

SECTION 230593 – TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Testing, adjusting and balancing of air and water systems.
- B. Preparation of interim and final reports.

1.2 REFERENCES

- A. The commissioning responsibilities stated elsewhere in this Project Manual are applicable to this section.

1.3 SUBMITTALS

- A. Submit name and resume' of proposed balancing contractor.
- B. Submit Interim and Final Reports as herein described.

1.4 QUALIFICATION

- A. The testing and balancing agency shall be an independent organization specializing in this type of work. The organization shall be a member of the Associated Air Balance Council and shall present evidence of having satisfactorily performed work of similar size and complexity for a minimum period of two years.

PART 2 PRODUCTS

2.1 PERSONNEL AND INSTRUMENTS

- A. Perform all work with properly trained personnel using accurately calibrated instruments. All instruments shall have been calibrated within the six months immediately preceding the commencement of work.

PART 3 EXECUTION

3.1 SCHEDULING

- A. Schedule trial operations in coordination with Adjusting and Balancing work. If permitted by the Engineer more than one system may be operated at the same time. Submit schedule for Engineer's review.

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper T&B of systems and equipment.

- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine equipment performance data including fan and pump curves.
- E. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and controls are ready for operation.
- F. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the controls contractor and functioning.
- G. Examine strainers to verify that mechanical contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.
- H. Examine two-way valves for proper installation and function.
- I. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

3.3 PREPARATION

- A. Prepare a T&B plan that includes:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Prepare system-readiness checklists, as described in the AABC National Standards for Total System Balance, for use by contractors in verifying system readiness for T&B. These shall include, at a minimum:
 - 1. Airside:
 - a. All ductwork is complete with all terminals installed.
 - b. All volume, smoke and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. All fans are operating, free of vibration, and rotating in correct direction.

- e. VFD start-up is complete and all safeties are verified.
- f. Automatic temperature-control systems are operational.
- g. Ceilings are installed.
- h. Windows and doors are installed.
- i. Suitable access to balancing devices and equipment is provided

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing on each system according to the procedures contained in the latest version of the AABC National Standards for Total System Balance and in this Section.
- B. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare a single-line schematic diagram of systems for the purpose of identifying HVAC components.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow as follows:
 - a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.

- b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
 - 3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows.
- 1. Measure airflow of sub-main and branch ducts.
 - 2. Adjust sub-main and branch duct volume dampers for specified airflow.
 - 3. Re-measure each sub-main and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
- 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure airflow at all inlets and outlets.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after all have been adjusted.
- D. Verify final system conditions
- 1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
 - 2. Re-measure and confirm total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
6. Record final fan-performance data

3.7 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans: Plus or minus 5 percent.
 2. Air Outlets and Inlets: Plus or minus 5 percent.
 3. Minimum Outside Air: Zero to plus 10 percent.
 4. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.8 FINAL TEST & BALANCE REPORT

- A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the AABC technicians or test and balance engineers.
- B. The report must be organized by systems and shall include the following information as a minimum:
 1. Title Page
 - AABC Certified Company Name
 - Company Address
 - Company Telephone Number
 - Project Identification Number
 - Location
 - Project Architect
 - Project Engineer
 - Project Contractor
 - Project Number

- Date of Report
- AABC Certification Statement
- Name, Signature, and Certification Number of AABC TBE

2. Table of Contents

3. AABC National Performance Guaranty

4. Report Summary

- The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.

5. Instrument List

- Type
- Manufacturer
- Model
- Serial Number
- Calibration Date

6. T&B Data

- Provide test data for specific systems and equipment as required by the most recent edition of the *AABC National Standards*.

- C. One copy of the final test and balance report shall be sent directly to the engineer of record. Provide five (5) additional copies to the contractor.

3.9 ADDITIONAL BALANCING REQUIREMENTS

- A. Compensate for condition of filters at time of balancing so that system will deliver proper amount of air when filters become dirt-laden and nearly due for replacement.
- B. Record positions of outdoor, return, and relief dampers as set for cooling cycle; vortex dampers, and bypass dampers.
- C. Adjust duct volume dampers to minimize outlet damper throttling.
- D. Permanently mark position of balancing dampers for future reference.
- E. Air quantities shall be balanced to the tolerance of -5%/+10%.
- F. The balancing agency will witness all duct leakage testing and will provide a certified report on these tests.

- G. Provide Xerox copy or a plan drawing of duct configuration and indicate on as-built drawings where duct traverses are taken. This information shall be included in both the interim and final balance report.

END OF SECTION 230593