

SECTION 230593 - TESTING AND BALANCING AIR SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work covered by this section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required for testing and balancing the air systems.

1.2 GENERAL REQUIREMENTS

- A. The provisions of Section 230500, "Supplemental Mechanical Requirements", apply to this section.

1.3 DEFINITIONS

- A. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment, (e.g., reduce fan speed, throttling).
- B. Balance: To proportion flows within the distribution system (submains, branches and terminals) in accordance with specified design quantities.
- C. Procedure: Standardize approach and execution of sequence of work operations to yield reproducible results.
- D. Report Forms: Test data sheets arranged for collection of test data in logical order to submission and review. This data should also form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.
- E. Test: To determine quantitative performance of equipment.

1.4 SUBMITTALS: Submit the following:

- A. Standards Compliance:

Testing Agency  
Testing Agency Personnel  
Professional Engineers  
Instrument Calibration

1.5 TESTING AND BALANCING AGENCY

- A. Air Systems Testing and Balancing: Upon completion of the installation and field testing, performance test and adjust the supply, return, make-up, and exhaust air systems to provide the air volume quantities indicated. Accomplish work in accordance with the agenda and procedures specified and AABC 71679 and standards of the NEBB. Correct air system performance deficiencies disclosed by the test before balancing the systems.

- B. Agency Qualifications: Obtain the services of a qualified testing organization to perform the testing and balancing work as herein specified. Prior to commencing work under this section of the specifications, the testing organization shall have been reviewed by the Architect. The criteria for determining qualifications shall be membership in the AABC, or certification by the NEBB, or the testing organization shall have submitted proof to satisfy the Architect that the organization meets or exceeds the technical standards for membership of the AABC as published in the AABC 71679. The testing organization shall be independent of both the installing contractors and equipment suppliers for this project.

1.6 AGENDA

- A. Preliminary Report: Review drawings and specifications prior to installation of any of the affected system. Submit a written report to the Architect indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.

1.7 PROCEDURES, GENERAL

- A. Requirements: Adjust systems and components thereof that perform as required by drawings and specifications.
- B. Test Duration: Operating tests of heating and cooling coils, fans and other equipment shall be of not less than 4 hours duration, after stabilized operating conditions have been established. Capacities shall be based on temperatures and air quantities measured during such tests.
- C. Instrumentation: Method of application of instrumentation shall be in accordance with the manufacturer's instructions. Furnish personnel, instruments, and equipment for tests specified herein.
- D. Accuracy of Instruments: Instruments used for measurements shall be accurate. Provide calibration histories for each instrument for examination. Calibrate each test instrument by an reviewed laboratory or by the manufacturer. The Architect has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.
- E. Accuracy of Thermometers: Plus or minus one graduation at the temperatures to be measured. Graduations shall conform with the following schedule:

Medium	Design Temperature Differential (°F)	Maximum Graduation (°F)
Air	10 or less	1/2
Air	over 10	1

- F. Flow Rate Tolerance: Values are based on discussion in ASHRAE "HVAC Applications", Chapter 34. Air filter resistance during tests, artificially imposed if necessary, shall be 80 percent of final values.

- 1. Air Handling Unit CFM: Minus 0 percent to plus 10 percent.

2. Other Fans: Minus 0 percent to plus 10 percent.
3. Minimum Outside Air (for manually set dampers): Minus 0 percent to plus 10 percent.
4. Individual Room Air Outlets and Inlets, and Air Flow Rates Not mentioned Above: Minus 10 percent to plus 10 percent.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.1 AIR SYSTEM PROCEDURES

- A. Adjustments: Adjust air handling systems to provide the required design air quantity to, or through, each component. Conduct adjusting and balancing of systems during periods of the year approximating maximum seasonal operation.
- B. Balance: Use flow adjusting (volume control) devices to balance air quantities only; i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of specified limits.
- C. Balancing Between Runs (submains, branch mains, and branches): Use flow regulating devices at, or in, the divided - flow fitting. Minimize restriction imposed by flow regulating devices in or at terminals.
- D. Final Measurements of Air Quantity: Make final measurements of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion.
- E. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds, or axial-flow fan wheel blade pitch. For systems with direct-connected fans (without adjustable pitch blades), damper restrictions of a system's total flow or variable speed rheostats shall be adjusted as appropriate.
- F. Air Measurement:
  1. Pitot Tube: Except as specifically indicated herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform with the ASHRAE Handbook Fundamentals.
  2. Pitot Tube Traverse: Pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of Pitot-tube traverse, determine airflow in the duct by totaling volume of individual terminals served, measured as described herein.

3. Measurements of Air Quantity: Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

- G. Air Terminal Balancing: Measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing.

### 3.3 CERTIFIED REPORTS

- A. Submittal: Submit three copies of the reports described herein, covering air system performance, air motion (fpm), to the Architect prior to final tests and inspection.
- B. Instrument Records: Include types, serial numbers, and dates calibration of instruments.
- C. Reports: Reports shall identify conspicuously items not conforming to contract requirements, or obvious maloperation and deficiencies.
- D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air balancing and who is not affiliated with any firm involved in the design or construction phases of the project.

### 3.4 AIR SYSTEM DATA

- A. Report: The certified report shall include for each air-handling system the data listed below:
  1. Equipment (fan or factory fabricated station unit):
    - a. Installation Data:
      - 1) Manufacturer and Model
      - 2) Size
      - 3) Arrangement, Discharge, and Class
      - 4) Motor H.P., Voltage, Phase, Cycles, and Full Load Amps.
      - 5) Location and Local Identification Data
    - b. Design Data: Data listed in schedules on drawings and specifications.
    - c. Fan Recorded (Test) Data
      - 1) C.F.M.
      - 2) Static Pressure
      - 3) R.P.M.
      - 4) Motor Operating Amps.
      - 5) Motor Operating B.H.P.

## 2. Duct Systems:

## a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-Air, and Exhaust

- 1) Duct size(s)
- 2) Number of Pitot-tube (Pressure) Measurements
- 3) Sum of Velocity Measurement, excluding pressure measurements
- 4) Average Velocity
- 5) Recorded (Test) C.F.M.
- 6) Design C.F.M.

## b. Individual Air Terminals:

- 1) Terminal Identification (Supply or Exhaust, Location and Number Designation)
- 2) Type Size, Manufacturer, and Catalog Identification
- 3) Design and Recorded Quantities - C.F.M.
- 4) Deflector Vane or Diffusion Cone Settings
- 5) Applicable Factor for Application, Velocity, Area
- 6) Design and Recorded Velocities - F.P.M. (State "core" "inlet," as applicable)

## 3.5 FINAL TESTS, REVIEW, AND ACCEPTANCE

- A. Capacity and Performance Tests: Make tests to demonstrate that capacities and general performance of air systems comply with contract requirements.
- B. Final Inspection: At the time of final review, recheck, in the presence of the Engineer, random selections of air quantities and air motion recorded in the certified report.
- C. Points and Areas for Recheck: As selected by the Architect.
- D. Measurement and Test Procedures: As reviewed for work forming basis of certified report.
- E. Selections for Recheck (specific plus random): In general, selections for recheck will not exceed 25 percent of the total number tabulated in the report.
- F. Retests: If random tests elicit a measured flow deviation of ten percent or more greater than that recorded in the certified report listings, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made.
- G. Marking of Settings: Following final acceptance of certified reports by the Architect, the settings of valves, dampers, and other adjustment devices shall be permanently marked, so that adjustment can be restored if disturbed at any time. Do not mark devices until after final review.

\*\*\* END OF SECTION \*\*\*