

AGENCE SPATIALE CANADIENNE
CANADIAN SPACE AGENCY



JOHN H. CHAPMAN SPACE CENTRE
6767, ROUTE DE L'AÉROPORT
LONGUEUIL (ARR. ST-HUBERT), QUÉBEC

**INDOOR AIR QUALITY WORKS
PROJECT # A13-3.1.2**

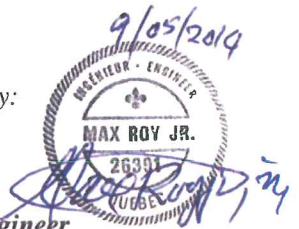
**TECHNICAL SPECIFICATIONS
MECHANICAL**

Issued May 9th, 2014

For tender

Prepared and verified by:

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Rochon Experts-Conseils inc.

Dossier R E-C : 14-003-B

Division 23: Heating, ventilation and air conditioning

Section 230500E	Common work results for mechanical	13 pages
Section 230502E	HVAC installation air duct cleaning	5 pages
Section 230593E	Testing Adjusting and Balancing (TAB) of mechanical systems	3 pages
Section 233300E	Air duct accessories	3 pages

Appendix

Location description	34 pages
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1. PART 1 – GENERAL

1.1 General

- .1 This section applies to mechanical works indicated on plans and in attached Division 23 that form the Mechanical Specification.
- .2 This section complements all contract clauses, all general clauses of Departmental Representative clauses. Most restrictive clauses take precedence.
- .3 These Mechanical Specifications concern the Contractor responsible for the whole works and the Mechanical Contractors. The Contractor responsible for the whole works has overall responsibility and ensures good coordination for work performed by its Mechanical Contractors regarding the work. The Contractor responsible for the whole works must resolve any conflict that arises between Contractors.
- .4 The word "Contractor" in this specifications document means the Contractor responsible for the whole works. The words "Departmental Representative" in this document means PWGSC, or the Canadian Space Agency or its authorized representative including "Rochon Experts-Conseils inc." for the professional engineering services.
- .5 Responsibilities – Scope of work
 - .1 Work described in sections of divisions below, is an integral part of the responsibilities of the Contractor.
 - .1 Division 23: HVAC,
 - .2 The work described on the following plans are an integral part of the Contractor responsibilities:

CSA project file no.	Project title	Mechanical drawings No.
A13-3.1.2	Indoor air quality works	H-01 to H-22

- .3 The drawings and specifications complete each other and shall be read together in order to well understand the scope of work and associated specifications.
- .4 Special notes regarding the works:
 - .1 The cleaning works are by a specialized Contractor well known in the discipline and he will take charge of the coordination and the general responsibility of the works.
 - .2 The HVAC systems balancing works are by a Contractor specialized in that discipline and he will be a sub-contractor of the Contractor responsible for the whole works.
- .5 Scope of works
 - .1 The HVAC systems cleaning works will be realized following the specifications of the section 230502E of this document and concerning all the systems listed in the schedule shown on plan H-01, except when otherwise indicated.
 - .2 The HVAC systems balancing works will be realized following the specifications of the section 230593E of this document and immediately after a system having been cleaned or a group of systems cleaned up.
 - .3 Systems of less than 4 700 l/s (10 000 cfm) are out of the scope of work, except the following ones:
 - .1 Every type A or B system, whatever flow capacity.
 - .2 Systems of type different then A or B and of the following numbers listed in the schedule of plan H-01:
 - .1 # 8, 23, 24, 41, 42, 43, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 61, 62, 63, 64 and 72.
 - .3 Systems indicated "out of contract" on plans will not have to be cleaned neither balanced.

- .4 Phasing and working hours:
 - .1 The works planning shall be sprayed over a three (3) year period in multiple separated phases.
 - .2 Systems stopping and their cleaning shall happen during evenings between 6:00 PM and 6:00 AM or during week-ends from Friday 6:00 PM to Monday 6:00 AM, all upon written authorization given to the Contractor by the Canadian Space representative.
 - .3 TAB works may be done during normal operation hours of the J.H. Chapman Centre inside technical mechanical and/or electrical rooms, but during the above hour periods in rooms occupied by Canadian Space Agency's personnel.

1.2 Work schedule diagram

- .1 Within fifteen (15) business days following the award of the contract, submit milestones for work of this nature, a scheduling diagram and a work schedule indicating the dates of the various completion stages of work, which should be completed by the deadline specified in the contract.
- .2 Revision of work progress, according to submitted schedule, will be held at the discretion of the Departmental Representative. The schedule will be updated by the Contractor, with collaboration of and approval by the Departmental Representative.
- .3 The J.H. Chapman Centre normal operation hours are from 6:00 AM to 6:00 PM, from **Monday to Friday**.
- .4 Any **noisy work** or any **service interruption** shall happen outside of these normal operation period above, and upon written authorisation of the Departmental Representative.
- .5 Works inside mechanical rooms or technical corridors that do not jeopardize the normal operation of the J.H. Chapman Centre may be executed during the above normal operation hours.

1.3 Permits and certificates

- .1 Obtain all required permits, inspection certificates and certificates of acceptance before starting and completing successfully all work, and pay for the cost of such permits and certificates.
- .2 Refer to the description of each section for individual permits and certificates required. These permits and certificates shall be returned to the Departmental Representative and will be a condition for acceptance of work.
- .3 The City of Longueuil (arr. St-Hubert) construction permit is not required.

1.4 Plans and specifications

- .1 Plans and specifications are an integral part of the contract and complement each other and work appearing on one and not the other, and vice-versa, shall be executed as if they were mentioned in both. All work or material not listed or specified but implicitly required for the installation of a complete system, as proposed in plans and specifications, shall be included in the bid and installed.
- .2 The Contractor shall inform the Contracting Authority for any errors or omissions that he could detect on plans at the time of bidding, in order to obtain any necessary clarification to present a full bid.
- .3 In case of conflict, the Contractor shall inform the Contracting Authority who will give an exact interpretation of the disputed point.
- .4 All notes on plans are deemed to be part of this contract.
- .5 Any change in plans and specifications during the bidding process will be given in writing.

1.5 Codes and standards

- .1 Unless otherwise stated, work shall be done in accordance with National Building Code of Canada (NBC), and any other applicable provincial or municipal code. In case of omissions and contradictions between these standards, the most stringent requirements shall apply.
- .2 Work must comply with or exceed requirements of standards, codes and other documents referred to.

