advanced building solutions

CANADIAN SPACE AGENCY
Cleaning of the ventilation systems and distribution

Specifications – Mechanical

2021-11-05
Project: ASC: 2021-19/ BPA: 2020-134-1012

CANADIAN SPACE AGENCY

6767, ROUTE DE L'AÉROPORT

SAINT-HUBERT (QUÉBEC)

J3Y 8Y9

CLEANING OF THE VENTILATION SYSTEMS AND DISTRIBUTION

DIVISIONS 01 AND 23

DOCUMENT ORIGINAL PDF SIGNÉ NUMÉRIQUEMENT

For tenders
November 5, 2021

TABLE OF SECTIONS

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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 Refer to the 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.

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 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 Restrictions regarding tobacco usage:

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

.4 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 HANDLING AND PROTECTION OF THE PREMISES

.1 During the work, the interested section, if necessary, must remove and replace ceiling tiles, floor tiles or access doors to reach its equipment and repair, at its own expense, all damage that it will have caused. Protect the furnishing and restore to a clean condition local when the work is complete.

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 the following work during periods of inoccupation, Monday to Friday between 18 h and 7 h, as well as on Saturdays, Sundays and holidays.

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

.6 The verification of shop drawings is general and has the main purpose of avoiding as many errors as possible in manufacturing. This verification does not relieve the relevant section of its liability for errors, omissions, information, dimensions, quantity of equipment, etc., appearing in their drawings.

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

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

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

.10 The drawings must be in French and/or in English.

1.17 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.

1.18 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.

1.19 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 The Contractor must determine the location and size of the doors to ensure easy access for cleaning ducts and ventilation systems.

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

.4 Cost associated with the installation of access doors required for cleaning must be included in the Contractor's bid. To help the latter in its estimate, the existing access doors are annotated on the reference drawing provided.

.5 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.

.6 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.

.4 Floors with carpet finish: Zurn no. ZN-1400-3 with clamp ring for the carpet, screws finished in bronze or polished bronze, as chosen by Architect.

.5 Floors with tile finish: Zurn no. ZN-1400-6 (round), fame and cover in polished bronze with removal for tile.

.6 Floors with cement finish: Zurn no. ZN-1400-2, frame and grille in ductile iron for heavy traffic, screws in stainless steel. Frame designed to be installed in concrete, grille of 3375 mm x 375 mm (14½" x 14½").

1.20 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

1.21 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".

1.22 MANUFACTURERS' INSTRUCTIONS

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

.2 Ensure the presence of the manufacturers' representative to attest the conformity of the installation.

1.23 LAYOUT AND ACCESS TO THE EQUIPMENT

.1 Install the equipment so that they are easily accessible for maintenance, disassembly, repair, and moving.

.2 If necessary, install access doors and accessories, such as extensions for the lubrication of bushings, etc.

1.24 SUPERVISOR

.1 Each section must retain and pay for the services of a competent and permanent supervisor or superintendent who must remain on site until the works are accepted, and, having full authority to represent the section. All communications, orders, etc. supplied by the 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.

1.25 INSPECTIONS

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

1.26 "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".

1.27 FINAL TESTING

.1 Each section must include all costs of final testing to the overall price in its tender. When the work is fully completed and settings, calibrations, and preliminary tests are successfully performed, run the final tests. Notify the Departmental Representative early enough to allow him to attend any of the tests judged necessary.

.2 In order to demonstrate that the work is complete and executed satisfactorily, each piece of equipment must run for a minimum period of fifteen days and that, prior to acceptance "with reservation". During this period, all equipment must operate simultaneously and not consecutively. The operation must be in automatic mode and set on controls as planned in the operating sequences.

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

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

1.29 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.

1.30 CLEANING WORK

.1 Continuous service:

.1 The ventilation systems must remain functional during the period of occupancy of the building, as established in the scheduling paragraph, therefore from 7h to 18h, Monday to Friday. If cleaning work is carried out during the week, outside this time slot, the operations should be scheduled so as to restart the ventilation system the next day.

.2 All major service cuts must be performed outside the occupancy hours of the building.

.2 Occupied rooms:

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

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

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

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

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

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

.3 Other restrictions:

.1 In order not to impair the function of the building that must remain in operation during construction:

.1 No vehicles other than trucks used to transport equipment has access to the site for the duration of the works.

.2 The use of all elevators is prohibited for construction purposes.

.2 Obey the Owner's rules and directives about signs, announcements, advertisements, smoking, etc.

.3 Limit equipment/materials to the area delimited set by the Owner for the storage of equipment. They must not congest the area. No part of the construction is to be burdened with a load of equipment that may be hazardous for it.

.4 Follow the Owner's sterility standards.

1.31 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.

1.32 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.

1.33 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.

1.34 SECURITY ESCORT

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

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

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

.4 Refer to the general and specific conditions of the contract.

1.35 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 Final balancing report.

.4 Demobilization.

.5 Drawings "as annotated by the Contractor".

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

COMPLIANCE CERTIFICATE

Project: _____

Project address: _____

Discipline: _____

Specification section: _____

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

Company name: _____

Address: _____

Telephone number: _____

Signatory name: _____

Signature: _____

Signatory title: _____

COMPANY SEAL

RESPONSIBILITY WAIVER – DWG PLANS

The _____

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

Project: _____

Subject: _____

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

We also recognize and agree that:

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

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

Signature: _____

Name (in print): _____

Address: _____

Telephone: _____

Email: _____

END OF SECTION

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PART 3 EXECUTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 PAYMENT FOR TEST LABORATORY SERVICES

.1 Retain the services of an independent testing laboratory and assume the costs.

1.3 REFERENCES

.1 Definitions:

.1 HVAC installation: collection of devices and components associated with a network of air ducts connecting outdoor air intakes to the furthest terminal distribution elements, notably consisting of:

.1 Rigid supply and return air ducts.

.2 Flexible ducts.

.3 Mixing boxes.

.4 Return air plenums, including ceiling distribution chambers.

.5 Heating and cooling coils.

.6 Condensate pans, drip separators and humidifiers.

.7 Fans, including their blades and casings.

.8 Filters, including their casings and frames.

.9 Duct acoustical lining.

.10 Diffusers, register grilles and other terminal elements.

.11 Registers and control/regulator devices.

.2 References:

.1 National Air Duct Cleaners Association (NADCA):

.1 ACR Standard, 2006 edition: Assessment, Cleaning and Restoration of HVAC Systems.

.2 North American Insulation Manufacturers Association (NAIMA):

.1 NAIMA 2005 – Cleaning Fibrous Glass Insulated Duct Systems – Recommended Practices.

.3 United States Environmental Protection Agency (US EPA):

.1 US EPA 1999, 40 CFR, parties 152 and 156.

.4 Canadian Standards Association (CSA):

.1 CSA-Z204-94 1999, Guideline for Managin Indoor Air Quality in Office Buildings.

