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CANADIAN SPACE AGENCY
COLLABORATION AREAS

Specifications – Mechanical

2022-07-18
Project: 2020-134-1020-1001

CANADIAN SPACE AGENCY

6767 ROUTE DE L'AÉROPORT

SAINT-HUBERT (QUEBEC)

J3Y 8Y9

COLLABORATIONS AREAS

DIVISIONS 20, 21, 23, AND 25

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Part 1 General

1.1 DEFINITION

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

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

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

1.2 EXAMINATION OF THE SITES

.1 See general and specific conditions of the contract.

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.

.3 Perform work during "normal work hours". See Architect's specification and Owner’s instructions.

.4 Work in occupied areas must be performed outside of normal work hours. See Architect's specification and Owner’s instructions.

.5 Perform the following work during periods of inoccupation. See Architect's specification and Owner’s instructions.

.6 Notify the Engineer and the Owner 48 h before performing work during periods of inoccupation.

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 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 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.

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

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

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

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

.10 The drawings must be in French.

1.17 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.

.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 Anchors.

.2 Work on the fire sprinkler and fire prevention.

.3 All ventilation work – air conditioning.

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

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

.6 Places described in sections of the Divisions 21, 23, 25, and 26.

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

.8 For all work on automatic sprinklers, the coordination drawings are the responsibility of the Division 21.

.9 Original coordination drawings:

.1 At the end of the work a USB flash drive (containing the DWG) including each O&M manual and a secure electronic transmission of the as-builts are to be submitted to the Owner, for no additional charge, by each section. Also applicable when transmitting as-built by the contractor.

1.18 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.

1.19 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.

1.20 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.

1.21 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

1.22 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 copy of the approved shop drawings, and as executed.

.2 A diagram of the controls with explanatory text.

.3 A list identifying access points to fire shutters and controls in the walls and ceilings.

.4 A list of legends of the piping, the piping identification codes, and ventilation systems.

.5 A list of the systems' final calibration values, as approved.

.6 A list of the different sub-Contractors with names, addresses, and phone numbers.

.7 A list of representatives and/or manufacturers of the installed equipment with names, addresses, and phone numbers.

.8 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.

.3 The entirety must be written in French.

.4 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.

.5 These manuals should be submitted before final trials. Provide an empty section to later add calibration and commissioning reports.

1.23 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".

1.24 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 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.

.3 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.

.4 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.

1.25 MANUFACTURERS' INSTRUCTIONS

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

.2 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.

1.26 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 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.

1.27 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 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.

.3 See section 23 05 53.01 – Identification of systems and mechanical equipment.

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

.2 When openings are required in rooms with sensitive equipment (example: server rooms), take all the necessary means to protect the equipment in operation during the penetrations (source capture, additional protections, etc.).

.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 Firestop and smoke stop assemblies: in accordance with CAN/ULC S115-05 Standard Method of Testing Fire Performance of Firestop Assemblies. Install firestops and smokestops around pipes, ducts, cables and other objects penetrating firewalls to provide fire resistance equal to that of surrounding floors, ceilings and walls.

1.29 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.

1.30 INSPECTIONS

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

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

.5 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.

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

.7 Submit the written test results to the Engineer.

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

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

.10 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.

.11 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.

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

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

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

1.33 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.

1.34 WARRANTY

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

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

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

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

.5 General conditions:

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

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

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

1.35 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.

1.36 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: electricity, water, steam, telecommunications services, etc.

.2 Demolition:

.1 All demolition work is the responsibility of each concerned mechanical and electrical section.

.3 Occupied rooms:

.1 The work is being done during the occupancy of rooms in the building, therefore, the work must be performed by stages in the rooms designated by the Owner.

.2 Perform work after prior agreement with the Owner and establish an acceptable work schedule with the Owner.

.3 Before undertaking work in a given area, ensure the availability of all equipment, tools, and labour required to perform the work without interruption.

.4 Follow the Owner's instructions as to the delivery to the worksite of its personnel and equipment.

.5 The Owner will indicate which staircase can be used and within what limits it is permitted to circulate in the present corridors.

.6 Take all necessary precautions to adequately protect existing installations in these areas.

.7 At no time must the traffic and the functioning of the building services be impeded. Follow all of the Owner's instructions.

.4 Noise:

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

.5 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.

.6 Piping insulated with asbestos:

.1 Workers holding the required qualifications must perform work involving the removal of asbestos-containing insulation. In situations where asbestos-containing insulation is discovered on catalogues or non-catalogues piping, the Contractor or the related section must refer to the general clauses of the contract and immediately inform the Project Manager and/or the Owner's representative.

1.37 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.

1.38 CLEANLINESS OF THE SYSTEMS

.1 Take every necessary measure and precaution to keep the inside of all of the ventilation systems' components and ducts clean. Otherwise, duct cleaning and sample analysis may be required at the Contractor's expense to ensure that the dust level does not exceed 0.75 mg/100 cm² in order to comply with the NADCA-ACR standards.

.2 Duct cleanliness:

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

1.39 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 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.

1.40 SECURITY SCREENING

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

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

1.41 BREAKDOWN OF COSTS

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

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

.1 Mobilization.

.2 Insurance and surety bonds.

.3 Erection drawings.

.4 Hydraulic calculations for fire protection.

.5 One line per activity per sector, floor or phase.
.6 Tests and trials.
.7 Preliminary balancing reports (aeraulics and hydraulics).
.8 Final balancing report.
.9 Seismic measurement compliance report.
.10 Demobilization.
.11 Operation and maintenance manual.

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: _____

RESPONSIBILITY WAIVER – REVIT MODEL IN .IFC FORMAT

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 Revit model in .ifc format 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, in the event that the Revit model in .ifc format in question contains certain inaccuracies or errors.
- That Bouthillette Parizeau cannot be held responsible for any errors that results from the use of the model 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 Revit model, as if we had created it ourselves.

Signature: _____

Name (in print): _____

Address: _____

Telephone: _____

Email: _____

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 The use of multiple brands or manufacturers for the same device is prohibited.

1.2 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

.2 Section 21 13 13 – Wet pipe sprinkler systems.

.3 Section 23 05 05 – Installation of pipework.

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

.5 Section 23 05 48 – Vibrations and seismic controls for HVAC piping and equipment.

.6 Section 23 05 53.01 – Mechanical identification.

1.3 REFERENCES

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

.1 ANSI/AWWA C110/A21.10 12 – Ductile Iron and Gray Iron Fittings.

.2 ANSI/AWWA C151/A21.51 09 – Ductile Iron Pipe, Centrifugally Cast, for Water.

.2 American National Standards Institute (ANSI):

.1 ANSI/ASME B1.20.1-2013 – Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.3-2011 – Malleable Iron Threaded Fittings Classes 150 and 300.

.3 ANSI/ASME B16.9-2012 – Factory Made Wrought Buttwelding Fittings.

.4 ANSI/ASME 2013 – Boiler and Pressure Vessel Code – Section IX, Welding and Brazing Qualifications.

.3 American Society of Mechanical Engineers (ASME):

.1 ASME B31.1-2014 – Power Piping.

.4 American Society for Testing and Materials International (ASTM):

.1 ASTM-A53/A53M-2012 – Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

.2 ASTM-A106/A106M-2015 – Standard Specification for Seamless Carbon Pie for High Temperature Service.

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

.4 ASTM-A135/A135M-09 (2014) – Standard Specification for Electric Resistance Welded Steel Pipe.

.5 ASTM-A197/A197M-00 (2015) – Standard Specification for Cupola Malleable Iron.

.6 ASTM-A234/A234M-2015 – Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

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

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

.9 ASTM-A795/A795M 13 – Standard Specification for Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

.10 ASTM-D3139-98(2011) – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

.5 Canadian Standards Association (CSA):

.1 CSA B131.9-1978 – Gray Iron and Ductile Iron Fittings, 2 Inches Through 48 Inches for Water and Other Liquids.

.2 CSA B137 Series 13 – Thermoplastic Pressure Piping Compendium (Consists of B137.0, B137.1, B137.2, B137.3, B137.3.1, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).

.6 National Fire Protection Association (NFPA):

.1 NFPA-13 – Standard for the Installation of Sprinkler Systems, 2013 Edition.

.2 NFPA-25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems. 2014 Edition.

1.4 SCOPE OF WORK

.1 Work includes:

.1 The work generally includes labour, delivery and installation of all materials and equipment necessary for the work of fire protection shown in the drawings and specifications.

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

.1 Dismantling of certain sprinklers with associated piping in the work area as indicated on the plans. However, if any fire protection equipment is not shown on the plans and may interfere with the redevelopment work, this section shall proceed with the removal of such equipment and reinstallation after the work.

.2 Supply and install new sprinklers as indicated on the drawings.

.3 Alteration or relocation of existing fire piping or sprinklers for installation of new ventilation ducts or structural and architectural work.

.4 Testing of the fire protection systems and test reports.

.5 Dismantle as indicated on the plans.

.6 Payment of all fees, permits, inspection fees and other charges.

.7 Structural steel supports and members required to support piping and equipment.

.8 All special connections as specified and/or shown on the drawings.

.9 All items required to make the installation seismically safe.

.10 Erection drawings.

.11 Installation drawings.

.12 Hydraulic calculations.

.2 Work excludes:

.1 In general, the following work is excluded:

.1 The temporary fire protection system during construction.

.2 The detection system and fire monitoring system.

.3 Electrical conduit, wiring and connections for alarm switches and valve supervisors, starters, etc.

.4 Electrical conduit, wiring and connections for alarm switches and supervisors for valves, starters, etc.

1.5 STANDARDS

.1 Work in accordance with the following standards and regulations:

.1 National Building Code modified Quebec (2010).

.2 Federal, provincial, and municipal building and fire regulations.

.3 National Fire Protection Association Standards, latest edition: NFPA 13 and NFPA 25.

1.6 AUTHORITIES HAVING JURISDICTION

.1 The authorities having jurisdiction are:

.1 Fire department of the city or municipality.

.2 City or municipal licensing department.

.3 Régie du Bâtiment du Québec.

.4 Departmental Fire Protection Coordinator of Canada.

1.7 APPROVAL

.1 The company in charge of the work of this section must be recognized/specialized for performing this kind of work.

.2 All materials must be UL/ULC listed and FM and meet the latest published requirements.

.3 Inspect the facility before the plaster and ceilings are completed so that the inspection is easy and thorough.

.4 During final inspection by the Consultant and expensing of this section, make any necessary changes to obtain final acceptance.

.5 The Consultant shall verify and inspect the erection/installation drawings, complete installation, equipment, and materials and monitor all testing.

.6 The Consultant shall verify and inspect the erection/installation drawings, the complete installation, the equipment, and materials, and monitor all testing.

1.8 INSTALLATION DRAWINGS

.1 Refer to "WORKSHOP DRAWINGS" and "ERECTION DRAWINGS" in Section 20 00 10 - Mechanical and electrical general instructions.

.2 Prepare all installation drawings, details and hydraulic calculations required to obtain approvals, prior to commencement of work.

.3 Erection drawings and hydraulic calculations shall be signed and sealed by a Fire Engineer.

.4 Drawings shall clearly indicate:

.1 The name of the department or agency.

.2 Location, including address.

.3 Orientation.

.4 Ceiling construction details.

.5 Full height cross sections.

.6 Location of fire walls.

.7 Type of occupancy for each area or room.

.8 Location and dimensions of dead ends and closets.

.9 Any confined rooms or spaces not equipped with automatic sprinklers.

.10 Size of water service main under the roadway, pressure, if dead end or through pipe, distance to nearest through pipe and direction. Provide test results for the water service line.

.11 Other water supply sources, giving pressure or elevation.

.12 Make, model and orifice size of automatic sprinklers.

.13 The rated operating temperature and location of high operating temperature automatic sprinklers.

.14 For each floor, the number of automatic sprinklers per riser per area and the total area of each protected area.

.15 Number of automatic sprinklers per riser and total per floor.

.16 Make, type, model and diameter of alarm valve and accessories.

.17 Length of pipe sections to be cut or centerline dimensions.

.18 Crossings, riser connections and their dimensions.

.19 Type of brackets, sockets, and sleeves.

.20 All control valves, flaps, and test hoses.

.21 Small garden hose and associated hardware.

.22 Where drawings include underground piping, give class of pipe, diameter, type of valves, meters, valve pits and depth of burial from top of pipe.

