

HVAC - Testing, Adjusting, and Balancing (TAB) Guideline Specifications

Division 230593

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. All Division 23 specification sections, drawings, and general provisions of the contract apply to work of this section, as do other documents referred to in this section.

1.02 SCOPE OF WORK

- A. The Division of Engineering and Contract Administration will directly contract with a certified testing, adjusting, and balancing contractor (“TAB Agency”) to test, adjust, and balance the HVAC systems.
- B. This specification section is included herein to assist and inform the Contractor of the standards, requirements and scope of the work to be performed by the Commonwealth’s TAB Agency.

1.03 PREPARATION AND COORDINATION REQUIREMENTS – GENERAL

- A. Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided to the TAB Agency no later than 30 days prior to the start of TAB work.
- B. System installation and equipment startup shall be complete prior to the TAB Agency’s being notified to begin.
- C. The building control system shall be complete and operational. The Building Control system (sub)contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.
- D. All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.
- E. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

1.04 PREPARATION AND COORDINATION REQUIREMENTS – HVAC CONTROLS

- A. Written notice shall be submitted through the General Contractor to the Architect-Engineer stating that the Control System is operating and controlling the HVAC System. This letter is to be provided to the DECA Project Manager and the TAB Agency prior to any balancing.
- B. The Contractor/Control (sub)contractor shall have entered all data needed for the TAB Agency to begin work.
- C. The Contractor/Control (sub)contractor shall be available to correct any problems that the TAB Agency may encounter with the systems.
- D. All costs for additional work by the TAB Agency due to the Contractor’s failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for HVAC controls.

1.05 PREPARATION AND COORDINATION REQUIREMENTS – MECHANICAL

- E. Written notice shall be submitted through the General Contractor to the Architect stating that the HVAC system is operational and ready for the TAB Agency. This letter is to be provided to the DECA Project Manager and the TAB Agency prior to any balancing.
- A. The Contractor/Mechanical subcontractor shall have proved all units operational and all air outlets in the full open position.
- B. The Contractor/Mechanical subcontractor shall be available to correct any problems that the TAB Agency might have with any equipment or systems.
- C. The Contractor/Mechanical subcontractor shall furnish and install any replacement sheaves, pulleys and drive belts required for flow adjustments, as determined by the TAB Agency. Adjustable sheaves shall be selected so that the final adjustment position is in the middle third of the total adjustment range.
- D. All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for mechanical work.

1.06 PREPARATION AND COORDINATION REQUIREMENTS – DUCTWORK

- A. Ductwork air leakage testing shall be performed by the TAB Agency.
- B. The ductwork/sheetmetal subcontractor shall promptly correct any related problems discovered by the leakage tests.
- C. All costs associated with retesting and/or delays or other problems which impede the TAB Agency from performing such testing shall be paid by the contractor and any subcontractor(s) for ductwork.

1.07 WORK BY TAB AGENCY

- A. The work included in the remainder of this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. This work shall be performed by the TAB Agency under direct contract to the owner. The remainder herein is also for the information of the Contractor and all subcontractors.
- B. The items requiring testing, adjusting, and balancing include the following:

[Consultant to edit list as required]

AIR SYSTEMS:

- Supply Fan AHU
- Return Fans
- Relief Fans
- Exhaust Fans
- Zone branch and main ducts
- Diffusers, Registers and Grilles
- Coils (Air Temperatures)

HYDRONIC SYSTEMS:

- Pumps
- System Mains and Branches
- Chillers
- Cooling Towers
- Boilers
- Coils

1.08 QUALIFICATIONS

- A. Agency qualifications: The TAB Agency shall be a current member of a nationally recognized balance organization (“National Organization”). This Organization shall provide the owner with National Guarantee document certifying the work of the TAB Agency. Acceptable organizations are Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB).
 - 1. The selected TAB Agency must provide proof of certification for the total project (air, water, sound, vibration, etc.).
 - 2. The selected TAB Agency shall be provided access to computers, cables or any software needed to operate the building control system during the balancing phase.
- A. All work shall be in accordance with the latest edition of the National Standards, as published by the National Organization affiliated with the TAB Agency.

