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CANADIAN SPACE AGENCY
Renewal of water towers

Specifications – Mechanical

2021-04-30
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CANADIAN SPACE AGENCY

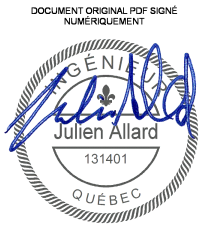
6767, ROUTE DE L'AÉROPORT

SAINT-HUBERT (QUEBEC)

J3Y 8Y9

RENEWAL OF WATER TOWERS

DIVISIONS 01, 22 AND 23



2021-04-30

Authorized for tender
April 30, 2021

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Part 1 General

1.1 DEFINITION

.1 The terms "Contractor", "General Contractor" and "Supervisor" refer to the person or entity designated as in contract with the Owner or Manager of the works.

.2 The expressions "section", "sections", "each section", "each related section", "performed by section" and "supplied by section" refers to the firm responsible for the work of that section.

.3 The terms "Engineer" and "Engineers" mean the firm or the Designated Representative of the engineering firm that issued the engineering section, specifications or plans related to the work covered by these documents.

1.2 EXAMINATION OF THE SITES

.1 Before submitting its bid, each bidder must visit and inspect the site to become familiar with everything that could affect the works in any way. No later claims due to ignorance of local conditions will be considered by the Owner.

1.3 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.

.9 In case of contradiction between the English version and the French version of the specification book, the French version will be considered as the official version.

1.4 PRODUCTS USED FOR TENDERS AND EQUIVALENCY

.1 Each section must prepare an overall price for a tender based only on the products described in the drawings and specifications. The person preparing the tender must not assume that the manufacturers' materials and equipment whose names appear on the "MANUFACTURER LIST" are automatically equivalent. Each section is solely responsible for the verification and validation of equivalence (and, where appropriate, of the special manufacturing requirements for it) of the product that will need to be used from a manufacturer on the list.

.2 Where an asterisk (*) is used in the manufacturer list at the request of the Customer, the relevant section must bid with the product from that manufacturer.

All modifications required by the usage of an equivalent material or device to that specified is to be performed at the cost of the division supplying the device, even if it applies to other specialties and if implications are discovered after the acceptance of the substitution request.

1.5 SUBSTITUTION OF MATERIALS

.1 Equipment and materials from manufacturers other than those mentioned in the manufacturer list may be substituted only after the presenting the tender, provided that they are approved according to the following procedure:

.1 Equivalency requests must be made by the relevant section only. They must be submitted within a maximum of fifteen business days following the signing of the contract. They must be accompanied by the following documents:

.1 Original tender for the specified products.

.2 Tender received for products to be substituted.

.3 Justification of the request.

.4 Proofs of equivalency.

.2 The submission of equivalency requests to periods other than that mentioned above will only be considered for reasons truly exceptional and extraordinary.

.2 The main points of comparison are construction, performance, capacity, dimensions, weight, encumbrance, technical specifications, parts' availability, maintenance, delivery delays, the evidence of tried and true equipment in service and impact on other specialties.

.3 Any changes caused by the use of an equivalent equipment or material is to the cost of the section that provided the equipment, even when it applies to other specialties, and even if the implications are made apparent after the substitution request is accepted.

.4 Any request for substitution will be rejected if it were to impede or delay the execution of the works.

1.6 QUEBEC TENDER OFFICE (BDSQ)

.1 Each section whose work falls under the jurisdiction of the Submission Code of the Quebec Tender Office must submit a copy of their tender to the Engineer at the same time as their submission to the electronic submission system (TES) of the BDSQ.

1.7 IMPORTANT NOTE: SUPPLY AND INSTALL

.1 Supply and install all materials and equipment described in this specification and/or shown in the drawings, whether the term "supply and install" is used or not. See also the article "MINOR WORKS".

1.8 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 organisations having jurisdiction.

.3 Submit to the Engineer a copy of the drawings bearing the seal of approval of the relevant inspection services.

.4 Upon completion of the works, obtain and submit to the Owner, complete with a copy of the mailing slip for the package sent to the Engineer, all permits, approval certificates, and other obtained from the different offices and departments that have jurisdiction over this building.

.5 Restrictions regarding tobacco usage:

.1 It is prohibited to smoke inside the building. Comply with restrictions applying to tobacco usage on the building property.

.6 Discovery of dangerous materials:

.1 If materials applied by spray or trowel, likely to contain asbestos, polychlorinated biphenyls (PCBs), moulds or other designated hazardous materials are discovered during demolition, immediately stop work.

.1 Take corrective action and immediately notify the Owner.

.2 Do not restart work until written instruction is received.

1.9 TAXES

.1 Pay all taxes required by law, including federal, provincial and municipal.

1.10 MINOR WORKS

.1 Each section is required to provide all the required components and to do all the jobs which, although not specified in the estimate, are necessary for the operation of the equipment and to complete the work included in his contract.

1.11 TOOLS AND SCAFFOLDING

.1 On the worksite, provide the full range of tools required for the proper execution of the work. Also supply, erect, and remove the scaffolding required to perform the work.

1.12 COOPERATION WITH OTHER TRADES

.1 Each section must:

.1 Cooperate with other trades working in the same building or on the same project.

.2 Keep itself informed of additional drawings issued to these other trades.

.3 Ensure that these drawings do not come in conflict with its work.

.4 Organize its work so as not to interfere in any way with other work done in the building.

.5 Collaborate with the other sections to determine the location of accesses in walls and ceilings.

.2 During the work, 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 return the premises to a clean condition when the work is completed.

1.13 SCHEDULING OF OPERATIONS

.1 Plan and execute work in such a way as to minimally disturb the normal use of the building.

.2 During the tender process of the contract, present a schedule for the work in the form of a bar graph (Gantt diagram), specifying the expected steps in the work until completion, including the project milestones. Once the schedule is reviewed and approved, take necessary action to ensure the project progresses on schedule. Do not modify the calendar without consulting the Engineer and the Owner.

.3 Perform work during "normal work hours", Monday to Friday between 8 h and 18 h.

.4 The Winter Tower may be stopped on June 1 and must be returned to service no later than September 30.

.5 Summer tours may be stopped on October 1 and must be returned to service by April 30.

.6 The operations are located int the technical spaces and must be organized to avoid the occupied spaces.

1.14 MATERIALS

.1 Unless otherwise indicated, use new materials clear of imperfections or defects, in the required quality, bearing the approval labels CSA, ULC, FM, AMCA, ARI and other according to the specialties.

1.15 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 workday, seal with a screw cap or a suitable metal cap all openings in conduits of any kind.

1.16 WASTE MANAGEMENT

.1 Perform a "waste audit" in order to determine what waste will be created by demolition and construction activities. Write a "waste reduction plan" and apply the principles of reduction, reuse and recycling of material where possible.

.2 Provide a "source material triage program" to disassemble and collect, in an orderly manner, among the "general waste" the materials bound for "environmental disposal" listed below:

.1 Brick and Portland cement concrete.

.2 Corrugated cardboard.

.3 Drywall (unfinished).

.4 Steel.

.5 Wood (except painted, treated or laminated).

.3 Submit logs of all material removed from site as "general waste" and "environmental disposal" with the following information:

.1 Time and date of removal operations.

.2 Description of the material and the quantity.

.3 Proof that the material was received at an approved waste treatment or disposal facility, as required.

1.17 SHOP DRAWINGS

.1 Before fabrication or order of any component, submit a PDF copy by email for approval. Each drawing or data sheet should be submitted as a distinct PDF file. The PDF name should include the section, article and name of the article title in the specifications (example: 00_00_00_0.00_Equipment XYZ.pdf).

.2 Drawings must include the dimensions, weight, number of attachment points, centre of gravity, seismic requirements, wiring schematics, capacities, controls schematics, curves, space requirements for maintenance and operation, and all other relevant information. If present, clearly indicate the location and dimensions of plumbing, heating, cooling, electrical, etc., connections by device. Each drawing must be verified, coordinated, signed, and dated by the relevant section before being submitted for approval.

.3 All correspondence and/or document submitted via project management software by the Contractor or a Sub Contractor will not be reviewed and will be not be considered as submitted/received.

.4 Shop drawings must be relevant to the proposed equipment. The sheets from general catalogs are not accepted as shop drawings. Each drawing must be preceded by a title page indicating with the name of the project, the consultant's name, the date and identification tag of the equipment shown in the drawings and specifications. The title page must also include the revision number of the documents as well as the expected delivery date of the product. Drawings must be prepared and signed by the supplier. Drawings pulled from the supplier's website are not accepted.

.5 Drawings for non-catalogued items must be specifically prepared for the project.

.6 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 their drawings.

.7 The verification of the shop drawings by the Engineers does not diminish the responsibility of the supplier to ensure that the equipment meets all applicable codes and standards, as well as the requirements in this specification.

.8 When shop drawings are resubmitted or installed, inform the Engineer in writing of changes made, other than those requested by the Engineer.

.9 When equipment is manufactured before the verification of the shop drawings by the Engineer, the Engineer may refuse the equipment. The Contractor is responsible for any costs associated with the refusal.

.10 The drawings must be in French.

1.18 COORDINATION DRAWINGS

.1 General:

.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 work involved, those of the relevant section and those done by others.

.3 Communicate with the Architect to procure Architectural base plans.

.2 Description:

.1 Coordination drawings consist of dimensioned plans, to scale, indicating the position of the equipment, ducts, piping, valves and other accessories with cuts and details required, complete with piping and duct dimensions, locations of sleeves, openings, anchorages and supports, relative positions with structure, architectural works, mechanical and electrical work, the positioning of the access doors, the clearances required for the maintenance of equipment and all other disciplines.

.2 Each mechanical and electrical section must provide on their coordination drawings the details of their levelling bases and housekeeping pads.

.3 Preparation:

.1 Each relevant section must make their coordination drawings and coordinate them with other disciplines.

.2 All drawings must be coordinated by the Contractor in collaboration with all sections.

.3 The coordination drawings for each sector must be submitted all at once for verification.

.4 The section "HEATING – CHILLED WATER " is responsible for coordinating drawings with each section. These sections must provide all the data, diagrams, drawings and diagrams necessary for this coordination work.

.5 The section "HEATING – CHILLED WATER" must prepare a drawing with its own work with all data and dimensions necessary and incorporate all the information provided by the other sections.

.4 Collaboration:

.1 Close collaboration must exist between the sections in order to determine the location of their respective work and avoid incompatibilities.

.5 Distribution of coordination drawings:

.1 Before submitting the drawings to the Engineer for verification, the general Contractor and each of the sections must sign the plans.

.2 Submit to the Engineer two paper copies and one emailed digital PDF copy of the scaled coordination drawings signed by the General and Sub Contractors for verification.

.3 All correspondence and/or document submitted via project management software by the Contractor or a Sub-Contractor will not be reviewed and will be not be considered as submitted/received.

.4 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 placement and exact dimensions of openings, perforations and sleeves, the location of its equipment, pipes and ducts, whether the structural, Architectural or Engineering drawings are included or not.

.2 The Division 23 (section "HEATING – CHILLED WATER") must ensure the full coordination of its work with the coordination drawings.

.3 No compensation will be given for the modifications of the work for the purpose of coordination and integration of the electromechanical systems.

.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 fully integrated and in perfect condition.

.5 Verification of the coordination drawings by the Engineer serves to ensure that the technical requirements appear to be generally met. The Engineer does not check the quality of the coordination carried out by the Contractors.

.7 Pre-existing work:

.1 Coordination drawings should account for existing mechanical, electrical, structural and Architectural installations as well as planned work.

.8 Coordination drawings are required for:

.1 Work performed by a section that could have implications on the work of another section.

.2 Places described in sections of the Divisions 22, 23, 25 and 26.

.3 This clause is not restrictive. Coordination drawings may be demanded for places deemed necessary.

.4 Coordination drawings of the heating plant, cooling towers, etc., are the responsibility of the Division 23 (section "HEATING – CHILLED WATER").

.9 Original coordination drawings:

.1 At the end of the work a USB flash drive (containing the "dwg" and "3D Revit model", depending on program used) is to be included with each O&M manual and two paper copies of the as-builts are to be submitted to the Owner, for no additional charge, by each section.

1.19 USING DIGITAL MODELS FOR COORIDNATION

.1 DWG plans:

.1 Where approved by the Owner Representative, the Engineer may provide to the contractor the digital DWG plans which were used to produce contractual documents.

.2 The Contractor must respect the "RESPONSIBILITY WAIVER – DWG PLANS" form included at the end of this section, understanding the limitations of using the digital plans, and complete and sign the form. Submit the duly completed form to the Engineer.

.3 The Engineer reserves the right to not provide the design files to the Contractor and/or related sections.

.4 The Engineer reserves the right to claim fees for the conversion of design files and specifications issued "for tender" to the format or edition requested by the Contractor and/or related section.

1.20 TECHNICAL REQUESTS FOR INFORMATION

.1 The Contractor must submit all requests for information (RFIs) by email.

.2 All correspondence and/or document submitted via project management software by the Contractor or a Sub Contractor will not be reviewed and will be not be considered as submitted/received.

.3 Technical Requests for Information:

.1 Each question must be submitted using a standardized RFI form.

.2 Each PDF RFI form may include only one question.

.3 Each question must be assigned a sequential number to facilitate tracking.

.4 The Contractor is responsible to review questions submitted by other sections to ensure that answers are not present in the contractual documents or previously provided, and to track progress of the RFIs to ensure work is not delayed.

.5 The RFI form must include, at minimum:

.1 Submission date of the question.

.2 Name of the sender and recipient.

.3 Subject line.

.4 Clearly formulated question.

.5 Clips of the plans, specifications and photos relating to the question.

.6 Proposed solutions.

.7 Sufficient space for the engineer to respond to the question on the form.

1.21 DIGGING AND BACKFILLING

.1 The digging, backfilling and compaction, both inside and outside the building, are the responsibility of the Contractor under the supervision of all relevant mechanical and electrical sections.

.2 For underground piping install the well tamped stone dust or sand as follows:

.1 200 mm (8") deep under the piping.

.2 150 mm (6") on each side.

.3 300 mm (12") above metal piping.

.4 600 mm (24") above the non-metallic piping.

.5 Any other thickness if the applicable regulations require more than those above.

.6 Or as recommended by the civil and/or structural Engineers.

.3 The relevant section shall permit backfilling only once the inspection of the work is done and the authorization to proceed is given.

1.22 CONCRETE WORKS

.1 Consult the documents provided by the structural Engineer.

1.23 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.

1.24 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 manuals 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 sub-Contractors 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 capacities 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 French.

.4 Divide each manual in the sections using blank sheets which have coloured 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 (8" x 11") binding strips.

.6 Submit one PDF copy to the Engineer for comment. Once approved, provide three (3) copies of the manual 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.

1.25 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 leveling shall be borne by the Contractor.

.4 Reread the articles "COOPERATION WITH OTHER TRADES" and "TESTING".

1.26 PLACEMENT OF PIPING AND DUCTS

.1 No pipe may be in contact with another. Allow a clearance of at least 15 mm (½") 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 headroom of the area. 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 Departmental Representative 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.

1.27 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.

1.28 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 plates and the seals or labels of the equipment standards and approvals organizations must be visible and legible once the equipment is installed.

.3 Provide fasteners and metal accessories of the same texture, colour 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 pieces of equipment, as well as those of the rectangular identification plaques, and other similar parts with the building walls.

.5 Future provisions:

.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.

1.29 PAINTING

.1 Apply a base coat of sealant 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 coloured 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, Sierra Performance S30 Griptec from Rust-Oleum or Sierra Performance S71 as an aerosol.

.3 Apply one coat of metal mordant and one additional coat of black paint to the soldered joints of uninsulated black steel pipes.

.4 On insulated black steel pipes, apply one layer of metal mordant on the soldered joints.

.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 systems and mechanical equipment.

1.30 FRAMES, SUPPORTS, AND BRACKETS

.1 Each relevant section must provide and erect all frames and brackets 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 (3") 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.

1.31 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 Engineer or 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. Following revisions made at the request by the Owner's representative, a lack of experience and qualifications relevant to the project will result in the mandatory replacement of the Superintendent by one meeting the requirements.

.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.

1.32 INSPECTIONS

.1 It is absolutely necessary before any inspection request to the Engineer, that the testing was previously conducted and successful.

1.33 TESTING

.1 Each section must cooperate with the other sections, so as to enable them to complete their tests within the time period allowed 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 The Engineer may assist, at any time, in any test they deem necessary.

.2 All tests must be performed to the satisfaction of the Engineer.

.3 The Engineer may require a test of installations and equipment before accepting them.

.4 For temporary trials, obtain written permission to operate and test installations and permanent equipment before being accepted by the Engineer.

.5 Give a written 48 h notice to the Engineer before the date of the test.

.6 Provide equipment, meters, material and staff required to run tests during the project until the acceptance of installations by the Engineer and pay all fees.

.7 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.

.8 Prevent dust, dirt, and other foreign matter from entering the openings of installations and equipment during testing.

.9 Provide to the Engineer a certificate or letter from the manufacturer confirming that each section of the installation was implemented to their satisfaction.

.10 Submit the written test results to the Engineer.

.11 The tests must be performed and accepted prior to the installation of the thermal insulation.

.12 Do not conceal or embedded piping, conduits, or equipment before the tests are completed and accepted.

.13 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.

.14 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.

.15 Provide hydraulic pumps, air compressors, fans and other equipment necessary to perform all tests and related temporary work.

.16 Correct any leak detected. The defective part must be removed, repaired and the test is redone until the results are satisfactory.

.17 Whenever tests are conducted with water, place the pressure gauge at the highest point of the installation.

.18 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.

.19 For joints with caulking, it is not permitted to repair cracks using other materials.

.20 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 Engineer and the Owner reserve the right to examine the equipment in the factory and attend factory trials described in this specification.

.2 Notify the Engineer 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 Engineer.

1.34 "EARLY ACCEPTANCE", "WITH RESERVATION" AND "WITHOUT RESERVATION"

.1 Refer to general conditions and additional general conditions of the Client for the definition of "early acceptance", "with reservation " and "without reservation".

1.35 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 set on controls as planned in the operating sequences.

.3 During this time, until the acceptance "with reservation", each section must perform the normal maintenance, in compliance with the maintenance manual supplied by the Contractor. The maintenance in the period between the acceptance "with reservation" and "without reservation" will be performed by the Owner if all relevant information has been provided and training has been completed. Otherwise the Contractor is to perform the maintenance.

1.36 EQUIPMENT CALIBRATION AND OPERATION

.1 General:

.1 Vibration tests are required to ensure that:

.1 The equipment operates within acceptable levels of vibrations.

.2 That vibrations or noises 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 values (IRD 1988).

.6 Also refer to the chapter "Sound and Vibration Control" from ASHRAE.

.7 Minimum criteria:

.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 General:

.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 running-in 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 (3) 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/s, 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

1.37 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

1.38 WARRANTY

.1 Each section guarantees its work for a period of one year after acceptance "with reservation" of the work by the Owner. It is required to repair or replace, at its expense, any defects that would become apparent during this period and that, within 48 h after having been formally notified.

.2 Manufacturers must offer a one (1) year warranty from the starting operation date or eighteen (18) months from the date of delivery to the site, as appropriate. The warranty must include the cost of materials and labour, and the replacement of defective parts and/or manufacturing defect. In the case of chillers, a five-year warranty applies if the refrigerant charge is contaminated due to the compressor motor burning.

.3 The warranty is for a period greater than one (1) year (extended/or special warranties), for the areas indicated in the respective specifications.

.4 This warranty is fully independent of the article of the Civil Code concerning the five (5) year warranty.

.5 General conditions:

.1 It is expected that several contracts of the same discipline may be executed by different companies, that another company may have adjustments or tests to be executed on its work, that another company may have work to be done which are a subsequent phase of its work, that each company is committed, through this specification, to accept that its work is subject to all conditions listed above without changing the terms of the warranty.

.6 The use of permanent equipment for temporary purposes does not relieve the relevant section of its responsibilities and obligations with respect to the acceptance and guarantee of its work.

.7 The Engineer and/or the Owner reserve the right start the equipment and mechanical and electrical works without affecting the section's obligation to see to the full maintenance of its work up to acceptance "with reservation".

1.39 OBLIGATIONS DURING THE WARRANTY PERIOD

.1 During the warranty period, in addition to the obligations described in the specifications, the relevant section must provide any technical assistance required by the Engineer and/or Owner with respect to the operation of the installations and their improvements or adjustments as required.

.2 The temporary use or testing with the goal of adjusting equipment or any other purpose, or permanent use by the Owner of the mechanical and electrical works before the final acceptance of the works should not be interpreted as evidence that such works are accepted by the Owner and does not alter the terms of the warranty. During this time period, the relevant section retains responsibility for the maintenance of installation. No claim for damage or failure of any part of the work put into use will be considered by the Owner.

1.40 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 labour 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. However, it 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.

1.41 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, aqueduct water, domestic water, sanitary plumbing, storm drainage, external drainage systems, ventilation – 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 labour and equipment.

.3 All major service cuts must be performed with the agreement of the Client and his seasonal needs.

.2 Demolition:

.1 All demolition work is the responsibility of each concerned mechanical and electrical 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 labour 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 is prohibited for construction purposes.

.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 equipment/materials 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. Unless otherwise instructed:

.1 Any removed pipe, fitting, or valve should not be reused.

.2 No device 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 mechanical and electrical section must anticipate the cost of transporting waste off site and bear all related costs to dispose of it.

.7 Reusing removed existing equipment and materials:

.1 Any equipment, material, or accessory to be removed and reused should be disassembled and transported carefully by the relevant section, be protected in appropriate packaging, and stored in a suitable location, shielding from weather and moisture.

.8 Refurbishment of existing materials and equipment:

.1 See the article "DISMANTLING OF EXISTING PIPING, MATERIALS AND EQUIPMENT".

.2 See each section for a list of equipment.

1.42 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.

1.43 CERTIFICATION OF COMPLIANCE

.1 At the end of the work, each section must submit to the Engineer a certification of compliance stating that all work was performed following the drawings and specifications, and all applicable standards and codes. Refer to example form at the end of this section.

.2 Submit the certificate to the Engineer 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 their seal to it.

1.44 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. Otherwise, duct cleaning and sample analysis may be required at the Contractor's expense to ensure that the dust level does not exceed 0.75 mg/100 cm² in order to comply with the NADCA-ACR standards.

.2 Duct cleanliness:

.1 See section 23 05 00 – CVCA – Common work results for HVAC.

1.45 CLEANING

.1 Clean the work area as work progresses. At the end of each workday, 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 and polish glass, mirrors, hardware parts, ceramic tiles, chrome or enamel surfaces, laminated surfaces, aluminum, stainless steel or porcelain-enamel parts, floors and sanitary fixtures. Clean manufactured items in accordance with manufacturer's written instructions.

.4 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.

1.46 SECURITY SCREENING

.1 All personnel involved in the execution of the work will be subjected to a security screening. Obtain the required authorisations, as per the requirements, for all personnel who are to be present on site.

.2 Personnel will be screened every day the beginning of the workday, where they will be provided with a security pass they must carry on their person at all times, to be returned to security at the end of the day.

1.47 SECURITY ESCORT

.1 All personnel involved in the execution of the work will be required to be accompanied by a security officer when performing work in areas prohibited to the public during normal working hours. They must be accompanied in all areas when working during unoccupied times.

.2 Submit all requests for escorts at least fourteen (14) days in advance. Where requests are made within the prescribed period, the cost of the security escort will be covered by the Departmental Representative. In the case of late requests, the cost will be the responsibility of the Contractor.

.3 All requests for escorts may be cancelled, without penalty, if notice is give at least four (4) hours before the time. In the case of late requests, the cost will be the responsibility of the Contractor.

1.48 BREAKDOWN OF COSTS

.1 Before submitting a request for first payment, provide a detailed breakdown of costs relative to the contract, indicating also the overall price of the contract, as per the Engineer's instructions. Once approved by the Engineer, the breakdown will serve as a reference for payment installment calculations.

.2 Where applicable, include the following lines, as well as the related amounts, in the monthly statements of each of the specialized Contractors:

.1 Mobilization.

.2 Insurance and surety bonds.

.3 Erection drawings.

.4 Hydraulic calculations for fire protection.

.5 One line per activity per sector, floor or phase.

.6 Tests and trials.

.7 Preliminary balancing reports (aeraulics and hydraulics).

.8 Final balancing report.

.9 Alignment of equipment (pumps, fans, etc.).

.10 Equipment start-up.

.11 Commissioning of systems.

.12 Seismic measurement compliance report.

.13 Demobilization.

.14 Operation and maintenance manual.

.15 Training.

.16 Drawings "as annotated by the Contractor".

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

COMPLIANCE CERTIFICATE

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, laws and regulations in effect.

Company name: _____

Address: _____

Telephone number: _____

Signatory name: _____

Signature: _____

Signatory title: _____

COMPANY SEAL

RESPONSIBILITY WAIVER – DWG PLANS

The _____

Mr./Ms. _____
Bouthillette Parizeau
8580 de l'Esplanade Avenue, office 200
Montréal (Québec),
H2P 2R8

Project: _____

Subject: _____

We, _____ , relieve Bouthillette Parizeau of any liability resulting from the use of their digital drawings for the development of contractual documents and our coordination, and/or detail drawings, or for any other use related to the project.

We also recognize and agree that:

- That the electronic drawings in question are provided to us for our use only and that they cannot be disseminated without the permission of Bouthillette Parizeau.
- That no assurance is given to us as to the consistency and accuracy of the information contained in it.
- That Bouthillette Parizeau cannot be held responsible should the digital drawings in question contain certain inaccuracies or errors.
- That Bouthillette Parizeau cannot be held responsible for any errors that results from the use of the drawings by us, our subcontractors, or our suppliers.
- That we will remain fully responsible for our submitted drawings or orders, according to contract stipulations.

In addition, we will undertake to verify in site the accuracy of the dimensions and information contained within the digital drawings, as if we had created them ourselves.

Signature: _____

Name (in print): _____

Address: _____

Telephone: _____

Email: _____

END OF SECTION

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2.1 NOT USED

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3.2 PROTECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 The special requirements for mechanical and electrical work, Division 01, apply to this section.

.2 The following sections are part of the scope of the plumbing work and complement each other to form a whole:

- .1 Section 01 00 10 – Mechanical and electrical general instructions.
- .2 Section 22 11 16 – Domestic water piping.
- .3 Section 22 13 19 – Drainage waste and vent piping.
- .4 Section 22 42 01 – Plumbing specialties and accessories.
- .5 Section 23 05 05 – Installation of pipework.
- .6 Section 23 05 13 – Common motor requirements for HVAC equipment.
- .7 Section 23 05 17 – Pipe welding.
- .8 Section 23 05 29 – Hangers and supports for HVAC piping and equipment.
- .9 Section 23 05 48 – Vibrations and seismic controls for HVAC piping and equipment.
- .10 Section 23 05 53.01 – Mechanical identification.
- .11 Section 23 05 93 – Testing, adjusting and balancing for HVAC.
- .12 Section 23 07 14 – Thermal insulation for equipment.
- .13 Section 23 07 15 – Thermal insulation for piping.

1.2 SCOPE OF THE WORK – PLUMBING

.1 Work included:

- .1 Generally, the works include labour, delivery, and installation of all materials and equipment needed for the plumbing works indicated in the drawings and the specification.
- .2 These works include, but are not limited to:
  - .1 The removal of all fixtures, piping and other existing accessories that are not essential or that disrupt the new installation and/or need to be removed in accordance with the municipal and provincial plumbing regulations.
  - .2 Cold water:
    - .1 Replacement of the water supply pipes for the towers.
  - .3 Drainage:
    - .1 Complete sanitary drainage networks of the water tower room.
  - .4 Fixtures:
    - .1 All plumbing fixtures, floor drains, etc.
  - .5 Specialties:
    - .1 The acoustic and vibration works described in the Division 23 related to this section.

.2 The thermal insulation works described in sections 23 07 14 and 23 07 15 related to this section.

.6 Seismic measures:

.1 All seismic measures for plumbing work, in accordance with section 23 05 48 – Vibration and Seismic Controls for HVAC piping and equipment.

.2 Works excluded:

.1 In general, the following activities are excluded:

.1 Control works; except those specifically requested in the tender.

.2 Electrical connections, except those specifically requested in the tender.

1.3 SPECIAL CONNECTIONS

.1 In general, special connections include all connections to fixtures, all pipes, adapters, stop valves, by-passes, unions, flanges, filters, air vents, test valves, drain valves, control valves, shock dampers, buffer tanks, traps, ventilation ducts, flexible joints and other accessories necessary to operate the fixtures.

.2 When special connections are made by others to their fixtures, each relevant section should be monitoring these connections and is solely responsible for the proper functioning of their own equipment.

.3 Each section is responsible for any damage it may cause to the fixtures to which it makes connections.

.4 Part of the plumbing contract:

.1 All plumbing connections and all points of connections to the various fixtures shown in the drawings and/or described in the specification.