1.6 Site examination

- .1 In his bid, the Contractor implicitly confirms that he knows all local conditions that may affect the performance of his work and that he has taken them into account in his bid. No supplement will be granted for works and materials needed but not planned by the Contractor.
- .2 Prior to work, the Contractor shall check all elevations and dimensions on site.

1.7 Modification of work

- .1 No change to original plans and specifications shall be made without a written request by the Departmental Representative writing and before an assessment, in accordance with the following, if first approved by the Departmental Representative. If the Departmental Representative asks for modification that entails no price adjustment, the Contractor shall perform it immediately without further notice.
- .2 In all cases, the Departmental Representative will have to be consulted and he/she alone can give permission for change to be made regarding plans and specifications. All work that does not comply with plans and specifications will be modified by Contractor, without any additional costs.
- .3 The Departmental Representative will have the right to request changes to plans and specifications as required during construction. These changes will not affect neither nullify this contract's terms and conditions. If these changes entail an increase or a decrease in the cost of work, this contract will be amended following an assessment, in accordance with the following section.
- .4 All additional work will be governed by the terms and conditions of this contract.

1.8 Specified and equivalent equipment or materials

- .1 When equipment or material is specified by reference to a standard, choose equipment or material that meets or exceeds the requirements of this standard.
- .2 The Contractor shall base his bidding price on equipment or materials identified by catalogue numbers or on equipment manufactured by one of the manufacturers or on trademark identified in plans and specifications for such equipment. If a single product is specified, the bid shall be based on this product.
- .3 Mention of names of manufacturers on plans and specifications in addition to the product specified by a catalogue number does not mean that the Departmental Representative agrees to accept a product brand. It is the responsibility of the Contractor to ensure the equivalency of the products he uses in his bid and to prove it during presentation of shop drawings. The Departmental Representative will be the sole judge for equivalency of a product, and in case of refusal of a submitted product by the Departmental Representative, the Contractor shall provide the equipment specified by a catalogue number.
- .4 The Contractor may propose in his bid products differing from those listed in plans and specifications, but the conditions of the "Substitutions" section below will apply.
- .5 Changes in the work, design and drawings caused by an equivalent product will be the responsibility of the Contractor.

- .6 It is understood that the choice of material does in no way modify Contractor responsibilities.
- .7 Unless otherwise stated, use the products of a single manufacturer for materials and equipment that are of the same type or same class.
- .8 Required quality or acceptable product:
 - .1 Means that the equipment or material indicated and identified by a catalogue number is an integral part of the specifications and serves as performance and quality indicator for material and work.

1.9 Substitutions

- .1 When equipment or material is specified by a catalogue number or by a trademark or a manufacturer, the Contractor may request for alternative equipment or material if brand or manufacturer's name is not mentioned.
- .2 Request for substitution must be made in writing within thirty (30) days of award of contract.
- .3 Enclose with the request for substitution a comparative table of the main specifications of specified equipment or material and of proposed equipment or material; this table will include all data on overall dimensions and electrical and mechanical data specific for this kind of equipment or material.
- .4 Join to the request for substitution the following information:
 - .1 Copy of the bid for specified equipment or material;
 - .2 Copy of the bid for proposed equipment or material; if it is possible go save money, price difference will be submitted to the Departmental Representative;
 - .3 Reasons for the request for substitution.
- .5 Request for substitution will be taken into consideration only if:
 - .1 Specified equipment or materials is not available; or
 - .2 Delivery schedule for specified equipment or materials unduly delays work; or
 - .3 Proposed equipment or materials is deemed equivalent to specified equipment, taking into consideration maintainability and availability of spare parts.
- .6 The Contractor is responsible to demonstrate equivalence, at his own expense.
- .7 The Departmental Representative reserves the right to require the Contractor to pay for the examination of the substitutions.
- .8 The decision regarding approval or refusal of substitution will be taken by the Departmental Representative and this decision will be final.
- .9 If the specifications of the approved substitution equipment or material require changes to plans and work to be perform, pay for the costs of all these changes. In case of refusal of the proposed equipment or material, supply and install the equipment or material specified by a number, all without additional charges.

1.10 Shop drawings and product data

- .1 Submit shop drawings and product data as specified. Submit shop drawings and product data in an electronic Acrobat form.
- .2 Shop drawings shall bear the seal of the Contractor and the signature of an authorized representative stating that submitted documents have been approved, that measures taken on site have been verified and that they comply with contract documents.
- .3 Shop drawings must also include the following information:
 - .1 Dates of preparation and revision;
 - .2 Project name and number;

- .3 Section number where a shop drawing is required;
- .4 Name and address of:
 - .1 Subcontractor;
 - .2 Supplier;
 - .3 Manufacturer.
- .4 Shop drawings and product data must be accompanied by typed information sheet.
- .5 Shop drawings and product data must show the following information:
 - .1 Details of installation;
 - .2 Working space necessary to operate and maintain equipment, e.g. working space necessary for the operation of access doors;
 - .3 Power supplies required and their specifications;
 - .4 Technical details for evaluating the performance of submitted equipment.
- .6 Submit the following documents with shop drawings and product data:
 - .1 Drawing details of bases, materials and anchor bolts;
 - .2 Data on acoustic power of systems and equipment, as appropriate;
 - .3 Performance curves showing operating points;
 - .4 Document submitted by the manufacturer certifying that the products in question are current models;
 - .5 Certificate of compliance to the relevant codes;
- .7 Shop drawings will be commented by the Departmental Representative and the Contractor must comply with the following comments:
 - .1 Supply equipment as submitted on shop drawings;
 - .2 Supply equipment taking into account corrections and annotations;
 - .3 Review equipment drawings and resubmit;
 - .4 Equipment refused. Resubmit drawings using specified equipment.
- .8 Comments indicated on shop drawings are broad in nature and are not intended to serve as final document. Therefore, they do not relieve the Contractor of his responsibility to verify plans himself or to supply materials and work required by plans and specifications.
- .9 The Departmental Representative retains the right to remove, at Contractor's expenses, all materials or products that have not been officially presented on shop drawings and installation plans.
- .10 Retain a copy of shop drawings and product data on work site and ensure that they are always available for reference.
- .11 All shop drawings and product data must be written in French.