.23 Provisions for draining the system.

.24 Where the equipment to be installed would be an addition to an existing sprinkler system, without additional supply from the external system, a sufficient portion of the old system shall be shown on the drawings to indicate the total number of sprinklers to be provided and all installation requirements.

.25 Installer's name and address.

1.9 DOCUMENTS/SAMPLES TO BE SUBMITTED FOR APPROVAL/INFORMATION

.1 Provide the following documents:

.1 A list of identification legends for piping and fittings. Refer to Section 23 05 53.01 - Identification of systems and mechanical devices.

.2 Certificates of materials and tests performed by the Contractor.

.3 Certificates of approval from appropriate authorities.

.4 Certificates of approval of erection drawings from the authorities concerned prior to commencement of work.

.5 Inspection certificates from the competent authorities.

.6 Installation drawings authenticated by a Professional Engineer.

.7 Certificate of Compliance of the Work authenticated by the Fire Protection Contractor's Engineer for fire protection work performed in accordance with the Contractor's installation drawings and specifications.

.8 Warranty certificates, see "WARRANTY" in Section 20 00 10 - Mechanical and electrical general instructions.

.9 Instruction manuals for operation and maintenance of equipment. See "EQUIPMENT OPERATING AND MAINTENANCE INSTRUCTION MANUALS" in Section 20 00 10 - General Mechanical and Electrical Instructions.

.10 Drawings maintained, see "DRAWINGS MAINTAINED" section of 20 00 10 - Mechanical and electrical general instructions.

1.10 OVERALL PACKAGE PRICE - SEPARATE PRICE

.1 Sprinklers and equipment are shown on the drawings, coordinated with architectural, structural, and other disciplines. They are for reference purposes only, to assist the Contractor in understanding the scope of the work. In no case shall the Contractor base his bid on the quantity of sprinklers and equipment shown on the drawings. The Contractor shall coordinate the final location of sprinklers and equipment with the Architect.

.2 Provide with the submission, an overall fixed price covering all the work of the "FIRE PROTECTION" section. In addition to the lump sum covering the work indicated in the quote and in the drawings, provide a list of unit prices requested in the tender form.

Part 2 Product

2.1 GENERAL – PIPING

.1 Design the system to NFPA standards, complete with all accessories, excess pressure pumps, alarms and monitoring and fittings of approved type.

.2 Pipes and fittings of an approved type, conforming to the FM or ULC NFPA identified and designed to withstand an operating pressure of 1210 kPa.

.3 Each type of piping, elbows, reducers elbows, adapters, couplings, and unions, must be of the same brand.

2.2 PIPING ABOVE GROUND AND UNDER 1210 KPA

.1 Conforms to NFPA.

.2 Steel pipe:

.1 NPS 2 and under:

.1 Piping with threaded joints:

.1 Piping in black steel or galvanized steel, series 40, ASTM-A53, ASTM-A135 and ASTM-A795.

.2 Cast iron fittings ASTM-A126, 860 kPa, approved by UL, threaded, hydrostatic pressure of 1210 kPa operating at 66°C.

.2 Piping with rolled mechanical joints:

.1 Piping in black steel, series 10, ASTM-A53, ASTM-A135 and ASTM-A795.

.2 Cast iron fittings ASTM A126, 860 kPa, approved by UL, threaded, hydrostatic pressure of 1210 kPa operating at 66°C.

.3 Piping with grooved mechanical joints:

.1 Piping in black steel, series 40, ASTM-A53, ASTM-A135 and ASTM-A795.

.2 Cast iron fittings ASTM-A536, 860 kPa, approved by UL, threaded, hydrostatic pressure of 1210 kPa operating at 66°C.

.2 NPS 2½ to NPS 8:

.1 Flanged and rolled mechanical joint piping:

.1 Black or galvanized steel piping, series 10, ASTM-A53, ASTM A135 and ASTM A795.

.2 Cast iron fittings, ASTM-A536, 860 kPa, UL approved, 1210 kPa hydrostatic operating pressure at 66°C and below, Anvil.

.3 Companion flange adapter, cast iron ASTM A126, 860 kPa, standard, UL approved, hydrostatic operating pressure 1210 kPa at 66°C, Anvil fig. 1016.

.4 Square or hex head flange bolts and heavy nut, ASTM A307 76b.

.5 Rubber flange gaskets, 3.2 mm, Albion 300.

.2 Grooved joint piping:

.1 Black steel piping, series 40, ASTM-A53, ASTM-A135 and ASTM-A795.

.2 Cast iron fittings ASTM-A536, 125 psi (860 kPa), UL approved, operating hydrostatic pressure of 175 psi at 150F (1210 kPa at 66°C) and below.

.3 Mechanical Joint Piping:

.1 General:

.1 Mechanically jointed piping, free of marks, spatter, or cavities over the entire surface in contact with the sealant. Cut straight and prepare pipe ends to manufacturer's standards.

.2 Groove:

.1 Groove shall be square or roll-formed and shall be of dimensions indicated in the manufacturer's catalog tables.

.3 Trim:

.1 Elastomeric resilient, center cavity gasket that conforms to the contour of the cavity and forms a pressurized sealing point around the pipe when the crown is tightened.

.4 Connections:

.1 Fittings formed of ductile iron ring segments enclosing the liner and fitting into the grooves of the pipes.

.2 Use fittings with or without set, so as to allow for expansion and angular adjustment, as required by the installation.

.3 Accepted materials:

.1 For steel: such as Victaulic nos. 005, 07, 72, 77, 920N, 922 and 009H or approved equivalent,

.4 Prohibited materials:

.1 Mechanical T joints must be made using two collars in ductile iron. Assembly using cast iron collars and U-bolts, such as Victaulic nos. 921 and 925 or other similar styles, are not acceptable.

.5 Bolting:

.1 Use thermally treated bolts, oval collar and pulling head, adapting to the same hole shape and for clamping one side.

2.3 MANIFOLDS

.1 Unless otherwise indicated in the drawings, construct manifolds from black steel pipes having a diameter the size of the largest pipe connected to it and seal the ends using mechanical joints (Victaulic nos. 75 or 77 and 60 cap).

.2 Provide all connections indicated in the drawings for piping, appliances for measuring wells, drains and outlets for testing.

.3 Sufficient length for installation of unobscured connections.

2.4 DIELECTRIC SEALS

.1 Making connections between two pipes of different metals such as copper and steel, by means of dielectric unions or flanges with gaskets between the flanges and insulating sleeves to the bolts, in order to avoid contact between the two metals, UL approved connections, union and Epco flange.

2.5 SEISMIC CONTROLS

.1 Seismic controls must be made according to standards and enforced regulations. Refer to section 23 05 48 – Vibrations and seismic controls for HVAC piping and equipment

2.6 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 20 00 10.

.2 List of manufacturers, section 21 05 05:

- .1 Piping:
  - .1 Allied Tube
  - .2 American Tube and Piping
  - .3 Bull Moose Tube
  - .4 Grinnell
  - .5 Nova Tube
  - .6 Steel of Canada
  - .7 Stelco
- .2 Mechanical Joints:
  - .1 Anvil
  - .2 Victaulics
  - .3 Tyco
- .3 Threaded connections:
  - .1 Anvil
  - .2 Central
  - .3 Ward
- .4 Dielectric seals:
  - .1 Epco
  - .2 Victaulic

Part 3 Execution

3.1 GENERAL

.1 Piping placement, location of equipment and special devices, etc., mentioned in the specifications or in drawings indicating the general layout of equipment.

.2 Perform installation according to the standards and learn about the architectural layout of the building.

.3 Install upright piping in a straight line according to the required gradients.

.4 No pipe should come in contact with the concrete or the ground.

.5 Install all hoses in such a way to avoid tensile stress or compression.

.6 Do not bend the pipe in any way.

.7 The identification of the pipe markings must always be legible for easy inspection.

3.2 ABOVE GROUND PIPING

.1 See the article "LOCATION OF PIPING AND CONDUIT" in section 20 00 10 – Mechanical and electrical general instructions.

3.3 SLOPES

.1 Install the system in such a way that it empties completely. Install drain taps at the low points.

3.4 CLEANING OUTLETS

.1 Install cleaning outlets where required by NFPA.

3.5 SUPPORTS

.1 Conform to the NFPA.

.2 Secure all pipes using brackets and anchors approved by NFPA.

.3 Adjustable supports with steel rod securely fastened to the structure.

.4 Piping up to NPS 4, the threaded rods will be 9 mm. For piping NPS 5 to NPS 8, the rods will be 13 mm. For piping NPS 10 and NPS 12 in diameter, the rods will be 15.6 mm.

3.6 ANCHORS

.1 Adequately anchor in such a way to avoid any stress to joints and/or warping. Using anchors made of welded structural steel firmly secured to the structure by means of anchoring bolts, size and capacity proportional to the weight.

.2 Attach anchors to the main beams and slabs cast, but not to pre-stressed or precast slabs.

.3 The structure should not be damaged by the anchors. Submit anchor positions for approval to the structural Engineer with proper coordination drawings.

3.7 TESTING

.1 See articles "TEST" and "FINAL TEST" of section 20 00 10 - Mechanical and electrical general instructions.

.2 Maintain leak-free status for at least two hours in all piping, with hydrostatic pressure of 1400 or 350 kPa over the normal operating pressure.

.3 Provide a certificate stating the results of the tests for each system.

.4 The Contractor will provide the hydraulic pump, connections, and temporary labor needed for these tests.

.5 Set all devices so that they function properly.

3.8 PAINT

.1 Apply a metal mordant layer on all exposed pipes.

.2 Ensure that no sprinkler head is painted. Protect the heads with plastic bags or polythene securely held in place by a string or wire prior to painting.

.3 Once the painting is completed, remove the temporary protection from the heads. All painted or damaged heads will be replaced and expensed.

END OF SECTION

TABLE OF CONTENTS

Partie 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

.2 Section 21 05 05 – Common work results for fire suppression.

1.2 REFERENCES

.1 National Fire Prevention Association (NFPA):

.1 NFPA-13 – Standard for the Installation of Sprinkler Systems – 2013 Edition.

.2 NFPA-25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems – 2014 Edition.

1.3 DESIGN REQUIREMENTS

.1 Design the sprinkler water systems in accordance with the requirements and recommendations of NFPA-13, with respect to the hydraulic calculations, for a uniform distribution of water throughout the protected area. See section 21 05 05 – Common work results for fire suppression, design criteria.

.2 Implemented systems must be complete and ready for use, and they must include all the materials, elements and interior and exterior accessories necessary for this purpose.

.3 Design each system taking into account all design features and all structures and elements such as hidden spaces, piping, electrical equipment and air ducts, indicated in detail on shop drawings.

.4 Determine the location of sprinkler heads according to the panels/ceiling tiles, lighting fixtures and air diffusers.

.5 Materials and fire protection equipment must be approved by the ULC for use in an automatic water sprinkler system.

.6 Design the system with seismic protection in the case of buildings in earthquake zones (3) and (4), and protection for essential services or to very high risk in the case of buildings located in the seismic zone (2).

.7 Location of sprinkler heads:

.1 Determine the location of the sprinklers according to the characteristics of the ceiling, the spacing between the heads must not exceed that specified in NFPA-13.

.2 Ensure uniform spacing of sprinklers along the bypass lines.

.8 Water distribution:

.1 Ensure that water distribution is uniform throughout the area or throughout the area protected by the requested extinguisher heads.

.2 The flow of the most hydraulically disadvantaged heads must match 100% of the prescribed spray density.

.9 Surface application:

.1 Most hydraulically disadvantaged area, determined in accordance with NFPA-13.

.10 Flow intended for outdoor nozzles:

.1 Provide the feed rate of external nozzles in the hydraulic calculations.

1.4 SUBMITTALS

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

.2 Product data:

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

.3 Certificates:

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

1.5 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

1.6 DELIVERY, STORAGE AND HANDLING

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

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

Partie 2 Product

2.1 PIPING AND VALVE CONNECTIONS

.1 In accordance with NFPA-13.

.2 See section 21 05 05 – Common work results for fire suppression.

2.2 SPRINKLERS

.1 Approved type, misting with fuse, to varying degrees as required.

.2 With appropriate melting points at places where hot air is circulated through the ventilation grilles, heaters or other appliances that produce heat.

