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CANADIAN SPACE AGENCY
Air-conditioning of room 2B-203

Specifications – Mechanical

2022-08-26
Project: 2020-134-1024

CANADIAN SPACE AGENCY

6767, ROUTE DE L'AÉROPORT

SAINT-HUBERT (QUÉBEC)

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AIR-CONDITIONNING OF ROOM 2B-203

DIVISIONS 01, 23 AND 25

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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.

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.

.3 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.

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 or English.

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 "VENTILATION – AIR-CONDITIONING" 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 "VENTILATION – AIR-CONDITIONING" 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 "VENTILATION – AIR-CONDITIONING") 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 The placement of sleeves, openings and perforations expected in the walls, floors, beams and columns.

.2 Anchors.

.3 All ventilation work – air conditioning.

.4 All mechanical and electrical work in mechanical rooms, tunnels, wells, parking lots, and primary and secondary electrical rooms.

.5 All mechanical and electrical work in all places where space is particularly restricted.

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

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

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

.9 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 FRAMES AND ACCESS DOORS

.1 Unless otherwise specified, recessed frames and access doors in walls and ceilings, other than easily removable ceilings, shall be provided by the relevant section but installed by the company responsible for the construction of walls and ceilings.

.2 Each mechanical and electrical section shall determine the size and location of doors in such a way as to ensure easy access to all baffles, control devices, fire dampers, valves, vents, cleanouts, siphons, sieves, traps, ventilation units, pull boxes, electrical appliances, etc.

.3 The doors must be at the same fire resistance specified for the walls and ceilings.

.4 These frames and doors shall be built-in, constructed of 1.6129 mm (16-gauge) galvanized sheet metal with a layer of sealant. Hidden frames with exposed line with face flush with wall or ceiling, concealed hinge, 150° opening with lock and key (except on fire doors). The door must self-closing.

.5 The types of frames and doors are as follows:

.1 Walls made of brick, concrete block, finished in tile, poured cement blocks covered with gypsum boards or other similar finish: Karp no DSC-214M.

.2 Ceilings and walls of plaster or with cement finish or other similar finish: Karp KDW.

.3 Firewalls: Karp no KRP150FR, in steel, 16-gauge, with 50 mm (2") of insulation in the door, fire resistance of ULC 1½ h, with self-closing mechanism and without lock/latch.

.6 All Contractors must coordinate in order to provide the same type of door for all mechanical and electrical sections.

1.22 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

1.23 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 or English.

.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.

1.24 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".

1.25 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.

1.26 MANUFACTURERS' INSTRUCTIONS

.1 Install the various pieces of prefabricated materials and equipment, in accordance with the manufacturer's instructions. Obtain all relevant instructions.

1.27 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.

1.28 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.

1.29 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.

1.30 SLEEVES

.1 Unless otherwise indicated, all direct and indirect costs of the supply and installation of the sleeves are the responsibility of the concerned section.

.2 Refer to the prescriptions of the relevant sections of the mechanical and electrical specifications.

1.31 NEW OPENINGS, DRILLING IN WALLS, FLOORS, BEAMS, AND COLUMNS

.1 General:

.1 Unless otherwise indicated, all necessary openings for piping and ventilation and electrical conduits in the form of holes to be made are the responsibility of the General Contractor, including all direct and indirect costs, such as tracking and marking.

.2 The General Contractor is responsible for all damages and repair caused by the openings.

.3 Openings must be shown and located on the coordination drawings, located and identified on the site in a manner accepted by the Contractor and the structural Engineer before drilling.

.4 The openings must be sufficiently large to permit the laying of sleeves and thermal and acoustic insulation.

.5 Any drilling in the structure must be approved by the structural Engineer.

.6 Piercing holes with pneumatic or electric hammers by vibratory action as well as hand drilling and any other process by mechanical impacts are prohibited.

.7 In the concrete, drill the holes using a rotary water drill or any other equipment accepted by the structural Engineer.

.8 In the steel bridging, drill and reinforce openings, according to the guidelines of the structural Engineer.

.9 It is not allowed to drill in capitals and column projections or strips without special permission from the structural Engineer who will decide how to proceed.

.10 The General Contractor is responsible for all formwork required for the installation of rectangular ducts. Instructions related to dimensions, quantity, location, and testing must come from the related section. All additional steel framing and related work are also the responsibility of the General Contractor.

.11 The General Contractor must employ a specialised firm to scan and digitize the existing slabs, with Georadar (GPR) or similar technology, in order to determine the location of buried elements and services such as conduits, pipes, and reinforcements, before making openings in the existing concrete. Unless otherwise indicated, these elements must not be damaged when the opening is made.

.2 Round, square and rectangular openings in concrete:

.1 All new openings of 150 mm (6") or less are the responsibility of the concerned section, under the instructions of the structural Engineer.

.2 All new openings of more than 150 mm (6") must be made by the Contractor, at the expense of the latter, under the direction of the structural Engineer.

.3 Openings in concrete block walls and drywall:

.1 Sealing of openings by the Contractor.

.2 All new openings of 150 mm (6") and less are the responsibility of the section concerned, under the instructions of the structural Engineer.

.3 All new openings over 150 mm (6") must be made by the General Contractor, at his expense, under the directives of the Structural Engineer and the Architect.

.4 Openings to be drilled into the foundation walls and sump:

.1 By the Contractor, under the instructions of the structural Engineer.

.5 Concrete beams and columns:

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

.6 Steel beams and columns:

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

.7 Steel bridging:

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

.8 Firestop and smoke deflector assemblies: complies with the standard CAN/ULC S115-05 – Standard method of fire tests of firestop systems. Place firestops and smoke deflectors around pipes, conduits, cables and other objects passing through firewalls in order to provide the same fire resistance as the neighbouring floors, ceilings and walls.

1.32 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.

1.33 INSPECTIONS

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

1.34 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 forty-eight (48) hours 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 any piping, conduits, accessories 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.

1.35 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 period, and until receipt "with reservation", each section concerned shall carry out normal maintenance, in accordance with the manufacturers' recommendations and the instruction manuals supplied by the Contractor. Maintenance between "qualified" and "unqualified" receptions will be performed by the Owner if all information is provided and training has been completed. Otherwise, the Contractor will have to assume 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 forty-eight (48) hours 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 TEMPORARY SERVICES

.1 From a mechanical and electrical point of view, temporary services include: electricity, telephone service, fire alarms, lighting, water supply, sanitation and drainage, heating, ventilation, controls, intercom systems, fire protection, refrigeration, and all the systems necessary for the completion of the works.

.2 All temporary services, as well as energy costs, are the responsibility of the general Contractor. Refer to general conditions of contract.

.3 No device that is not part of the permanent installation will be used for temporary services before the building is deemed complete.

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

1.42 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 outside the occupancy hours of the building. For example: medical gas, electricity, water, steam, etc.

.2 Demolition:

.1 All demolition work, including road cuts, utilities, and sealing of disused pipes, are the responsibility of the Contractor.

.3 Noise:

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

.4 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.

1.43 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.

1.44 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.

1.45 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: see section 23 05 00 – CVCA – Common work results for HVAC.

1.46 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.

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

.5 Tests and trials.
.6 Preliminary balancing reports (aeraulics and hydraulics).
.7 Final balancing report.
.8 Alignment of equipment (pumps, fans, etc.).
.9 Equipment start-up.
.10 Commissioning of systems.
.11 Seismic measurement compliance report.
.12 Demobilization.
.13 Operation and maintenance manual.
.14 Training.
.15 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

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

1.2 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 33 00 – Submittal Procedures.

.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 For all systems or equipment that require an engineering design, 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

1.3 CLOSEOUT SUBMITTALS

.1 Submit the required documents/elements in accordance with section 01 00 10 – 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 – 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 01, 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 01 00 10 – General instructions.
- .2 23 05 00 – Common work results for HVAC.
- .3 23 05 13 – Common motor requirements for HVAC equipment.
- .4 23 05 15 – Common installation requirements for HVAC pipework.
- .5 23 05 17 – Pipe welding.
- .6 23 05 19.13 – Thermometers and pressure gauges – Piping systems.
- .7 23 05 29 – Hangers and supports for HVAC piping and equipment.
- .8 23 05 48 –Vibration and seismic measures for HVAC.
- .9 23 05 53 – Identification for HVAC piping and equipment.
- .10 23 05 93 – Testing, adjusting and balancing for HVAC.
- .11 23 07 16 – HVAC equipment insulation.
- .12 23 07 19 – HVAC piping insulation.
- .13 23 21 13 – Hydronic systems.
- .14 23 21 14 – Hydronic specialties.

.3 Chilled water – Scope of the work:

- .1 Included work:
  - .1 The work includes, in general, the labor, the delivery, and the installation of all materials and equipment necessary for the heating – chilled water work indicated on the drawings and specifications.
  - .2 This work includes, but is not limited to:
    - .1 All modifications related to chilled water systems.
    - .2 Removal of floor tiles required in the work area and their reinstallation following the execution of the work, including the replacement of damaged tiles.
    - .3 All special connections described in the specification and/or shown in the drawings.
    - .4 Insulation work relating to heating-chilled water work.
    - .5 All acoustic and vibration work related to heating-chilled water work, including the supply and installation of springs, anti-vibrations bases, flexible hoses, and other noise attenuation devices required for the equipment 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 All special connections.

.9 Sealing of sleeves and openings.

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

.11 All the paraseismic measures concerning heating – chilled water work, in accordance with section 23 05 48 – Vibration and seismic measures for HVAC.

.3 Instrumentation openings:

.1 In the pipes and/or ducts, create the openings necessary for measuring instruments and temperature, pressure, flow, etc. control instruments, where required by the Division 25.

.2 Install wells in the piping for the thermometers and the temperature readings.

.3 Install access doors to the ventilation controls.

.2 Work excluded:

.1 In general, the following work is excluded:

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

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

.3 Flashing.

.4 The steel framework supporting the cooling towers.

.4 Special connection:

.1 In general, special connections include all required connections to devices, all piping, adapters, shut-off valves, bypasses, unions, flanges, screens, air vents, controls, test valves, drain valves, control valves, shock absorbers, buffer tanks, traps, ventilation ducts, flexible joints, and other accessories necessary to operate the devices.

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

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

.4 Part of the chilled water work:

.1 All connections and all chilled water, hot water, cooling tower water, glycolated water, and steam connection points for various devices shown in the drawings, as well as those described in the specifications.

.2 Controls:

.1 The installation and connections to the piping of chilled water, brine, hot water for heating, cooling water for cooling towers and steam, all control valves supplied by the Division 25.

.2 Install the control valves following the guidelines of the Division 25 and under their supervision.

.3 Obtain the necessary directives.

.4 The diameters of the control valves shown on the drawings are for reference only.

.5 When the control valves or other accessories are supplied by this section, but installed by others, this section remains directly responsible for the operation of its equipment.

.6 Provide the directives and the supervision required for the installation.

.7 All demolition, relocation, and recalibration of equipment and piping, as indicated on the plans.

.3 Ventilation:

.1 All ventilation coil chilled water connections.

.4 Ventilation – Coil drain pans:

.1 Drainage from a pan to the lower pan with galvanized DWV or stainless steel piping with appropriate fittings to the drain and the pipe left at the bottom of the tray by "VENTILATION".

.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 01.

.5 The drawings kept up to date, in accordance with Division 01.

.6 Coordination drawings, in accordance with Division 01.

.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.

.6 Tender – Price to be provided:

.1 Provide with the tender, a global fixed price covering the work of "HEATING – CHILLED WATER".

1.6 SPECIFIC CONDITIONS – VENTILATION

.1 The specific requirements of the mechanical and electrical works, Division 01, apply to this section.

.2 The following sections are included in the scope of the ventilation work and complement each other to form a whole:

.1 23 05 00 – Common work results for HVAC.
.2 23 05 13 – Common motor requirements for HVAC equipment.
.3 23 05 29 – Hangers and supports for HVAC piping and equipment.
.4 23 05 48 – Vibration and seismic measures for HVAC.
.5 23 05 53 – Mechanical identification.
.6 23 05 93 – Testing, adjusting and balancing for HVAC.
.7 23 07 13 – Duct insulation.
.8 23 07 16 – HVAC equipment insulation
.9 23 31 13.01 – Metal Ducts – Low pressure to 500 Pa.
.10 23 33 00 – Air duct accessories.
.11 23 33 15 – Dampers – Operating.
.12 23 33 46 – Flexible ducts.
.13 23 37 13 – Diffusers, registers and grilles.
.14 23 82 19 – Fan-coil units.

.3 Scope of work

.1 Work included:

.1 The work includes, in general, labor, supply, and installation of all materials and equipment necessary for ventilation – air-conditioning work indicated on the drawings and in the specification.

.2 This work includes, but is not limited to:

.1 The supply and installation of a new fan coil with chilled water cooling coil for room 2B-203, including all required ducts and accessories.

.2 Removal of ceiling tiles required in the work area and their reinstallation following the execution of the work, including the replacement of damaged tiles.

.3 All special connections and ducts.

.4 All supports and structural steel components required to support the ducts and the equipment.

.5 All access doors.

.6 Insulation work relating to ventilation – air-conditioning work.

.7 All acoustic and vibration work related to ventilation-air conditioning work including the supply and installation of springs, anti-vibration bases, acoustic plenums, silencers, and other devices required by the ventilation – air-conditioning work.

.8 All new openings. See Division 20.

.9 Sealing sleeves and openings.

.10 All demolition, relocation, and recalibration work for ducts, terminal units, and diffuser grilles, as shown in the drawings.

.11 The coordination of coordination drawings from sections from Divisions 23, 25, and 26, in accordance with the requirements of the section 01 00 10 – General instructions, as well as the coordination of acoustic and vibration work.

.12 Identification of the systems' ventilation ducts, the devices, and the other accessories, in accordance with section 23 05 53 – Identification for HVAC piping and equipment.

.13 All tests.

.14 All work for the balancing and the adjustments of the air quantities.

