

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

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.
2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.
3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.
4. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - b. Procedural Standards for Measuring Sound and Vibration.
5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.

1.02 SUBMITTALS

A. Informational Submittals:

1. Documentation of experience record of testing authority.
2. Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract.
3. Submit detailed test and balance procedures, including test conditions for systems to be tested, prior to beginning the Work.
4. Written verification of calibration of testing and balancing equipment.
5. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

1.03 QUALITY ASSURANCE

A. Air Balancing and Test Agency Qualifications:

1. Certification by AABC or NEBB for testing, adjusting and balancing of HVAC systems.
2. Corporately and financially independent organization functioning as an unbiased testing authority.
3. Professionally independent of manufacturers, suppliers, and installers of HVAC equipment being tested.

4. Have a proven record of at least five similar projects.
5. Employer of engineers and technicians regularly engaged in testing, adjusting and balancing of HVAC equipment and systems.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials, tools, test equipment, computers and instrumentation required to complete the work included.
- B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.
- C. Drives for Belt-Driven Fans:
 1. Physical Characteristics:
 - a. Furnish cast iron or flanged steel sheaves.
 - b. Sheaves and belt combination shall be capable of providing 150 percent of motor horsepower.
 2. Functional Characteristics: None.
 3. Performance Characteristics: None.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust and balance air and water systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.
- B. Adjust and balance the following systems:
 1. Supply, return and exhaust air systems.
 2. Heating and cooling systems.
 3. Odor control system.

3.02 ADJUSTING AND BALANCING AIR SIDE

- A. Preparation:
 1. Prior to beginning the Work, perform the following activities:
 - a. Review shop drawings and installed system for adequate and accessible balancing devices and test points.
 - b. Recommend to Contractor dampers that need to be added or replaced in order to obtain proper air control.
 - c. Verify proper startup procedures have been completed on the system.
 - d. Verify controls installation is complete and system is in stable operation under automatic control.

- e. Verify test instruments have been calibrated to a recognized standard and are within manufacturer's recommended calibration interval before beginning the Work.

B. General:

1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.
2. Lock and mark final positions of balancing dampers with permanent felt pen.
3. Correct fan and airflow measurements for Site elevation.

C. Equipment Data:

1. Collect the following data and included in final report:
 - a. Type of unit.
 - b. Equipment identification number.
 - c. Equipment nameplate data (including manufacturer, model, size, type, and serial number).
 - d. Motor data (frame, hp, volts, FLA rpm, and service factor).
 - e. Sheave manufacturer, size, and bore.
 - f. Belt size and number.
 - g. Sheave centerline distance and adjustment limits.
 - h. Starter and motor overload protection data.
 - i. Include changes made during course of system balancing.

D. Fan Systems:

1. Measure fan system performance in accordance with AMCA 203.
2. In each system at least one airpath from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.
3. Adjust Fan Air Volumes:
 - a. Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of plus 10 percent minus 0 percent.
 - b. After final adjustments, do not operate motor above nameplate amperage on any phase.
 - c. After final adjustments, do not operate fan above maximum rated speed.
 - d. Perform airflow test readings under simulated or actual conditions of full cooling, full heating, minimum outside air, full outside air and exhaust, and full return air.
 - e. Provide and make drive and belt changes on motors or fans as required to adjust equipment to specified conditions. Drives shall

be able to deliver 150 percent of motor horsepower. Provide written notice to air handling unit manufacturer and Contracting Officer if drive or belt changes were made.

4. Adjust outside air dampers, return air dampers, relief air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.
5. Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, and plenums on every supply, return, and exhaust fan for each test condition.
6. Read and record motor amperage on all phases for each test condition.

E. Air Outlets and Inlets:

1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.
2. Adjust air volumes on supply diffusers and grilles, and on return and exhaust grilles, to the quantity shown, with allowable variation of plus or minus 10 percent.
3. Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.
4. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.

F. Building Static Pressure:

1. Measure building static pressure relative to outside in perimeter entrances during normal system conditions that would yield widest range in internal building pressure.
2. For multi-story buildings, test pressure conditions at ground, intermediate, and upper levels.

G. Odor Control System:

1. Adjust balancing dampers at each foul air connection to the design air flow rates below:
 - a. Septage Receiving Equipment: 50 acfm.
 - b. Septage Receiving Vault: 300 acfm.
 - c. Grit Classifier: 50 acfm.
 - d. Grit Basin: 600 cfm.
2. Isolation dampers at each fan are to remain either full open or full closed.
3. Adjust fan speed if required to avoid having balancing dampers more than 50 percent shut.
4. Odor control for Headworks is designed to pull foul air from the Influent Box through the covered Screen Channels and the Grit Basin where the foul air duct is connected. Adjust the open area of air intake

- gooseneck at fine screen channels to ensure foul air is ventilated at rates specified herein. The foul air collected from the channels is conveyed to the FA duct connected to the Grit Basin. Air flow test ports and a balancing damper are located on that FA duct for balancing.
5. Once above individual flows are balanced and total of 1,000 cfm is measured at the inlet to the odor control facility, operate one of the compost fans to flow an additional 300 cfm to the odor control facility. Document the odor control fan speed for this mode of operation, suction and discharge pressures, and damper positions.
 6. Document air flow rate in each segment, final fan speed, fan suction pressure and fan discharge pressure for each odor control fan.

3.03 FIELD QUALITY CONTROL

- A. General: Perform functional tests as required by Section 01 91 14, Equipment Testing and Facility Startup.
- B. Performance Testing:
 1. Electric Heating Coil Testing:
 - a. Adjust system as required to achieve full output from coil.
 - b. Read and record amperages and voltages for all phases.
 2. Heating or Sensible Cooling Coil Testing:
 - a. Adjust system as required to achieve design flow conditions for both air and water sides of coil.
 - b. Measure and record airflow rate, water flow rate, entering air temperature, entering water temperature, leaving air temperature and leaving water temperature.
 3. Cooling or Dehumidification Coil Testing:
 - a. Adjust system as required to achieve design flow conditions for both air and water sides of coil.
 - b. Measure and record airflow rate, water flow rate, entering air dry bulb and wet bulb temperatures, entering water temperature, leaving air dry bulb and wet bulb temperatures and leaving water temperature.
- C. Balancing Log Report Requirements:
 1. Include narrative description for each system explaining TAB methodology and assumptions used. Clearly identify test conditions for tests performed. Include control setpoint.
 2. Log and record operational information from every test for each system, as necessary to accomplish services described.
 3. Include equipment data for units tested.
 4. Include reduced set of HVAC Drawings or system schematic diagrams with each element uniquely identified and indexed to balance log.

5. Indicate recorded site values, and velocity and mass correction factors used to provide equivalent standard air quantities.
6. Include separate section in log, if necessary, describing operating difficulties in air or water systems that could not be eliminated by specified procedures. Identify these problems by system and location within building; include outline or summary of condition and its effect on building, and describe corrective actions attempted and recommended.

D. Quality Control Verification:

1. After adjustments have been completed and balance logs submitted, balancing and testing agency shall be available to demonstrate the following:
 - a. Air and water balancing procedures, vibration tests, and verification of test results.
 - b. Perform spot tests on a maximum of 20 percent of total diffusers and grilles, on two air handling fan devices per building, and on 10 percent of total water balance fittings, with measuring equipment used in original tests, at random points selected by contracting officer.
 - c. Results of these spot tests shall agree with balance logs within plus or minus 10 percent. Where this accuracy cannot be verified, rebalance portions of system as requested by contracting officer.
 - d. At completion of rebalance procedures, perform another spot test if required to verify results.

END OF SECTION