

SECTION 23 08 13
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Summary
 - 1. Section Includes:
 - a. Testing & Balancing Air Systems:
 - 1) CRAC Units
 - 2) Perforated tiles
 - 3) Makeup Air Units
 - 4) Humidifiers
 - 5) Exhaust Fans
 - 6) Supply Registers
 - 7) Rooftop Units
 - 8) Fan Powered Terminals
- B. Provide qualified personnel, equipment, apparatus and services for start-up, testing and balancing of mechanical systems, to performance data shown on drawings, in schedules, and as specified, for the air and water distribution systems included herein. Note that some start-up procedures require the cooperation of the Balancing Vendor, the equipment manufacturer's representative and the BMS vendor. Ensure that all associated parties are present on site during the entire time that these procedures take place.
- C. The Scope of Work includes adjustment of dampers, belt drives, and coupled shafts. The Mechanical Installer shall provide the services of the appropriate skilled trades for each phase of start up, testing, and balancing to ensure that work is done properly.
- D. Start-up, testing and balancing shall not diminish guarantee requirements.
- E. Coordinate work with Owner's Commissioning Agent.
- F. Notify Engineer and authorities involved at least two days before start up, testing and balancing begins.
- G. Do not cover or conceal work before testing and inspection and obtaining approval.
- H. Instruments for testing and balancing shall have been calibrated within one month prior to testing and balancing. Calibration shall be traceable to NBS Standards. Provide photocopy of certificate of calibration to Engineer with submittal of balancing report.
- I. Leaks, damage and defects discovered or resulting from start up, testing and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.
- J. Provide reports for each testing and balancing procedure as specified below.

1.2 REFERENCES

- A. Associated Air Balance Council (AABC): National Standards for Total System Balance
- B. ASHRAE Standard 111-1988: Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems

- C. National Environmental Balancing Bureau (NEBB): Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems
- D. SMACNA: HVAC Systems Testing, Adjusting, and Balancing
- E. ASME B31.9 – Building Services Piping Standard

1.3 RELATED SECTIONS

- A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.4 COORDINATION

- A. Coordinate work under provisions indicated in Section 23 00 10:
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

1.5 QUALIFICATIONS / QUALITY ASSURANCE

- A. Conform to requirements indicated in Section 23 00 10.
- B. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Field Supervisor and Technicians: Employees of the TAB contractor and certified by AABC or NEBB.

1.6 QUALITY ASSURANCE

- A. The Contractor shall be an independent balancing vendor with not less than five years experience in balancing commercial or industrial HVAC system installations of greater than 10,000 sq. ft., and shall submit sample documentation for at least three reference projects involving data centers contracted within the last three years. The Contractor shall indicate whether certification has been granted by an independent agency such as AABC or NEBB.

1.7 SUBMITTALS

- A. Submittals required here and under Section 23 00 10.
- B. Prepare a test report form which includes space for all data required by these specifications, and submit the form to the Engineer for approval prior to use.
- C. Submit complete testing and balancing reports, including system drawings, as specified below within two weeks of completion of the work for approval by the Engineer. Final acceptance of the project by the Owner shall be contingent upon receipt of approved testing and balancing reports.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit under provisions indicated in Section 23 00 10.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions indicated in Section 23 00 10.

1.10 WARRANTY

- A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EQUIPMENT START-UP

- A. The precision cooling system technician, with any assistance required from the Balancing Vendor and the BMS Vendor, shall coordinate and perform the start-up of the refrigerant based precision cooling system, and all related control systems in strict accordance with equipment Manufacturer's instructions.
- B. The precision cooling system technician shall check out all control sensors and devices for the system, including the, high temperature and low pressure devices and alarms, the alternating and sequencing controls, leak detection systems, and condensate pump overflow alarms, as well as monitoring of general operation of the CRAC units, heating, cooling, makeup air, and exhaust air systems controlled through the BMS to ensure that all sequences of operation called for in drawings and specifications operate properly. Ensure that all control components are properly calibrated in accordance with manufacturer's instructions. For further requirements see BMS section of these specifications (Section 23 09 00).

