rust proofing or galvanization.

### 3.5 DECK SHEATHING

- .1 Mechanically fasten to steel deck Gypsum Board Sheathing to steel deck's upper rib surfaces, spaced 400mm on centre each way.
- .2 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

### 3.6 PRIMING DECK

- .1 Apply deck primer to deck substrate at the rate recommended by manufacturer.

### 3.7 VAPOUR RETARDER (CONCRETE/GYPSUM BOARD/PLYWOOD DECK)

- .1 Modified bituminous vapour retarder sheet.

### 3.8 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Insulation: fully adhered, adhesive application:
  - .1 Adhere insulation to laminated vapour barrier using solvent-based adhesive.
  - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
  - .3 Cut end pieces to suit.
  - .4 Apply adhesive in continuous ribbons at 300 mm on centre.
  - .5 Separate the membrane and insulation with a drainage layer or slipsheet.
- .2 Insulation: fully adhered, bitumen application:
  - .1 Embed insulation in 1 to 1.5 kg/m<sup>2</sup> mopping of bitumen.
  - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
  - .3 Cut end pieces to suit.
- .3 Insulation: mechanically fastened application:
  - .1 Mechanically fasten insulation using screws and pressure distribution plates.
  - .2 Fasten insulation as per manufacturer's written recommendations.
  - .3 Number and pattern of screws per board to meet Factory Mutual requirements.
  - .4 Place boards in parallel rows with ends staggered, and in firm contact with one another.
  - .5 Cut end boards to suit.
- .4 Overlay Board: adhesive application:
  - .1 Adhere overlay board to insulation with vulcanized adhesive at the rate of one litre per m<sup>2</sup>.
  - .2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.
  - .3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.

- .5 Base sheet application:
  - .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
  - .2 Unroll and embed base sheet in uniform coating of asphalt applied at rate of 1.2 kg/m<sup>2</sup>, at 230 degrees C.
  - .3 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.
  - .4 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
  - .5 Application to be free of blisters, wrinkles and fishmouths.
- .6 Cap sheet application:
  - .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
  - .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
  - .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.
  - .4 Application to be free of blisters, fishmouths and wrinkles.
  - .5 Do membrane application in accordance with manufacturer's recommendations.
- .7 Flashings:
  - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
  - .2 Torch sheet onto substrate in 1 metre wide strips.
  - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.
  - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
  - .5 Provide 75 mm minimum side lap and seal.
  - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
  - .7 Do work in accordance with manufacturer's recommendations Section 07 62 00 - Sheet Metal Flashing and Trim.

### 3.9 CLEANING

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

### END OF SECTION

**Part 1            General**

**1.1            RELATED SECTIONS**

- .1        Section 07 13 52        Modified bituminous sheet waterproofing
- .2        Section 07 46 13        Preformed metal siding

**1.2            REFERENCES**

- .1        The Aluminum Association Inc. (AAI)
  - .1        AAI-Aluminum Sheet Metal Work in Building Construction.
  - .2        AAI DAF45, Designation System for Aluminum Finishes.
- .2        American Society for Testing and Materials International (ASTM)
  - .1        ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .2        ASTM A606, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
  - .3        ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4        ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .5        ASTM B32, Standard Specification for Solder Metal.
  - .6        ASTM B370, Standard Specification for Copper Sheet and Strip for Building Construction.
  - .7        ASTM D523, Standard Test Method for Specular Gloss.
  - .8        ASTM D822, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3        Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-51.32, Sheathing, Membrane, Breather Type.
  - .2        CAN/CGSB-93.1, Sheet Aluminum Alloy, Prefinished, Residential.
- .4        Canadian Standards Association (CSA) / CSA International
  - .1        CSA A123.3, Asphalt Saturated Organic Roofing Felt.
  - .2        AAMA/WDMA/CSA 101/I.S.2/A440, Standard/Specification for Windows, Doors, and Unit Skylights.
  - .3        CSA B111, Wire Nails, Spikes and Staples.
- .5        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).
- .6        South Coast Air Quality Management District (SCAQMD), California State
  - .1        SCAQMD Rule #1113, Architectural Coatings.

.2 SCAQMD Rule #1168, Adhesives and Sealants.

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

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

## **Part 2 Products**

### **2.1 FABRICATION**

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths.
- .1 Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm.
- .1 Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

### **2.2 METAL FLASHINGS**

- .1 Form flashings, copings and fascias to profiles indicated, with stainless steel, like he existent. SPEC NOTE: Use the following article if reglets or cap flashing to be fabricated from sheet metal by roofer. Specify supply of prefabricated reglets elsewhere.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install sheet metal work as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
- .1 Secure in place and lap joints 100 mm.

- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

**3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 07 92 00 Joints sealants
- .2 Section 09 21 99 Partitions for minor works

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 ULC-S115-[1995], Fire Tests of Fire stop Systems.

**1.3 DEFINITIONS**

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
  - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

**1.4 SUBMITTALS**

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

**1.5 QUALITY ASSURANCE**

- .1 Qualifications:

- .1 Installer: company specializing in fire stopping installations with five (5) years experience.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate [brand name], [manufacturer], [ULC markings].
- .2 Storage and Protection:
  - .1 Store materials [indoors] [in dry location] and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
  - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.



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**Part 3            Execution**

**3.1                MANUFACTURER'S INSTRUCTIONS**

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

**3.2                PREPARATION**

- .1        Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
  - .1        Ensure that substrates and surfaces are clean, dry and frost free.
- .2        Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3        Maintain insulation around pipes and ducts penetrating fire separation.
- .4        Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

**3.3                INSTALLATION**

- .1        Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2        Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3        Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4        Tool or trowel exposed surfaces to neat finish.
- .5        Remove excess compound promptly as work progresses and upon completion.

**3.4                SEQUENCES OF OPERATION**

- .1        Proceed with installation only when submittals have been reviewed by consultant.
- .2        Install floor fire stopping before interior partition erections.
- .3        Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

**3.5                FIELD QUALITY CONTROL**

- .1        Inspections: notify consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

### **3.6 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

### **3.7 SCHEDULE**

- .1 Fire stop and smoke seal at:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2 Edge of floor slabs at curtain wall and precast concrete panels.
  - .3 Top of fire-resistance rated masonry and gypsum board partitions.
  - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
  - .7 Openings and sleeves installed for future use through fire separations.
  - .8 Around mechanical and electrical assemblies penetrating fire separations.
  - .9 Rigid ducts: greater than 129 cm<sup>2</sup> : fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials, preparation and application for caulking and sealants.
- .2 Text to complete other various Sections containing sealant or caulking specifications, including Section 07 52 00 - Modified Bituminous Membrane Roofing.