1.4 INSPECTIONS PRIOR CLEANING

.1 The Contractor must inspect each system before cleaning.

.2 For each system, submit the inspection report prior to carrying out the work for analysis to the Owner and the Engineer.

.3 Submit the detailed video controlled cleaning plan following the inspection.

.1 Carry out a visual examination of the systems to be cleaned to be able to establish the type of work, tools and equipment required in order to perform the cleaning of the systems.

.2 Verify the accuracy of plans and specification.

.3 Verify flow rates for balancing purposes.

.4 Make sure that the inspection plan clearly indicates the camera entry points.

.5 Attach photos of each insertion point allowing the analysis of the accumulation of dust in the ventilation ducts.

.4 Provide the following number of camera entry points, depending on the type of ventilation system inspected:

.1 Air Handler Unit: two (2) points verification points in the system.

.2 Low pressure returns ducts: at least two (2) verification points.

.3 Cold supply ducts: at least two (2) verification points.

.4 Hot supply ducts: at least two (2) verification points.

.5 Exhaust ducts: at least two (2) verification points.

.5 The inspection of the systems must not disturb the normal operations of the premises nor have an impact on the environment.

1.5 SUBMITTALS

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

.2 Submit the detailed video controlled cleaning plan following a site visit.

.1 Ensure that the plan clearly indicates the sequence of operations, the camera and cleaning device insertion points, as well as the work calendar.

.3 Product data:

.1 Submit the required data sheets, as well as the manufacturer documentation relating to antimicrobial agents used in the work. Data sheets must list the product characteristics, performance criteria and limitations.

.2 Submit, for antimicrobial agents and coatings, the MSDS required by WHMIS.

.4 Testing laboratory: provide the name and address of the testing laboratory whose services are retained for the work.

.1 Submit the report for the analysis of the collected particles, which must contain the following:

.1 Location that particles were collected.

.2 Type of particles.

.3 Dimensions of the particles.

.4 Percentage of concentration of each type of particle in each sample.

.5 EPA registration: submit documentation certifying that the anti microbial agent proposed for use is EPA registered.

.6 The Contractor shall provide a detailed inspection of the system for approval prior to cleaning.

1.6 CLOSEOUT SUBMITTALS

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

.2 Post-cleaning inspection report: submit two (2) copies of the final inspection report, which must include data on collected particles, observations and recommendations, as well the following information and elements:

.1 Name and address of installation.

.2 Name and address of cleaning Contractor.

.3 Description of different HVAC systems, with drawings and sketches marking systems cleaned.

.4 Identification scheme for the various parts of the systems that have been inspected, with notes describing the methods of inspection or analyses performed.

.5 Identification of sampling points and type of analysis performed for each sample.

.6 Identification of every sample collected.

.7 Commentary and photographs of each sampling location and all other system characteristic observations made.

.8 Identification of systems tested, observations, suggestions for measure to be put in place and recommendations for maintenance activities to be carried out in the future.

.9 The seal and signature of the chemist responsible for preparing the report, which is from a testing laboratory independent of the company carrying out the cleaning work.

.3 Post-cleaning video survey: submit two (2) copies of video survey on USB key, which must include the following:

.1 Parts of the systems subjected to particle analysis and an evaluation of microbial growth.

.2 Parts of the system of particular interest and their location.

.3 Special internal characteristics.

.4 Problems such as damaged elements or control/regulation devices.

.5 Systems subjected to analysis, observations, measure put in place and recommendations made verbally or in writing.

.4 Submit a document proving that the dangerous or toxic material removed from the system were sent to a facility for contaminated waste.

1.7 STANDARDS AND BIBLIOGRAPHICAL REFERENCES

.1 IRSST – Institut de Recherche en Santé et Sécurité au Travail.

.2 WHMIS (Workplace hazardous materials information system) rules for all chemical products and liquid cleaners used on site.

.3 National Air Duct Cleaners Association (NADCA) – ACR 2002, Assessment, Cleaning and Restoration of HVAC Systems, latest edition.

.4 National Air Duct Cleaners Association (NADCA) – Understanding Microbial Contamination in HVAC Systems, latest edition.

.5 National Air Duct Cleaners Association (NADCA) – Introduction to HVAC System Cleaning Services, latest edition.

.6 National Air Duct Cleaners Association (NADCA) – Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems", latest edition.

.7 Underwriter's Laboratories (UL) – UL Standard 181.

.8 Environmental Protection Agency (EPA) – Building Air Quality, latest edition.

.9 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) – HVAC Duct Construction Standards – Metal and Flexible, latest edition.

.10 North American Insulation Manufacturers Association (NAIMA) – Cleaning Fibrous Glass Insulated Air Duct Systems, latest edition.

1.8 CONTRACTOR QUALIFICATIONS

.1 Contractor must be a member of the National Air Duct Cleaners Association (NADCA).

.2 The company must have been incorporated for ten (10) years, shown that it has ten (10) years of experience cleaning ventilation systems at provide proof when submitting its tender.

.3 That contactor will have in their employment a qualified workforce with at least two (2) years experience in cleaning ventilation systems and in the performance of work required for the completion of projects.

1.9 SITE SURVEY

.1 Refer to instructions in tender documents to see date and time for the site visit, as well as general instructions.

.2 The Contactor will be responsible for identifying height work areas during the site visit. No additional charges will be accepted during the execution following contract award.

1.10 SCHEDULE OF WORK

.1 Before starting work, the Contractor must supply a timeline, as the sections where they will start their work, all in coordination with the Owner.

.2 Consult the general conditions to establish the relation with the other work and prospective times to perform the cleaning,

1.11 SAFETY

.1 The Contractor is responsible for the development and respect of site (and adjacent) safety measures during the entirety of the work and all measure must be taken to ensure occupant safety.

.2 Before starting the cleaning work, the technicians must be provided with appropriate safety equipment to handle the dangerous conditions identified by the laboratory analysis.

.3 The Contractor is responsible for the development of lockout procedures to protect technicians from any accidental start up of the ventilation systems or other equipment during the work.

.4 The technicians must have completed the course "Health and safety on construction sites (ASP Construction)", including confined space training, as well as WHMIS, and carry their ASP Construction card with them at all times.

.5 In existing buildings, the Contractor must respect the codes and standards for occupant safety, as well as for the disposal of debris.

1.12 PROTECTION OF THE SITE

.1 The Contractor must ensure the protection of the building and equipment by using protective tarps and covers. At the end of work in each area all surfaces must be cleaned with HEPA filter equipped vacuum cleaners. Area and goods to be returned to same state of cleanliness as before the execution of work.

1.13 METHODOLOGY AND EQUIPMENT

.1 The Contractor must provide a list of primary equipment that will be used during the execution of cleaning work (photos, descriptions, specifications). Contractor must prove that they possess the required equipment. The Owner, in coordination with the Contractor, must establish a location for storage of equipment and material required for work.