.3 Sprinklers shall be as specified or an approved equivalent.

.4 The location of heads in the same room should be symmetrical to 6 mm.

.5 Sprinklers of the following type:

.1 Ordinary straight: Viking: Microfast, with glass fuse, bronze finish.

.2 Semi-recessed pendent: Viking: Microfast #E-1, with glass fuse, chrome finish and ring, chrome finish, for flush ceiling mounting.

.3 Invisible pendent: Viking: Mirage no. VK-462, completely recessed in the suspended ceiling and concealed by a 70 mm diameter disc mounted at ceiling level. The disc will be the color chosen by the architect.

.4 Institutional heads: Viking #VK-410, chrome finish with ring for flush ceiling mounting.

2.3 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 20 00 10.

.2 List of manufacturers, section 21 13 13:

.1 Sprinkler heads:

.1 Central
.2 Globe
.3 Grinnell
.4 Reliable
.5 Victaulic
.6 Viking

Partie 3 Execution

3.1 MANUFACTURERS INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install automatic sprinkler systems, check and submit them to an acceptance test in accordance with NFPA-13 and NFPA-25.

3.3 PIPING INSTALLATION

.1 Install level and square the piping so that it rests evenly on its supports and suspensions. Do not attach the suspensions to plaster ceilings.

.2 Make sure the interior and the ends of the new pipe as well as the existing pipe are free from water debris.

.3 During the installation and at the end of each work period, seal the open ends of the pipe with caps or other approved methods to prevent the entry of foreign matter.

.4 Inspect the pipes before setting them into place.

3.4 ON SITE QUALITY CONTROL

.1 Testing/Site Inspections:

.1 Perform the required tests to verify compliance with the prescribed requirements.

.2 Perform the required tests and inspections and approve the piping prior to concealing it.

.3 Preliminary tests:

.1 Conduct hydrostatic testing for each system at a pressure of 200 lb/in² for a period of two (2) hours, there must be no leakage or pressure drop during this test.

.2 Flush drinking water pipes in accordance with NFPA-13.

.3 Perform required tests and inspections and approve the piping installed in empty ceiling spaces before setting the ceilings.

.4 Test the alarms and other related devices.

.5 Once testing is complete and corrections have been made, submit the certificate of inspection, signed and dated in accordance with NFPA-13.

.4 Final tests and inspections:

.1 Do not request to have tests and final inspections performed before the preliminary tests are completed and any corrections made.

.2 Application for final inspection must be made at least fifteen (15) days before the desired inspection date.

.3 Repeat required testing as directed.

.4 Correct any anomalies and conduct additional tests until the systems comply with contractual requirements.

.5 Provide the hydraulic pump, temporary connections, and labor necessary for carrying out the tests.

.6 Provide a certificate indicating the test results for each system.

END OF THE SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

1.2 SUBMITTALS

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

.2 Product data:

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

1.3 CLOSEOUT SUBMITTALS

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

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

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

.2 Operational documentation must include the following:

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

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

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

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

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

.6 Table of flow devices and a flow diagram.

.7 A colour code legend.

.8 TAB (test, adjustment and balancing) reports as required by section 23 05 93 – Testing, adjustment and balancing of HVAC systems.

.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 20 00 10 – Mechanical and electrical general instructions.

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

1.5 SPECIFIC CONDITIONS – HEATING WATER

.1 The specific requirements of the mechanical and electrical works, Division 20, apply to this section.

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

.1 20 00 10 – Mechanical and electrical general instructions.

.2 23 05 00 – Common work results for HVAC.

.3 23 05 05 – Installation of pipework.

.4 23 05 13 – Common motor requirements for HVAC equipment.

.5 23 05 17 – Pipe welding.

.6 23 05 29 – Hangers and supports for HVAC piping and equipment.

.7 23 05 48 –Vibration and seismic measures for HVAC.

.8 23 05 53.01 – Mechanical identification

.9 23 05 93 – Testing, adjusting and balancing for HVAC.

.10 23 07 15 – Thermal insulation for piping

.11 23 21 13 – Hydronic systems.

.3 Heating water– Scope of the work:

.1 Included work:

.1 The Work generally includes the labour, supply and installation of all materials and equipment required for the ventilation and heating work as indicated on the drawings and specifications.

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

.1 Replacement of pneumatic actuators, including minor adjustments to piping and lagging to accommodate electronic actuators. Use same type of piping and lagging as existing for repairs or adjustments to existing piping.

.2 Electronic actuators are provided by Division 25 and installed by this Division.

.3 Keep duct water heating coils. Install necessary fittings to allow proper operation of electronic valves from water heating coils to new electronic terminal boxes. See drawing for more information.

.4 Complete identification of all devices and accessories in accordance with section 23 05 53.01 – Identification of Systems and Mechanical Devices and the Drawings.

.5 All seismic measures for heating - chilled water work in accordance with section 23 05 48 – Anti-vibration and seismic systems and devices for HVAC Piping and Equipment.

.6 All balancing and flow adjustment work. Ensure flow measurements are taken prior to commencement of work as required in section 23 05 93.

.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 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.

.2 Controls:

.1 The installation and connections to the piping of hot water for heating, 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 Provide the directives and the supervision required for the installation.

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

.3 Ventilation:

.1 All hot water heating coil connections to the hot water.

.4 Documents to provide:

.1 Provide the following documents:

.1 The manufacturers' warranty certificates.

.2 The pressure vessel certificates.

.3 The certificates of approval from the concerned authorities.

.4 The instruction manuals for the operation and the maintenance of the equipment, in accordance with Division 20.

.5 The drawings kept up to date, in accordance with Division 20.

.6 Coordination drawings, in accordance with Division 20.

.7 A list of legends with piping identification, in accordance with Division 20.

.8 List of the flow meters' flows.

.5 Tender – Price to be provided:

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

1.6 SPECIFIC CONDITIONS – VENTILATION

.1 The specific requirements of the mechanical and electrical works, Division 20, apply to this section.

.2 The following sections are included in the scope of the 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 53.01 – Mechanical identification.

.6 23 05 93 – Testing, adjusting and balancing for HVAC.

.7 23 07 13 – Duct insulation.

.8 23 31 13.01 – Metal Ducts – Low pressure to 500 Pa.

.9 23 33 00 – Air duct accessories.

.10 23 33 15 – Dampers – Operating.

.11 23 33 46 – Flexible ducts.

.12 23 36 00 – Air terminal units.

.13 23 37 13 – Diffusers, registers and grilles.

.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 Replace pneumatic double-sheathed terminal boxes with new electronic double-sheathed terminal units, including all required conduit and accessories.

.2 The addition of new double sheathed terminal boxes.

.3 Replacement, addition or/and removal of diffuser and/or return grilles.

.4 Replacement of terminal unit boxes with pneumatic parallel flow fans with new electronic parallel flow terminal units including new ductwork, filter and required accessories. Electrical connection shall be made by Divisions 25 and 26.

.5 Connect new ventilation ducts to existing water heating coil casing.

.6 Balance of affected ventilation systems such as the following associated with the area of work. Contractor is required to validate the accuracy of the affected systems.

.1 M1-002

.2 M1-011

.3 M1-005

.7 All special connections and ducts.

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

.9 All access doors.

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

.11 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.

.12 All concrete work. See Division 20.

.13 Sealing sleeves and openings.

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

.15 The coordination of coordination drawings from sections from Divisions 21, 23, 25, and 26, in accordance with the requirements of the section 20 00 10 – Mechanical and electrical general instructions, as well as the coordination of acoustic and vibration work.

.16 Identification of the systems' ventilation ducts, the devices, and the other accessories, in accordance with section 23 05 53.01 – Identification for HVAC piping and equipment.

.17 All tests.

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

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

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

.21 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 Special connections and related work:

.1 See Division 20.

.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 drainpipes.

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

.5 Documents to provide:

.1 Provide the following documents:

.1 The certificates of approval from the concerned authorities.

.2 Shop drawings, device drawings, and 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.

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

.6 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

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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):

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

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

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

.3 Green Seal Environmental Standards (GSES):

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

.4 National Fire Code of Canada (NFC 2015)

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

.1 SCAQMD Rule 1113-A2007 – Architectural Coatings.

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

1.3 SUBMITTALS

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

.2 Product data:

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

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 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, chilled water coils, hot water coils, 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 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 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.

3.5 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.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

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

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

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

1.3 SUBMITTALS

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

.2 Product data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment in accordance with section 20 00 10 – Mechanical and electrical general instructions. Data sheets must include product characteristics, performance criteria, dimensions, limits and finish.

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

.3 Documents to submit at the end of work:

.1 Submit the maintenance documents of the motors, transmissions and guards, and attach them to the manual described in section 20 00 10 – Mechanical and electrical general instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging, shipping, handling and receiving:

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

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

Part 2 Product

2.1 GENERAL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.6 BELT DRIVE GUARDS

.1 Provide guards for the unprotected transmissions.

.2 Belt drive guards:

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

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

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

.4 Removable for maintenance.

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

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

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

.2 Securely fastened in place.

.3 Removable for maintenance.

.5 Guards for unprotected fan air inlets and outlets:

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

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

.3 Securely fastened in place.

.4 Removable for maintenance.

2.7 MANUFACTURER LIST

.1 Must comply with the article "PRODUCTS USED FOR SUBMISSIONS AND EQUIVALENCES" from section 20 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 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

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

- .1 ANSI B16.12-2009(R2014), Cast Iron Threaded Drainage Fittings
- .2 ANSI/ASME B31.1-2014 – Power Piping.
- .3 ANSI/ASME B31.3-2014 – Process Piping.
- .4 ANSI/ASME, Boiler and Pressure Vessel Code 2007:
  - .1 BPVC 2015 – Section I – Power Boilers.
  - .2 BPVC 2015 – Section V – Non-Destructive Examination.
  - .3 BPVC 2015 – Section IX – Welding and Brazing Qualifications.

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

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

.3 American Welding Society (AWS):

- .1 AWS C1.1M/C1.1-2000(R2012) – Recommended Practices for Resistance Welding.
- .2 AWS Z49.1-2012 – Safety in Welding, Cutting and Allied Process.
- .3 AWS W1-2015 – Welding Inspection Handbook.

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

- .1 CSA W47.2-2011 – Certification of companies for fusion welding of aluminum.
- .2 CSA W48-14 – Filler metals and allied materials for metal arc welding.
- .3 CSA B51-14 - Boiler, pressure vessel, and pressure piping code.
- .4 CSA-W117.2-12 – Safety in welding, cutting, and allied processes.
- .5 CSA W178.1-14 – Certification of welding inspection organizations.
- .6 CSA W178.2-14 – Certification of welding inspectors.

1.3 SUBMITTALS

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

.2 Deliver materials to the job site in their original packaging, which shall be labelled with the name and address of the manufacturer.

Part 2 Product

2.1 GENERAL

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

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

2.2 THREAD

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

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

2.3 ELECTRODES

.1 Comply with relevant CSA W48 series standards.

2.4 WELDING – GENERAL

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

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

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

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

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

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

.7 Welding – Copper piping:

.1 "Unleaded solder" means brazing with an alloy composed of antimony, copper, silver and tin (Aquasol).

.2 "95-5 solder" means brazing with 95% tin and 5% antimony.

.3 According to the descriptions of the piping and valves, weld copper piping with unleaded solder, 95-5, or silver solder.

.4 DWV type: 95-5 solder.

.5 K, L, and M types:

.1 NPS 2 and smaller: unleaded solder.

.2 NPS 2½ and larger: silver solder.

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

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

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

.8 Welding – Steel pipe:

.1 Arc welding.

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

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

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

.5 Present the welders' certificates of qualification.

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

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

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 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B31.1-07 – Power Piping.

.2 ASTM International:

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

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

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

.3 Factory Mutual (FM).

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

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

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

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

.5 Underwriters' Laboratories of Canada (ULC).

1.3 SUBMITTALS

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

.2 Product data:

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

.3 Shop drawings:

.1 Submit shop drawings for the following elements:

.1 Supports, bases and suspensions.

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

.3 Structural assemblies.

.4 Certificates:

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

.5 Manufacturer instructions:

.1 Submit installation instructions provided by manufacturer.

.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 20 00 10 – Mechanical and electrical general instructions.