**1.2 RELATED SECTIONS**

- .1 Section 07 26 00 Vapour retarders
- .2 Section 07 46 13 Preformed metal siding
- .3 Section 07 84 00 Fire stopping
- .4 Section 09 21 99 Partitions for minor works

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM C919, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
  - .1 CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
  - .2 CAN/CGSB-19.13, Sealing Compound, One-component, Elastomeric, Chemical Curing.
  - .3 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
  - .4 CAN/CGSB-19.17, One-Component Acrylic Emulsion Base Sealing Compound.
  - .5 CAN/CGSB-19.24, Multi-component, Chemical Curing Sealing Compound.
- .3 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .4 General Services Administration (GSA) - Federal Specifications (FS)
  - .1 FS-SS-S-200-[E(2)1993], Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992.

#### **1.4 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's product to describe.
  - .1 Caulking compound.
  - .2 Primers.
  - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Submit duplicate samples of each type of material and colour.
- .5 Cured samples of exposed sealants for each color where required to match adjacent material.
- .6 Submit manufacturer's instructions in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Instructions to include installation instructions for each product used.

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

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

#### **1.6 PROJECT CONDITIONS**

- .1 Environmental Limitations:
  - .1 Do not proceed with installation of joint sealants under following conditions:
    - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
    - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
  - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
  - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Ventilate area of work as directed by consultant by use of approved portable supply and exhaust fans.

## **Part 2 Products**

### **2.1 SEALANT - DESCRIPTION**

- .1 Primer: as recommended by the manufacturer. The primer has to comply the SCAMD 1168 for the VOC content limits to be observed.
- .2 Polyurethane Joint Sealant high performance, very elastic, non-sag and medium-modulus in accordance to ASTM C 920 CAN/CGSB-19.13-M87 and the American Federal Specification TT-S-00230C
  - .1 Product: Tremco Dymonic 100, or approved equivalent.
  - .2 Applications:
    - .1 Joints between the exterior covers.
    - .2 Joints at exterior panels cornices.
    - .3 All the joints required by the plans but not covered by other sections.
- .3 Single-Component, Nonsag, Non-Staining, Neutral-Curing Silicone Joint Sealant, in accordance to ASTM C920, ASTM C1248, CAN/CGSB-19.13M87, and the American Federal Specification TT-S-00230C
  - .1 Product: Tremco Spectrem 2, or approved equivalent
  - .2 Application:
    - .1 Joint for metal flashings caulk in roofing.
- .4 Single-Component, Nonsag, Moisture-Cure, Polyurethane Hybrid Joint Sealant, , in accordance to ASTM C920, ASTM C1248, CAN/CGSB-19.13M87, and the American Federal Specification TT-S-00230C
  - .1 Product: Tremco Dymonic FC, or approved equivalent.
  - .2 Applications:
    - .1 Joints between the exterior covers.
    - .2 Joined aluminium works and the neighboring internal surfaces.
    - .3 Sealing between gypsum and metallic works.
    - .4 Exposed interior control joints, unless otherwise indicated.
- .5 Preformed Compressible and Non-Compressible back-up materials.
  - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
    - .1 Extruded cell foam backer rod.
    - .2 Size: oversize 30 to 50 %.

- .2 Neoprene or Butyl Rubber.
  - .1 Round solid rod, Shore A hardness 70.
- .3 High Density Foam.
  - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.
- .4 Bond Breaker Tape.
  - .1 Polyethylene bond breaker tape which will not bond to sealant.

## **2.2 JOINT CLEANER**

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .2 Primer: as recommended by manufacturer.

## **Part 3 Execution**

### **3.1 PROTECTION**

- .1 Protect installed Work of other trades from staining or contamination.

### **3.2 SURFACE PREPARATION**

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

### **3.3 PRIMING**

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

### **3.4 BACKUP MATERIAL**

- .1 Apply bond breaker tape where required to manufacturer's instructions.

- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

### **3.5 MIXING**

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

### **3.6 APPLICATION**

- .1 Sealant.
  - .1 Apply sealant in accordance with manufacturer's written instructions.
  - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - .3 Apply sealant in continuous beads.
  - .4 Apply sealant using gun with proper size nozzle.
  - .5 Use sufficient pressure to fill voids and joints solid.
  - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
  - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
  - .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing.
  - .1 Cure sealants in accordance with sealant manufacturer's instructions.
  - .2 Do not cover up sealants until proper curing has taken place.
- .3 Cleanup.
  - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
  - .2 Remove excess and droppings, using recommended cleaners as work progresses.
  - .3 Remove masking tape after initial set of sealant.

**END OF SECTION**





**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 13 52 Modified bituminous sheet waterproofing
- .2 Section 07 26 00 Vapour retarders
- .3 Section 09 91 99 Painting for minor works

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM C1396/C1396M, Standard Specification for Gypsum Wallboard.
  - .2 ASTM C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .3 ASTM C514, Standard Specification for Nails for the Application of Gypsum Board.
  - .4 ASTM C645, Standard Specification for Nonstructural Steel Framing Members.
  - .5 ASTM C754, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
  - .6 ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.
  - .7 ASTM C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.122 in. (2.84 mm) in Thickness.
  - .8 ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .9 ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .10 ASTM C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .2 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum, framing, sealants and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials [off ground] [indoors] [in dry location] and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed instructions.
  - .3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
  - .4 Store and protect [partition materials] from [nicks, scratches, and blemishes].
  - .5 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Performance / Design Criteria:
  - .1 Partition assembly to be fire resistance rated.
- .2 Non-structural Metal Framing:
  - .1 Non-load bearing channel stud framing: to ASTM C645, 92 mm stud size, roll formed from 0.53 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.
  - .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
  - .3 Metal channel stiffener: 19 x 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .3 Gypsum Board:
  - .1 Standard board: to ASTM C1396/C1396M, regular, 13 mm thick exterior type, 13 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges tapered.
  - .2 Metal furring runners, hangers, tie wires, inserts, and anchors.
  - .3 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
  - .4 Steel drill tapping screws: to ASTM C514.

