

**Part 1            General**

**1.1            SUMMARY**

- .1    Content of this Section
  - .1    Materials, equipments, accessories and methods of installation related to ventilation duct.
  - .2    Materials, equipments, accessories and methods of installation related to flexible ducts, fans, terminal units and air conditioners.
  - .3    The following section is aimed at operations, maintenance, methods and requirements concerning testing, adjusting and balancing (TAB) of HVAC systems.
  - .4    TAB operations are testing, adjusting and balancing operations destined to ensure that the various systems function in accordance to the contractual requirements stated.

**1.2            QUALIFICATIONS OF PERSONNEL IN CHARGE OF TAB OPERATIONS**

- .1    Within 90days following the awarding of the contract, submit the list of persons who will be in charge of executing the testing, adjusting and balancing operations.
- .2    Submit documentation which demonstrates the competence and experience of the personnel.
- .3    The testing, adjusting and balancing operations must be executed according to the standard which controls the qualifications of the company and of the personnel in charge of it.
  - .1    Associated Air Balance Council, (AABC), National Standards for Total System Balance, MN-1.
  - .2    National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - .3    Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .4    TAB operations must be carried out according to the suggested recommendations and practices of the retained standard.
- .5    In order to satisfy the contractual requirements, conform to the provisions of the retained standard which are aimed at TAB operations and use the verification lists and forms offered.
- .6    Conform to the provisions of the retained standard in regards to TAB operations including company and personnel (those in charge of the work) qualifications, and calibration of measurement equipment.
- .7    Conform to manufacturer recommendations for the calibration of measurement equipment when they are more rigorous than those stated in the relative TAB operations standard.

- .8 The provisions of the retained standard concerning quality assurance, notably the warranties related to performance, are an integral part of the contract.
  - .1 In the case of systems or components which are not covered by the retained standard concerning TAB operations, use the methods established by the specialist in charge of the work.
  - .2 When new methods and requirements which are applicable to the contractual requirements and which have been published or enforced by the policy-maker (AABC, NEDD, or TABB), the requirements and recommendations defined are mandatory.

### **1.3 GOAL OF TAB OPERATIONS**

- .1 Carry out systems testing to verify whether they function reliably and appropriately, to determine the true operating point and to evaluate the qualitative and quantitative performances of equipments, systems and related command/regulation apparatus, at nominal load, at medium or light load, this load being real or simulated.
- .2 Adjust the equipment and systems such that they respond to the performance requirements prescribed and that they can interact with related systems in the prescribed way, within normal and emergency loading and operating conditions.
- .3 Balance equipment and systems such that the flow corresponds to the load over the entire operating window.

### **1.4 EXCEPTIONS**

- .1 The testing, adjusting and balancing of equipment and systems subject to standards or specific codes must be executed to the satisfaction of the proper authority.

### **1.5 COORDINATION**

- .1 Schedule time, within the construction work calendar, for trial operations and for the adjustment and balancement of systems (including fixes and reworks) which need to be done before the work is handed over.
- .2 Test-drive, adjust and balance each distinct system then repeat for each system with respect to related systems, in the case of systems with control mechanisms.

### **1.6 REVIEW OF TERMS IN CONTRACTUAL DOCUMENTS RELATED TO TAB OPERATIONS**

- .1 Review contractual documents before the start of construction work and confirm in writing to the Engineer that the provisions regarding testing, adjusting and balancing of equipment and systems, as well as all other aspects relating to their conception and installation are appropriate and will ensure the success of these operations.
- .2 Review standards and other prescribed reference documents and inform the Engineer in writing of the proposed methods in the contractual documents which differ from those described in the standards or reference documents.
- .3 During construction work, coordinate the location as well as the installation or layout of the devices, equipment and accessories and of the openings and gauging fittings necessary to execute TAB operations.

## **1.7 EQUIPMENT AND SYSTEMS START-UP**

- .1 Unless indicated otherwise, follow the equipment and systems' manufacturer recommended start-up procedure.
- .2 Follow any particular start-up procedure specified elsewhere.

## **1.8 OPERATION OF EQUIPMENT AND SYSTEMS DURING TAB ACTIVITIES**

- .1 Run equipment and systems for the required period for the execution of TAB activities and for the verification of TAB reports by the Engineer.