.2 Installation of all necessary controls valves to the fixtures' plumbing connections. These controls valves are provided by the company responsible for carrying out the plumbing work or another section according to the requirements in the drawings and the specification. When the control valves are provided by other sections, install them following the directives and under the supervision of those other sections.

.3 When the control valves are provided by the company responsible for carrying out the plumbing work but are installed by others, the installation must be done according to the directives and under the supervision of the company in charge of the plumbing work, which remains directly responsible as to the proper functioning of the equipment.

.4 The fixtures provided by the landlord.

.5 Specialties:

.1 All domestic cold water and hot water connections of the specialties' contracts.

.2 All drainage, vent, and funnel drain connections, of the specialties' contracts.

.6 Heating – Chilled water:

.1 All drains and funnel drains installed near "heating – chilled water" appliances. However, the connections of the drainage and the piping from these devices to the funnel drains are the responsibility of the Division 23 "HEATING – CHILLED WATER".

.2 All domestic cold-water connections to "heating – chilled water" appliances.

1.4 DOCUMENTS TO SUBMIT

.1 Submit the following documents:

.1 A list of the identification legends for the piping, valves, and fittings, in compliance with Division 01.

.2 Copies of the instruction manuals for the operation and maintenance of the equipment, in compliance with Division 01.

.3 Up to date drawings, in compliance with Division 01.

.4 A list indicating, for each electric motor, the current in amperes, at no load and normal load, the capacity of the thermal element installed in the starter, and the value of the maximum current, in amperes, registered on the motor plate.

.5 A list indicating, for each pump, the following pressures measured with calibrated pressure gauges.

.1 At normal operating conditions, the pressures at the pump suction and discharge.

.2 At zero flow, the discharge pressure of the pump.

.6 Certificates of compliance from an approved body for all plumbing appliances and equipment.

1.5 GLOBAL PRICE – SEPARATE PRICE

.1 Provide with the tender an all-inclusive price covering all the work done by Division 22 "PLUMBING".

.2 Provide a declared price included in the global price for all insulation work applicable to the plumbing works.

.3 All excavation and backfilling work is not part of this provisional sum and must be performed by the general Contractor to ensure complete work without extra charge to the Owner.

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 SYSTEM CLEANING

.1 Clean the inside and outside all components, devices, and systems, including strainers and filters.

3.2 PROTECTION

.1 By the means of suitable elements, prevent dust, dirt and other foreign matter from entering the openings of the devices, equipment, and systems.

CERTIFICATE OF 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

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.1 Section 23 05 05 – Installation of pipework.

.2 Section 23 05 29 – Hangers and supports for HVAC piping and equipment.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME):

.1 ANSI/ASME B16.15-13– Cast Copper Alloy Threaded Fittings: Classes 125 and 250.

.2 ANSI/ASME B16.18-12 – Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-13 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24-11 – Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 600, 900, 1500 and 2500.

.2 ASTM International Inc.:

.1 ASTM-A126-04(2014) – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

.2 ASTM-A276/A276M-16 – Standard Specification for Stainless Steel Bars and Shapes.

.3 ASTM-A307-14 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

.4 ASTM-A536-84(2014) – Standard Specification for Ductile Iron Castings.

.5 ASTM-B16/B16M-10(2015) – Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.

.6 ASTM-B61-08(2013) – Standard Specification for Steam or Valve Bronze Castings.

.7 ASTM-B62-15 – Standard Specification for Composition Bronze or Ounce Metal Castings

.8 ASTM-B88M-14 – Standard Specification for Seamless Copper Water Tube (Metric).

.9 ASTM-B584-14 – Standard Specification for Copper Alloy Sand Castings for General Applications.

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA):

.1 ANSI/AWWA C111/A21.11-12 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA):

.1 CSA B242-05(R2011) – Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (DJC):

.1 Canadian Environmental Protection Act, 1999, ch.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-67-11 – Butterfly Valves.
.2 MSS SP-70-11 – Grey Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS SP-71-11 – Grey Iron Swing Check Valves, Flanged and Threaded Ends.
.4 MSS SP-78--2005a, Cast Iron Plug Valves, Flanged and Threaded Ends.
.5 MSS SP-80-13 – Bronze Gate, Globe, Angle and Check Valves.
.6 MSS SP-85--2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

.8 The National Research Council (NRC)/ NRC Construction:

.1 NRCC 38728F – National Plumbing Code – Canada (NPC) - 2010.

.9 Transport Canada (TC):

.1 Transportation of Dangerous Goods Act, 1992, Ch. 34 (TGDA).

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, instructions, specifications and data sheet for fixtures and equipment. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.3 Certificates:

.1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 02 81 01 – Hazardous materials.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

.3 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.

.4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.

.5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 VALVES – GENERAL

.1 Drain valve:

.1 NPS ¾ ball valve, two-part bronze body, stainless steel ball, teflon (PTFE) gasket, locking plate, threaded fittings with hose, chain and cap connector, cold service pressure of 4145 kPa (600 psi), similar to Jenkins fig. no LF-201CSJ.

2.2 LOW PRESSURE ABOVE GROUND PIPING (UP TO 1035 KPA)

.1 Piping:

.1 Material:

.1 NPS 3 or smaller:

.1 Copper, ASTM-B88, hard L type.

.2 Fittings:

.1 NPS 3 or smaller:

.1 Elbows, reducers, adapters, and couplings of the same brand as the tees made of wrought bronze. Cast brass unions, 860 kPa of steam, ASA B16.17, Grinnell no. 1949.

.2 NPS 4 to NPS 12:

.1 Ductile cast iron, 1725 kPa.

.3 NPS 4 to NPS 12:

.1 Stainless steel, 10S series, finish 1, ASTM-A403-WP304L-W.

.3 Junctions:

.1 NPS 3 or smaller:

.1 Wrought forged tees. Cast tees accepted for NPS 3 and larger.

.2 NPS 4 to NPS 12:

.1 Ductile cast iron, 1725 kPa.

.3 NPS 4 to NPS 12:

.1 Stainless steel tees, série 10S, ASTM-A403-WP304L-W.

.2 NPS 8 to NPS 12 sides in stainless steel, 10S series, ASTM-A304, with reinforcement capable of supporting 1035 kPa.

.4 Joints:

.1 NPS 3 or smaller:

.1 Welded joints, lead-free composed of antimony, copper, silver and tin, similar to Aquasol by AIM Solder

.2 NPS 4 to NPS 12 ductile iron:

.1 Flanged or Victaulic No. 31 joints, EPDM type gasket.

.3 NPS 4 à NPS 12 stainless steel:

.1 TIG welding, see section 23 05 17 – Welding of piping.

.2 Welding neck flanges, ASTM-A182, F304L, class 150.

.3 Slip-on flanges, ASTM-182, F304L, class 150

.4 Inorganic fiber flange fittings with nitrile binder, Garlock style 5500, 3 mm (⅛") thick, ring type or solid, depending on the equipment to be connected.

.4 Bolts for flanges:

.1 Steel bolts, grade 5, zinc plated.

.2 ASTM-A563 nuts, grade A.

.3 Studs, grade B7.

.2 Valves:

.1 General:

.1 All valves must be manufactured according to the following standards, depending on the application and unless otherwise specified:

.1 Class 200 CPW.

.2 MSS SP-70, SP-78, SP-80, SP-85 or ANSI applicable.

.3 Bronze: ASTM-B62, ASTM-584.

.4 Brass: ASTM-B16.

.5 Cast iron: ASTM-A126, classes B and C.

.6 CSA B125.

.7 NFS/ANSI, appendix G.

.2 Gate valves:

.1 50 mm or smaller:

.1 Bronze body, bronze disc, non-rising brass stem, solder fittings, cold working pressure of 2070 kPa, Jenkins fig. no. LF992AJ.

.3 Globe valves (not to be used in water systems):

.1 50 mm or smaller:

.1 Bronze body, bronze seat and replaceable disc, bronze non-rising stem, solder fittings, cold working pressure of 2070 kPa, Jenkins fig. no 106BPJ.

.4 Other valves:

.1 Ball valve – 100 mm (4") or smaller, lead free:

.1 Two-part brass body, naval brass ball, teflon gasket (PTFE), locking lever, threaded fittings, cold working pressure of 4145 kPa (600 psi), Jenkins fig. LF-201J, with extended stem for insulated piping, Jenkins fig. 74083X-SJ.

.5 Check valves:

.1 50 mm or smaller:

.1 Bronze body, bronze seat and replaceable disc, Y configuration with swing check valve, threaded fittings, cold working pressure of 1380 kPa (200 psi), Jenkins fig. no. LF996AJ.

2.3 EXPANSION JOINTS

.1 Take all necessary precautions to allow for the expansion and contraction of the pipes using expansion joints.

.2 The expansion of the piping must be based on a temperature of -28.9°C and a hot temperature corresponding to the maximum possible temperature of the liquid.

.3 Use expansion joints of the same diameter as the piping and pre extend them where required.

.4 By submitting the piping to the required test pressure, take precautions to prevent the deterioration of expansion joints that cannot withstand that pressure or the expansion created by this pressure.

.5 Joints manufactured with the piping:

.1 Manufacture swing joints with the same material as the piping and design them so as not to exceed the yield strength of the material used.

.2 In general, use wrought type fittings instead of cast fittings in loops.

2.1 MANUFACTURER LIST

.1 Domestic water:

.1 Ductile iron piping:

.1 Canron Inc.

.2 Copper piping:

.1 Mueller

.2 Wolverine

.3 Copper fittings:
- .1 Cello Products
- .2 Grinnell
- .3 Mueller

.4 Taps:
- .1 Crane/Jenkins
- .2 Kitz
- .3 MAS
- .4 Red-White

Part 3 Execution

3.1 GENERAL

.1 Comply with requirements of sections 23 05 05 – Installation of pipework and section 23 05 29 – Hangers and supports for HVAC piping and equipment.

.2 Connection to municipal services:

- .1 Before starting the plumbing, determine on site the availability of water supply services, as well as their exact location and depth.
- .2 If the locations shown for these services or the connection projections shown in the drawings do not correspond fully to the site requirements, immediately submit all details of the deviations to the Engineer and suspend that part of the work until as instructions and drawings correcting the deviations are issued.
- .3 This section is responsible for any inaccuracies in the work and expenditures that may result if it fails to take the aforementioned precautions.

.3 General layout of the work:

- .1 The layout of the pipe network, the position of sanitary fixtures, special equipment, etc., mentioned in the specification or shown on the drawings give the general layout of the equipment. This section must execute this installation while complying with provincial and municipal health regulations while respecting the architectural and structural arrangement of the building.
- .2 Apply extra caution to avoid any interference of plumbing pipes with other disciplines.

.4 Levels:

- .1 Establish levels with surveying instruments following the usual surveying methods.

3.2 VALVES

.1 Domestic water control valves:

.1 Each group of devices must use straight valves with the same dimensions as the supply pipes and a valve with a hose connection for drainage. In addition, in large washrooms, each group of devices must have straight valves for hot water and recirculation, of the same size as the cold-water supply pipes.

.2 Drain valve:

.1 In all low points of the hot water, cold water, and recirculation systems as well as on each network and system, supply and install an NPS ¾ drain valve.

.3 Isolation valve:

.1 At the base of each cold water, hot water, and recirculation column, as well as the locations shown in the drawings, supply and install one valve to isolate the column, with a valve fitting for the connection to the drain. Each device must also be isolated.

.2 Supply and install an isolation valve at each branch of a master pipe.

3.3 SLOPES

.1 Domestic hot, cold, and recirculated water piping:

.1 Main pipes: leveled.

.2 Branches: slope of 15 mm to 25 mm towards the drainage points.

3.4 TESTS, ADJUSTMENTS AND BALANCING

.1 General:

.1 Perform all the tests specified below.

.2 All tests must have been performed successfully prior to being performed in the presence of the Engineer.

.3 Any piping or part thereof must be proven before being covered with insulation or be concealed in partitions, ceilings or walls. Prior to pressure testing systems remove or protect devices such as control devices, air valves, or any equipment that is not designed to be subjected to pressures corresponding to those used in the tests.

.4 During hydrostatic testing ensure that the piping is completely filled with liquid and purged of all the air.

.5 In cold weather use an antifreeze for hydrostatic tests, and at the end of the tests drain the piping completely to prevent any risk of freezing.

.6 Send for analysis, comments, and approval three copies of the final report of all tests and adjustment. Enter the results on 8½ "x 11" format sheet by noting the name of the system, the device, the requested specifications and those obtained.

.2 Domestic water piping:

.1 A pressure of 345 kPa above the maximum operating pressure and a minimum of 1035 kPa must be maintained without leaks for a period of at least two hours throughout the domestic water piping and/or drainage and the non-potable water piping. Perform this test with cold water.

.2 Subject all joints to mechanical shocks with a suitable tool.

.3 If it is impossible to test the entire installation at once, it can be divided into several sections, each tested as described above.

.4 In booster pump systems, the maximum pressure must correspond to the maximum pump pressure at zero flow.

.3 Specific tests and balancing of systems:

.1 When all the mechanical installation is completed and before final approval, make the following specific tests and adjustments.

.1 When all cold, hot, recirculating and other water distribution systems are completed and connected this section must carry out the adjustment of all manual and pressure reducing valves, booster and circulation pumps, and other related equipment to ensure that the operation of the equipment and the behavior comply with the specification requirements.

.2 Adjust the valves to obtain a constant and uniform temperature in the domestic hot water line.

.3 All these tests and adjustments must be made by a qualified Engineer or technician and in cooperation with the representative of the manufacturer of the related equipment and other trades involved. All tests must be done according to the current recommendations and requirements of ASME, AIEE, and ASHRAE. All systems must be kept in constant operation for a period of two weeks before possession.

.4 Send for analysis, comments, and approval of the final report of all tests and adjustment. Enter the results by noting the name of the system, the device, the requested specifications and those obtained.

.5 All equipment, accessories, pressure gauges, thermometers, Pitot tubes, and other similar items, as well as any labour required for the testing and adjustments are the responsibility of this section.

3.5 FLUSHING AND CLEANING

.1 Flush the network for a period of eight (8) hours. Flush water outlets for two (2) hours. Let the rinsing water sit for 24 hours and then collect one (1) water sample from the longest segment. Submit the sample to the designated laboratory which will make the analysis. The copper levels in the water must comply with the relevant guidelines for drinking water established by the provincial and federal authorities. Flush the system for two (2) additional hours, then take another sample for analysis.

.2 Cleaning the clean the sieves:

.1 Clean sieves periodically.

3.6 COMMISSIONING

.1 Start-up the network once:

- .1 The hydrostatic testing is completed.
- .2 The disinfection is completed.
- .3 The test certificate is delivered.
- .4 The water treatment system is running and functional.

.2 Ensure continuous monitoring throughout the duration of the commissioning.

.3 Commissioning:

- .1 Pressurize the network and purge the air.
- .2 Ensure that the pressure is appropriate for smooth functioning of the network and prevent water hammers, gas expansion and/or cavitation.
- .3 Slowly raise the temperature of the water in the domestic hot water heater to the design temperature.
- .4 Anticipate the expansion displacements of the hot water pipeline (distribution/supply/recirculation).
- .5 Ensure that the control, regulation, and security devices promote the normal and safe operation of the network.

.4 Correct deficiencies identified during the commissioning.

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

.2 Section 23 05 05 – Installation of pipework.

.3 Section 23 05 29 – Hangers and supports for HVAC piping and equipment.

1.2 REFERENCES

.1 ASTM International Inc.:

- .1 ASTM-A53/A53M 12 – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless.
- .2 ASTM-A88-1931 – Standard Specification for High Test Gray Iron Castings.
- .3 ASTM-B32-08(2014) – Standard Specification for Solder Metal.
- .4 ASTM-B88 14 – Standard Specification for Seamless Copper Water Tube.
- .5 ASTM-A105/A105M 14 – Standard Specification for Carbon Steel Forgings for Piping Applications.
- .6 ASTM-A234/A234M 15 – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .7 ASTM-A312/A312M – Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- .8 ASTM-B306-13 – Standard Specification for Copper Drainage Tube (DWV).
- .9 ASTM-C76 13a – Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
- .10 ASTM-C428/C428M-05(2011)e1 – Standard Specification for Asbestos-Cement Non-pressure Sewer Pipe.
- .11 ASTM-C564-14 – Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .12 ASTM-D2235-04(2011) – Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- .13 ASTM-D2564-12 – Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International):

- .1 CSA B67-1972(R1996) – Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
- .2 CSA B70-12 – Cast Iron Soil Pipe, Fittings and Means of Joining.
- .3 CSA B125.3-12 – Plumbing Fittings.
- .4 CSA B181.2-M87 – PVC Drain, Waste, Vent Pipe and Pipe Fittings.
- .5 CSA B602-16 – Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe.
- .6 CSA B1800-15 – Thermoplastic Non-Pressure Pipe Compendium.

.3 Green Seal Environmental Standards (GSES):

.1 Standard GS-36 – Adhesives for Commercial Use, Edition 2.1, July 12, 2013.

.4 South Coast Air Quality Management District (SCAQMD), California State:

.1 SCAQMD Rule 1168-A2005 – Adhesive and Sealant Applications.

1.3 SUBMITTALS

.1 Submit documents in accordance with 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.

.3 Shop drawings:

.1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada, in the province of Québec.

.4 Certificates:

.1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with 02 81 01 – Hazardous materials.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with 01 00 10 – Mechanical and electrical general instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.

.4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.

.5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 MATERIAL

.1 Cast iron:

.1 Grey iron, class no. 4000.

.1 The labelling of the trademark, the diameter, and the seal of the CSA and ASTM must be stamped on the entire length of the pipe.

.2 CSA B70-12.

.2 Stainless steel:

.1 ASTM-A312, series no. 10.

.10 DWV copper:

.1 ASTM-B306.

.11 Hard L type copper:

.1 ASTM-B88.

2.2 LOCATIONS

.1 Sanitary, storm water, and combined sewer connections and collectors, branch vents, vent headers, and continuous and circuit vent pipes:

.1 NPS 2 or smaller: in DWV copper (aboveground).

.2 In cast iron, class no 4000 (aboveground and underground).

.2 Equipment and ventilation device drainage:

.1 NPS 1 or smaller: hard type L copper.

.2 NPS 1¼ or larger: copper DWV.

2.3 FITTINGS AND ACCESSORIES

.1 Cast iron pipes: the labelling of the trademark, the diameter and the insignia of the CSA and ASTM must be cast in the metal, class no. 4000.

.2 Cast iron pipes with mechanical joints: the labelling of the trademark, the diameter, and the insignia of the CSA and ASTM will be cast in the metal, provided with a locking lever for the positioning of the seals.

.3 Copper pipes: welding fittings.

.4 In the ground, appliance plumbing fittings: cast iron, ASTM-A74, class no. 4000.

.5 Equipment venting and device drains:

.1 NPS 1 and smaller: soldered joints.

.2 NPS 1¼" and larger: soldered joints, drainage type.

.6 For piping made of other materials, use fittings of the same material and the same class as the pipe on which they are used.

2.4 JOINTS

.1 Cast iron piping and fittings with hub joints for a buried installation:

- .1 Compression type joints for the casing.
- .2 EPDM compression seals, compliant with CSA B70.
- .3 Series 4001 "Bi-Seal", Bibby Ste-Croix.
- .4 All piping must be supported on the structural slab with supports and rebar made of stainless steel.

.2 Cast iron piping and fittings with spigot ends and mechanical couplings – sanitary drainage network, storm water, or combined:

- .1 Mechanical couplings, series no. SD4000 Husky, extra strength, Bibby Ste-Croix (Anaco).
- .2 Stainless steel corrugated rings, compliant with CSA B-602, with neoprene seal CAN/ULC S102.2.
- .3 Joint components compliant with CSA B-70-M1991.
- .4 Clamps in stainless steel 304.
- .5 Collars installed alternatingly and tightened to 550 kPa (80psi).
- .6 All joints and fittings must be secured mechanically and held in place using axial mechanical restraints, series 117, Holdrite. Pipes must laid in such a way that the axial restraints can be installed.

.3 Copper:

- .1 Unless otherwise specified, joints are welded with 50% tin and 50% lead solder.
- .2 For pumped sewers, the solder is 95% tin and 5% antimony.

2.5 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10.

.2 Manufacturer list, section 22 13 19:

- .1 Drainage piping and vent:
  - .1 Cast iron piping:
    - .1 Fonderie Bibby Ste-Croix
    - .2 Tyler
  - .2 Copper piping:
    - .1 Mueller
    - .2 Wolverine

.3 Stainless steel piping:
- .1 Bristol
- .2 Felker
- .3 Douglas Barwick
- .4 Merit Brass
- .5 Pinacle
- .6 ResistAloy Inc.
- .7 Russel Metals (Acier Leroux)

.4 Copper fittings:
- .1 Cello Products
- .2 Emco
- .3 Grinnell
- .4 Mueller
- .5 Nibco

.5 Mechanical joints:
- .1 Bibby Ste-Croix
- .2 Mission
- .3 Straub
- .4 Tyler

Part 3 Execution

3.1 GENERAL

.1 Comply with requirements of section 23 05 05 – Installation of pipework and section 23 05 29 – Hangers and supports for HVAC piping and equipment.

.2 General layout of the works:

.1 The layout of the pipe network, the position of sanitary fixtures, special equipment, etc., mentioned in the specification or shown on the drawings give the general layout of the equipment. This section must execute this installation while complying with provincial and municipal health regulations while respecting the architectural and structural arrangement of the building.

.2 Apply extra caution to avoid any interference of plumbing pipes with other disciplines.

3.2 SLOPES

.1 Drainage and vent piping:

.1 The drainage and horizontal vent piping must slope in the direction of flow. Unless otherwise indicated, an incline of 2% for NPS 3 pipes and under and 1% for NPS 4 or larger pipes.

3.3 TESTS, ADJUSTMENTS AND CLEANING

.1 General:

.1 Perform all the tests specified below.

.2 All tests must have been performed successfully prior to being performed in the presence of the Engineer.

.3 Any piping or part thereof must be proven before being covered with insulation or be concealed in partitions, ceilings or walls. Prior to pressure testing systems remove or protect devices such as control devices, air valves, or any equipment that is not designed to be subjected to pressures corresponding to those used in the tests.

.4 During hydrostatic testing ensure that the piping is completely filled with liquid and purged of all the air.

.5 In cold weather use an antifreeze for hydrostatic tests, and at the end of the tests drain the piping completely to prevent any risk of freezing.

.6 Send for analysis, comments, and approval three copies of the final report of all tests and adjustment. Enter the results on 8½ "x 11" format sheet by noting the name of the system, the device, the requested specifications and those obtained.

.2 Drainage, sewer, and vent piping testing:

.1 Perform hydrostatic testing on the drainage and vent piping by sections of a maximum height of 15 m. Completely fill each section of water to a height of 2.1 m above the highest lateral branch of each section. The water level should remain stable for a period of two (2) hours.

.3 Pumped sewage piping testing:

.1 A pressure of 345 kPa above the maximum operating pressure and a minimum of 1035 kPa must be maintained without leaks for a period of at least two (2) hours throughout the domestic water and/or drainage piping, and the non-potable water piping. Perform this test with cold water.

.2 Subject all joints to mechanical shocks with a suitable tool.

.3 If it is impossible to test the entire installation at once it can be divided into several sections, each tested as described above.

.4 In booster pump systems, the maximum pressure must correspond to the maximum pump pressure at zero flow.

3.4 CAMERA INSPECTION

.1 Proceed to a full camera inspection of the entire underground drainage piping system once the backfill has been compacted.

.2 Fill the entire drainage piping system with potable water (or glycol water when tests are done when the ambient temperature falls below 0°C) and drain by gravity before the camera inspection.

.3 Provide the Engineer the video recordings of the inspection within forty-eight (48) hours.

.4 Provide a plan indicating the sections of plumbing inspected with reference to the presented video recordings.

.5 The Engineer requires over seventy-two (72) business hours to conduct the verification of the presented recordings.

.6 Any work deemed unsatisfactory by the Engineer following the verification of the video recordings must be corrected suitably at the expense of the sector concerned.

.1 Once the corrective work has been carried out and the backfill and compaction work completed, resume the camera inspection process for the section concerned.

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 23 05 19.01 – Thermometers and pressure gauges – Piping systems.

1.2 REFERENCES

.1 ASTM International:

.1 ASTM-A126-04(2014) – Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM-B62-15 – Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM-B306-13 – Standard Specification for Copper Drainage Tube (DWV).

.2 American Water Works Association (AWWA):

.1 ANSI/AWWA C700-15 –Cold-Water Meters, Displacement Type, Metal Alloy Main Case.

.2 ANSI/AWWA C701-15 – Cold-Water Meters, Turbine Type for Customer Service.

.3 ANSI/AWWA C702-15 – Cold-Water Meters, Compound Type.

.3 CSA International:

.1 CSA B64 Series-11 – Backflow Preventers and Vacuum Breakers.

.2 CSA B79-08 (R2013) – Commercial and Residential Drains and Cleanouts.

.3 CSA B356-10 – Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Efficiency Valuation Organization (EVO):

.1 International Performance Measurement and Verification Protocol (IPMVP).

.1 IPMVP, version 2007.

.5 Plumbing and Drainage Institute (PDI):

.1 PDI-G101-R2015– Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201-R2010 – Water Hammer Arresters Standard.

Part 2 Products

2.1 FLOOR DRAINS

.1 General:

.1 By Zurn with integrated or separate P-trap.

.2 Traps:

.1 Separate traps provided with a bronze cleanout plug at the bottom of the trap and a NPS ½ connection for the trap primer.

.2 Deep trap seal, 100 mm minimum depth.

.3 Floor drains serving ventilation units with deep trap seals are supplied by this section. The height of the trap seal must be at least 80 mm higher than the height corresponding to the vacuum or the pressure generated in the ventilation unit. Zurn no. Z-1000P or 62180 by Bibby Ste-Croix if mechanical joints are used.

.3 Cast iron body, extendable fittings, threaded if necessary, Zurn no. Z-1040 (joints).

.4 Water seal guard for the trap seal, TrapGuard model byProSet Systems (distributed by Les Entreprises Roland Lajoie Inc.), TG model, complete with a ten years warranty.

.5 Floor drain description:

.1 Funnel floor drain:

.1 Cast iron, covered with a protective paint.

.2 Heavy grid, 172 mm in diameter, polished nickel bronze 206 mm diameter top.

.3 Cast iron sediment bucket.

.4 Membrane flashing clamp comprised of a mechanical joint and a secondary seepage pan.

.5 Polished drain funnel.

.6 Adjustable frame.

.7 Frame 213 mm in diameter, ensuring proper adhesion to the membrane.

.8 Complete grate with 85 mm x 232 mm oval funnel or round funnel of 102 mm or 152 mm in diameter.

.9 Acceptable products: Zurn no. ZN-556-Y (FO: oval), (F4 or F6: round).

2.2 DRAINAGE – CHECK VALVES

.1 Cast iron, extra heavy weight, bronze seat and flapper, no-hub inlet and outlet connections.

.2 All check valves must be equipped with a vent. No-hub inlet and outlet connections.

.3 Zurn no. Z 1090 or Bibby Ste-Croix no. B4055.

2.3 DRAINAGE – CLEANOUT PIPES

.1 Copper DWV piping:

.1 Construct cleanouts using Y connectors with adaptors and bronze screw caps.

.2 Galvanized pipe:

.1 Construct cleanouts using Y connectors and cast iron square head screw caps.

.3 Cast iron piping with lead fittings or PC-4 and caulking:

.1 Construct cleanouts with cast iron Y connectors, cast iron spool sealed with lead or PC-4, and bronze hex head screw caps, Zurn no. 1440-BP.

.4 Cast iron pipework with mechanical joints:

.1 Construct cleanouts using Y connectors, STC caps and fittings, Zurn no. 1449 with access cover no. ZANB-1463.

.5 Accessible cleanouts for finished floor:

.1 Supply and install an adjustable cleanout with a cast iron body, bolted cover with gasket, flush to the floor, with adjustable non-slip, heavy, round polished nickel bronze strainer, Zurn no. ZXN-1612-SP.

2.4 DRAINAGE – FUNNELS

.1 Unless indicated otherwise, funnels to be made of 0.74 kg gauge copper with a reinforced edge using a copper wire with a rectangular section at the top, removable grate and cover, with a cut out opening for the passage of piping.

.2 In visible areas with stainless steel furnishings, manufacture stainless steel funnels the same way as copper funnels, with rounded and polished edges, stainless steel 316, finish no. 4.

.3 For floor drains combined with funnels, see the article "FLOOR DRAINS" in this section.

2.5 STRAINERS

.1 General:

.1 The strainers must be of same size as the piping, or larger if indicated on the drawings. All strainers must have an eccentric drain connection at the bottom with screwed caps.

.2 Description:

.1 NPS 2 or smaller:

.1 Bronze type ASTM-B62, screwed or flanged fittings up to 2070 kPa, operating pressure of 2758 kPa at 65.6°C up to 1724 kPa at 207°C, Sarco type BT.