1.09 SUBMITTALS

- A. Qualifications: The TAB Agency shall submit a company resume listing personnel and project experience in air and hydronic system balancing and a copy of the agency’s test and balance engineer (TBE) certificate. Certification in noise, vibration, and air quality shall be submitted as the job requires. At minimum, the balance technician shall possess their technician certification.
- B. Procedures and agenda: The TAB Agency shall submit the TAB procedures and agenda proposed to be used.

1.10 REPORTS

- A. Final TAB Report – The TAB Agency shall submit the final TAB report for review by the engineer. All equipment including but not limited to fans, outlets, traverses, static pressure profiles, pumps, coils, etc. shall be identified in the report. The report must also include, at minimum, electronic drawings that correspond to all test points for additional report clarification. The TAB Agency shall submit an “National Project Performance Guaranty” assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and National Standards.

Submit three (3) electronic copies of the Final TAB Report to the Architect-Engineer, and (1) electronic copy to the Project Manager from the Division of Engineering and Contract Administration. A maximum of three (3) additional hard copies shall be submitted on request.

Payments for the TAB work shall be contingent upon the proper submittal and approval of the TAB reports.

1.11 DEFICIENCIES

- A. Any deficiencies in the installation or performance of a system or component observed by the TAB Agency shall be brought to the attention of the appropriate responsible person. Also notify the mechanical project representative from the Division of Engineering and Contract Administration.
- B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

PART 2 – INSTRUMENTATION

- A. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of the National Standards.

PART 3 – EXECUTION

3.01 GENERAL

- A. The specific systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with national Standards. Adjustment tolerances shall be + or – 10% unless otherwise stated.
- B. Equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.
- C. All information necessary to complete a proper TAB project and report shall be per National Organization's standards unless otherwise noted. The descriptions for work required, as listed in this section, are guides to the minimum information needed.

3.02 AIR SYSTEMS

- A. The TAB Agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. The TAB Agency shall perform the following TAB procedures in accordance with the National Standards:

For supply fans:

- 1. Fan speeds – Test and adjust fan RPM to achieve maximum or design CFM. Confirm proper rotation direction.
- 2. Current and Voltage – Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
- 3. Pitot-Tube Traverse – Perform a Pitot-tube traverse of main supply and return ducts, as applicable to obtain total CFM.
- 4. Outside Air – Test and adjust the outside air on applicable equipment using a Pitot-tube traverse. If a traverse is not practical use the mixed-air temperature method if the inside and outside temperature difference is at least 20 degrees Fahrenheit or use the difference between Pitot-tube traverses of the supply and return air ducts.
- 5. Static Pressure – Test and record system static profile of each supply fan.

For return fans:

- 1. Fan speeds – test and adjust fan RPM to achieve maximum or design CFM. Confirm proper rotation direction.
- 2. Current and Voltage – Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
- 3. Pitot-Tube Traverse – Perform a Pitot-tube traverse of the main return ducts to obtain total CFM.
- 4. Static Pressure – Test and record system static profile of each return fan.

For relief fans:

- 1. Fan speeds – Test and adjust fan RPM to achieve maximum or design CFM. Confirm proper rotation direction.

2. Current and Voltage – Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
3. Static Pressure – Test and record system static profile of each relief fan.
4. Pitot Tube Traverse – If possible, per system ductwork, perform a traverse to determine Relief Air CFM.

For exhaust fans:

1. Fan speeds – Test and adjust fan RPM to achieve maximum and design CFM. Confirm proper rotation direction.
2. Current and Voltage – Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
3. Pitot-tube Traverse – Perform a Pitot-tube traverse of main exhaust ducts to obtain total CFM.

For zone, branch and main ducts:

1. Adjust ducts to within design CFM requirements. As applicable, at least one zone balancing damper shall be completely open. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.

For diffusers, registers and grilles:

1. Tolerances – Test, adjust, and balance each diffuser, grille, and register to within 10% of design requirements. Minimize drafts.
2. Identification – Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.

For coils:

1. Air Temperature – Once air flows are set to acceptable limits, take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

3.03 HYDRONIC SYSTEMS

- A. The TAB Agency shall, as applicable, confirm that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing valves (except bypass valves) are set full open. The TAB Agency shall perform the following testing and balancing functions in accordance with the National Standards:

For pumps:

1. Test and adjust chilled water, hot water, and condenser water pumps to achieve maximum or design GPM. Check pumps for proper operation. Confirm proper rotation direction. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations.
2. Current and Voltage – Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.