1.11 Equipment and materials

- .1 Quality
 - .1 Equipment and materials used in performing the work must be new (unless otherwise indicated), in perfect condition, manufactured, assembled and tested at the factory, of the highest quality in accordance with terms and conditions of contract documents and ready to be installed for intended purpose; if necessary, provide evidence showing nature, origin and quality of supplied products.
 - .2 Equipment and materials shall be affixed with appropriate CSA, ULC or other certification labels, and be installed in accordance with applicable codes and standards.
 - .3 All markings on equipment and materials (operating instructions or other) must be in French.
 - .4 Equipment and materials found defective before completion of work will be rejected, whatever the findings of previous inspections. Inspections are not intended to relieve Contractor of his responsibilities, but simply to reduce the risk of omission or error. The Contractor shall ensure removal and replacement of defective products at his own expense, and will be held responsible for delays and costs.

- .5 In the event of conflict regarding quality or suitability of products, only the Departmental Representative shall settle the matter, based on the requirements of contract documents.
 - .6 Unless otherwise indicated, ensure some degree of uniformity by ensuring that equipment or material of a similar nature come from the same manufacturer, that they are the same standard product from a manufacturer and that parts required for maintenance are available at all times.
 - .7 Labels, trademarks and permanent nameplates affixed in a conspicuous way on to be installed equipment or materials are not acceptable unless they contain operating instructions or they are affixed on equipment or material installed in mechanical or electrical rooms.
 - .8 Equipment or material shall have specifications and dimensions suitable for sites where they will be installed. Notify the Departmental Representative before installing equipment or material which does not respect these conditions.
- .2 Availability
- .1 Immediately after award of contract, review requirements for delivery of equipment or material and anticipate any delay. Order required quantities in a timely manner, taking into account work schedule and storage capacity on site. If some delays in delivery is to be anticipated, notify the Departmental Representative so that measures can be taken to substitute equipment or material for alternative ones or make necessary corrections sufficiently in advance to avoid any delay in project.
 - .2 In the event that the Departmental Representative had not been notified of delays in delivery that could have been anticipated prior to work, and that it seems likely that execution of work will be delayed, the Departmental Representative reserves the right to change planned equipment or materials for comparable equipment or materials that can be delivered more quickly, without any increase in contract prices.
- .3 Transportation
- .1 Pay for the cost of transportation for equipment or materials required for executing the work.
 - .2 Departmental Representative will pay the cost of transportation for equipment or materials supplied by the Departmental Representative. Assume responsibility for unloading, handling and storing equipment and materials. The Contractor will supply lifting equipment required from delivery point to installation point of equipment and materials.
 - .3 Coordinate deliveries and pay demurrage charges.
- .4 Storage, handling and protection of equipment or materials
- .1 Contractor is responsible for the inspection of equipment and materials arriving on site, their storage, installation and connection.
 - .2 Move and store in locked premises equipment and materials, avoiding damage, alteration or dirt and following manufacturer's instructions wherever applicable.
 - .3 Store equipment and materials in their original packaging, and leave intact manufacturer's labels and seals. Do not unpack or untie equipment or materials prior to their inclusion to the work.
 - .4 Equipment or materials that could be damaged by adverse conditions must be kept in suitable premises.
 - .5 Replace at no additional cost damaged equipment or materials, to Departmental Representative satisfaction.

1.12 Manufacturers recommendations

- .1 Unless otherwise indicated, install or set up equipment or materials following manufacturer's instructions.
- .2 Do not rely on information contained on labels and containers provided with equipment or materials; obtain directly from the manufacturer diagrams, drawings, and all written instructions required for proper installation of equipment and all other information that could facilitate the work.
- .3 Copy of these instructions will be given to the Departmental Representative prior to installation.
- .4 The Departmental Representative may require removal and reinstallation, without increase of contract price, of all products that were put or installed incorrectly.

1.13 Coordination of plans and specifications

- .1 Plans and specifications show in a schematic and approximate way the location of equipment, ducts, piping, pull and junction boxes, etc.
- .2 Check sizes and exact location of equipment on site and not to scale on plans.
- .3 There will be no supplement for changes of openings for conduits, piping, shafts, etc., that may be deemed necessary by conditions on site.

1.14 Usage of premises

- .1 If necessary, determine with the Departmental Representative access routes to site, storage areas, materials stacking areas, location of facilities, etc.
- .2 Do not unduly accumulate equipment or materials that could clutter work site.
- .3 Displace stored equipment or materials that cause obstruction to work by Departmental Representative or another Contractor.
- .4 After obtaining necessary authorizations, pay usage fees for additional storage or work areas required for performance of work.
- .5 Provide evidence that materials and waste coming from work site have been removed to an authorized site.

1.15 Implementation

- .1 General
 - .1 Implementation shall be of the highest quality possible and be done to good engineering practices, codes and standards in force, by teams of experienced workers, composed of professional workers skilled in their respective trade. Notify the Departmental Representative immediately if the nature of work to be performed is such that it would be almost impossible to obtain anticipated results.
 - .2 Do not hire unskilled persons not having adequate qualifications to perform work they have been assigned. The Departmental Representative reserves the right to demand the lay-off of any person deemed incompetent, negligent, insubordinate or whose presence should not be tolerated on site.
- .2 Cooperation
 - .1 Ensure that workers work together to the performance of the work. Monitor closely and constantly work done by workers.
 - .2 Ensure coordination and implementation of openings, sleeves and fittings.
 - .3 Ensure that openings planned in the building are large enough to allow entry of equipment.