## **1.9 BEGINNING OF TAB OPERATIONS**

- .1 Advise the Engineer 14 days before proceeding to testing, adjusting and balancing operations.
- .2 Only proceed with TAB operations when the building is, for the most part, serviceable:
  - .1 The construction of ceilings and the installation of doors, windows and other elements which can have an influence on the results of the TAB operations are completed;
  - .2 The installation of weather-tight products, caulks and weather strips is completed;
  - .3 Trials for pressure, weather-tightness and others prescribed in Section 23 are completed;
  - .4 The material necessary to the execution of TAB operations is installed and ready to run;
  - .5 The mechanical installations and the electrical and related command/regulation systems, which can impact the results of the TAB operations, are running and the following items in regards to proper operation are verified:
    - Thermal protection of electrical equipment against overloads;
    - Aeraulic networks:
      - filters are in place and clean;
      - air ducts are clean;
      - ducts, shafts and plenums are air-tight, within the specified limits;
      - fans are rotating in the proper direction;
      - volumetric dampers and fire-protection shutters are in place and open;
      - coil corrugations are clean and straightened;
      - inspection doors and panels are installed and closed;
      - Exhaust openings are installed and volumetric dampers are open.
    - Hydronic networks:
      - pipings is rinsed, filled and vented;
      - pumps are rotating in the proper direction;
      - filters are in place and baskets are clean;
      - isolating and balancing valves are in place and open;
      - balancing valves are installed and calibrated to the manufacturer's specifications;
      - Liquids treatment systems are in good operating condition.

**1.10 DIFFERENCE BETWEEN ADJUSTMENT AND THEORETICAL VALUES**

- .1 Carry out testing, adjusting and balancing of systems until the difference are no larger than the following values:
  - .1 HVAC systems: plus 10 %.

**1.11 DIFFERENCE BETWEEN MEASURED AND REAL VALUES**

- .1 Measured values must correspond to more or less 2 % of real values.

**1.12 MEASUREMENT INSTRUMENTS**

- .1 Before starting TAB operations, submit the list of instruments that will be used to the Engineer and include their serial numbers.
- .2 Calibrate the instruments in compliance with the requirements of the standard or reference document, whichever is most rigorous in regards to HVAC systems or to those submitted to TAB operations.
- .3 Calibrate instruments within the three (3) months preceding the start of TAB operations. Submit a calibration attestation to the Engineer.

**1.13 DOCUMENTS/SAMPLES TO SUBMIT**

- .1 Before proceeding with TAB operations, submit the following:
- .2 The proposed method to test, adjust and balance the systems if it differs from the method described in the standard or reference document retained.

**1.14 PRELIMINARY REPORT**

- .1 Before officially submitting the TAB report to the Engineer, submit, for verification and approbation purposes, a preliminary report in which the following must be indicated:
  - .1 The details concerning the instruments used.
  - .2 The details concerning the TAB method employed.
  - .3 The calculation methods used.
  - .4 Recapitulation.

**1.15 TAB REPORT**

- .1 The presentation of the report must comply with the requirements of the standard or reference document retained regarding TAB operations.
- .2 The results expressed in the report must be in SI units. The report must contain the following:
  - .1 The drawings to keep in the project's folder.
  - .2 The schematic diagrams of the targeted systems.
- .3 Submit to the engineer, for verification and approbation purposes, six (6) copies of the TAB report, in French, presented in D-ring binders containing tab separators.

**1.16 DATA VERIFICATION**

- .1 The recorded measurements are likely to be checked by the Engineer.
- .2 Anticipate sufficient personnel and instruments for the verification of recorded measurements.
- .3 The Engineer will determine the number of verifications to conduct and the location of gauging points.
- .4 Rerun testing, adjusting and balancing operations until the results are to the satisfaction of the Engineer, and assume the fees for such tasks.

**1.17 CONTROLS**

- .1 Once the TAB operations are completed to the Engineer's satisfaction, reinstall the protective guards on the driving mechanism or transmission device, close the inspection doors and traps, block the control devices in their operating positions and verify whether the sensors are fixed at the required set points.
- .2 Permanently mark the control positions; these must not be erased or covered in any way.

**1.18 END OF TAB OPERATIONS**

- .1 The testing, adjusting and balancing operations of the systems will only be considered as complete when the final report will have been approved by the Engineer.

**1.19 AERAULIC SYSTEMS**

- .1 TAB operations must be executed in compliance with the most rigorous requirements stated in either the present section or in the standards and relevant reference documents from the AABC or SMACNA.
- .2 Proceed with testing, adjusting and balancing of systems, equipment, elements, and command/regulation devices specified in Division 23.
- .3 The persons in charge of executing TAB operations must be entitled to provide the specified services, according to the standards of the AABC.
- .4 The surveys to be done will address the following, according to the systems, equipment, elements or command/regulation devices targeted: air speed, static pressure, flow, head loss, temperature (dry bulb, wet bulb, dew point), air duct cross-section, rotation speed, demand set-up, pressure.
- .5 Depending on the situation, gauging points, in the case of equipment, will be situated in the following locations:
  - .1 At the entrance and exit of dampers, filters, heating and cooling air coils, humidifiers, fans and any other equipment which can modify conditions.
  - .2 At the controllers and at the apparatus and devices controlled.
- .6 Depending on the situation, measuring points, in the case of systems, will be situated in the following locations: primary and secondary air ducts, supply ducts of terminal elements (grilles, damper or diffuser grilles).