### **2.2 ACCESSORIES**

- .1 Sealants: in accordance to ASTM C475.
  - .1 VOC limit [50]g/L maximum to SCAQMD Rule 1168.
- .2 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 92 mm wide, with self sticking permanent adhesive on one face, lengths as required.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions prior to partition installation.
  - .1 Visually inspect substrate/surfaces in presence of consultant.
  - .2 Inform consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

**3.2 ERECTION OF FRAMING**

- .1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.
- .2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .3 Place studs vertically at 300 mm on centre and maximum of 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .4 Erect metal studding to tolerance of 1:1000.
- .5 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .6 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .7 Extend partitions to ceiling height except where indicated.
- .8 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use double track slip joint.
- .9 Install continuous insulating strips to isolate studs from uninsulated surfaces.

**3.3 ERECTION OF GYPSUM BOARD AND ACCESSORIES**

- .1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.
- .3 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .4 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .5 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .6 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .7 Install gypsum boards in direction that will minimize number of end-butt joints. Stagger end joints 250 mm minimum.

### **3.4 APPLICATION**

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Apply single (1) layer gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.

### **3.5 INSTALLATION**

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. [Seal joints with sealant].
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install access doors to electrical and mechanical fixtures specified in respective sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .6 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .7 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .8 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .9 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Protect installed products and components from damage during construction.
- .4 Repair damage to adjacent materials caused by partition installation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 99 Partitions for minor works

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - [current edition].
  - .2 Maintenance Repainting Manual - [current edition].
- .3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1113-[A2007], Architectural Coatings.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for [paint and coating products] and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Provide and maintain dry, temperature controlled, secure storage. Store painting materials and supplies away from heat generating devices.
  - .2 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .4 Fire Safety Requirements:
  - .1 Supply 1 9 kg fire extinguisher adjacent to storage area.

- .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

## 1.5 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
  - .2 Co-ordinate use of existing ventilation system with consultant and ensure its operation during and after application of paint as required.
  - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
  - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
  - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of consultant such that painted surfaces will have dried and cured sufficiently before occupants are affected.

## Part 2 Products

### 2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
- .4 Colours:
  - .1 Submit proposed Colour Schedule to consultant.
- .5 Mixing and tinting:
  - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from [Departmental Representative] [DCC Representative] [Consultant] for tinting of painting materials.
  - .2 Use and add thinner in accordance with paint manufacturer's recommendations.

- .1 Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Gloss/sheen ratings:

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated and as noted on Finish Schedule.
- .7 Interior painting:
  - .1 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
    - .1 INT 5.1E Alkyd – gloss level 2 finish.
  - .2 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
    - .1 INT 9.2A - Latex gloss level 3 finish (over latex sealer).
    - .2 INT 9.2C - Alkyd gloss level 3 finish (over latex sealer).
    - .3 INT 9.2M - Institutional low odour/low VOC gloss level 3 finish.
- .8 Interior re-painting:
  - .1 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
    - .1 RIN 5.1E - Alkyd gloss 2.
  - .2 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock" type material, etc.
    - .1 RIN 9.2A - Latex gloss level3.
    - .2 RIN 9.2C - Alkyd gloss level3 finish.

## 2.2 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.



## 2.3 EXAMINATION

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

## 2.4 PREPARATION

- .1 Protection of in-place conditions:
  - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by [Departmental Representative] [DCC Representative] [Consultant].
  - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
  - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
  - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
  - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
  - .3 Place "WET PAINT" signs in occupied areas as painting operations progress.
  - .4 Clean and prepare surfaces in accordance with [MPI - Architectural Painting Specification Manual] [and] [MPI - Maintenance Repainting Manual] specific requirements and coating manufacturer's recommendations.
  - .5 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
  - .6 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
  - .7 Touch up of shop primers with primer as specified.

## 2.5 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by consultant.
- .2 Use method of application approved by consultant.
  - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
  - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.



- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .7 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

## **2.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Place paintdefined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

**END OF SECTION**







**RESEARCH AND DEVELOPMENT  
CENTER OF SHERBROOKE**

Major renovation of the hydraulic heating and  
cooling network - Phase 2 – Structure sections –  
PWGSC : R.078727.001

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**VOLUME 4 – SPECIFICATIONS –  
STRUCTURE**

**2012-186-103-1**

**2016-04-06**



**RESEARCH AND DEVELOPMENT CENTER OF SHERBROOKE  
2000, COLLEGE STREET  
SHERBROOKE (QUÉBEC)  
J1M 0C8  
MAJOR RENOVATION OF THE HYDRAULIC HEATING  
AND COOLING NETWORK – PHASE 2 –  
STRUCTURE SECTIONS – PWGSC: R.078727.001.**

**DIVISION 05**



**For Tender  
April 6, 2016**

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- VOLUME 2	ELECTRICITY
- VOLUME 3	ARCHITECTURE
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INDEX OF SECTIONS

DIVISION 05 – METALS

- 05 12 23 – STRUCTURAL STEEL FOR BUILDINGS
- 05 51 29 – METAL STAIRS AND LATTERS
- 05 52 16 – HANDRAILS AT ROOF AREAS



**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Sections 01.
- .2       Section 05 51 29 – Metal Stairs and Ladders.
- .3       Section 05 52 16 – Handrails at Roof Areas.

**1.2               REFERENCES**

- .1       American Society for Testing and Materials (ASTM)
  - .1       ASTM A 36/A 36M, Specification for Structural Steel.
  - .2       ASTM A 193/A 193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
  - .3       ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile.
  - .4       ASTM A 325, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .5       ASTM A 325M, Specification for High-Strength Bolts for Structural Steel Joints (Metric).
  - .6       ASTM A 490, Specification for Heat Treated, Steel Structural Bolts, 150 Ksi (1035 MPa) Tensile Strength.
  - .7       ASTM A 490M, Specification for High-Strength Steel Bolts, Classes 10.9 and, for Structural Steel Joints (Metric).
- .2       Canadian General Standards Board (CGSB)
  - .1       CAN/CGSB-1.40, Protective Coatings for Metals.
  - .2       CGSB 85-GP-14M, Painting Steel Surfaces Exposed to Normally Dry Weather.
  - .3       CAN/CGSB-85.100-93, Painting
- .3       Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).
  - .1       CISC/CPMA Standard 1, A Quick-drying One-coat Paint for Use on Structural Steel.
  - .2       CISC/CPMA Standard 2, A Quick-drying Primer for Use on Structural Steel
- .4       Canadian Standards Association (CSA)
  - .1       CAN/CSA-G40.20-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2       CAN/CSA-G40.21-M92, Structural Quality Steels.
  - .3       CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .4       CAN/CSA-S16-M94, Limit States Design of Steel Structures.