.15 All paraseismic measures for ventilation – air conditioning work, according to section 23 05 48 – Vibration and seismic measures for HVAC.

.16 The tests required to demonstrate the operating characteristics of the air diffusers installed at the window head and sill.

.17 Duct cleanliness:

.1 All ventilation ducts and equipment should be regularly maintained to a state of cleanliness.

.2 All ventilation ducts and accessories must be cleaned and sealed (polythene or others) at the factory. The ducts and accessories must remain sealed during delivery, storage and installation on site. The temporary protection for ducts and accessories can only be removed when cleanliness level of the site alloys the equipment to start up without clogging the systems or any ducts.

.1 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 Work excluded:

.1 In general, the following work is excluded:

.1 The controls: the supply and the installation.

.4 Samples:

.1 See section 01 00 10 – General instructions.

.2 Submit all samples requested by the different sections of Division 23.

.5 Special connections and related work:

.1 See Division 01.

.2 Part of this section's work:

.1 The complete ventilation connections of the various devices indicated on the drawings and/or specifications, whether these devices are part of this section or not. The dimensions of the ventilation ducts to the devices shown in the drawings are approximate and should be verified with the other involved sections before the pipes are manufactured.

.2 The directives, the supervision, and the responsibility for the installation of the various devices provided by this section, but installed by another section.

.3 The welded or screwed connections for the ventilation devices and ducts prepared to receive the drain pipes.

.4 The openings and the access doors required for the control devices and the other instruments. The sealing of the pipes passing through the ventilation units.

.6 Documents to provide:

.1 Provide the following documents:

.1 The certificates of approval from the concerned authorities.

.2 Shop drawings, device drawings, and coordination drawings.

.3 A list of duct identification legends.

.4 Copies of the instruction manuals for the equipment operation and maintenance.

.5 Up to date drawings.

.6 A list indicating for each electric motor: the current in amperes at zero load and at normal load, the capacity of the heater installed in the starter, and the value of the maximum current in amperes inscribed on the motor plate.

.2 A full report of the results requested in the article "VENTILATION SYSTEMS' TAB REPORT" from the section 23 05 93 – Testing, adjusting and balancing for HVAC.

.7 Submissions – Prices to provide:

.1 Provide with the submission, a global inclusive price covering all the "VENTILATION – AIR-CONDITIONING" work.

1.7 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

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 00 10 – 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 – 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 – 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 – General instructions.

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 – 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. Motors of 1 HP and more used with frequency inverters must also be fitted with a non-contact earthing ring made of a minimum of two rows of conductive microfibers to protect the bearings against electric shocks. Earthing rings must be factory installed by the engine manufacturer.

.1 Grounding rings, such as Aegis Shaft Grounding Ring or approved equivalent.

.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 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.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 – 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 – 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 Flanged joints with appropriately sized bolts and nuts, bolt length equal to the thickness of the two flanges and the nut.

.4 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 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.

.5 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 Install globe valves on branches bypassing the control valves.

.11 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.

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

3.8 SLEEVES

.1 Install the sleeves where the piping passes through masonry, concrete, and fireproofing constructions, and the other indicated locations.

.2 In the concrete beams and joists, use sleeves made of schedule 40 black steel pipe, placed before pouring the concrete.

.3 In the case of foundation walls and where they project onto the covered floors, equip the sleeves at their midpoint with seam welded annular fins.

.4 For openings in concrete walls or floors for piping, install metal or plastic sleeves prior to pouring the concrete.

.5 Install the sleeves so that they are flush with the concrete or masonry surfaces.

.6 Concealed or apparent piping going through a slab not on grade must have steel sleeves extending 50 mm above the finished floor to hold backwater. Round off the edges.

.7 Before installing the sleeves, cover the exposed exterior surfaces with a thick layer of zinc rich paint compliant with the CAN/CGSB-1.181 standard.

.8 For kitchens and laundry rooms, use stainless steel sleeves.

.9 The diameter of the sleeve must be sufficient to allow the installation of the piping and its thermal insulation. Leave a 6 mm annular clearance between the sleeves and the pipes or between the sleeves and the thermal insulation that covers the pipes.

.10 The sleeve must be of a diameter leaving little opening clearance between the wall and the outside of the sleeve.

.11 Watertight steel sleeves:

.1 Manufactured with schedule 40 pipe provided with a sealing plate, 3 mm on the outer perimeter. Seam weld the plate to the outer wall of the pipe. The plates can be round or square. They can also be common for a series of sleeves placed one near the other. Each plate must be fixed to the floor.

.2 Steel sleeves with sealing plate must be installed for any tube or pipe passing through a slab not on grade.

3.9 SEALING OF OPENINGS

.1 General:

.1 The seal must meet water, fire, smoke, and acoustic requirements.

.2 The seal applies to the sleeves and the openings.

.3 The seals must be done by each relevant mechanical and electrical section, in cooperation with the other sections, under the Contractor's coordination.

.4 Each section must provide the sealing method to be used.

.5 Elsewhere:

.1 Provide space for the installation of a fire-stop material or device.

.2 Be sure to respect the required fire resistance rating.

.6 Fill sleeves installed for future use with easily removable filler material to maintain watertightness and fire separation of walls and floors penetrated.

.7 Prevent all contact between the pipes or between the copper pipes and the sleeves.

.2 Fire protection, firestop walls and floors:

.1 For all penetrations, sleeves or openings in fire separations and other fire rated construction, the space between the pipe and the sleeve or opening shall be caulked using complete CAN/ULC-S115 approved systems.

.2 If space to be caulked around pipes or ducts exceeds 25 mm, consult the product manufacturer's representative for a complete CAN/ULC-S115 listed system including arrangement details and product installation instructions.

.3 Smoke seals and acoustic seals:

.1 Unless otherwise specified, seal the space between the pipe and the sleeve or opening, the space between the conduit and the sleeve or opening with a complete CAN/ULC-S115 approved system.

.4 Watertight seals:

.1 In places where there is a possibility of water damage, and particularly in engine rooms, kitchens, dishwashing rooms, in rooms located above transformer rooms, control centers for communications, alarms, and computers, and all wells with pipes going through a floor must be surrounded by a concrete low wall of 75 mm in height from the finished floor to prevent water leaks through these openings. See the article "CONCRETE WORKS" in section 01 00 10 – General instructions.

.2 In places where there is a possibility of water damage, and in the specific places mentioned in the preceding paragraph, all pipe passing a floor must be fitted with a watertight steel sleeve, extending above the finished floor by 50 mm.

.3 The area between the inside of the sleeve, wall (or concrete, where no sleeve is required) and the pipe shall be watertight by the appropriate section with a complete CAN/ULC-S115 approved system.

.4 All work and pipes going through the tiles with water proofing membrane should be installed in such a way as to ensure the watertight integrity of these floors.

.5 Floating floors:

.1 Sealing is the responsibility of the Contractor.

.6 Wells:

.1 Blocking the wells' horizontal openings must be done by the relevant mechanical section, in accordance with specifications from other divisions, while ensuring protection against fire, smoke, and water. The Contractor must coordinate each stakeholder's tasks. For boiler room and mechanical room ceilings, blocking should be done with cut steel plates, sealing the space between the pipes, the required profiles irons, and the concrete of a thickness ensuring protection against the fire and smoke.

.7 Products:

.1 Resilient putty: firestop type 3M, Hilti, Vulken.

.2 Fire barrier: Fire Barrier Double AD or Roxul fiber, UL approved.

.3 Non-shrink filling concrete: In Pakt of Master Flow 13, without iron filings.

3.10 ESCUTCHEON PLATES

.1 Install the escutcheons (chrome-plated rings) in places where pipes pass through walls, partitions, floors, ceilings, and in the finished areas and rooms. This article does not apply to mechanical rooms, parking lots, or warehouses.

.2 Manufacturing: single piece escutcheons, fixed by a locking screw.

.1 Material: chrome or nickel-plated brass or stainless steel grade 302.

.3 Dimensions: outer diameter greater than that of the opening or sleeve.

.1 Inner diameter appropriate to outer diameter of the pipes on which they are mounted, or their insulation.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 – General instructions.

1.4 QUALITY ASSURANCE

.1 Qualifications of the labour:

.1 Welders:

.1 All welders must have the experience and capabilities listed in the standard CSA B51.

.2 Employ qualified welders who have certificates from the relevant authorities for every welding process used.

.3 Submit the qualification certificates of the welders.

.4 Every welder must identify their work with a stamp provided to them by the relevant authority.

.5 Companies performing aluminum fusion welding must be accredited in compliance with the standard CSA W47.2.

.2 Inspectors:

.1 Inspector must have the experience and competencies defined in CSA W117.2.

.3 Certification:

.1 The welding processes must be performed in compliant with CSA B51.

.2 A copy of the description of the welding processes employed must be kept on-site for reference purposes.

.3 Safety rules must be followed for welding, cutting and other related activities compliant with CSA W117.2.

1.5 DELIVERY, STORAGE AND HANDLING

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

.2 Deliver materials to site in original packaging, labeled with manufacturer's name and address.

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.

2.2 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.

.3 Sealing of threaded joints:

.1 Domestic, non-potable and softened water: polytetrafluoroethylene (PTFE) sealing tape and sealant paste certified for application to a drinking water network.

.1 Products:

.1 BMI white PTFE Teflon or approved equivalent.

.2 Masters Pro-Dope or approved equivalent.

.2 Chilled water: polytetrafluoroethylene (PTFE) sealing tape and compound liquid.

.1 Products:

.1 BMI pink teflon PTFE or approved equivalent.

.2 Gunk Tite-Seal T55 or approved equivalent.

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

.5 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.

.6 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 3 and smaller: unleaded solder.

.2 NPS 4 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.

.7 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.

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.

END OF SECTION

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B40.100-2005 – Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008 – Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (ONGC or CGSB):

.1 CAN/CGSB-14.4-M88 – Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88 – Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

.3 Efficiency Valuation Organization (EVO):

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

.1 IPMVP, version 2007.

.4 Green Seal Environmental Standards (GS):

.1 GS-11-11 – Standard for Paints and Coatings.

.2 GS-36-11 – Standard for Commercial Adhesives.

1.3 SUBMITTALS

.1 Submit the documents and samples required in accordance with section 01 00 10 – 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 Certificates:

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

.4 Test and evaluation reports:

.1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

Part 2 Product

2.1 THERMOMETERS

.1 General:

.1 All thermometers must be of the same brand.

.2 Provide a list of all the thermometers, indicate the scale and the wells used.

.3 The thermometer probe must be long enough to be in contact with the heat transfer fluid while taking into account the thickness of the thermal insulation. The penetration of the well must be equal to at least 50% of the pipe's diameter.

.4 Adjustable angle thermometers, aluminum housing 230 mm (9") in height, mercury in a glass tube, black graduation on white background, brass probe, depending on the length of the probe, Trerice no. BX9.

.5 Stainless steel wells complete with union fitting and extension when there is thermal insulation, Trerice no. 138.

.6 All thermometers should be calibrated.

.2 Scales:

.1 Scales with graduations in the international and the imperial systems (°C/°F).

.2 Chilled water: -40 at 40°C (-40 at 110°F).

.3 Installation:

.1 Install thermometers at the locations shown in the drawings, so that they are easily visible, and protected from mechanical shocks.

.2 Install them within 300 mm of the chillers' water boxes.

.3 Provide tee fittings with female threads for the installation of the wells.

.4 Coat the inside of the wells with silicone grease or graphite for an accurate reading.

2.2 PRESSURE GAUGES

.1 General:

.1 All pressure gauges must be of the same brand. Provide a list of all the pressure gauges and specify the range used.

.2 Type A pressure gauge:

.1 Polypropylene housing reinforced with fiberglass, acrylic window, watertight assembly, 114 mm (4½") diameter, white dial back and black marking.

.2 Adjustable pointer, micrometric adjustment.

.3 Stainless steel movement.

.4 Bourdon tube: stainless steel tube and socket.

.5 Liquid: glycerine for temperatures of -18 at 66°C.

.6 Accuracy: ± 0.5% of the scale.

.7 Acceptable product: Liquid Filled, Trerice no. 450.

.3 Pressure impulse dampeners – Models:

.1 Trerice no. 870 stainless steel.

.2 Trerice no. 885 brass for steam service.

.4 Valve – Model:

.1 Jenkins no. 201SJ.

.5 Scale:

.1 Scale with international and imperial system graduations (kPa/psi).

.2 Select the operating range of each pressure gauge according to the normal operating pressure with possible extreme pressures.

.6 Installation:

.1 Install pressure gauges at the locations shown in the drawings and the specific sections, so that they are easily visible and sheltered from mechanical shocks.

.2 Provide a tee fitting with female thread.

.3 When the piping is located more than 2.4 m above the floor, install the gauges at 2 m or less from the floor with appropriate tube and anchor.

2.3 MANUFACTURER LIST

.1 List of manufacturers, section 23 05 19.13.

.1 Thermometers and pressure gauges:

.1 Ashcroft

.2 Marsh

.3 Mueller

.4 Pitanco

.5 Trerice

.6 Winters Instruments

Part 3 Execution

3.1 THERMOMETERS

.1 Place the thermometers in thermowells lined with a thermally conductive material.

.2 Install the thermometers where indicated, and at the inlets/outlets of the following devices:

.1 Fan-coil unit

.3 Install thermowells for the purpose of network balancing.

.4 Use extensions when the thermometers are installed on insulated pipes.

3.2 PRESSURE GAUGES

.1 Install pressure gauges in the following locations.

.1 Upstream and downstream of control valves.

.2 Provide pressure gauges with a shut-off valve for the purposes of network balancing.

.3 Use extensions when the pressure gauges are installed on insulated pipes.

3.3 PROTECTION

.1 Protect the installed equipment and components against damage during the construction.

.2 Repair the damage to the adjacent materials and equipment caused by the installed thermometers and pressure gauges.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 01 00 10 – 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.

.6 For vertical pipe support systems in high-rise buildings, submit shop drawings and calculations with the seal and signature of an Engineer validating the design of the supports.