1.5 DELIVERY, STORAGE AND HANDLING

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

.2 Shipping and receiving:

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

Part 2 Product

2.1 SYSTEM DESCRIPTION

.1 Design requirements:

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

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

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

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

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

2.2 GENERAL

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

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

.3 The supports must be adjustable in length.

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

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

.6 Finish:

.1 The supports and the hangers must be galvanized.

.2 For copper or brass piping, isolate the support with a strip of neoprene or plastic placed between the support and the pipe. Alternatively, tin the portion of the pipe in contact with the support.

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

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

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

2.4 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.

2.5 ANCHOR BOLTS AND TEMPLATE

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

2.6 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

.3 Supports for vertical piping in high-rise buildings:

.1 Kinetics Noise Control

.2 Mason Industries Inc.

.3 Vibro-Acoustics

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.

END OF SECTION

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3.4 SEISMIC CABLE

3.5 CLEARANCES

Part 1 General

1.1 RELATED SECTIONS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

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

.1 Material Safety Data Sheet (MSDS).

.2 National Fire Protection Association (NFPA):

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

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

1.3 SUBMITTALS

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

.2 Submit shop drawings required in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging, shipping, handling and receiving:

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

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

1.5 SCOPE OF THE WORK

.1 Work included:

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

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

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

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

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

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

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

.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 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: Montréal: $S_a(0.2) = 0.64$.

.3 The site acceleration factor F_a to be considered in the calculations comes from the data sent by the structural Engineer which is related to the soil profile (zone category). In the context of this project, the zone category is E.

.4 Seismic importance factor I_E:

.1 Mechanical piping, ventilation ducts, and electrical conduits anchored directly (rigid fixation) to the framework: Civil protection: $I_E = 1.5$.

.5 For Montreal:

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

.1 Submit a complete dynamic analysis of the systems and the equipment referred to above, provide details concerning the maximum planned forces that will be applied to the equipment, and make recommendations for modifications or additional supports aiming to maintain the equipment in good working condition.

1.8 CALCULATIONS

.1 The consultant specializing in seismic restraint systems must obtain from the relevant mechanical or electrical section all information relating to devices, pipes, ventilation ducts, and electrical conduits required for the seismic restraint calculations (weight, type of fluid number, thermal insulation, run, spacing between supports, groups on trapeze supports).

.2 The consultant specializing in seismic restraint systems must obtain from the manufacturers of each device and equipment of the concerned discipline, the characteristics required in article "SHOP DRAWINGS AND DEVICES" in section 20 00 10 – Mechanical and electrical general instructions (weight, location of the center of gravity, number of attachment points, location of the center of gravity of the mounting points, rotational speed, seismic fragility of the internal components, etc.).

.3 The calculation parameters, the calculations, and the installation details for the anchor bolts and the seismic restraint systems should be checked by an Engineer specializing in seismic control design.

.4 For vertical loads or equipment overturning risks, use the equations detailed in the standard FEMA 450-1.

.5 Provide for information: the seismic Engineer's design report, the parameters or the values used in compliance with the Building Code of Québec, the bases of calculations, the data of the analyzed equipment or networks, the calculations for seismic bracing, the overturning calculations, the overturning moments, the anchor calculations, the recommended restraint systems, and the installation details, and this for each installed network and equipment. Provide the plans locating the restraints and the drawings for each device along with product specifications.

.6 In the event that the weight of a tank/equipment and its contents have a mass greater than 10% of the floor's mass, the seismic forces will need to be subject of a rational analysis.

.7 Confirm with calculations that if rigid braces are installed, no undue force will be applied to the supports.

.8 Also, see the article "SEISMIC STANDARDS".

1.9 DOCUMENTS TO PROVIDE

.1 Provide the shop drawings of the seismic restraint systems, the calculations, and the calculation coefficients.

.1 The calculation coefficients represent the categories for location, risk, seismic zone, building height, height of installation, and all required parameters listed in the Quebec Construction Code.

.2 For each electromechanical device, provide:

.1 The identification.

.2 The manufacturer's name and the model.

.3 The physical dimensions.

.4 The weight.

.5 The location of the center of gravity (indicate whether the location was obtained from the manufacturer of the device or supposed).

.6 The location and the number of attachment points.

.7 The location of the attachment points' centers of gravity (when the center of gravity is different from the unit's center of gravity).

.8 The seismic fragility of the internal components of the device.

.9 The horizontal and vertical force considered in the calculations.

.10 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 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 protection systems must be able to oppose the forces in all directions.

.8 The fasteners and the fixation joints must be capable of withstanding the same maximum loads as the seismic protection devices.

.9 For the longitudinal braces, the pipe fastener must necessarily be directly on the pipe (under the thermal insulation).

.10 The seismic braces must be located near the supports (maximum distance of 100 mm (4")) for piping, ventilation duct, or electrical conduit systems.

.11 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.

.12 The seismic restraints installed on the pipe networks must be compatible with the requirements relating to anchors and pipe network guidance.

.13 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.

.14 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.

.15 The use of supports made of cast iron, threaded pipes, or any other brittle materials is prohibited.

.16 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.

.17 The seismic protection devices must not interfere with the fire protection devices nor compromise their integrity.

.18 The vertical supports, including vibration isolators, should in no way develop moments (righting (opposition) forces) during the normal operation of the networks or equipment.

.19 Stiffeners will need to be added to the hanger rods when required, to prevent buckling.

.20 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.

.21 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.

.22 Reread the article "PAINTING" in section 20 00 10 – Mechanical and electrical general instructions.

2.2 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.

2.3 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.

.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.

2.4 ELECTRICAL CONDUITS

.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 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.

.3 A rigid conduit must not be anchored to a structure or to a part of the building that responds differently to earthquakes.

2.5 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 The minimum number of anchors is four and they must be lined with neoprene.

.5 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.

2.6 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 20 00 10 – Mechanical and electrical general instructions.

.2 Manufacturer list, section 23 05 48:

- .1 Stiffeners on hanger rods:
  - .1 Mason Industries Inc. and Vibro-Acoustics (Distributions P.G.A.L. Inc.)
  - .2 Power-Strut (Mueller Flow Control)
  - .3 Unistrut (Routleco Inc.)
  - .4 Vibro-Racan, Vibration Mountings & Controls Inc. and Korfund Dynamics Co. Inc. (Racan Carrier).

.5 Vibron Ltd, Kinetics Noise Control (The Master Gtoup ltd).

.2 Mechanical piping and electrical conduit supports without vibration isolators:

.1 Mason Industries Inc. and Vibro-Acoustics (Distributions P.G.A.L. Inc.)

.2 Power-Strut (Mueller Flow Control)

.3 Unistrut (Routleco Inc.)

.4 Vibro-Racan, Vibration Mountings & Controls Inc. and Korfund Dynamics Co. Inc. (Racan Carrier).

.5 Vibron Ltd, Kinetics Noise Control (The Master Gtoup ltd).

.3 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 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.

3.3 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.

3.4 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).

3.5 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.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Canadian Gas Association (CGA):

.1 CSA/CGA B149.1-05 – Natural gas and propane installation code.

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.60-97 – Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92 – Identification of Piping Systems.

.3 National Fire Protection Association (NFPA):

.1 NFPA-13-2002 – Standard for the Installation of Sprinkler Systems.

.2 NFPA-14-2003 – Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

.1 Data sheets:

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

.2 Submit data sheets for the products specified in this section, including colour code.

.2 Samples:

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

.2 Submit samples of signage plates, identification plates and the proposed legend.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging, shipping, handling and receiving:

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

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

.2 Waste management and disposal:

.1 Construction/demolition waste management and disposal: separate waste materials for recycling in accordance with section 20 00 10 – Mechanical and electrical general instructions.

.2 Divert unused paints and coating products from landfill to recognized hazardous material facility.

Part 2 Product

2.1 IDENTIFICATION 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	Sprinklers and fire protection:	red
.5	Controls:	brown
.6	Electricity:	pink
.7	Communications:	orange

.3 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.

.4 Include the legend in the operations and maintenance manuals.

2.2 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.

2.3 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.

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

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

.7 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.

.8 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.

.9 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.

2.5 OPERATION AND MAINTENANCE MANUALS

.1 Each section should include in its operation and maintenance manuals:

.1 The identification legend for the accesses.

.2 The identification legend for the pipes, the ventilation ducts, the ventilation units, and fans must be separate.

.3 The identification legend for the valves.

.4 The identification legend for the devices.

.2 Each relevant mechanical section must provide the identification tables of all valves, including: the valve number, the service, liquid, gas, or steam, the sector, the floor, the diameter, the model, the make, and the number of the valve located upstream.

2.6 IDENTIFICATION CODIFICATION

.1 The codification of mechanical and electrical equipment used on drawings and specifications is intended to simplify the work while being compatible with the codes used by the centralization microprocessors. Therefore, use this coding for the identification of equipment: pipes, ducts, etc.

.2 Codification:

X	XX	XXX
Project subdivision:	Set or system:	Element:
Examples: 2 – Tower A 3 – Units AB 4 – Unit C 5 – Unit D 6 – Boiler room	Examples: 45 – Staircase pressurization A1 – Steam P1 –Domestic cold water	Examples: V31 – Supply air fan V60 – Humidifier

2.7 IDENTIFICATION ACCORDING TO THE EXISTING SYSTEM

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

.2 Where the existing identification system does not provide for the identification of newly installed structures, they shall be identified as required by this section.

.3 Before starting the work, obtain the Engineer's written approval of the identification system.

Part 3 Execution

3.1 PLACEMENT OF THE PIPING AND AIR DUCT IDENTIFICATION ELEMENTS

.1 At changes in direction.

.2 In each small room through which pipes or air ducts pass (at least one element).

.3 On each side of visual obstacles or where it is difficult to follow the path of the networks.

.4 On each side of separations, such as walls, floors, or partitions.

.5 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.

.6 Immediately upstream of the main automatic or manual control valves, otherwise, as close as possible, preferably upstream.

3.2 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 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 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.

.2 Hydronic systems:

.1 Systems flushed, filled and vented.

.2 Isolating and balancing valves are installed and open.

.3 Balancing valves are installed and calibrated to factory settings.

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 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.

.2 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 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.

.4 Hydraulic TAB Report:

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

.1 Measurement results:

.1 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).

.2 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 Measure the flows at the terminal elements, grilles and diffusers and branch, hot duct and cold duct, of the work areas identified on the plans before the dismantling of the existing terminal units and ducts. Submit the measurement report before starting the dismantling.

.2 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.

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

.4 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).

.5 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.

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

.7 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).

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

.9 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.

.10 Low Pressure duct :

.1 Subject ducts to a static test pressure of 500 Pa.

.2 Maximum Allowable Loss :

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

.2 For the system, the sum of the leaks shall not exceed 3% of the airflow of the fan(s).

.2 Leak tests:

.1 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.

.2 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% ±

.4 General procedure:

.1 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.

.2 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.

.5 Dual-duct systems:

.1 General:

.1 Most constant volume dual-duct systems are designed to supply a portion of the total airflow through the cold duct and a smaller portion through the hot duct.

.2 Adjustment procedure:

.1 Check, by measuring the temperature at the outputs of the terminal units, that the hot and cold side mechanisms of the terminal units are airtight.

.2 Ensure that the static pressure at the end of line is sufficient for the proper functioning of the terminal units and consider the air distribution downstream of the units.

.3 Adjust the supply terminal unit to the required airflow rate, adjust each diffuser for the required quantity of air.

.4 Take the measurements for the full heating and cooling demand.

.5 Make adjustments according to general procedures.

.6 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 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

.3 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.

.4 Additional information:

.1 Air distribution system:

.1 Pressure reading at main branches.

.2 List of Pitot tube tests with their results.

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

.7 Acceptable Contractors:

.1 Comply with article "MANUFACTURER LIST" from Section 20 00 10 - Mechanical and electrical general instructions.

.2 Accepted companies:

.1 Montreal region:

.1 Caltech

.2 Hydrauliques R&O Services Inc.

.3 Service de Mise au Point Leblanc Inc.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical 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.

.2 References:

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

.1 ANSI/ASHRAE 90.1-04-SI Edition – Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.:

.1 ASTM-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 20 00 10 – Mechanical and electrical 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.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

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 20 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.

.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.