3.2 AIR BALANCING REQUIREMENTS

- A. The Air Balance Vendor shall provide qualified personnel, equipment and services for balancing and adjusting of airside mechanical systems as specified herein. Submit procedures, recording forms, and test equipment calibration documentation for review by Engineer at least two weeks prior to scheduled start of balancing procedures.
- B. Work shall be performed in accordance with practices recommended by ASHRAE and/or SMACNA. Forms may be obtained from SMACNA by its member contractors.
- C. Prepare a drawing of the system, showing the location of all MAUs, CRACs. Electronic files will be made available by the Engineer for use as a background reference for the drawing. This drawing shall accompany the test report.
- D. For each CRAC, verify the Mechanical installer has completed installation and start up by the equipment manufacturer is completed and documented.
 - 1. Set EC fans to specified flow.
 - 2. Check nameplate voltage and full load amps on each motor, compare to scheduled values. Notify Engineer immediately of any discrepancies. Measure and record actual voltage and current draw across all power leads. If there are marked discrepancies in amperage draws between legs, or if any motor draws more than its nameplate rating, shut down fan and notify Engineer immediately.
 - 3. Measure and record fan and motor rpm. Check that motor rpm agrees with nameplate and scheduled rpm.
 - 4. Measure and record intake, discharge, total and external static pressure.
- E. Using a rotating vane or hot wire anemometer traverse of the top inlet area, measure the total airflow rate through each CRAC unit. Record total airflow rate for each unit on the drawing and in the report. Adjustment of airflow is not required, unless total airflow is more than 10% below

the rated airflow, or if fan is overloaded for any unit. If adjustment is necessary, advise Engineer.

- F. Computer Room: Using a calibrated flow hood, after the raised access floor installation is complete and all unused cable openings are sealed off, measure air flow rate from each perforated floor tile diffuser in the computer room and record on the drawing and in the report. Adjustment of airflow is not required. Perform test:
1. All non-redundant CRACs (redundant units off) operating at 100% fan capacity. This may be accomplished by lowering room temperature set point, which will force operating CRAC fan drives to 100%. Measure and record static pressure at six locations under the floor evenly spread out through the white space and indicate locations in TAB report.
 2. Calculate overall room airflow and leakage from floor plenum. Leakage shall be below 10% of the total CRAC unit airflow.
- G. Electrical Infrastructure Spaces: Using a calibrated flow hood, after the raised access floor installation is complete and all unused cable openings are sealed off, measure air flow rate from each perforated floor tile diffuser in the rooms served and record on the drawing and in the report. Adjustment of airflow is not required. Perform test:
1. Suites 230 and 236
 - a. Normal Operation: CRAC-29,30 & CRAC-31,32 operating at 100% fan capacity. This may be accomplished by lowering room temperature set point, which will force operating CRAC fan drives to 100%. Measure and record static pressure at locations under the floor as indicated on the floor plans.
 - b. Calculate overall room airflow and leakage from floor plenum.
 - c. Failure Mode 1: CRAC-31/32 operating and serving both UPS Room C & D with CRAC -31/32 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
 - d. Failure Mode 2: CRAC-29/30 operating and serving both UPS Rooms A & B with CRAC-29/30 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
 2. Suite 242
 - a. Normal Operation: CRAC-21,22,23 operating at 100% fan capacity. This may be accomplished by lowering room temperature set point, which will force operating CRAC fan drives to 100%. Measure and record static pressure at locations under the floor as indicated on the floor plans.
 - b. Calculate overall room airflow and leakage from floor plenum.
 - c. Failure Mode 1: CRAC-21/22 operating and serving UPS Rooms A, B, & C with CRAC -23 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
 - d. Failure Mode 2: CRAC-21/23 operating and serving UPS Rooms A, B & C with CRAC-22 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
 - e. Failure Mode 3: CRAC-22/23 operating and serving UPS Rooms A, B & C with CRAC-21 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
- H. Balance the air distribution systems related to each MAU.
1. Using a calibrated flow hood, measure and adjust airflow rate from each supply register for the data center ventilation system and split systems to within +/- 10% of values shown on plan. Ensure that all equipment is in operation and under automatic control.

2. Measure and document total air flow and outdoor airflow rates for each MAU. Measure and document inlet and discharge static pressures and motor current draw, and notify the engineer immediately if the supply fan motor operates in excess of its nameplate rated amps.
- I. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Where sufficient duct space is unavailable for Pitot-tube traverse measurements; measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 3. Measure static pressure across each component that makes up the fan coil.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Obtain approval from Architect, Construction Manager, and Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for MAUs for adjustment of fans, belts, and pulley sizes to achieve indicated MAU performance.
 5. 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.
- J. Adjust volume dampers for main duct and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- K. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or by using outlet manufacturer's written instructions and calculating factors.
- L. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.3 TESTING AND BALANCING REPORTS

- A. Air balance reports shall include as a minimum, full nameplate data for each item of equipment balanced, including motor data, belt drive information, and operating limits. Verify that each motor matches the scheduled data.

- B. Record all measurements taken, and all adjustments made to arrive at final values. Reference all air flow rates and static pressures to specific terminals or loads, and coordinate with locations on drawings which are specified to accompany the report.
- C. Air balance reports shall be signed and certified by the responsible balancing technician, and six (6) copies shall be submitted to the Engineer for approval within two weeks of the completion of work.
- D. Provide signed copies of start up reports completed by the respective equipment manufacturer's representative using their standard forms and procedures.

END OF SECTION