.2 NPS 2½ or larger:

.1 Very thick "semi-steel" cast iron ASTM-A126, series 30, dielectric flanged fittings, operating pressure of 1200 kPa at 65.6°C, Sarco type D.

2.6 THERMOMETERS

.1 General:

.1 See section 23 05 19.01 – Piping thermometers and pressure gauges – Piping systems.

.2 Install at the following locations:

.1 Domestic cold-water booster pump suction manifold marked from 1.11 to 54.5°C.

.2 On each of the domestic hot water tanks marked from -17.8 to 120°C.

.3 On the inlet of every recirculated hot water pump marked from -17.8 to 120°C.

.4 At the outlet of each thermostatic mixing valve of each of the domestic hot water tanks marked from 0 to 115°C.

.5 On the marked inlet of the recirculated hot water pump marked from 0 to 115°C.

.6 Elsewhere, at locations shown on the drawings, with appropriate scale.

2.7 PRESSURE GAUGES

.1 General:

.1 See section 23 05 19.01 – Piping thermometers and pressure gauges – Piping systems.

.2 Install at the following locations:

.1 Domestic cold-water, domestic hot water, and recirculated hot water:

.1 Near each domestic cold-water inlets, 0 to 1100 kPa range (type A).

.2 Domestic water booster pumps' suction manifold, 101 kPa at vacuum and 1035 kPa range (type B).

.3 At the suction inlet of each domestic cold-water booster pump, between the pump and the strainer 101 kPa at vacuum and 1035 kPa range (type B).

.4 At the discharge of each domestic cold-water booster pump upstream of the shut-off valve, 0 to 3450 kPa range (type B).

.5 Before and after each domestic col- water pressure reducing valve (type A).

.6 Before and after each hot water recirculation pump, install only tees with fittings and shut-off valves for future installation of pressure gauges, all between the shut-off valves.

.2 Sump pumps:

.1 At the discharge of all sump pumps, install only tees with fittings and stop valves for future installation of pressure gauges, the all between the pump and the shut-off valve.

2.8 WATER – PRESSURE RELIEF VALVE

.1 Pressure relief valve with test lever, capacities certified according to ASME, Kunkle make.

.2 On domestic hot water tanks, of the pressure and temperature type.

2.9 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10.

.2 Manufacturer list, section 22 42 01:

.1 Floor drains:

.1 Watts-Drainage

.2 Zurn

.2 Cleanouts:

.1 Watts-Drainage

.2 Zurn

.3 Strainers:

.1 Armstrong

.2 Crane

.3 Sarco

.4 Zurn Wilkins

.4 Pressure relief valves:

.1 Kunkle

.2 Watts

.3 Zurn Wilkins

Part 3 Execution

3.1 INSPECTION

.1 Verification of conditions: prior to the installation of special fixtures and equipment, ensure that the surfaces/materials condition, previously implemented under other sections or contracts, is acceptable and that the work can be performed in accordance with manufacturer's written instructions.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with the manufacturer's requirements, recommendations and written instructions, including product technical bulletins, instructions for handling, storage and installation of the products, and datasheet indications.

3.3 INSTALLATION

.1 Install the fixtures and equipment as required by the plumbing code of the province where the work is carried out.

.2 Install special plumbing fixtures according to the manufacturer's instructions and issued requirements.

3.4 FLOOR DRAINS

.1 Floor drains installed within monolithic slabs and ceramic tiles, tiles or other finishing materials: during the floor pour, coat the adjustable part of the floor drain with polythene for subsequent adjustment of the grate to the level of the finished floor.

3.5 DRAINAGE – CLEANOUT

.1 Supply and install on all drain pipes, envision cleanouts at all locations where obstructions can occur, at the pipe ends, at all direction changes, after 15 m of horizontal runs, at the bottom of each column, at all locations where provincial or municipal regulations require them and at the locations specified and/or indicated on the drawings.

.2 Construct the cleanouts using Y connectors.

.3 The main cleanouts for the building sewage outlets must have the same diameter as the drain pipe.

.4 Elsewhere, all cleanouts must be the full size of the pipe for pipes up to NPS 4.

3.6 DRAINAGE – FUNNELS

.1 Supply and install all drains and funnels needed for the drainage, the overflow, and pressure relief valves of all fixtures or systems.

.2 The air gap between the funnel and the drain pipe must not exceed the nominal pipe diameter.

.3 Bevel at 45° the end of pipes discharging into a funnel. The higher flow rate drain pipe must be centered with the drain.

3.7 STRAINERS

.1 Supply and install all the strainers shown on the drawings and those required for the protection and proper operation of equipment.

.2 In general, install the strainers at the suction inlet of all pumps, upstream of all control valves, upstream of all solenoid valves, and upstream of all water pressure reducing valves.

3.8 WATER – PRESSURE RELIEF VALVE

.1 Connect the pressure relief valves to the drain by means of drainage pipes and funnels. Securely anchor the piping, center it in the funnel preventers and bevel at 45°.

3.9 TESTING AND BALANCING

.1 Perform the testing and balancing of special fixtures and equipment at this time.

.1 Defects found in the start-up have been rectified.

.2 The completion certificate was issued by the competent authorities

.2 Tolerances:

.1 Pressure at fixtures: allowable deviation of more or less 70 kPa.

.2 Flowrate at fixtures: allowable deviation of more or less 20%.

.3 Floor drains:

.1 Check the operation of the trap primer.

.2 Initiate the trap seal using the trap primer. Set the flow according to the existing conditions.

.3 Check the operation of the flushing device.

.4 Check that the grate is in place, accessible and easy to remove.

.5 Clean the sediment bucket.

.4 Cleanouts:

.1 Ensure the cover is gas-tight, securely in place and easy to remove.

END OF SECTION

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 SUBMITTALS

.1 Submit the documents and samples required.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for new equipment and accessories for water towers, products and methods used for the renovation of water towers. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.1 Shop drawings:

.1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada, in the province of Québec.

.2 Shop drawings must include:

.1 Assembly and installation details.

.2 Required information to permit operation and maintenance (O&M) of the devices.

.3 Submit the following documents along with the shop drawings and data sheets:

.1 Shop drawings for the bases, stands, supports and anchoring bolts.

.2 Data regarding sound level of systems and devices if applicable.

.3 Performance curves with operating points indicated.

.4 Documentation from the manufacturer certifying that the products provided are the most current model.

.5 Certificate of compliance with relevant codes.

.4 In addition to the transmittal letter required by section 01 33 00 – Submittal procedures, use the document titles "Shop Drawing Submittal Title Sheet" published by MCAC (Mechanical Contractors Association of Canada). Specify the section number and article in question.

1.3 CLOSEOUT SUBMITTALS

.1 Submit the required documents/elements in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and Maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

.1 The O&M manual must be approved, before the final inspection, by the Consultant. Final copies to be submitted to the Owner.

.2 Operational documentation must include the following:

.1 Control diagrams for each system, including local interface controls.

.2 A description of each system and related control devices.

.3 A description of the operating sequences for each system under different loads, including programmed set points and seasonal changes.

.4 Instructions for the operation of each device and its components.

.5 Instructions of measures to be taken in case of equipment/material failure or malfunction.

.6 Table of flow devices and a flow diagram.

.7 A colour code legend.

.3 Maintenance documentation must include the following:

.1 Instructions for the maintenance, reparation, operation and troubleshooting of every component,

.2 A maintenance schedule specifying the frequency and the length of work as well as tools required to perform the work.

.4 Performance documentation must include the following:

.1 Performance data supplied by the manufacturer of the equipment/material, specifying the performance level of each, measured after the commissioning process has been completed.

.2 Results from the performance testing of the equipment/material.

.3 All other documentation specified in other sections of the contractual documents.

.4 TAB (testing, adjusting and balancing) reports in accordance with requirements from section 23 05 93 – Testing, adjusting and balancing for HVAC.

.5 Additional information:

.1 Prepare sheets for any additional documentation to add to the appendix of the O&M manual.

.6 "As-built" drawings:

.1 Before performing TAB work, complete the as built drawings.

.2 Mark on every drawing on the lower right side in at least 12 mm font "AS-BUILT' DRAWINGS: THIS DRAWING WAS REVIEWED AND REPRESENTS THE SYSTEMS/MECHANICAL DEVICES AS THEY WERE INSTALLED" (Contractor signature) (Date).

.3 Submit the as-built drawings to the Consultant for approval and make any required corrections as instructed.

.4 Perform TAB work with as built drawings at hand.

.5 Submit reproducible as built drawings along with O&M manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

1.5 SPECIFIC CONDITIONS – HEATING – CHILLED WATER

.1 The specific requirements of the mechanical and electrical works, Division 20, 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 Section 01 00 10 – Mechanical and electrical general instructions.
- .2 Section 23 05 00 – Common work results for HVAC.
- .3 Section 23 05 05 – Installation of pipework.
- .4 Section 23 05 13 – Common motor requirements for HVAC equipment.
- .5 Section 23 05 17 – Pipe welding.
- .6 Section 23 05 19.01 – Thermometers and pressure gauges – Piping systems.
- .7 Section 23 05 29 – Hangers and supports for HVAC piping and equipment.
- .8 Section 23 05 48 – Vibration and seismic controls for HVAC piping and equipment.
- .9 Section 23 05 53.01 – Mechanical identification.
- .10 Section 23 05 93 – Testing, adjusting and balancing for HVAC.
- .11 Section 23 07 14 – Thermal insulation for equipment.
- .12 Section 23 07 15 – Thermal insulation for piping.
- .13 Section 23 21 13 – Hydronic systems.
- .14 Section 23 21 14 – Hydronic specialties.
- .15 Section 23 21 15 – Glycol specialties.
- .16 Section 23 21 23 – Hydronic pumps.
- .17 Section 23 65 10 –Cooling towers.

.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 The complete water system of the forced-circulation chilled cooling towers feeding and returning to the water tower space including equipment such as existing and as shown in plan including support, fitting and insulation.
    - ~~.2~~ The complete rewal of existing water towers and their equipments in the mechanical room as described in section 23 65 10.
    - .3 The complete system for extra water from the cooling towers located in the cooling tower space as shown in plan, including support, fitting and insulation.

.4 All special connections described in the specification and/or shown in the drawings.

.5 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.

.6 The supports and structural steel components required to support the pipework, the fittings, and the equipment.

.7 All tests.

.8 The complete identification of all devices and accessories, in accordance with section 23 05 53.01 – Mechanical identification.

.9 The paraseismic 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 All thermal insulation work.

.2 Control work, except those specifically requested in this section.

.3 The electrical connections, except those specifically requested in this section.

.4 The provision of acoustic and vibration devices.

.5 Flashing.

.6 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, ethylene glycol, and steam connection points for various devices shown in the drawings, as well as those described in the specifications.

.2 Plumbing – Drainage:

.1 All connections for drainage, overflow, safety valve exhaust, etc., from each water towers to the funnels.

.2 Anchor the connections near the funnels.

.3 Bevel to 45° and ream the end of the pipes flowing into the funnel.

.4 Install the drain piping with the highest flow above the center of the funnel.

.5 Determine the dimensions of the funnels according to the number and size of the indirect drains discharging into it.

.6 The actual funnels are part of the plumbing work, as well as any piping from the funnels to the sanitary or storm drainage systems.

.7 The drainage piping from the backflow devices' funnels to the drainage funnels are part of this section's work.

.3 Plumbing – Domestic Cold Water:

.1 Supply and install all domestic cold-water connections to the various heating and refrigeration devices from Division 22's domestic cold-water network. For this purpose, a shut-off valve is installed by this section at each connection point to the domestic cold-water network.

.4 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.

.3 At the bottom of each of the main water risers to the cooling towers, provide NPS 8 flanged connections.

.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 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 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.

.6 Overall price – Separate price:

.1 Upon submission, present an overall inclusive price covering the heating – chilled water work.

.2 Also, provide the prices declared as included in the overall price for the following work:

.1 All work described in Section 23 05 93 – Testing, adjustment, and balancing for HVAC. Indicate the name of the selected specialized company.

.1 Acceptable companies:

.1 Montreal:

.1 Caltech

.2 Hydraulque

.3 Service de mise au point Leblanc Inc.

.2 Gatineau/Ottawa:

.1 Calibration Brassard

.2 Kanata Air Balancing

.3 Maxima

.2 All work described in section 23 05 48 – Vibration and seismic controls for HVAC piping and equipment. Indicate the name of the selected specialized company.

.1 Acceptable companies:

.1 Hydraulique

.2 Paul Gilles Vibration

.3 Proaxion Technologies Inc.
.4 Silentec Consultants
.5 Vibra K Consultants
.6 Vibro-Mec JPB Ltée

1.6 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 Division 26.

.3 According to the indications on the diagrams and the drawings, 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 USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181-99 – Ready Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA)/CSA International:

.1 CSA B139-04 – Installation Code for Oil-Burning Equipment.

.3 Green Seal Environmental Standards (GSES):

.1 Standard GS-11-2008, 2nd Edition – Environmental Standard for Paints and Coatings.

.4 National Fire Code of Canada (NFC 2015)

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards:

.1 SCAQMD Rule 1113-A2007 – Architectural Coatings.

.2 SCAQMD Rule 1168-A2005 – Adhesive and Sealant Applications.

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving:

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

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 PIPING CONNECTIONS TO DEVICES

.1 Unless otherwise specified, comply with the manufacturer's instructions.

.2 Use valves with union fittings or flanges to isolate the piping network's devices and to facilitate the maintenance and the assembly/disassembly of the components.

.3 Use double joint fittings when the devices are mounted on vibration pads and when the piping is susceptible to movement.

3.2 UNIONS, FLANGES, MECHANICAL COUPLINGS

.1 To permit easy dismantling of the piping and the devices, install unions, flanges, or mechanical seals at all devices, manifolds, pumps, chilled water coils, hot water coils, glycol coils, steam coils, cooling towers, tanks, fan-coil units, etc.

.2 Piping NPS 2 or smaller: unions.

.3 Piping NPS 2½ or larger: flanges or mechanical seals.

.4 Flanged joints with appropriately sized bolts and nuts, bolt length equal to the thickness of the two flanges and the nut.

.5 Mechanical coupling: Victaulic Style 77, Victaulic Zero-Flex.

3.3 CLEARANCE

.1 Provide a clearance around the devices to facilitate the inspection, the maintenance and the observation of their operation, according to the manufacturer's recommendations and the National Fire Code of Canada requirements.

.2 Also, provide sufficient working space, as per the indications, to dismantle and remove devices or pieces of equipment, where appropriate, without needing to interrupt the operation of other network devices or units.

3.4 DRAIN VALVES

.1 Unless otherwise specified, install piping giving it a slope in the direction of flow of the fluid.

.2 Install evacuation/drain valves at the low points of the network, at the devices, and at the isolation valves.

.3 Connect a pipe to each evacuation/drain valve and route it to above a floor drain. The discharge point must be clearly visible.

.4 Use drain valves with the following characteristics: gate or ball type with a nominal diameter of NPS ¾, unless otherwise specified, threaded connections, flexible pipe, cap, and chain.

3.5 DIELECTRIC UNIONS

.1 Use dielectric joints appropriate to the type of piping and suitable for the network's nominal pressure.

.2 Use dielectric unions to connect parts made of different metals.

.3 Dielectric unions with a nominal diameter equal to or smaller than NPS 2: bronze union fittings or valves.

.4 Dielectric fittings with a nominal diameter larger than NPS 2: flanges.

.5 On the steam and condensate piping, perform the connections between two pipes of different metals, such as copper and steel, using cast iron connectors and brass adapters or flanges with gaskets. Install the bolts in isolated sleeves. Nuts and bolt heads with isolated washers.

.6 Between the copper pipes and the cast iron pipes, perform the connections by means of a 19 mm ring welded to the copper piping and caulked into the neck of the cast iron pipe.

3.6 PIPING

.1 Piping must not be in contact with the concrete or the ground.

.2 All galvanized piping must be so on the inside and the outside.

.3 Install all pipes so as to not induce any tensile or compressive stress.

.4 Do not bend the piping in any way whatsoever.

.5 The piping identification must always be visible to facilitate its inspection.

.6 For each type of piping, the elbows, the elbow reducers, the adapters, the couplings, and the unions must be of the same brand as the tees.

.7 In general, use long radius elbows.

.8 Cover the fitting threads with Teflon tape.

.9 Prevent the introduction of foreign materials into the unconnected openings.

.10 Install the piping so that the various devices can be isolated and thus enable the disassembly or removal of the latter, if necessary, without needing to interrupt the operation of other network devices or units.

.11 Connect the pipes using fittings manufactured in compliance with the relevant ANSI standards.

.12 Connection saddles can be used on the main pipes if the connected bypass branch diameter is not greater than half the diameter of the main pipe.

.1 Before welding the saddle, create an opening with a saw or a drill in the main pipe with a diameter equal to the full internal diameter of the branching pipe to be connected, and deburr the edges.

.13 Install the exposed piping, appliances, rectangular cleanouts, and other similar components in parallel or perpendicularly to the building lines.

.14 Install the concealed piping in such a way as to minimize the space reserved for furring and maximize the headroom and the available space.

.15 Except where otherwise indicated, install the piping giving it a slope in the direction of the fluid's flow to promote the free drainage of the latter and the network's free ventilation.

.16 Except where otherwise indicated, install piping in such a way as to allow the thermal insulation of each pipe.

.17 Deburr the pipe ends and rid them of slag and foreign matter accumulated prior to the assembly.

.18 Use eccentric reducers at the diameter changes to ensure the free flow of the fluid and the network's free ventilation.

.19 Provide means to compensate for the piping thermal expansion, as indicated.

3.7 VALVES

.1 Supply and install all valves indicated on the drawings.

.2 Install the valves in accessible locations. Install the valves so that they are accessible for maintenance purposes, without the need to disassemble the adjacent piping.

.3 Supply and install all the valves required for the operation, the maintenance, and the repair of various devices, without requiring the shut-off of the main pipelines.

.4 When the water piping serving one or more devices passes under the floor, install shut-off valves above the floor.

.5 Unless otherwise indicated, the valves have the same dimensions as the pipes to which they are connected.

.6 Unless otherwise specified, install the valves so that their actuator stem is located above the horizontal line.

.7 When a valve is not manufactured in the requested diameter, install a larger diameter valve with appropriate fittings.

.8 In the places shown on the drawings, at the inaccessible places, and places out of reach, use valves fitted with a wheel and a shaft covered in a special coating of stainless steel and the accessories required for operation from the floor.

.9 Drain valve:

.1 Install drain valves with screens for watering hoses at the following locations:

.1 At each main branch. Also, install a shut-off valve.

.2 Wherever pipes form a low point.

.3 At the places shown in the drawings.

.10 Unless otherwise indicated, install gate valves, ball valves, and butterfly valves at the connection points of the bypass branches for isolating parts of the network.

.11 Install butterfly valves between butt weld neck flanges to ensure the perfect compression of the sleeve.

.12 Provide valves of a nominal diameter equal to or greater than NPS 2½ with a chain-operated device when installed more than 2400 mm above the floor, in a mechanical room.

END OF SECTION

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.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE 90.1-01 – Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment in accordance with section 01 00 10 – Mechanical and electrical general instructions. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.2 Shop drawings: shop drawings must include the seal and signature of a professional Engineer recognized in Canada.

.3 Documents to submit at the end of work:

.1 Submit the maintenance documents of the motors, transmissions and guards, and attach them to the manual described in section 01 00 10 – Mechanical and electrical general instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Transport and store materials according to manufacturer’s written instructions.

Part 2 Product

2.1 GENERAL

.1 Provide the prescribed motors for the aimed mechanical devices and systems.

.2 T-Frame type motor housing, class B insulation, type with silencer, and special type junction box.

.3 Unless otherwise indicated, squirrel-cage induction type, operating at 208 V, three-phase, and 60 Hz or at 575 V, three-phase, and 60 Hz. Some motors operate at different voltages, according to their description which is given in each of the respective sections.

.4 1 HP or higher motors, high efficiency type, according to the standards CSA C390M1985, IEEE 112B, IEC 34-2, or JEC 37.

.5 Some motors must be explosion-proof. See the respective sections.

.6 Some motors must be of a special type, which can withstand high ambient temperatures, such as those installed in boiler rooms, transformer rooms, generator rooms, or other.

.7 All motors, except those that are directly connected, must be installed on sliding rails enabling easy adjustment and connected to their respective devices with V belts. Adjustment on sliding rails should be done with worm screws. The metal frame forming the bottom of the unit and the motor must be built in one piece if the frame is the assembly's only base. All motors connected to devices with belts must have their axes chosen to firmly support the pulleys and to cross them entirely.

.8 When frequency inverters are used to control the speed of the motors, the motors must be of the Inverter-Duty type, class F insulation, compliant with NEMA MG1-1993, part 31.

.9 Replace, at no cost to the Owner, all excessively noisy or vibrating motors.

2.2 CHARACTERISTICS

.1 Comply with the following characteristics:

Description	Power (HP)		
	0 to 7½	10 to 15	20 or more
Regular "drip proof" (open engine protected)	Yes	Yes	Yes
Service factor	1.15	1.15	1.15
Possible overheating	90°C	90°C	90°C
Thermistor type thermal protection on each winding			Yes
Multiple groove pulley for V-belt and variable diameter	Yes		
Multiple groove pulley for V-belt and fixed diameter		Yes	Yes
Grease lubricating ball and/or roller bearings		Yes	Yes
Permanently lubricated ball bearings	Yes		

.2 For axial fans with motors placed in the airflow, the totally enclosed and cooled by the outside airflow type of motor (TEAO) with a minimum service factor of 1.0 can be used.

.3 The manufacturer must provide terminals with identified connections. The motor's terminal box must be of an appropriate size and have a double compartment, without knockouts (knockouts will be made on-site by the Division 26).

2.3 SINGLE SPEED MOTORS

.1 Single coil and normal torque motors. Unless otherwise indicated, the motors with six leads for star and triangle connections are prohibited when used with starters other than star-delta.

2.4 TWO SPEED MOTORS

.1 Unless otherwise indicated, motors with star connections and variable torque.

.1 1 800 and 1 200 rpm: separate windings type.

.2 1 800 rpm and 900: consequent poles.

2.5 BELT DRIVES

.1 Reinforced belts must be installed in the drive pulley. The multiple belts must be provided and installed by matched sets.

.2 The pulleys must be in cast iron or steel, and be fixed on the shafts by means of removable keys, unless otherwise indicated.

.3 Motors under 10 HP: standard drive pulleys with pitch diameter adjustable in a range of plus or minus 10%. Use the intermediate position when setting the prescribed speed.

.4 10 HP and higher motors: unless otherwise indicated, fixed pitch diameter pulleys, with split taper bushing and keyway. Provide pulleys of suitable dimensions, suitable to the system balancing characteristics.

.5 The required dimensions of the pulleys will be determined during commissioning.

.6 Transmission design features: at least 1.5 times the nominal values stated on the motor nameplate. On the drive motor shafts, the cantilevered loads must stay below the manufacturer's calculation limits.

.7 The mounting plates on rails must allow adjustments along the axis.

2.6 BELT DRIVE GUARDS

.1 Provide guards for the unprotected transmissions.

.2 Belt drive guards:

.1 Expanded metal grating, welded to a steel frame.

.2 Sheet metal top and bottom, at least 1.2 mm thick.

.3 Holes 38 mm in diameter on the two axes of the shaft, for the installation of a tachometer.

.4 Removable for maintenance.

.3 The lubrication of the equipment and the use of test instruments must be possible even when the guards are in place.

.4 The belt guards must permit the displacement of the motors for the tension adjustments.

.1 U-shaped components made of galvanized mild steel, at least 1.6 mm thick.

.2 Securely fastened in place.

.3 Removable for maintenance.

.5 Guards for unprotected fan air inlets and outlets:

.1 Wire rod or expanded metal gratings, galvanized, 19 mm mesh.

.2 Net free area of at least 80% of the fan openings' area.

.3 Securely fastened in place.

.4 Removable for maintenance.

2.7 MANUFACTURER LIST

.1 Must comply with the article "PRODUCTS USED FOR SUBMISSIONS AND EQUIVALENCES" from section 01 00 10.

.2 List of manufacturers, section 23 05 13:

.1 Motors:

.1 Baldor

.2 Canadian General Electric

.3 Canadian Westinghouse

.4 Leeson

.5 Magnetek

.6 Marathon

.7 Reliance

.8 Tamper

.9 Toshiba

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with the requirements, the recommendations, and the manufacturer's written specifications, including product technical bulletins, instructions for product handling, storage, and installation, and data sheet indications.

3.2 INSTALLATION

.1 Fix the devices and the components securely into place.

.2 The appliances and the components must be removable for maintenance and they must be easy to put back and fix into place.

3.3 MOTOR START–UP

.1 Before operating the engine for the first time, the Division 26 must:

.1 Ensure the presence of the section that provided the engine.

.2 Check the motor's direction of rotation. If the rotation is wrong, see to the corrections and the new connections on the motor and not in the starter, in order to respect the wiring's colour coding.

.3 Ensure the main shaft's free movement for all pumps with mechanical joints before starting the motor.

.4 Check the overload protection and the overcurrent protection to ensure that they are adequate.

.5 Check the insulation at the "megger".

.6 Measure the voltage of the electric circuit powering the motor.

.7 Check the voltage (volt) and the current (ampere) of each motor at the start-up and normal operation on each phase.

.8 Check the operation of the motor control centers and the switches.

.2 Ensure the presence of the manufacturer of the engine and/or the device.

.3 The motors' manufacturers must provide the start-up curves of the motor.

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1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):

.1 ANSI B16.12-2009(R2014), Cast Iron Threaded Drainage Fittings

.2 ANSI/ASME B31.1-2014 – Power Piping.

.3 ANSI/ASME B31.3-2014 – Process Piping.

.4 ANSI/ASME, Boiler and Pressure Vessel Code 2007:

.1 BPVC 2015 – Section I – Power Boilers.

.2 BPVC 2015 – Section V – Non-Destructive Examination.

.3 BPVC 2015 – Section IX – Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA):

.1 ANSI/AWWA C206-11 – Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS):

.1 AWS C1.1M/C1.1-2000(R2012) – Recommended Practices for Resistance Welding.

.2 AWS Z49.1-2012 – Safety in Welding, Cutting and Allied Process.

.3 AWS W1-2015 – Welding Inspection Handbook.

.4 Canadian Standards Association (CSA)/CSA International:

.1 CSA W47.2-2011 – Certification of companies for fusion welding of aluminum.

.2 CSA W48-14 – Filler metals and allied materials for metal arc welding.

.3 CSA B51-14 - Boiler, pressure vessel, and pressure piping code.

.4 CSA-W117.2-12 – Safety in welding, cutting, and allied processes.

.5 CSA W178.1-14 – Certification of welding inspection organizations.

.6 CSA W178.2-14 – Certification of welding inspectors.

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 00 10 – Mechanical and electrical general instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

Part 2 Product

2.1 GENERAL

.1 Piping NPS 2 or smaller: unless otherwise indicated, threaded fittings (standard threads) with union-fittings at the equipment.

.2 Piping NPS 2½ or larger: unless otherwise indicated, welded joints with flanged fittings at the equipment.

2.2 THREAD

.1 The thread must have a length equal to the threading tool's thickness and seals coated with a thick layer of paint. The paint can be replaced with Teflon tape if the temperature permits. Perfectly ream all pipe ends.

.2 Fittings with threaded joints, compliant with ANSI B16.12.

2.3 ELECTRODES

.1 Comply with relevant CSA W48 series standards.

2.4 WELDING – GENERAL

.1 All welds must be perfectly smooth and free of lumps, scales, and other imperfections.

.2 The reducers and branches made of cut and welded pipe are not accepted. Only use fittings prepared for welding.

.3 The metal used for welding connections must comply with the standard ASTM-B32 "Solder Metal".

.4 In potable domestic water systems, no filler or flux metal should have a lead content of greater than 0.2%.

.5 Soldered joint fluxes must comply with the standard ASTM-B813 "Liquid and Paste Flux for Soldering of Copper and Copper Alloy Tube".

.6 Alloys used for brazing must comply with the standard ANSI/AWS A5.5M/A5.5 "Filler Metal for Brazing and Braze Welding" and be BCuP type.

.7 Welding – Copper piping:

- .1 "Unleaded solder" means brazing with an alloy composed of antimony, copper, silver and tin (Aquasol).
- .2 "95-5 solder" means brazing with 95% tin and 5% antimony.
- .3 According to the descriptions of the piping and valves, weld copper piping with unleaded solder, 95-5, or silver solder.
- .4 DWV type: 95-5 solder.
- .5 K, L, and M types:
  - .1 NPS 2 and smaller: unleaded solder.
  - .2 NPS 2½ and larger: silver solder.

.6 Gaskets between flanged valves and copper piping are fitted with welded "wrot" wrought bronze flange couplings, with appropriate gaskets, bolts, washers, and nuts.