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 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 Hot ducts and plenums (20 at 65°C):

.1 Rigid insulation:

.1 Preparation:

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

.2 Application:

.1 Cut insulation without integral vapor barrier to the right size and apply to exterior of duct and/or plenum with overlapping ends of horizontal and vertical surfaces and edges tightened together. Secure insulation to mechanical fasteners. Install retaining washers.

.2 Flexible insulation:

.1 Preparation:

.1 On the round and rectangular ducts 740 mm or less in width, no preparation is necessary. On rectangular ducts 762 mm or more in width, secure mechanical fasteners to the lower surface at approximately 450 mm centre to centre.

.2 Application:

.1 Cut insulation without integral vapor barrier of a size leaving 50 mm in overlap at each joint and apply it to exterior of duct. Attach the insulation with either string or wire at about 300 mm centre to centre or by stapling the overlaps.

.3 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 Outside air ducts and plenums (-40°C to ambient):

.1 As in "rigid insulation" above, but first applying a layer of rigid insulation without vapor barrier before applying the layer of rigid insulation with vapor barrier. All joints must be staggered.

.4 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.

.4 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 modified as part of the project work:

.1 Up to the grilles and diffusers (only if there is no acoustic insulation):

.1 Insulation: type C (type D when exposed)

.2 Thickness: 25 mm on hot ducts, 50 mm on cold ducts.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general instructions.

1.2 REFERENCES

.1 Definitions:

.1 For the purposes of this section, the following definitions apply:

.1 In this section, the term "insulation" and "thermal insulation" will be considered synonymous.

.2 The acronym "CGSB" stands for the Canadian General Standards Board.

.3 "Concealed" elements: insulated mechanical services and equipment located above suspended ceilings or in inaccessible chases, furred-in spaces, and the floor-ceiling assemblies

.4 "Exposed" elements: elements that are not concealed (as previously defined), located in mechanical rooms, tunnels, accessible service spaces, and outdoor spaces.

.5 Insulation system: systems consisting in particular of the insulation itself, the fasteners, jackets and other accessories.

.2 References:

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

.1 ASHRAE Standard 90.1-19 – 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.33, 1995.

.2 Canadian Environmental Protection Act (CEPA), ch. 33, 1999.

.3 Transportation of Dangerous Goods Act (TDGA), ch. 34, 1992.

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

.1 Material Safety Data Sheet (MSDS).

.6 Manufacturers' associations:

.1 Thermal Insulation Association of Canada (TIAC), National Insulation Standards (C2004).

.7 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102-10 – Method of test for surface burning characteristics of building materials and assemblies.

.2 CAN/ULC-S701-2017 – Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-2014 – Standard for Mineral Fibre Thermal Insulation for Buildings.

.4 CAN/ULC-S702.2-2015 – Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

1.3 SUBMITTALS

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

.2 Data sheets:

.1 Submit required data sheets, including the manufacturer's documentation for the piping insulation. Data sheets must include product characteristics, performance criteria, dimensions, limits, and finish:

.1 A description of the devices and materials, including the manufacturer name, type, model, year of fabrication, the strength, or the flow.

.2 Details relevant to the operation, usage, and maintenance of the devices and materials.

.3 A list of recommend spare parts.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Packing waste management: collect packing waste for reuse/recycling in accordance with section 20 00 10 – Mechanical and electrical General Instructions.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Submit the manufacturers' instructions for the installation of the insulating materials.

.2 The instructions must specify the methods to be used, as well as the required execution quality, particularly in regards to the joints and the overlaps.

1.6 QUALIFICATIONS OF THE WORKFORCE

.1 The installer must be an expert in the field, with at least three years of proven and successful experience in the installation of work in this size, type and scope of work, and possess the qualifications required by the TIAC.

1.7 SCOPE OF THE WORK

.1 The work generally includes, but is not limited to labor, supply and installation of all materials and equipment necessary for the insulation work shown on the drawings and in the specification for plumbing, heating, chilled water, and fire protection.

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

1.8 INCLUSIVE PRICE

.1 Provide an overall fixed price with the tender, covering all the work by section 23 07 13 and 23 07 15.

Part 2 Product

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102.

.1 Maximum flame spread rating: 25

.2 Maximum smoke developed rating: 50

2.2 TYPE A INSULATION

.1 Preformed wrap made of mineral fiber bonded with thermosetting resin, maximum service temperature of 454°C.

.2 Reinforced vapor barrier: factory applied all service jacket, paintable finish. Jacketing permeability: 0.02 perm. maximum.

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

.4 Products:

.1 Alley K from Manson Insulation.

.2 Earthwool 1000° from Knauf Insulation.

.3 Micro-Lok HP from Johns Manville.

2.3 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 Adhesives for joints, laps, and all-purpose jacketing:

.1 Products:

.1 230-06 from Bakor.

.2 CP-85 from Childers.

.4 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 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" from section 20 00 10 – Mechanical and electrical general instructions.

.2 List of manufacturers, section 23 07 15:

.1 Type A thermal insulation:

.1 Johns Manville

.2 Knauf Insulation

.3 Manson Insulation

.2 Adhesives:

.1 Bakor

.2 Childers

.3 Mulco

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 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.

3.3 PARTS TO BE INSULATED – PLUMBING

.1 Where specified as type A, thicknesses are given for type A.

.2 Pipe sizes are given in NPS (nominal pipe size).

3.4 PIPING INSULATION SCHEDULE – HEATING – CHILLED WATER

.1 Table of networks that require insulation:

Networks	Location	Pipe dimensions	Insulation types	Thickness	Jacketing (when installation is exposed)
Heating water (between 50 and 149°C)	For the installation of the new valves*	3/4*	A	50 mm	PVC

* See ventilation plans to determine location of existing actuators and valves to be demolished. Insulate the new section of piping that will be adapted according to the demolition to allow the installation of the new valves. Piping dimension to be validated on site by the contractor.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical 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 20 00 10 – Mechanical and electrical general instructions.

.2 Product data:

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

.3 Shop drawings:

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

.2 Identify the items referred to in the documentation provided by the manufacturer, namely: valves.

.4 Certificates:

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

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

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

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

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

Part 2 Product

2.1 PIPING – GENERAL

.1 NPS 2½ to NPS 24 branch connections:

.1 For the welded connection of a pipe of diameter "d" onto a pipe of diameter "D" and/or for the construction of a header of diameter "D":

.1 If the ratio d/D > 2/3, use tees prepared for welding.

.2 If the ratio d/D ≤ 2/3, use reinforced fittings conforming to the Power Piping standard ASME B31.1 or tees prepared for welding, Anvil Anvilets.

.2 If a condition d/D > 2/3 is shown in the drawings, "D" can be increased so that the condition d/D ≤ 2/3 applies.

.2 Mechanical joints:

.1 Without flexible connections between the piping and equipment:

.1 Only the three first joint connecting the piping to the chillers, the cooling towers and pumps can be flexible mechanical joints, type Victaulic or Gruvlock by Anvil. Bolts and nuts to be of stainless steel, compliant with ASTM-f-593 and ASTM-F-594, with rupture-resistance strength of 110 000 psi. Bolts to be in vertical position with nuts below.

.2 With flexible connections between the piping and equipment:

.1 No mechanical joints, piping must be anchored.

2.2 GUIDES

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

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

.3 Special guides:

.1 On riser pipes, for the cooling tower supply and return, construct the guides as shown in the drawings, so as to prevent noise transmission to the building structure with anti-vibration pads formed of two outer steel plates with neoprene inside.

2.3 SUPPORTS

.1 General:

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

.2 In service tunnels, for long lengths of piping and those requiring expansion joints or loops, such as piping for heating, steam, and condensate, the piping to be mounted on roller supports.

2.4 CHILLED WATER, HOT WATER, ETHYLENE GLYCOL, 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.

.5 Flange gaskets:

.1 Inorganic fiber with nitrile binder, Garlock style 5500, 3 mm (⅛") thick, ring or full type, depending on equipment to connect.

.6 Bolts for flanges:

.1 Steel bolts, grade 5, zinc plated.

.2 Nuts, ASTM-A563, grade A.

.3 Dowels, grade B7.

.2 Valves:

.1 Gate valves:

.1 NPS 2 and smaller:

.1 Bronze body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: bronze, rising stem.

.5 Model: Crane fig. 428. Milwaukee no. 1148.

.2 Globe valves:

.1 NPS 2 and smaller:

.1 Bronze body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: bronze, replaceable synthetic alloy disk.

.5 Model: Crane fig. 1. Milwaukee no. 502.

.3 Butterfly valves:

.1 NPS 2 and smaller:

.1 Cast iron body.

.2 Lug style ends.

.3 Class 150.

.4 Internal parts: stainless steel 416 stem, bronze disk, replaceable EPDM seat.

.5 Model: Keystone no. 222. Bray, series 31.

.4 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.

.5 Eccentric plug valves:

.1 NPS 2 and smaller:

.1 Cast iron body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: ductile cast iron plug covered with EPDM, epoxy covered seat.

.5 Position indicator and adjustable stop.

.6 Model: Milliken Millcentric no. 603E0.

.6 Check valves:

.1 NPS 2 and smaller:

.1 Bronze body.

.2 Threaded ends.

.3 Class 125.

.4 Internal parts: bronze, replaceable disk.

.5 Model: Crane fig. 37. Milwaukee no. 509.

.7 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 20 00 10.

.2 List of manufacturers, section 23 21 13.

.1 Piping:

.1 Copper piping:

.1 Mueller

.2 Wolverine

.2 .2 Copper Fittings :

.1 Anvil International

.2 Cello

.3 Mueller

.4 Nibco

.5 Smith-Cooper

.2 Valves:

.1 Globe and gate valves:

.1 Crane

.2 Hattersley

.3 Jenkins

.4 Kitz Corp.

.5 Milwaukee

.6 Velan

Part 3 Execution

3.1 GUIDES

.1 Install guides to control the longitudinal movement of the pipe where expansion joints are installed.

.1 Slip joint type of expansion joints, such as Yarway.

.2 Bellow expansion joints, such as Flexonics.

.3 Expansion loops manufactured with piping.

.4 Ball joints.

3.2 SLOPES

.1 Hot water heating, high temperature hot water, ethylene glycol, chilled water, and cooling 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.

3.3 SUPPORTS

.1 General:

.1 For very large pipes, heavy devices, and devices subject to vibration, install the supports' rods through the slab with a steel plate above the latter. Steel plates 150 mm x 150 mm x 6 mm, or larger, according to the diameter. Consult the structural Engineer for these special cases.

3.4 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.

3.5 TESTING AND CLEANING

.1 General:

.1 See the article "TESTING" in section 20 00 10 – Mechanical and electrical general instructions.

.2 Perform all tests specified below.

.3 All tests must have been conducted satisfactorily before requesting an inspection by the Engineer.

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

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

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

.2 Tests:

.1 Piping:

.1 Chilled water, hot water, cooling water, ethylene or propylene glycol:

.1 A pressure 50% higher than the opening pressure of the safety valve or 1035 kPa minimum must be maintained without leakage for a period of at least two hours throughout the piping. Perform this test with cold water.

.2 Domestic water, softened water, and non-potable water:

.1 A pressure of 345 kPa above the maximum operating pressure or of the adjustment pressure of the safety valve or 1035 kPa minimum must be maintained without leakage for a period of at least two hours throughout the piping. Perform this test with cold water.

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

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

.4 In booster pump systems, the maximum operating pressure corresponds the maximum pump pressure at zero flow.

.2 Chemical process piping:

.1 Subject the piping to a hydrostatic pressure of 2400 kPa for six (6) hours.

.3 Cleaning the strainers:

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

3.6 BALANCING

.1 Chilled water, cooling water, hot water, ethylene glycol and high temperature hot water:

.1 Adjust the valves to obtain the required water flow at each chiller in each main network, in every primary and secondary network, in each branch, in each coil group, in each coil, in each group of fan-coil units, unit heaters, etc.

.2 Provide three copies for review and comment, a full report of all tests and adjustments performed, indicating the final readings obtained.

.3 Enter the results on a 216 mm x 279 mm size format, entering the name of the system, the device, the required characteristics, and those obtained.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical 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 20 00 10 – Mechanical and electrical 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 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 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

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

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

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

Part 2 Product

2.1 GENERAL

.1 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 Round and oval ducts:

.1 For diameters of up to 150 cm, these ducts must be manufactured from helicoidally wound sheet metal with spiral joints, four-ply lockseam (outside wall) for excellent rigidity, operating pressure up to 2500 Pa, as manufactured by Spiro Mega Inc.