.2 The Contractor must submit a procedure they intend to use for each component. It should be noted, for the cleaning of the supply and return ducts, only the “suction with moving brush” with be accepted.

.1 Mechanical method.

.2 Manual method.

.3 Cleaning products for ducts must be VOC-free and biodegradable.

.3 The Contractor is advised that the main ventilation ducts are equipped with reinforcement cross inside the ducts. Consider that reinforcement is applicable to all ducts larger than 600 mm.

1.14 LIST OF ACCEPTED COMPANIES

.1 Must comply with the article "PRODUCTS USED FOR SUBMISSIONS AND EQUIVALENCES" from section 20 00 10.

.1 Accepted companies:

.1 BioVac System
.2 Désinfectair
.3 Environ/Air
.4 Groupe Danco
.5 Hydraulique R&O Services Inc.

Part 2 Product

2.1 SCOPE OF WORK

.1 The cleaning work required is:

.1 As a first step, the Contractor must carry out an inspection of each systems described below to determine the accumulation level of dust particles. Following this inspection, the owner, in conjunction with the Engineer will decide whether it is necessary to clean the systems on an individual basis. Refer to the inspection prior to cleaning section for more details.

.2 Provide labor, material, equipment, and supervision necessary to perform cleaning of air ducts components and ventilation systems as specified below.

.3 List of systems to clean:

.1 System mentioned in the list below must be inspected beforehand by the Contractor and the validation that the cleaning work must be carried out will be confirmed by the Owner and the Engineer following receipt of the inspection report.

.1 System no. 1:

.1 001-alim-VA1
.2 001-alim-VA2
.3 001-retour-V21

.2 System no. 2:

.1 002-alim-VA1
.2 002-alim-VA2
.3 002-retour-VR1

.3 System no. 3
- .1 003-alim-VA1
- .2 003-alim-VA2
- .3 003-retour-VR1

.4 System no. 4:
- .1 004-alim-VA1
- .2 004-alim-VA2
- .3 004-retour-VR1

.5 System no. 5:
- .1 005-alim-VA1
- .2 005-alim-VA2
- .3 005-retour-VR1

.6 System no. 6:
- .1 006-alim-VA1
- .2 006-retour VR1

.7 System no. 7:
- .1 007-alim-VA1
- .2 007-alim-VA2
- .3 007-retour-VR1

.8 System no. 8:
- .1 008-alim-VA1

.9 System no. 9:
- .1 009-alim-VA1
- .2 009-alim-VR1

.10 System no. 11:
- .1 011-alim-VA1
- .2 011-alim-VA2
- .3 011-retour-VR1

.11 System no. 12:
- .1 012-alim-VA1
- .2 012-retour-VR1

.12 System no. 13:
- .1 013-alim-VA1
- .2 013-retour-VR1

.13 System no. 14:
- .1 014-VA2

.14 System no. 15:
- .1 015-alim-VA1
- .2 015-alim-VA2
- .3 015-retour-VR1

.15 System no. 16:
- .1 016-alim-VA1
- .2 016-alim-VA2
- .3 016-retour-VR1

.16 System no. 17:
- .1 017-alim-VA1
- .2 017-retour-VR1

.17 System no. 18:
- .1 018-alim-VA1
- .2 018-VA2

.18 System no. 19:
- .1 019-alim-VA1
- .2 019-retour-VR1

.19 System no. 20:
- .1 020-alim-VA1
- .2 020-alim-VA2
- .3 020-retour-VR1

.20 System no. 21:
- .1 021-alim-VA1
- .2 021-retour-VR1

.21 Exhaust systems nos.:
- .1 002-VE2
- .2 002-VE3
- .3 003-VE1
- .4 004-VE1
- .5 004-VE2
- .6 004-VE3
- .7 004-VE4
- .8 004-VE5
- .9 006-VE1
- .10 006-VE2
- .11 006-VE3
- .12 006-VE4
- .13 006-VE5

.14 008-VE1
.15 008-VE2
.16 013-VE2
.17 013-VE3
.18 014-VE1
.19 014-VE2
.20 014-VE3
.21 014-VE4
.22 014-VE5
.23 014-VE6
.24 014-VE8
.25 017-VE1
.26 018-VE1
.27 021-VE1

.4 List of components to clean:

.1 Clean the inside and outside of the fresh air and exhaust louvers.

.2 Clean the inside of the fresh air ducts.

.3 Clean the supply and exhaust fans.

.4 Clean the inside of the fresh and return air mixing boxes, the chamber, the shutters and the linkages.

.5 Clean the inside of the filter supports and all other mechanical components.

.6 Clean the chambers of the units.

.7 Clean the heating and cooling coils, the drain pan, and straighten the coil fins.

.8 Clean the inside of the supply, return and exhaust fan housing and the protective guards.

.9 Clean the inside of the supply and return ducts.

.10 Clean all the blades of the air baffles and extractors, and all other internal components of the ducts.

.11 Clean the inside of the high-speed ducts and their mechanical components.

.12 Clean the inside of the vertical ducts.

.13 Clean the by-pass flaps, the automatic and manual shutters and fire dampers within ducts, indicating their original position.

.14 Clean the electric heating coils.

.15 Clean all components inside the terminal units.

.16 Clean all return grilles, supply diffusers and their registers.

.17 Clean all drainage and drip trays.

.18 Clean the inside of the peripheral cabinets.

.19 Sanding and painting of components.

2.2 ACCESS DOORS

.1 Use existing access doors to perform the cleaning.

.2 If other access is needed, proceed as follows:

.1 For openings of more than 300 mm x 300 mm, a leak-tight door with locks must be installed according to accessibility, while maintain the operating pressure of the system. The Contractor must provide shop drawings for the access doors to be used (acceptable products: Nailor and Duct Mate).

.2 For small openings, pre-cut galvanised steel plates of the same gauge or thicker than the existing material, may be used. The plate must overlap the duct by at least 25mm all around the opening. For an opening of 250 mm x 250 mm, the plate must be at least 300 mm x 300 mm. A neoprene gasket of 3.2 mm x 15 mm must be installed around the opening to ensure leak-tightness. The plate to be fastened using self-drilling screws, installed a maximum interval of 100 mm. No openings will be made on flexible duct. Any insulating material on the outside must be replaced and match with existing.

.3 For medium and high-pressure ducts, openings will be permanently closed with pre-cut galvanised steel plates of the same gauge or thicker than the existing material. A permanent leak-tight seal for the duct will be made using cotton tape. The plate to be fastened using self-drilling screws, installed a maximum interval of 100 mm.

.4 During the work, the Contractor must take notes on the plans regarding where openings were made and any mismatch between the plan provided and actual system, and provide these plans to the Owner when work is completed.

.5 Openings made and their closing should not, under any circumstance, effect or restrict the volume of air traveling through the ducts.

2.3 ANTIMICROBIAL AGENTS

.1 Antimicrobial agents used must be registered with the US EPA (40 CFR).