.7 Joints between threaded valve ends and copper piping are with copper adapters and welded male and female ends.

.8 High pressure copper pipe joints (1200 kPa or higher) are welded with silver solder, in accordance with ANSI B16.22.

.8 Welding – Steel pipe:

.1 Arc welding.

.2 Welded V-joints with piping properly prepared for this purpose. Spot weld pipes first (it must be possible to pass a thin blade between the two parts to be welded). Complete the welding only after verification. Ensure that the welding procedures used are registered with and are approved in writing by the appropriate authorities.

.3 The welders must possess the qualifications defined in the standard CSA B.51.

.4 Retain the services of qualified welders possessing certification issued by the appropriate authority for each welding process used.

.5 Present the welders' certificates of qualification.

.6 Each welder must identify his work with a stamp that provided to him by the appropriate authority.

.7 For the verification of weld quality, a visual examination by a specialized independent laboratory and samples may be required, and this at the expense of the relevant section.

.9 Welding – Stainless steel piping:

.1 TIG welding (arc welding, according to the Heliarc method), without filler metal. Use argon as the inert shielding gas from the ambient air.

.2 Adequately purge the inside of the pipe and use argon as the carrier gas during the welding.

.3 Welded V-joints with piping properly prepared for this purpose. Spot weld pipes first (it must be possible to pass a thin blade between the two parts to be welded). Complete the welding only after verification. Ensure that the welding procedures used are registered with and are approved in writing by the appropriate authorities.

.4 Retain the services of qualified welders possessing certification issued by the appropriate authority for each welding process used.

.5 Present the welders' certificates of qualification.

.6 Each welder must identify his work with a stamp provided to him by the appropriate authority.

.7 For the verification of weld quality, a visual examination by a specialized independent laboratory and samples may be required, and this at the expense of the relevant section.

Part 3 Execution

3.1 QUALITY OF THE WORK EXECUTION

.1 Execute the welding work in accordance with the standards ANSI/ASME B31, ANSI/ASME Boiler and Pressure Vessel Code, sections I and IX, and ANSI/AWWA C206, by using methods compliant to the AWS standards B.3 and C1.1 and the relevant requirements of the relevant provincial authorities.

3.2 REQUIREMENTS RELATED TO THE INSTALLATION OF COMPONENTS NECESSARY FOR PIPE WELDING

.1 Each weld must bear the mark of a welder who did it.

.2 Backup rings:

- .1 If necessary, adjust the rings so as to minimize the space between themselves and the inner pipe wall.
- .2 Do not install rings for orifice flanges.

.3 Fittings:

- .1 Fittings NPS 2 and smaller: welded couplings.
- .2 Bypass fittings: welded tees or wrought fittings.

3.3 INSPECTIONS AND CONTROLS – GENERAL REQUIREMENTS

.1 Before starting the work, review with the Engineer all requirements relating to the quality of the welds and the acceptable defects indicated in the relevant standards and codes.

.2 Establish an inspection and control plan for approval by the Engineer.

.3 Do not conceal welds until they have been examined, subjected to controls, and approved by an inspector.

.4 Allow the inspector to visually inspect welds at the start of welding work, as required by the Welding Inspection Handbook. If necessary, repair or redo defective welds according to the requirements of the relevant codes and the specification's requirements.

.5 Definitions:

- .1 Tests:
  - .1 Procedures for all visual observations and non-destructive testing, such as: radiography and ultrasound.
- .2 Inspection:
  - .1 Performance verification of the tests mentioned above.
  - .2 Note: the welds that do not require testing by the standard B31.1 will be deemed acceptable if they pass the visual inspection and the pressure testing.
- .3 Hydrostatic test:
  - .1 Air vents at high points to remove air during the filling.
  - .2 Media: water.

.3 All equipment and accessories that cannot withstand the test pressure must be disconnected or isolated.

.4 Test pressure: minimum of 1.5 times the design pressure for a minimum period of two hours, then the test pressure may be reduced to the design pressure and that for the entire period required to inspect the network and detect leaks.

.5 Do not perform any tests with air, unless the piping system is designed not to be filled with water, the pipe system cannot tolerate traces of the test media.

.4 Visual examination:

.1 Visual examination must be performed by a specialized independent laboratory under the responsibility of the Contractor.

.2 The following indications are unacceptable:

.1 Cracks on the outer surface.

.2 Undercut (maximum 0.8 mm).

.3 Reinforcement (maximum 1.6 mm).

.4 Lack of fusion at the surface.

.5 Incomplete penetration (when the inner surface is accessible).

.5 Pressure test:

.1 Boiler external piping:

.1 Hydrostatic test according to ASME section 1 PG-99. These tests must be performed in the presence of an authorized inspector.

.2 Other piping.

.6 Non-destructive test requirements for the welds:

Description	Operating conditions		
Temperature	400°C or lower	401°C or higher	175°C < T < 450°C
Pressure	All	All	P > 7100 kPa
Weld type: Butt weld Circumference – Longitudinal	Visual inspection – Pressure test	RT for NPS 2 or larger. RT or MT for NPS 2 or smaller.	RT for NPS 2 and walls ¾" or larger. Visual for walls ¾" or smaller, for all diameters.
Soldered connection	Visual inspection – Pressure test	RT for NPS 4 or larger MT or PT for 4" in diameter or smaller.	RT pour branches > NPS 4 and walls ¾" or larger. Visual for walls ¾" or smaller, for all diameters.
Fillet welding, socket, tab, sealing solder	Visual inspection – Pressure test	PT or MT for all dimensions and thicknesses.	Visual for all the diameters and the walls.

RT : radiographic testing
MT : magnetic particle testing
PT : penetrative liquid testing

3.4 REJECTED WELD REPAIRS

.1 Subject welds that have been repaired or redone to new inspections and controls, and this, at no additional cost.

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1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B31.1-07 – Power Piping.

.2 ASTM International:

.1 ASTM-A125-1996(2007) – Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM-A307-07b – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM-A563-07a – Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM).

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP58-2002 – Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003 – Pipe Hangers and Supports – Selection and Application.

.3 MSS SP89-2003 – Pipe Hangers and Supports – Fabrication and Installation Practices.

.5 Underwriters' Laboratories of Canada (ULC).

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 20 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.3 Shop drawings:

.1 Submit shop drawings for the following elements:

.1 Supports, bases and suspensions.

.2 Attachments to the devices and to the building structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

.5 Manufacturer instructions:

.1 Submit installation instructions provided by manufacturer.

1.4 CLOSEOUT SUBMITTALS

.1 Submit required documents in accordance with section 20 00 10 – Mechanical and electrical general instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 20 00 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving:

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

Part 2 Product

2.1 SYSTEM DESCRIPTION

.1 Design requirements:

.1 The piping support must be executed according to manufacturer's recommendations, by means of common parts, components, and assemblies.

.2 The maximum load ratings must be determined from the indications concerning allowable stresses, contained in the standards ASME B31.1 or MSS SP58.

.3 The supports, the guides, and the anchors must not transmit too much heat to the building’s structural members.

.4 The supports and the hangers must be designed to support the pipes, the air ducts, and the mechanical equipment in operating conditions, allow the contraction and the expansion movements of supported elements, and prevent excessive stress on the pipes and the devices to which these are connected.

.5 The supports and the hangers must be vertically adjustable after their installation and during the commissioning of the installations. The extent of the adjustment must conform to MSS SP58.

2.2 GENERAL

.1 The components covered by this section must be used for support purposes only. They must not be used to lift, raise, or support other components or devices.

.2 Adequately support to the building’s framework all the piping, equipment, and devices. These supports include all steel structures, steel beams, angle irons, steel angles, steel rods, steel plates, supports from specialised manufacturers, and other accessories needed for this work and all drilling and welding work required.

.3 The supports must be adjustable in length.

.4 The supports must have the strength necessary for all trial, testing, and normal operation conditions.

.5 The supports must allow for the normal expansion and contraction of the piping in all trial, testing, and operation conditions, thus avoiding the transmission of undue forces onto the devices and the structure.

.6 The horizontal and vertical piping must be supported in areas where the vertical displacement of the piping is the smallest.

.7 The vertical piping must be independently supported from the connections and the horizontal branches.

.8 The supports must be installed so as to give the required slopes for the pipes.

.9 When the movement of the horizontal pipe between the two positions hot and cold is such that it causes an angle greater than 4° between the support rod and the vertical, install the pipes' supports and its attachments so that the rod is vertical in the hot position of the pipe.

.10 Install the spring supports at uneven distances to prevent resonance effects.

.11 Completely install, outside the insulation, all piping supports for chilled water, domestic cold water, and water tower water (insulated). Install steel saddles with two grooves of appropriate length and width at each support to distribute the weight, to the satisfaction of the "THERMAL INSULATION" section which provides a rigid material over the entire length of the saddle.

.12 When several horizontal pipes are supported at the same level, build trapezoidal type supports or other types with steel angles, of a welded construction and made with angle iron or I beams, of sizes proportionate to the loads and firmly anchored to the framework with steel rods or anchor bolts, according to the media type. The spacing between the trapezoidal supports must be determined based on the supported pipe with the smallest diameter.

.13 Install the supports in the mechanical shafts, in the same horizontal plane, to allow for the installation of a floor by others.

.14 Submit shop drawings of all the types of supports before their manufacturing and installation.

.15 Finish:

- .1 The supports and the hangers must be galvanized.
- .2 For copper or brass piping, isolate the support with a strip of neoprene or plastic placed between the support and the pipe. Alternatively, tin the portion of the pipe in contact with the support.

.16 Prohibited work:

- .1 The use of perforated or non-perforated metal strips or any other type of non-adjustable supports is prohibited.
- .2 Using power socket is prohibited.

.3 It is not allowed to support onto precast concrete structures, unless specially permitted by the structural Engineer who will decide what procedure to follow.

.4 No pipe must be used as an attachment point to support another pipe.

2.3 ANCHORS – GENERAL

.1 Adequately guide and anchor all piping to allow proper functioning of the expansion loops, the expansion joints, and the ball joints, and to avoid stress at joints and any pipe warping.

.2 Manufacture the anchors from steel framework using fully welded construction, and solidly fixe to the building's frame.

.3 In general, attach the anchors to the main beams and the cast slabs, but not to prestressed or prefabricated slabs.

.4 The frame should not be damaged by the anchors.

.5 Submit the position of the anchors and the appropriate construction drawings for verification by the structural Engineer.

.6 Design the anchors so that they do not transmit excess heat to the building's steel framework.

.7 The temperature of the anchors' component must be based on a 2.2°C temperature variation factor per mm of distance between the outer surface of the piping and the steel framework.

.8 Securely anchor all piping connected to a device by means of flexible connections.

.9 See the anchor details for piping.

2.4 PIPE HANGERS

.1 The rods for the supports suspended from the ceiling are selected as follows:

.1 Before the concrete is poured: use special concrete inserts (Grinnell fig. 282 type).

.2 After the concrete is poured: using a dowel or expansion anchor combining drill and anchor, such as Hilti HDV and Kwick Bolt TZ or approved equivalent. The dowels must not damage the rebars in the concrete.

.3 Beam clamps for beams and other steel works (like Grinnell fig. 292, 94 and 92), appropriately sized for the load.

.4 For very large pipes, heavy devices, devices subject to vibrations, and anchors subject to considerable loads, install the support rods through the slab, welded to steel plates above the latter. 150 mm x 150 mm x 6 mm steel plates or larger, according to the load.

.5 Consult the structural Engineer for these special cases.

.2 Hanger rods: threaded, compliant with MSS SP58.

.1 The suspension rods must not be subjected to stresses other than tensile loads.

.2 Hinge components must be provided as required to allow the horizontal movement and the vertical movement of the supported pipe.

2.5 ROD DIAMETERS AND SPACING OF MECHANICAL SUPPORTS

.1 Mild steel support rods, of suitable diameter, and provided with threading of sufficient length to permit level adjustment of the pipes. Each rod with washers, two clamping bolts.

.2 Spacing:

.1 The distance between the supports must be within the maximum allowable spacing indicated in the following tables. Also, provide a supports at very direction change.

.1 Steel piping:

Piping nominal diameter	Rod diameter	Maximum horizontal spacing
NPS ½	9.5 mm	1.5 m
NPS ¾	9.5 mm	1.8 m
NPS 1	9.5 mm	2.1 m
NPS 1¼	9.5 mm	2.4 m
NPS 1½	9.5 mm	2.7 m
NPS 2	9.5 mm	3 m
NPS 2½	12.7 mm	3.4 m
NPS 3	12.7 mm	3.7 m
NPS 4	15.9 mm	4.3 m
NPS 5	15.9 mm	4.9 m
NPS 6	19 mm	5.2 m
NPS 8	22.2 mm	5.8 m
NPS 10	22.2 mm	6.7 m
NPS 12	22.2 mm	7 m
NPS 14	25.4 mm	7.6 m
NPS 16	31.8 mm	8.3 m
NPS 18	31.8 mm	8.5 m
NPS 20	31.8 mm	9.1 m
NPS 24	38.1 mm	9.8 m

.2 Copper or brass piping:

Piping nominal diameter	Rod diameter	Maximum horizontal spacing
NPS 1 or smaller	9.5 mm	1.8 m
NPS 1¼	9.5 mm	2.1 m
NPS 1½	9.5 mm	2.4 m
NPS 2	9.5 mm	2.7 m
NPS 2½	12.7 mm	3 m
NPS 3	12.7 mm	3.4 m
NPS 3½	12.7 mm	3.7 m
NPS 4	15.9 mm	3.7 m
NPS 5	15.9 mm	3.7 m
NPS 6	19 mm	4.3 m
NPS 8	22.2 mm	4.9 m
NPS 10	22.2 mm	5.6 m
NPS 12	22.2 mm	5.8 m

.3 PVC or fibre-reinforced plastic (FRP):

Piping nominal diameter Schedule 80	Rod diameter	Maximum horizontal spacing
NPS ½ to NPS 1¼	9.5 mm	1.2 m
NPS 1½ to NPS 2	9.5 mm	1.8 m
NPS 2½	9.5 mm	2.4 m
NPS 3	12.7 mm	2.4 m
NPS 4	12.7 mm	2.4 m
NPS 6	15.9 mm	3 m
NPS 8	15.9 mm	3 m
NPS 10	15.9 mm	3 m
NPS 12	15.9 mm	2.4 m
NPS 14	19 mm	2.4 m
NPS 16	19 mm	2.4 m
NPS 18	19 mm	2.4 m
NPS 20	19 mm	1.8 m
NPS 24	22.2 mm	2.4 m

.4 Note: steel supports and rods. In places where there is a risk of corrosion, the hangers and the rods are to be constructed of FRP fiberglass, welded steel painted with epoxy resin, and stainless steel 304.

2.6 SUPPORTS FOR HORIZONTAL PIPING

.1 Adjustable saddle support: fitted with a bolt with nipple-spacer, a vertical adjustment nut and a locknut, compliant with the standard MSS SP69.

.2 Pipe roller supports: with carbon steel yoke, rod, and nuts, and cast iron roller, compliant with the standard MSS SP69.

.3 U-bolts: carbon steel, compliant with MSS SP69, with two (2) nuts at each end compliant with the standard ASTM-A563.

.4 Pipe roller stands: cast iron stand and roll and carbon steel support rod, compliant with the standard MSS SP69.

.5 Steel piping:

.1 Adjustable Clevis type hanger, Grinnell fig. 260.

.6 Copper or brass piping:

.1 Piping NPS 4 or smaller:

.1 Hangers in contact with the piping, adjustable Clevis type, copper plated, Grinnell fig. CT-65.

.2 In other cases, Grinnell fig. 65.

.2 Piping NPS 5 or larger: adjustable Clevis type hanger, Grinnell fig. 260.

.7 Cast iron drainage plumbing and vent with mechanical joints:

.1 Hangers painted with minimum (red lead), series no. 6600 (Fonderie Bibby Ste-Croix).

.8 In places where the horizontal pipe is too close to the tiles to allow the installation of no. 260 hangers, in technical tunnels (installed on steel supports of worked metal), and to allow the pipe to expand in both the longitudinal and lateral directions of the pipe, provide and install supports allowing horizontal sliding. These sliders consist of two adequately supported horizontal steel plates sliding on graphite plates, according to the weight and the longitudinal movements required. Grinnell fig. 257, type 4, 5, 6 or 7.

.9 Installation:

.1 Horizontal aboveground piping: depending on the material and diameter, support the horizontal pipe at the following maximum distances:

.1 Steel, copper, or brass: as indicated in paragraph "ROD DIAMETERS AND SPACING OF MECHANICAL SUPPORTS".

.2 Lead: over its entire length.

.3 Cast iron: at each socket or each joint, the interval between two supports should not exceed 3 m, at every meter when adjacent connections spaced by 300 mm or less are installed on piping with mechanical seals.

.4 Plastic: every 1.2 m, at the end of any connection, at any change of direction, as close as possible to the trap if this is a device's drain pipe longer than 2 m.

.2 Horizontal underground piping:

.1 The horizontal underground piping must rest its full length on a uniform and firm bed. Any material used for leveling must be compacted and free of rocks, ash, or frozen earth. Provide pockets where the collars are placed in order to facilitate making the joints. The socketing must be done carefully to ensure the seamless extension of the interior walls.

.3 Support for a vent above the roof:

.1 When a vent pipe extends above a roof, it must be securely supported and anchored so as to maintain its alignment.

.4 Supports at mechanical joints:

.1 Install the supports so as to allow the joints to slide and to prevent the direct transmission of vibration by the piping. Install the supports in accordance with the manufacturer's instructions.

2.7 SUPPORTS FOR VERTICAL PIPING

.1 Steel or cast iron piping, drainage, and vents, steel pipe clamps, compliant with the standard MSS SP58, or corrugated steel and U-bolts, Grinnell, fig. 137.

.2 Copper or brass piping, copper plated carbon steel clamps, compliant with MSS SP58, Grinnell, fig. CT-121.

.3 If the liquid’s temperature does not exceed 100°C, a support with plastic covering may be used, Grinnell, type 42, fig. CT-121C.

.4 Bolts: compliant with the standard ASTM-A307.

.5 Nuts: compliant with the standard ASTM-A563.

.6 Installation: support or guide the pipes at each floor.

.1 To prevent piping slip:

.1 Cast iron piping with mechanical joints: use fittings with outer shoulders.

.2 Steel pipe: weld steel furring to the plumbing.

.3 Copper or brass pipe: weld copper rings to the pipe.

.2 The maximum distance between two supports must never exceed 6 m (20').

.3 Depending on the material and the diameter, vertical piping must be supported at the following maximum distances:

.1 Lead: every 1.2 m.

.2 Copper or brass: every 2 m for NPS 1¼ or smaller or every 3 m for NPS 1½ and larger.

.3 Cast iron with mechanical joints or compression fittings: at all joints.

.4 Plastic: every 1.2 m.

.4 The base of a cast iron column must rest on a concrete pillar, a masonry pillar, or another equivalent material, unless properly suspended or anchored to the building framework.

2.8 SADDLES

.1 Thermally insulated pipes:

.1 Shields consist of a 300 mm long curved plate, with raised edges, with welded central reinforcement for pipes of nominal diameters equal to or larger than NPS 12, carbon steel, compliant with the standard MSS SP69.

.2 Ribbed shields, fig. 251 or 251S from E. Myatt or 168 from Grinnell.

2.9 SUPPORTS FOR DEVICES

.1 When they not provided by the devices' manufacturer, the components for their support must be made of structural steel. Submit the calculations with the shop drawings.

.2 Devices rigidly suspended by four threaded rods:

MAXIMUM WEIGHT OF THE SUSPENDED DEVICE, ACCORDING TO THE LENGTH AND THE DIAMETER OF THE RODS, FOR INSTALLATION WITHOUT STIFFENER OR BRACING
POUNDS (KG)

Maximum length of the threaded rods		Threaded rod diameter								
		in	¼	3/8	½	5/8	¾	7/8	1	1 ¼
in	mm	mm	6.4	9.5	12.7	15.9	19	22.2	25.5	31.8
15	381		870 (395)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
18	457		830 (377)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
21	533		670 (305)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
24	610		550 (250)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
27	686		460 (209)	2210 (1005)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
30	762		390 (177)	1960 (891)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
33	838		320 (145)	1720 (782)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
36	914		270 (123)	1520 (691)	4100 (1864)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
39	991		230 (105)	1350 (614)	3870 (1759)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
42	1067		200 (91)	1200 (545)	3490 (1586)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
45	1143		180 (82)	1080 (491)	3170 (1441)	6580 (2991)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
48	1219		160 (73)	960 (436)	2890 (1314)	6460 (2936)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
51	1295		140 (64)	850 (386)	2650 (1205)	5950 (2705)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
54	1372		---	770 (350)	2440 (1109)	5490 (2495)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
57	1448		---	690 (314)	2240 (1018)	5090 (2314)	9850 (4477)	13700 (6227)	18030 (8195)	29090 (13223)
60	1524		---	630 (286)	2070 (941)	4730 (2150)	9380 (4264)	13700 (6227)	18030 (8195)	29090 (13223)
63	1600		---	570 (259)	1910 (868)	4410 (2005)	8770 (3986)	13700 (6227)	18030 (8195)	29090 (13223)
66	1676		---	530 (241)	1750 (795)	4120 (1873)	8220 (3736)	13700 (6227)	18030 (8195)	29090 (13223)

Note: this table is valid for the Montreal and the Ottawa/Gatineau regions. In the Quebec City region, it is valid for levels below mid-height of the building. This table takes into account the paraseismic measures, for devices suspended with four threaded rods, without spring, stiffening, or bracing.

MAXIMUM WEIGHT OF THE SUSPENDED DEVICE, ACCORDING TO THE LENGTH AND THE DIAMETER OF THE RODS, FOR INSTALLATION WITHOUT STIFFENER OR BRACING
POUNDS (KG)

Maximum length of the threaded rods		Threaded rod diameter								
		in	¼	0.375	½	0.625	¾	0.875	1	1 ¼
in	mm	mm	6.4	9.5	12.7	15.9	19	22.2	25.5	31.8
9	229		470 (214)	1340 (609)	2580 (1173)	4230 (1923)	6410 (2914)	8980 (4082)	11830 (5377)	19100 (8682)
12	305		410 (186)	1260 (573)	2490 (1132)	4130 (1877)	6290 (2859)	8840 (4018)	11710 (5323)	19100 (8682)
15	381		330 (150)	1170 (532)	2390 (1086)	4010 (1823)	6160 (2800)	8690 (3950)	11550 (5250)	18930 (8605)
18	457		260 (118)	1070 (486)	2270 (1032)	3880 (1764)	6020 (2736)	8540 (3882)	11380 (5173)	18730 (8514)
21	533		210 (95)	960 (436)	2150 (977)	3740 (1700)	5860 (2664)	8370 (3805)	11200 (5091)	18520 (8418)
24	610		170 (77)	830 (377)	2010 (914)	3590 (1632)	5700 (2591)	8190 (3723)	11000 (5000)	18290 (8314)
27	686		140 (64)	710 (323)	1870 (850)	3430 (1559)	5520 (2509)	8000 (3636)	10800 (4909)	18060 (8209)
30	762		120 (55)	620 (282)	1710 (777)	3260 (1482)	5340 (2427)	7800 (3545)	10580 (4809)	17810 (8095)
33	838		100 (45)	540 (245)	1530 (695)	3080 (1400)	5140 (2336)	7580 (3445)	10360 (4709)	17550 (7977)
36	914		80 (36)	480 (218)	1360 (618)	2880 (1309)	4930 (2241)	7360 (3345)	10120 (4600)	17290 (7859)
39	991		70 (32)	420 (191)	1220 (555)	2680 (1218)	4710 (2141)	7120 (3236)	9870 (4486)	17010 (7732)
42	1067		60 (27)	380 (173)	1100 (500)	2440 (1109)	4480 (2036)	6880 (3127)	9610 (4368)	16720 (7600)
45	1143		50 (23)	340 (155)	1000 (455)	2220 (1009)	4230 (1923)	6620 (3009)	9340 (4245)	16410 (7459)
48	1219		50 (23)	300 (136)	910 (414)	2040 (927)	3980 (1809)	6350 (2886)	9050 (4114)	16100 (7318)
51	1295		40 (18)	270 (123)	830 (377)	1870 (850)	3680 (1673)	6070 (2759)	8760 (3982)	15780 (7173)
54	1372		40 (18)	240 (109)	770 (350)	1730 (786)	3410 (1550)	5780 (2627)	8450 (3841)	15440 (7018)
57	1448		30 (14)	220 (100)	710 (323)	1600 (727)	3170 (1441)	5480 (2491)	8140 (3700)	15090 (6859)
60	1524		30 (14)	190 (86)	650 (295)	1490 (677)	2960 (1345)	5120 (2327)	7810 (3550)	14740 (6700)
63	1600		30 (14)	180 (82)	600 (273)	1390 (632)	2770 (1259)	4800 (2182)	7470 (3395)	14370 (6532)
66	1676		20 (9)	160 (73)	550 (250)	1300 (591)	2590 (1177)	4510 (2050)	7110 (3232)	13990 (6359)

Note: this table is valid for the Quebec region for levels located above the mid-height of the building. This table takes into account the paraseismic measures, for a device suspended with four threaded rods, without spring, stiffening, or bracing.

2.10 ANCHOR BOLTS AND TEMPLATE

.1 Provide templates that will help determine the exact location of the anchor bolts.

2.11 MANUFACTURER LIST

.1 Manufacturer list, section 23 05 29.

.1 Supports:

.1 Cantruss

.2 Grinnell

.3 Fonderie Bibby Ste-Croix

.4 Myatt

.2 Bolts and anchors:

.1 Hilti

.2 Phillips Red-Head

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with the requirements, the recommendations, and the manufacturer's written specifications, including product technical bulletins, instructions for handling, storage, and product installation, and technical information sheets.

3.2 HANGER INSTALLATION

.1 Install the hangers so that the rods are properly vertical during operating conditions.

.2 Adjust the height of the rods so that the load is evenly distributed among the hangers.

.3 Fix the hangers to the framework. In this regard, supply and install any additional metal framing members necessary if there are no structural supports provided at to mounting points or if the anchoring sleeves are not arranged at the required locations.

3.3 HORIZONTAL MOVEMENT

.1 The inclination of the suspension rods resulting from the horizontal movement of the pipe from the "cold" to the "hot" position must not exceed 4° relatively to the vertical.

.2 When the horizontal movement of the pipe is less than 13 mm, shift the supports or the hangers so that the rods are vertical in the "hot" position.

3.4 FINAL ADJUSTMENT

.1 Hangers and Supports:

.1 Ensure that in operating conditions, the pipe suspension rods are oriented vertically.

.2 Balance the loads.

.2 Adjustable cradles:

.1 Tighten the vertical adjustment nut to optimize the performance of the cradle.

.2 Tighten the locknut once the adjustment is completed.

.3 C-clamps:

.1 Fix the C-clamps to the bottom flange of the beams in accordance with the manufacturer's recommendations, and tighten to the torque specified by the latter.

.4 Beam fixation:

.1 Using a hammer, firmly secure the clamp to the beam’s lower flange.

END OF SECTION

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Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Health Canada/ Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheet (MSDS).

.2 National Fire Protection Association (NFPA):

.1 NFPA-13 – Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (CNB) – 2010.

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section ~~20~~01 00 10 – Mechanical and electrical general instructions.

.2 Submit shop drawings required in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.1 Shop drawings: shop drawings must include the seal and signature of a professional Engineer recognized in Canada.

.2 Submit a distinct shop drawing for each independent system, the complete installation drawings, and the technical and performance documentation.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging, shipping, handling and receiving:

.1 Transport, store and handle materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

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

1.5 SCOPE OF THE WORK

.1 Work included:

.1 In general, the work includes the calculation, the supply, the supervision, and the responsibility for all materials and equipment necessary for the mechanical and electrical work on seismic restraint systems:

.1 In the event that the work or a sector of the works does not require seismic restraint systems, a letter signed and sealed by a seismic Engineer is required to confirm this fact.

.2 The calculations, the assumptions, the factors, and the installation details for the seismic restraint systems needed to meet the required standards. A signed and sealed Engineering report is required by a seismic Engineer for any new construction. This report also testifies the compliance with the various codes. This report is also required for retrofitting (renovation) projects, whose works include the installation of new equipment and distribution networks. A report must also be produced by the same Engineer for the purpose of work acceptance.

.3 Supplying seismic restraint systems and delivering this equipment to the site are this section's responsibility.

.4 The supervision of the installation of all mechanisms used for seismic control and the presentation of a compliance report issued by the seismic Engineer attesting the installations' compliance with the requirements stated in this report and those dictated by the Quebec Construction Code. A certificate of compliance will be issued prior to the work acceptance.

.5 Seismic control mechanisms include, for each discipline, but are not limited to:

.1 Braces and stiffeners at the supports (if required) for mechanical piping and electrical conduits.

.2 Properly anchoring all devices not fitted with vibration isolators to the framework (anchored directly to the framework), whether they be mechanical or electrical.