- .3 Concealment of pipes
 - .1 In finished areas, conceal pipes, ducts and electrical wiring in ceilings, walls and floors, unless otherwise indicated.
 - .2 Before concealing pipes, notify Departmental Representative of any abnormal situation. Proceed to install in accordance with the instructions of the Departmental Representative.
 - .3 No work, such as pipes, conduits, etc., will be concealed until it has been inspected and approved.
- .4 Cutting and patching
 - .1 Cutting and patching work to be done such that all parts of the work form a coherent whole. Coordinate work accordingly.
 - .2 Cutting and patching work must be performed by specialists familiar with materials they are going to use. Work to be done so as not to damage or risk to damage any part of structure.
- .5 Location of equipment and materials
 - .1 The exact location of equipment or materials for which location is defined only schematically on plans will be made jointly with the Departmental Representative on site; location can be changed at no additional charge or credit, provided that displacements do not exceed 5 m.
 - .2 Install equipment, materials and pipes in order to limit overall dimensions and to conserve as much floor space as possible in accordance with manufacturer's recommendations as to safety, access and maintenance.
 - .3 Inform the Departmental Representative of any problem that may be caused by the location of equipment or material, and install according to his instructions.
 - .4 If access traps need to be installed for maintenance or access to equipment or materials, obtain approval of Departmental Representative before installation. Supply and installation of access traps will be made at no additional cost for the Departmental Representative.
- .6 Concrete pouring, excavation and backfilling
 - .1 Concrete pouring, excavation and backfilling required for work in accordance with this division will be borne by other divisions unless otherwise indicated on plans or specifications of each individual division.
 - .2 When trenches or concrete bases are required for equipment, each division will identify required dimensions, determine the exact location and monitor it to ensure proper execution of work in accordance with plans and specifications.
- .7 Protection of work during construction
 - .1 Ensure completed works or in construction have sufficient protection. Works damaged or modified because of lack of compliance with the specified protective measures are to be replaced or repaired without charge, as specified by the Departmental Representative.
 - .2 Do not overload any part of work. Unless otherwise indicated, obtain Departmental Representative's written authorization before cutting, drilling or installing sleeves in any part of the building structure.
- .8 Existing installations
 - .1 When connection works to existing systems are required, connect at times established by responsible authorities, with minimum disruption of normal usage of premises, tenants and pedestrian and vehicle traffic.
 - .2 Repair any damage to facilities and systems during connection works.
 - .3 Protect, move or maintain in service existing pipes. If abandoned pipes are discovered during work, they should be closed and identified by signs, or their location should be recorded. Seal conduits, pipes, etc., in accordance with applicable codes and standards.
 - .4 Submit to the Departmental Representative the work schedule and obtain his approval for temporary shutdown of existing systems or services. Cut services according to approved schedule and notify in advance those affected.

- .5 Any interruption of service must be coordinated in writing with the Departmental Representative, at least forty-eight (48) hours in advance, unless otherwise specified in writing by the Departmental Representative.
- .6 Unless otherwise specified by the Departmental Representative, connection to existing systems must be carried without service disruption.
- .7 Reusable existing equipment will be dismantled carefully, stored in a climate controlled room, cleaned and reinstalled in accordance with manufacturer's recommendations.
- .9 Temporary services
 - .1 No permanent equipment shall be used for temporary services without written authorization of the Departmental Representative.
 - .2 If the Contractor fails to respect this warning, the Departmental Representative reserves the right to reject material so used and to replace it with new material, all at the expenses of the Contractor.
- .10 Start-up
 - .1 Contractor shall include in his bid services required to ensure, upon completion of work, start-up, coordination and integration of mechanical systems and their adjustment for optimum operation.
 - .2 Start-up must be performed for a full season, such as heating in winter and air conditioning in summer in the case of an air-conditioned building. When start-up is carried out through a heating period, the Contractor will have to come back and perform start-up during an air conditioning period, or vice-versa.

1.16 Work coordination

- .1 Each division will review all submission plans before installation of its equipments and ensure, according to equipment and/or shop drawings, that it can install them at location indicated on plans without impeding installation of equipments by other divisions.
- .2 It should be noted that plans are schematic and that final coordination between each division will be done on site under the supervision of the Contractor. In the event of contradiction between installation and plans and/or specifications, and if works cannot be coordinated at site level without affecting the design, the Contractor shall notify the Departmental Representative and obtain written authorization for modifications prior resuming work.
- .3 Particular attention will be paid to installation of equipments in ceilings (surface-mounted and/or suspended ceiling) and in risers in shafts and on/in walls. Equipment that must remain accessible will be installed so that their access is not impeded by other equipment, ventilation ducts or in inaccessible ceilings. Verify depth of equipments recessed in walls and ceilings as not to hamper their installation.
- .4 Installation in mechanical and electrical rooms, and in particular location of equipments, ducts and concrete bases, must be coordinated between the different sections and divisions and approved by the Departmental Representative prior to installation. In these rooms, installation of equipment in ceilings must comply with above sections and take into account locations of lighting equipment and the fact that lighting equipment will be determined after installation of other equipments.
- .5 When a section or a division will perform work that could damage existing building or work done by another section or division, it must notify this section or division in the presence of the Contractor and agrees on how to protect equipment in the most effective way.
- .6 Considering above remarks, if any section or division hampers or prevents the installation of equipment by another section or division, begins or continues work without coordination, it will be required to prove that it was unable to install its equipment without hampering this section or division, or, failing that, to undo or modify the installation of its equipment in order to remedy the situation, as directed by the Departmental Representative.

1.17 Tests and certification

- .1 Upon completion of work, demonstrate that all equipment is working as designed. If required, a second series of tests will be done within a period of two (2) weeks after the first one. Submit test report to the Departmental Representative.
- .2 Execute testing and supply all equipment required. Notify the Departmental Representative twenty-four (24) hours in advance so that his operating and maintenance staff can be on site to attend tests and help if required.
- .3 Manufacturer of equipment shall be present on site for start-up and give necessary instructions to maintenance staff.
- .4 Refer to the description of each section for specific tests requested.
- .5 Submittal of test reports will be a condition for acceptance of work by the Departmental Representative.
- .6 Submit all certificates required by regulations, laws and contract.

1.18 Repairs

- .1 If necessary, repair any damage caused to existing or new installations and systems, in the course of carrying the work.
- .2 No additional charge will be granted when work has to be redone due to error, omission or lack of coordination on part of the Contractor.

1.19 Departmental Representative's privilege

- .1 The Departmental Representative reserves the right to use other Parties, to his own expenses, to perform work related to the project but not included in plans and specifications. Contractor will therefore not be held liable for works that are part of his contract.

1.20 Site inspection

- .1 Unless otherwise indicated, Departmental Representative requires that the Contractor notify him forty-eight (48) hours prior to concealing installed materials, for inspection. Omission to this procedure will require the Contractor, if so ordered by Departmental Representative, to uncover these materials for the required tests.
- .2 Periodically, the Departmental Representative will visit the construction site and review work progress. If a deficiency is brought to the attention of the Contractor, he or she will make every effort to correct this anomaly. Refusal by the Contractor to comply with this order may result in the interruption of work until an agreement is reached between those responsible.

1.21 Architecture and structure details

- .1 Since all architecture and structure details are not repeated on mechanical plans, the Contractor for each trade should, before beginning work, check all architecture and structure plans to ensure they know all the details that might affect their work.