2.4 FILTERS

.1 Coordinate replacement of filters with owner, in conjunction with finalizing cleaning of each unit. Filter will be supplied and installed by the owner's representative.

2.5 AIR DUCT CLEANING MATERIAL

.1 Manually operated rotary contact brushes:

.1 Ensure that brushes are specifically designed and made for adapting to different ducts, materials and elements in HVAC systems.

.1 Ensure that the brushed are an appropriate size for the different diameters of ducts in the HVAC systems.

.2 Make sure that the brushes allow scrubbing by direct contact of the interior walls of the ducts and equipment to be cleaned.

.2 Bushes: rotating, manual operation, with integrated motor, with nylon, polypropylene of other non-metal bristles.

.1 Ensure that the motor is strong enough to continue to turn the brush after the bristles are deformed.

.2 Replace used or inefficient brushes as needed.

2.6 MULTIFUNCTIONAL ROBOTIC CLEANING SYSTEM

.1 Self-propelled device with remote control, crawler or on wheels, equipped with the following accessories, especially camera, halogen lights, rotating brushes and a vacuum cleaner.

.1 Ensure that brushes are specifically designed and made for adapting to different ducts, such as those with acoustical lining, materials and elements in HVAC systems.

.2 Ensure that the brushes scrub with direct contact between the bristles and the elements to be cleaned.

.3 Replace used or inefficient brushes as needed.

.2 Camera: 360° rotating digital camera, remote focus, dustproof, with four (4) hours recording capacity,

.1 Lights: two (2) halogen lights, 20 W with dimmer.

2.7 DEFICIENCIES AND EXISTING DAMAGE

.1 If modifications need to be made to existing systems, or damage or deficiencies are found, report to Owner and Engineer.

.2 See also part 3 – Execution, article "FIBERGLASS INSULATION".

Part 3 Execution

3.1 PROTECTION OF COMPONENTS

.1 Ensure that all mechanical and electrical devices near the work are protected.

.2 Do not place objects, equipment, tools and other materials on the duct insulation.

.3 Note the position of balancing registers before cleaning. Ensure that baffles and registers are not moved. If some are moved by accident, return to their original position.

.4 Existing systems:

.1 Install a media filter or a sealed envelope (polyethylene) to the outside of the grilles and diffusers in order to prevent dust entering the rooms during the work.

3.2 CEILINGS

.1 Acoustical tile ceilings:

.1 Open and close ceilings. Clean and repair if they were dirtied or damaged during work.

.2 Gypsum or plaster ceilings:

.1 If it is necessary to open this type of ceiling, notify the Owner and Engineer, who will arrange for the cutting and the repairs.

3.3 FIBERGLASS INSULATION

.1 Use only cleaning methods and equipment compliant with standards from NADCA and NAIMA.

.2 Damaged insulation:

.1 If there evidence of damage, deterioration and/or of mildew and humidity such that insulation cannot be returned to a proper condition by cleaning or the addition of a layer of antimicrobial protection, notify the Owner and Engineer so repairs can be made.

.3 Replacement of damaged acoustic or thermal insulation is not part of the contract, but cleaning work must be performed after such repairs are completed.

3.4 REMOVAL OF MATERIAL AT RISK OF MICROBIAL CONTAMINATION

.1 All work involving removal of acoustical insulation or other contaminated material inside the ventilation system components must be performed in negative pressure. Negative confinement to be achieved by evacuating the air in the area to be treated using HEPA filters (99.97%, 0.3 micron), and an airlock be constructed at the area entrance using a support frame and plastic film with a minimum thickness of 0.6 mm. In addition, decontamination workers are required to wear protective equipment such as hooded covers, half face masks with HEPA filters, safety boots, gloves, protective glasses, etc. The Contractor must perform the decontamination of the surfaces following a submitted and approved method, as required by article "STANDARDS AND REFERENCES".

.2 Respect the norms and regulations in force in the locality.

3.5 ANTIMICROBIAL AGENTS

.1 See article "FIBERGLASS INSULATION".

.2 The use of antimicrobial agents should not be used unless there is significant appearance of mildew growth or if an unacceptable level of contamination is determined through testing.

.3 Application of anti microbial agents of permitted after the removal of surface deposits and debris.

.4 Application to be performed following manufacturer instructions. The agent must be sprayed directly onto the surface and not "atomized" through the system.

3.6 QUALITY CONTROL

.1 Quality:

.1 The quality control programme for the work must satisfy NADCA standards.

.2 Standards for dust:

.1 Ventilation ducts are considered clean if they pass visual inspection under a strong light (100 W) and if they meet NADCA-ACR dust standards of 0.75 mg/100 cm².

.3 The dust collection must be performed by the Contractor, according to the locations predetermined by the Engineer.

.2 Inspection:

.1 Provide remote-controlled video equipment (robot), as well as qualified personnel to operate the equipment, allowing the Engineer to inspect the duct interior at any time.

.2 If some of the inspected ducts do not meet standards and requirements listed above (visual and dust test), repeat cleaning of this part. Repetition of cleaning and inspection/testing fees will be at the Contractor's expense, without cost to the Owner.

.3 Video report:

.1 Provide two (2) copies of the complete video report, showing each component after cleaning for verification by the Engineer.

.2 The video must include identification of the systems and components.

.4 Written report:

.1 Provide two (2) copies of the written report for verification by the Engineer, and must include the following information:

.1 Name and address of the Contractor.

.2 Project name, number (and lot number, if applicable).

.3 Identification of installation cleaned and cleaning dates.

.4 Description of different HVAC systems, with drawings and sketches marking systems cleaned.

.5 Commentary and photographs of each dust collection location.

.6 Cleaning and dust collection methodology.

.7 Laboratory where analysis was performed and what type of analysis.

.8 Laboratory results.

.2 List of recommendations following cleaning, if any.

.3 Identification of the system must always accompany results, comments and recommendations.

.4 Each report must contain a title page and an index, placed inside a 3-ringed binder, and accompanied by a vide report. Plans mark ups were made they should be included in the report.

.5 Work will be considered complete when all reports are accepted by the Engineer.

3.7 LABORATORY ANALYSIS

.1 Ensure that the independent laboratory possess experience in testing samples for work in air duct cleaning.

.2 Ensure that the laboratory uses an electronic supermicroscope to perform the analysis and determine the constituent particles in the samples.

.1 Constituents to be identified by category and size.

.2 Submit analysis reports, containing the percentage concentration amounts of the constituents.

.3 Do not start cleaning work until analysis results are received.

.4 The analysis must be carried out by a chemist who is a member of the Ordre des chimistes du Québec.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 SUBMITTALS

.1 Inspection prior cleaning according to section 23 01 31 – Air duct cleaning for HVAC systems.

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

.1 Drawings of equipment used for cleaning.

.2 Access doors, thermal insulations etc.