.3 Seismic mechanisms of all pipes and devices replaced or equipment fitted with vibration isolators.

.4 Properly anchoring all pipes and devices with vibration isolators to the framework.

.2 Work excluded:

.1 In general, the following work is excluded:

.1 The storage of equipment provided by this section (at the expense of the relevant section).

.2 The installation of equipment provided by this section (at the expense of the relevant section).

1.6 RESPONSIBILITIES

.1 Each section (plumbing, heating - chilled water and electrical) remains responsible for its discipline's seismic restraints systems.

.2 It is to be noted that only each relevant section knows the details, the dimensions, and the run of the mechanical pipes, the ventilation ducts, and the electrical conduits, and the names of the manufacturers that provide the devices (boilers, pumps, chillers, ventilation units, water towers, MCC, etc.).

.3 Each section retains the services of an experienced professional to design, supply, and supervise the installation of all the seismic restraint systems. This professional must have recognized expertise in the field of seismic protection for similar electromechanical installations.

.4 The consultant specialized in seismic control is responsible towards the section of the discipline concerned with the design, the supply, and the supervision of the installation of their seismic restraint systems of the concerned discipline. He remains the supervisor of the seismic measurements' structural integrity of the concerned discipline. This design report will be transmitted to the Engineering consultant for information.

.5 Each relevant section hires a consultant specializing in seismic design, whose specialized Engineer performs the calculations and elaborates the installation details for the seismic restraint systems. Before the end of the work, he must produce a compliance report for the installed seismic restraint systems. This report must be signed by the same Engineer who signed the design report.

1.7 SEISMIC CONTROL STANDARDS

.1 Unless otherwise indicated, the seismic restraints systems and the required anchors should be designed and selected to meet the requirements of the latest edition of:

.1 Construction Code of Quebec.

.2 NFPA (fire protection).

.3 CSA S86, S832.

.4 FEMA-450r1 (for existing buildings and for reference).

.5 The best Engineering (accepted) practices are also detailed in ASHRAE (Practical Guide to Seismic Restraint) and SMACNA (Seismic Restraint Manual – Guidelines for Mechanical Systems).

.6 The standards FEMA-172 and FEMA-365 must be used for the seismic rehabilitation of an existing building.

.2 The seismic zone considered is the following: Saint-Hubert: $S_a(0.2) = 0.64$.

.3 The site acceleration factor F_a to be considered in the calculations comes from the data sent by the structural Engineer which is related to the soil profile (zone category). In the context of this project, the zone category is E.

.4 Seismic importance factor I_E:

.1 Mechanical piping, ventilation ducts, and electrical conduits anchored directly (rigid fixation) to the framework: Civil protection: $I_E = 1.5$.

.5 For Saint-Hubert:

Description	Location Category: E and I_E = 1.5		
	Lateral force V_p (g)		
	Ground level	Mid-height	Roof
Flat bottom tank (with contents) attached directly to a floor located at ground level or below it in a building (table 4.1.8.18 no. 13).	0.10	0.20	0.30
Rigid components with non-ductile materials or assemblies (table 4.1.8.18 no. 19).	0.35	0.71	1.06
Flat bottom tank (with contents) attached directly to a floor located at ground level or below it in a building containing toxic or explosive substances, liquids with a flash point below 38°C (100°F), or fire-extinguishing liquids (Table 4.1.8.18 No. 14).	0.14	0.28	0.43
Rigid components with ductile materials and assemblies (table 4.1.8.18 no. 18).			
Machinery, accessories, equipment, conduits, and reservoirs (with contents) containing toxic or explosive substances, liquids with a flash point inferior to 38°C (100°F), or fire-extinguishing liquids (rigid with rigid assembly and flexible with flexible assembly) (table 4.1.8.18 no. 12).	0.53	1.06	1.60
Electrical cable trays, bus bar ducts, conduits (table 4.1.8.18 no. 17).	0.18	0.35	0.53
Flexible components with non-ductile materials or assemblies (table 4.1.8.18 no. 21).	0.89	1.77	2.66
Machinery, accessories, equipment, conduits, and reservoirs (with contents) (rigid with rigid assembly or flexible with flexible assembly) (table 4.1.8.18 no. 11).	0.35	0.71	1.06
Flexible components with ductile materials and assemblies (table 4.1.8.18 no. 20).			
Pipes and ducts (with contents) containing toxic or explosive materials (table 4.1.8.18 no. 16).	0.18	0.35	0.53
Pipes and ducts (with contents) (table 4.1.8.18 no. 15).	0.12	0.24	0.35

.6 For buildings other than those for civil protection, if the product $I_E*F_a*S_a(0.2)$ is less than 0.35, the seismic restraint systems may be omitted.

.7 Other coefficients (Cp, Ar, Ax, R_p) are according to the Quebec Construction Code.

.8 For non-ductile assemblies, the adhesives, or the compressive anchor cartridges, the R_p value is 1.0.

.9 For superficial, chemical, epoxy resin, or embedded anchors, the R_p value is 1.5 if the embedding length/diameter ratio is less than 8.

.10 Anchor cartridges and simply installed anchors should not be used as anchors to resist tensile loads.

.11 Installation:

.1 For I_E = 1.5 : at the least, the following systems must remain operational during and after an earthquake:

.1 Heating and steam piping installations.

.2 Communication system.

.3 Static uninterruptible power supply.

.4 Emergency generating units.

.5 Fire protection system.

.6 Elevators.

.7 Those identified by the Owner.

.2 Submit a complete dynamic analysis of the systems and the equipment referred to above, provide details concerning the maximum planned forces that will be applied to the equipment, and make recommendations for modifications or additional supports aiming to maintain the equipment in good working condition.

1.8 CALCULATIONS

.1 The consultant specializing in seismic restraint systems must obtain from the relevant mechanical or electrical section all information relating to devices, pipes, ventilation ducts, and electrical conduits required for the seismic restraint calculations (weight, type of fluid number, thermal insulation, run, spacing between supports, groups on trapeze supports).

.2 The consultant specializing in seismic restraint systems must obtain from the manufacturers of each device and equipment of the concerned discipline, the characteristics required in article "SHOP DRAWINGS AND DEVICES" in section 20 00 10 – Mechanical and electrical general instructions (weight, location of the center of gravity, number of attachment points, location of the center of gravity of the mounting points, rotational speed, seismic fragility of the internal components, etc.).

.3 The calculation parameters, the calculations, and the installation details for the anchor bolts and the seismic restraint systems should be checked by an Engineer specializing in seismic control design.

.4 For vertical loads or equipment overturning risks, use the equations detailed in the standard FEMA 450-1.

.5 Provide for information: the seismic Engineer’s design report, the parameters or the values used in compliance with the Building Code of Québec, the bases of calculations, the data of the analyzed equipment or networks, the calculations for seismic bracing, the overturning calculations, the overturning moments, the anchor calculations, the recommended restraint systems, and the installation details, and this for each installed network and equipment. Provide the plans locating the restraints and the drawings for each device along with product specifications.

.6 In the event that the weight of a tank/equipment and its contents have a mass greater than 10% of the floor’s mass, the seismic forces will need to be subject of a rational analysis.

.7 Confirm with calculations that if rigid braces are installed, no undue force will be applied to the supports.

.8 Also, see the article "SEISMIC STANDARDS".

1.9 DOCUMENTS TO PROVIDE

.1 Provide the shop drawings of the seismic restraint systems, the calculations, and the calculation coefficients.

.1 The calculation coefficients represent the categories for location, risk, seismic zone, building height, height of installation, and all required parameters listed in the Quebec Construction Code.

.2 For each electromechanical device, provide:

.1 The identification.

.2 The manufacturer's name and the model.

.3 The physical dimensions.

.4 The weight.

.5 The location of the center of gravity (indicate whether the location was obtained from the manufacturer of the device or supposed).

.6 The location and the number of attachment points.

.7 The location of the attachment points' centers of gravity (when the center of gravity is different from the unit's center of gravity).

.8 The rotational speed (if applicable).

.9 The seismic fragility of the internal components of the device.

.10 The horizontal and vertical force considered in the calculations.

.11 For civil protection projects, I_E = 1.5: the OSHPD Special Seismic Certification or the certification from the manufacturer confirming the capability of the equipment to withstand seismic forces and the confirmation that it will remain operational during and after an earthquake.

.3 Anchor bolt calculations indicating:

.1 The type of bolts, the manufacturer, and the model.

.2 The diameter.

.3 The embedment depth in the concrete.

.4 The concrete's compressive strength.

.5 The minimum spacing between the bolts and the concrete bases' edges.

.6 The applied and allowable stresses in shear and in tension.

.7 The overturning moments.

.8 The component's opposing (righting) moment.

.4 The types of mechanical seismic restraint systems for each device and indicate the characteristics of the cables and the rigid structural members, as well as the various elements of the seismic restraint system.

.5 For I_E = 1.5: present calculations or test results (or both) demonstrating that the equipment and systems listed in paragraph 1.4.2.2 can remain operational during and after an earthquake.

.6 For I_E = 1.5: the consultant specialized in seismic control should submit the 100% complete documents, prepared in accordance with the quality standard, and of the same dimensions as the construction documents that constitute the tender documents. These must contain in entirety the working drawings, the list of equipment, the design calculations, the drawings, and the specifications that are used for the detailed design of the seismic restraint systems.

.2 The consultant specializing in seismic control must provide a written document countersigned by the relevant section certifying that the plans, the specifications, the shop drawings, the products supplied, and the installation have been checked by an Engineer specializing in seismic design, and are adequate and compatible with the entire building, while respecting the seismic design standards, and must provide a compliance report.

.3 Provide the following documents:

.1 The operation and maintenance instruction manuals.

.2 The plans maintained up to date.

1.10 SEPARATE PRICES

.1 See the article "INSTRUCTIONS TO BIDDERS – SEPARATE PRICES".

.2 Upon submission of the tender, present an overall price covering the calculations, the supply, and the supervision of seismic restraint systems for each of the relevant disciplines.

1.11 INSPECTIONS

.1 After having installed all rigid and flexible restraints and ensured proper operation under standard operating conditions, proceed to the seismic restraint system inspection and repairs.

.2 The specialized consultant will inspect all seismic restraint system installations it has calculated and provided. Submit a written report signed by the same Engineer who produced the design report including, among other things:

.1 The installation errors with the corrective actions to be implemented.

.2 The improperly (inappropriately) selected seismic dampers.

.3 The other deficiencies that could affect the proper operation of seismic restraint systems with the corrective actions to be implemented.

.4 The steps to correct the installations.

.5 The electromechanical installation’s signed certification of compliance with the standards previously listed, to be issued once all defects or errors have been corrected. This report must be delivered to the Consulting Engineer prior to the work acceptance.

Part 2 Product

2.1 GENERAL

.1 All seismic restraint systems must be fully integrated and compatible with the noise reduction requirements and the anti-vibration systems of the mechanical and electrical equipment and the related systems, as specified in the documents.

.2 The seismic restraint systems must be compatible with the mechanical and electrical designs, and the building's structure. They must not impede the mechanical and electrical systems' normal operation, including the expansion of normal operation networks and the expansion joints of the buildings. They must be designed and installed to withstand the minimal acceleration forces described.

.3 At the building's joints, the seismic restraint systems must be designed to bear a multiplicative factor of two times the expansion joint movement planned by the structural Engineer.

.4 Seismic protection devices must not be anchored to two different structures, such as a wall and a ceiling, and they cannot be attached to another component.

.5 A distribution network or a piece of equipment that is braced or is not required to be braced must not cause damage to an essential type of distribution network or equipment.

.6 The seismic restraint systems should be able to, in the event of an earthquake, prevent all permanent displacement, in all directions, caused by lateral, rising, or rocking movements.

.7 The seismic consultant shall verify that the combined vibration isolators are sufficient to respond to the calculated seismic forces. Seismic shocks, cable attachment hardware and other fastener systems from manufacturers who specialize in these products are to be used, and adjustments to be made by each concerned section, as required.

.8 The seismic protection systems must be able to oppose the forces in all directions.

.9 The fasteners and the fixation joints must be capable of withstanding the same maximum loads as the seismic protection devices.

.10 For the longitudinal braces, the pipe fastener must necessarily be directly on the pipe (under the thermal insulation).

.11 The seismic braces must be located near the supports (maximum distance of 100 mm (4")) for piping, ventilation duct, or electrical conduit systems.

.12 Depending to the type of service and its manufacturing material, the positioning and the number of braces must consider the maximum permissible offset according to the forces involved throughout distribution network.

.13 The seismic restraints installed on the pipe networks must be compatible with the requirements relating to anchors and pipe network guidance.

.14 Do not add rigid type seismic restraints to existing supports for piping, ventilation ducts, and electrical conduits without checking the ability of these supports to withstand the increased forces created.

.15 Highly resistant mechanical expansion anchors must be used to fix seismic restraints to concrete structures. The use of anchors and fasteners installed with a nail gun is prohibited. Cartridge fasteners and anchors simply installed must not be used for tensile loads. See section 23 05 29 – Hangers and supports for HVAC piping and equipment.

.16 The use of supports made of cast iron, threaded pipes, or any other brittle materials is prohibited.

.17 The seismic protection devices installed on piping networks, duct networks, and related fasteners attached to the equipment must be compatible with the anti-vibration and anti-seismic devices destined for the components. They add to the devices provided for the vertical support of the component.

.18 The seismic protection devices must not interfere with the fire protection devices nor compromise their integrity.

.19 The vertical supports, including vibration isolators, should in no way develop moments (righting (opposition) forces) during the normal operation of the networks or equipment.

.20 Service risers and those in the wells must include seismic restraint systems and follow this section's recommendations.

.21 Stiffeners will need to be added to the hanger rods when required, to prevent buckling.

.22 For I_E = 1.3 and 1.5 buildings: the accessories, such as diffusers and the lighting fixtures installed in the suspended ceilings, must be stabilized everywhere, including the issue corridors.

.23 Check with the division "STRUCTURE" prior to anchoring the suspension or wall stabilization elements. The equipment aimed by these fastening elements are, among others, the tanks.

.24 Reread the article "PAINTING" in section 01 00 10 – Mechanical and electrical general instructions.

2.2 PIPES WITHOUT VIBRATION ISOLATORS OTHER THAN THE FIRE PROTECTION

.1 The pipe supports must withstand all transitory conditions (in case of seismic event), including:

- .1 The weight of the pipe, the valves, the accessories, the fittings, the thermal insulation, and the internal fluids.
- .2 The forces imposed by the thermal expansion and contraction effects in the elbows and the loops.
- .3 The friction forces generated in the expansion joints to the guides (rails) and the supports.
- .4 The other loads, such as water hammers, the vibrations, and the reactions to safety valve forces.
- .5 The occasional loads, such as ice, wind, and seismic forces.

.2 The pipe supports must be fitted with longitudinal and transverse bracing. They can be of the rigid type or the flexible (cable) type. In a same bracing system, always use identical spacers (do not use rigid spacers with cables). Comply with the SMACNA installation diagrams.

.3 Use one or more of the following methods, according to the site conditions:

- .1 Securely affix the piping to the framework.
- .2 Reinforce the pipe in all directions.

.3 Reinforce the piping's fixation points to the framework.

.4 Affix the piping with braces. Fixing the pipe by bracing prevents oscillations in the horizontal plane, swinging in the vertical plane, and sliding and buckling in the axial direction.

.5 Use flexible bracing for a trapeze hanger piping installations.

.6 Use flexible bracing for a piping installations with vibration isolators. The flexible bracing must not be in full tension to avoid undue forces on the components.

.4 Except for fire protection, seismic bracing may be omitted for:

.1 Oil, diesel, propane, natural gas, refrigeration, medical gases, vacuum, and compressed air piping, with a diameter smaller than NPS 1.

.2 The piping installed in the boiler room and in the mechanical rooms, with a diameter smaller than NPS 1¼.

.3 The NPS 2½ or smaller piping. For the pipes installed on trapeze hangers, whose total weight is less than the weight of an NPS 2½ pipe or the equivalent of 14.9 kg/m (10 lb/ft).

.4 The individually suspended pipe, whose length between the top of the pipe and the anchors is 300 mm (12") or less. The seismic restraints cannot be omitted if a single support respecting this length is present throughout pipe's run. If the ducts are installed on a trapeze, the allowable length of 300 mm (12") is located between the bottom of the trapeze and the anchor.

.5 The equipment weighing less than 9.1 kg (20 lb) in operation.

.5 The maximum spacing between seismic bracing must be as follows, unless otherwise specified in the various tables (see the SMACNA tables):

Description	Oil, diesel, natural gas, and propane gas pipes, PVC pipe, and pipes with clamping screws or rings	Others
Transverse		
0.25 g 0.5 g 1.0 g 2.0 g	7.6 m 6.1 m 6.1 m 3 m	15.2 m 12.2 m 12.2 m 6.1 m
Longitudinal		
0.25 g 0.5 g 1.0 g 2.0 g	12.2 m 12.2 m 12.2 m 6.1 m	24.4 m 24.4 m 24.4 m 12.2 m
Riser		
0.25 g 0.5 g 1.0 g 2.0 g	12.2 m 9.1 m 9.1 m 6.1 m	12.2 m 9.1 m 9.1 m 6.1 m

.6 Each pipe run must have at least two transverse braces and one longitudinal brace. A transverse bracing must be installed at each end of the run.

.7 A transverse brace can be used as a longitudinal brace at a 90º elbow of the same diameter if installed within 600 mm of an elbow, or as shown in the offset tables issued by SMACNA, or a tee fitting, provided that the brace is of suitable dimensions for longitudinal bracing.

.8 For gas piping, the bracing calculations must consider the weight with a multiplying factor of 2.

.9 When piping passes through a building's seismic joint or expansion joint, or when piping is connected to a device based on vibration isolators, flexible multidirectional joints must be installed. Consult the regulations issued by ASHRAE (Handbook and Practical Guide to Seismic Restraint) for the allowable deviation length (refer to tables 8.1 and 8.2).

.10 The embranchments should not be used as braces for the main pipes.

.11 A rigid pipe must not be anchored to a structure or a part of the building that responds differently to earthquakes.

.12 All cast iron pipe, glass pipe, or other pipe having mechanical joints with rings and clamping screws supported by supports 300 mm or further from the framework should be fitted with seismic braces at all the changes of direction of 90° or more. The riser pipe joints must be stabilized with braces between the floors.

.13 The riser pipes must be supported laterally at each floor (see SMACNA details).

.14 The walls constituting the compartmentation, the firewalls, or other security features may not be considered as a means of bracing.

2.3 ELECTRICAL CONDUITS, BUSBARS, RACEWAYS, ETC.

.1 The electrical duct supports must withstand all transitory conditions (in case of seismic event), including:

.1 The weight of the pipes, the accessories, and the internal wires.

.2 The occasional loads, such as ice, wind, and seismic forces.

.2 The conduit supports must be fitted with longitudinal and transverse bracing. They can be of the rigid type or the flexible (cable) type. In a same bracing system, always use identical spacers (do not use rigid spacers with cables), according the SMACNA installation diagrams.

.3 Use one or more of the following methods, according to the site conditions:

.1 Securely affix the piping to the framework.

.2 Reinforce the conduits in all directions.

.3 Reinforce the conduits' fixation points to the framework.

.4 Affix the conduits with braces. Fixing the conduits by bracing prevents oscillations in the horizontal plane, swinging in the vertical plane, and sliding and buckling in the axial direction.

.4 Seismic bracing may be omitted for:

.1 Electrical conduits suspended individually, whose length between the top of the conduit and the anchor is 300 mm or less. If the conduits are installed on a trapeze, the allowable length of 300 mm is located between the bottom of the trapeze and the anchor.

.2 Electrical conduits smaller than 80 mm in diameter. If the electrical conduits are installed on trapezes and if the total weight is less than an NPS 2½ pipe or the equivalent of 14.9 kg/m.

.5 The maximum spacing between seismic braces should be as follows, unless otherwise specified in the various tables (refer to the SMACNA tables):

Description	Electrical conduits		
	Transverse	Longitudinal	Risers
0.25 g	15.2 m	24.4 m	12.2 m
0.5 g	12.2 m	24.4 m	9.1 m
1.0 g	12.2 m	24.4 m	9.1 m
2.0 g	6.1 m	12.2 m	6.1 m

.6 Transverse braces must be installed at each end if the conduit length is less than the maximum allowable distance. Transvers braces must be installed at each elbow and at each length end. The minimum is two per conduit length.

.7 When the conduits pass through a seismic joint or a building expansion joint or that the conduits are connected to a device based on vibration isolators, flexible multidirectional joints must be installed.

.8 A rigid conduit must not be anchored to a structure or to a part of the building that responds differently to earthquakes.

.9 The conduit risers must be supported laterally at each floor (see SMACNA details).

2.4 ELECTROMECHANICAL DEVICES WITHOUT VIBRATION ISOLATORS

.1 The supports must withstand all transitory conditions (in case of seismic event), including:

.1 Their weight with the accessories, the thermal insulation, and the internal fluids.

.2 The forces imposed by the thermal expansion and contraction effects.

.3 The reactions during start-ups and stops.

.4 The vibration.

.5 The occasional loads, such as ice, wind, and seismic forces.

.2 Coordinate with structural Engineer for the weight of the equipment and the internal tanks, as well as the weight of their contents. If this weight is greater than 10% of the mass of the floor that supports the whole, rational analysis must be undertaken and consider its lateral forces.

.3 The devices or equipment must be securely anchored or fixed to the building's framework of the same structural composition to prevent them from sliding, oscillating, or tilting. Provide the supports (hanger brackets) in sufficient quantity and of adequate strength to withstand the shear stress and to prevent movement. Avoid support failure in tension, compression, or by an excessive rotation imposed to the foundation (framework).

.4 Devices resting on the floor (slab) are anchored securely to the floor or fixed to a structural wall with metal straps, etc. For devices with a high center of gravity (from the floor), provide rigid supports to avoid overturning, which, from the top of the equipment and diagonally, can be installed to the ceiling, the floor, or even to a structural wall.

.1 For equipment not fitted with attachment points, see to the addition of these anchor points, by welding or by another method of attachment, or provide the installation of fixing belts.

.2 For MCC motor controls center cabinets, electrical inlets, etc., where indicated, use external steel frames with cabinets anchored to the floor (and to the ceiling if possible).

.5 Seismic restraints may be omitted for equipment or components with operating weights less than 9.1 kg.

.6 The minimum number of anchors is four and they must be lined with neoprene.

.7 Suspended devices:

.1 With flexible type of bracing, anchoring to the slab, in compliance with the regulations. The installation angle varies from 45 to 60° relative to the horizontal.

.2 Lighting fixtures installed in the issued corridors or if the ceiling is specifically designed to withstand earthquakes (placed on the suspended ceiling's tees or surface mounted): attached to the structural slab with 12-gauge cables or chains of a length so that no part of the lighting fixture hangs lower than 2 m above the floor to at least two opposite corners. The cable has a PVC protective covering (sleeve). The lighting fixture must be able to oscillate at an angle of 45° without any risk of it colliding into a component. The brace must be capable of supporting twice the weight of the suspended component.

2.5 VIBRATION ISOLATORS

.1 General:

.1 Characteristics:

.1 Types of vibration isolators:

.1 Nested

.2 Fitted with motion limiter

.3 Hangers

.4 Stabilizer

.2 The model selection is the isolator supplier's responsibility. Choose them for lower frequencies that are susceptible of causing problems.

.3 A maximal compression must not damage the spring. Calculate them and select for a compression not exceeding 2/3 of their maximum compression.

.4 They must be able to control the oscillations and the lateral forces from all direction, and be stable for a lateral displacement of 10 to 20% of the spring's height.

.5 The ratio of the horizontal spring constant to the vertical spring constant must be 1.0 ± 10% (k_H/k_V).

.6 The static deflection in mm is equal to the load divided by the isolator's stiffness constant (f = F/K). This deflection must never be less than the one shown in the vibration bases and isolators tables.

.7 When the required deflection is less than 5 mm, anti-vibration pads can be used to replace the steel springs.

.8 When used to support devices containing a large volume of fluid, they must have motion limiters.

.9 In order to control the lateral movement, install stabilizers when required.

.10 Location and specifications:

.1 See the vibration bases and isolators tables at the end of this section.

.2 Construction:

.1 Protect the spring with a layer of neoprene or PVC based paint.

.2 Housing made of aluminum or plated with zinc chromate.

.3 Cadmium plated screw fasteners, bolts, nuts, and washers.

.4 Leveling device.

.5 Weld the springs to a steel base at the lower end and to a steel compression plate at the top.

.6 Calculate and choose the dimensions of the plate so that the load does not exceed 690 kN/m². Completely cover the base with a sound-absorbing pad made of 50 durometers embossed neoprene, of a 6.4 mm thickness.

.3 Nested isolators:

.1 Comprising one or more springs placed inside an aluminum casing (heat treated aluminum alloy or 345 MPa cast iron), resistant to corrosion.

.2 Isolate the upper and lower parts of the housing using neoprene linings designed to minimize the vertical friction.

.3 Use this type isolator as little as possible and always after having received the approval.

.4 Nested isolators with motion limiters:

.1 Comprising one or more helical springs placed inside a casing made of welded steel parts. The lower part of the rigid casing and the top plate serving as mounting surfaces.

.2 Upper and lower parts connected together with locking mechanisms to prevent the device from rising when emptied.

.5 Vibration isolation hangers:

.1 Spring hanger rods comprising of a steel frame, helical spring(s), spring seats, neoprene impregnated fabric washers, and steel washers, all corrosion proof.

.2 The frame must be capable of withstanding a load exceeding the spring's load by 200% without apparent deformation.

.6 Stabilizers:

.1 Construction similar to the vibration isolation hangers.

.2 Installed vertically, horizontally, or at an angle to always be in compression.

.3 See the drawings.

.7 Anti-vibration pads:

.1 Made of 30 or 50 durometer neoprene, embossed, 16 mm thick. Stick a 6.4 mm thick galvanized steel plate on both faces.

.2 Calculate the dimensions of each pad for an optimal load of 275 kN/m² which corresponds to a 5 mm static deflection.

.8 Flexible pipes:

.1 Genera:

.1 Provide the flexible pipes shown in the vibration bases and isolators table.

.2 The dimensions of the piping and not of the connections to the device.

.1 For pipes NPS 2 and smaller:

.1 Threaded fittings.

.2 For pipes NPS 2½ and larger:

.1 Flanged fittings. Ensure that the alignment of the piping does not exceed the flexible piping's allowable alignment limits.

.2 For pipe NPS 2 and smaller:

.1 Flexible pipe made from a stainless steel mesh, minimum operating pressure of 1035 kPa, resistant to fatigue loading, lateral movement of 13 mm in amplitude at 500 Hz, Flexi-Tube TSN model.

.2 For copper pipe, brass mesh, Flexi-Tube CBH model.

.3 For pipe NPS 2½ and larger:

.1 Stainless steel flexible pipe with multiple rings, malleable iron flanges and control rods, resistant to an axial compression and extension of a minimum of 13 mm, and to a lateral motion of a minimum of 7 mm, operating pressure of 1100 kPa, at a temperature of 38°C, Flexi-Tube FST model.

.4 For pipe NPS 2½ or larger in diameter at the suction and the discharge of the pumps:

.1 Spherical expansion joints made of treated EPDM and polyester cord. All joints have two spheres and malleable cast iron retaining rings and steel flanges. Operating pressure of 1725 kPa at 77°C. 3/1 blowout and elongation safety factors. When the piping is not anchored, use motion control rods.

.2 Safeflex models, SFDEJ, SFDCR from Mason Industries Inc.

.3 When the flexible joint serves as an elbow, use the model MFNEC from Mason Industries Inc.

2.6 DEVICES WITH VIBRATION ISOLATORS

.1 The supports must withstand all transitory conditions (in case of seismic event), including:

.1 The weight of the devices, the accessories, the thermal insulation, and the internal fluids.

.2 The forces imposed by the thermal expansion and contraction effects.

.3 The reactions during start-ups and stops.

.4 The vibration.

.5 In general, other occasional expenses, such as ice, wind and seismic forces.

.2 These devices must be securely anchored to the building structure to prevent them from slipping or tipping.

.3 Apply one or more methods, according to the site conditions:

.1 Use anti-vibration devices with integrated damping systems.

.2 Use separate dampers additionally to anti-vibration devices.

.3 Use a damping system constructed from a combination of structural elements and an elastomeric material, with the approval of the Engineer.

.4 The damping effect achieved by an elastomeric material or other means must be soft and regular so as to prevent high impact loads.

.5 Seismic restraint systems should not interfere with the vibration isolators. They must only operate in the event of an earthquake and not cause any overturning moment.

.6 Each device must have at least four flexible seismic dampers in no tension, installed as near as possible to device's corners so as to avoid preventing the vibratory movement of the equipment during operation.

.7 Each type of seismic damper must have the following characteristics:

.1 The non-cemented impact surface must have a high quality elastomeric in place for resetting.

.2 The resilient material must be easily accessible for damage inspection and replacement.