1.22 Equipment location

- .1 Location of equipment and materials indicated or specified must be regarded as approximate.
- .2 Install equipment and piping in order to limit overall dimensions and conserve as much floor space as possible, in accordance with manufacturer's recommendations as to safety, access and maintenance.
- .3 At the request of the Departmental Representative, submit a layout plan indicating the relative position of various services and equipment parts.
- .4 The Contractor shall respect perfect symmetry between the various parts of systems in each trade. Moreover, it should be noted that plans are provided as a guide and are sometimes at a small scale and do not always present elevations and dimensions. Therefore, judgment is required to ensure that fittings for those systems are well integrated to the structure and the architecture of the building.
- .5 Location of major equipment, even if it is indicated accurately on drawings, may be modified at any time by the Departmental Representative if required in his judgment by existing conditions, at no additional cost to the Departmental Representative when it is specified prior to installation.
- .6 Pull and junction boxes must be located in protected and easily accessible locations.
- .7 If equipment is installed without regard to these Specifications and constitutes an obstacle or is damaged, the Contractor must displace it or replace at no additional cost to the Departmental Representative.
- .8 Respect applicable laws and codes regarding working space around equipments.

1.23 Levels and grades

- .1 Before proceeding with installation of pipes, cabletroughs and other equipment, check all levels and grades indicated on drawings to ensure that required slopes can be obtained and that there is no interference between trades.
- .2 Failure to notify the Departmental Representative about errors found on drawings will make the Contractor responsible for any necessary change, without additional compensation.

1.24 Site cleaning

- .1 The Contractor shall, regularly or at the request of the Departmental Representative, clean the site and remove debris caused by his work.
- .2 Before the Departmental Representative inspects work for temporary acceptance, the Contractor must remove remaining tools and materials and entirely clean the site of all work debris and waste. The Contractor shall clean the buildings and other structures in order to perfect order to Departmental Representative satisfaction.
- .3 In addition, he shall replace in good condition, at his own expense, anything that could have been affected by his work.
- .4 He shall also clean and restore, at his own expense, any area used as "service area". However, the Contractor shall not claim any cost supplement for this work.
- .5 Clean reflectors, diffusers, globes and any lighting fixtures at the end of work.

1.25 Foreman

- .1 Every building trade should be represented on site by a foreman.
- .2 The foreman shall have sufficient experience and knowledge of his trade to allow good collaboration with other contractors and ensure proper execution of orders transmitted by his superiors.

- .3 The foreman shall be the same person from start to completion of work, unless otherwise authorized by the Departmental Representative.
- .4 The Departmental Representative reserve the right to demand the dismissal of the foreman if, in their opinion, this person is not competent for the work assigned to him.
- .5 Moreover, the foreman is required to attend all regular meetings on site, unless otherwise authorized by the Departmental Representative.
- .6 The foreman shall be able to speak French.

1.26 Protection of work during performance

- .1 All open pipes laid by the Contractor shall be hermetically closed with screw caps to prevent dust and waste from entering these pipes during performance of work. All machinery shall be protected by polythene tarps against dust and weather.

1.27 Concrete base and structural supports

- .1 Supports made of pipes are acceptable. All steel supports, legs, etc., must be laid on steel plates bolted to floor.
- .2 For ceiling or wall mounting, use suspended platforms or suspension rods, supports or shelves. Suspend and/or attach to the building structure with Departmental Representative approval.
- .3 The Contractor shall supply all steel structures required for the installation of equipment. Non-galvanized steel must be cleaned properly and be coated with one (1) primer layer and two (2) layers of grey paint finish.

1.28 Protection against corrosion

- .1 All galvanized steel parts, supports for piping, anchors, machinery or other must be coated on site with one (1) layer of anti-corrosion paint after metallic surfaces are cleaned.
- .2 All caps, screws, etc., outside will be either in bronze or cadmium-plated.

1.29 Anchoring

- .1 No anchor gun shall be used, unless otherwise authorized by the Departmental Representative. Expansion bolts shall be used to secure pipes to walls or ceilings. The Departmental Representative reserve the right to ask for any type of anchoring they consider particularly suited to conditions of construction work, at no extra cost.
- .2 Anchoring used to support equipment other than pipes on concrete walls and ceilings will be of HILTI type, HVA series and on hollow block walls, HILTI, series HY20.

1.30 Warranty

- .1 Guarantee good working of all installations and equipment for five (5) years material and labour.
- .2 Replace immediately any part of the installation that is found defective during the sixty (60) months following written final approval by the Departmental Representative, of the entire undertaking, without cost to the Departmental Representative..

1.31 Requirements for interim inspection

- .1 Before requesting interim inspection, the Contractor shall:
 - .1 Submit balancing reports.
 - .2 Provide all other documents deemed appropriate by the Departmental Representative.
- .2 During inspection, the Contractor shall:
 - .1 Systematically demonstrate that the works have been done according to plans and specifications requirements.
 - .2 Make available to the personal hired by the Departmental Representative means for verification, such as a person available to open access doors and make readings.

1.32 Acceptance of work

- .1 Upon reception of written notice sent by the Contractor to the effect that his work is complete and a certificate of acceptance is required, the Departmental Representative will conduct an initial inspection of the work.
- .2 He will prepare a list indicating deficiencies that should be corrected. This list will be titled "LISTE DE DÉFICIENCES #1".
- .3 Following written confirmation from the Contractor that his work is complete according to the contract documents and the "LISTE DE DÉFICIENCES #1" issued by the Departmental Representative, the Departmental Representative will conduct a second verification and, if necessary, produce a "LISTE DE DÉFICIENCES #2", or if installation is deemed in accordance with the contract and acceptable, an official document approving mechanical and electrical works will be issued.
- .4 Following written confirmation from the Contractor that his work is complete according to the contract documents and the "LISTE DE DÉFICIENCES #2" issued by the Departmental Representative, the Departmental Representative will conduct a second verification and, if necessary, produce a "LISTE DE DÉFICIENCES #3", or if installation is deemed in accordance with the contract and acceptable, an official document approving mechanical and electrical works will be issued.
- .5 The Contractor will be required to pay all costs of inspection subsequent to the third general inspection if it proves insufficient.
- .6 Consequently, a list of deficiencies "number 4, number 5", etc., required for the emission of acceptance documents of work will be computed on an hourly basis and the amount will be deducted one indicated in the contract with the Contractor.
- .7 Above sections are not intended to unduly penalise the Contractor, but rather to obtain his full collaboration to complete his work and to ensure that his negligence does not cause unwarranted charges to the Departmental Representative.