.3 Certificate of compliance with relevant codes.

1.3 CLOSEOUT SUBMITTALS

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

.1 Performance documentation must include the following:

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

.2 Closeout report cleaning according to section 23 01 31 – Air duct cleaning for HVAC systems.

.2 "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 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 01 31 – Air duct cleaning for HVAC systems.
.2 23 05 00 – Common work results for HVAC.
.3 23 05 93 – Testing, adjusting and balancing for HVAC.
.4 23 07 13 – Duct insulation.
.5 23 31 13.01 – Metal Ducts – Low pressure to 500 Pa.
.6 23 33 00 – Air duct accessories.

.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 Inspection and cleaning of ventilation ducts according to the requirement of section 23 01 31 – Air duct cleaning for HVAC systems.
.2 All access doors required for inspection and cleaning.
.3 The insulation repair work required following the inspection and cleaning work.
.4 All tests.
.5 All balancing and adjustment of air quantities.

.4 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.

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

.5 Submissions – Prices to provide:

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

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 QUALIFICATION OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to the Engineer within ninety (90) days of award of contract.

.2 Submit documentation confirming staff's qualifications and experience.

.3 The testing, adjusting, and balancing operations must be performed in accordance with the requirements of standard governing the qualifications of the company and the staff responsible for the work.

.1 Associated Air Balance Council (AABC) – National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB, HVAC Systems – Testing, Adjusting and Balancing of 2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.2 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.3 COORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.4 START-UP

.1 Notify the Engineer seven (7) days prior to TAB.

.2 Only undertake TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, and other components that may affect results are complete.

.2 Installation of sealants, caulking, and weather-stripping is complete.

.3 Pressure tests, seal tests, and other tests defined in other sections of Division 23 are completed.

.4 Equipment required for TAB are installed and in good working condition.

.5 Start-up and verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Clean filters in place.

.2 Duct systems clean.

.3 Ducts, duct shafts, and plenums including ceilings are airtight, within specified tolerances.

.4 Correct fan rotation.

.5 Balancing, fire, and smoke dampers are installed and open.

.6 Coil fins are combed and clean.

.7 Access doors and hatches, installed and closed.

.8 Outlets installed, volume control dampers open.

.3 Hydronic systems:

.1 Systems flushed, filled and vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves are installed and open.

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

.6 Chemical treatment system complete, operational.

1.5 INSTRUMENTS

.1 Prior to starting TAB, submit to the Engineer a list of instruments to be used, with their serial numbers.

.2 Calibrate in accordance with requirements of the most stringent of referenced Standard for applicable system or HVAC system.

Part 2 Product

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 VENTILATION SYSTEMS

.1 General:

.1 Perform tests, measurements and adjustments to:

.1 Adjust fans to obtain the specified airflows.

.2 Adjust quantity of air to terminal equipment.

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

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

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

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

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

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

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

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

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

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

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

.2 Adjustment precision:

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

.1 Airflow adjustment:

.1 At terminal equipment: 10% ±

.2 In main ducts: 5% ±

.2 Differential pressure:

.1 Positive pressure zones:

.1 Supply: 0 to +10%

.2 Exhaust and return: 0 to -10%

.2 Negative pressure zones:

.1 Supply: 0 to -10%

.2 Exhaust and return: 0 to +10%

.3 General procedure:

.1 Equipment and system verification:

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

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

.2 Verify:

.1 Voltage and amperage of motors to avoid overload.

.2 Motor and fan rotation.

.3 Differential pressure switch (DPD) operation.

.4 Position of motorized dampers.

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

.6 Any obvious air leaks.

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

.2 Airflow at main branches:

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

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

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

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

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

.3 Minimum outside air:

.1 Adjust static pressure in unit's mixing plenum to zero or slightly negative, following the requirements of the site conditions, when the return damper is open to its maximum position. Balancing dampers installed before the mixing plenum is used to set the static pressure in the plenum.

.2 Adjust dampers to set the outside air to a maximum of 105% of design requirement.

.4 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 Terminal equipment adjustments:

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

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

.3 These adjustments may require multiple iterations.

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

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

.1 Motor amperage.

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

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

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

.4 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.

.5 Variable airflow systems:

.1 General:

.1 There are two main types of systems with variable airflows:

.1 Systems that depend on pressure (pressure dependent).

.2 Systems that are independent of pressure (pressure independent).

.2 Pressure dependant systems:

.1 This type of system is composed of terminal units modulated by a thermostat signal.

.2 The supply airflow varies to maintain the temperature in the room, the temperature of the supply air remains constant. The airflow in the system and the pressure constantly vary according to the demand.

.3 Pressure independent systems:

.1 Consists of terminal units that use a signal from the thermostat to vary the airflow and on air velocity controller limits the supply air to a set minimum and maximum.

.2 The supply airflow varies to maintain the temperature in the room, the temperature of the supply air remains constant for the same position of the flow control device.

.4 The main difference between the two types of systems is that for the same flow control device position, the pressure dependant system supplies a different quantity of air in the room in function of the pressure variation upstream of the terminal unit. In the case of a pressure-dependent system, if the thermostats are not properly calibrated, some areas might overcool or overheat. When zones are overcooled and receive more air than required, it reduces the quantity of air available to supply the overheated areas. Whereas the pressure independent system is not affected by the poor calibration of the thermostat because the air speed sensor limits the quantity of air supplied to the room.

.2 Adjustment procedure:

.1 Check maximum airflow rates that must be obtained by the supply and return fans. Diversity implies that the airflow of the fans will be less than the total airflow at grilles and diffusers.

.2 Obtain fan curves and surge data.

.3 Obtain characteristics of VFD or any other airflow control device where applicable.

.4 Obtain minimum and maximum operating pressures of terminal units.

.5 Establish theoretical operating curve of the system.

.6 Adjust terminal units in accordance with maximum airflow.

.7 Adjust fans to required speed, plus 5%.

.8 Check the most representative terminal units.

.1 If the variation of static pressure is significant or if the airflow to the terminal units is below the minimum with a maximum system flow rate, check all terminal units.

.9 At main branches, read airflow with a Pitot tube.

.10 If static pressure or flow is too low, increase fan speed.

.1 If flow is satisfactory, but the static pressure is too high, decrease fan speed.

.2 If static pressure is satisfactory or high, but the airflow is too low, check the fan installation for system effect.

.3 If there is no system effect re-adjust all air terminal units to required airflow.

.11 Repeat procedures 3.6.2.7 to 3.6.2.10 for the return and exhaust fans once the system is adjusted to the minimum outside air quality.

.12 Adjust airflows to the diffusers and verify design airflow when air terminal unit is fully open. Check minimum adjustment.

.13 Set terminal units to the minimum and adjust airflow rate control mechanisms at fans to obtain minimum flow and pressure.

.14 Coordinate with the Division 25 for the adjustment of airflow switches, static pressure sensors, terminal unit airflow regulators, etc.