.3 The assembly must be able to reduce movements in all directions.

.4 The dampers must be tested by independent laboratories and be certified by an Engineer registered in this discipline.

.5 In general, a maximum spacing of 6 mm between the device and the seismic damper.

.8 Pipes, ventilation ducts, and devices supported with the vibration isolators:

.1 To avoid transmitting the vibrations through the rigid bracing during normal operation, these suspended components will have slack cables made of galvanized steel or stainless steel, see F type seismic dampers.

.2 The seismic restraint equipment must have the characteristics described for pipes and ventilation ducts without vibration isolators.

2.7 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10 – mechanical and electrical general instructions.

.2 Manufacturer list, section 23 05 48:

.1 Stiffeners on hanger rods:

.1 Mason Industries Inc. and Vibro-Acoustics (Distributions P.G.A.L. Inc.)

.2 Power-Strut (Mueller Flow Control)

.3 Unistrut (Routleco Inc.)

.4 Vibro-Racan, Vibration Mountings & Controls Inc. and Korfund Dynamics Co. Inc. (Racan Carrier).

.5 Vibron Ltd, Kinetics Noise Control (The Master Gtoup ltd).

.2 Mechanical piping and electrical conduit supports without vibration isolators:

.1 Mason Industries Inc. and Vibro-Acoustics (Distributions P.G.A.L. Inc.)

.2 Power-Strut (Mueller Flow Control)

.3 Unistrut (Routleco Inc.)

.4 Vibro-Racan, Vibration Mountings & Controls Inc. and Korfund Dynamics Co. Inc. (Racan Carrier).

.5 Vibron Ltd, Kinetics Noise Control (The Master Gtoup ltd).

.3 Seismic dampers:

.1 Mason Industries Inc. and Vibro-Acoustics (Distributions P.G.A.L. Inc.)

.2 Vibro-Racan, Vibration Mountings & Controls Inc. and Korfund Dynamics Co. Inc. (Racan Carrier).

.3 Vibron Ltd, Kinetics Noise Control (The Master Gtoup ltd).

.4 Steel framing external to certain equipment’s cabinets:

.1 Power-Strut (Mueller Flow Control)

.2 Unistrut (Routleco Inc.)

.5 Vibration isolators:
- .1 Korfund Sampson Ltd
- .2 Mason Industries
- .3 Vibro-Racan (Racan Carrier)
- .4 Vibron Ltd

.6 Flexible Hoses:
- .1 Flex-Hose (Enviroair)
- .2 Flex-Pression
- .3 Flexi-Tube
- .4 Flexonics

.3 List of experts certified for seismic calculations:
- .1 Blais Expert-conseils & associés (450-923-3337)
- .2 ParaSis (514-949-7272)
- .3 Polydex (819-536-3332)

.4 None of the manufacturers are certified to perform the seismic calculations signed by an Engineer member in O.I.Q. (project in Québec). The Contractor must use the above specialists with the products from the certified manufacturer.

Part 3 Execution

3.1 LOCATIONS

.1 At locations described in Part 2.

3.2 VIBRATION ISOLATORS

.1 In general, anchor the vibration isolators onto leveling bases and fix them to the supported devices. Adjust the leveling nuts.

3.3 SEISMIC RESTRAINT SYSTEM INSTALLATION

.1 All anchoring and fixation points must be able to withstand the same maximum loads as the seismic protection devices, according to the latest version of the Quebec Construction Code.

.2 Do not weld the seismic braces directly to the supports and the reinforcements that transport the mechanical pipes, ventilation ducts, or electrical conduits.

.3 For equipment not fitted with attachment points, provide an attachment device or install fixing belts, all approved by an Engineer specialized in seismic design.

.4 The structural bases of the equipment must be stabilized to prevent the seismic devices from overturning. The installation of equipment on two simple beams, for example, is prohibited.

3.4 SEISMIC ANCHORING

.1 Check on site that the anchor bolts, the diameters of the inserts (pins), the embedment depth in the concrete, and the length of the welds are in conformance with the drawings submitted and follow the instructions.

.2 Bolted to the frame all the various equipment that is not isolated against vibration. Check with the division "STRUCTURE" for imposing equipment.

.3 The holes around the bolts must be a maximum of 1.6 mm larger than bolt's diameter.

.4 Oblong holes for bolt adjustment is prohibited.

.5 The anchors in the concrete slabs will have to be distanced from the concrete edges, follow the anchor manufacturer's recommendations, according to the standard ASTM-E488.

3.5 SEISMIC CABLE

.1 Attach the cables to the equipment suspended from the ceiling so that the axial projection of the cables pass through the equipment's center of gravity.

.2 Install the cables using cable grommets, mounting lugs, and other appropriate hardware parts to ensure the alignment of the protection devices and prevent the cables from bending at the fixation points.

.3 Guide the ceiling suspended equipment's cable restraints for them to preferably be at 90° from each other (in the plane) and then attach them to the ceiling slab so that they have an angle not exceeding 45° with the latter.

.4 Adjust the cable restraints so as to allow the normal operation of the vibration isolators without being visibly slack (6mm movement or less).

.5 At a same bracing, always use identical spacers (do not use a rigid brace with a cable brace).

3.6 CLEARANCES

.1 All seismic restraint systems must be checked after the mechanical and electrical systems have been started to ensure that the recommended clearances are obtained. No more than recommended, since the fragility of the unit may be affected. Make adjustments where required. Ensure that the seismic dampers do not cause short circuits at the vibration isolators.

.2 A clearance of at least 25 mm must be provided between the seismic protection devices and all other service equipment and elements.

3.7 BASES

.1 Type II – Inertia base:

.1 Pour the concrete constituting the inertia bases onto a flat smooth surface using a polyethylene provided by this section. Anchor the devices to the bases using bolts and expansion shields.

3.8 SUPPORTS – PIPING

.1 On piping NPS 3 or larger connected to a device capable of generating vibration, install spring vibration isolators at the first three supports.

.2 The static deflection of the first support being equal to the deflection of the isolators supporting the device, the others must have a deflection of 25 mm.

.3 Note: if the equipment is installed on anti-vibration pads, use supports having an equal deflection.

END OF SECTION

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.1 Section 01 000 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Canadian Gas Association (CGA):

.1 CSA/CGA B149.1-05 – Natural gas and propane installation code.

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.60-97 – Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92 – Identification of Piping Systems.

.3 National Fire Protection Association (NFPA):

.1 NFPA-13-2002 – Standard for the Installation of Sprinkler Systems.

.2 NFPA-14-2003 – Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

.1 Data sheets:

.1 Submit required data sheets in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Submit data sheets for the products specified in this section, including colour code.

.2 Samples:

.1 Submit required samples in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Submit samples of signage plates, identification plates and the proposed legend.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging, shipping, handling and receiving:

.1 Transport, store and handle materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

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

.2 Waste management and disposal:

.1 Construction/demolition waste management and disposal: separate waste materials for recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Divert unused paints and coating products from landfill to recognized hazardous material facility.

Part 2 Product

2.1 IDENTIFICATION AND REGISTRATION PLATES

.1 The devices must be fitted with identification plates showing the dimensions, the equipment designation, and all the information normally provided: serial number, voltage, serial number, number of cycles, number of phases, motor power in HP, capacity, manufacturer name, etc.

.2 The lettering stamped, printed, or engraved on the plates must be perfectly legible. Do not paint the identification plates. When units are insulated, provide openings in the insulation for these plates to be legible. The plates supplied by the manufacturer must not be modified in any way.

.3 Provide registration plates for the devices under pressure and the approval plates from certification laboratories and the CSA on the equipment provided, in accordance with the different regulations. These plates must be perfectly legible.

.4 Each unit or device, pump, fan, compressor, breaker, contactor, starter, transformer, and other control point must be clearly identified, according to the application or the specification's appellations, by a white ebonite plate with black engraved lettering, firmly fixed on or near the device. These plates are supplied and installed by the section providing the device.

.5 Place the identification plates visibly.

.6 The plates must have the following minimum dimensions: 90 mm x 40 mm x 2.5 mm minimum thickness.

.7 The characters must be 25 mm high on important devices.

.8 Have the list of plates checked before engraving them.

2.2 IDENTIFICATION OF ACCESSES

.1 The identification of accesses applies to valves, manual dampers, motorized dampers, pressure reducing boxes, control points, electrical boxes, and any other device, instrument, or accessory.

.2 Each concerned section must identify the access doors on their visible side with self-adhesive labels of 20 mm in diameter, from Avery, and in the colour shown below:

.1	Heating and cooling:	yellow
.2	Plumbing:	green
.3	Electricity:	pink

.3 Provide samples of each colour for verification.

.4 In ceilings with acoustic panels, each relevant mechanical and electrical section is required to identify the panels serving as accesses with coloured labels on the underside of the reversed tee according to the table above.

.5 Include the legend in the operations and maintenance manuals.

2.3 VALVE IDENTIFICATION

.1 Each relevant mechanical section must identify the valves that are part of their installation.

.2 All valves must be equipped with a 50 mm x 50 mm coloured plastic tag with rounded corners, displaying the letters and the numbers engraved in a different colour and attached with a sturdy steel wire to the valve stem.

.3 Use multi-stranded steel wire with lead cylinder to permanently seal the tag's wire.

.4 The numbering must be alphanumeric. It must take into account the sector and the floor. It must be continuous for all the sections. Each section must collaborate with the other sections to determine the numbering.

.5 Provide a numbering list for approval.

2.4 IDENTIFICATION OF PIPING

.1 Perform the identification of piping after the insulation work is completed.

.2 Each relevant mechanical section must identify the pipes and the devices that are part of its installation.

.3 Identify exposed plumbing, insulated or not. Identify the pipes installed in the suspended ceilings above the access doors. In suspended ceilings with removable panels, identify the pipes everywhere.

.4 Perform the identification using letters, numbers, and arrows indicating the direction of the flow of liquids, steam, gas, or air.

.5 Print the numbers, letters, and arrows using rubber stamps and black ink.

.6 Characters:

- .1 For piping NPS 2 or smaller, including the insulation, letters and numbers are 25 mm x 6 mm, arrows are 25 mm in height by 150 mm in length.
- .2 For ducts and piping NPS 2 ½ or larger, including the insulation, letters and numbers are 50 mm x 10 mm, arrows are 25 mm in height by150 mm in length.

.7 Piping:

- .1 On all non-insulated pipes where no base coat is provided, on the insulated pipes with aluminum exterior finish, apply two coats of white paint at the site of identification prior to the identification. This paint should form a perfect rectangle.
- .2 As an alternative for uninsulated pipes, the identifying characters must be aluminum coloured if the pipe is black and not rusty. If the pipe is rusty, it must be painted with a coat of rustproof paint and a coat of black paint before proceeding to the identification with aluminum paint.
- .3 As an alternative on insulated pipe with an aluminum exterior finish, apply a canvas with fire retardant coating on a surface forming a perfect rectangle, and identify the piping on this surface.

.8 Approval and identification legend:

.1 Have the numbers, letters, and arrow characters and the stamps approved. Provide lettering specimens before proceeding to the identification work. It is understood that the characters for the numbers, the letters, and the arrows must be the same for all sections and for the entire project.

.2 The identification legend must be in English and French.

.3 Once the legend is established, each section must get approval for the legend of all its identifications before proceeding to its work.

.9 Identification methods:

.1 The identifications are as follows:

.1 Identify the pipe at each shut-off valve so as to clearly identify its contents.

.2 At each identification, draw an arrow pointing in the direction of the flow.

.3 If the flow can be in two directions, draw an arrow with two heads or two parallel arrows with opposite heads.

.4 Every time a pipe or a duct goes through a wall, floor, or ceiling, identify the pipe or duct on each side with arrows.

.5 Identify every riser and tee with arrows.

.6 On a continuous line, identify the pipe and the ducts with arrows every 16 m.

.1 Safety colour designations: these functional colours attract attention to certain dangers, but cannot substitute adequate accident prevention measures.

.2 Red: Reserved for fire protection equipment: fire extinguishers and their locations, fire alarms, emergency exits, emergency shut-off switches for dangerous devices.

.3 Orange: safeguarded for risks of cuts, crushing, or burning, reports the dangerous machine parts, sharp parts, press surfaces, particularly inside the guards.

.4 Yellow: indicates any danger of collision or falls: sharp or protruding angles, ledges, steps, low beams, hoists, hooks. The visibility of this colour can be accentuated by applying oblique stripes on a black background.

.5 Green: indicates emergency stations, pharmacies, and first aid stations.

.6 Blue: draws attention to all equipment that must not be in put into operation because they are defective or under repairs. Also indicates the distribution boxes and the electrical controls.

.7 Reference colours:

.1 A few examples of safety colours used as reference colours.

.1 Red:

.1 Portable containers for flammable liquids.

.2 Firefighting equipment.

.3 Fire protection piping.

.4 Carbon dioxide (fire).

.5 Halon.

.2 Orange:

.1 Heat, risk of burns, steam, tank for hazardous substances.

.2 Engine exhaust.

.3 Yellow:

.1 Containing hazardous substances: highly flammable or combustible, explosive, toxic.

.2 Acid.

.3 Evacuation of radioactive water.

.4 Refrigerant suction (freon).

.5 Oil and gas.

.6 Natural gas.

.7 Chlorine.

.8 Oxygen.

.9 Hot water heating.

.10 Steam condensate return.

.11 Compressed air at more than 700 kPa.

.12 Vent.

.4 Green: (non-hazardous substances)

.1 Sewer.

.2 Vent (plumbing).

.3 Compressed air for controls.

.4 Vacuum.

.5 Compressed air at less than 700 kPa.

.6 Chilled water.

.7 Cooling tower water.

.8 Domestic water.

.9 Treated, distilled, and demineralized water.

.5 Blue: (protective substances)
.1 Nitrogen.
.2 Compressed air.
.6 Purple: (valuable substances)
.7 White: (sanitary fixtures and waste receptacles)

Services	Identification legend	Back colours	Secondary identification colours
River water	RIV. WATER	Green	None
City water	CITY WATER	Green	None
Cold water	COLD WATER	Green	None
Distilled water	DIST WATER	Green	None
Demineralized water	DEMIN. WATER	Green	None
Condenser water supply	COND. WATER SUPPLY	Green	None
Condenser return water	COND. WATER RETURN	Green	None
Chilled water supply	CHILLED WATER SUPPLY	Green	None
Chilled water return	CHILLED WATER RETURN	Green	None
Refrigerated water supply	REF. WATER SUPPLY	Green	None
Refrigerated water return	REF. WATER RETURN	Green	None
Domestic hot water supply	DHW SUPPLY	Green	None
Recirculated domestic hot water	DHW RECIRC.	Green	None
Hot water heating supply, up to 120ºC	HEATING SUPPLY	Yellow	Black
Hot water heating return, up to 120ºC	HEATING RETURN	Yellow	Black
Superheated water supply, higher than 120ºC	SUPER HEATED WATER SUPPLY	Yellow	Black
Superheated water return, higher than 120ºC	SUPER HEATER WATER RETURN	Yellow	Black
Makeup water	MAKE-UP	Yellow	Black
Boiler water supply	BOILER WATER FEED	Yellow	Black
Condensate water return	CONDENSATE	Yellow	Black
Purge	PURGE	Yellow	Black
Treated water	TREATED WATER	Green	None
Brine	BRINE	Green	None
Waste water	WASTE WATER	Green	None
Storm drain	STORM DRAIN	Green	None
Sanitary drain	SANITARY DRAIN	Green	None
Combined sewer	COMBINED SEWER	Green	None
Acid drainage	ACID DRAINAGE	Yellow	Black
Motor exhaust	MOTOR EXH	Yellow	Black
Combustible (indicate the type)	COMB. (TYPE)	Yellow	Orange
Steam (indicate the pressure)	STEAM. ... KPA	Yellow	Black

Services	Identification legend	Back colours	Secondary identification colours
Lubricating oil	LUB OIL	Yellow	Orange
Compressed air for controls	COMP. AIR FOR CONTROL	Green	None
Gasoline	GASOLINE	Yellow	Orange
Liquefied petroleum gas	LIQUIFIED PETROLEUM	Yellow	Orange
Natural gas	NAT. GAS	Yellow	Orange
Chlorine	CL	Yellow	Black
Nitrogen	N	Blue	Yellow
Oxygen	O	Yellow	Orange
Vacuum	VACCUM	Green	None
Compressed air with gauge pressure equal or less than 700 kPa	CA. ... KPA	Green	None
Compressed air with gauge pressure equal or more than 700 kPa	C.A. ... KPA	Yellow	Black
Water, fire protection	FIRE PROTECTION WATER	Rouge	White
Water, automatic sprinkler	SPRINKLER	Rouge	White
Carbon dioxide (fire)	CO_2	Rouge	White
Vent (plumbing)	PLUMBING VENT.	Green	None
Vent	VENT	Yellow	Black
Glycol	GLYCOL	Yellow	Black
Halon	HALON	Rouge	White
Suction refrigerant (include refrigerant no.)	REFRIG. SUCTION. (NO ...)	Yellow	Black
Ventilation ducts:			
Cold air supply	(NO OF SYST.) COLD SUPPLY	White	None
Hot air supply	(NO OF SYST.) HOT AIR SUPLLY	White	None
Return	(NO DU SYST.) RETURN	White	None
Evacuation	((NO OF SYST.) EXHAUST	White	None
New air	(NO OF SYST.) FRESH-AIR	White	None

2.5 OPERATION AND MAINTENANCE MANUALS

.1 Each section should include in its operation and maintenance manuals:

.1 The identification legend for the accesses.

.2 The identification legend for the pipes, the ventilation ducts, the ventilation units, and fans must be separate.

.3 The identification legend for the valves.

.4 The identification legend for the devices.

.2 Each relevant mechanical section must provide the identification tables of all valves, including: the valve number, the service, liquid, gas, or steam, the sector, the floor, the diameter, the model, the make, and the number of the valve located upstream.

.3 Each mechanical section should provide a table showing the main valves of each service and for each sector and floor serviced.

.4 The Division 23, section "HEATING – CHILLED WATER" must provide a table of the main valve(s) of each of service for the entire building and for all mechanical sections.

.5 Photocopied table with black characters on a white background, glass framed. The table must be handed to the Owner. Provide ten additional copies of this table.

.6 The tables mentioned above must be included in the operation and maintenance manuals and be printed in a sufficient number of copies.

.7 All tables mentioned in previous articles must have the same format.

2.6 IDENTIFICATION CODIFICATION

.1 The codification of mechanical and electrical equipment used on drawings and specifications is intended to simplify the work while being compatible with the codes used by the centralization microprocessors. Therefore, use this coding for the identification of equipment: pipes, ducts, etc.

.2 Codification:

X		XX		XXX	
Project subdivision:		Set or system:		Element:	
Examples:	2 – Tower A	Examples:	45 – Staircase pressurization	Examples:	V31 – Supply air fan
	3 – Units AB		A1 – Steam		V60 – Humidifier
	4 – Unit C		P1 –Domestic cold water		
	5 – Unit D				
	6 – Boiler room				

2.7 IDENTIFICATION ACCORDING TO THE EXISTING SYSTEM

.1 Identify the added or renovated work according to the existing identification system.

.2 When the existing identification system does not cover the identification of the new work installed, they must be identified in accordance with this section's requirements.

.3 Before starting the work, obtain the Engineer's written approval of the identification system.

Part 3 Execution

3.1 IDENTIFICATION PLATES

.1 Location:

.1 The plates must clearly identify the devices and/or piping networks and they must be installed in locations where they are highly visible and easy to read from the work floor.

.2 Spacers:

.1 On hot and/or heat-insulated surfaces, provide spacers under the identification plates.

.3 Protection:

.1 Do not apply paint, insulation, or any covering on the identification plates.

3.2 PLACEMENT OF THE PIPING AND AIR DUCT IDENTIFICATION ELEMENTS

.1 On long piping in the open areas of the boiler rooms, equipment rooms, and service galleries: at intervals not exceeding 16 m, so that at least one is visible from any point of operating areas or walkways.

.2 At changes in direction.

.3 In each small room through which pipes or air ducts pass (at least one element).

.4 On each side of visual obstacles or where it is difficult to follow the path of the networks.

.5 On each side of separations, such as walls, floors, or partitions.

.6 In places where the piping or air ducts are concealed in a shaft, a ceiling space, a sleeve, a service gallery, or any other confined space, at entry and exit points, and near access openings.

.7 At the starting and ending points of each conduit or duct, and near all pieces of equipment.

.8 Immediately upstream of the main automatic or manual control valves, otherwise, as close as possible, preferably upstream.

.9 Such that the identification can be easily read from the normal operating areas and from all easily accessible points.

.1 Perpendicularly to the best line of vision possible, taking into consideration the area where the operating personnel usually are, the lighting conditions, the reduced visibility of the colours or legends caused by the accumulation of dust and dirt, and the risk of damage.

3.3 LOCATION OF THE VALVE IDENTIFICATION ELEMENTS

.1 Attach the labels by means of chains or closed S hooks made of nonferrous metal on the valves, except for those related to medical devices or those connected to heating

radiators, and unless they are near and in sight of the equipment to which they are connected.

.2 Install a copy of the block diagram and the list of valves, framed in anti-reflective glass, at a location determined by the Engineer. Also, insert a copy (in reduced size, if necessary) in each of the operation and maintenance manuals.

.3 Number the valves of each network in order.

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Part 1 General

1.1 QUALIFICATION OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to the Engineer within ninety (90) days of award of contract.

.2 Submit documentation confirming staff's qualifications and experience.

.3 The testing, adjusting, and balancing operations must be performed in accordance with the requirements of standard governing the qualifications of the company and the staff responsible for the work.

.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 of 2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.2 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.3 COORDINATION

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

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.4 START-UP

.1 Notify the Engineer seven (7) days prior to TAB.

.2 Only undertake TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, and other components that may affect results are complete.

.2 Installation of sealants, caulking, and weather-stripping is complete.

.3 Pressure tests, seal tests, and other tests defined in other sections of Division 23 are completed.

.4 Equipment required for TAB are installed and in good working condition.

.5 Start-up and verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Clean filters in place.

.2 Duct systems clean.

.3 Ducts, duct shafts, and plenums including ceilings are airtight, within specified tolerances.

.4 Correct fan rotation.

.5 Balancing, fire, and smoke dampers are installed and open.

.6 Coil fins are combed and clean.

.7 Access doors and hatches, installed and closed.

.8 Outlets installed, volume control dampers open.

.3 Hydronic systems:

.1 Systems flushed, filled and vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves are installed and open.

.5 Balancing valves are installed and calibrated to factory settings.

.6 Chemical treatment system complete, operational.

1.5 INSTRUMENTS

.1 Prior to starting TAB, submit to the Engineer a list of instruments to be used, with their serial numbers.

.2 Calibrate in accordance with requirements of the most stringent of referenced Standard for applicable system or HVAC system.

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 HYDRONIC SYSTEMS

.1 General:

.1 Perform all measurements and adjustments required to obtain correct flow rates in all parts of the systems and all equipment. These flows are determined using the specification as well as relevant shop drawings.

.2 Unless otherwise indicated, TAB firm required to use the following methodology:

.1 Check installations as to the availability and the accessibility of all elements necessary to the carry out the adjustments.

.2 For each piece of equipment part of a system, determine, measure, and adjust flow rates required to meet the requirements of the specifications or shop drawings.

.3 Present the results in a report, including hydraulic diagram showing all devices and equipment measured and adjusted and tables showing the measurement results.

.4 Before starting TAB, submit an outline of the proposed procedures required to comply with of this article, and a list of equipment and instruments to be used.

.2 Procedures:

.1 Produce a hydraulic diagram of the system by identifying all devices and equipment that will need to be measured or adjusted. Also, identify all measuring points to ensure that sufficient connections are provided in appropriate locations on the piping. Use this identification as a reference in the balancing report. Ensure that piping does not have any short-circuits.

.2 Establish a diversity factor by comparing pumping capacity to the sum of flows of the end devices.

.3 Using the controls schematic, determine the required position of control devices in order to obtain flow conditions representative of the calculated diversity factor. Coordinate with Division 25.

.4 Ensure that system has been properly flushed and purged of air.

.1 Operate all manual valves and set them to their normal operating position.

.2 Ensure that all control valves are in desired position prior to starting measurement.

.3 Ensure that expansion tanks are adequately charged.

.5 When design flow conditions are reached, measure suction and discharge pressure at the pump(s). Measure at zero flow.

.6 Measure voltage between phases and amperage of each phase of the pump motor, at the conditions mentioned above.

.7 Check correlation between pressure versus the flow rate readings and the pump curve.

.8 Constant flow shall be maintained for the entire TAB procedure by either manually adjusting valves at discharge of the pump or by adjusting the pump speed, as appropriate.

.9 Start the balancing procedure by adjusting first the branch with the least resistance (usually, but not necessarily the shortest) and ending with the branch pipes having the most.

.3 Primary/secondary circuits:

.1 For primary/secondary pumping systems, reasonably adjust the primary circuit before adjusting the secondary circuits. During the adjustment of the primary circuit, the secondary pumps must be in operation. Ensure that there is flow.

.4 Flow measurements:

.1 In places where balancing valves are shown, refer to relevant technical data sheets and perform measurements and adjustments as per manufacturer's instructions.

.2 Any equipment, such as coils, some valves, control valves, chillers, etc., having a flow versus pressure drop relationship certified by the manufacturer, can be used to measure the flow. If fluid density is constant, flow rate can be determined by measuring the pressure difference delta P_2 between the inlet and the outlet by applying the Bernoulli equation as follows:

.1 Where P_1 is the pressure drop at flow Q_1, as provided by the manufacturer, actual flow (Q_2) can be calculated by measuring the actual pressure drop P_2.

$$\frac{Q_1^2}{Q_2^2} = \frac{\Delta P_1}{\Delta P_2}$$

.2 Control valves are excellent devices for measuring flow rates. As Cv or Kv is known from the valve's data sheet, we can determine the pressure difference across it and therefore determine the flow rate (Q_1).

.3 Using the Cv value, we apply the equation $h = 2.3 (Q_1/Cv)^2$ where Q_1 is in gpm (US) and h is in feet.

.4 Using the Kv value, we apply the equation $h = (36 Q_1/Kv)^2$ where Q_1 is in L/s and h is in kPa.

.5 Ensure that the control valve is fully open before taking any measurements. Adjust the balancing valve to required "h" value.

.6 The accuracy of the results depends on the accuracy of the manufacturer's data, the accuracy of the pressure gauge used, as well as the constancy of the fluid's density.

.3 The system's pump can be used as a flow indicator, if a calibration curve is provided. Pump specification will indicate if the calibration curve is required.

.1 Measure the differential pressure between the suction and discharge of the pump. Use the pump curve to determine the flow rate.

.2 If the pump curve is a calibration curve, its reading can be considered exact and the result used as is.

.3 If the pump curve is the published curve, the curve can be validated by taking a pressure reading at the pump's discharge at zero flow and comparing it with the value given on the curve.

.4 If the values are the same, the published curve can be used as if it were a calibration curve.

.5 If the values are not the same, draw a new curve parallel to the published curve with the pressure measured at zero flow as a starting point. This new curve will be used to determine flow rates at other pressures.

.6 Measure the pressures with the greatest possible precision. The flatter the pump curve, the more important the reading's accuracy becomes.

.7 Ensure that the measured pressure reading at the suction of the pump is above the NPSH (Net Positive Suction Head) required by the manufacturer.

.8 Measure the amperage and voltage of the pump's motor at operating flow rate. Locate the operating point on the pump curve and compare it with the calculated power requirements to check for concordance.

.9 Compare flow rate at the pump with the flow rate of the system.

.5 Hydraulic TAB Report:

.1 For each balanced system, the report shall include, as a minimum, the following information:

.1 Pumps:

.1 Design information:

.1 Identification (refer to drawings and specification).

.2 Flow rate.

.3 Hydrostatic head.

.4 Brake horsepower (BHP).

.5 Nominal motor power.

.2 Equipment data:

.1 Identification (refer to drawings and specification).

.2 Manufacturer, model, serial number.

.3 Size.

.4 Type.

.5 Design pressure (corresponding to maximum operating temperature).

.6 Seal types.

.7 Motor nameplate: power, voltage, number of phases and frequency, FLA, rpm.

.2 Measurement results:

.1 Pumps:

.1 Identification (refer to drawings and specification).

.2 RPM.

.3 Fluid temperature.

.4 Voltage and amperage (each phase).

.5 Pressure before and after strainer.

.6 Shut-off pressure.

.7 Suction and discharge pressure at design flow.

.8 Corrected curve, if required.

.9 Measured pressure where pressure sensors (by the Division 25) are installed.

.2 Terminal equipment:

.1 Identification (refer to drawings and specification).

.2 Manufacturer, model, size.

.3 Identification of the manufacturer's reference curve: pressure versus flow.

.4 Pressure in.

.5 Pressure out.

.6 Pressure and corresponding flow rate (following the corrected curve, if applicable).