**1.20                   REFERENCE CODES**

- .1           Execute works according to:
- Municipal Ventilation Code;
  - National Building Code;
  - SMACNA Standards;
  - ASHRAE Standards.

## **Part 2            Products**

### **2.1            VENTILATION DUCTS**

- .1 Low pressure ducts, to 500 Pa (2" WC).
  - .1 Galvanized steel, gauge according to SMACNA, with the exception of round duct which must be spiral type. No duct thinner than gauge 26 will be accepted.
  - .2 Joints "T" with sealant and screw each 300 mm (12") and each corner.
  - .3 Maximum leakage according to SMACNA 12 (rectangular ducts) and SMACNA 6 (circular and oval ducts).
  - .4 Seal class (SMACNA) B.
- .2 High pressure ducts to 2500 Pa (10" WC)
  - .1 Galvanized steel, gauge according to SMACNA, with the exception of round duct which must be spiral type. No duct thinner than gauge 26 will be accepted.
  - .2 Maximum leakage according to SMACNA 3 (circular and oval ducts) and SMACNA 6 (rectangular ducts).
  - .3 Seal class (SMACNA) A.
- .3 Central radius of curvature of 1.5 x width of ducts with aerodynamic vanes.
- .4 Flexible ducts between ventilation ducts, air control boxes and diffusers.
  - .1 Spiral wound flexible with thermal insulation.
    - Acceptable products:
      - Flexmaster T/L-VT;
      - Boflex AL (with lagging).
  - .2 Maximal length of 2 m (6'-7").
  - .3 When distance is greater than 2 m (6'-7"), use thermally insulated rigid duct work.
- .5 Refer to "Ductwork pressure classification" table.

### **2.2            ACCESSORIES**

- .1 Flexible connections for fans, conforming to UL, ULC and NFPA-90A.
- .2 Water base sealer and tape
  - .1 Acceptable products:
    - Duro-Dyne SWB.
- .3 Prefabricated access doors, double wall with latches.
- .4 Fire dampers UCL approved, 100 % free area in open position.

### **2.3            LINING**

- .1 Acoustic lining, made of fiberglass according to CGSB-91-11-92, bonded and stapled to duct walls each 300 mm (12") C/C.

- .2 To be used for secondary branches starting from main ducts to the diffuseurs.

## 2.4 **BALANCING DAMPERS**

- .1 Splitter dampers
- .1 Single thickness, made of the same material as the duct, 18 gauge for heights up to 600 mm (24") and 16 gauge for heights above 600 mm (24").
  - .2 Dimensions and configuration to SMACNA recommendations.
  - .3 Provided with one or two operating rods with setscrew lock; two rods on ducts 600 mm (24") and over. A curved end prevents rod from entering duct.
  - .4 Hinge: piano type.

## 2.5 **INSULATION TYPE D-2: RIGID FIBERGLASS WITH VAPOR BARRIER, RECTANGULAR DUCTS**

- .1 Used on rectangular air ducts.
- .2 Materials
- .1 Rigid fiberglass panel for air ducts, density 48 kg/m<sup>3</sup> (3 lbs/cu.ft.) according to ASTM C612, and FSK vapor barrier according to ASTM C1136, maximum K factor: 0.034 W/m °C (0.24 BTU in/hr sq.ft. °F) at 24°C (75 °F).
  - .2 Acceptable products:
    - Certainteed, CertaPro CB300 FSK;
    - Johns Manville, Spin-Glas serie 1000 FSK;
    - Knauf, Insulation board FSK;
    - Manson, AK Board FSK;
    - Owens Corning, Isolant Fiberglas serie 700 FSK.
- .3 Insulation thickness

Nominal insulation thickness	Service temperature
2 x 25 mm (2 x 1") overlapped joints	-40 °C to -22 °C (-40 °F to -8 °F)
25 mm (1")	-22 °C à 58 °C (-8 °F to 129 °F)
38 mm (1½")	59 °C to 67 °C (130 °F to 150 °F)
50 mm (2")	68 °C and over (151 °F and over)
100 mm (4"), overlapped joints	Outside

## 2.6 **ADHESIVES, TAPES AND FASTENERS**

- .1 For ductwork
- .1 Tape: self adhesive, 100 mm (4"), wide rated lower than 25 for flame spread and lower than 50 for smoke development.
    - Acceptable products: FSK Venture Tape.
  - .2 Contact adhesive: quick-setting, non-flammable fire resistant adhesive to bond fiberglass to ducts. Flame spread 15, smoke development 0.
    - Acceptable products: Duro Dyne "WSA"; Foster 85-60.