.15 Verify that the return fan speed is adjusted in synchronization with supply fan to ensure that the correct outside airflow is supplied and that static pressure is maintained in the mixing plenum at all operating conditions.

.16 Operate the system at 100% outside air and check power and static pressure for the supply and return fans.

.6 Air induction systems:

.1 General:

.1 Usually, air induction systems are high-speed systems.

.2 Procedure:

.1 Proceed according to the general procedures for equipment and main branches. Determine the quantity of primary air to each unit by measuring the pressure in the unit's plenum and comparing to the airflow-pressure curve, published by the unit's manufacturer.

.7 Ventilation TAB report:

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

.1 Dated reports:

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

.2 Design data:

.1 Airflows:

.1 Supply

.2 Return

.3 Exhaust

.2 Fan static pressure.

.3 Motor power (HP).

.4 Brake horsepower (BHP).

.5 Fan speed (rpm).

.6 Minimum percentage of outside air.

.3 Characteristics of installed equipment:

.1 Manufacturer (model and serial no.)

.2 Unit size and dimensions.

.3 Arrangement.

.4 Construction class.

.5 Motor nameplate:

.1 Power

.2 Voltage

.3 Number of phases

.4 Frequency

.5 FLA

.6 Rotation speed

.4 Tests at main:

.1 Fan speed.

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

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

.4 Pressures at suction and discharge of the fan.

.5 Measured airflow.

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

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

.5 Test at the terminal devices:

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

.2 Type of terminal device:

.1 Manufacturer

.2 Model

.3 Dimensions

.4 Output factor

.3 Design airflow and air speed.

.4 Airflow and air speed results.

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

.6 Additional information:

.1 Fans:

.1 Dimensions and number of belts.

.2 Dimensions of pulleys.

.3 Position of adjustable pulleys.

.4 Full load motor speed.

.5 Overload protection adjustment.

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

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

.8 Airflow control device type.

.2 Air distribution system:

.1 Pressure reading at main branches.

.2 Pressure reading in ceiling spaces.

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

.4 List of Pitot tube tests with their results.

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

.8 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 Hydraulique

.3 Service de Mise au Point Leblanc Inc.

.2 Ottawa/Gatineau region:

.1 Calibration Brassard

.2 Kanata Air Balancing

.3 Maxima

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 10 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.

.3 References:

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

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

.2 ASTM International Inc.:

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

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

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

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

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

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

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

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

.9 ASTM-C921-03a – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):

.1 Preformed mineral fiber insulation: ONGC 51-GP-9M.

.2 Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering: ONGC 51-GP-40.

.3 Mineral fiber flexible blanket: ONGC 51-GP-11M.

.4 Mineral fiber rigid and semi-rigid boards: ONGC 51-GP-10M.

.5 Hydrated calcium silicate insulation: ONGC 51.2-M88 or 51-GP-2M.

.6 Vapor barrier covering: ONGC 51-GP-52Ma.

.7 PVC jacketing: ONGC 51.53-95.

.4 "k" thermal conductivity factors:

.1 ASTM-C-335 for precast or rigid insulation.

.2 ASTM-C-177 or C-518 for the other types.

.5 Green Seal Environmental Standards (GSES):

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

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

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

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

.8 Underwriters' Laboratories of Canada (ULC):

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

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

1.3 SUBMITTALS

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

.3 A list of recommend spare parts.

.3 Samples:

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

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

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

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Packing waste management: collect packing waste for reuse/recycling in accordance with section 01 00 10 – Mechanical and electrical general instructions.

1.5 MANUFACTURER'S INSTRUCTIONS

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

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

1.6 QUALIFICATIONS OF THE WORKFORCE

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

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 Elastomeric cellular thermal insulation in tubular, flexible sheet, or roll form, according to the application.

.3 Maximum thermal conductivity "k": 0.039 W/m.°C at 32°C.

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 PVC jackets:

.1 Preformed one piece molded jacketing compliant with CGSB 51.53-95, similar to the Proto Corp. PVC type or equivalent.

.2 Operating temperatures:

.1 Minimum: -20°C

.2 Maximum: 65°C

.3 Permeability: 0.02 perm.

.4 Thickness:

.1 Internal: 20 mils minimum.

External: 30 mils minimum; 40 mils minimum on piping 380 mm and larger.

.5 Adhesive and sealant: follow the manufacturer's recommendations.

.2 ABS jackets (for external use only):

.1 Preformed one piece molded jacketing.

.2 Operating temperatures:

.1 Minimum: -40°C

.2 Maximum: 82°C

.3 Permeability: 0.012 perm.

.4 Adhesive, sealant, and fastenings: Follow the manufacturer's recommendations.

.3 Canvas jackets:

.1 Cotton canvas having a density of 220 g/m² and when exposed and 120 g/m² when concealed, coated with a diluted insulating fire retardant adhesive, compliant with the standards ASTM-C921 and ASTM-E84.

.4 Aluminum jackets:

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

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

.3 Jackets for connecting to matrix elements made of 0.4 mm thick aluminum alloy with factory installed internal protective covering.

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: 8.6×10^{-8}/°C

.6 Maximum operating temperature: 482°C

.7 Thermal conductivity: 0.48 W/m.°C.

.8 Foamglas from Pittsburg Corning.

2.8 MANUFACTURER LIST

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

.2 List of manufacturers, section 23 07 13:

.1 Type B thermal insulation:

.1 Armacell AP from Armaflex with adhesive 520 and WB finish.

.2 Rubatex Insul-Tube 180 with adhesive R-373 from Nomaco RBX.

.2 Type C thermal insulation:

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

.2 Knauf: sleeve for air ducts with FSK.

.3 Alley Wrap with FSK.

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

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

.3 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.

.4 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.

.5 Insulating cement:

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

.6 Mechanical Fasteners:

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

.7 Canvas jackets:

.1 Flexpak

.2 S. Fattal Cotton Inc.

.8 PVC jackets:

.1 Johns-Manville

.2 Proto Corp.

.9 Aluminum jackets:

.1 Thermoclad Plus jacketing with anti-corrosion protection, Polysurlin type, Stucco finish.

.10 Fire protection insulating direct sleeves:

.1 Fire Master type Thermal Ceramics

.2 CL4 Fire

.11 Thermal insulation protection support:

.1 Insulgard

.2 Steel support

.12 Exterior Duct Membrane:

.1 Rubberized asphalt membrane with aluminum coating Flexclad MFM.

.2 Self-adhering aluminized coating, five ply, Venture Clad no. 1577CW from Venture Tape.

.3 Rubberized asphalt membrane with aluminum coating, Polyguard from Alumaguard.

Part 3 Execution

3.1 PREPARATORY WORK

.1 Only install the insulation once the system has been tested and the results have been certified by the responsible authority who has witnessed the test.

.2 Ensure surfaces to be covered with insulation or with a finish coating are clean, dry, and free of foreign matter.