.3 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.

.4 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.

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

.6 Seal the joints of the ducts.

.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.

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 Round ducts:

.1 See details in the drawings.

.2 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.

2.4 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" in section 20 00 10 – Mechanical and electrical 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 Trim:
.1 Hardcast Carlisle (Flange Gasket 1902)
.2 Multifeutre du Québec Ltd
.3 3M Compagnie Ltée (LC-105 Gaskets)

.5 Prefabricated round and oval ducts:
.1 J.P. Lessard
.2 Les Industries Mégatube Canada Inc.
.3 Spiro Méga Inc.
.4 Spiro Métal Inc.

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

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

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

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

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.

.2 Round ducts:

.1 Construct the supports out of 25 mm wide steel rings with tightening screws and a 6.4 mm steel rods. Before installation, apply a layer of aluminum based paint to all the rings and rods.

.2 Use the external reinforcements as attachment point for the oval ducts having a major axis larger than 580 mm.

.3 For oval ducts without reinforcement, install the supports starting as close as possible to a joint. Construct the supports from a continuous metal strip.

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.

.2 Round ducts:

.1 Construct elbows with a radius of curvature (measured from the center of the pipe) equal to at least 1.5 times the diameter of the duct. Construct them in five sections or more for 280 mm or larger diameters and three sections for 250 mm and smaller.

.3 Oval ducts:

.1 Construct elbows with a radius of curvature measured at the center of the axis and equal to 1.5 times the major axis or 1.5 times the minor axis, depending on whether the change of direction is in the plane of the major axis or in the plane of the minor axis.

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.

.5 For circular ducts, use prefabricated transformer sections in medium and high-pressure systems, to allow maximum static regain.

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 05.

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.

.6 See the article "SPECIAL DUCTS" in part 2 "Products" for the access doors in ducts with Firemaster type insulating wrap.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical general requirements.

.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 20 00 10 – Mechanical and electrical 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 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 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Waste management and disposal:

.1 Separate waste materials for recycling in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

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

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

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

Part 2 Product

2.1 GENERAL

.1 The 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 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 Doors measuring between 451 mm and 1000 mm wide: a piano hinge and at least two (2) latches for the frame.

.4 Doors measuring over 1000 mm side: a piano hinge and two (2) handles operable from the inside and from the outside.

.5 Device to hold the open position.

2.4 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 20 00 10.

.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 Adhesive for insulation:

.1 Duro-Dyne

.2 Hardcast Carlisle

Part 3 Execution

.1 Not Used.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical 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 20 00 10 – Mechanical and electrical 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 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 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

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 Flow diverter dampers:

.1 Construction:

.1 Of the same material and thickness as the ducts in which they are installed (minimum of 0.853 mm, 22 gauge), profiled shape, length at least 1.5 times the width of the smallest branch serviced. Securely fastened with hinges along the oval edge. Mechanism accessible from outside the duct to adjust the damper's position and to anchor it firmly in its permanent position.

.2 Locations:

.1 Install this type of damper to distribute the airflow from a main duct in each branch in the required volumes.

.5 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.

.6 Motorized dampers – General:

.1 Single-blade or multi-blade.

.2 Frame made of extruded aluminum, 101.6 mm deep x 2.03 mm thick, stainless steel 316 cap screw.

.3 Pivoting rods of each of blade on oil impregnated Celcon or bronze bearings, all permanently lubricated.

.4 Connecting rods, cranks, and motor controls supplied and installed by the Division 25, unless otherwise specified.

.5 102 mm x 25 mm x 2.03 mm frame, aluminum profiles, alloy no. 6063T5. Every corner reinforced for maximum rigidity.

.6 Blades constructed of aluminum profiles, a maximum width of 204 mm, with structural ribs continuous over the entire length of each blade.

.7 Formed silicone or EPDM blade seals.

.8 Square or hexagonal shaft, 13 mm.

.9 Blade rotation: opposed action.

.10 Linkage outside the airflow, zinc-coated aluminum and steel.

.11 Multiple sections: the damper section surfaces must not exceed 0.64 m², 2.2 m², or 4.6 m², depending on the actuator's power. Coordinate with the Division 25. **Exception**: for leak-proof dampers (VME), the area of each section must not exceed 1.86 m².

.12 A set of multi-section dampers must be activated by an intermediate jack shaft. The connecting rods will be connected to the shaft by means of a device secured to it to prevent slippage. The jack shaft must be manufactured from a solid rod, and not with a hollow tube.

.13 Similar to the 1000 series damper from Tamco.

.7 Regular motorized dampers (MD):

.1 See the article "MOTORISED DAMPERS – GENERAL".

2.2 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" in section 20 00 10 – Mechanical and electrical 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.

.4 When the dampers control the outside air, the blades must be finely adjustable to prevent any air leaks.

.5 In horizontal ducts, install backdraft dampers at a 5° angle to provide better blade closure.

.2 Rigidity and airtightness of backdraft or motorized dampers:

.1 On the perimeter of the damper, between the damper’s frame and the ventilation duct, and between the frames of the modular dampers, supply and install a galvanized steel corner with stainless steel bolts. Seal the whole assembly with an elastomeric sealant.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical 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 20 00 10 – Mechanical and electrical 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 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 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

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, medium, and high 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 20 00 10 – Mechanical and electrical 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 20 00 10 – Mechanical and electrical general requirements.

.2 Section 23 05 53.01 – Mechanical identification.

.3 Section 23 33 46 – Flexible ducts.

1.2 REFERENCES

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):

.1 ANSI/AMCA – Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 International Organization for Standardization (ISO):

.1 ISO 3741-2010 – Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for reverberation test rooms.

.3 National Fire Protection Association (NFPA):

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

.4 Underwriter's Laboratories (UL):

.1 UL 181-2005(R2008) – Factory-Made Air Ducts and Air Connectors.

1.3 SUBMITTALS

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

.2 Product data:

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

.3 Certificates:

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

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

Part 2 Product

2.1 STANDARDS

.1 All units are pressure independent type.

.2 The standards and the norms to be respected are given in the component descriptions.

.3 The recorded data must be certified by an independent laboratory, member of the ADC (Air Diffusion Council).

.4 NC data to be obtained according to standard AHRI 885-2008 (or most recent version).

.5 Units must have the ARI seal.

2.2 DOCUMENTS TO BE PROVIDED

.1 Shop drawings:

.1 For each type of supply air terminal units, provide shop drawings specifying the following:

.1 Models.

.2 Dimensions and construction details of each model.

.3 Minimum operating pressure required at the inlet of the unit.

.4 Sound power transmitted and radiated to each of the frequency bands from 2 to 7 inclusively.

.5 Curves modulating the amount of air.

.6 Air leak curves when the unit is closed.

.7 Characteristics of the thermal acoustic insulation and protection against erosion.

.8 Controls diagram, component characteristics, and description of operation for each type of unit.

.2 List of supply air terminal units:

.1 The list of supply air terminal units must provide the following information:

.1 Identification on drawings and unit as per article "DENTIFICATION CODIFICATION" in section 23 05 53.01 – Mechanical identification, and identification of this section.

.2 Model of the unit.

.3 For each unit: air flow in L/s (cfm), for units with variable airflow: minimum and maximum airflows.

.4 Orientation (left or right) for dual air intake units.

.5 Static pressure loss through the unit.

2.3 CONSTRUCTION

.1 Rigid galvanized steel construction, 0.853 mm (22 gauge) minimum. The construction of the joints, the gaskets, and the dampers must ensure a maximum leakage of 2% of the unit's rated capacity when a pressure of 750 Pa is applied at the input of the unit and according to the ASHRAE test method 130.

.2 Heavy gauge galvanized steel air flow control damper with self-lubricating steel or brass shaft and bearings, shaft with position indicator, damper stops with neoprene gaskets to minimize air leakage.

.3 Operating pressure of 75 to 1000 Pa.

.4 The dimensions of the air inlets and outlets must allow for air speeds to be effectively measured using flow sensors.

.5 Ensure easy access to the modulation and control mechanisms.

.6 Protect the controls using an easily removable steel sheet.

.7 See the article "CALIBRATION".

.8 Interior covering:

.1 Acoustical fiberglass insulation (standard covering).

.2 Adhesive approved by UL or ULC, having been tested according to ASTM-E-84-814, and meeting the following maximum levels:

.1 Flame propagation: 25

.2 Fuel supply: 50

.3 Smoke emission: 50

.3 On the interior walls of the end unit, rigid acoustic insulation 25 mm (1") thickness with protective coating (acrylic polymer) resistant to dust, dirt, and microbial growth, meeting the requirements of NFPA-90A and UL 181.

2.4 TERMINAL UNIT TYPES

.1 See the articles "CONSTRUCTION" and "CONTROLS".

.2 Types:

.1

B01 – Double inlet, variable air flow:

.1 Acoustic insulation: see article "INTERIOR COVERING".

.2 The arrangement of flaps or airflow control mechanisms shall be designed to ensure minimum air turbulence and a perfect mix of hot and cold.

.3 The temperature of the air mixture shall not vary by more than ½°C (1°F) on average for each 6° C (10°F) difference in temperature between hot and cold air.

.4 The unit will be equipped with two (2) multiport speed sensors, similar to Price model SP300, one at the cold air inlet and one at the exit of the unit.

.5 Similar to Price model DDS.

.2 B02 – double inlet supplied by recirculation air section and primary air supply:

.1 Same construction as type B01, including:

.1 Acoustic insulation: see "PERFORMANCE" section.

.2 Equipped with a recirculation fan operating independently of the primary air. Recirculation air is used to meet the heating demand.

.3 Controlled by the same room thermostat.

.4 Terminal box lined on the inside with fiberglass insulation.

.5 Similar to Price's FDV LP5000 model.

.6 Connect B02 box to existing water heating coil.

.7 Merv 8 filter.

.2 Hot water reheat coil in existing ductwork shall be reinstalled.

.1 Protection:

.1 Initial thermal protection by automatic reset circuit breaker, second manual reset protection. Circuit breaker with fuses not acceptable.

.2 Differential pressure switch ensuring sufficient air flow before power supply to the element.

.3 Provide connection terminals, contactors, required SSR or SCR relay and low voltage transformer installed in the control box. The coil must provide proportional modulation according to an analog input signal (0 to 10 V D.C., 4 to 20 mA or PWM). Coordinate with Division 25 "CONTROLS".

2.5 CONTROLS

.1 The supply air terminal unit controls are digital and compatible with the building management and control system. These controls are for: digital controllers, actuators, flow transmitters, flow sensors.

.2 The flow sensors supplied and installed in the unit by the manufacturer shall be located at locations representative of the air velocity and where the flow is turbulence free to have a reliable and accurate measurement.

.3 When the sensor controller must control the total air flow of a dual air input unit, the location of the sensor and the dimensions of the unit must be such that the controller can readjust the air flow modulating mechanism(s) to obtain the amounts of air within the limits prescribed by supply air terminal unit tables.

2.6 ACCESS DOORS

.1 When required, install an access door on the ATU, such as Acudor access door no. CD-5080 for low and medium pressures.

.2 Galvanized steel, 24 gauge.

.3 Galvanized steel frame, 24 gauge.

.4 Micro-Airc, 25 mm (1") M/F insulation, type 475.

.5 Closed-cell neoprene sealing gasket ,3 mm (⅛") thick x 13 mm (½") de between the door and the frame, and 1.6 mm (1/16") thick x 38 mm (1½") wide between the frame and the duct.

.6 Self-tightening manual cam latch.

2.7 CALIBRATION

.1 Adjust and calibrate the units in factory so as to obtain the specified air quantities.

.2 To allow field calibration after installation, provide a barbed fitting tee on the tubes that transmit the probe readings to the controller.

2.8 CHOICE OF AIR SUPPLY TERMINAL UNITS

.1 The Contractor is responsible for the final selection of supply air terminal units so that the following requirements are met:

.1 Noise level in the rooms supplied.

.2 Supplied air quantity.

.3 Modulation of the amounts of air according to the variables indicated in the diagrams.

2.9 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 20 00 10.