- .5 CAN/CSA-S136-M94, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .6 CSA W47.1-92, Certification of Companies for Fusion Welding of Steel.
- .7 CSA W48 Serie, Filler Metals and Allied Materials for Metal Arc Welding.
- .8 CSA W55.3-1965, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .9 CSA W59-M1989 (R2001), Welded Steel Construction (Metal Arc Welding) (metric units).

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

- .1 Provide submittals, including fabrication and erection documents, as well as the list of materials.
- .2 The erection drawings must indicate details and information necessary for assembly and erection purposes, including a description of methods, the sequence of erection, the type of equipment used in erection, and temporary bracings.
- .3 Verify that details concerning assemblies and components calculated by the fabricator, as well as related drawings, are stamped and signed by a qualified professional engineer licensed in the Province of Quebec, Canada.

### **1.4 DESIGN REQUIREMENTS**

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16.1 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections :
  - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
  - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in the province of Quebec, Canada for non standard connections.

### **1.5 SOURCE QUALITY CONTROL SUBMITTALS**

- .1 Submit mill test reports at least four weeks prior to fabrication of structural steel, showing chemical and physical properties and other details of steel to be incorporated in project. Those reports must be certified by metallurgists qualified to practice in the province of Quebec, Canada.
- .2 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

**Part 2            Products**

**2.1                MATERIALS**

- .1       Structural steel: to CAN/CSA-G40.21, Grade 350W for profiles and 300W for plates.
- .2       Bolts, nuts and washers: to ASTM A 325 and ASTM A 325M.
- .3       Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .4       Shop paint primer: to CAN/CGSB-1.40.
- .5       Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m<sup>2</sup>.

**2.2                FABRICATION**

- .1       Fabricate structural steel in accordance with CAN/CSA-S16.1 and in accordance with approved reviewed shop drawings.
- .2       Continuously seal members by continuous welds and a plastic filler, where indicated. Grind smooth.

**2.3                SHOP PAINTING**

- .1       Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16.1.
- .2       Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to SSPC-SP1 Solvent cleaning.
- .3       Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of .065 to .08 mils, except:
  - .1       Surfaces to be encased in concrete.
  - .2       Surfaces to receive field installed stud shear connections.
  - .3       Surfaces and edges to be field welded.
  - .4       Faying surfaces of slip-critical connections.
  - .5       Below grade surfaces in contact with soil.
- .4       Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5       Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6       Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
- .7       Toutes les structures d'acier extérieur doivent être galvanisées par immersion à chaud.

**Part 3            Execution**

**3.1                GENERAL**

- .1        Structural steel work must conform with CAN/CSA-S16.1.
- .2        Welding work must conform with CSA W59.
- .3        Companies are to be certified under Division 1 of this submittal or article 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

**3.2                CONNECTION TO EXISTING WORK**

- .1        Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

**3.3                MARKING**

- .1        Mark materials in accordance with CSA G40.20. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2        Match marking: shop mark bearing assemblies and splices for fit and match.

**3.4                ERECTION**

- .1        Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings.
- .2        Field cutting or altering structural members: to approval of Departmental Representative.
- .3        Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4        Continuously seal members by continuous welds where indicated. Grind smooth.

**3.5                FIELD QUALITY CONTROL**

- .1        Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by the Departmental Representative.
- .2        The Departmental Representative will pay costs of tests.

**3.6                FIELD PAINTING**

- .1        Touch up damaged surfaces and surfaces without shop coat with primer to CAN/CGSB-1.40 except as specified otherwise. Paint in accordance to CGSB 85-GP-14.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Sections 01

**1.2 REFERENCES**

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
  - .1 ANSI/NAAMM MBG 531-00, Metal Bar Grating Manual.
- .2 ASTM International
  - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric).
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
  - .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 CSA International
  - .1 CSA G40.20/G40.21-F04 (C2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA G164-FM92 (C2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA W59-F03 (C2008), Welded Steel Construction (Metal Arc Welding).
- .5 Health Canada - Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 National Association of Architectural Metal Manufactures (NAAMM)
  - .1 AMP 510-92, Metal Stair Manual.
- .7 The Society for Protective Coatings (SSPC)
  - .1 Systems and Specifications Manual, Volume 2, 2008 Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for ladders and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
- .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.

#### **1.4 QUALITY ASSURANCE**

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect ladders from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
- .2 Design metal stair, balustrade and landing construction and connections to NBC vertical and horizontal live load requirements.
- .3 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

#### **2.2 MATERIALS**

- .1 Steel sections: to CSA G40.20/G40.21 Grade 300 W.
- .2 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.
- .3 Steel tubing: to CSA G40.20/G40.21, Grade 300W, round, sizes and dimensions as indicated.
- .4 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with corrugated nosings.
- .5 Welding materials: to CSA W59.
- .6 Bolts: to ASTM A307.
- .7 High strength bolts: to ASTM A325M.



## **2.3 FABRICATION**

- .1 Fabricate in accordance with NAAMM, Metal Stair Manual.
- .2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .3 Accurately form connections with exposed faces flush:
  - .1 Make mitres and joints tight.
  - .2 Make risers of equal height.
- .4 Grind or file exposed welds and steel sections smooth.
- .5 Shop fabricate stairs in sections as large and complete as practicable.

## **2.4 PIPE/TUBING BALUSTRADES**

- .1 Construct balusters and handrails from steel tubing.
- .2 Cap and weld exposed ends of balusters and handrails.
- .3 Terminate at abutting wall with end flange.

## **2.5 FINISHES**

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m<sup>2</sup> to CAN/CSA-G164.
- .2 Shop coat primer: to CAN/CGSB-1.40.
- .3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

## **2.6 SHOP PAINTING**

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one coat of shop primer except interior surfaces of pans.
- .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7 degrees C.
- .5 Do not paint surfaces to be field welded.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs and ladders installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION OF STAIRS**

- .1 Install in accordance with NAAMM, Metal Stair Manual.
- .2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Do welding work in accordance with CSA W59 unless specified otherwise.
- .5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

### **3.3 CLEANING**

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

### **3.4 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1       Sections 01.

**1.2               REFERENCES**

- .1       ASTM International
  - .1       ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2       ASTM E935-00(2006), Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
- .2       CSA International
  - .1       CSA W59-03 (C2008), Welded Steel Construction, (Metal Arc Welding).