.3 Other locations:

.1 At branches pressure reading. Identify branches on the diagram.

.2 At risers: pressure reading. Identify the risers on the diagram.

.3 Primary/secondary circuits: pressure or flow. Identify the primary/secondary circuit on the chart.

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Definitions:

.1 For the purposes of this section, the following definitions apply:

.1 In this section, the term "insulation" and "thermal insulation" will be considered synonymous.

.2 The acronym "CGSB" stands for the Canadian General Standards Board.

.3 "Concealed" elements: insulated mechanical services and equipment located above suspended ceilings or in inaccessible chases and furred-in spaces.

.4 "Exposed" elements: elements that are not concealed (as previously defined).

.5 Insulation system: systems consisting in particular of the insulation itself, the fasteners, jackets and other accessories.

.2 TIAC acronyms:

.1 CRD: Code Round Ductwork.

.2 CRF: Code Rectangular Finish.

.3 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-C795-03 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM-C921-03a – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):

.1 Preformed mineral fiber insulation: ONGC 51-GP-9M.

.2 Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering: ONGC 51-GP-40.

.3 Mineral fiber flexible blanket: ONGC 51-GP-11M.

.4 Mineral fiber rigid and semi-rigid boards: ONGC 51-GP-10M.

.1 Hydrated calcium silicate insulation: ONGC 51.2-M88 or 51-GP-2M.

.5 Vapor barrier covering: ONGC 51-GP-52Ma.

.6 PVC jacketing: ONGC 51.53-95.

.4 "k" thermal conductivity factors:

.1 ASTM-C-335 for precast or rigid insulation.

.2 ASTM-C-177 or C-518 for the other types.

.5 South Coast Air Quality Management District (SCAQMD), California State:

.1 SCAQMD Rule 1168-A2005 – Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC):

.1 National Insulation Standards 2005.

.7 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102-07 – Standard for Method of Test for Surface Burning

.2 Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 00 10 – Mechanical and Electrical General Instructions.

.2 Data sheets:

.1 Submit required data sheets, including the manufacturer's documentation for the equipment insulation. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish:

.1 A description of the devices and materials, including the manufacturer name, type, model, year of fabrication, the strength or the flow.

.2 Details relevant to the operation, usage, and maintenance of the devices and materials.

.3 A list of recommend spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

.3 Packing waste management: collect packing waste for reuse/recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Submit the manufacturers' instructions for the installation of the insulating materials.

.2 The instructions must specify the methods to be used, as well as the required execution quality, particularly in regards to the joints and the overlaps.

1.6 QUALIFICATIONS OF THE WORKFORCE

.1 The installer must be an expert in the field, with at least three years of proven and successful experience in the installation of work in this size, type and scope of work, and possess the qualifications required by the TIAC.

1.7 SCOPE OF THE WORK

.1 The work generally includes, but is not limited to: labor, supply and installation of all materials and equipment necessary for the insulation work shown on the drawings and in the specification for plumbing, heating and chilled water. All the existing heat-insulated winter tower equipment in the water tower room.

.2 Consult the drawings and the specification of all mechanical work.

1.8 INCLUSIVE PRICE

.1 Provide an overall fixed price with the tender, covering all the work by sections 23 07 13, 23 07 14 and 23 07 15.

Part 2 Product

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 TYPE B INSULATION

.1 Elastomeric cellular thermal insulation in tubular, flexible sheet, or roll form, according to the application.

.2 Maximum thermal conductivity "k": 0.039 W/m.°C at 32°C.

2.3 ADHESIVES

.1 Compliant with the standards ASTM-E-84-76 and CAN/ULC-S102.

.2 Use to secure the canvas, the tabs and all-service jackets, seal the joints, and secure the insulation to the metal surfaces.

2.4 JACKETS

.1 PVC jackets:

.1 Preformed one piece molded jacketing compliant with CGSB 51.53-95, similar to the Proto Corp. PVC type or equivalent.

.2 Operating temperatures:

.1 Minimum: -20°C

.2 Maximum: 65°C

.3 Permeability: 0 .02 perm.

.4 Thickness:

.1 Internal: 20 mils minimum.

External: 30 mils minimum; 40 mils minimum on piping 380 mm and larger.

.5 Adhesive and sealant: follow the manufacturer's recommendations.

.2 ABS jackets (for external use only):

.1 Preformed one piece molded jacketing.

.2 Operating temperatures:

.1 Minimum: -40°C

.2 Maximum: 82°C

.3 Permeability: 0.012 perm.

.4 Adhesive, sealant, and fastenings: follow the manufacturer's recommendations.

.3 Canvas jackets:

.1 Cotton canvas having a density of 220 g/m² and when exposed and 120 g/m² when concealed, coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM-C921 and ASTM-E84.

2.5 RIGID SUPPORT MATERIAL

.1 Characteristics:

.1 Permeability: 0 .00 perm/cm.

.2 Non-combustible.

.3 Compressive strength: 7.0 kg/cm²

.4 Average density: 128 kg/m³

.5 Coefficient of linear thermal expansion: 8.6 x 10^{-8}/°C

.6 Maximum Operating Temperature: 482°C

.7 Thermal conductivity: 0.048 W/m.°C.

.8 Foamglas from Pittsburgh Corning.

2.6 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" from section 20 00 10 – Mechanical and electrical general instructions.

.2 List of manufacturers, section 23 07 14:

.1 Type B thermal insulation:

.1 Armacell AP from Armaflex with adhesive 520 and WB finish.

.2 Rubatex Insul-Tube 180 with adhesive R-373 from Nomaco RBX.

.2 Adhesives:

.1 To secure canvas: Bakor No. 120-18, Foster no. 120-09, POL-R from Nadeau, Childers no. CP-52 or 81-42W.

.2 For sealing joints, tabs, and multi-purpose jackets, vapor barrier, flame retardant, and colorless adhesive: Bakor no. 230-06, Foster no. 85-15 or Childers no. CP85.

.3 To stick the insulation to the metal surfaces: Bakor no. 230-38, Foster no. 85-23, Childers no. CP89 or Mulco no. 89.

.3 Mechanical Fasteners:

.1 Welding pins, pin fasteners, Duro-Dyne.

.4 Canvas jackets:

.1 Flexpak

.2 S. Fattal Cotton Inc.

.5 PVC jackets:

.1 Johns-Manville

.2 Proto Corp.

.6 Thermal insulation protection support:

.1 Insulgard

.2 Steel support

Part 3 Execution

3.1 PREPARATORY WORK

.1 Only install the insulation once the system has been tested and the results have been certified by the responsible authority who has witnessed the test.

.2 Ensure surfaces to be covered with insulation or with a finish coating are clean, dry, and free of foreign matter.

3.2 INSTALLATION METHOD

.1 The insulation work is considered as:

.1 Concealed: pipes and ducts are installed in suspended ceilings, walls, shafts, and floors.

.2 Exposed: exposed pipes and ducts must be insulated on all sides, even on non-visible sides against walls or ceilings.

.3 Ducts and pipes in mechanical rooms, tunnels, and service spaces are considered exposed.

.2 Install insulation once all tests are complete and accepted, and air inside the building is dry enough and in conditions conforming to the manufacturers standards. Install insulation continuously, without interruption.

.3 All equipment, piping, and ducts must be clean and dry before installing the insulation.

.4 Consult the other mechanical sections to determine the type of ducts, piping, fittings, valves, and other accessories installed by other Contractors. The insulation Contractor must consider that Contractors from Divisions 21, 22, and 23 will use the Victaulic type fittings where allowed, and will tender accordingly.

.5 This section is responsible for the proper installation of insulation, where specified.

.6 When insulation is likely to be damaged by impact or crushing near the access doors, doors, access panels, corridors, etc., protect with a 1.3 mm galvanized steel sleeve (18 gauge).

.7 For all insulated piping exposed to water, steam, or oil, and all insulated piping passing through the mechanical room floor: cover the insulation with a 0.75 kg copper sheet with blind welded 50/50 joints or with a corrugated aluminum sheet with two stainless steel straps of 225 mm in minimum height.

.8 Install all piping supports for chilled water, cold glycol water, and domestic cold water completely outside the insulation. For this piping, use a rigid material at each support. Install a steel saddle of appropriate length and width to distribute the weight. This material must be supplied and installed by this section. Steel supports and saddles are supplied and installed by each relevant mechanical section to this section's satisfaction. Alternatively, when applicable, Insuguard protectors can be used.

.9 Notify applicable sections and properly adjust the supports and saddles to ensure that saddles remain in place.

.10 Leave access to strainers uncovered. However, for domestic cold water and chilled water piping, insulate them with a removable cover shaped piece of insulation to allow removal of the strainer for cleaning purposes. Have a sample of this cover approved.

3.3 APPLICATION

.1 See sections "EQUIPMENT INSULATION SCHEDULE" for thicknesses.

.2 Apply insulation blocks, panel segments, or molded pipe insulation and secure them firmly with mechanical fasteners, wires, or straps. Insulation must fill all contours without gaps. Insulation must be covered with 12 mm thick cement finish to ensure a smooth surface contour. The cement must be reinforced with mesh or reinforcing membrane.

.3 On resilient insulation, use a reinforcing mesh prior to applying cement finish. On rectangular flues, install a metal corner bead before applying cement finish.

.4 In the case of cold equipment, use insulation with vapor barriers or apply a vapor barrier treatment on-site.

.5 Depending on the type of insulation, provide an air space between the flue, chimney and ducts.

.6 Finishes:

.1 Interior/exterior:

.1 On insulation (hard cement layer not required), apply an aluminum jacket fixed with sheet metal screws or rivets, caulk or seal every joint.

.2 Interior:

.1 Above hard cement layer, apply a fireproof canvas jacket using adhesive coating and then apply a coating of canvas finish. Alternatively, finish with PVC jacket with all joints and seams sealed.

.3 Exterior:

.1 Over the hard cement layer, apply a layer of weatherproof coating (minimum 1 liter/1.5 m^2). While it is still damp, impregnate a reinforcing membrane and then finish with a layer of weatherproof coating (minimum 1 liter/15 m^2).

.4 Irregular spots or protrusions are to be finished with canvas jacket or weatherproof coating to ensure a proper finish.

3.4 EQUIPMENT INSULATION SCHEDULE

.1 Chilled water pumps:

.1 Insulation: type B

.2 Thickness: 9.5 mm flexible mat or roll

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Definitions:

.1 For the purposes of this section, the following definitions apply:

.1 In this section, the term "insulation" and "thermal insulation" will be considered synonymous.

.2 The acronym "CGSB" stands for the Canadian General Standards Board.

.3 "Concealed" elements: insulated mechanical services and equipment located above suspended ceilings or in inaccessible chases, furred-in spaces, and the floor-ceiling assemblies

.4 "Exposed" elements: elements that are not concealed (as previously defined), located in mechanical rooms, tunnels, accessible service spaces, and outdoor spaces.

.5 Insulation system: systems consisting in particular of the insulation itself, the fasteners, jackets and other accessories.

.2 References:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ASHRAE Standard 90.1-01 – Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM).

.3 ASTM-B209M-04 – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.4 ASTM-C335-04 – Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.5 ASTM-C411-04 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.6 ASTM-C449/C449M-00 – Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.7 ASTM-C533-2004 – Calcium Silicate Block and Pipe Thermal Insulation.

.8 ASTM-C547-2003 – Mineral Fiber Pipe Insulation.

.9 ASTM-C795-03 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.10 ASTM-C921-03a – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB):

.1 Preformed mineral fiber insulation: ONGC 51-GP-9M.

.2 Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering: ONGC 51-GP-40.

.3 Mineral fiber flexible blanket: ONGC 51-GP-11M.

.4 Mineral fiber rigid and semi-rigid boards: ONGC 51-GP-10M.

.5 Hydrated calcium silicate insulation: ONGC 51.2-M88 or 51 GP 2M.

.6 Vapor barrier covering: ONGC 51-GP-52Ma.

.7 PVC jacketing: ONGC 51.53-95.

.3 "k" thermal conductivity factors:

.1 ASTM-C-335 for precast or rigid insulation.

.2 ASTM-C-177 or C-518 for the other types.

.4 Department of Justice Canada (JUS):

.1 Canadian Environmental Assessment Act (CEAA), ch.33, 1995.

.2 Canadian Environmental Protection Act (CEPA), ch. 33, 1999.

.3 Transportation of Dangerous Goods Act (TDGA), ch. 34, 1992.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheet (MSDS).

.6 Manufacturers' associations:

.1 Thermal Insulation Association of Canada (TIAC), National Insulation Standards (C2004).

.7 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-S701-01 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-1997 – Standard for Mineral Fibre Thermal Insulation for Buildings.

.4 CAN/ULC-S702.2-03 – Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Data sheets:

.1 Submit required data sheets, including the manufacturer's documentation for the piping insulation. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish:

.1 A description of the devices and materials, including the manufacturer name, type, model, year of fabrication, the strength or the flow.

.2 Details relevant to the operation, usage, and maintenance of the devices and materials.

.3 A list of recommend spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

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

.3 Packing waste management: collect packing waste for reuse/recycling in accordance with section 01 00 10 – mechanical and electrical General Instructions.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Submit the manufacturers' instructions for the installation of the insulating materials.

.2 The instructions must specify the methods to be used, as well as the required execution quality, particularly in regards to the joints and the overlaps.

1.6 QUALIFICATIONS OF THE WORKFORCE

.1 The installer must be an expert in the field, with at least three years of proven and successful experience in the installation of work in this size, type and scope of work, and possess the qualifications required by the TIAC.

1.7 SCOPE OF THE WORK

.1 The work generally includes, but is not limited to labor, supply and installation of all materials and equipment necessary for the insulation work shown on the drawings and in the specification for plumbing, heating, and chilled water.

.2 Insulating works of modified pipes in the room of water towers.

.3 Consult the drawings and the specifications of all mechanical work.

1.8 INCLUSIVE PRICE

.1 Provide an overall fixed price with the tender, covering all the work by section 23 07 13, 23 07 14 and 23 07 15.

Part 2 Product

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 TYPE A INSULATION

.1 Preformed wrap made of mineral fiber bonded with thermosetting resin, maximum service temperature of 454°C.

.2 Reinforced vapor barrier: factory applied all service jacket, paintable finish. Jacketing permeability: 0.02 perm. maximum.

.3 Maximum thermal conductivity "k": 0.035 W/m.°C at 24°C.

.4 Products:

.1 Alley K from Manson Insulation.

.2 Earthwool 1000° from Knauf Insulation.

.3 Micro-Lok HP from Johns Manville.

2.3 TYPE C INSULATION

.1 Flexible wrap made of mineral fiber bonded with thermosetting resin with vapor barrier and reinforced aluminum, with a density of 36 kg/m³, maximum service temperature of 121°C.

.2 Maximum thermal conductivity "k": 0.042 W/m.°C at 24°C.

.3 Products:

.1 Microlite, with vapor barrier FSK from Johns Manville.

.2 Friendly Feel, with vapor barrier FSK from Knauf Insulation.

.3 Alley Wrap, with vapor barrier FSK from Manson Insulation.

2.4 TYPE G INSULATION

.1 Type A thermal insulation with stapled joints, a protective and damp-proof membrane and an aluminum jacket.

2.5 TYPE J INSULATION

.1 IPI removable and reusable sleeve with outer jacket made of mineral fiber impregnated silicone, FRP grating in contact with hot section, mineral fiber thermal insulation, capable of withstanding 260°C, density of 16 kg/m^3, thickness of 25 mm. The sleeve to be used to insulate valves, including the flanges on hot piping networks less than 100°C only.

.2 Products: Reusable envelope for faucet from No Sweat.

2.6 RIGID INSULATION FOR PIPING

.1 Pre-shaped envelopes with over 60% recycled glass containing no VOC or other volatile substances.

.2 Thermal conductivity: 0.0.48 W/m.°C

.3 Coefficient of linear thermal expansion: 8.6 x 10^{-8}/°C

.4 Compressive strength: 7.0 kg/cm²

.5 Average density: 128 kg/m³

.6 Products: Foamglas from Owens Corning.

2.7 ADHESIVES

.1 Compliant with ASTM-E-84-76 and CAN/ULC-S102.

.2 Use to adhere the canvas, tabs and all service jackets, seal joints, and secure the insulation to metal surfaces.

.3 Canvas adhesives:

.1 Products:

.1 120-18 from Bakor.

.2 CP-52 from Childers.

.4 Adhesives for joints, laps, and all-purpose jacketing:

.1 Products:

.1 230-06 from Bakor.

.2 CP-85 from Childers.

2.8 CEMENT INSULATION

.1 Compliant with the standard ASTM-C449/C449M.

.2 Use for fittings, flanges, valves, and accessories.

.3 Products: Calcoat-127 from Johns Manville.

2.9 JACKETING

.1 PVC jacketing:

.1 Preformed one-piece molded jacket compliant with CGSB 51.53-95 for piping, fittings, valves and equipment.

.2 Operating temperatures between -20 and 65°C.

.3 Permeability of 0.02 perm.

.4 Thickness:

.1 Internal: 20 mils minimum.

External: 30 mils minimum; 40 mils minimum on piping 380 mm and larger.

.5 Adhesive and sealant: follow manufacturer's recommendations.

.6 PVC jacketing or fittings used outdoors or where exposed to fluorescent lighting must be resistant to ultraviolet rays.

.7 Products:

.1 LoSmoke PVC Jacketing and Fittings from Proto Corporation.

.2 Zeston PVC Jacketing from Johns Manville.

.2 Canvas jackets:

.1 Cotton canvas having a density of 220 g/m² where exposed and 120 g/m² where concealed, coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM-C921 and ASTM-E84.

.3 Insulation jacketing tapes:

.1 Multi-layered laminate coated with resistance to sever environmental conditions, humidity, mould, and UV rays in accordance with the UL1709 standard, 3M VentureClad 1577 Series.

2.10 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" from section 01 00 10 – Mechanical and electrical general instructions.

.2 List of manufacturers, section 23 07 15:

.1 Type A thermal insulation:
- .1 Johns Manville
- .2 Knauf Insulation
- .3 Manson Insulation

.2 Type B thermal insulation:
- .1 Armacell
- .2 Rubatex

.3 Type C thermal insulation:
- .1 Johns Manville
- .2 Knauf Insulation
- .3 Manson Insulation

.4 Type E thermal insulation:
- .1 Johns Manville
- .2 Knauf Insulation
- .3 Manson Insulation

.5 Type F thermal insulation:
- .1 Johns Manville
- .2 Knauf Insulation
- .3 Manson Insulation

.6 Type J thermal insulation:
- .1 No Sweat

.7 Type P thermal insulation:
- .1 Gilsulate International Inc.

.8 Rigid insulation for piping:
- .1 Owens Corning

.9 Adhesives:
- .1 Bakor
- .2 Childers
- .3 Mulco

.10 Insulating cement:
- .1 Johns Manville

.11 Canvas jackets:
- .1 Robson Thermal Mfg. Ltd.
- .2 S. Fattal Cotton Inc.

.12 Insulation jacketing tapes:
- .1 3M

Part 3 Execution

3.1 INSTALLATION METHOD

.1 Install insulation once all tests are complete and accepted, and air inside the building is dry enough and in conditions conforming to the manufacturer's standards. Install insulation continuously, without interruption.

.2 All equipment, piping and ducts must be clean, dry and free from foreign matter before installation of the insulation.

.3 Consult the other mechanical sections to determine the type of ducts, piping, fittings, valves, and other accessories installed by other contractors. The insulation contractor must consider that contractors from Divisions 21, 22, and 23 will use the Victaulic type fittings where allowed and will tender accordingly.

.4 This section is responsible for the proper installation of insulation, where specified.

.5 When insulation is likely to be damaged by impact or crushing near the access doors, doors, access panels, corridors, etc., protect with a 1.3 mm galvanized steel sleeve (18 gauge).

.6 For all insulated piping exposed to water, steam, or oil, and all insulated piping passing through the mechanical room floor: cover the insulation with a 0.75 kg copper sheet with blind welded 50/50 joints or with a corrugated aluminum sheet with two stainless steel straps of 225 mm in minimum height.

.7 Pipes, accessories, and exposed equipment must be insulated on all sides, even if non-visible side is by a wall or a ceiling, using the same material on all surfaces.

3.2 APPLICATIONS OF INSULATION

.1 See the articles "PIPING INSULATION SCHEDULE" for thicknesses.

.2 Hot piping (15 at 315°C):

.1 Piping:

.1 Pipe insulation without integrated jacketing must be held in place using ties no smaller than 300 mm center to center. Insulation with integrated jacketing must be held in place by stapling the laps every 75 mm center to center. Insulation with integrated self-sealant jacketing does not require any additional fastening.

.2 For high temperature steam and hot water pipes, use type F insulation in any areas where there is risk of shock damage or undue crushing.

.2 Fittings:

.1 Insulate the fittings with segments of piping insulation, miter cut to fit the connections.

.2 For flexible fittings on steam pipes, cover the flanges and fittings with a galvanized cylindrical sheet fixed to the flanges on one side only to allow movement of the other flanges inside the cylinder. Cover this sheet with type A insulation with a thickness of 75 mm. For piping connected to the slip-on flange, bevel cut the insulation at 45°. Do not insulate the steam traps, the valves, or the connected accessories shown in the steam trap arrangement details.

.3 Valves and strainers:

.1 Insulate the valve and strainer bodies with segments of adjusted or miter cut piping insulation with a similar thickness to that of the adjacent pipes. Drains, drain plugs, and caps should not be covered.

.4 Flanges:

.1 Insulate flanges with oversized pipe covering or mitred blocks of the same thickness as the adjacent pipe covering.

.2 Insulation termination points:

.1 Terminate insulation at 75 mm from the fittings to provide a working clearance and bevel the insulation at a 45° angle.

.5 Closed cell insulation:

.1 Where indicated, flexible elastomeric or closed cell insulation to be used and installed in accordance with the manufacturer's instructions with an adhesive covered by a paint specific to the product.

.3 Cold piping (5 at 15°C):

.1 Insulation vapour barriers:

.1 The vapour barrier must be installed in a continuous manner, without any openings, in such a way to include all valves, flanges, equipment, fittings, accessories, etc.

.2 Piping:

.1 Apply pipe insulation with an integral vapor barrier jacket to the piping and hold it in place by securing the jacket flap. Seal all flaps and butt strips with vapor barrier adhesive, or alternatively, secure them with staples every 75 mm and cover them with vapor barrier tape. Pipe insulation with integral self-sealing vapor barrier jacketing does not require additional fastening.

.2 Install the rigid pipe insulation between the pipe and every pipe support. The adjacent insulation vapour barrier must be lengthened to envelop the rigid pipe insulation.

.3 Install all pipe supports for chilled water, cold glycol water, and domestic cold-water piping outside of the insulation. For this type of piping, use rigid material at each support. Install steel pipe saddle with appropriate length and width to spread the weight.

This material must be supplied and installed by this section. Steel saddles and supports are supplied and installed by each respective mechanical sector, to the satisfaction of this section.

.4 Advise the respective sectors to adequately adjust the supports and pipe saddles to ensure they remain in place properly. This section is responsible for attaching the pipe saddles to the insulation on either side of the supports.

.3 Fittings:

.1 Insulate fittings with sections of pipe insulation mitered to fit tightly or with tightly fit flexible insulation then apply reinforcing membrane embedded in vapour barrier coating.

.4 Valves and strainers:

.1 Insulate valve bodies, flanges, and strainers with insulating cement, fitted pipe insulation segments, or mitred blocks, of the same thickness as the adjacent insulation and then apply a vapor barrier coated reinforcing membrane. Drains, drain plugs, and caps must be insulated with a removable lid-shaped insulator allowing for the removal of the strainer flanges for cleaning purposes. A sample of this lid should be approved.

.5 Flanges:

.1 Insulate flanges with oversized pipe covering or mitred blocks of the same thickness as the adjacent pipe covering, then cover with a vapor barrier coated reinforcing membrane.

.6 Grooved fittings:

.1 Where the use of grooved pipe fittings is accepted, the method known as "oversized" and recommended by the ACTI will be applied.

3.3 APPLICATIONS OF JACKETING

.1 All insulation installed on pipes, valves, fittings, or any other equipment in an exposed area must be covered in jacketing.

.2 PCV jacketing inside/outside:

.1 Apply PVC jacketing on the insulation et attach in place with adequate ties 100 mm center to center. Cover longitudinal and circumferential joints with a tight edge band.

.2 Apply jacketing or PVC fitting covers on insulated fittings to ensure a complete jacketing of the system. Attach with ties and appropriate jacketing edge bands.

.3 The longitudinal overlap of the jacketing must be positioned on the underside of the pipe to minimize water infiltration.

.3 Self-adhesive jacketing:

.1 Apply jacketing on pipe insulation in accordance with the manufacturer's installation instructions.

.2 Apply jacketing on insulated fittings to ensure a complete jacketing of the system.

.3 The longitudinal overlap of the jacketing must be positioned on the underside of the pipe to minimize water infiltration.

3.4 PIPING INSULATION SCHEDULE – PLUMBING

.1 When specified, type A or B, the thicknesses are given for type A. For type B, use a thickness 13 mm smaller than the one specified.

.2 Pipe dimensions are in NPS (nominal diameter).

.3 Table of networks that require insulation

Networks	Location	Pipe dimensions	Insulation types	Thickness	Jacketing (when installation is exposed)
Combined and storm water drainage	Everywhere	All	C	25 mm	PVC
Condensation basin drainage	Everywhere	All	C	15 mm	PVC
Piping vents	6 m from exit to roof	All	C	25 mm	PVC
Domestic cold water	Everywhere	All	A	25 mm	PVC

.4 Piping fitted with a heating cable:

.1 The contractor must adjust the dimensions of the insulation so as to not decrease its thickness to allow its installation. The insulation thicknesses indicated in this table have precedence over the ones in the table of systems that require insulation.

Piping dimensions	Thickness of insulation
NPS ½ to NPS 1	25 mm
NPS 1¼ and NPS 1½	38 mm
NPS 2	50 mm
NPS 2½	68 mm
NPS 3 or larger	75 mm

3.5 PIPING INSULATION SCHEDULE – HEATING – CHILLED WATER

.1 Table of networks that require insulation:

Networks	Location	Pipe dimensions	Insulation types	Thickness	Jacketing (when installation is exposed)
Valves, including flanges, shut-off valves, and steam check valves	Valves, flanges, and shut-off valves	All	J	25 mm	PVC
Heating water and glycol pipes (up to 50°C)	Everywhere	NPS 2 or smaller	A	25 mm	PVC
Heating water and glycol pipes (up to 50°C)	Everywhere	NPS 2½ or larger	A	38 mm	PVC
Cooling tower water	All piping outside the building	All	G	38 mm	Aluminum
Cooling tower water	Inside the building, gravity return and vent	All	A	25 mm	PVC
Cooling tower water	Tower suction piping	All	A	25 mm	PVC

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

.2 Section 23 05 29 – Hangers and supports for HVAC piping and equipment.

.3 Section 23 25 00 – HVAC water treatment systems.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS):

.1 ANSI/AWS A5.8/A5.8M-11 – AMD1 Specification Filler Metals for Brazing and Braze Welding.

.2 ASME:

.1 ANSI/ASME B16.4-06 – Gray-Iron Threaded Fittings Classes 125 and 250.

.2 ANSI/ASME B16.15-11 – Cast Copper Alloy Threaded Fittings Classes 125 and 250.

.3 ANSI B16.18-12 – Cast Copper Alloy, Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.22-12 – Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 ASTM International:

.1 ASTM-B32-08 – Standard Specification for Solder Metal.

.2 ASTM-B61-08 – Standard Specification for Steam or Valve Bronze Castings.

.3 ASTM-B62-09 – Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 ASTM-B88M-05(2011) – Standard Specification for Seamless Copper Water Tube Metric.

.5 ASTM-E202-12 – Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.4 Health Canada – Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheet (MSDS)

.5 Manufacturers Standardization Society (MSS):

.1 MSS SP67-2011 – Butterfly Valves.

.2 MSS SP70-2011 – Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS SP71-2011 – Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS SP80-2008 – Bronze Gate, Globe, Angle and Check Valves.

.5 MSS SP85-2011 – Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for the hydronic systems. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.3 Shop drawings:

.1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada.

.2 Identify the items referred to in the documentation provided by the manufacturer, namely: valves.

.4 Certificates:

.1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and Maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 0100 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.

.4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.

.5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 PIPING – GENERAL

.1 NPS 2½ to NPS 24 branch connections:

.1 For the welded connection of a pipe of diameter "d" onto a pipe of diameter "D" and/or for the construction of a header of diameter "D":

.1 If the ratio d/D > 2/3, use tees prepared for welding.

.2 If the ratio d/D ≤ 2/3, use reinforced fittings conforming to the Power Piping standard ASME B31.1 or tees prepared for welding, Anvil Anvilets.

.2 If a condition d/D > 2/3 is shown in the drawings, "D" can be increased so that the condition d/D ≤ 2/3 applies.