3.2 INSTALLATION METHOD

.1 The insulation work is considered as:

.1 Concealed: pipes and ducts are installed in suspended ceilings, walls, shafts, and floors.

.2 Exposed: exposed pipes and ducts must be insulated on all sides, even on non-visible sides against walls or ceilings.

.3 Ducts and pipes in mechanical rooms, tunnels, and service spaces are considered exposed.

.2 Install insulation once all tests are complete and accepted, and air inside the building is dry enough and in conditions conforming to the manufacturers standards. Install insulation continuously, without interruption.

.3 All equipment, piping, and ducts must be clean and dry before installing the insulation.

.4 Consult the other mechanical sections to determine the type of ducts, piping, fittings, valves, and other accessories installed by other Contractors. The insulation Contractor must consider that Contractors from Divisions 21, 22, and 23 will use the Victaulic type fittings where allowed and will tender accordingly.

.5 This section is responsible for the proper installation of insulation in the locations specified.

.6 When insulation is likely to be damaged by impact or crushing near the access doors, doors, access panels, corridors, etc., protect with a 1.3 mm galvanized steel sleeve (18 gauge).

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

3.3 APPLICATION

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

.2 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.

.2 Outdoor:

.1 Rectangular and round ducts:

.1 Apply vapor barrier tape on all vapor barrier joints and breaks and all corners of mixed temperature and cold ducts.

.2 Over insulated surface, apply an embossed aluminum jacket fixed with rivets. All joints to be sealed.

.3 On insulation surfaces, apply a coat (minimum 1 liter/1.5 m²) of weatherproof coating. While it is still wet, impregnate the reinforcing membrane with a final coat (minimum 1 liter/1.5 m²) of weatherproof coating.

.4 Alternative:

.1 For rectangular ducts, Polygard membrane system or equivalent Flex Clad or Venture Clad, may be used. See paragraph Exterior Duct Membrane in "MANUFACTURER LIST". Use Alumaguard 60 membrane (top and sides) and Alumaguard Lite (underside). These membranes are designed to adhere to FSK and ASJ. For ambient air temperatures from -4 to 10°C, use the adhesive activator Cold Weather Activators from Polyguard. Always follow manufacturer's recommendations.

.5 Refrigerant piping:

.1 Application:

.1 Use methods recommended by the manufacturer. Seal all longitudinal and transverse joints with adhesives specified in this section. Where exposed, insulation is covered with a layer of vapor barrier paint specifically recommended for this type of insulation.

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 with external isolation on supply:

.1 All supply ducts from the system’s plenum boxes in the mechanical room and in shafts:

.1 In the mechanical room:

.1 Insulation: type D

.2 Thickness: 50 mm

.2 In shafts:

.1 Insulation: type C

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

.3 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

.3 Exhaust systems or any portion of duct leading to the outside:

.4 Outdoor air intakes, exhaust air outlets and outdoor air and exhaust air ducts:

.1 On exterior of plenum box, the entire acoustically uninsulated portion, or the underside and sides to a height of about 150 mm. The thermal insulation must overlap the interior acoustic insulation by 50 mm:

.1 Insulation: type D

.2 Thickness: 100 mm in two 50 mm thicknesses with overlapping joints.

.2 In mechanical rooms, on all outdoor air and exhaust air ducts, from the plenum box to the air handling unit or fan:

.1 Insulation: type D

.2 Thickness: 100 mm in 50 mm two layers with overlapping joints.

.3 On all outdoor air and exhaust air ducts located within the building, but outside the mechanical rooms:

.1 Insulation and thickness:

.1 As above, except at critical points (high humidity or electrical equipment rooms). These ducts will be double walled and insulated and do not require external insulation. Check plans and ventilation specification.

.4 On exhaust air ducts, at the outlet of the exhaust fans, extend the insulation 2.5 m upstream of the motorized dampers.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

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

.2 Section 23 01 31 – Air duct cleaning for HVAC systems.

.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 fixtures and equipment.

.1 Shop drawings:

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

.2 Certificates:

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

1.4 CLOSEOUT SUBMITTALS

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

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Waste management and disposal:

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

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

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

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

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

Part 2 Product

2.1 GENERAL

.1 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 stainless steel pipes, see the article "SPECIAL DUCTS".

.4 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.

.5 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.

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

.7 Seal the joints of the ducts.

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

.9 Ducts exiting service shafts: installed inside the shaft with a collar securely fastened to the duct and to the shaft wall. Seal the joints.

.10 Definitions:

.1 Low pressure ducts:

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

.11 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.

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

2.2 LOW PRESSURE DUCTS

.1 Ducts:

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

.2 Connections:

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

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

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

.3 Joints:

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

2.4 MANUFACTURER LIST

.1 Comply with the article "MANUFACTURER LIST" in section 01 00 10 – 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 Special ducts (double wall):
  - .1 Ingénia Technologies
  - .2 Racan-Carrier
  - .3 Rosemex
  - .4 Ventrol
- .3 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)
- .4 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)
- .5 Gaskets:
  - .1 Hardcast Carlisle (Flange Gasket 1902)
  - .2 Multifeutre du Quebec Ltd
  - .3 3M Ltd (LC-105 Gaskets)
- .6 Prefabricated round and oval ducts:
  - .1 J.P. Lessard
  - .2 Les Industries Mégatube Canada Inc.
  - .3 Spiro Méga Inc.
  - .4 Spiro Métal Inc.
- .7 Flexible ducts:
  - .1 Boflex Inc. (types AS and AI)
  - .2 Trans-Continental Equipment Ltd (AI-U-Flex)
  - .3 Flexmaster Co. Ltd (Triple Lock)

.8 FRP fibre-reinforced plastic ducts:
- .1 A.C. Plastiques
- .2 M.K. Plastics
- .3 Plastiques CY-BO

.9 Accoustic plenums:
- .1 Ingénia Technologies
- .2 Racan-Carrier
- .3 Vibron Ltd (P.G.A.L.)

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

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

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

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

Part 3 Execution

3.1 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.

3.2 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.

3.3 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.

END OF SECTION

TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

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

.2 Product data:

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

.3 Shop drawings:

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

.4 Certificates:

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

1.4 CLOSEOUT SUBMITTALS

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

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

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Waste management and disposal:

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

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

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

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

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

Part 2 Product

2.1 GENERAL

.1 The accessories must be manufactured according to the SMACNA HVAC Duct Construction Standard.

2.2 ACOUSTIC INSULATION – AIR DUCTS

.1 General:

.1 Provide samples of each proposed type.

.2 Supply and the install the acoustic insulation required inside the ducts and the ventilation units.

.3 This section does not apply to areas where there are acoustic plenums.

.4 Standards to be met:

.1 CAN/ULC-S102 and NFPA-90A/90B: flame spread index no more than 25, smoke developed index no more than 50, reduced combustibility.