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Product Data:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for handrails and include product characteristics, performance criteria, physical size, finish and limitations.
- .2       Shop Drawings:
  - .1       Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Quebec, Canada.
    - .1       Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

**1.4               QUALITY ASSURANCE**

- .1       Perform welding to CSA W59.

**1.5               DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1                MANUFACTURERS**

- .1            Not used.

**2.2                DESIGN CRITERIA**

- .1            Installed hand rail assembly and attachments to resist lateral force of 333 N at any point without damage or permanent set. Test in accordance with ASTM A935.

**2.3                STEEL RAILING**

- .1            Rails and Posts: 51 mm diameter steel tubing; welded joints.
- .2            Fittings: elbows, T-shapes, wall brackets, escutcheons; machined steel.
- .3            Mounting: adjustable brackets and flanges. Prepare backing plate for mounting in steel structure.
- .4            Exposed Fasteners: flush countersunk screws or bolts; consistent with design of railing.
- .5            Splice Connectors: steel welding collars.
- .6            Galvanizing: to ASTM A123, provide minimum 600 g/sq m galvanized coating.
  - .1            Touch-Up Primer for Galvanized Surfaces: SPCC 20 Type I Inorganic, zinc rich.

**2.4                FABRICATION**

- .1            Fit and shop assemble components in largest practical sizes for delivery to site.
- .2            Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- .3            Provide anchors, plates and angles required for connecting railings to structure.
- .4            Exposed Mechanical Fastenings: flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
  - .1            Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
  - .2            Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  - .3            Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
  - .4            Accurately assemble components to each other and to building structure.
  - .5            Accommodate for expansion and contraction of members and building movement without damage to connections or members.

**Part 3            Execution**

**3.1                EXAMINATION**

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

**3.2                INSTALLATION**

- .1      Install components plumb and level.
- .2      Anchor railings to structure with anchors, plates, and angles.
- .3      Field weld anchors as indicated:
  - .1      Grind welds smooth.
  - .2      Touch-up welds with primer.
- .4      Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- .5      Assemble with spigots and sleeves to accommodate tight inconspicuous joints and secure installation.

**3.3                ERECTION TOLERANCES**

- .1      Maximum Variation From Plumb: 6 mm.
- .2      Maximum Out-of-Position: 6 mm.

**3.4                CLEANING**

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

**3.5                PROTECTION**

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

**END OF SECTION**

**RESEARCH AND DEVELOPMENT  
CENTER OF SHERBROOKE**

Major renovation of the hydraulic heating and  
cooling network - Phase 2 – Civil sections –  
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**VOLUME 5 – SPECIFICATIONS – CIVIL**

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**RESEARCH AND DEVELOPMENT CENTER OF SHERBROOKE  
2000, COLLEGE STREET  
SHERBROOKE (QUÉBEC)  
J1M 0C8  
MAJOR RENOVATION OF THE HYDRAULIC HEATING  
AND COOLING NETWORK – PHASE 2 –  
CIVIL SECTIONS – PWGSC: R.078727.001.**

**DIVISIONS 02, 03, 31 & 32**



**For Tender  
April 6, 2016**



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**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 02 50 13 – Management of Toxic Waste.
- .2        Section 31 00 00 – Earthwork.

**1.2                REFERENCES**

- .1        Section 11.4.7.2 du Cahier des charges et devis généraux CCDG (édition en vigueur) du Ministère des Transports du Québec.
- .2        Provincial regulations
  - .1        Loi sur la qualité de l'environnement (L.R.Q., c. Q-2) et règlements correspondants
- .3        Federal regulations
  - .1        Canadian Environmental Protection Act (CEPA), 1999.
  - .2        Transportation of Dangerous Goods Act (TDGA), ch. 34.

**1.3                DELIVERY, STORAGE AND HANDLING**

- .1        Protect in accordance with Section 31 00 00.01 – Earthwork.
- .2        Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Departmental Representative and at no cost.
- .3        Ensure that selective demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.
- .4        Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout the project.
- .5        Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
- .6        Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities.
- .7        Protect trees, plants, and foliage on site and adjacent properties where indicated.

**1.4                EXISTING CONDITIONS**

- .1        Remove contaminated or hazardous materials as defined by authorities having jurisdiction from site, prior to start of demolition Work, and dispose of at designated disposal facilities in safe manner in accordance with TDGA and other applicable regulatory requirements.

## **1.5 REGULATION**

- .1 Perform work in accordance with Provincial regulations.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Prior to beginning of Work on site submit detailed Waste Reduction Workplan and indicate the descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled, the schedule of selective demolition, the number and location of dumpsters, the anticipated frequency of tipping, as well as the name and address of waste receiving organizations.
- .2 Submit certified receipts from authorized disposal sites and reuse and recycling facilities for material removed from site. Written authorization from Departmental Representative is required to deviate from receiving organizations listed in Waste Reduction Workplan.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Inspect site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.

### **3.2 INSTALLATION/APPLICATION**

- .1 Removal Operations
  - .1 Remove items as indicated.
  - .2 Do not disturb items designated to remain in place.
  - .3 Removal of pavements, curbs and gutters:
    - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Departmental Representative.
    - .2 Protect adjacent joints and load transfer devices.
    - .3 Protect underlying and adjacent granular materials.
  - .4 Excavate at least 300 mm below pipe invert, when removing pipes under existing or future pavement area.
  - .5 Remove designated trees during demolition. Obtain written approval of Departmental Representative prior to removal of trees not designated.

- .6 Trees designated for removal must be disposed according to an ecological method. Grind, chip, or shred other vegetation for mulching and composting, or use as process fuel.
- .7 Stockpile topsoil for final grading and landscaping. Provide erosion control and seeding if not immediately used.
- .2 Removal From Site
  - .1 Remove stockpiled material as directed by Departmental Representative when it interferes with operations of project.
  - .2 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.
  - .3 Transport material designated for alternate disposal using approved receiving organizations listed in Waste Reduction Workplan and in accordance with applicable regulations. Written authorization from Departmental Representative is required to deviate from Waste Reduction Workplan.
- .3 Caping
  - .1 Cap and seal pipes, man holes and sumps according to plans.
- .4 Disposal of Material
  - .1 Dispose of materials not designated for salvage or reuse on site at authorized facilities approved in Waste Reduction Workplan.
  - .2 If on site disposal is authorized, restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work as directed by Departmental Representative.
- .5 Backfill:
  - .1 Backfill in areas as indicated and in accordance with Section 31 00 00.01 – Earthwork.