1.4 CLOSEOUT SUBMITTALS

.1 Submit required documents in accordance with section 01 00 10 – General instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 01 00 10 – 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 and coated with a zinc-rich paint after manufacture.

.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 support at very direction change.

.2 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

.3 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

Piping nominal diameter	Rod diameter	Maximum horizontal spacing
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

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".

2.7 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.

.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 (12") 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	⅜	½	⅝	¾	⅞	1	1¼
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.

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 3 EXECUTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 00 10 – 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 01 00 10 – General instructions.

.2 Submit shop drawings required in accordance with section 01 00 10 – 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 – 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 – General 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, ventilation ducts, 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 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, fire protection, ventilation – air-conditioning, controls, 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:

.1 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:

.1 Civil protection: $I_E = 1.5$

.5 For Saint-Hubert:

Description	Location category: E and $I_E = 1.0$		
	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).	0.07	0.13	0.20
Rigid components with non-ductile materials or assemblies (table 4.1.8.18 no. 19).	0.24	0.47	0.71
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).	0.09	0.19	0.28
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).	0.35	0.71	1.06
Electrical cable trays, bus bar ducts, conduits (table 4.1.8.18 no. 17).	0.12	0.24	0.35
Flexible components with non-ductile materials or assemblies (table 4.1.8.18 no. 21).	0.59	1.18	1.77
Machinery, accessories, equipment, conduits, and reservoirs (with contents) (rigid with rigid assembly or flexible with flexible assembly) (table 4.1.8.18 no. 11).	0.24	0.47	0.71
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).	0.12	0.24	0.35
Pipes and ducts (with contents) (table 4.1.8.18 no. 15).	0.08	0.16	0.24
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).	0.09	0.17	0.26
Rigid components with non-ductile materials or assemblies (table 4.1.8.18 no. 19).	0.31	0.62	0.92
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).	0.12	0.25	0.37
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).	0.46	0.92	1.38
Electrical cable trays, bus bar ducts, conduits (table 4.1.8.18 no. 17).	0.15	0.31	0.46
Flexible components with non-ductile materials or assemblies (table 4.1.8.18 no. 21).	0.77	1.54	2.31
Machinery, accessories, equipment, conduits, and reservoirs (with contents) (rigid with rigid assembly or flexible with flexible assembly) (table 4.1.8.18 no. 11).	0.31	0.62	0.92
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).	0.15	0.31	0.46
Pipes and ducts (with contents) (table 4.1.8.18 no. 15).	0.10	0.21	0.31

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 Other coefficients (Cp, Ar, Ax, R_p) are according to the Quebec Construction Code.

.7 For non-ductile assemblies, the adhesives, or the compressive anchor cartridges, the R_p value is 1.0.

.8 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.

.9 Anchor cartridges and simply installed anchors should not be used as anchors to resist tensile loads.

.10 Installation integrity level:

.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 01 00 10 – 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".

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 = 1.5 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 – 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 FIRE PROTECTION PIPES AND EQUIPMENT

.1 The pipe or equipment supports must withstand all transitory conditions (in case of seismic event), including:

- .1 The weight of the pipe, valves, fittings and internal fluids must consider a multiplying factor of five (5) times the mass of the pipes and accessories filled with water.
- .2 Other loads, such as water hammers.
- .3 The occasional loads, such as a weight of 114 kg (to represent a worker grabbing a pipe during a fall from a ladder during installation, NFPA-13), and seismic forces.

.2 Seismic restraint systems must be according to the NFPA-13 standards, latest edition.

.3 The equipment must include seismic restraint systems and comply with the NFPA-20 requirements, latest edition.

.4 Comply with the FM Global requirements, if these are more stringent than the NFPA recommendations.

.5 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.

2.4 VENTILATION DUCTS WITHOUT VIBRATION ISOLATORS

.1 The ventilation duct supports must withstand all transitory conditions (in case of seismic event), including:

.1 The weight of the ducts, the accessories, the fittings, the stiffeners, the thermal insulation, and the acoustic insulation.

.2 The forces imposed by the pressure of the air moving in the ducts.

.3 The occasional loads, such as ice, wind, and seismic forces.

.2 The ventilation duct 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 Respect the brace installation angle that must vary from an angle of 45 to 60° relative to the horizontal.

.4 Seismic bracing may be omitted for:

.1 Rectangular ducts with cross sections smaller than 0.56 m².

.2 Oval ducts with cross sections smaller than 0.56 m².

.3 Circular ducts with a diameter smaller than 700 mm.

.4 Ducts whose length between the top of the duct and the level of the anchor is 300 mm or less. The seismic restraints cannot be omitted if a single support respecting this length is present throughout the duct's run. If the ducts are installed on a trapeze, the allowable length of 300 mm is located between the bottom of the trapeze and the anchor.

.5 Ventilation ducts that are installed on trapezes and the total weight of the ducts is less than the weight of a duct of 700 mm, 0.56 m², or the equivalent of 14.9 kg/m.

.6 The terminal units, the fans, or other equipment that weigh less than 9 kg, connected rigidly or flexibly to the duct, and must be suspended by at least four rods.

.7 Only for normal buildings, I_E = 1.0: the braces can be omitted for grilles, diffusers, and lighting fixtures, except those installed in the issued spaces, including the corridors.

.5 The spacing between seismic braces should be as follows (refer to the SMACNA tables):

Seismic risk levels	Maximum distance between braces	
	Transverse and riser	Longitudinal
0.25 g	12.2 m	24.4 m
0.5 g	9.1 m	18.2 m
1.0 g	9.1 m	18.2 m
2.0 g	6.1 m	12.2 m

.6 Transverse braces must be installed at each end if the length of the duct is less than the maximum allowable distance. Transverse braces must be installed at each elbow and at the each end of a length. The minimum is two per duct length.

.7 Install at least one longitudinal bracing per duct length. A transverse brace can be used as a longitudinal brace for 90° elbows if installed within two times the width of the duct fitting or as recommended by SMACNA and that the brace is calculated for larger cross sections.

.8 The ducts may be grouped on a same support and the braces are calculated accordingly.

.9 The walls through which ventilation ducts run can serve as transverse bracing, provided that the walls securely surround the pipes.

.10 When ducts pass through a seismic joint or a building expansion joint, a flexible connector must be installed (minimum length of 250 mm).

.11 The grilles and the diffusers can be fixed with the metal screws in the tees of the false ceiling, which is itself braced, and the loads are calculated accordingly.

.12 For a redevelopment (retrofitting) project, the flexible bracing must be selected.

.13 If flexible joints are installed in the conduits' run, then flexible bracing must be selected.

.14 A conduit should not be anchored to a structure or to a part of the building that responds differently to earthquakes.

2.5 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).

2.6 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.

2.7 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: 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.

2.8 BASES

.1 General:

.1 This section must provide the directives and the supervision for the installation of all bases.

.2 See the details of the different types of bases.

.3 Also see the article "VIBRATION ISOLATORS".

.4 Locations: see the vibration bases and isolators tables.

.2 Calculations:

.1 These calculations comprise for each rotary machine:

.1 The machine identification.

.2 The manufacturer.

.3 The model.

.4 The speed.

.5 The engine power.

.6 The rotor’s diameter.

.7 The weight.

.8 The physical dimensions.

.9 The type of base.

.10 The dimensions of the concrete base.

.11 The weight of the concrete base.

.12 The base’s frame.

.13 The type of spring.

.14 The positioning of the springs.

.15 The positioning of the anchors.

.16 The springs' kH/kV ratio.

.17 The attenuation percentage of the base in function of the anticipated load.

.3 Type VI – Suspended devices:

.1 See the drawings.

.4 Supports – Piping:

.1 Piping supports with vibration isolators:

.1 Hanger type isolators, depending on whether the pipe is suspended or supported at the floor.

2.9 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.

.9 Seismic damper types:

.1 In general, the seismic dampers will be integrated with the vibration isolators. When seismic forces are too high or that the vibration isolators are pre-existing, they are the separate type.

.2 Description:

.1 Types:

A Separate omnidirectional dampers consisting of a neoprene replaceable molded element with a minimum thickness of 4.8 mm, maximum capacity of 6900 kPa, minimum clearance of 3.2 mm, minimum of two bolts, similar to Mason no. Z-1225.

B Separate omnidirectional dampers consisting of a neoprene replaceable molded element with a minimum thickness of 9.6 mm, maximum capacity of 6900 kPa, clearance of 3.2 mm to 6.4 mm maximum, minimum of two bolts, similar to Mason no. Z-1011.

C Omnidirectional integrated damper consisting of one or more springs with neoprene elements placed inside of a ductile cast iron housing (gray cast iron housings are not accepted), minimum clearance of 3.2 mm, minimum of two bolts, similar to Mason SLR and SSLFH.

D Omnidirectional integrated damper consisting of two neoprene replaceable molded elements placed inside a ductile iron housing, minimum of six bolts, similar to Mason BR.

E Omnidirectional integrated damper for guiding or anchoring the risers, consisting of two steel tubes separated by 12.5 mm of 60 durometer neoprene, load capacity of 3450 kPa, anchor plate at the base for two bolts, similar to Mason ADAH.

F Galvanized steel or stainless steel aviation type pre-stressed cable, complete with the appropriate hardware (fasteners at the ends, mounting lugs, etc.). Use a multiplication factor of 2 if it is not pre-stressed.

G Flexible rubber hoses, spherical expansion joints with several layers of nylon, capable of withstanding 1725 kPa at 76.7°C and 1140 kPa at 121.1°C, joint must be similar to the model MFTNC, and 90° connectors similar to Mason MFNEC.

H Steel platform with suspended steel frame, capable of withstanding the seismic forces imposed by the equipment's weight.

K Separate damper consisting of structural elements and neoprene cushions, minimum of two bolts.

L Separate damper consisting of two separate neoprene bushings and two steel discs, allowing the bolt to anchor the metal panel surfaces to a wall, similar to Mason PB.

2.10 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 00 10 – 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 Stiffeners on suspension rods and fire protection pipe supports:

.1 Hilti

.2 Nvent (Erico/Caddy)

.3 Tolco Inc.

.4 Victaulic

.5 Or approved equivalent

.4 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).

.5 Steel framing external to certain equipment's cabinets:
- .1 Power-Strut (Mueller Flow Control)
- .2 Unistrut (Routleco Inc.)

.6 Vibration isolators:
- .1 Korfund Sampson Ltd
- .2 Mason Industries
- .3 Vibro-Racan (Racan Carrier)
- .4 Vibron Ltd

.7 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 HTS Engineering
- .5 EH price

.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 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.

VIBRATION BASES AND ISOLATORS CHARACTERISTICS							
Identification		**2-URA-025**					
Localization		Room 2B-204.A					
Leveling bases		No					
Bases	Type	VI					
	Thickness						
Vibrations isolators	Type spring	ST					
	Cushions						
	Flexion (in.)						
Flexibles fittings	Suction						
	Discharge						
Comments							

Notes :

E : nested isolator
ELM : nested isolator with a motion limiter
S : vibration isolation hangers
N : Neoprene pad
NSN : Neoprene-steel-neoprene pad
SNS : steel -neoprene-steel pad
RP : seismic spring
ST : with stabilizer
VD : see the description in the specifications

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 – 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 – 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 – 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 – 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	Ventilation:	black
.4	Controls:	brown
.5	Electricity:	pink
.6	Communications:	orange

.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 CONTROLS EQUIPMENT

.1 By Division 25.

.2 For valves, see the article "VALVE IDENTIFICATION".

.3 Devices located outside of a local control panel:

.1 Identify the devices with a white ebonite plate and black lettering, glued and screwed to the device or attached to the device such as described in section "VALVE IDENTIFICATION". The numbering must be alphanumeric with 12 mm lettering and must correspond with the numbering from the controls diagrams.

.4 Devices and accessories installed in the panels:

.1 Identify the devices with "P-Touch" adhesive tape, white lettering on black background. The numbering must correspond with the numbering from the controls diagrams.

.5 Compressed air piping:

.1 Piping NPS 1 and larger:

.1 Identify the pipe, according to the article "IDENTIFICATION OF PIPING, DUCTS, AND VENTILATION UNITS".

.2 Piping NPS ¾ and smaller:

.1 Identify the pipping such as valves with tags, steel wire, and lead. The tag must indicate the controls, the compressed air, and the operating pressure in kPa.

.6 Provide samples, as well as the identification list for verification.

2.5 IDENTIFICATION OF STARTERS OTHER THAN THOSE PROVIDED BY DIVISION 26

.1 Each mechanical section providing their starters must identify them as described in the article "DIVISION 26 ELECTRICAL EQUIPMENT IDENTIFICATION".

2.6 IDENTIFICATION OF PIPING, DUCTS, AND VENTILATION UNITS

.1 Perform the identification of piping and ventilation ducts after the insulation work is completed.

.2 Each relevant mechanical section must identify the pipes, the ventilation ducts, 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 Identify all apparent ventilation ducts, insulated or not, in the mechanical rooms. Identify all ventilation units. In suspended ceilings, identify the ventilation ducts above the access doors. In suspended ceilings with removable panels and where the ducts are exposed, except in mechanical rooms, identify the ducts only in shafts accessible to the shaft's exit.

.5 Identify the ducts at all fire dampers.

.6 For identification purposes, the terms "exposed pipes and exposed ventilation ducts" apply to those located in mechanical rooms and those that are visible.

.7 In trenches and/or in non-removable suspended ceilings, pipes and ventilation ducts are considered concealed.

.8 Perform the identification using letters, numbers, and arrows indicating the direction of the flow of liquids, steam, gas, or air.

.9 Print the numbers, letters, and arrows using rubber stamps and black ink.

.10 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.

.11 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.

.12 Ventilation ducts:

.1 On the exposed galvanized surfaces of the ventilation units and the ventilation ducts, apply a special primer on a surface forming a perfect rectangle allowing the adhesion of the finishing paint to the galvanized surface. Apply two coats of white paint, then proceed to the identification.

.2 Alternatively, stick a 0.22 kg canvas, 300 mm x 300 mm, with fire retardant adhesive and apply the identification.

