

SECTION 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC INTRODUCTORY INFORMATION

The purpose of this guide specification is to assist the Specifier in correctly specifying Mechanical System Testing Adjusting and Balancing. The Specifier needs to edit the guide specifications to fit the needs of specific projects. Contact a representative of the Testing, Adjusting, and Balancing Bureau (TABB) www.tabbcertified.org to assist in making the appropriate selections.

Throughout the guide specification, there are Specifier notes to assist in the editing of the file. The term "Architect" is used throughout these guide specifications only as a guide and may be edited to read "Design Professional", "Engineer", "Owner", or other appropriate designations as required for the specific project.

TABB is the only certification organization recognized and endorsed by Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). TABB members are required to sign a code of conduct and continued certification depends upon maintaining this code of conduct. Technicians are required to sign and adhere to the code of conduct, thus eliminating the necessity for a third party to perform the testing, adjusting, and balancing work.

TABB certified technicians have passed a 21-hour exam on testing, adjusting, and balancing fluid dynamics. The AABC certifies TAB contractors who do not perform installation of HVAC systems. The NEBB and TABB both certify mechanical contractors who may provide installation services, as well as independent contractors that only provide testing, adjusting, and balancing services.

COORDINATION WITH DIVISION 01: Specifier should coordinate work of this section with each Division 01 – General Requirement Sections that address testing. In cases where the Division 01 – General Requirements are not provided by the Specifier editing this Section, ensure coordination is addressed by requesting a copy of the Division 01 documents edited for the project from the provider. Sections that may include conflicting information are:

- Section 01 33 29 – Sustainable Design Reporting
- Section 01 40 00 – Quality Requirements
- Section 01 70 00 – Execution and Closeout Requirements
- Section 01 75 00 – Starting and Adjusting
- Section 01 78 53 – Sustainable Design Closeout Documentation
- Section 01 86 19 – HVAC Performance Requirements
- Section 01 91 13 – General Commissioning Requirements

Additionally, the Specifier needs to be aware that the above listed section numbers and titles are generic in nature, as well as in the best interest of the project to review all project-specific Procurement and Contracting Requirements and General Requirements.

Specifier should consider including the following language in the Quality Requirements Specification Section of Division 01. Language may also be appropriate for inclusion in the other Division 01 Sections as Starting and Adjusting, and the HVAC Commissioning Requirements.

Specialists: certain sections of the specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy the qualification requirements indicated. Specialists and related requirement shall include:

1. "All Certification programs must be endorsed by a nationally recognized organization".

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, Adjusting, and Balancing of:
 - 1. Air conditioning equipment including air distribution devices, supply ducts, air handling units, condensing units, fans, coils, and related equipment.
 - 2. Hydronic systems including pumps, water distribution systems, chillers, boilers, heat exchangers, coils, and related equipment.

1.02 REFERENCES

- B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) 111 – Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) – TAB Procedural Guide – Endorsed by Testing, Adjusting and Balancing Bureau (TABB)
- D. Associated Air Balance Council (AABC) – National Standards for Total System Balance.
- E. National Environmental Balancing Bureau (NEBB) – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.03 DEFINITIONS

- A. Adjusting: Varying of system flow by modifying settings of dampers and valves, in combination with varying fan speeds to obtain optimum operating conditions for the HVAC system.
- B. Balancing: Proportioning of air and hydronic flows through system mains, branches, and terminal devices using standardized procedures to obtain specified air or hydronic flow while imposing the least amount of restriction on the HVAC system.
- C. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristic, air and hydronic flow in velocities or quantities used in evaluating the performance of the HVAC system.

1.04 SUBMITTALS

- A. Qualification Statements – submit company certification documents including:
 - 1. Contractor Certification
 - 2. Supervisor Certification
 - 3. Technician Certification
 - 4. Submit name of testing agency to Owner within 30 days of Notice to Proceed.

5. Submit list of projects completed by testing agency of similar size, scope, and equipment. Include name of Contractor and Building Owner contacts.

B. Reports:

1. Deficiency Report: Following examination of installed system, prior to balancing, submit report indicating system deficiencies that would prevent proper testing, adjusting, and balancing of systems and equipment to meet specified performance.
2. TAB Report: Submit <XX> copies of the complete testing, adjusting and balancing report, including any drawings indicating air outlets, thermostats, and equipment identified to correspond with data sheets.
 - a. Reports shall be on TABB/SMACNA, AABC, or NEBB forms that indicate information addressing each of the testing methods, readings, and adjustments.

C. Closeout Submittals:

1. Provide complete copy of testing, adjusting, and balancing report. (Include report in Operation and Maintenance Manual.)

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Testing and Balancing shall be performed by a testing agency who specializes in testing, adjusting, and balancing of heating, ventilating, air-moving equipment, air-conditioning systems and hydronic systems and has a minimum of one year experience.
2. Testing agency shall have successfully completed a minimum of five projects, similar in size and scope.
3. Testing agency shall be a certified member of TABB, AABC, and/or NEBB.
4. Maintain a copy of applicable standards at the project site.

B. Certifications:

1. TAB Technician shall be certified by a nationally recognized certifying agency.

C. Perform total system balance in accordance with:

1. TABB – Quality Assurance Program.
2. AABC – National Standards for Field Measurement and Instrumentation.
3. NEBB Quality Assurance Program – Conformance Certification.

1.06 PROJECT CONDITIONS

- A. Testing, adjusting, and balancing shall commence after HVAC systems installation is complete and in working order. Associated areas of general construction shall be in place including interior and exterior doors, windows, walls, and ceilings.