### **3.3 RESTORATION**

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

### **3.4 CLEANING**

- .1 Remove debris, trim surfaces and leave work site clean, upon completion of Work.
- .2 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 02 41 13 – Selective Site Demolition
- .2        Section 02 50 13 – Management of Toxic Waste
- .3        Section 31 00 00.01 – Earthwork

**1.2                REFERENCES**

- .1        Canadian Council of Ministers of the Environment (CCME)
  - .1        PN 1327, Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products (current edition).
  - .2        PN 1300, Canadian Environmental Quality Guidelines (current edition).
    - .1        Chapter 7, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health.
- .2        Canadian Federal Legislation
  - .1        Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .2        Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .3        Canada Labour Code (R.S. 1985, c. L-2).
    - .1        Part II (September 2000) - Occupational Health and Safety.
  - .4        Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .3        Underwriters' Laboratories of Canada (ULC)
  - .1        ULC-S603, Standard for Steel Underground Tanks for Flammable and Combustible Liquids.
  - .2        ULC-S615, Standard for Reinforced Plastic Underground Tanks for Flammable and Combustible Liquids.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide Departmental Representative with copy of vapour removal test results.
- .2        Forward affidavit of destruction of underground storage tanks to authority having jurisdiction.

**1.4                QUALITY ASSURANCE**

- .1        Contractor must be licensed by Province authorities having jurisdiction for removal of underground storage tanks.
  - .1        License title and number must accompany tender document.
  - .2        Regulatory Requirements: ensure Work is performed in compliance with CEPA and applicable Provincial regulations.



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

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Section 02 41 13 – Selective Site Demolition.
  - .2 Divert metal materials from landfill to metal recycling facility approved by the Departmental Representative.
  - .3 Segregate and deliver non-salvageable or non-recyclable materials, including waste liquids and sludges to Provincially licensed waste facility.

## **Part 2 Products**

### **2.1 NOT USED**

## **Part 3 Execution**

### **3.1 PREPARATION SAFETY AND SECURITY**

- .1 Conform to or exceed Federal, Provincial and Territorial codes, local municipal by-laws, by-laws, and codes and regulations of utility authorities having jurisdiction.
- .2 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Protection:
  - .1 Meet safety requirements of Occupational Safety and Health, Canada Labour Code Part II and Regulations for Construction Projects.
  - .2 Disconnect or remove source of ignition from vicinity of tank.
  - .3 Provide temporary protection for safe movement of personnel and vehicle traffic.
  - .4 Cut, braze or weld metal only in monitored areas established to be free of ignitable vapour concentrations.
  - .5 Ground and bond metal equipment, including tanks and transfer pipes, before operating equipment or transferring flammable materials.
  - .6 Use non-sparking tools and intrinsically safe electrical equipment.
  - .7 Smoking is not permitted.

### **3.2 DRAINING**

- .1 Drain and flush piping into tank.
- .2 Pump out liquid from tank
  - .1 Use explosion proof, air driven or hand pump.
- .3 Remove sludge from tank bottom.
  - .1 Dispose of product and sludge in accordance with local, Provincial and Territorial regulations using waste disposal carrier licensed by Provincial/Territorial Environmental Agency having jurisdiction.

### **3.3 EXCAVATION TRENCHING AND BACKFILL**

- .1 Do work in accordance with Section 31 23 10 - Excavation, Trenching and Backfilling.
- .2 Provide protective material around excavation.
- .3 Provide constant supervision during excavation and backfilling.
- .4 Excavation:
  - .1 Excavate until top of tank and connections and openings are exposed.
  - .2 Disconnect piping:
    - .1 Remove fill tube.
    - .2 Disconnect fill gauge, product and vent lines.
    - .3 Cap or plug open ends of lines that are not to be used further.
    - .4 Remove piping from ground.
  - .3 Temporarily plug tank openings.
  - .4 Continue excavation until tank is completely exposed.
  - .5 Temporarily stockpile on site soil in vicinity of tank, until waste classification can be established prior to final disposal.
- .5 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping adjacent grades. Provide bracing and shoring as required.

### **3.4 TANK REMOVAL**

- .1 Remove tank in accordance with CCME Code of Practice PN 1327 and/or applicable provincial standards and regulations, and place in secure location.
- .2 Block tank to prevent movement.
- .3 Contact Departmental Representative immediately if there is evidence of contamination in tank excavation, stop work until further notice.
- .4 Remove and replace contaminated soil and accumulated flammable or combustible liquid with clean fill common to local area in accordance with Section 31 00 00.01 – Earthwork.

### **3.5 VAPOUR REMOVAL**

- .1 Purging:
  - .1 Purge vapours to less than 10% of lower explosive limit (LEL).
  - .2 Verify with combustible gas metre.
- .2 Inverting:
  - .1 Displace oxygen to levels below necessary to sustain combustion.
  - .2 Verify with combustible gas metre.
- .3 Water Method:
  - .1 Fill tank with water to expel vapours.
  - .2 Remove and dispose of contaminated water in accordance with regulations after tank is removed from site.
  - .3 Verify with combustible gas metre.

- .4 Dry Ice Method:
  - .1 Add 1.85 gm of solid carbon dioxide (dry ice) for each 100 litre capacity.
  - .2 Crush and distribute ice evenly over greatest area to secure rapid evaporation.  
Avoid skin contact.
  - .3 Verify dry ice has vapourized.
- .5 Air Method:
  - .1 Ventilate tank with air using small gas exhaustor of appropriate type.
  - .2 Air to enter opening at one end and to exit opening at other end to quickly remove vapour.
  - .3 Test interior of tank to determine when tank is free of vapour.

### **3.6 CAPPING**

- .1 Cap holes after tank has been freed of vapours and before tank is moved from site.
  - .1 Leave vents open.
- .2 Plug corrosion leak holes using screwed plugs.
- .3 Leave 50 mm vent hole in one plug to prevent tank from being subjected to excessive pressure differential caused by extreme temperature change.

### **3.7 SECURING AND REMOVAL FROM SITE**

- .1 Check vapour levels prior to transport:
  - .1 Remove vapour if required.
- .2 Dispose of tank in accordance with local, Provincial, Federal or Territorial regulations.
- .3 Truck removal:
  - .1 Secure tank on truck for transport to disposal site.
  - .2 Cut suitable openings in tank sides to render tank unusable.
  - .3 Ensure 50 mm vent hole located at uppermost point on tank.

