

Section 15990 – Testing, Adjusting and Balancing: Add the following articles and subparagraphs to Part 3 – Execution.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust each fan to deliver the specified total indicated (or approved) airflows within the maximum allowable fan speed, transmission, and motor limitations listed by the manufacturer.
 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure duct static pressure as far downstream from the fan as practicable 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 flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan
 2. Measure and record static pressure in each component that makes up an air-handling unit, rooftop unit, and other air-handling and air-treating equipment.
 - a. Engage the TC system to provide full cooling during this test to provide full condensate loading and restriction on cooling coils.
 - b. Engage the TC system or the unit's OEM controls to position the economizer damper section at 0%, 50%, and 100% outside air and compare static pressure measurements at each setting. Check for starvation, flow direction through dampers, or inoperative dampers. Verify damper modulation between multiple damper sections is coordinated and proportional throughout the stroke.
 - c. Measure and record position of gravity relief dampers that may exist during this test.
 - d. Ensure full face position of bypass dampers that may exist during this test.
 - e. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure the condensate trap depth and verify against approved submittals, installation recommendations by the manufacturer, and

contract requirements. Effective trap depth to be at least 1 inch more than the highest read negative or positive static pressure measured at the compartment of trap connection.

4. Measure and record static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 5. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Record such changes in the Monthly Progress Reports.
 6. 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 modes, to determine the maximum required brake horsepower.
 7. The TAB shall DOCUMENT the adjusted operating diameter of the sheave so it may be duplicated in the future for sheave changes or if a sheave “comes loose” and moves. This documentation is to be permanently posted inside the unit near the motor.
 - a. Once final fan speeds are set using the existing or adjustable sheaves, use Red Loctite to lock the adjustable sheaves in the proper position.
 8. In the event any equipment has FIXED sheaves and the sheaves are not the correct size the TAB is to calculate the correct size and turn that information over to the mechanical contractor. Original Sheave size and corrected sheave are to be listed in the deficiency report. The unit is to be re-balanced after the new sheave is installed.
- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in sub-main 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. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or other approved device. Utilize the manufacturer's written instructions and calculating factors for the device used to measure airflows.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using 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.
- E. Measure and adjust Economizer minimum position. Engage the TC contractor (or the MC contractor for OEM economizer control) to position economizer dampers during test. Measure and establish single or multiple positions for outside air intake control per TC specification. Dampers to be positioned under full control of the TC system, and damper blade angles, (not linkage arms) physically marked at flow settings. Record the corresponding TC positioning value. Ensure the minimum position values established are entered into the TC system.
- F. Where return fans exist, verify the supply and return fan are sharing flow loads. Supply and return fans shall not develop excess negative or positive static pressure in the mixing chamber during 100% return air operation.
- G. Assist the TC contractor in calibrating all airflow monitoring stations.
- H. Place system in the normal state of operating control. If systems are not returned to a 100% operational condition at end of testing, record the reason on the daily report and report the condition to the General Contractor immediately.

3.06 PROCEDURES FOR SINGLE DUCT AIR TERMINAL UNITS (VAVs)

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the AHU fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the AHU fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts. See procedures outlined below.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the AHU fan systems have been adjusted per applicable portions of the Variable Air Volume Units Systems Procedures, adjust the variable-air-volume air terminal units as follows:
1. Ensure ALL safeties are in place, static pressure safeties are calibrated, adjusted, and functional to the satisfaction of the TAB contractor before proceeding.
 2. Set-up the Air Handling Unit (AHU) with the minimum OA dampers positioned for design minimum OA CFM and the economizer OA

dampers closed. The AHU is to be configured as it would be for full mechanical cooling during the occupied mode.

3. Configure each terminal unit for maximum primary airflow and measure the airflow from each connected supply air outlet. Calibrate the TC airflow sensor so the TC system records the measured total supply air.
4. Program the TC for the scheduled maximum and minimum CFM (Cooling/Heating) values.
5. When the TC system is properly calibrated, configure the terminal unit for design maximum CFM and balance the air outlets downstream from terminal units as described below:
 - a. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - b. 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.
 - c. Adjust patterns of adjustable outlets for proper distribution without drafts.
6. Engage the TC contractor to manipulate the electric heaters. Measure and record the temperatures entering and leaving the heaters under full load at final balanced conditions.
7. Record the final fan performance data.
8. Place each air terminal unit in the normal state of operating control. If units are not returned to a 100% operational condition at end of testing, record the reason on the Daily Deficiency Report and report the condition to the General Contractor immediately.

Increment all subsequent Part 3 articles by two: Example; the existing 3.05 will become 3.07, etc.

Please add the following sub-paragraph to article ~~3.11~~ (3.13)

3.13 FINAL REPORT

- H. Exhaust and Ventilation Fan Test Reports: For general exhaust fans include the following:
 1. Fan Data:
 - a. System identification
 - b. Location

- c. Make and type
- d. Model number and size
- e. Manufacturer's serial number
- f. Type of fan (forward inclined, forward curve, airfoil, etc)
- g. Arrangement and class
- h. Sheave make, size in inches, and bore
- i. Sheave dimensions, center-to-center, and amount of adjustments in inches
- j. Final fixed sheave size installed

2. Motor Data:

- a. Make and frame type and size
- b. Horsepower and rpm
- c. Volts, phase, and hertz
- d. Full-load amperage and service factor
- e. Sheave make, size in inches, and bore
- f. Sheave dimensions, center-to-center, and amount of adjustments in inches
- g. Number of belts, make, and size
- h. Final fixed sheave size installed

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm
- b. Total system static pressure in inches wg
- c. Fan rpm
- d. Discharge static pressure in inches wg
- e. Suction static pressure in inches wg
- f. Intake path is per contract documents