.2 Mechanical joints:

.1 Without flexible connections between the piping and equipment:

.1 Only the three first joint connecting the piping to the chillers, the cooling towers and pumps can be flexible mechanical joints, type Victaulic or Gruvlock by Anvil. Bolts and nuts to be of stainless steel, compliant with ASTM-f-593 and ASTM-F-594, with rupture-resistance strength of 110 000 psi. Bolts to be in vertical position with nuts below.

.2 With flexible connections between the piping and equipment:

.1 No mechanical joints, piping must be anchored.

2.2 EXPANSION JOINTS

.1 As indicated on drawings, use the following expansion joints, installed according to manufacturer's recommendations:

.1 On piping containing liquids:

.1 For diameters up to NPS 3:

.1 Compensators: Flexi-Tube no. HP-2 or HP-3, according to the required axial movement.

.2 For diameters greater than NPS 3:

.1 Expansion joints, 2100 kPa, with stainless steel bellows, number of bellows appropriate with the axial movement required.

.2 Such as flexonics controlled flexing by Flexonics.

2.3 SUPPORTS

.1 General:

.1 See section 23 05 29 – Hangers and supports for HVAC piping and equipment.

.2 In service tunnels, for long lengths of piping and those requiring expansion joints or loops, such as piping for heating, steam, and condensate, the piping to be mounted on roller supports.

2.4 COOLING TOWER WATER, 1035 KPA AND LESS

.1 Piping:

.1 Material:

.1 NPS 2 to NPS 4:

.1 Black steel, Std series, ASTM-A53, CW, grade A.

.2 NPS 8 to NPS 16:

.1 Black steel, Std series, ASTM-A53, grade B, ERW.

.2 Fittings:

.1 NPS 2 and smaller:

.1 Malleable cast iron, ASME/ANSI B16.3, 1035 kPa, threaded.

.2 Malleable cast iron unions, ASME/ANSI B16.39, ASTM-A197, 2070 kPa, threaded.

.2 NPS 2½ to NPS 30:

.1 Black steel, same series as the piping.

.3 Branch connections:

.1 NPS 2 and smaller:

.1 Malleable cast iron threaded tees, ASME/ANSI B16.3, class 150.

.2 NPS 2½ and larger:

.1 See "PIPING – GENERAL".

.2 Standard tees, seamless, ASTM-A234 steel, WPD series.

.4 Joints:

.1 NPS 2 and smaller:

.1 Threaded for fittings, unions, and connections.

.2 NPS 2½ and NPS 30:

.1 Connections: welded joints.

.2 Other joints, according to one of the following methods:

.1 Welded.

.2 Mechanical. See the restrictions in section "PIPING – GENERAL".

.3 Flanges with welding neck, 1035 or 2070 kPa (150 or 300 psi), ASTM-A-105 for NPS 24 and smaller, ASTM-A-181 forged for NPS 26 and larger, depending on connected equipment.

.4 Slip on flanges, ASTM-A-105, class 150 or 300, with one internal welding pass and two external welding passes.

.5 Note: Victaulic style 77 joint for joints where there is vibration and where required for expansion.

.5 Flange gaskets:

.1 Use Victaulic style 77 for devices where there is vibration and where required for expansion.

.6 Bolts for flanges:

.1 Steel bolts, grade 5, zinc plated.

.2 Nuts, ASTM-A563, grade A.

.3 Dowels, grade B7.

.2 Valves:

.1 Gate valves:

.1 NPS 2 and smaller:

.1 Bronze body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: bronze, non-rising stem.

.5 Model: Crane fig. 438. Milwaukee no. 105.

.2 NPS 2½ to NPS 6:

.1 Cast iron body.

.2 Flanged ends.

.3 Class 125.

.4 Internal parts: bronze, rising stem.

.5 Model: Crane fig. 465½. Milwaukee no. F-2885A.

.2 Globe valves:

.1 NPS 2 and smaller:

.1 Bronze body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: bronze, non-rising stem, synthetic alloy replaceable disk.

.5 Model: Crane fig. 1. Milwaukee no. 502.

.6 Note: use with automatic air vents.

.3 Butterfly valves:

.1 NPS 2½ to NPS 6:

.1 Cast iron body.

.2 Lug style fittings.

.3 Class 150.

.4 Internal parts: stainless steel 316 stem, bronze disc, replaceable EPDM seat.

.5 Model: Keystone no. 222. Bray, series 31.

.2 NPS 8 and larger:

.1 Cast iron body.

.2 Lug style fittings.

.3 Class 150.

.4 Internal parts: stainless steel 316 stem, bronze disc, replaceable EPDM seat.

.5 Model: Keystone no. 222. Bray, series 31.

.4 Eccentric plug valves:

.1 NPS 2 and smaller:

.1 Cast iron body.

.2 Threaded ends.

.3 With key, position indicator, and adjustable stop.

.4 Class 125.

.5 Internal parts: EPDM covered plug, epoxy covered seat.

.6 Model: Milliken Millcentric no. 603E.

.2 NPS 2½ and larger:

.1 Cast iron body.

.2 Flanged ends.

.3 Class 125.

.4 Mechanical stop and adjustable valve key.

.5 Internals: EPDM coated cast iron plug, epoxy covered seat.

.6 Model: Milliken Millcentric no. 601E.

.7 For valves NPS 8 and larger, provide with handwheel and gears.

.5 Check valves:

.1 NPS 2 and smaller:

.1 Bronze body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: bronze, replaceable disk.

.5 Model: Crane fig. 37. Milwaukee no. 509.

.2 NPS 2½ and larger:

.1 Cast iron body.

.2 Wafer fittings.

.3 Class 125.

.4 Internal parts: replaceable disk, stainless steel seat.

.5 Model: Check-Rite no. 210. Prince (Tyco) fig. 810.

.6 Pressure regulating valves:

.1 Starting pressure adjustment from 20 to 140 kPa, complete with hydraulic regulator isolation valves, pressure gauge, automatic air vent, as shown in the drawings, CLA-VAL no. 750-01 or 50-01.

2.5 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from Section 01 00 10.

.2 List of manufacturers, section 23 21 13.

.1 Piping:

.1 Steel and galvanized steel piping:

.1 Nova Tube
.2 Olympia Tube
.3 Omega Steel Company
.4 US Steel
.5 Wheatland (Zeckelman)

.2 Copper piping:

.1 Crane Copper Tube
.2 Great Lakes Copper
.3 Mueller Industries
.4 Yorkshire Copper Tubes (KME Group)

.3 Stainless steel piping:

.1 Bristol
.2 Felker
.3 Douglas Barwick
.4 Merit Brass
.5 Pinacle
.6 ResistAloy Inc.
.7 Russel Metals (Acier Leroux)

.4 Vinyl polychloride piping:

.1 JM Eagle
.2 Manville
.3 Rehau Industries Inc.
.4 Uponor
.5 Watts Water Tech.

.2 Piping accessories:
- .1 Steel flanges and fittings:
  - .1 Anvil International Ladish
  - .2 Taylor Forge
  - .3 Ward
- .2 Stainless steel flanges and fittings:
  - .1 Douglas/Barwick Inc.
  - .2 Keystone
  - .3 Pinacle
  - .4 Resistaloy Inc.
  - .5 Russel Metals (Acier Leroux)
- .3 Malleable cast iron fittings:
  - .1 Anvil
  - .2 Bibby Ste-Croix
  - .3 Ward
- .4 Joints:
  - .1 Gruvlock (Anvil)
  - .2 Shurjoint
  - .3 Victaulic Co. of Canada Ltd
- .5 Flange gaskets:
  - .1 Garlock
  - .2 John Crane
  - .3 Robco Inc.
- .6 Copper fittings:
  - .1 Anvil International
  - .2 Cello
  - .3 Mueller
  - .4 Nibco
  - .5 Smith-Cooper

.3 Unions, flanges, and mechanical joints:
- .1 Gruvlock (Anvil International)
- .2 Victaulic Co. of Canada Ltd

.4 Dielectric insulators:
- .1 Corrosion Service Co. Ltd (10 Price Street, Toronto)
- .2 Epco Sales

.5 Valves:

.1 Globe and gate valves:

.1 Crane
.2 Hattersley
.3 Jenkins
.4 Kitz Corp.
.5 Milwaukee
.6 Velan

.2 Check valves:

.1 Crane
.2 Hattersley
.3 Jenkins
.4 Kitz Corp.
.5 Milwaukee
.6 Mission
.7 Prince
.8 RitePro (Robin Néron)

.3 Silent check valves:

.1 Apco (see also De Zurik)
.2 Check Rite from RitePro (Robin Néron)
.3 Crane
.4 De Zurik/Apco
.5 Milwaukee
.6 Mission Duo-Check
.7 Smolensky
.8 Williams-Hager

.4 Butterfly valves:

.1 Bray
.2 Crane
.3 De Zurik
.4 Hattersley
.5 Keystone
.6 Milwaukee

.5 Plug valves and eccentric plug valves:
- .1 Clow
- .2 Crane
- .3 De Zurik
- .4 Duriron Canada
- .5 Hattersley
- .6 Jenkins
- .7 Kieley & Mueller
- .8 Milliken
- .9 Rockwell-Nordstrom

.6 Manual main shut-off valves:
- .1 Crane
- .2 Hattersley
- .3 Jenkins
- .4 Kitz Corp.
- .5 Viking

.7 Supports and anchors:
- .1 Anvil
- .2 Cantruss
- .3 E. Myatt
- .4 Fee & Mason

Part 3 Execution

3.1 GUIDES

.1 Install guides to control the longitudinal movement of the pipe where expansion joints are installed.
- .1 Slip joint type of expansion joints, such as Yarway.
- .2 Bellow expansion joints, such as Flexonics.
- .3 Expansion loops manufactured with piping.
- .4 Ball joints.

3.2 EXPANSION JOINTS

.1 Take all necessary precautions to ensure that the expansion and the contraction of the pipes due to temperature changes do not cause undue stresses in the piping and the equipment.

.2 As indicated and where necessary, install expansion loops built with piping and fittings.

.3 Size the expansion loops so as to exert the least possible stress to the joints in the piping. Design it so as not to exceed the yield strength of the material used. Install them with pre-expansion corresponding to half the calculated expansion between operation at cold (-20°C) and at hot (maximum possible temperature of the liquid or vapor).

.4 For copper piping, use wrought (wrot) type fittings to manufacture the expansion loops.

.5 Slip and bellow type joints must be installed in strict compliance with the manufacturer's recommendations.

.6 Provide, for verification, the calculations for each expansion joint.

.7 When submitting the piping to the test pressure requested in this specification, take the necessary precautions to prevent the deterioration of the expansion joints that cannot withstand this pressure or the expansion caused by this pressure.

3.3 BALL JOINTS

.1 Install the joints according to the guidelines of the manufacturer's representative and under his supervision.

.2 Once the installation is complete, obtain a written report from the manufacturer stating that the joint installation complies with their recommendations.

.3 Install the joints pre-extended to the full expansion calculated between the hot and cold operation of the piping.

.4 Provide, for verification, the calculations for each expansion loop.

.5 Install the joints in groups of four with the longest possible pipe between joints to lessen the bending that occurs in the piping between the hot position and the cold position. Calculate the length of the pipe between the joints, as described in the technical bulletin from the company Aéroquip, using the expansion of the pipe at -20°C as a basis for cold position and the anticipated expansion in the tests planned in the specification.

3.4 FLEXIBLE EXPANSION LOOPS

.1 Install the loops in a neutral, pre-stretched, or pre-compressed position depending on the application requirements.

.2 Install and guide as per manufacturer instructions.

3.5 ANCHORING

.1 See section 23 05 29 Hangers and supports for HVAC piping and equipment.

.2 Anchors with concrete abutments (beam, slab, or column) at the bottom of the riser pipes for water tower supply and return: special anchors supplied and installed by others, but welded to the piping by this section.

.3 Special anchoring to the steel frame with appropriate adaptors and in accordance with the structural Engineer's requirements. Submit the drawings of these special anchors for approval.

3.6 SUPPORTS

.1 General:

.1 For very large pipes, heavy devices, and devices subject to vibration, install the supports' rods through the slab with a steel plate above the latter. Steel plates 150 mm x 150 mm x 6 mm, or larger, according to the diameter. Consult the structural Engineer for these special cases.

.2 Floor supports:

.1 In mechanical rooms, suspend the supports from an independent steel frame, welded and anchored to the floor, steel structural frame constructed from angle iron, steel pipes serving as columns, and horizontal members permitting the installation of the supports. Structural support frame with single or double column, arranged so as not to impede traffic or obstruct access to the devices. Provide fabrication drawings of this structure.

3.7 VALVES

.1 For valves, especially for the eccentric plug type, follow the manufacturer's recommendations as to the liquid's direction of flow, as appropriate for the different applications.

.2 For butterfly valves, install them with the horizontal rod.

3.8 TESTING AND CLEANING

.1 General:

.1 See the article "TESTING" in section 01 00 10 – Mechanical and electrical general instructions.

.2 Perform all tests specified below.

.3 All tests must have been conducted satisfactorily before requesting an inspection by the Engineer.

.4 All piping or part thereof must be tested before being covered with insulation or being concealed in partitions, ceilings, or walls. Prior to pressure testing systems, remove or protect devices such as control devices, air vents, or any equipment that is not designed to be subjected to pressures corresponding to those used during the tests.

.5 During hydrostatic testing, ensure that the piping is completely filled with liquid and purged of all air.

.6 In cold weather, use an antifreeze for hydrostatic tests, and at the end of the tests, drain piping completely to prevent any risk of freezing.

.2 Tests:

.1 Piping:

.1 Chilled water, hot water, cooling water, ethylene or propylene glycol:

.1 A pressure 50% higher than the opening pressure of the safety valve or 1035 kPa minimum must be maintained without leakage for a period of at least two hours throughout the piping. Perform this test with cold water.

.2 Domestic water, softened water, and non-potable water:

.1 A pressure of 345 kPa above the maximum operating pressure or of the adjustment pressure of the safety valve or 1035 kPa minimum must be maintained without leakage for a period of at least two hours throughout the piping. Perform this test with cold water.

.2 Submit all joints to mechanical shocks with a suitable tool.

.3 If it is impossible to test the entire installation at once, it can be divided into several parts, and each tested as described above.

.4 In booster pump systems, the maximum operating pressure corresponds the maximum pump pressure at zero flow.

.2 Chemical process piping:

.1 Subject the piping to a hydrostatic pressure of 2400 kPa for six (6) hours.

.3 Cleaning the networks:

.1 See section 23 25 00 – HVAC water treatment systems.

.2 Fill the piping of the various systems with cold water, then drain. Also, clean all strainers.

.3 Fill the piping with cold water and circulate the water using the pumps for approximately two hours, then drain the pipe. Clean the strainers again.

.4 Chemically clean the systems by adding the product described in section 23 25 00 – HVAC water treatment systems. Completely drain the systems and flush with water to the satisfaction of the chemical treatment's manufacturer. Clean the strainers again.

.4 Cleaning the strainers:

.1 The strainers must be cleaned periodically by this section.

3.9 BALANCING

.1 Chilled water, cooling water, hot water, ethylene glycol and high temperature hot water:

.1 Adjust the valves to obtain the required water flow at each chiller in each main network, in every primary and secondary network, in each branch, in each coil group, in each coil, in each group of fan-coil units, unit heaters, etc.

.2 Provide three copies for review and comment, a full report of all tests and adjustments performed, indicating the final readings obtained.

.3 Enter the results on a 216 mm x 279 mm size format, entering the name of the system, the device, the required characteristics, and those obtained.

END OF SECTION

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3.3 SAFETY VALVES (WATER)

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

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-A278/A278M-01(2011) – Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (350°C).

.3 ASTM-A516/A516M-10 – Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower – Temperature Service.

.4 ASTM-A536-84(2009) – Standard Specification for Ductile Iron Castings.

.5 ASTM-B62-09 – Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 CSA group:

.1 CSA B51-F09 – Boiler, pressure vessel, and pressure piping code.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for the hydronic specialties. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.3 Shop drawings:

.1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada.

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and Maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.

.4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.

.5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 AIR VENTS

.1 Manual air vents:

.1 Notch for screwdriver slot, operating pressure 0 to 1035 kPa, Bell & Gossett no. 4V.

.2 Automatic air vents:

.1 Up to NPS 3, with shut-off ball valve, operating pressure 0 to 1035 kPa, Watts no. FV4.

.2 Larger than NPS 3, with shut-off ball valves, operating pressure 0 to 1035 kPa, Armstrong no. 1AV.

2.2 SAFETY VALVES

.1 Pressure relief type with test lever, proven capacities in accordance with the ASME and N.B.S. standards.

.2 On headers: bronze, with safety cap on adjustment mechanism, adjustable up to 1725 or 2070 kPa, depending on diameter, Farris no. 1855-0L.

.3 Adjusted diameter and pressure, as indicated.

2.3 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10 – Mechanical and electrical general instructions.

.2 List of manufacturers, section 23 21 14:

.1 Air vents:

.1 Armstrong
.2 Bell & Gossett
.3 Dunham
.4 Maid O'Mist
.5 Sarco

.2 Safety valves:

.1 Farris
.2 Kunkle
.3 Watt

Part 3 Execution

3.1 GENERAL

.1 Route drain piping, and the discharge pipes connected to the vent connections, to the nearest flour drain.

.2 Provide adequate clearance to allow access to accessories for repair and maintenance purposes.

.3 If the planned clearances cannot be respected, consult the Engineer and comply with their directives.

3.2 AIR VENTS

.1 Manual air vents:

.1 Install at the end of an air chamber constructed by a length of NPS ¾ pipe approximately 150 mm long, surmounted by an elbow. Install the vent in line with the opening created for this purpose in the heating device cabinet, maximum distance of 6 mm from the front panel.

.2 Automatic air vents:

.1 Install in following locations: on chilled water coils, hot water coils, glycol coils, as indicated in drawings, and each high point.

.2 For glycol coils, drain each vent towards the glycol tank.

.3 High temperature hot water manual air vents: install as indicated in drawings, and each high point.

3.3 SAFETY VALVES (WATER)

.1 Pipe safety valves to funnel floor drains, firmly anchor piping, cut end of pipe at 45° where it enters funnel.

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3.2 IN-LINE PUMPS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Electrical and mechanical general instructions.

.2 Section 23 05 13 – Common motor requirements for HVAC equipment.

.3 Section 23 05 48 – Vibrations and seismic controls for HVAC piping and equipment.

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 and Electronic Manufacturers Association of Canada (EEMAC)

.4 National Electrical Manufacturers' Association (NEMA):

.1 NEMA MG 1-2011 – Motors and Generators.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for the pumps. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.3 Shop drawings:

.1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada.

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and Maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.

.4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.

.5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 GENERAL

.1 The impeller must not exceed 85% of its maximum diameter.

.2 Pump and motor with flexible coupling. Select the flexible coupling joint according to the start-up torque of the motor, plus a safety factor of 150%, and for frequent start-ups.

.3 Flexible coupling protected by a removable metal guard, of very rigid construction, compatible with the weight and the rotation speed of the joint.

.4 Pumps perfectly aligned and free of vibrations. See section 01 00 10 – Mechanical and electrical general instructions.

.5 Conduct tests to determine the natural frequency of the pump assembly – motor and base. Perform the corrections to eliminate any risk of resonance over the entire range of operating speeds, pay special attention to pumps operating at variable speeds.

.6 The pumps must have the characteristics indicated in the pump schedules. Discharge on the right or left, according to the drawings or site conditions.

.7 Parallel pumps must be able to operate individually within the operating limits of the pump.

.8 For ethylene glycol, use mechanical joints compatible with the heat transfer fluid.

.9 Motors and starters: see section 23 05 13 – Common motor requirements for HVAC equipment.

.10 Unless otherwise specified, all pumps must be supplied with a suction diffuser.

2.2 SUCTION DIFFUSER

.1 Reinforced cast iron body rated for operating pressure of 1207 kPa, flanged connections rated for 1030 kPa, according to ASA standard, drainage port, pressure gauge connection and adjustable support to support the suction piping weight.

.2 Stainless steel inlet valves and suction diffuser.

.3 The suction diffuser must have a surface area five times greater than the suction port of the pump and provided with 0.19 mm (3/16") openings. The pressure loss must not exceed 10 kPa. Removable cylinder diffuser for cleaning.

.4 The suction diffuser inlet with disposable bronze screen (16 mesh) after the start of the network.

2.3 IN-LINE PUMPS

.1 Centrifugal type, single-stage, vertical, cast iron casing, operating pressure as indicated in the schedules.

.2 Bronze impeller statically and dynamically balanced, carbon steel drive shaft, bronze shaft sleeve.

.3 Radial gasket, split type, external mechanical seal, spacer, and coupling.

.4 Pump protected by stainless steel cyclone separator with integral copper connections with shut-off valves and drain valve, the mechanical joint of each chilled water pump, heating hot water pump, and water tower cooling water pump. Cyclone separator and assembly to permit the removal of suspended solids in the water and to protect mechanical joints. Cyclones designed to operate at a minimum pressure of 1050 kPa. No cyclone on glycol pumps.

.5 Pump base complete with drain valve with hose connection.

.6 Motor to be one-piece drive shaft, normal thrust bearing, P-base type, induction type squirrel cage, drip proof. See section 23 05 13 – Common motor requirements for HVAC equipment.

.7 Glycol pumps only, under the bearings provide an L-type copper drain pipe, 50 mm in diameter, to drain into the glycol storage tanks.

2.4 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10.

.2 List of manufacturers, section 23 21 23:

.1 Pumps:

.1 Baltimore
.2 Bell & Gossett
.3 Leitch
.4 Paco
.5 Plad
.6 Taco

Part 3 Execution

3.1 GENERAL

.1 Piping:

.1 No piping weight must rest on the pump connections. Accordingly, provide pipe supports on the anti-vibration and leveling base. Enlarge these bases accordingly.

.2 Victaulic joints:

.1 Install a minimum of three Victaulic joints on the piping at the suction and the discharge of the pumps.

.3 Drainage:

.1 Under the pads, provide a connection to the drain for each pump. Drain pipe from the pump to the floor drain to be NPS ¾ in diameter and fitted with unions and cleaning plugs. Black steel piping, schedule 40, with class 860 kPa cast iron fittings. For glycol pumps only, a copper drain hose, L-type, NPS 2, to drain into the glycol storage tanks.

.4 Tests:

.1 Conduct tests to determine the natural frequency of the pump assembly – motor and base. Perform the corrections to eliminate any risk of resonance.

3.2 IN-LINE PUMPS

.1 Pump with 10 HP and less motor, support piping with metal supports downstream and upstream.

PUMP SCHEDULE							
Identification		**6-PET-006**					
Location		Tower no. 4					
Flow rate (L/min)							
Pump head (ft water)	Total						
	Suction						
	Discharge						
Pump	Brand	Baltimore					
	Type	300521					
	Model	R92800342					
	rpm	1 755					
Motor	HP	3					
	rpm	1 755					
	Volt/Phase	575/3					
Comments		1	1				

Notes:

1 Identical pump replacement at flow rates, pressure losses and dimensions.

END OF SECTION

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3.1 COOLING TOWERS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM-A48/A48M-03 – Standard Specification for Gray Iron Castings.

.2 ASTM-A123/A/123M-2001 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM-A153/A153M-04 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.4 ASTM-B117-2003 – Standard Practice for Operating Salt Spray (Fog) Apparatus.

.5 ASTM-C67-2003 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

.6 ASTM-D520-2000 – Standard Specification for Zinc Dust Pigment.

.2 Canadian Standards Association (CSA)/CSA International:

.1 CSA B52-1999(C2004) – Mechanical refrigeration code.

.3 Cooling Technology Institute (CTI):

.1 CTI-ATC-105-2000 – Acceptance Test Code.

.2 CTI-STD-201-2004 – Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.

.4 Health Canada/ Workplace Hazardous Materials Information System (WHMIS):

.1 Material safety data sheets (MSDS).

.5 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102-M88(C2000) – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.6 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG 1 2003 – Motors and Generators.

1.3 GENERAL

.1 Notwithstanding the article "TENDERS AND EQUIVALENCIES" in section 01 00 10 – Mechanical and electrical general instructions, when an asterisk (*) is used in the list of manufacturers, the Contractor must tender with this manufacturer. A credit or an addition in prices, accompanied by the relevant documentation describing the specifications of the proposed equipment and the procedures used, may be submitted with the tender for the other manufacturers listed in the list of manufacturers.

.2 The analysis of the separate prices and the specifications of the equipment and the procedures used will be performed by the Contractor selected for the contract. This analysis will not be used for purposes of negotiation between bidders.

1.4 SEPARATE PRICES

.1 The tenderer must submit, during his bid, a price declared included in the cost of the tender for the supply of heat exchangers fully compatible with the alternative refrigerant.

1.5 DOCUMENTS TO BE SUBMITTED WITH THE TENDER

.1 The following documents must accompany the tender:

.1 The complete technical of the work for the cooling towers and their components.

.2 For each water tower, the characteristics of the equipment and the final performance of the cooling tower or for any other alternative submitted by the manufacturer or requested by the specification.

1.6 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, instructions, specifications and data sheets for products. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

.1 Shop drawings:

.1 Shop drawings must include the seal and signature of a professional Engineer recognized in Canada, in the province of Québec.

.2 Drawings must include, but are not limited to:

.1 Details of concrete foundations and anchors required.

.2 Installation details of anti-vibrations plates.

.3 The drawings of the connections and the dimensions to be respected for the installation.

.4 Complete electrical diagrams, including starters, control panels, safety checks, connections, etc.

.5 Capacities, as well as sound power levels, certified and performed according to recognized standards.

.2 Certificates:

.1 Submit certificates signed by the manufacturer certifying that the products and materials comply with the specified performance and physical requirements.

1.7 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Operation and maintenance data (O&M): provide instructions with respect to the operation and maintenance, to be incorporated into the O&M manual.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle hazardous materials in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Shipping and receiving: deliver material to site in the original packaging, which must bear the name and address of the manufacturer.

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with the waste management plan.

.4 Separate steel, metal and plastic materials in designated containers for recycling in accordance with the waste management plan.

.5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Product

2.1 COOLING TOWERS

.1 General:

.1 Each tower consists of two main sections, one basin– fans section and one section including heat exchange surfaces, the water jets with piping and eliminators.

.2 Disassemble, replace, reassemble and align all moving, water exchange and distribution parts. Insert the fans into the basin section to blow the air through the water cascade.

.3 Renew all internal surfaces of the lower and upper towers.

.4 The water towers have to be leave installed on site.

.2 Basin – Fans section:

.1 Each section will receive sanding, painting, cold galvanizing and cleaning treatment. Following this surface work, the ponds will be disinfected, and a complete sealing of the panels and corners will be carried out.

.2 These following accessories have to be replaced:

.1 Access door 430 mm in diameter, on the side.

.2 Removable anti-cavitation screen constructed of hot galvanized steel.

.3 Drain hose with shutoff valve.

.4 Connection for filler pipe.

.5 Make-up water valve in brass with a plastic float.

.3 Fans:

.1 All mechanical moving parts and corroded or worn parts must be replaced including, but not limited, the bearing, the fans shaft and the ventilation wheels.

.4 Fan motor:

.1 The fan motor shall be replaced by an equivalent model in terms of dimensions and electromechanical characteristics.

.2 V-belts must be replaced and selected for 150% of the capacity of each motor. Pulleys and all moving parts must be replaced too.

.3 Provide pulleys for an external static pressure of 125 Pa.

.3 Section for heat exchange, water distribution, and eliminators must be replaced and contain the described characteristics:

.1 The heat transfer surface made of corrugated polyvinyl chloride (PVC) must be approved by the Factory Mutual Research Corporation for cooling towers assembled in factory and be registered in the Factory Mutual Approval guide.

.2 Water distribution system constructed of PVC pipe, schedule 40, with plastic atomizers and 19 mm x 8 mm minimum opening.

.3 Eliminators constructed of hot galvanized steel with at least three corners and stapled edges, removable and easy to handle.

.4 All screws and seals must be replaced.

.5 Pipe fittings:

.1 All cooling water connections with grooves for Victaulic fittings, as installed.

.2 Replacement of the cooling water supply connections as well as the make-up water connection and the overflow pipe are located on the rear wall of the cooling towers. Return water connection on the side of the tower.

.1 Coil of the winter tower no. 4:

.1 The glycol exchange coil from the winter operating tower is retained but must be cleaned. If fins are crushed before or during cleaning, a comb adjustment must be made.

2.2 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10.

.2 List of manufacturers, section 23 65 10:

.1 Cooling towers:

.1 Baltimore Aircoil (Aquavap Equipment Ltd)

.2 Evapco

.3 Marley

Part 3 Execution

3.1 COOLING TOWERS

.1 Ensure that the steel frame is compatible with the towers' support bases, the vibration isolators, and the piping supports. Provide all relevant details to the structural Engineer for this purpose, if needed.

.2 Victaulic fittings with gaskets, installed so as to take into account the movements due to the expansion of the piping, as installed.

END OF SECTION