

## **AABC Specifications for Testing and Balancing HVAC Systems**

The Associated Air Balance Council (AABC) Total System Balancing – Specifications for HVAC Testing, Balancing and Performance Verification

TOTAL SYSTEM BALANCE INCLUDES -- The following chapter references are taken from the AABC 2002 National Standard for Total System Balance:

1. Fan Systems: Supply / Return / Relief / Exhaust (Chapter 10)
2. Constant and Variable Air Systems (Chapter 8)
3. Dual Duct Systems and High Pressure Systems (Chapter 9)
4. Multi-Zone Systems (Chapter 7)
5. Laboratories and Positively Pressurized Areas (Chapter 16)
6. Hydronic Systems (Chapter 11)
7. Sound Testing (Chapter 18)
8. Vibration Testing (Chapter 19)
9. Duct Leakage Testing (Chapter 5)
10. Cooling Tower Testing (Chapter 13)
11. Smoke Control Testing (Chapter 20)
12. Commissioning (Chapter 21)
13. Temperature Control System (Chapter 12)

### **SELECTION OF THE TEST AND BALANCE AGENCY**

The Test and Balance Agency shall be selected from the list of pre-qualified, pre-approved Certified Test and Balance Agencies below: These specified agencies have a proven track record of properly test and balance and standing behind their work:

**AMERICAN AIR BALANCE CO., INC.**

*Main Office*  
4721 E. Hunter Ave.  
Anaheim, CA 92807  
(714) 693-3700

**LOS ANGELES AIR BALANCE  
COMPANY, INC.**

1848 W. 11<sup>th</sup> St., Unit N  
Upland, CA 91786  
(909) 931-1114

**PENN AIR CONTROL, INC.**

*Main Office*  
5941 Lakeshore Drive  
Cypress, CA 90630  
(714) 220-9091

**WINAIRE, INC.**

*Main Office*  
15641 Chemical Lane, Suite #A  
Huntington Beach, CA 92649  
(714) 901-2747

The Test and Balance Agencies named comply with the universally accepted National Standards set forth by The Associated Air Balance Council which were developed to help the engineer achieve design intent.

System Balance shall be performed by these agencies who are not affiliated with any mechanical contractor, architect, or engineer. Only timely submittals (within 90 days of award of contract) naming one of these pre-approved Test and Balance Agencies will receive approval.

The name of the selected Test and Balance Agency, plus the name and registration number of the certified Test and Balance Engineer, shall be submitted to the Mechanical Engineer by the General Contractor for approval within thirty (90) days after the award of the contract.

If a complete and qualifying submittal specifying one of the pre-approved

Test and Balance Agencies named above is not received within the specified time, the Mechanical Engineer shall select the Test and Balance Agency from the pre-approved list of qualified Test and Balance Agencies above.

In addition, **no work by the Mechanical Contractor shall commence until one of the Test and Balance Agencies named above has signed off on the shop drawings;** it is understood, that many functions of Test and Balance, including pre-construction meetings, duct leakage testing and inspection of installation require early involvement in the project in a support function to the Mechanical Engineer.

## **WORK OF OTHER TRADES**

The General Contractor will provide the Test and Balance Agency with:

1. Within thirty (90) days after selection:
  - a. Construction drawings
  - b. Equipment specifications
  - c. Written contract
  - d. Equipment submittals
2. As issued or received:
  - a. Change orders
  - b. Equipment manufacturer's submittal data
  - c. Mechanical Contractor's shop drawings
  - d. Temperature control drawings
  - e. Project schedule
  - f. Reasonable time
  - g. Completely operable system
3. Before testing and balancing is started, the Mechanical Contractor shall adjust belts and sheaves, align all parts, oil and grease bearings in accordance with manufacturer's instructions, clean exterior surfaces of coil tubes and fins, flush interior of oil tubes until clean and check mixing damper operation to insure free operation and activation by the correct thermostat.
4. The Mechanical Contractor shall be responsible for certifying, in writing, that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but the Mechanical Contractor's certification that the prime movers, fans, pumps, refrigeration machines, boilers, etc. are installed in good working order, and that the full load performance has been preliminarily tested under the certification of the

Mechanical Contractor. Before any testing and balancing is started, a complete report shall be sent to the Test and Balance Agency.