1. PART 1 – GENERAL

1.1 Definitions

- .1 In the context of this specification the terms "clean, cleanliness levels and all other mention of cleanliness "are specified so as to meet NADCA scales #1 and 2 levels of cleanliness. .
- .2 Definition of the cleanliness standard :
 - .1 Scale # 1 - low: clean when visually examined with the naked eye under a high lighting level (100W or more) and for ducts, with no acoustic insulation, meets the NADCA 01 standards, that is, 1 mg/100 cm² ;
 - .2 Scale # 2 - normal: thin layer or particles uniformly spread out on the bottom of the duct; maximum thickness of 1 millimeter and with no accumulation in any way what so ever.

1.2 Standards and references

- .1 Assessment Cleaning Restoration of HVAC systems (NADCA Standard ACR 2013).
- .2 Cleaning Fibrous Glass Insulated Air Duct Systems (NAIMA).
- .3 Solvents, detergents and others - Standard on SIMDUT (Système d'information des matières dangereuses utilisées au travail).

1.3 Requirements

- .1 So as to ensure that cleanliness results for ventilation systems are respected, the companies who analyse this cleanliness and who execute the cleaning, must be in compliance with the requirements and minimally apply the following work methods:
 - .1 General :
 - .1 Consult architectural, structural, mechanical and electrical plans. Coordinate his works with other trades.
 - .2 Supply all necessary labour, tools and material required to realise the complete work.
 - .3 Comply with applicable and current codes and regulations.
 - .2 The contractor must demonstrate the following qualifications :
 - .1 That he or she is presently qualified to perform the required works;
 - .2 Refer to a similar project that has already been completed.

1.4 Qualifications

- .1 The analysis and cleaning works shall be executed by specialised Contractors in inspection and equipment cleaning and of HVAC ducts. The company must be able to submit a list of five projects of similar works and scope already having been completed by his staff in the past five years.

2. PART 2 – PRODUCTS

2.1 Cleanliness of the ventilation systems

- .1 The cleanliness of the ventilation systems and the plenums is critical for the proper operation of the set of the ventilation systems.
- .2 All ventilation systems and components must be delivered clean to the job site:
 - .1 Ventilation accessories;
 - .2 Supply ducts;
 - .3 Grilles and diffusers;
 - .4 All other pertinent elements which are part of the targeted HVAC network.
- .3 All the following elements must be protected and sealed during the works so as to remain clean or to prevent the infiltration of dust in supply air ducts.
- .4 Supply and install temporary filters of sufficient efficiency to ensure that systems shall remain clean at the following location.
 - .1 At every return and exhaust air outlets.
 - .2 At the entrance of each HVAC systems of the project.
- .5 Install at the end of cleaning of each system and before the TAB works by the balancing sub-contractor the final filters inside the filter casings of the cleaned systems. Filters will be supplied by the Canadian Space Agency.
- .6 When all system have been cleaned, submit a report, signed by a qualified professional, stating that all ventilation systems conform the cleanliness levels specified.

2.2 Cleaning products

- .1 All cleaning products used must meet current codes and standards in force.
- .2 All cleaning products used must not have pollution or damaging effects on the equipment, the rooms and the inside environment, nor be toxic, irritating, cancerous (mutagenic or teratogenic) or incommoding for the occupants.
- .3 The contractor must submit for approval toxicological forms (SIMDUT) for each product that he foresees using for cleaning or sealing purposes.

2.3 Equipment approval

- .1 All equipment used to execute cleaning will have to be approved before the beginning of works. Equipment other than those specified in the specifications could be approved if their performances are at least equivalent to those specified with the approval of the owner's representative.
- .2 The contractor will have to demonstrate the proper operation of the equipment on a section of acoustically insulated duct and a non insulated section as well as on a few elements of the system to be cleaned, at the owner's choice.
- .3 If the equipment does not operate adequately, the contractor will have to execute the required corrections.

3. PART 3 – EXECUTION

3.1 Cleaning preparations

- .1 Before beginning cleaning, obtain drawing copies.
- .2 Also, obtain a copy of the inspection report (if necessary) of the system with corresponding video tapes as well as a noted copy of the existing drawings indicating where sampling was done, the sections of ducts inspected and the existing access doors used for the sampling.
- .3 Establish a cleaning plan per section, taking into account all elbows and turning vanes, fire dampers, side take-offs branches and other existing elements such as coils, boxes and dampers.
- .4 Supply and install access doors everywhere where required to execute a complete cleaning. These doors shall comply to the specifications of section 233300E and installed in such a way that they are accessible for the cleaning of the ducts and other elements such as coils, boxes and dampers. For reheat coils, an access door shall be installed on both sides to facilitate cleaning. Seal the contour of the new doors with Tremco 555 for low pressure ducts and with fibreglass sealant for medium and high pressure ducts. Repair existing insulation damaged during the installation of new access doors with sealant for insulation.
- .5 Mark all adjustable dampers or other flow balancing devices and note their position so as to be able to be able to replace them as before if they were displaced. Same goes for all fire dampers, balancing dampers, distribution dampers, grille and diffuser adjustments and any other adjustable dampers in the system.

3.2 Execution

- .1 Coordination
 - .1 All cleaning works shall be coordinated beforehand.
 - .2 The contractor shall immediately advise the Departmental Representative of any and all encountered defects or problems which could thwart him from executing or completing a part of his works.
 - .3 At the end of the works, the contractor shall include a visit with the Departmental Representative so as to check for major problems from cleaning.

3.3 Scope of works

- .1 Clean the following systems, if necessary, to achieve a #2 cleanliness level :
 - .1 **The systems indicated in the schedule shown on plan H-01.**
 - .2 **Any other system indicated in the whole mechanical plans H-02 to H-22.**
- .2 If required, clean ventilation units for each indicated system, their components including coils, supply and return fans or exhaust fans, filter boxes, fresh air intakes, etc.
- .3 If required, clean ventilation supply, return and exhaust ducts for each system indicated as well as all elements installed in the ducts including terminal boxes, fan coils, reheat coils, fire dampers, motorised dampers, balancing dampers, grilles, diffusers, etc.
- .4 Proceed by visual inspection and inspection by remote controlled motorized camera.
- .5 Start-up ventilation systems only once the concerned system is clean and all activities which risk dusting the systems are completed.