.2 List of manufacturers, section 23 36 00:

.1 Air supply terminal units:

.1 Carnes

.2 Carrier

.3 Krueger

.4 Nailor Industries

.5 Price

.6 Titus

.7 Tuttle Bailey

Part 3 Execution

3.1 INSTALLATION

.1 At the inputs of each unit, install the flexible ducts as described in 23 33 46 – Flexible air ducts, according to the manufacturer's recommendations.

.2 The installation will be done so as to facilitate access to the control devices and the access doors.

.3 Use separate supports from those used for the ducts.

.4 Directly upstream of each terminal member, provide a straight length of section equal to at least four (4) times the diameter of the duct used, which must have the same diameter as the entry of the element.

.5 Install the terminal elements so as to facilitate access to controls/regulation devices, dampers, and access doors.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 00 10 – Mechanical and electrical 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 20 00 10 – Mechanical and electrical 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.

.2 Shop Drawings:

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

.3 Certificates:

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

1.4 CLOSEOUT SUBMITTALS

.1 Submit all document/elements required, in accordance with section 20 00 10 – Mechanical and electrical general instructions.

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

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 The return grilles are also used for exhaust.

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

.5 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°.

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

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

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

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

.10 See the diffuser tables on the drawings.

2.2 INDUCTION DIFFUSERS ON THE CEILING OR UNDER AN EXPOSED DUCT

.1 Type AA (square):

.1 Construction:

.1 High induction swirl diffuser shall be constructed of satin finish steel. The square faceplate shall incorporate adjustable off-center rollers.

.2 Diffuser plate shall be available in one, two or three way, corner or L-shaped air distribution configurations.

.3 Finish to be factory painted white or as selected by architect.

.2 The following flow ranges are to be used for diffuser selection:

.1 300: 65 to 85 cfm

.2 400: 80 to 150 cfm

.3 500: 150 to 280 cfm

.4 600: 280 to 400 cfm

.5 800: 400 to 600 cfm

.3 Model: as NAD Klima DAL 358, complete with air plenum. Color white or as selected by architect.

.2 See table on drawings for specifications.

.2 Type AVH (linear high induction diffusers):

.1 Eccentric rollers, 100 mm long, provided with an identification allowing the adjustment of the air distribution pattern over 180°.

.2 Number of slots and length of plenum: see drawings.

.3 Architect's choice of color, smooth powder-coated painted finish.

.4 Watertight plenum in 24 gauge galvanized steel, complete with connection on the side, perforated plate, and balancing key accessible from the visible face of the diffuser to allow the air flow to be adjusted between 0 and 100%.

.5 The performance must be guaranteed by the manufacturer and be demonstrated using performance curves or simulation software. These should indicate the pressure drops and the acoustic power generated and show a sectional view of the critical air path in "cooling", "isothermal" and "heating" modes. The performance data of the diffuser must demonstrate a maximum speed of 0.15 m/s (30 ppm) in an occupied zone at 1.3 m from the ground. This performance guarantee must be demonstrated in plan by curves illustrating the path of the air jet. The diffuser must ensure a maximum temperature difference of -1° C between the air jet and the occupied area 1.3 m from the ground.

.6 Model: such as SAL-35 from NAD Klima or approuved equivalent.

2.3 RETURN GRILLES IN CEILINGS OR UNDER EXPOSED DUCTS

.1 Type RL:

.1 Construction:

.1 Extruded aluminum frame.

.2 Center with 13 mm x 13 mm square pattern in aluminum.

.2 Model: such as 80-F from E.H. Price Ltd or approved equivalent.

2.4 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 20 00 10.

.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 SECTIONS

.1 Section 20 00 10 – General instructions for mechanical and electrical.

.2 All Divisions 23 and 26 sections.

1.2 GENERAL

.1 All mechanical and electrical general requirements of Division 20 apply to Division 25.

.2 All of Division 25 sections complement each other to form a whole.

.3 All mechanical and electrical drawings apply to Division 25.

.4 For uniformity reasons only Delta Controls products distributed by Regulvar are acceptable for this project.

1.3 ACRONYMS AND ABBREVIATIONS

.1 Acronyms used in this section:

.1 AEL – Average effectiveness level.
.2 BACnet - Building automation and control network.
.3 BMS – Building Management System
.4 BTL – BACnet testing laboratories.
.5 CDL - Control description logic.
.6 COSV – Change of state or value.
.7 CPU - Central processing unit.
.8 HVAC - Heating, ventilation, air-conditioning.
.9 VFD – Variable frequency drive.
.10 DDC – Direct digital control.
.11 I/O - Input/Output.
.12 LAN – Local area network.
.13 NC – Normally closed.
.14 NO – Normally open.
.15 O&M - Operation and Maintenance.
.16 OWS - Operator Workstation.
.17 MCU(s) – Master control unit.
.18 TCU(s) – Terminal control unit.
.19 PID – Proportional, integral and derivative.
.20 DP – Differential pressure.
.21 SP – Static pressure.
.22 RAM – Random access memory.
.23 ROM - Read Only Memory.
.24 EMCS – Energy management and control system.

.25 USB - Universal serial bus.

.26 UPS - Uninterruptible power supply.

.27 VAV – Variable air volume.

.28 WAN – Wide area network.

1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers to measure physical properties, to provide status conditions of contacts or relays or to provide interaction with related equipment (system start/stop, modulation control, etc.).

.2 Point object type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 BI (binary input).

.4 BO (binary output).

.5 Pulse input.

1.5 SCOPE OF WORK

.1 Work included:

.1 In general, the work covered includes labour, materials, installations, adjustments, calibrations and connections of electric and electronic equipment of all control systems indicated in the plans and specifications.

.2 Division 25 must include, unless specified otherwise, all devices, accessories, conduits and wiring for electrical and/or electronic devices pertaining to the control centre and miscellaneous control equipment, the interconnections between two type of controls and the electrical connection to panels.

.3 Dismantle:

.1 The control contractor must be aware of the scope of dismantle work. He must be present at the beginning of the work project for the dismantle.

.2 The followings list present the equipments and systems to be dismantle by the control contractor

.1 All VAV boxes room thermostat has indicated on the mechanical demolition drawing.

.2 All the pneumatic tubing.

.3 All the pneumatic controls for the dismantle VAV boxes.

.4 The EMT controls conduits if they are not in good condition.

.3 Existing EMT conduits can be reused if it’s still in good condition.

.4 Return all the equipment that has been dismantle to the Owner.

.4 The work includes, but is not limited to, the following:

.1 Supply and install of new controllers for dual duct box and dual box with fan coil unit, model EZVP or DVC under the existing master controller supplying the dual duct box, also provide an enclosure to install the controllers, also provide a new panel to install the controller. Provide transformers dedicated to the dual duct controllers that will be installed in a panel, install these panels in the different sector where the dual duct boxes are installed.

.2 Provide a dedicated fuse for each controller.

.3 Supply, installation and connection of all temperature probes, pressure, motorized actuators and everything else showed in the drawings.

.4 Supply and installation of controllers and actuators on supply air terminal boxes.

.5 Supply and installation of secondary communication networks (BACnet MS/TP) required for the BMS.

.6 All controls required for ventilation systems - air conditioning.

.7 The power sources 120 V and 24 V for all equipment's provided by the control contractor.

.8 Programming and complete database for the DDC and centralized systems including all building the dynamic graphics. Provide all floor plan graphics showing location off all space temperature sensors and its value.

.9 Provide support and assistance during the calibration of the terminal air supply units.

.10 Identify all components, conduits and conductors according to standards at the Canadian Space Agency.

.11 Provide documentation for system start-up, initial commissioning, training, operating and maintenance for terminal units.

.12 Supply, installation and connection of two valve actuator for valve type Honeywell VP525A 1416 and VP525C1016 2. The valve body stays in place, only the actuator is replaced, see drawings for quantity and location.

.13 Supply and connection of tree valve motorized valve for baseboard heating.

.14 Lighting control for the zones supplied with the new vav boxes.

.2 Excluded work:

.1 In general, the work excluded by this section includes:

.1 Access doors for controls equipment.

.2 Openings for instrumentations, see section 20 00 10 – General instructions for mechanical and electrical.

1.6 DOCUMENT SUBMITTAL

.1 Provide all the shop drawings for the project for every control apparel provided.

1.7 QUALITY ASSURANCE

.1 All wiring must be completed in accordance with manufacturer's recommendations for all electrical work.

.2 The system must include all the devices, control and monitoring equipment as well as all the devices, accessories and equipment installed remotely, the software, the interlock wiring and required to obtain a fully functional system, as described in this section. The system must meet all newest local and national codes. If a conflict between the two reference codes appears, the most recent and most severe local codes must be applied.

1.8 WARRANTY

.1 Regardless of the warranty period stipulated in item "WARRANTY" of section 20 00 10 – General instructions for mechanical and electrical, the complete control system must have a two (2) year warranty period from the final acceptation date.

1.9 FIXED PRICE

.1 Provide in the quote, a global lump sum that includes all the work covered in Division 25.

Part 2 Execution

2.1 GENERAL

.1 All controls shall be installed and adjusted by specialized technicians, regularly employed by the EMCS manufacturer. All costs related to adjustments form part of this contract. All controls components must be easily accessible for maintenance and calibration.

.2 Any control device installed on an insulated ductwork must be install on an appropriate metal support, supplied by Division 25.

.3 Any piping or tubing going through an obstacle must be protected by a sealed nylon bushing.

.4 In finished room, enclose the controls in metal boxes with frames covering the joint between the box and the adjacent construction. The box must be of approved construction.

.5 The location of the thermostats on the drawing is approximate and is given as a reference only.

.6 Under any circumstances, the space thermostat should be affected by the sun or any other heat source, cold source or air draft. When it has to be installed on a hot or cold wall, the thermostat must be installed on an insulated base, supplied by Division 25.

.7 Install the space thermostat at 1.5 m (5') from the floor covering.

.8 Never install the thermostats above switches, rheostats, dimmers or any other heat generating control equipment.

.9 The control panel cannot have any unprotected openings.

.10 Protect all cables from abrasion when passing through openings.

.11 Identify the position of the control components installed in the ceiling by a "P-Touch" label.

2.2 ELECTRICAL WIRING

.1 Division 25 must supply and install the panels, the controls, etc., and others specialized control devices. In addition, it must supply and install conduit, wiring and junction boxes required to connect all the control devices.

.2 Must comply with the requirements of the Quebec Electrical code for the install of conduits, wiring, junction boxes, etc.

.3 The wire gage for conductors being used for control only are as follow:

.1 120 V: minimum gage 14 AWG.

.2 24 V : minimum gage 18 AWG, FT6.

.4 The wire gages for control must be such that the voltage loss is below 5% of the supplied voltage.

.5 All cables must be installed under EMT conduit, except if mentioned in the following article.

.6 The use of "plenum cable" without EMT conduit is only allowed in room ceilings when cables remain accessible, for the connection of terminal control equipment (dual duct box, actuators and thermostat) for secondary level communication and for 24 V terminal control.

.7 In the case of FT-6 cables without conduits, the cables must follow the lines of the building and be neatly fastened to at least every 1.5 m with hooks (as used by network installers) specifically designed for this purpose.

.8 The filling rate for electrical conduits must be 50% maximum of their theoretical capacity.

.9 Grounding systems required for all systems and devices provided under Division 25, in accordance with manufacturer’s instructions.

2.3 INSTALLATION

.1 The installation includes: electrical diagrams, factory and on-site wiring, workmanship, surveillance, calibration, start-up and verification for a fully operational system.

.2 All wiring must comply with the requirements of the local authorities as well as article "ELECTRICAL CONNECTION".

2.4 MEASUREMENTS, VERIFICATION, CALIBRATION

.1 Calibration:

.1 Calibrate all control devices.

.2 The controls of each section or contract must be verified and adjusted and proven to be in working condition.

.2 Simulate all control panel alarms and record results.

.3 Division 25 must provide great support in the testing and commissioning of the equipment and systems of the other contracts.

2.5 START-UPS

.1 The control contractor, once installation is completed, must proceed with the start-up of the system. In order to proceed in a safe environment, the start-up is divided in the following phases: verification of the control systems and start-up of the control systems with the electromechanical equipment operational.

.2 During the control system verification, the control contractor must include, but not limited to, the following activities:

.1 Verify and calibrate all transmitter's signals.

.2 Verify the operation of all actuators

.3 Verify the operation and feedback of all controlled devices.