1.07 SPECIAL WARRANTY

- A. Provide warranty for period of 90 days following submission of completed report, during which time Owner may request a recheck of up to 10% of total number of terminals, or resetting of any outlet, coil, or device listed in the test report.
- B. Warranty shall meet the requirements of the following program(s):
 - 1. TABB – Quality Assurance Program
 - 2. AABC – National Project Performance Guarantee
 - 3. NEBB – Conformance Certification

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to commencing the testing, adjusting, and balancing of environmental system(s), verify the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed, complete, and operable.
 - 3. Automatic and manual dampers are operable and fully open.
 - 4. Thermal overload protection is in place for fans, pumps, chillers, and other equipment.
 - 5. Start up air filters are removed.
 - 6. Final filters are clean and properly installed.
 - 7. Duct and fan systems are clean.
 - 8. Fans are rotating correctly.
 - 9. Fire and volume dampers are in place and open.
 - 10. Air coil fins are cleaned and combed.
 - 11. Access doors are closed and duct end caps are in place.
 - 12. Air outlets are installed and connected.
 - 13. Hydronic systems are pressure tested, flushed, filled, and properly vented.
 - 14. Leak testing on duct system has been performed in accordance with SMACNA standards <or as specified...>.
 - 15. Pumps are rotating correctly.
 - 16. Start-up/construction strainers have been removed and all permanent strainers are clean and in place.

17. Gauges and/or test ports are properly located for balancing.

18. Service and balance valves are fully open.

B. If deficiencies are evident, submit Deficiency Report to Architect. Do not begin testing, adjusting, and balancing of environmental systems until deficiencies have been remedied.

3.02 SITE TOLERANCES

A. Air Handling Systems: Adjust to within plus 10 percent of outlet total plus allowable leakage rate.

B. Air Outlets and Inlets: Adjust total to within plus or minus 10 percent of design for the space.

C. Hydronic Systems: Adjust to within 10 percent of design flow.

D. Hydronic terminal devices: Adjust to within plus or minus 10 percent of design flow.

3.03 AIR SYSTEMS PROCEDURE

A. Adhere to the follow procedure:

1. TABB – SMACNA TAB Procedural Guide, with particular focus on the following chapters:

a. Preliminary TAB Procedures.

b. General Air System TAB Procedures.

c. TABB Procedures for Specific Air Systems.

2. AABC – National Standards for Total System Balance.

3. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

B. Minimum air procedures should include the following:

1. Test and adjust fan RPM to design requirements.

2. Test and record motor full load nameplate rating and actual ampere draw.

3. Test and record system static pressures, fan suction, and discharge.

4. Adjust all main supply and return air duct to within tolerances of proper design CFM.

5. Test and adjust each diffuser, grille, and register. Reading and tests of diffusers, grilles, and registers shall include design velocity (FPM) and adjusted velocity, design CFM, and adjusted CFM.

6. Test and record outside air, mixed air, and discharge temperatures (D.B. for heating cycle, D.B. and W.B. for cooling cycle).

7. In coordination with the ATC contractor, set adjustments of automatically operated dampers to operate as specified, indicated and/or noted.

8. Test and adjust air handling and distribution systems to provide required supply, return, outside, and exhaust air quantities within design tolerance.
9. Make air velocity measurements in ducts by Pitot tube traverse across entire cross-sectional area of duct in accordance with SMACNA equal area method or Log Linear method.
10. Measure air quantities at all air inlets and outlets.
11. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels.
12. Vary total system air quantities by adjustment of fan speeds. Provide drive changes recommendations. Vary branch air quantities by damper regulation.
13. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for loading of filters and coils.
14. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions within specified tolerances.
15. Where modulating dampers or economizers are provided, take measurement at full return air, minimum outside air, and 100% outside air mode of operation.

3.04 HYDRONIC SYSTEM PROCEDURE

A. Adhere to the follow procedure:

1. TABB – SMACNA TAB Procedural Guide, with particular focus on the following chapter:
 - a. Hydronic System TAB Procedures.
2. AABC – National Standards for Total System Balance.
3. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

B. Hydronic balancing shall include the following minimum data:

1. Prepare itemized equipment schedules listing all heating and/or cooling elements and equipment in the systems to be balanced. List in order on equipment schedules, by pump or zone according to the design, all heating and/or cooling elements, all zone balancing valves, and circuit pumps, ending with the last items of equipment or transfer element in the respective zone or circuit. Include on schedule sheet column titles listing the location, type of element or apparatus, design conditions, and measured conditions. Prepare individual pump report sheets for each zone or circuit.
2. Adjust hydronic systems to provide plus or minus 10 percent of required design quantities.
3. Use calibrated Venturi tubes, orifices, metered fittings, pressure gages, and direct-reading instrumentation to determine flow rates for system balance. Where flow-metering devices are not installed, flow balance on temperature difference across various heat transfer elements in the system is acceptable.

4. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
5. Effect system balance with automatic control valves fully open to heat or cooling transfer elements.
6. Adjust hydronic distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
7. Test pumps and adjust flow. Record the following on pump report sheets:
 - a. Suction and discharge pressure.
 - b. Running amps and brake horsepower of pump motor under full flow and no flow conditions.
 - c. Pressure drop across pump in feet of water and total GMP pump is handling under full flow conditions.
8. Where available pump capacity is less than total flow requirements or individual system parts, proportional balancing must be performed.

3.05 ADJUSTING

- A. Recorded data shall represent actual measured or observed conditions.
- B. Permanently mark the setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- C. Final report to include identification of all key outlets, key branches, and key trunks in each air system that shows a critical path of no dampening from the fan to terminal device.
- D. Final report to include identification of all key terminal devices, key branches, and key trunks in each hydronic system that shows a critical path of no throttling of valves from the pump to terminal device.
- E. Leave systems in proper working order by: replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

END OF SECTION