.3 On ventilation ducts thermally insulated on the outside, before applying the two coats of white paint at the point of identification, install a rosin-sized paper, a glued 0.17 kg canvas, and a chemical adhesive ready to receive paint.

.13 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.

.14 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.

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

Services	Identification legend	Back colours	Secondary identification colours
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
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

Services	Identification legend	Back colours	Secondary identification colours
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

2.7 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.

2.8 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				

2.9 IDENTIFICATION ACCORDING TO THE EXISTING SYSTEM

.1 Identify the added or renovated work according to the existing identification system.

.2 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.

END OF SECTION

TABLE OF CONTENTS

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.

3.2 VENTILATION SYSTEMS

.1 General:

.1 Perform tests, measurements and adjustments to:

.1 Demonstrate the ventilation systems are airtight.

.2 Adjust fans to obtain the specified airflows.

.3 Establish quantitative performance of all equipment installed under this section.

.4 Adjust quantity of air to terminal equipment.

.5 Check the adjustment of certain control components.

.2 Check installations for compliance with this section's requirements.

.3 For each system, establish, measure, and adjust the airflow required to meet the specified quantities.

.4 Record and present the results in the form of a report.

.5 Before starting TAB, TAB firm must be approved. The firm must be a certified member of the National Environmental Balancing Bureau Canada (NEBB Canada) or the Associated Air Balancing Council (AABC).

.6 Before starting TAB, submit an outline of the proposed procedures required to comply with this article and a list of equipment and instruments to be used.

.7 The selected firm must, for the duration of the installation work, carry out regular site visits and submit a report indicating corrective measures required in order to adequately proceed with TAB (minimum one visit per month or more often depending on site conditions).

.8 Take corrective actions submitted by the retained specialized firm.

.9 Supply the equipment and work force required for leak tests.

.10 Perform the tests according to the methods recommended by the Associated Air Balance Council and SMACNA (HVAC Air Duct Leakage Test Manual, second edition, 2012).

.11 Once ducts are installed, but before ceilings, walls, and insulation are installed, check the airtightness of all seals and the condition of all ducts.

.12 Hermetically seal each section undergoing a test and temporarily seal all openings. Run the tests, section by section, on each system, according to the convenience of the location and the established procedure.

.2 Leak tests:

.1 Water tests:

.1 Fill every horizontal duct susceptible of receiving water during standard operation with 25 mm of water and spray the inside vertical ducts subject to the same conditions, sufficiently to check the seals.

.2 This test applies to all sealed ducts requested in this specification, such as fresh air intakes and exhaust air outlets and their plenums, chilled water coil drain pans, heat recovery coils, kitchens hood exhaust, and dishwashers.

.3 Provide connections to drains and screwed drain caps at the low points of these ducts.

.2 Low pressure ducts:

.1 Conduct 500 Pa static pressure test on the ducts.

.2 Maximum allowable loss:

.1 For all ducts, as per "Leakage Class 6" from HVAC Air Duct Leakage Test Manual, second edition, 2012, for each section tested, maximum leakage of 0.48 L/s/m² of duct wall.

.2 For overall system, the sum of the leakage must not exceed 3% of the fan(s) airflow.

.3 Portable test equipment to include, among other things, a radial blade fan, ventilation duct with calibrated orifice and a U-tube manometer.

.4 Follow recommendations of the American Blower Corporation, the Associated Air Balance Council, or SMACNA. The orifice curve must have been calibrated by an independent laboratory.

.5 Plenums made of acoustic panels:

.1 Subject the ventilation plenums constructed of acoustic panels to a static pressure of 2500 Pa. All seals must be airtight.

.3 Adjustment precision:

.1 Do TAB to the following tolerances of the design values:

.1 Airflow adjustment:

.1 At terminal equipment: 10% ±

.2 In main ducts: 5% ±

.2 Differential pressure:

.1 Positive pressure zones:

.1 Supply: 0 to +10%

.2 Exhaust and return: 0 to -10%

.2 Negative pressure zones:

.1 Supply: 0 to -10%

.2 Exhaust and return: 0 to +10%

.4 General procedure:

.1 Equipment and system verification:

.1 Once leak tests are performed and results are satisfactory, proceed with TAB of the equipment and systems as follows:

.1 Start up fans (supply, return, exhaust).

.2 Verify:

.1 Voltage and amperage of motors to avoid overload.

.2 Motor and fan rotation.

.3 Differential pressure switch (DPD) operation.

.4 Position of motorized dampers.

.5 Temperature control of chilled water, hot water or glycol with controls Contractor.

.6 Any obvious air leaks.

.2 Develop a ventilation system diagram which identifies all devices and equipment that will be used for testing, adjusting and/or balancing flow. Also, identify all locations where measurements will be taken to ensure that sufficient connections are provided on the ductwork. Use this identification as a reference in the balancing report. Ensure that there is no short-circuiting in the ductwork system.

.2 Airflow at main branches:

.1 Using a Pitot tube, measure flow rate in the main branches.

.2 If required, adjust fan speed to obtain design airflow.

.3 Check motor power and fan speed to ensure that operation is within critical limits.

.4 Adjust balancing dampers at main branches until design airflow has been reached.

.5 Refer to each type of system described in this section.

.3 System adjustment for balancing work:

.1 Adjust dampers for minimum outside air.

.2 Dual-duct system and constant volume multizone, ensure the proper airflow through the cooling coils and maintain it throughout the adjustments.

.4 Terminal equipment adjustments:

.1 Adjust airflow from terminal units up to the fan.

.2 Use balancing dampers at main branches for major adjustments and dampers at terminal units for precise adjustments.

.3 These adjustments may require multiple iterations.

.4 Note: the total airflow adjusted at the terminal units compared to the readings obtained in the ducts may provide an indication of leakage.

.5 When the system is set to the design airflow, at the branches and the outlets, perform the following readings:

.1 Motor amperage.

.2 Differential pressure at the fans (discharge minus inlet).

.3 Differential pressure at all secondary components (upstream minus downstream).

.4 Differential pressure at all system's primary components (air intake, air exhaust, filters, coils, air-mixing plenums, etc.).

.5 Ventilation TAB report:

.1 For each balanced system, the balancing report shall include, as a minimum, the following information:

.1 Dated reports:

.1 On the report cover page, and on all pages of the report, clearly indicate dates when measurements and adjustments, at all stages (preliminary, corrections, and revisions) were taken.

.2 Design data:

.1 Airflows:

.1 Supply

.2 Return

.3 Exhaust

.2 Fan static pressure.

.3 Motor power (HP).

.4 Brake horsepower (BHP).

.5 Fan speed (rpm).

.6 Minimum percentage of outside air.

.3 Characteristics of installed equipment:

.1 Manufacturer (model and serial no.)

.2 Unit size and dimensions.

.3 Arrangement.

.4 Construction class.

.5 Motor nameplate:

.1 Power

.2 Voltage

.3 Number of phases

.4 Frequency

.5 FLA

.6 Rotation speed

.4 Tests at main:

.1 Fan speed.

.2 Power readings at the motor terminals (voltage and current on each phase).

.3 Differential pressure across each system component (coils, filters, etc.).

.4 Pressures at suction and discharge of the fan.

.5 Measured airflow.

.6 Fan curve indicating the operating point, based on measurements.

.7 Pressures measured with pressure sensors supplied and installed by the Division 25.

.5 Test at the terminal devices:

.1 Identification of the terminal device by ID number and location.

.2 Type of terminal device:

.1 Manufacturer

.2 Model

.3 Dimensions

.4 Output factor

.3 Design airflow and air speed.

.4 Airflow and air speed results.

.5 Adjustment, where applicable, of airflow pattern diffuser.

.6 Additional information:

.1 Fans:

.1 Dimensions and number of belts.

.2 Dimensions of pulleys.

.3 Position of adjustable pulleys.

.4 Full load motor speed.

.5 Overload protection adjustment.

.6 Filter type, initial pressure loss at full flow, final pressure loss for filter replacement.

.7 Air speed readings at coil faces, where possible.

.8 Airflow control device type.

.2 Air distribution system:

.1 Pressure reading at main branches.

.2 Pressure reading in ceiling spaces.

.3 Pressure difference between building interior and exterior when building is operating at minimum and maximum outside air.

.4 List of Pitot tube tests with their results.

.5 List of airflows measured at each grille and diffuser. Indicate the required airflows.

.6 Acceptable Contractors:

.1 Comply with article "MANUFACTURER LIST" from Section 01 00 10 – General instructions.

.2 Accepted companies:

.1 Montreal region:

.1 Caltech

.2 Hydrauliques R&O Services Inc.

.3 Service de Mise au Point Leblanc Inc.

.2 Ottawa/Gatineau region:

.1 Calibration Brassard

.1 Kanata Air Balancing

.2 Maxima

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

.2 Section 23 31 13.01 – Metal air ducts – Low pressure to 500 Pa.

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-B209M-07 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM-C335-05ae1 – Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM-C411-05 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM-C449/C449M-00 – Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM-C547-07e1 – Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM-C553-02e1 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM-C612-04e1 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM-C795-03 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 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.

.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.

.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 Green Seal Environmental Standards (GSES):

.1 Standard GS-36-00 – Commercial Adhesives.

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

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

.7 Thermal Insulation Association of Canada (TIAC), National Insulation Standards (2005).

.8 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102-03 – Method of test for surface burning characteristics of building materials and assemblies.

.2 CAN/ULC-S701-05 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

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

.2 Data sheets:

.1 Submit required data sheets, including the manufacturer’s documentation for the 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.

.3 Samples:

.1 Submit a complete set of each type of thermal insulation (system) proposed, including the insulating material itself, the coating material, and the adhesives with VOC (volatile organic compounds) content.

.2 Mount the sample on a 12 mm plywood panel.

.3 Place a typewritten label under the sample indicating the conveyed system/fluid.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Transport, store and handle materials in accordance with section 01 00 10 – 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 – 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, chilled water, fire protection, ventilation, and air conditioning.

.2 Consult the drawings and the specification of all mechanical work.

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 C INSULATION

.1 Flexible wrap made of mineral fiber bonded with thermosetting resin with vapor barrier and reinforced aluminum, with a density of 12 kg/m², maximum service temperature of 121°C.

.2 Maximum thermal conductivity "k": 0.042 W/m.°C at 24°C.

2.3 TYPE D INSULATION

.1 Rigid mineral fiberboard bonded by a thermosetting resin with integrated FSK vapor barrier, with a density of 36 kg/m³, maximum service temperature of 232°C.

.2 Maximum thermal conductivity "k": 0.035 W/m.°C at 24°C.

2.4 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.

2.5 CEMENT INSULATION

.1 Compliant with the standard ASTM C449/C449M.

.2 Use for fittings, flanges, valves, and accessories.

2.6 JACKETS

.1 Canvas jackets:

.1 Cotton canvas having a density of 220 g/m², coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM-C921 and ASTM-E84.

2.7 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: 0.48 W/m.°C.
.8 Foamglas from Pittsburg Corning.

2.8 MANUFACTURER LIST

.1 Comply with "MANUFACTURER LIST" from section 01 00 10.

.2 List of manufacturers, section 23 07 13:

.1 Type C thermal insulation:

.1 Johns Manville: Microlite with a FSK vapor barrier.

.2 Knauf: sleeve for air ducts with FSK.

.3 Alley Wrap with FSK.

.4 Owens-Corning Fiberglas: 454°C (850ºF) with GTU.

.5 Note: For LEED projects, the insulation must not contain formaldehyde.

.2 Type D thermal insulation:

.1 Johns Manville: Spin-Glas 814, type II with a FSK vapor barrier.

.2 Knauf: panel for air ducts with FSK.

.3 Owens-Corning Fiberglas: AF530 with FRK.

.3 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.

.4 Insulating cement:

.1 IIG Calcoat No. 127 applied in successive 8 mm (0.3") layers.

.5 Mechanical Fasteners:

.1 Welding pins, pin fasteners, Duro-Dyne.

.6 Canvas jackets:

.1 Flexpak

.2 S. Fattal Cotton Inc.

.7 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 in the locations 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 Notify applicable sections and properly adjust the supports and saddles to ensure that saddles remain in place.

3.3 APPLICATION

.1 See section "DUCTWORK INSULATION SCHEDULE" for thicknesses.

.2 Mixed temperature, cold ducts and plenums (13 at 65°C):

.1 Rigid insulation:

.1 Preparation:

.1 Secure the mechanical fasteners to horizontal and vertical surfaces at approximately 300 mm centre to centre in each direction.

.2 Application:

.1 Cut insulation with integral vapor barrier to the right size and apply to the exterior of duct and/or plenum, with the vapor barrier towards the exterior and its horizontal surfaces overlapping its vertical surfaces. Tighten the edges firmly. Secure the insulation to mechanical fasteners. Install retaining washers.

.2 In places where mechanical fasteners go through the vapor barrier and at each corner and joint, apply adhesive vapor barrier tape or vapor barrier tape applied with vapor barrier adhesive. If there are raised joints, cover them with an overlapping strip or a flexible insulating material with integral vapor barrier to ensure a complete vapor barrier.

.3 Cover all joints and duct reinforcements with an overlapped strip of flexible insulation material with integrated vapor retarder of the same thickness as the thermal insulation used for the duct. Glue this overlapping strip with a vapor barrier adhesive to ensure integral protection.

.2 Flexible insulation:

.1 Preparation:

.1 On round and rectangular ducts 740 mm or less in width, no preparation is necessary. On rectangular ducts 762 mm or more in width, either secure mechanical fasteners to the lower surface at approximately 450 mm centre to centre, or apply 100 mm wide bands of the insulating adhesive at approximately 300 mm centre to centre.

.2 Application:

.1 Cut insulation with integral vapor barrier to the right size and apply to exterior of duct with the vapor barrier on the outside. In places where the mechanical fasteners go through the vapor barrier and at all joints, apply an adhesive vapor barrier tape or vapor barrier tape applied with vapor barrier adhesive. All joints must overlap by at least 50 mm and be stapled at approximately 100 mm centre to centre. Attach insulation with either string or wire at approximately 300 mm centre to centre.