For system mains and branches:

1. Adjust water flow in pipes to achieve maximum or design GPM.

For chillers:

1. Verify that chillers have been started by others and are in operation. Test and adjust chiller water flows to achieve maximum or design GPM.
2. Current and Voltage – Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
3. Test and record temperature profiles of chillers.

For cooling towers:

1. Verify that cooling towers have been filled and started by others, and are in operation. Confirm proper rotation direction for all motors.
2. Test and adjust water flows to balance tower cells and flows between towers.
3. Test and record temperature profiles for water and air side operation.

For boilers:

1. Verify that boilers have been filled and started by others, and are in operation.
2. Current and Voltage – As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
3. Test and adjust water flow through water boilers.
4. Test and record temperature and pressure profiles of water or steam boilers.

For coils:

1. Tolerances – Test, adjust, and balance all chilled-water and hot-water coils within 10% of design requirements.
2. Verification – Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.
3. All automatic flow control devices shall be measured for correct differential pressure and flow. Each devices shall be included in the report with the appropriate information.

3.04 OPTIONAL TAB SERVICES-----

[THESE OPTIONS CAN BE REQUIRED ON A PER JOB BASIS. CONSULTANT SHALL EDIT AS REQUIRED.]

A. Preconstruction Plan Check and Review:

The TAB Agency shall review the project documents and contractor submittals for their effect on the TAB process and overall performance of the HVAC system. It shall submit recommendations for enhancements or changes to the system within 30 days of document review.

B. Job Site Inspections:

During construction, the TAB Agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of two times. (Typically, these are performed when 60% of the total system is installed and again when 90% of the total system is installed, prior to insulation of the duct and piping). The TAB Agency shall submit a written report of each inspection.

C. Duct Leakage Testing:

[Note to Consultant: duct leakage testing shall be done on a per-diem basis, e.g. Unit price for travel to/from job site plus hourly rate for actual test work, as requested by the Contractor and approved by the Project Manager. Otherwise, the number of required trips is very difficult for the TAB bidder to estimate in advance.

Include a unit price in the TAB procurement package for duct testing, along with an estimated number of daily trips to be included in the TAB bid price.]

The installing contractor shall isolate and seal sections of ductwork for testing. The test pressures required and the amount of duct to be tested shall be described by the engineer in the appropriate duct classification section. All testing shall be based on one test per section only unless otherwise noted.

D. Temperature Testing:

To verify system control and operation, a series of three temperature tests shall be taken at approximately two-hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than two degrees Fahrenheit from the thermostat or control set point during the tests. Outside temperature and humidity shall also be recorded during the testing periods. (Random zones may be selected by the Engineer if such a test is needed to prove building system.)

E. Fume hood Testing:

The TAB Agency shall test and adjust fume hood total air flow by duct Pitot-tube traverse or best possible method. If a Pitot-tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Test and record face velocities under design operating conditions using a maximum of a one square foot grid pattern across the entire open face. The TAB Agency shall set sash height on hoods to obtain face velocities within 20% to 100 feet per minute unless specified otherwise. It shall test and adjust VAV controllers to obtain design exhaust air flows and make-up air flows to maintain design hood pressures and face velocities, and design room pressurization. The TAB Agency shall test for turbulence and proper air flow patterns at the face and inside the hoods using a hand-held smoke puffer or other approved smoke-emitting device.

F. Kitchen Hood Testing:

The TAB Agency shall test and adjust kitchen hood total airflow by duct Pitot-tube traverse or best possible method, if applicable under local code. All sealing of test holes in the exhaust duct to be by others per local code requirements. The TAB Agency shall test and record face velocities in accordance with design requirements. It shall test and adjust makeup airflow (if included) to meet design face velocities and pressurization and to minimize turbulence.

G. Building/Zone Pressurization:

The TAB Agency shall test and adjust building/zone pressurization by setting the design flows to meet the required flow direction and pressure differential. For positive pressure areas, it shall set the supply air to design flow, and gradually reduce and exhaust air rate to obtain the required flow or pressure difference. For negative pressure areas, it shall set the supply air to design flow, and gradually increase the exhaust air rate to obtain the required flow or pressure difference.

H. TAB Verification

The TAB Agency is to include time to verify a minimum of 10% of all readings or maximum of 1 day.

END OF SECTION 230593