.2 ASTM-C1071: type 1 for flexible insulation and type 2 for rigid panels.

.3 ASTM-C518: thermal efficiency at a temperature of 24°C.

.4 ASTM-C423: type A assembly for optimum sound absorption coefficient.

.5 ASTM-C916: adhesives and sealants suitable for temperatures up to 93°C.

.6 NAIMA and NADCA: the surface exposed to the air flow must comply with the standards from NAIMA (North American Insulation Manufacturer's Association) in order to be capable of withstanding the dry cleaning methods recommended by NADCA (National Air Duct Cleaning Association).

.2 Definitions:

.1 Ventilation units:

.1 For acoustic insulation, ventilation units imply the return air plenum, the rooms upstream and downstream of the coils and filters, the fan’s plenum, and the fan’s exhaust plenum.

.2 When a partition sheet is required within a duct or a plenum and acoustic insulation is required, install the partition sheet with insulation on both faces.

.3 Interior dimensions:

.1 The dimensions of the ducts and the ventilation units indicated in the drawings are the free inner dimensions. Increase the dimensions of the ducts and units with acoustic insulation in order to maintain the same inner section.

.4 Materials:

.1 Flexible insulation:

.1 For use on specified surfaces (see part 3 "Execution").

.2 Fiberglass liner, 13 to 50 mm thick.

.3 Density of at least 24 kg/m³.

.4 Thermal resistance of at least:

.1 0.39 m².°C/W, for a 12 mm thick liner.

.2 0.74 m².°C/W, for a 25 mm thick liner.

.3 1.41 m².°C/W, for a 50 mm thick liner.

.5 On the reinforced lined side, air flow velocity of up to 30.5 m/sec.

.6 Noise reduction coefficient of 0.70 for a 25 mm thickness.

.7 Similar to the type Linacoustic RC from Manville.

.2 Rigid insulation:

.1 Use on flat surfaces where indicated (see section 3 "Execution").

.2 Rigid fiberglass panels, 16 to 50 mm thick.

.3 Density of at least 48.1 kg/m³.

.4 Thermal resistance of at least:

.1 0.76 m².°C/W, for a 25 mm thick liner.

.2 1.15 m².°C/W, for a 38 mm thick liner.

.3 1.53 m².°C/W, for a 50 mm thick liner.

.5 Surface exposed to the air flow and edges, treated with a durable acrylic coating.

.6 On the exposed lined side. Maximum airflow velocity of 30.5 m/s.

.7 Noise reduction coefficient of 0.70 for a 25 mm thickness.

.8 Similar to the type Permacote Linacoustic R-300 from Manville.

2.3 EROSION PROTECTION FOR INSULATION

.1 Protective fabric to be installed where specified (see section 3 "Execution").

.1 Plain weave fabric, 12.6 threads/cm chain and 10.6 threads/cm weft, 0.125 mm thick and weighing 98 g/m².

.2 Adhesive and fabric:

.1 The adhesive and the fabric must be UL approved, have been tested according to the method ASTM-E-84-81A, and conform to the following maximum indexes:

.1 Flame spread: 25

.2 Combustibility: 50

.3 Smoke developed: 50

2.4 ACCESS DOORS

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

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

.3 Seals: neoprene.

.4 Hardware parts:

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

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

.3 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.

2.5 MANUFACTURER LIST

.1 Comply with article "PRODUCTS USED FOR TENDERS AND EQUIVALENCES" from section 01 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 Pressure relief dampers:

.1 American Warming & Ventilating

.3 Adjustable volume dampers:

.1 Anémostat

.2 E.H. Price Ltd

.3 Nailor Industries Inc.

.4 Titus

.4 Acoustic insulation –Ventilation ducts:
- .1 Certainteed
- .2 Isolation Manson Inc.
- .3 Knauf FiberGlass
- .4 Manville
- .5 Ottawa Fiber
- .6 Owens Corning

.5 Erosion protection for insulation:
- .1 Bay Mills
- .2 BGF Industries Inc. (fiberglass fabric)

.6 Catwalks, guard rails, stairs, and ladders:
- .1 Suppliers:
  - .1 Amico ISG
  - .2 Fisher & Ludlow
- .2 Manufacturer suppliers:
  - .1 Acier St-Denis Inc.
  - .2 Orbi Metal Construction Inc.
  - .3 Waverley Metal

.7 Adhesive for insulation:
- .1 Duro-Dyne
- .2 Hardcast Carlisle

Part 3 Execution

3.1 ACOUSTIC INSULATION –VENTILATION DUCTS

.1 General:
- .1 Unless otherwise indicated, install according to the applicable SMACNA standards.
- .2 When the acoustic insulation also serves as a thermal insulation, install the insulation continuously, seal all joints and cover the entire interior metal surface.
- .3 The dimensions of the ducts and ventilation units indicated in the drawings are the free inner dimensions. Increase the dimensions of the ducts and the units with an acoustic insulation in order to maintain the same inner section.

.2 Fastening method:
- .1 Protect the ends of the acoustic insulation with a Z riveted to the duct.

.2 When the insulation also serves as a thermal insulation, completely seal the ends with a non-hardening compound.

.1 Low pressure pipe:

.1 Fix the insulation in place as described below:

.1 The leading edges and the transverse joints exposed to the air flow must be coated in-factory, in-shop, or covered in adhesive during installation.

.2 Attach the acoustic insulation using an adhesive on at least 90% of the sheet surface to be covered.

.3 Use mechanical fasteners consisting of plates fixed with suitable adhesive or welded to the surface of the duct, sufficiently long pins and attaching and retaining rings. These mechanical fasteners are installed with a maximum spacing of 455 mm, but in numbers sufficient according to the manufacturer's recommendations.

.2 Medium and high pressure pipes:

.1 Rectangular ducts:

.1 Acoustic insulation fixed by a sheet of galvanized steel 0.701 mm (24 gauge) thick with openings providing a maximum attenuation while preventing erosion of the acoustic medium, or 25 mm galvanized hexagonal wire mesh fully covering the acoustic insulation.

.2 Circular and oblong ducts:

.1 Acoustic insulation covered by a fiberglass fabric, type 126, held in place by a galvanized wire mesh, 1.613 mm (16 gauge) diameter.

.3 Sealing joints:

.1 Seal with tape and a sealant: the edges exposed to the air flow, the covering's butt joints, the spaces around the pins, and any areas with damaged covering. Lay the tape on the joints according to the manufacturer's written recommendations.

.4 Thickness exceeding 50 mm:

.1 In the case where the specified thickness exceeds 50 mm, install a blanket composed of successive layers of 25, 38, or 50 mm thick rigid insulation under the final cover plate of 50 mm so as to obtain the total specified thickness.

.5 Locations:

.1 The Contractor is responsible for repairing acoustic insulation where it would have been damaged by cleaning and where access doors are added to ventilation ducts provided with acoustic insulation.

END OF SECTION