- .3 Use weld pins on bottom of duct if duct is over 635 mm (25") wide.
- .2 For vapor barrier
  - .1 Lap seal adhesive: Quick-setting adhesive for joints and lap sealing of vapor barriers. Flame spread 10, smoke development 0.
  - .2 Acceptable products: Foster 85-75.
- .3 Pins
  - .1 Weld pins 4 mm (0.15") diameter, with 35 mm (1.4") diameter head for installation through the insulation. Length to suit thickness of insulation.
  - .2 Acceptable products: Duro Dyne, Clip-Pin.
  - .3 Weld pins 2 mm (0.08") for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32 mm (1.25") square.
  - .4 Acceptable products: Duro Dyne spotter pins with spotter clips or stop clips as required.
- .4 Jackets
  - .1 Canvas Jackets
    - .1 Apply in exposed areas: compact, firm ULC listed heavy tight weaved, cotton fabric at 220 g/m<sup>2</sup> (6.5 oz/sq.yd.).
    - .2 On concealed valves and fittings use ULC listed plain weaved, cotton fabric at 120 g/m<sup>2</sup>, (3.5 oz/sq.yd.).
    - .3 Acceptable products: S. Fattal Thermocanvas.

**Part 3            Execution**

**3.1                DUCT INSTALLATION**

- .1        Install duct in accordance with SMACNA, ASHRAE, ANSI/NFPA 90A, ANSI/NFPA 90B and as indicated.
- .2        Hangers shall be steel angles with supporting rods, lock-nuts and washers.

**3.2                DUCT LEAKAGE TESTING**

- .1        Make trial leak test, as instructed to demonstrate workmanship.
- .2        Install no additional ductwork until leak test has been successful.
- .3        Ductwork shall be free of audible leaks in quiet ambient. Leakage shall not exceed the prescribed classes for conduits.

**3.3                AIR BALANCE**

- .1        Use SMACNA or AABC methods. Indicate requested and gauged flow, static pressure upstream and downstream fans and coils, and driving force.

**3.4                BALANCING DAMPERS**

- .1        Install where indicated on drawings and according to SMACNA recommendations and manufacturer's instructions.

**3.5                IDENTIFICATION**

- .1        Identification with stenciled letters. Direction arrows and identify fluid type. Use symbols, colors and abbreviations.

**3.6                INSULATION**

- .1        General
  - .1        Apply insulation after required tests have been completed and approved by Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Clean the insulation surface before applying coating or covering.
  - .2        Work shall be performed by insulation journeymen.
  - .3        Apply insulation and coverings on hot piping duct or equipment while surface is between 50°C and 60°C (120°F and 140°F).
  - .4        Vapor barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, and without interruption at sleeves, pipe and fittings.
  - .5        Install insulation with smooth and even surfaces.
  - .6        Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

- .7 Use multilayers, overlapping joints when insulation thickness exceeds 50 mm (2").
  - .1 Make seams on top side of ducts
  - .2 Glue and seal vapor barrier with vapor tight adhesive.
  - .3 With multilayered insulation, stagger joints horizontally and longitudinally.
- .8 Mechanical fasteners
  - .1 On rectangular ducts, cover partially (50 %) of the insulation surface with adhesive and install on each side at least two (2) rows of weld pins every 200 mm (8").
  - .2 On round ducts, cover completely the insulation surface with adhesive and seal seams with autoadhesive tape.
- .9 On acoustically insulated ducts, reduce thickness of thermal insulation by an amount equal to the acoustical insulation thickness.
- .10 Final thermal insulation not to be less than 25 mm (1").
- .11 Finish
  - .1 For exposed elements, install angles to prevent insulation crushing. Finish with canvas net with the insulating cement and apply one additional coating of insulation cement.

### 3.7 INSULATION INSTALLATION

- .1 Works for this section include but are not limited to the thermal insulation of the following elements:

Ductwork	Insulation type
<ul style="list-style-type: none"><li>• Main ducts for air supply</li></ul>	D-2

**END OF SECTION**