### **3.8 SITE REMEDIATION**

- .1 To CCME PN 1300.
- .2 Repair finish grade to match surrounding area, including but not limited to sods as specified in Section 32 92 23 - Sodding.
- .3 Prepare tank closure report containing results of soil sampling analysis to determine level and extent of hydrocarbon contamination.

### **3.9 WORKMANSHIP AND DISPOSAL**

- .1 Tanks destined for disposal:
  - .1 Dismantle, cut sufficient openings or otherwise render unusable.

**END OF SECTION**

## **Part 1            General**

### **1.1                REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C109/C109M-95, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).
  - .2 ASTM C260-94, Specification for Air-Entraining Admixtures for Concrete.
  - .3 ASTM C309-94, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .4 ASTM C494-92, Specification for Chemical Admixtures for Concrete.
  - .5 ASTM D1751-83 (1991), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .6 D1752-84 (1992), Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian Standard Association (CSA)
  - .1 CAN/CSA-A5-93, Portland Cement.
  - .2 CAN/CSA-A23.1-14, Concrete materials and methods of concrete construction.
  - .3 CAN/CSA-A23.2-14, Tests methods and standard practice for concrete
  - .4 CAN/CSA-A3000-13, Cementitious materials compendium
  - .5 CAN/CSA-A363-M88 (R1996), Laitier hydraulique cimentaire.

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

- .1 At least 2 weeks prior to beginning Work, inform Departmental Representative of the aggregates source and allow access for sampling materials.
- .2 At least 2 weeks prior to beginning Work, provide Departmental Representative with samples of materials proposed for use as follows, if required:
  - .1 10 kg of each type of Portland cement.
  - .2 3 kg of each admixture.
  - .3 10 kg of each type of blended hydraulic cement.
  - .4 5 L of each additive.
  - .5 5 L of curing compound.
  - .6 1 m length of each type of joint filler.

### **1.3                QUALITY ASSURANCE**

- .1 Provide the Departmental Representative, minimum 2 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete. Provide test

data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

- .1 Portland Cement.
  - .2 Blended hydraulic cement.
  - .3 Admixture.
  - .4 Grout.
  - .5 Additives.
  - .6 Aggregates
  - .7 Water.
  - .8 Seal.
  - .9 Seal Joint.
  - .10 Joints
- 
- .2 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete mixture meets performance requirements of concrete as established by CAN/CSA-A23.1 Standard.
  - .3 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established by CAN/CSA-A23.1 Standard.

#### **1.4 QUALITY CONTROL**

- .1 Provide the Departmental Representative, minimum 2 weeks prior to starting concrete work, with valid and recognized quality control for the following:
  - .1 Curing
  - .2 Finish
  - .3 Joints

#### **1.5 CLEANING**

- .1 Use the most effective cleaning method .
- .2 Design a cleaning site limiting water consumption and run off.
- .3 Execute concrete works according to weather.
- .4 Empty containers to be disposed should be sealed and kept away from children
- .5 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard. Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial and National regulations.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Supplementary cementing materials with maximum of 40% fly ash replacement, by mass of total cementitious materials to CSA A3001.
- .2 Supplementary cementitious materials : to CAN/CSA-A23.5.
- .3 Hydraulic cement slag : to CAN/CSA-A363.
- .4 Water: to CAN/CSA A23.1.
- .5 Aggregates: to CAN/CSA A23.1.
- .6 Air entraining admixture: to ASTM C260.
- .7 Chemical admixtures: to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .8 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board: to ASTM D1751.

**2.2 MIXES**

- .1 Alternative 1 - Performance : to CSA A23.1/A23.2.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Obtain Departmental Representative written approval before placing concrete. Provide 24 hours minimum notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative approval of proposed method for protection of concrete during placing and curing.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.

**3.2 INSTALLATION/APPLICATION**

- .1 Do cast-in-place concrete work to CAN/CSA A23.1.
- .2 Sleeves and inserts:

- .1 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
- .2 Confirm locations and sizes of sleeves and openings shown on drawings.
- .3 Finishing:
  - .1 Finish concrete to CAN/CSA A23.1.
  - .2 Use procedures as noted in CAN/CSA A23.1 to remove excess bleed water. Ensure surface is not damaged.

### **3.3 SURFACE TOLERANCE**

- .1 Concrete tolerance to CAN/CSA A23.1, Straightedge Method.

### **3.4 FIELD QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by the Departmental Representative for review to CAN/CSA A23.1.
- .2 The Departmental Representative will pay for costs of tests, except in the case of defects.
- .3 The Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .4 Non-Destructive Methods for Testing Concrete: to CAN/CSA-A23.2.
- .5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 02 41 13 – Selective Site Demolition
- .2        Section 02 50 13 – Management of Toxic Waste
- .3        Section 02 65 00 – Underground Storage Tank Removal

**1.2                REFERENCES**

- .1        BNQ 1809-300/2004 (R 2007) of Bureau de normalisation du Québec.
- .2        Section 11, CCDG (current edition) of Ministères des transports du Québec.
- .3        Tome VII, Matériaux, Normes ouvrages routiers 2012 of Ministères des transports du Québec.

**1.3                REGULATION**

- .1        Shore and brace excavations, protect slopes and banks and perform work in accordance with Provincial regulations (CSST).

**1.4                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Testing of materials and compaction of backfill and will be carried out by testing laboratory designated by the Departmental Representative.
- .2        Not later than 1 week minimum before backfilling or filling, submit to designated testing agency, 23 kg samples of each backfill or fill materials proposed for use.
- .3        Do not begin backfilling or filling operations until material has been approved for use by testing agency.
- .4        Not later than 48 hours before backfilling or filling with approved material, notify testing agency to allow compaction tests to be carried out.
- .5        Before commencing Earthwork, verify with Departmental Representative for existing conditions and validate items that could be affected by Earthworks.

**1.5                BURIED SERVICES**

- .1        Before commencing work verify and establish locations of buried services on and adjacent to site.
- .2        Arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work. Pay costs of relocating services.
- .3        Remove obsolete buried services within 2 m of foundations: cap cut-offs.

**1.6                PROTECTION**

- .1        Protect excavations from freezing.
- .2        Keep excavations clean, free of standing water, and loose soil.



- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative's approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Refer to section 6.5 des clauses techniques générales du document BNQ 1809-300/2004 (R 2007) du Bureau de normalisation du Québec for aggregate materials  
And chapter 2 du Tome VII, Matériaux, Normes ouvrages routiers 2012 du Ministères des transports du Québec (MTQ).
- .2 Refer to section 6.6 des clauses techniques générales du document BNQ 1809-300/2004 (R 2007) du Bureau de normalisation du Québec for Unshrinkable fill.
- .3
- .4 Use similar material as the existing conditions for backfill according to 1101 standard of MTQ compacted at 90% of maximum dry density.

## **Part 3 Execution**

### **3.1 REMOVAL**

- .1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas designated on drawings.
- .2 Remove stumps and tree roots below footings, slabs, and paving, and to 600 mm below finished grade elsewhere.
- .3 Remove debris daily to an authorized site.

### **3.2 EXCAVATION**

- .1 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil. Stockpile topsoil on site for later use.
- .2 Excavate as required to carry out work. Do not disturb soil or rock below bearing surfaces. Notify Departmental Representative when excavations are complete. If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work. Excavation taken below depths shown without Departmental Representative's written authorization to be filled with concrete of same strength as for footings at Contractor's expense.

- .3 Excavate trenches to provide uniform continuous bearing and support for 150 mm thickness of pipe bedding material on solid and undisturbed ground. Trench widths below point 150 mm above pipe not to exceed diameter of pipe plus 600 mm.
- .4 Excavate for slabs and paving to subgrade levels. In addition, remove all topsoil, organic matter, debris and other loose and harmful matter encountered at subgrade level.

### **3.3 BACKFILLING**

- .1 Do not begin backfilling operations until material and areas to backfill have been inspected and approved for use by Departmental Representative.
- .2 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.
- .3 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.
- .4 Compaction of subgrade: compact existing subgrade under walks, paving, and slabs on grade, to same compaction as fill.
- .5 Placing:
  - .1 Place backfill, fill and base course material in 300 mm lifts: add water as required to achieve specified density.
- .6 Compaction: compact each layer of material to following densities for material to ASTM D698:
  - .1 To underside of base courses: 95%.
  - .2 Base courses: 98%.
  - .3 Elsewhere: 90%.
- .7 Under seeded and sodded areas: use site excavated material to bottom of topsoil except in trenches and within 600 mm of foundations.
- .8 Blown rock material, not capable of fine grading, is not acceptable, imported material must be placed on this type of material
- .9 Against foundations (except as applicable to trenches and under slabs and paving): excavated material or imported material with no stones larger than 200 mm diameter within 600 mm of structures.

### **3.4 GRADING**

- .1 Grade so that water will drain away from buildings, walls and paved areas, to catch basins and other disposal areas. Grade to be gradual between finished spot elevations shown on drawings.

### **3.5 REQUIRED MATERIALS**

- .1 Provide backfill materials in totality according to plan.
- .2 Dispose of cleared and grubbed material off site.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 31 00 00.01 – Earthwork.

**1.2                REFERENCES**

- .1            Norme BNQ 0605-100 VIII (2001), Aménagement paysager à l'aide de végétaux.

**1.3                QUALITY ASSURANCE**

- .1            Qualifications:
  - .1            Landscape Contractor: to be a Member in Good Standing of the Association des Paysagistes Professionnels du Québec.
  - .2            Landscape Planting Supervisor: Landscape Industry Certified Technician with Softscape Installation designation.
  - .3            Landscape Maintenance Supervisor: Landscape Industry Certified Technician with Turf Maintenance designation.

**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 supplier's recommendations.
  - .2            Replace defective or damaged materials with new.

**Part 2            Products**

**2.1                MATERIALS**

- .1            Planting Soil (100 mm):

Must contain between 4% and 20 % organic matter from natural decaying or compost.  
Must be fertile and crumbly.

Remove and dispose of weeds; debris; stones 25 mm in diameter and larger.
- .2            Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
  - .1            Turf Grass Nursery Sod types:

- .1 Number One Kentucky Bluegrass Sod: Nursery Sod grown solely from seed of cultivars of Kentucky Bluegrass, containing not less than 50% Kentucky Bluegrass cultivars.
  - .2 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.
  - .3 Number One Named Cultivars: Nursery Sod grown from certified seed.
- .2 Turf Grass Nursery Sod quality:
  - .1 Not more than 1 broadleaf weed and up to 1% native grasses per 40 square metres.
  - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
  - .3 Mowing height limit: 35 to 65 mm.
  - .4 Soil portion of sod: 6 to 15 mm in thickness.
- .3 Fertilizer:
  - .1 To Canada "Fertilizers Act" and Fertilizers Regulations.
  - .2 Complete, synthetic, slow release with 65 % of nitrogen content in water-insoluble form.

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

#### **3.2 PREPARATION**

- .1 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .2 Fine grade surface free of humps and hollows to smooth, even grade, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod, and plus or minus 15 mm for Commercial Grade Turf Grass Nursery, surface to drain naturally.
- .3 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

### **3.3 SOD PLACEMENT**

- .1 Ensure sod placement is done under supervision of certified Landscape Planting Supervisor.
- .2 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.
- .3 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .4 Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

### **3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD**

- .1 Perform following operations from time of installation until acceptance.
  - .1 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.
  - .2 Cut grass to 50 mm when or prior to it reaching height of 75 mm.
  - .3 Maintain sodded areas weed free 95%.
  - .4 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.
  - .5 Temporary barriers or signage to be maintained where required to protect newly established sod.

### **3.5 ACCEPTANCE**

- .1 Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:
  - .1 Sodded areas are properly established.
  - .2 Sod is free of bare and dead spots.
  - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.
  - .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.
- .3 When environmental conditions allow, all sodded areas showing shrinkage cracks shall be top-dressed and seeded with a seed mix matching the original.
- .4 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

### **3.6 MAINTENANCE DURING WARRANTY PERIOD**

- .1 Perform following operations from time of acceptance until end of warranty period:
  - .1 Water sodded Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.
- .2 Repair and resod dead or bare spots to satisfaction of Departmental Representative.
- .3 Cut grass and remove clippings to height as follows:

- .1 Turf Grass Nursery Sod:
  - .1 50 mm during normal growing conditions.
- .2 Cut grass as directed by Departmental Representative, but at intervals so that approximately one third of growth is removed in single cut.

**END OF SECTION**