5. The Mechanical Contractor shall be responsible for making all modifications to rectify discrepancies reported by the Balancing Contractor as indicating non-compliance with the contract documents.
6. The HVAC Controls Contractor shall, at no additional cost, provide three (3) sets or copies of all necessary programs, software, cables and specialty tools to the Test and Balance Agency to operate and calibrate all systems. Further, the Controls Contractor shall coordinate with the Test and Balance Agency as necessary to accomplish fully operational and properly balanced systems.

## **TESTING AND BALANCING**

1. Within thirty (30) days after receipt of the testing and balancing contract, plans, specifications and complete equipment submittals, the Test and Balance Agency shall submit an agenda describing the following:
  - a. Field observation reports
  - b. An overview of system Test and Balance procedures:
    1. Demonstrating complete understanding of the design intent by the Test and Balance Agency.
    2. Identifying potential problems for performing Total System Balance and suggesting possible changes to allow the most effective Total System Balance.
  - c. AABC National Project Performance Guaranty.
  - d. AABC Certification of Test and Balance Engineers and Technicians.
  - e. Instrument calibration certificates of each instrument that may be used along with specific ID numbers (i.e., serial numbers.)

## **SCOPE OF WORK**

Ongoing Inspection

1. The Test and Balance Agency shall visit the job site during the early stages of fabrication to inspect duct Installation. A report shall be submitted to the Mechanical Engineer listing any deficiencies found and making recommendations for work to be performed or devices to be added to allow for proper balancing.

#### Total System Balance

1. Each piece of equipment and the entire system shall be adjusted to insure proper function of all controls, proper distribution of air, maintenance of temperatures, elimination of drafts and vibration and left in first class operating condition.
2. The air system shall be adjusted to obtain the air volumes specified by the Mechanical Engineer, but readjusted if required to obtain design temperature in each room. The Mechanical Contractor shall make drive changes, install additional dampers, vanes, grille baffles, etc., as may be required on the job.
3. Wherever the use of multi-louvers (in supply, exhaust, or return air grilles) creates objectionable noise, two (2) inch thick, six (6) lb. fiberglass board shall be installed in the grille opening, slotted for the proper air quantity. This shall be accomplished by the Mechanical Contractor.
4. Balance the supply and return air systems (with the chillers operating) by first arriving at the fan total air quantity, reading air velocities at cooling coils at 55 degrees F, return air and outside air openings; and a duct traverse. The fan RPM shall be adjusted for the specified air quantities allowing for the maximum of 2% for duct leakage. The quantity of air to each outlet shall not be less than that shown on the drawings and not greater than 10% of that amount. If so instructed by the mechanical engineer, further balancing of temperatures shall be made and indicated by a thermometer or by temperature recorder.
5. Perform Pitot Tube Traverse of all supply, return and exhaust systems.
  - a. Except as specifically indicated herein, Pitot Tube Traverse shall be taken in branch ducts to assure specified flow to all zones. Pitot tubes, associated instruments, traversing and testing techniques shall conform to the ASHRAE Handbook of Fundamentals.

- b. Test holes shall be in a straight duct, as far as possible downstream from the elbows, bends, take-offs and other turbulence generating devices, to optimize reliability of flow measurements.
  6. Furnish typewritten data for all supply fans tabulating:
    - a. Quantity of air in CFM at each air outlet or inlet.
    - b. Dry and wet bulb temperatures at each thermostat to the nearest 1/10 of 1 degree.
    - c. Outdoor dry and wet bulb temperatures, wind direction and velocity, and barometric pressure at the time tests are conducted.
    - d. RPM of fan or blower.
    - e. RPM of motor.
    - f. Ampere input of each motor (one reading on each leg if three (3) phase).
    - g. No load Amperage and brake horsepower calculations on all motors 1/2 horsepower or larger.
    - h. Static pressure in inches water gauge at inlet of fan or blower.
    - i. Duct Traverse data.
  7. Furnish typewritten data for the Coils tabulating:
    - a. Entering and leaving water temperature.
    - b. Quantity of air in CFM.
    - c. Face velocity in FPM.
    - d. Dry and wet bulb air temperature entering and leaving coil.
    - e. Capacity of coil in BTUH.
    - f. Quantity of water circulated through coil in GPM.
  8. Furnish typewritten data for the Chillers tabulating:

- a. Suction and condensing temperature and pressures.
  - b. Ampere input of motors under full load (one for each phase leg).
  - c. Temperatures of entering and leaving chilled and condenser water.
  - d. Capacity of machine in BTUH.
  - e. Quantity of chilled and condenser water circulated through machine in GPM.
9. Furnish typewritten data for the Pumps tabulating:
- a. Quantity of water circulating in GPM.
  - b. Suction and discharge pressure in PSIG.
  - c. Ampere input of motors (one reading for each leg on three (3) phase motors).
  - d. At no flow, (valve off), measure suction pressure, discharge pressure and motor amps (on all three (3) legs).
  - e. Calculate BHP.
10. Furnish typewritten data for the Cooling Tower tabulating:
- a. Quality of water circulating through Tower.
  - b. Temperature of entering and leaving water.
  - c. Capacity of Tower in BTUH.
11. Sound and Vibration Test Procedures: (optional, must be specified)
- a. Sound: Read and record sound levels at up to 15 locations in the building designated by the Engineer. All tests shall be conducted when the building is quiet, and in the presence of the Engineer, if he so desires.
  - b. The required sound levels shall be measured at any point within a room not less than six (6) feet from the air terminal or

room unit, and not closer than three (3) feet from any floor, wall, or ceiling surface.

- d. Sound levels shall be measured with the Octave Band Analyzer. The "A" scale shall be used to measure overall sound levels. The specified octave band levels shall be determined with the above sound meter set on "A".
- e. Vibration: Record vibration readings on air handling units, fans, inline fans, utility fans, van axial fans, pumps, and end suction pumps per test data found in AABC National Standards 2002 appendices.

## 12. Duct Pressure / Leakage Testing

- a. Test and Balance Agency shall conduct leakage test on ductwork after the Mechanical Contractor successfully runs pre-test. If the Mechanical Contractor is unable to perform pre-test, Test and Balance Agency will run pre-tests and charge the Mechanical Contractor. Test shall be performed prior to installing ductwork insulation and after the installation of all fire dampers and access doors.
- b. Systems shall be inspected and tested to positive pressures, in accordance with the following:
  - 1. There are no visible mechanical defects.
  - 2. There is no audible leakage at any point when area ambient noise is at normal-occupancy level.
- c. Measured total system leakage shall not exceed 1% of total system cubic feet per minute (cfm) when tested in accordance with "Leak Tests".
- d. Leak Tests
  - 1. Test apparatus and procedures shall be similar in all respects to those defined in AABC standards. Filtered blower inlet and automatic safety relief device shall be provided to protect system. Accuracy of measurement of leakage flow rate shall be certified to be within 1 percent of total system flow.
- e. Test Apparatus

1. Test apparatus shall consist of
  - A. A source of high pressure air - a portable rotary blower or tank type vacuum cleaner.
  - B. A flow measuring device usually an orifice assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated to its own calibration curve. Pressure and flow readings are usually taken with U-tube manometers.

f. Test Procedures

1. Test for audible leaks as follows:
  - A. Close off and seal openings in the duct section to be tested. Connect the test apparatus to the duct by means of a flexible duct section.
  - B. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches w.g.).
  - C. Gradually open the inlet damper until the duct pressure reaches specified pressure for the appropriate duct pressure class. Test pressure is read on manometer No. 1. Note that the pressure is indicated by the difference in level between the two legs of the manometer and not by the distance from zero to the reading on one leg only.
  - D. Survey joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.
2. After all audible leaks have been sealed, the remaining leakage should be measured with the test apparatus orifice section as follows:
  - A. Start blower and open damper until duct pressure reaches design duct leakage test pressure.

- B. Read the pressure differential across the orifice on manometer No. 2. Leakage rate in cfm is read directly from the calibration curve. If leakage does not occur, the pressure differential will be zero.
  - C. Total allowable leakage should not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
  - D. If all audible leaks have been corrected, it is unlikely that the measured leakage will exceed one percent of capacity. If it does, the leaks shall be located by careful listening or feeling along the joint.
  - E. It should be noted that even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak that shall be corrected.
- g. Test Report Criteria
- 1. A test report shall be provided for each system tested, identified by system or section thereof, and containing leak-test curves for apparatus used and data pertinent to acceptance requirements.

## REPORTS

- a. The Test and Balance Agency shall prepare and submit six (6) copies of the Test and Balance Analysis report to the owner within five (5) working days of completion.

This report shall contain, at a minimum:

- a. Project cover sheet.
- b. Table of contents and test forms for all systems
- c. "AABC" Certification for the responsible TBE and all technicians involved in the project.
- d. "AABC" National Performance Guaranty.
- e. Definitions, Abbreviations, and Terminology.
- f. Data and date tested.
- g. Calibration certificates for all test equipment.

h. AutoCAD drawings.