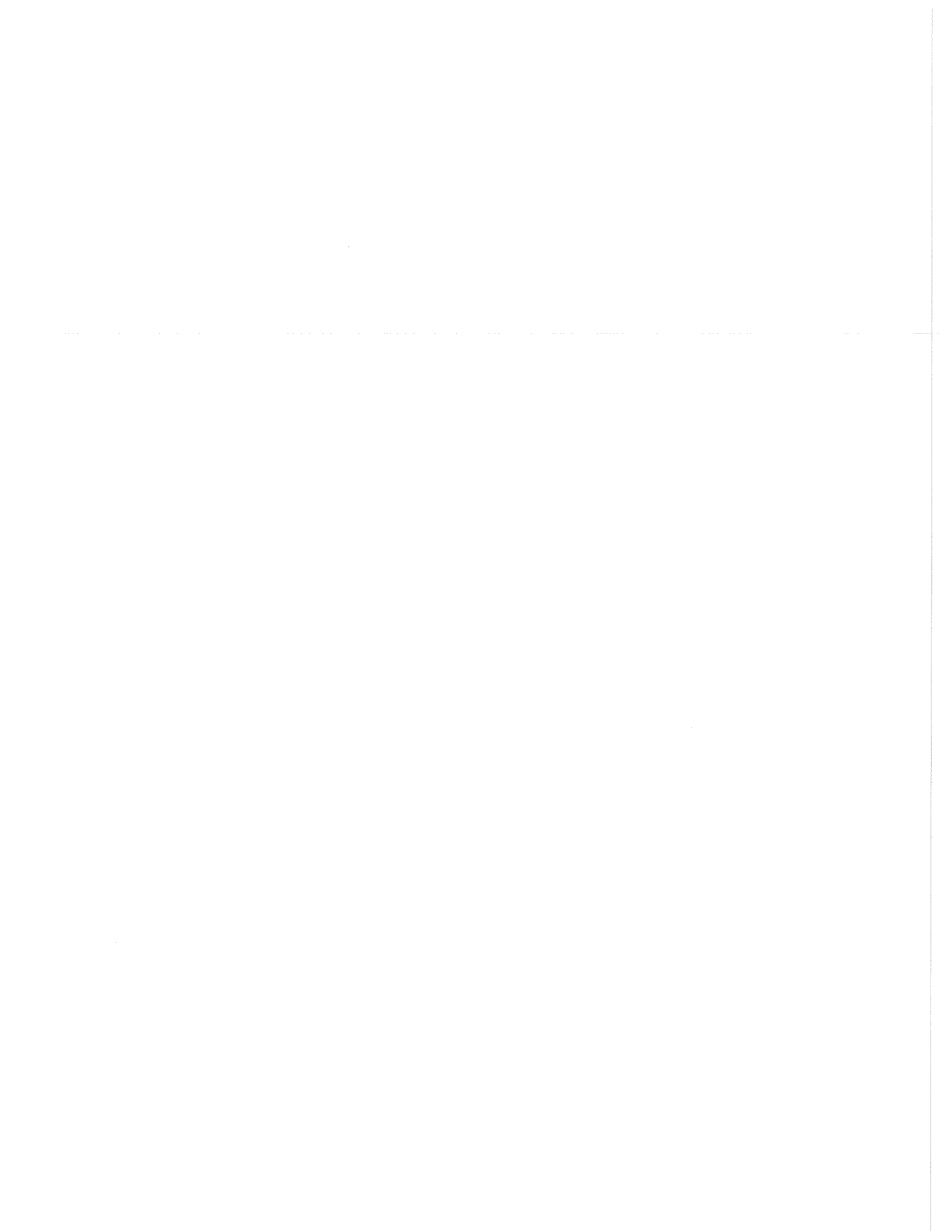
- .6 After the ventilation systems start-up, the cleanliness of these must be demonstrated to the satisfaction of the Departmental Representative:
 - .1 Take samples of contaminants in the system at least 100 points, 30 of which shall be chosen by the Departmental Representative, by an independent laboratory and these samples analysed by this laboratory.
 - .2 This laboratory shall submit a written report indicating if the ventilation systems conform to the specified level of cleanliness.
 - .3 In the event that the results are not satisfactory, the specified systems shall be recleaned. Execute sampling and clean again if required until the specified level of cleanliness has been reached.
- .7 Supply a report describing the general condition of each ventilation system and of its cleaned ducts as well as the degree of their cleanliness. Also mention the defects and repairs to be executed on each system.
 - .1 The report must include the following:
 - .1 Name and address of the cleaned installation as well as the date of the cleaning.
 - .2 Name and address of the inspection and cleaning contractor.
 - .3 Ventilation system description, accompanied with drawings or schematics indicating all the locations where the systems were cleaned.
 - .4 Comments backed with pictures describing the general condition for each system as well as defects and repairs to be undertaken.
 - .5 Comments backed with pictures indicating the location for each sample taken.
 - .6 Notes describing the method used to undertake the sampling.
 - .7 Location where samples were analysed and the type of analysis for each.
 - .8 Copies of the analysis grid indicating the criteria for each scale.
 - .9 Raw results of the laboratory's analysis for all quoted sampling according to the corresponding scale.
 - .10 An annexed and exact copy of the laboratory reports.
 - .11 Conclusions and recommendations following cleaning and analysis of the results of the samples.
 - .12 Electronic video showing all sections sampled for the particle analysis or microbiotic proliferation, all sections of interest the location of the internal elements and major problems noted during cleaning; For each video sequence, introduce the building, the date, the name of the system, the filmed element and/or the location (supply duct, return duct, exhaust duct, cold or hot, etc.).
 - .13 A copy noted in red of the existing HVAC.
 - .2 Report presentation :
 - .1 Each report shall be presented with an index, a cover page and in two binded copies, placed in 3 ring binders accompanied with the video recordings, pictures and notes existing HVAC drawings.
 - .2 The contractor shall submit his reports to the expert for approval.
- .8 Supply a report for the observed deficiencies on the state of the acoustic insulation (broken, torn, etc.), if necessary.
- .9 Plug and seal all holes and openings not required for the system's operation with a product approved by NFPA 90A.

3.4 End of works

- .1 The works shall be considered completed when the Departmental Representative has approved the reports.

3.5 Clean duct warranty

- .1 The owner will have the right to hire an external firm to validate the quality of works in the case where 10% of the ducts are considered not adequately cleaned. The cost of this firm shall be paid the contractor.
- .2 All works that do not conform shall be redone to the total satisfaction of the Departmental Representative and this, at the Contractor's cost.