.2 Cover all joints and duct reinforcements with an overlapped strip of flexible insulation material with integrated vapor retarder of the same thickness as the thermal insulation used for the duct. Glue this overlapping strip with a vapor barrier adhesive to ensure integral protection.

.3 Note: PVC jackets and fittings used outdoors or exposed to fluorescent light must be resistant to ultraviolet rays.

.3 Exceptions:

.1 Unless otherwise stated, when an internal duct liner is specified, external insulation is not required.

.2 For external applications of rigid insulation, where mechanical fasteners are not suitable because of a lack of space, it is possible to substitute them for string or wire, insulation adhesive, or other suitable fastening methods.

.3 Finishes:

.1 Indoor:

.1 Rectangular ductwork with rigid insulation:

.1 Install a continuous metal corner bead at all corners. Apply vapor barrier tape on all vapor barrier joints and breaks and on every corner.

.2 Where exposed, install fire retardant canvas jacket over insulation using fabric adhesive and finish with second layer of adhesive coating.

.2 Round ductwork with rigid or flexible insulation:

.1 Apply vapor barrier tape on all joints and breaks.

.2 Where exposed, install fire retardant canvas jacket over insulation using fabric adhesive and finish with second layer of adhesive coating.

.3 Rectangular ductwork with flexible insulation:

.1 Flexible insulation is not acceptable where ductwork is exposed.

3.4 DUCTWORK INSULATION SCHEDULE

.1 General:

.1 No insulation is required for:

.1 Ducts fitted with acoustic insulation serving as thermal insulation, unless otherwise indicated.

.2 Acoustic plenums (boxes).

.2 Systems nos. 2-URA-025:

.1 All supply ducts from the system's output:

.1 Everywhere:

.1 Insulation: type C (D when visible)

.2 Thickness: 25 mm

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 – 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 01 00 10 – 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 – 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, chilled water, fire protection, and ventilation – air conditioning.

.2 Consult the drawings and the specification of all mechanical work.

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 CEMENT INSULATION

.1 Compliant with the standard ASTM-C449/C449M.

.2 Use for fittings, flanges, valves and accessories.

2.5 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, coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM-C921 and ASTM-E84.

.4 Aluminum jackets:

.1 Aluminum jacketing compliant with the standards CSA HA.4-1980 and ASTM-B209, to be used on exposed elements located outdoors and in mechanical rooms, when specified.

.2 Corrugated or embossed aluminum alloy jacketing, 0.4 mm thick, with longitudinal S joints with 50 mm wide overlapping ends, factory installed internal protective covering and also featuring an aluminum alloy joint cover with mechanical fasteners. Vapor barrier membrane.

.3 Jackets for connecting to matrix elements made of 0.4 mm thick aluminum alloy with factory installed internal protective covering. For F type insulation: 0 .8 mm thick.

.5 Stainless steel jackets, series (302) (304) (316):

.1 Where specified, in stainless steel, compliant with CSA G110.6-1969, to be used on exposed elements located outdoors and in mechanical rooms.

.2 Preformed jackets made of austenitic stainless steel, smooth surface, 0.25 mm thick, having a degree of hardness of ¼ and adjustable to the outer diameter of the insulation, preformed longitudinal Z joints that can be stapled and with a 50 mm end overlap.

.3 Joint covers for austenitic stainless steel joint ends of 0.25 mm in thickness, pre-formed and cut to fit the diameter of the jacket's outer diameter. The outer lips of the joint cover's inner wall must be treated at the factory with a waterproof product that does not harden at high temperatures.

.4 All components (fittings, jackets, and elements manufactured at the factory) must be compatible.

2.6 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.

2.7 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" from section 01 00 10 – General instructions.

.2 List of manufacturers, section 23 07 16:

.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 Insulating cement:

.1 IIG Calcoat no. 127 applied in successive 8 mm (0.3") layers.

.4 Mechanical Fasteners:

.1 Welding pins, pin fasteners, Duro-Dyne.

.5 Canvas jackets:
- .1 Flexpak
- .2 S. Fattal Cotton Inc.

.6 PVC jackets:
- .1 Johns-Manville
- .2 Proto Corp.

.7 Aluminum jackets:
- .1 Thermoclad Plus jacketing with anti-corrosion protection, Polysurlin type, Stucco finish.

.8 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 m²). While it is still damp, impregnate a reinforcing membrane and then finish with a layer of weatherproof coating (minimum 1 liter/15 m²).

.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 Drain pan for fan heaters:

.1 Insulation: type B

.2 Thickness: 9.5 mm flexible mat or roll

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 90.1-19 – 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-14 – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.4 ASTM-C335-17 – Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.5 ASTM-C411-19 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.6 ASTM-C449/C449M-07 – Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.7 ASTM-C533-2017 – Calcium Silicate Block and Pipe Thermal Insulation.

.8 ASTM-C547-2019 – Mineral Fiber Pipe Insulation.

.9 ASTM-C795-18 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.10 ASTM-C921-10a (2015) – 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. 19, art. 52, 2012.

.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 – 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 – 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 – 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 regard 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, chilled water and fire protection.

.2 Consult the drawings and the specifications of all mechanical work.

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 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.

.5 Adhesives for adhering insulation on metal surfaces:

.1 Products:

.1 230-38 from Bakor.

.2 CP-89 from Childers.

.3 89 from Mulco.

2.4 CEMENT INSULATION

.1 Compliant with the standard ASTM-C449/C449M.

.2 Use for fittings, flanges, valves, and accessories.

.3 Product: Calcoat-127 from Johns Manville.

2.5 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.

2.6 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" from section 01 00 10 – General instructions.

.2 List of manufacturers, section 23 07 19:

.1 Type A thermal insulation:

.1 Johns Manville

.2 Knauf Insulation

.3 Manson Insulation

.2 Adhesives:

.1 Bakor

.2 Childers

.3 Mulco

.3 Insulating cement:

.1 Johns Manville

.4 Canvas jackets:

.1 Robson Thermal Mfg. Ltd.

.2 S. Fattal Cotton Inc.

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.

3.4 PIPING INSULATION SCHEDULE – HEATING – CHILLED WATER

.1 Pipe dimensions are in NPS (nominal diameter).

.2 Networks to be insulated which are contiguous but identified differently on the plans (or sub-networks which are an integral part of a network with similar temperatures or characteristics), must be insulated equally, unless otherwise indicated in the tables of the thicknesses to the following articles.

.3 Table of insulation thicknesses :

Networks	Location	Pipe dimensions	Insulation types	Thickness	Jacketing (when installation is exposed)
Chilled water	Everywhere	NPS 1½ and less	A	25 mm	PVC

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

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

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 – 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 – 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 – 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 – 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 Mechanical joints:

.1 With flexible connections between the piping and equipment:

.1 No mechanical joints, piping must be anchored.

2.2 GUIDES

.1 For steel piping, use Anvil fig. 255 type guides.

.2 For copper and brass piping, use Anvil fig. CT-255 guides.

2.3 SUPPORTS

.1 General:

.1 See section 23 05 29 – Hangers and supports for HVAC piping and equipment.

2.4 CHILLED WATER, 1035 KPA AND LESS

.1 Piping:

.1 Material:

.1 Black steel, Std series, ASTM-A53, CW, grade B.

.2 Fittings:

.1 Reducer elbows, adapters, and couplings, of the same brand as the tees.

.2 NPS 2 and smaller:

.1 Malleable cast iron, ASME/ANSI B16.3, class 150, threaded. Malleable cast iron unions, ASME/ANSI B16.39, class 300, threaded.

.3 Branch connections:

.1 NPS 2 and smaller:

.1 Malleable cast iron threaded tees, ASME/ANSI B16.3, class 150.

.4 Joints:

.1 NPS 2 and smaller:

.1 Threaded for fittings, unions, and branch connections.

.2 Valves:

.1 Ball valves:

.1 NPS 2 and smaller:

.1 Brass body.

.2 Threaded ends.

.3 Class 150.

.4 Internal parts: stainless steel balls, PTFE seat.

.5 Memory stop.

.6 Extension stem for insulated piping, such as Jenkins no. 74083X-SJ.

.7 Model: Crane fig. F9201. Jenkins fig. 201SJ.

.2 Circuit balancing valves:

.1 NPS 2 and smaller:

.1 AMETAL body.

.2 NPS threaded ends.

.3 Class 150.

.4 Self-sealing measuring points.

.5 Polyamide handwheel with digital read-out.

.6 Internal parts: brass, seat seals: stem with EPDM O-rings.

.7 Model: STAD NPT from TA Hydronics. CB from ITT Xylem. CBV from Armstrong Pumps.

2.5 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from Section 01 00 10 – General instructions.

.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 Piping accessories:

.1 Malleable cast iron fittings:

.1 Anvil

.2 Bibby Ste-Croix

.3 Ward

.2 Joints:

.1 Gruvlock (Anvil)

.2 Shurjoint

.3 Victaulic Co. of Canada Ltd

.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 Manual main shut-off valves:

.1 Crane
.2 Hattersley
.3 Jenkins
.4 Kitz Corp.
.5 Viking

.3 Supports and anchors:

.1 Anvil
.2 Cantruss
.3 E. Myatt
.4 Fee & Mason

Part 3 Execution

3.1 SLOPES

.1 Chilled water:

.1 Main pipes:

.1 Slope of 0.15%. Slope rising in the direction of flow of the supply piping. Downward slope in the direction of flow for the return piping. At critical points, the piping can be installed at level provided that it is fully supported.

.2 Branch connections:

.1 1% slope with a spacing of at least 1 m between two connections on the main pipe, wherever possible.

3.2 ANCHORING

.1 See section 23 05 29 – Hangers and supports for HVAC piping and equipment.

3.3 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.

3.4 TESTING AND CLEANING

.1 General:

.1 See the article "TESTING" in section 01 00 10 – 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.

.3 Cleaning the strainers:

.1 The strainers must be cleaned periodically by this section.

3.5 BALANCING

.1 Chilled 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

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – 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 – 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 – 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 – 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 – 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 STRAINERS

.1 General:

.1 Strainer of same dimension as piping, or larger as indicated, Y type, with eccentric drain connection with screw cap.

.2 Strainer descriptions:

.1 Steel piping:

.1 NPS 2 and smaller:

.1 Cast iron body, ASTM-A126, class B, threaded connections to 1725 kPa, capable of withstanding hydrostatic pressure of 2069 kPa at 65.6°C, up to 1725 kPa at 208°C, Sarco no. IT-250.

.3 Strainer screens:

.1 Stainless steel with perforations of:

.1 1.19 mm for water coils.

2.3 BALANCING VALVES

.1 NPS 2 and smaller:

.1 Bronze body, operating pressure of 2069 kPa, at 121°C, threaded connections, globe valve, characteristics: equal percentage.

.2 The faucet serves:

.1 Precise flow measurement.

.2 Precision flow balancing.

.3 Positive shut-off with memory stop for return to service.

.3 ¼" NPT drain, integral check connections, one on each side of seat, to allow connection of instruments, micrometer type indicator for valve's position, for size and locations refer to drawings.

.4 Victaulic no. TA 787.

2.4 MANUFACTURER LIST

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

.1 Armstrong

.2 Erwel

.3 Fisher

.4 Leslie

.5 Morrison

.6 Sarco

.7 Velan

.8 Watts

.3 Balancing valves:

.1 Armstrong

.2 Bell & Gossett ITT

.3 Tour & Anderson

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.

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.

3.4 STRAINER

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

.2 In general, install strainers at suction of all pumps and circulators upstream of all control valves and regulators, upstream of all solenoid valves, upstream of all automatic flow control valves, and upstream of all pressure reducing valves.

3.5 BALANCING VALVES

.1 Install balancing valves where indicated in drawings. Install with straight lengths upstream and downstream, according to the manufacturer's recommendations.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

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

.3 Section 23 33 00 – Air duct accessories.

1.2 REFERENCES

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

.2 ASTM International:

.1 ASTM A480/A480M-12 – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-09b – Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements.

.3 ASTM A653/A653M-11 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Green Seal Environmental Standards (GS):

.1 GS-36-11 – Standard for Adhesives for Commercial Use.

.4 National Fire Protection Agency Association (NFPA):

.1 NFPA 90A-12 – Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-12 – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 96-11 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC – Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA HVAC – Air Duct Leakage Test Manual, 2012.

.3 IAQ – Guideline for Occupied Buildings Under Construction 2007.

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

.1 SCAQMD Rule 1168-A2005 – Adhesives and Sealants Applications.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – General instructions.

.2 Product data:

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

.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 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 – 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 – 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 – 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 Unless otherwise specified, manufacture the ducts in galvanized steel. If the ducts are made of aluminum, use aluminum sheets with a thickness corresponding to the following table:

Galvanized steel:						
– CAL US	26	24	22	20	18	16
– mm	0.551	0.701	0.853	1.006	1.311	1.613
Aluminum:						
– CAL B & S	24	22	20	18	16	14
– mm	0.508	0.635	0.813	1.016	1.295	1.626

.2 For all cases, the faces of each duct section will have the same thickness. The thickness of the sheet and the dimensions of the transverse seals and the reinforcements are determined by the dimensions of the largest side. Visibly mark the caliber of the sheet on the outer face of the duct for inspection purposes.

.3 To ensure the rigidity to the ducts, the sheet will be marked with transverse ribs (stop beads) when manufacturing the pipes. The spacing between the ribs is 300 mm at most. The method of marking two diagonal plies (cross bracing) on all flat surfaces 200 mm and more in width is also acceptable. For either method, the sheet gauge required will be the same.

.4 In the ducts with dimensions having a greater ratio than 4 to 1, install a sheet division in the center of the longest dimension.

.5 Seal the joints of the ducts.

.6 At the locations shown in the drawings, block the ends of the ducts for future connections. Use galvanized steel sheet metal of the same gauge as the duct. These caps must be airtight and withstand the static pressures of the relevant systems.