.4 Simulate all alarms.

.5 Simulate all control loop and adjust parameters.

.6 Simulate a power fail and ensure proper restauration of the control system.

.3 The final phase of the start-up must be witness by the owner. During this phase, the systems are functional, under the supervision of the owner. The control contractor will make the necessary modifications and adjustments (fine-tuning) in order to have a functional and safe system. The control Contractor must perform these changes, at no cost, to optimize the system operation.

.4 Once the start-up is completed, demonstrate the control system operation.

2.6 TRAINING

.1 Provide the owner, the services of a qualified instructor for a period of four (4) hours, to inform the owner's representatives on the operation and maintenance of the EMCS.

.2 Owner's representatives will be able to convert unused training hours to a valid bank of hours for a period of twelve months following reception of the work. This bank of hours can be used, according to the request of the operator, for the programming of controllers or dynamic graphics, the installation of components (including controllers), calibration or additional training sessions. An Excel file must count the hours transferred. Work orders will be used to count these hours and must be signed by the Client representative.

2.7 EQUIPMENTS

.1 TR – Transformer:

.1 Single phase transformer, enclosed type complete with fuse holder and fuse. Transformer capacity in VA to be at least 20% greater than the rated charge to be connected. Use of transformers with integrated thermal protection or with intrinsic limitation as an alternative to fuses is prohibited.

.2 As per Marcus MC or approved equivalent from Hammond.

.2 T - Temperature sensor/transmitter:

.1 Room temperature

.1 Resistance type detector NTC, 10K accuracy of ± 0.2°C.

.2 Local temperature set point adjustment.

.3 With display of the temperature and set point.

.4 Override button.

.5 ABS plastic housing.

.6 Wall installation on an electrical box.

.7 By software programming, it must be possible to activate or deactivate the set point adjustment function. It must be possible to limit the adjustment value by plus or minus the setpoint adjustment knob, when enabled.

.2 Duct temperature sensor:

.1 Type: NTC 10k ohms, ± 0.2°C accuracy, standard resistance/temperature coefficient, sensor length: 460 mm (18"), temperature range: -40 to 121°C (-40 to 244°F).

.3 SD – Terminal unit flow sensor:

.1 Flow sensor compatible standard terminal unit measuring cross.

.2 Diverts particulates from sensor element using cyclone flow structure.

.3 As per Setra no 264 or approved equivalent from the designated professional.

.4 ME – Damper motors for terminal unit:

.1 Proportional type only.

.2 As per Belimo, type LMB24-SR and CMB24-SR, or approved equivalent from Siemens, Johnson Controls and Honeywell.

.5 CT – Current transmitter:

.1 Current transmitter with two (2) wire analog output.

.2 Amperage range: 1 to 120 A as per specific model.

.3 Isolation: 600 V A.C. rms.

.4 Accuracy: ± 2% on all ranges.

.5 Temperature: -15 to 60°C (5 to 140ºF).

.6 Relative humidity ratio: 10 to 90% without condensation.

.7 Output signal: 4 to 20 mA.

.8 Type H721 or H921 Hawkeye from Veris Industries.

2.8 MOTORIZED VALVE

.1 General:

.1 Valves shall be sized by the manufacturer so that the controlling entity and the valve will have stable, non-pumping operation.

.2 All motorized valves are spring loaded to normal position.

.3 Motorized valves of electric type are with electronic or electrohydraulic actuator.

.4 The normal position is shown on the drawings and indicated in the tables.

.5 Actuator capacity shall be 125% of the required theoretical capacity.

.2 Motorized two (2) way valve:

.1 For terminal reheat:

.1 Fittings 20mm (¾") and smaller

.1 Threaded, nickel plated brass body, stainless steel stem, stainless steel ball, teflon packing, Tefzel characterization disc, equal percentage flow characteristic, Series B2 Belimo.

2.9 LOCAL MONITORING PANEL

.1 General:

.1 NEMA-1 type, complete with key-lockable front door mounted on concealed hinges, easily removable to provide interior access. Installed on rigid support for mounting on wall, floor, ceiling or ductwork.

.2 Provide a minimum of 20% free space at the bottom of the panel, for future addition.

.3 All cables coming from outside must pass through a gutter before entering the control panel.

.4 Inside the control panel, all wires must be connected to a terminal block.

.2 Location:

.1 Locate to provide a minimum clearance of 1000 mm (40") in front of panel.

.3 Accessories:

.1 All wiring shall be inside raceways of adequate size with 50% of free space.

.4 Terminal blocks:

.1 All joints and connections inside the panel must be done on screw-type terminal blocks. The use of marrettes or shielded wires with electrical tape is prohibited.

.2 Industrial grade modular type terminal blocks, DIN-rail mounted with vibration proof screw connections and color coded labelled terminals and voltage and current separators.

.3 Allow 10% (minimum 10 terminals) spare capacity per panel.

.5 Wire raceway :

.1 Pass all wires through a raceway inside panel.

.2 The raceway must be closed by a removable cover

.3 Limit the filling of the raceway to 50%.

.6 Schematic:

.1 Permanently installed in the door of the panel, a schematic drawing showing the system’s arrangement.

.2 Schematic drawing to be sealed in a transparent plastic case.

2.10 CONTROL ENCLOSURE FOR VAV CONTROLLERS

.1 Generalities:

.1 NEMA-1 type, with interior acces. Installed on rigid support for mounting on wall, floor, ceiling or ductwork.

.2 Location:

.1 Locate to provide a minimum clearance of 100 mm (4") in front of panel.

.3 Accessories:

.1 All controls equipment including switches, fuses, terminal blocks, controllers, pressure transmitter/detector, etc., to be installed inside the panel.

.4 Identification:

.1 On the enclosure, identifying with a white and black ebonite plate the enclosure and also all the visible accessories. Screw the plates to the boxes.

.2 Inside the panel, identify all accessories with laminated tape (Dymo).

.3 Identify all pneumatic tubing and electrical wiring at both ends.

.5 Power source:

.1 Control panels are powered at 24 V only. No source above 30 V should be present inside the control panels. Provide fuse protection or a properly selected circuit breaker on the main power supply to the panel.

.2 Provide an external panel dedicated to 120 V to 24 V or 600 V to 24 V transformation, when required. This panel must be independent

.6 Terminal blocks:

.1 All joints and connections inside the panel must be done on screw-type terminal blocks. The use of marrettes or shielded wires with electrical tape is prohibited.

.2 Industrial grade modular type terminal blocks, DIN-rail mounted with vibration proof screw connections and color-coded labelled terminals.

.3 Allow 10% (minimum ten (10) terminals) spare capacity per panel.

2.11 SEQUENCE

.1 Generalities:

.1 For each room with a temperature sensor associated with a local control system, the following parameters must be programmed, adjustable and independent for each room:

.1 A occupied /unoccupied mode schedule

.2 Temperature set point in “occupied” mode.

.3 Temperature set point in “heating/unoccupied” mode

.4 Temperature set point in “cooling/unoccupied” mode

.2 The “occupied/unoccupied” modes can also be forced manually from the command center.

.3 For each terminal unit, the following parameters must be programmed, adjustable and independent:

.1 Minimum total “occupied” flow

.2 Minimum total “unoccupied” flow.

.3 Maximum total flow.

.4 If the schedule in “occupied” mode of a room is not covered upstream ventilation system’s schedule, a notification is sent to the command central.

.5 Special situations:

.1 Common room temperature sensor:

.1 In the case where several terminal equipment share the same electronic room temperature sensor (see mechanical drawings), the ASC controller to which the room temperature sensor is connected performs all the calculations of PID loop and consequently transmits the appropriate commands to the other associated controllers.

.2 Open areas:

.1 In the case of an open area served by several terminal units, each with their room temperature sensor, a strategy must be established to avoid the energy fight. The terminal unit is controlled by a master PID variable integrating its own PID (base PID) and those of the adjacent terminal units. The result of the master PID calculation is the weighted average of the adjacent PIDs each associated with a coefficient. Generally, the base PID will have a minimum of 50% authority. This equation must be adjusted for each zone. The algorithm will be based on the weight of the adjacent units. When adjacent terminal units share the same room temperature sensor, only the PID of the controller to which the thermostat if physically connected is used in the master PID calculation.

.2 Type A – Terminal unit dual duct variable flow:

.1 Mode "occupied" :

.1 The controller is maintaining the air flow set point to maintain the room temperature at its set point in "occupied" mode following the principle of the graphic presented in the drawing.

.2 The controller also controls the valve fallowing the principle of the graphic presented in the drawings, when the outside temperature is above 16°C the valve in maintain close by the controller.

.2 Mode "unoccupied" :

.1 The system operates as in "occupied" mode, but with a reduction of the air flow which will be at its minimum air.

.3 Fan coil unit:

.1 Mode "occupied" :

.1 The controller starts the fan according to a schedule determined with the end user.

.2 When the dual box is in heating mode (100%) for more than two minutes, the controller modulates the valve as a second heating stage to maintain the room temperature at its set point in "occupied" mode.

.3 When the heating demand goes down, the reverse sequences applies.

.4 When there is a cooling demand, the heating valve is closed.

.2 Mode "unoccupied":

.1 The fan is stop.

.2 The heating valve is closed.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – EMCS – General requirements.

.2 Division 27.

1.2 NAMEPLATES

.1 All devices must have nameplates indicating size, name of the device all other general information such as serial number, voltage, frequency, number of phases, capacity, manufacturer's name, etc.

.2 The lettering stamped, printed or engraved on the nameplate must be legible. Do not paint the nameplates. When the devices are insulated, leave openings in the insulation to keep the nameplate legible. The manufacturer's nameplate must not be modified in any way.

Part 2 Product

2.1 NAMEPLATES FOR PANELS

.1 Panels include: control panels, controller enclosures, monitoring panel and auxiliary control cabinets.

.2 Identify by white plastic laminate, 3 mm thick black core, glued and screwed to the panel front door.

.3 Sizes: 90 mm x 40 mm (3½" x 1½") minimum.

.4 Lettering: minimum 25 mm (1") high.

2.2 VAV CONTROLLER

.1 Identify controller with a printed 12 mm, black on white self-adhesive "P-Touch" ribbon.

.2 Controller access identification:

.1 Identify the location of controllers that are installed in the ceiling space with an orange sticker (25 mm x 25 mm). Sticker to include the panel's ID number.

.2 Access door: apply sticker on a visible side.

.3 Locate sticker on the T-Bar assembly or on an extremity of the access panel.

2.3 NAMEPLATES FOR CONTROL APPLIANCES

.1 Identify control appliances with metallic tags (or plastic token) with rounded edges, with contrasting engraved numbers and letters. Attach the tags with heavy steel wire or glue and screw them to the appliances.

.2 Sizes: 25 mm x 40 mm (1" x 1½") minimum.

.3 Lettering: minimum 12 mm (½") high.

.4 The indication must be alphanumerical and must correspond to the control diagrams.

2.4 APPLIANCES AND ACCESSORIES INSTALLED IN PANELS

.1 Identify equipment's with "P-Touch" ribbon. The indication must correspond to the control diagrams.

2.5 NAMEPLATES FOR ROOM SENSORS

.1 Identify each device with pre-printed electronically generated self-adhesive vinyl labels.

.2 Coordinate the characteristics and lettering size with the Owner.

2.6 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 WIRING

.1 Power wiring:

.1 Power wiring: identify circuit breaker number and panel ID inside each control panel.

.2 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.3 Distribution panels: Identify breaker for controls and EMCS.

.2 Energy management and control system (EMCS):

.1 Identify field device and network wiring end-to-end with plastic rings printed with indelible number markings. Alternatively, use pre-printed labels specifically designed for wiring identification.

.2 Inside control panels, label terminals of terminal blocks with the same identification used on wiring schematics.

.3 Use distinctive colour coded wiring for communications cables, matched throughout system. Color to be coordinated with the Owner.

2.8 CONDUIT

.1 Colour code EMCS conduits and boxes using paint.

.2 Conduits must be identified by painting all connectors and anchors. Pre-paint box covers and conduit fittings.

.3 Coding: Color to be coordinated with the Owner.

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates and identification nameplates are visible and legible at all times.

.2 Install nameplate to be visible.

3.2 ELECTRICAL PANELS

.1 Correct panel schedules to reflect changes made during work.

END OF SECTION