1. PART 1 – GENERAL

1.1 General

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of contract documents and to do other work as specified in this section.
- .2 Air system balancing is under responsibility of the balancing sub-contractor who will have to coordinate his works with the Contractor responsible for the whole works.

1.2 Qualifications of TAB personnel

- .1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.3 Purpose of TAB

- .1 The technical data sheets of fans and HVAC units to be balanced will be provided to the Contractor at the beginning of the work by the Departmental Representative.
- .2 Adjust and regulate equipment and systems so as 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.

1.4 Coordination

- .1 Schedule time required for TAB (including repairs, re testing) into project construction and completion schedule so as 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.

1.5 Pre-TAB Review

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

1.6 Start-Up

- .1 Follow start up procedures as recommended by equipment manufacturer unless specified otherwise.

1.7 Operation of systems during TAB

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

1.8 Start of TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when the cleaning work of HVAC ductwork and equipment of a system are completed and the clean filters installed.

1.9 Application tolerances

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

1.10 Instruments

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

1.11 Submittals

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

1.12 Preliminary report

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

1.13 TAB report

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

1.14 Verification

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

1.15 Settings

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

1.16 Completion of TAB

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

1.17 Air systems

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA, ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified in Division 23 following systems, equipment, components, controls shown on plans:
- .3 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross sectional area, RPM, electrical power, voltage, noise, vibration.
- .4 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, filters, heating/cooling coils, humidifiers, fans, other equipment causing changes in conditions.
 - .2 At controllers, controlled devices.
- .5 Locations of systems measurements to include, but not be limited to, following as appropriate: main ducts, main branch, sub branch, run out (or grille, register or diffuser).).

2. PART 2- PRODUCTS

2.1 Not applicable

- .1 Not applicable

3. PART 3 – EXECUTION

3.1 Air systems to balance

- .1 See plan H-01 and scope of work at section 230500E.

1. PART 1 – GENERAL

1.1 Purpose of products

- .1 Products described in this section shall be used to establish the quality to supply following the requirement to proceed with the ductworks and systems cleaning described in section 230502E of this document.

2. PART 2 - PRODUCTS

2.1 Access doors in ducts

.1 General

- .1 Non-insulated ducts
 - .1 Sandwich construction of same material as duct, non-insulated, one sheet metal thickness heavier, minimum 1.0mm thick complete with sheet metal angle frame.
- .2 Insulated ducts
 - .1 Sandwich construction of same material as duct, insulated, although with 25mm thick rigid glass fiber insulation. The fiber shouldn't be exposed.
- .2 Gaskets: neoprene or rubber mousse.
- .3 Hardware:
 - .1 For door measuring up to 300 x 300mm: 2 sash locks
 - .2 For door measuring from 301 to 450 mm: 4 sash locks
 - .3 For door measuring from 451 to 1 000mm: piano hinge and minimum 2 sash locks
- .4 Acceptable products: Nailor, Cendrex, Trolec or approved equivalent

2.2 Air distribution dampers

- .1 Dampers made of same material as the ventilation duct although with a standardized thickness sheet immediately greater than that of the air duct.
- .2 Dampers made from only one sheet thickness.
- .3 Dampers dimensions and configuration in accordance with the SMACNA.
- .4 Dampers provided with a control rod with locking mechanism.
- .5 Curve at the tip of the rod preventing this tip from entering into the ventilation duct.
- .6 Pivot: piano hinge.

2.3 Balancing dampers with only one shutter

- .1 Dampers made of same material as the ventilation duct and grooved to ensure a better rigidity.
- .2 Dimension and configuration of the dampers in accordance with the SMACNA, except the maximum height which will be 250mm.
- .3 Dampers equipped with locking devices.
- .4 Dampers provided with interior and external angles bearings.
- .5 Hardware for balancing shutters :
 - .1 Round or rectangular shutters less than 10 in. – Duro-Dyne KS-7.
 - .2 Round shutters of 11 in. with 20 in² - Duro-Dyne KSR-19.
 - .3 Rectangular shutters of over 11 in. – Duro-Dyne KS-19.

2.4 Balancing dampers with multiple shutters

- .1 Dampers made in factory with a compatible material of that of the ventilation duct.
- .2 Opposite shutters: configuration in accordance to the SMACNA.
- .3 Maximum height of the shutters: 100mm.
- .4 Bearings: needle bearings within a bronze padding.
- .5 Clutch control: shaft extension with locking device.
- .6 Frame in angles, provided with butted angle.
- .7 Hardware for balancing shutter:
 - .1 Round or rectangular shutters less than 10 in. – Duro-Dyne KS-7.
 - .2 Rectangular shutters of over 11 in. – Duro-Dyne KS-19.

2.5 Fittings for testing instruments

- .1 Requires quality: Duro-Dyne IP-2 model.

3. PART 3 – EXECUTION

3.1 Tape and sealing material

- .1 Apply the sealing material in accordance to the SMACNA recommendations and of that of the manufacturer.
- .2 Bathe the tape in the sealing material, than apply at least one coating in accordance to the manufacturers recommendations.

3.2 Access doors

- .1 Dimensions:
 - .1 According to the indications listed in section 230500E.
- .2 Location:
 - .1 At the required locations in order to permit the access to the fire and smoke dampers.
 - .2 At the required locations in order to permit the access to the air flow control.
 - .3 At the required locations in order to permit the access to the necessary devices requiring a periodical maintenance.
 - .4 At the required locations in accordance to the standards.

3.3 Fittings for instrument test ports

- .1 General
 - .1 For the flow readings, install in accordance with the SMACNA recommendations.
 - .2 For the temperature readings, install in accordance with the SMACNA recommendations.
 - .3 Install the fittings in accordance with manufacturer's instructions.
- .2 Locations:
 - .1 For air flow readings:
 - .1 At ducted inlets to roof or wall exhausters.
 - .2 At inlets or outlets of other fan systems.

.3 At main and sub-main ducts.

3.4 Adjusting and balancing dampers:

.1 Balancing dampers:

- .1 The contractor will supply and install upon request the missing balancing registers in order to allow the calibration of the ventilation/air-conditioning systems after approval of the justification of that supply by the Departmental Representative and acceptance of the change order by the Contracting Authority.
- .2 Install dampers in accordance with SMACNA.
- .3 Caulk and seal joints between multiple registers with a UL approved transparent silicone based sealer.

APPENDIX

Location description