.7 Definitions:

.1 Low pressure ducts:

.1 Ducts with a static pressure less than 500 Pa and an air velocity below 610 m/min.

.8 For each of the types of joint described in this section, provide samples and drawings showing the construction details, as well as the materials used.

.9 Before starting the installation of any ducts, demonstrate with tested samples that the specification requirements are met.

2.2 LOW PRESSURE DUCTS

.1 Ducts:

.1 For the sheet thickness, the types of joints, and the reinforcements for rectangular, round, and oval ducts, see the details in the drawings.

.2 Connections:

.1 All branch connections must have 45° angle lateral outlets, 150 mm in length.

.2 For any branch connections serving a supply grille placed within 600 mm of the main duct and any other branch connected at right angles without adaptors, install "extractor" type guide blades with adjustment rod and lock screw inside or outside the duct, depending on the ceiling type. The extractor must be able to completely close off the branch. If the air speeds are greater than 365 m/min., it must be manufactured to withstand these speeds.

.3 For the air supply terminal units and the diffusers, when connected by a flexible duct with adjustable damper, as well as for connecting a duct to a plenum, see the details in the drawings.

.3 Joints:

.1 Rectangular ducts:

.1 All corners of tee joints will be sealed using butyl tape placed over the joint and held in place by the cover flap of the two metal strips. See details in the drawings.

.4 Access doors:

.1 See details on the drawings.

2.3 PROTECTIVE PAINT

.1 When a steel sheet's galvanization is damaged by electric welding or some other act, apply two layers of cold galvanizing compound containing a maximum of 221 g/L of VOCs and leaving a dry film of 92% zinc. This compound will also be applied to protect any metal surface (galvanized steel, carbon steel, cast iron, and aluminum, when required). Similar to the compound ZRC-221, matte gray finish.

.2 Use two coats of paint (such as epoxy-based) for the protection of galvanized steel sheet for certain special systems described in paragraph "Locations" above. Apply these paint layers after degreasing.

2.4 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" in section 01 00 10 – General instructions.

.2 List of manufacturers, section 23 31 13.01:

.1 Rigid ducts:

.1 Alcan (aluminum)

.2 Algoma Steel Inc.

.3 Dofasco
.4 Stelco

.2 Sealant (less than 250 g/l of VOCs):
.1 Duro-Dyne (DDS-181)
.2 Hardcast Carlisle (Duct-Seal 321)
.3 Trans-Continental Equipment Ltd (Multipurpose MP)

.3 Tape:
.1 Duro-Dyne (fibre glass weave FT-2)
.2 Trans-Continental Equipment Ltd (Simple Seal and Simple Tape)
.3 Flexmaster (Duct Bond)
.4 Hardcast Carlisle (Foil Grip)

.4 Gaskets:
.1 Hardcast Carlisle (Flange Gasket 1902)
.2 Multifeutre du Quebec Ltd
.3 3M Ltd (LC-105 Gaskets)

.5 Flexible ducts:
.1 Boflex Inc. (types AS and AI)
.2 Trans-Continental Equipment Ltd (AI-U-Flex)
.3 Flexmaster Co. Ltd (Triple Lock)

.6 Resilient sealant:
.1 Minnesota Mining Mfg. from Canada (3M)
.2 Tremco

.7 Protective paint:
.1 Sico (Corostop, Crown Diamond)
.2 ZRC Products Co. (Kerry Industries Ltd)

.8 Bolts and anchors:
.1 Hilti
.2 Phillips Red-Head
.3 Ucan

.9 Seismic restraint systems:
.1 Racan-Carrier (Vibro)
.2 Mason Industries Inc.
.3 Unistrut (Routle Co. Inc.)

Part 3 Execution

3.1 SUPPORTS AND ANCHORS

.1 General:

.1 Comply with section 23 05 29 – Hangers and supports for HVAC piping and equipment, and with the tables included in the drawings.

.2 Adequately support all ducts, equipment, and devices to the structure. These supports include the entire steel structure, the steel beams, the structural irons, the angle irons, the steel rods, the steel plates, the supports from specialized manufacturers and other accessories necessary for the work, and all drilling, anchoring, and welding work required.

.3 Prior to the manufacturing and the installation, provide shop drawings of all types of supports.

.2 Support rods:

.1 Mild steel rods, diameter according to the table on drawings.

.3 Horizontal ducts:

.1 General:

.1 Securely support the ducts to the structural frame by means of rods and angles.

.2 Firmly affix the steel rods used to secure the supports to the concrete slabs or the steel frame.

.3 Coat all support elements with a layer of aluminium-based paint.

.4 Install additional hangers at every bend, every change of direction, the connections fittings, and any additional steel required to support the pipes in the shafts.

3.2 ELBOWS

.1 Rectangular ducts:

.1 Wherever pipes change direction with an average radius smaller than 1.5 times the dimension of the pipe, install directional vents arranged proportionately to ensure a pressure loss that is not greater than that caused by a change in direction respecting the ratio R/D = 1.5. For square elbows, install double-walled vents, with low-loss blades. Submit manufacturing details, performance details, and samples.

3.3 SECTION CHANGE

.1 The section changes must have a maximum angle of 15°.

.2 Install ducts as straight as possible.

.3 When there is an obstruction caused by piping and it is impossible to relocate the conduit or the pipe, install a contoured envelope around the pipe passing through the ventilation duct. Install an access door for visual inspection.

.4 If the obstruction is greater than 10% of the duct's section, proportionally increase the dimensions of the duct in order to maintain the effective area.

3.4 LEAK TIGHTNESS OF THE JOINTS BETWEEN PIPES, DUCTS, ETC.

.1 Make watertight and airtight the joints between the ventilation ducts and the pipes passing through these ducts, as well as the openings required for all control devices, humidifiers, and electrical conduits going through the ducts.

3.5 LEAK TIGHTNESS OF OPENINGS

.1 Perform the sealing work for the openings required through the slabs and the walls for the passage of ducts and pipes supplying the diffusers or others. See the article "SEALING SLEEVES AND OPENINGS" from section 23 05 15.

3.6 ACCESS AND INSPECTION DOORS

.1 Provide access doors at the locations indicated on the drawings and where required.

.2 Provide inspection doors of 450 mm x 450 mm or of equivalent dimensions, depending on the dimensions of the duct (unless otherwise indicated), close to each motorized or manual damper, control instrument, fire damper, combustion product analyzer, humidifier, intake or exhaust motor, upstream and downstream of each coil and other equipment.

.3 Place the doors for easy access.

.4 Reinforce the opening and align the doors. Seal the doors using a permanently installed flexible rubber seal (foam rubber not accepted).

.5 In insulated walls construct doors out of a double panel with mineral fibre filler between the two panels of a thickness equivalent to the wall insulation.

3.7 GROUNDING

.1 Ensure the complete grounding of all ventilation systems, units, ducts, etc., by a braid-shaped conductor made of stranded tinned copper and end each extremity with flat fixing rings electrically connecting the ducts and the units on each side of the jacketing joints. Conductors similar to the cables manufactured by Continental Cordage Corporation (Anixter Canada Inc.).

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

.2 Section 23 31 13.01 – Metal ducts – Low pressure to 500 Pa.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible, 2005.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – 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 – 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 – 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 – 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 accessories must be manufactured according to the SMACNA HVAC Duct Construction Standard.

2.2 OPENINGS FOR AIR VELOCITY AND AIR TEMPERATURE READINGS

.1 On the insulated ducts, provide openings for instrument ports, with neoprene handles and caps held by chains, for air velocity readings. Install the accesses downstream from a long straight duct with constant section, Duro-Dyne no. IP-1 or IP-2.

.2 On the ducts without insulation and at low velocity, we can use the model IP-4 with screw cap, Duro-Dyne no. IP-4.

.3 Coordination:

.1 To avoid any misunderstanding or error, the location of the openings should be carefully coordinated with the firm responsible for balancing the systems.

2.3 ADJUSTABLE VOLUME EXTRACTORS

.1 Locations:

.1 Install an adjustable extractor at each branch connected at a right angle without adaptor on the main ducts to allow proportional control of the flow in the ducts. See also section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa. The extractor must be able to completely close off the branch. Where necessary, the extractor must be manufactured to withstand air velocities greater than 365 m/min.

.2 Construction:

.1 E.H. Price Ltd. no. AE-2 Extractor with adjustment lever.

2.4 ACCESS DOORS

.1 Non-insulated ducts: double-walled doors (sandwich panels), the same material as used for the ducts, but of the next largest thickness (not be thinner than 0.6 mm), with angle iron frame.

.2 Insulated ducts: double-walled doors (sandwich panels), the same material as used for the ducts, but of the next largest thickness (not be thinner than 0.6 mm), with angle iron frame and rigid insulation, fiberglass, 25 mm thick.

.3 Seals: neoprene.

.4 Hardware parts:

.1 Doors measuring up to 300 mm wide: two (2) latches for the frame.

.2 Doors measuring between 301 mm and 450 mm wide: four (4) latches for the frame.

.3 Device to hold the open position.

2.5 MANUFACTURER LIST

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

.2 List of manufacturers, section 23 33 00:

.1 Openings for air velocity and air temperature readings:

.1 Duro-Dyne

.2 Lawson Taylor Ltd

.2 Adjustable volume dampers:

.1 Anémostat

.2 E.H. Price Ltd

.3 Nailor Industries Inc.

.4 Titus

Part 3 Execution

3.1 ADJUSTABLE VOLUME DAMPERS

.1 Install the extractors according to the manufacturer's recommendations and the article "ADJUSABLE VOLUME DAMPERS" in Part 2.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

.2 Section 23 07 13 – Duct insulation.

1.2 REFERENCES

.1 ASTM International:

.1 ASTM A653/A653M-11 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – 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 – 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 – 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 – 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 CONTROL DAMPERS

.1 General:

.1 Provide shop drawings and a sample of each type.

.2 Single-blade dampers (rectangular or butterfly type):

.1 In ducts 300 mm or smaller, a single-blade damper constructed of galvanized steel, 1.006 mm thick (20 gauge), pivot pin of 9.525 mm in diameter, with three lock seams.

.3 Multi-blade balancing dampers:

.1 In ducts 330 mm and larger, use multi-blade dampers, with opposed blade action, galvanized steel construction, 1.613 mm (16 gauge) or larger, oil lubricated bronze bearings, maximum blade length of 1220 mm, blade width of 150 mm minimum, 200 mm maximum.

.2 For most dampers more than 1220 mm in length, construct the dampers of two or more sections of blades with mullions between them and attachment rod interconnections.

.3 Using a mechanism, connect the blades to each other so that they work in unison. Secure the connecting rods to the axles.

.4 Adjustable and balancing dampers (VMA):

.1 Single-blade or multi-blades with opposed blade action, constructed according to the description of the multi-blade dampers.

.2 Adjustment regulators:

.1 Actuated by manual regulators with minimum leakage, neoprene gasket, indicator handle, locking handle and washer, and cap at the other end of the shaft.

.1 Such as SRS-388 from Duro-Dyne.

.2 On the insulation covered ducts, use of SRST series assembly depending on the thickness of the insulation.

.3 Install where indicated on the drawings and at locations required for the airflow calibration. Coordinate with the company hired to balance the systems.

2.2 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" in section 01 00 10 – General instructions.

.2 List of manufacturers, 23 33 15:

.1 Control dampers:

.1 Alumavent
.2 American Warming & Ventilating
.3 Nailor Industries Inc.
.4 Tamco
.5 Trolec Inc.

Part 3 Execution

3.1 INSTALLATION

.1 Install the dampers where indicated.

.2 Install the dampers according to the SMACNA recommendations and the manufacturer's instructions.

.3 Seal the multi-damper module joints with a silicone sealant.

.4 Install an access door near each damper. Refer to section 23 33 00 – Air duct accessories.

.5 Ensure that the dampers are visible and accessible.

3.2 DAMPERS

.1 General:

.1 Determine the exact dimensions on-site, according to the dimensions of the ducts.

.2 Install them where indicated on the drawings and where required.

.3 Install dampers square and plumb to ensure easy operation, free from vibration and clatter, the whole installation of a very solid construction.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 National Fire Protection Association (NFPA):

.1 NFPA-90A-12 – Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA-90B-12 – Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC – Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA IAQ – Guideline for Occupied Buildings under Construction, 2005.

.4 Underwriters' Laboratories (UL):

.1 UL 181-2005 – Standard for Factory-Made Air Ducts and Air Connectors.

.5 Underwriters’ Laboratories of Canada (ULC):

.1 CAN/ULC-S110-2007 – Standard Methods of Test for Air Ducts.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – 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 – 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 01 00 10 – 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 – 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 FLEXIBLE DUCTS

.1 General:

.1 Flexible ducts according to the standards NFPA-90A, NFPA-90B, and ULC.

.2 The pressure loss coefficients listed below are based on a reference coefficient of 1.00 established for metal ducts.

.3 The flame spread index must not exceed 25 and the smoke development index must not exceed 50.

.4 Submit a sample of each type.

.5 When required, use the proper tool to give the end of the flexible duct an oblong shape.

.6 Install a maximum length of 1500 mm.

.2 Low pressure:

.1 Aluminum, single ply, 0.15 mm thick, with mechanical joints, minimum radius of curvature at the center of the duct equal to the diameter of the conduit, minimum operating pressure of 3000 Pa, minimum collapsing pressure of 365 N/linear meter and puncture resistance with 3.175 mm diameter ball, 187 N.

.2 If insulation is required:

.1 In factory covering, 25 mm minimum thickness, fiberglass, density of 12 kg/m³, with integrated vinyl or PVC envelope having a resistance of 0.2 perm. This envelope must be protected by a sleeve made of galvanized sheet metal with a thickness of 0.551 mm (26 gauge), whenever a flexible duct passes through a wall. The sleeve must extend 100 mm past each side of the wall.

.3 Include fireproof wrapping where required, in accordance with the requirements of the local authorities.

.3 Joints between rigid and flexible ducts:

.1 Attach the flexible ducts to the rigid ducts, air supply terminal units, and diffusers using metal screws or metal clamping bands, make airtight with a sealant, and cover everything with tape. The sealant must have a VOC content below 250 g/L.

2.2 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" in section 01 00 10 – General instructions.

.2 List of manufactures, section 23 33 46:

.1 Sealant (less than 250 gr/l of VOCs):

.1 Duro-Dyne (DDS-181)

.2 Hardcast Carlisle (Duct-Seal 321)

.3 Trans Continental Equipment Ltd (Multipurpose MP)

.2 Tape:

.1 Duro-Dyne (fiberglass FT-2)

.2 Trans Continental Equipment Ltd (Simple Seal and Simple Tape)

.3 Flexmaster (Duct Bond)

.4 Hardcast Carlisle (Foil Grip)

.3 Gaskets:

.1 Hardcast Carlisle (Flange Gasket 1902)

.2 Multifeutre du Quebec Ltd

.3 3M Ltd (LC-105 Gaskets)

.4 Flexible ducts:

.1 Boflex Inc. (types AS and AI)

.2 Trans Continental Equipment Ltd (AI-U-Flex)

.3 Flexmaster Co. Ltd (Triple Lock)

.5 Protective paint:

.1 Sico (Corostop, Crown Diamond)

.2 ZRC Products Co. (Kerry Industries Ltd)

Part 3 Execution

3.1 INSPECTION

.1 Conditions verification: prior to proceeding to the installation of flexible air ducts, ensure that the state of the surfaces/supports previously implemented under the constraints of other sections or contracts is acceptable and permits the execution of the work in accordance with manufacturer's written instructions.

.2 Make a visual inspection of surfaces/supports in the presence of the Engineer.

3.2 FLEXIBLE DUCT INSTALLATION

.1 Install flexible air ducts in accordance with CAN/ULC-S110, NFPA-90A and NFPA-90B.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

1.2 EQUIPMENT TO BE RETURNED

.1 Also provide the following: keys for flow volume control and for air pattern adjustment.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – General instructions.

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications, and data sheet for the products. 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, 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 – 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 – 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 – 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 Grilles and diffusers to conform to the dimensions, the diffusion patterns, and the type indicated on the drawings. The dimensions are calculated so as to have sufficient air projection and a low noise level and can not be changed without authorization. When two or more grilles and diffusers are connected to the same unit and do not have integrated balancing dampers, supply and install a balancing damper in a branch. For the diffuser types AL, AN, ANC, AQ, CQA, and AS, see the diffuser connection detail.

.2 With neoprene gasket around the edge, allowing a very tight seal.

.3 When installed on exposed branches, fix them with flanges facing the interior of the duct.

.4 Adjustable frontal blades:

.1 For supply grilles in walls or on the sides of an exposed duct, direct the horizontal frontal blades upwards at an angle between 15 and 20°.

.5 When installed on the walls or on the exposed ducts, baked enamel finish, aluminum color.

.6 When installed on the ceiling, baked enamel finish, white color.

.7 When installed in a sill or in the floor, brushed aluminum finish with protective lacquer.

.8 Provide shop drawings and a sample of each type of grille and diffuser used.

.9 Fastened with exposed or concealed screws.

.10 All grilles and diffusers must be equipped with seismic restraint systems.

2.2 SUPPLY GRILLES ON CEILINGS

.1 Type PDDR (square):

.1 Construction:

.1 In steel.

.2 To be incorporated into a suspended ceiling on exposed grid.

.3 White

.4 Dimensions : 603 mm x 603 mm

.5 Complete with plenum and and internal perforated grille.

.2 Model: such as PDDR from E.H. Price Ltd or approved equivalent.

2.3 MANUFACTURER LIST

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

.2 List of manufacturers, section 23 37 13:

.1 Grilles and diffusers:

.1 E.H. Price Ltd

.2 Grada

.3 Krueger

.4 NAD Klima

.5 Nailor Industries Inc.

.6 Titus

Part 3 Execution

3.1 INSTALLATION

.1 Install grilles, grilles with dampers, and diffusers according to manufacturer's instructions.

.2 Where fasteners are visible, embed screws in countersunk holes.

.3 Linear diffusers, high induction roller diffusers, double deflection grilles and other adjustable grilles and diffusers: adjust the diffusers until the desired air distribution patterns are obtained.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 10 – General instructions.

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

1.2 REFERENCES

.1 ASTM International:

.1 ASTM-E84-11a – Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM-C916-1985(R2007) – Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM-C1071-05e1 – Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.2 National Fire Protection Association (NFPA):

.1 NFPA-90A-2012 – Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA-90B-2012 – Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).

.3 Underwriters' Laboratories (UL) Inc.:

.1 UL 2021-1997 – Fixed and Location-Dedicated Electric Room Heaters.

1.3 SUBMITTALS

.1 Submit documents in accordance with section 01 00 10 – General instructions.

.2 Product data:

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

.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 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 – 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 – 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 – 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 FAN COIL UNITS

.1 General:

.1 Approved for an operating pressure of 1380 kPa.

.2 Capacity tested by a certified, competent, independent organization for the operating conditions specified.

.3 Shop drawings to be submitted for each model for verification before manufacturing.

.4 Compliant with details in the drawings and the specifications listed in the tables in the appendix.

.5 Unless otherwise specified, they must be fitted with two coils, one for heating and one for chilled water cooling.

.6 Each fan coil and its connection and control panel must be designed to withstand a minimum short-circuit capacity of 10 kA at the connection terminals.

.2 Enclosures:

.1 Wipe coat galvanized steel sheet, 1.32 mm thick (18 gauge), coated with a layer of baked primer paint.

.2 Interior insulated with 12.7 mm thick thermal acoustic fiberglass insulation Linacoustic, covered with a fire-resistant plastic coated mat.

.3 Leveling legs allowing the precise alignment and level installation of the top of the units.

.4 Screw-free enclosure assembly.

.5 The front panel pivots about its upper hinge and is fixed at the bottom by a spring clasp.

.6 Unless otherwise indicated, air supply connection to the unit from the bottom and air exhaust through a grating on top of the unit.

.7 Enclosure height and length sufficient to contain the riser pipes and the accessories including the access doors on the top.

.3 Coils:

.1 Aluminum fins fixed to copper pipes.

.2 Flare type fittings.

.3 Water supply and return on the same side.

.4 Manual air vent at the high point of each coil.

.4 Centrifugal fan with forward curved blades, double air inlet balanced statically and dynamically for vibration-free operation, aluminum and cadmium plated steel construction.

.5 Quiet motor mounted on neoprene and fitted with lubricated bronze sleeve bearings rated for a minimum of twenty thousand (20 000) hours of operation, integrated overload relay, capable of starting at low voltage, pole-type variable speed operation, and with condenser, fan and motor assembled on an easy to dismantle rigid steel plate.

.6 Placed at the bottom of the unit, the return air box must allow the installation of easily removable filters. Unless otherwise indicated, replaceable filter type, 25 mm thick.

.7 Drain pan:

.1 Installed under the cooling coil and extending below the accessories, the fittings, and the chilled water control valve.

.2 Watertight, galvanized steel, 1.62 mm thick (16 gauge), with rounded corners, zinc wipe coat, forming a single piece with the front deflector panel.

.3 Thermally insulated on the outside with 12 mm of fire retardant insulation and a vapour barrier.

.4 Sloped towards the drainage point.

.5 NPS 3/4” drain connection in DWV copper.

.6 Drain connected to the nearest funnel drain.

.8 Accessories:

.1 Variable speed control from 100 to 50%, must not create interference with radio waves and television waves, adjustable low speed limit to prevent the motor from stopping at low speed, high speed stop position.

.2 Manual starter installed inside the enclosure.

.3 Disconnected switch

.4 Junction box with terminals and terminals identified for connections by the Division 26.

.5 Unless otherwise indicated, all the equipment to be factory mounted. Electrical accessories prewired in factory, in accordance with the CSA.

.6 Install the following accessories in the enclosure: motorized valves, manual valves, connection and distribution piping, and air vent.

.7 Coordinate the location of the screw-shut access opening for manual air vent adjustments.

.9 Individual specifications:

.1 See the details drawings on plans.

2.2 MANUFACTURER LIST

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

.2 List of manufacturers, section 23 82 19:

.1 Fan coil units:

.1 Dunham Bush

.2 McQuay

.3 Trane

.4 York

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with the requirements from section 01 00 10 – General instructions.

.2 Compliance:

.1 Comply with the manufacturer's requirements, recommendations, and written data, including all available product technical bulletins, instructions for the handling, the storage, and the installation of the products, and the technical data sheet indications.

.3 Installation:

.1 Install the devices according to the details indicated on the drawings and/or according to the architect's details.

.2 For suspended devices, see the details in section 23 05 29 – Hangers and supports for HVAC piping and equipment.

.3 In the cases where the air vents are the automatic type, install the screw caps, once testing and filling are completed and ensure that they are leak-tight.

FAN COIL UNIT CHARACTERISTICS								
Identification			**2-URA-025**					
Location			Room 2B-204.A					
Brand			E.H.Price					
Model			BCH					
Air	Flow (L/s)		285					
	S.P. (Pa) external		125					
Cooling	Total capacity (kW)		4.83					
	Sensible capacity (kW)		3.51					
	T° air inlet (°C)	DB	26.7					
		WB	19.4					
	T° air outlet (°C)	DB	16.2					
		WB	14.4					
	Water flow (L/min.)		3.57					
	T° water inlet (°C)		7.2					
	T° water outlet (°C)		12.3					
	PLW (Pa)		20 000					
Motor (HP)			½					
Voltage (V/PH/Hz)			115-1-60					
Comments – Accessories								

Notes :

DB : dry bulb

WB : wet bulb

PLW : pressure loss, water side

END OF SECTION

TABLE OF CONTENTS

General

1.1 RELATED SECTIONS

.1 Section 01 00 10 – General instructions.

.2 All Division 23 sections.

1.2 GENERAL CONDITIONS

.1 All requirements outlined in section 01 00 10 apply to Division 25.

.2 All mechanical and electrical drawings and installation details apply to Division 25.

1.3 DESIGNATED CONTRACTOR

.1 For uniformity, continuity, and compatibility reasons, only products from Delta Controls, are authorized. Retain the services of Regulvar to execute work specified in all the sections related to the EMCS sections and in Division 25.

1.4 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in this section:

.1 UPS – Uninterruptible power supply.
.2 BACnet – Building Automation and Control Network.
.3 BTL – BACnet Testing Laboratories.
.4 DDC – Direct Digital Control.
.5 HVAC – Heating, Ventilation, Air-Conditioning.
.6 HMI – Human Machine Interface.
.7 I/O – Input/Output.
.8 LAN - Local Area Network.
.9 LCU(s) – Local Control Unit(s).
.10 NC – Normally Closed.
.11 NO – Normally Open.
.12 PC - Personal Computer.
.13 MCU(s) – Master Control Unit(s).
.14 PID – Proportional, Integral and Derivative control loop.
.15 EMCS – Energy Management and Control System.
.16 NMC(s) – Network Management Controller(s).
.17 SSR – Solid state relay.
.18 TCU(s) – Terminal Control Unit(s).
.19 TRIAC – Triode for alternating current.
.20 USB - Universal Serial Bus.
.21 TQC – As Built

.22 VAV – Variable Air Volume.

.23 VFD – Variable Frequency Drive.

.24 VPN – Virtual private network.

.25 WAN – Wide Area Network.

1.5 DEFINITIONS

.1 EMCS: the energy management system includes all of the building's control and monitoring systems, i.e. all instrumentation, pneumatic, electrical and direct digital controls as well as the centralized management system.

.2 Point: a point may be physical or logic ("virtual").

.1 Physical points: inputs or outputs connected directly to digital controllers that monitor the status or signal amplitude of instrumentation or control the action of equipment (on, off, modulation) and actuators (position, modulation) through relay contacts or control signals.

.2 Logic points: values calculated by the digital controller, for example set points, total values, totalized pulses, corrections based on the results and/or instructions from the control logic.

.3 Point types:

.1 AI (analogue input).

.2 AO (analogue output).

.3 DI (digital input).

.4 DO (digital output).

.5 PI, PO (Pulsed signals)

1.6 SCOPE OF WORK

.1 Work included:

.1 Work includes detailed engineering, labour, supply, installation, adjustments, calibration, and all pneumatic, electrical, and electronic wiring of all control systems indicated on drawings and specifications.

.2 Division 25 must include unless otherwise specified, all devices, hardware, piping for pneumatic controls, conduits, junction boxes and wiring for electrical and/or electronic controls pertaining to the control system and to systems' various control components, interconnections between the two types of controls, electrical wiring for the normal operation of such controls, supply and installation of transformers required for low voltage controls.

.3 Division 25 must include all remote wiring of accessories supplied and installed by other Divisions and required for the proper operation of a mechanical equipment or system as shown on verified shop drawings.

.4 Dismantling:

.1 This Division's Contractor must read the dismantling scope of work of involved specialties and must be present at the start of the work to participate in selective dismantling.

.2 Dismantle control equipment, including cables and conduits, rendered obsolete by this contract's work.

.3 Make all related changes required for proper operation of the existing EMCS after equipment removal or system modifications, such as wiring connections, adjustments, equipment relocation, alarms removal, programming updates, graphics, and final control diagrams (Closeout documentation).

.4 Coordinate with the Owner the dismantled equipment to be returned.

.5 Construction, work includes more specifically:

.1 All coordination required with the Client, the designated professional and/or involved disciplines to produce the complete detail engineering including:

.1 Identification system of control points and devices.

.2 Typical graphics and operating sequences.

.3 Quantities and types of cables, as well as control signals required for devices and accessories supplied by other Divisions.

.4 Location and requirements for the installation of equipment supplied by others.

.2 Detail engineering from mechanical, electrical drawings and specifications and from information contained in shop drawings from other Divisions reviewed by the designated professional. Division 25 must coordinate with other Divisions to ensure that it has all the information required to produce its detail engineering. It is responsible for communicating to the designated professional any raised item that conflicts with controls drawings and specifications.

.3 All electrical and digital control work related to plumbing, heating – chilled water, ventilation – air-conditioning, electrical and controls work, except those specifically noted as part of another Division on controls drawings and specifications.

.4 Supply, installation and wiring of all the following equipment unless otherwise specified in the plans and specifications:

.1 The reuse of the thermostat.

.2 Supply and install of a new digital controller DAC-633 for the control of the fan coil. Supply and install a dedicated transformer.

.3 All probes and transmitters.

.4 All devices described in the control drawings and in this section.

.5 All the hardware required and/or indicated in this specification section to achieve a complete and operational system.

.5 Supply and wiring of all equipment to be handed over to others:

.1 Motorized valves (model: B211-LRB24SR).

.6 Wiring and integration of all digital controllers to the EMCS, including:

.1 Supply and installation of secondary communication networks linking the various local control panels.

.7 120 V electrical power and all the electrical distribution to medium-voltage control panels, enclosures and devices from normal electrical distribution panels.

.8 Transformation to 24 V and all the low voltage electrical distribution of the control devices and the digital controller.

.9 Identification of all devices, panels, enclosures, conduits and conductors as per the client's standards.

.10 Programming and configuration of all alarms and trend logs for each point.

.11 Programming of operating sequences and of general routines described in this section for all digital controllers to achieve fully functional systems.

.12 Additions and modifications of the database and all dynamic graphics for controlled systems and the floor plans.

.13 The closeout documentation required for system operation and maintenance as described in this section.

.2 Work excluded:

.1 Unless otherwise instructed, the following work is excluded:

.1 Access doors to controls in ventilation ducts and ceilings.

.2 Instrumentation openings as described in section 01 00 10.

.3 Installation of devices provided by Division 25 to be handed to others. See "CONTROL DEVICES TO BE HANDED TO OTHERS " of this section.

1.7 DOCUMENTS TO BE SUBMITTED FOR APPROVAL

.1 Provide all submittals required in accordance with section 01 00 10 – General instructions.

.2 In addition to submittals required in section 01 00 10, provide all shop drawings and closeout documents in accordance with the requirements of this section.

.3 Provide an electronic version of shop drawings (multipage PDF format) for review by the designated professional.

.4 When shop drawings have been reviewed, changes have been made in accordance with the professional's annotations and installation has been completed, provide a file regrouping all closeout documents (multipage PDF format).

.5 Shop drawings must carry the seal and signature of a qualified engineer who is licensed to practice in Canada, in the province of Quebec.

.6 Before proceeding with installation, submit the following documents:

.1 For each system provide schematic and wiring diagrams of the various controllers and instrumentation that make up local control loops, including a list of devices used, the identification used, the narrative sequence of operation, etc.

.2 For each control panel, provide scaled drawings of the panel, including all internal and front components, its electrical wiring diagram, CSA certification, etc.

.3 For each device or equipment, shop drawings or technical sheets. When the specification sheet of an equipment includes more than one model, specify which model is submitted for the project.

.4 Floor plans showing the proposed location of the controller.

.5 An updated detailed network architecture.

.6 Text programs or logical diagrams of operation for every system controlled through direct digital controls.

.7 For every digital controller, provide a table which includes the following information: network address, a list of input/output points, their address, identification and signal type, alarm thresholds and identification of free points.

.7 Once work is completed, supply:

.1 Corrected and up-to-date version of all documents requested in article "SHOP DRAWINGS".

.2 Identification on control drawings of electrical circuits used to supply power to the project's equipment.

.3 Letter of warranty for parts and labour, taking effect from the work's acceptance date.

.4 Start up report and calibration certificates.

.5 Electronic copy of all documents previously listed, regrouped in a single file (multipage PDF format).

1.8 QUALITY ASSURANCE

.1 See "LAWS, REGULATIONS AND PERMITS" in section 01 00 10.

.2 All wiring and installations must comply with manufacturers and the Régie du bâtiment du Québec requirements for all mechanical and electrical work.

.3 Unless otherwise specified, use new materials and devices, regularly produced by the manufacturer, CSA and ULC certified, complying to the referenced standards, and meeting any other prescribed requirements.

1.9 WARRANTY

.1 Notwithstanding the warranty period specified in the "WARRANTY" article of section 01 00 10, additions and modifications to the control system must carry a (2) two-year warranty starting on the work's final acceptance date.

1.10 TOTAL FIXED PRICE

.1 Provide with the bid, a total fixed price covering all works of Division 25.

Part 2 Product

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 Outdoor installations: use weatherproof construction in NEMA-4 enclosures.

.3 Control devices to satisfy the following requirements:

.1 Linearity: relationship between control device measurement (temperature, humidity, pressure, etc.) and output signal to be linear type.

.2 Control limits: control devices to maintain their controlled variable within the following set point limits:

.1 Temperature:

.1 ± 0.8°C (1.5°F) in spaces.

.2 ± 0.3°C (0.5°F) for chilled water, cooling tower water and hot water systems.

.3 ± 0.5°C (1.0°F) in all other applications.

.2 Humidity: ± 5% in all cases.

2.2 CONTROL DEVICES

.1 R – Electric relays:

.1 4PDT or DPDT, silver-nickel alloy contact, with indicator light and self-holding test button.

.2 Relays supplied with plug-in base with screw terminals.

.3 Activation coil of 12 V D.C., 24 V A.C. or 120 V A.C. voltage depending on application.

.4 Complete with enclosure, when installed outside of panels.

.5 In switching applications, use contactors of sufficient capacity.

.6 As per Omron MYxIN or approved equivalent Magnecraft.

.2 CT – Current transmitters:

.1 Split-core current transmitter.

.2 600 VA.C. RMS isolation.

.3 Full-scale accuracy of ± 2%.

.4 Current range according to application. Equipped with a range selection jumper. Models with a potentiometer to adjust the measuring range are prohibited.

.5 Output signal: 0 to 5 V D.C.

.6 As per Veris Industries Hawkeye no. H922 or approved equivalent Senva.

.3 XFO – Transformer:

.1 Voltage transformer, enclosed type, complete with fuse holder and fuse. The VA capacity must be at least 20% higher than the rated load. The use of transformers with built-in thermal protection or intrinsic limitation as an alternative to fuses is prohibited.

.2 As per Marcus MC series, Hammond HPS Fusion series or Transfab TMS DC series.

.4 Temperature sensors:

.1 General:

.1 10k ohm NTC resistor type, ± 0.2°C accuracy, standard resistance/temperature coefficient.

.2 Reading range of -50°C to 100°C.

.2 For air duct:

.1 Single measurement:

.1 Rod probe with point temperature measurement at tip.

.2 Length of probe according to duct dimensions, up to 18".

.3 As per Greystone no. TE200B series, ACI A/AN-D or equivalent from the control systems' manufacturer and approved by the designated Professional.

.5 DPT – Differential pressure transmitter:

.1 For air duct:

.1 Fully transistorized piezoresistive transmitter with integrated temperature compensation.

.2 Full-scale accuracy of ± 1% with integrated zero-point adjustment.

.3 4 to 20 mA output signal.

.4 Liquid crystal display (five values) of differential pressure in inches of water.

.5 With option for DIN rail mounting.

.6 As per ACI DLP series or approved by the designated Professional.

.6 Control panels:

.1 NEMA-1 rated steel panels with concealed hinged front door easily removable for interior access and key lock.

.2 Sufficient dimensions for the application.

Part 3 Execution

3.1 INSTALLATION

.1 All work conducted by Division 25 must be performed in accordance with requirements described in section 01 00 10.

.2 All controls must be installed and adjusted by competent technicians regularly employed by the contractor. Adjustment cost is part of this contract.

.3 The installation of each device provided by Division 25 must be done in accordance with the product manufacturer's instructions and recommendations.

.4 Similarly, the installation of equipment supplied by others and installed by Division 25 must be done in accordance with the product manufacturer's instructions and recommendations.

.5 This Division is responsible for the complete installation of all equipment it supplies. It is also responsible for all wiring including low or medium voltage power supply, communication wiring, electrical connections for remote controls and measurements these devices require and for the various remote components of mechanical systems.

.6 All wiring must comply with local authorities' requirements and those of the article "ELECTRICAL WIRING" of this section.

.7 Any control device installed on a thermally insulated ventilation duct must be fitted with an appropriate metal bracket provided by Division 25.

.8 All through-wall piping must be protected with a sealed nylon bushing.

.9 All electrical cables and flexible pneumatic tubing passing through a knockout opening must be protected from sharp edges with nylon braided sleeving. Groupings of the same type of cable or tubing in the same braided sleeve are permitted.

.10 Control panels must have no unused open knockout openings.

.11 For devices mounted on walls, install 50 mm x 100 mm (2" x 4") electrical boxes. Location and installation height must be coordinated with the electrical contractor.

.12 Low voltage transformer panels:

.1 Supply and install 24 V A.C. and 24 V D.C. transformer panels to power digital controllers and all control devices. Panels must be complete with all necessary electrical accessories (switches, fuses, protections, transformers, power supplies, terminal blocks, grounding ring, certification label, etc.).

.2 Connect 120 V power supply circuits to 24 V A.C. and 24 V D.C. transformer panels so that control panels/enclosures are strictly at low voltage without requiring an electrician for maintenance and modification.

.3 Transformation panels must be CSA certified for their complete assembly.

3.2 ELECTRICAL CONNECTIONS

.1 Division 25 must supply and install cables, conduits, junction boxes, connectors and all necessary hardware for the following complete connections:

- .1 All devices specific to its specialty.
- .2 All connections required to meet the operating sequences described in this Division's sections.
- .3 All remote connections of hardware supplied and installed by other Divisions and required for the proper operation of a mechanical equipment or system as indicated on its reviewed shop drawing.

.2 Comply with the prevailing Quebec Electrical Code requirements for the installation of conduits, junction boxes and wiring. These requirements apply to the entire installation, including low-voltage installations.

.3 Grounding of the entire installation by the controls Contractor is part of this contract and must be done in accordance with the Quebec Electrical Code requirements and the equipment manufacturers' recommendations.

.4 Notwithstanding the conductor sizes specified in Division 26, the conductor sizes used exclusively for control circuits are as follows:

- .1 120 V: 14 AWG minimum gauge.
- .2 24V: 18 AWG minimum gauge, shielded, twisted cable, FT4 rating when in EMT conduit and FT6 when exposed.
- .3 Secondary network communications: 24 AWG minimum gauge, low capacitance.

.5 Cables for input or output analogue processing signals must have two or three 18 AWG conductors, twisted with aluminum shielding, and drain wire, and fitted in a protective PVC sheath. Drain wires must be securely wired and grounded at the source point. The other end must be protected from grounding by a dielectric shield.

.6 Control conductor gauges must be selected so that the voltage loss is less than 5% of the supply voltage.

.7 Unless otherwise specified, all cables must be in EMT thin-walled metallic conduit. EMT conduits must be sized to meet a fill rate not exceeding 40%.

.8 Use of exposed (plenum) cables:

- .1 FT-6 certified cable is permitted only in the ceiling spaces of rooms and corridors where cables remain accessible (ceilings made of removable soundproofing tiles) and only for the connection of control signals, secondary level communication and 24 V voltage. Its use is prohibited in mechanical or electrical rooms, service shafts, on exposed walls or ceilings, or any other place where there is a risk of physical damage.

.2 Exposed FT-6 wiring must follow the building axis and be neatly tied at least every 1.5 m with J-hooks designed specifically for this purpose. The use of tie wraps, of suspended ceiling frames, ventilation duct or water pipe hangers, or other means of supporting cabling is strictly prohibited.

.3 For wall control connections, FT-6 cables must be run from the electrical box to the ceiling in metallic conduits.

.4 Install cord fittings at the ends of metallic conduits to protect FT-6 cables from abrasion.

.9 All junctions and connections must be made without exception within junction boxes provided by this Division and made on industrial grade screw terminals. The use of twist-on ("marrette") connectors, crimping fittings or twisted cables wrapped with electrical tape is prohibited.

3.3 TEST RUNS AND CALIBRATION

.1 Calibration:

.1 Calibrate all control devices.

.2 Controls of each Division must be checked and adjusted and demonstrated to be functioning properly.

.2 Alarms:

.1 Adjust the threshold for each alarm to provide adequate passive monitoring without flooding the EMCS with irrelevant events.

.2 Simulate all configured and programed alarms.

.3 Record alarm conditions and triggers in closeout documents.

.3 Assistance:

.1 Division 25 must cooperate with and assist in the testing and adjustment of devices and systems of other Divisions, both when requested by them and when the proper system operation is at stake.

3.4 START-UP

.1 The controls Contractor, upon completion of the system installation, must proceed with its system start-up. To ensure safe operation, start-up is divided into the following phases: control system verification and control system start-up with the electromechanical systems in operation.

.2 During the control system verification phase, the controls technician must perform, but not be limited to, the following steps:

.1 Check calibration and signal reception of all transmitters.

.2 Check operation of all electrical actuators.

.3 Check operation of all controls and feedback associated with the control.

.4 Simulate all alarms.

.5 Simulate all control loops and adjust parameters.

.3 Upon completion of start-ups, demonstrate to the designated professional the control system operation.

3.5 NARRATIVE SEQUENCES OF OPERATION

.1 General:

.1 Adjust all delays, dead bands and thresholds based on field observations during start-ups to achieve stable operation.

.2 Program historical data on all control points.

.3 Program the following alarms:

.1 High and low room and return temperatures.

.2 Dirty filters

.3 High and low system supply temperature.

.4 Unintended unit fan shutdown.

.2 Ventilation unit no. 2-URA-025:

.1 System stopped:

.1 The fan is off, and the cooling valve is closed.

.2 System starting:

.1 When the cooling valve is open more than 5%, the digital controller starts the fan of the fancoil.

.3 System running:

.1 The digital controller modulates the cooling valve to maintain the room set point.

.2 The digital controller shuts down the fan coil when the cooling valve is closed for more than five (5) minutes.

END OF SECTION