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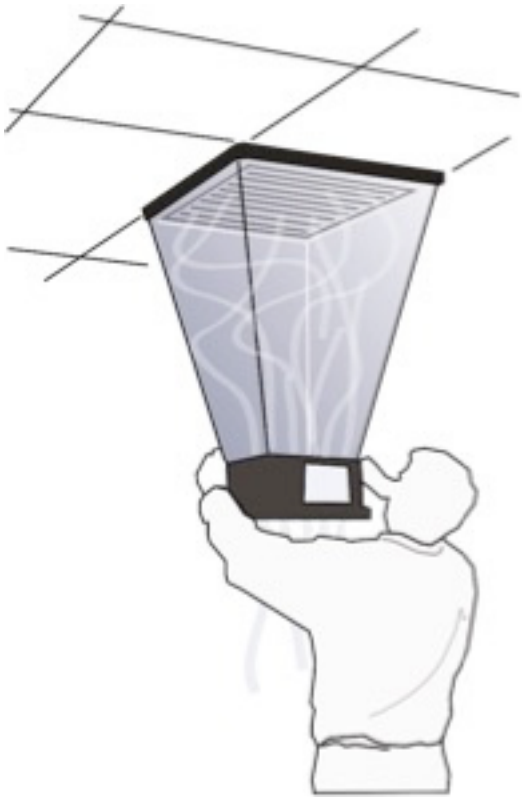

Testing and Air Balancing Constant- and Variable-Volume HVAC Systems

As of January 2016, all new equipment above 65,000 Btus must include two-speed fans. Without a consistent balancing protocol, the difference in resulting balance reports would be impossible to follow or interpret.

By Rob 'Doc' Falke

As of January 1, 2016, ASHRAE Standard 90.1 requires all new equipment above 65,000 Btus to include two speed fans. Commercial systems have employed variable-capacity functions for decades. An increasing number of residential fans also use variable speeds and variable capacity-functions that affect system air balance. Without a consistent balancing protocol, the difference in resulting balance reports would be impossible to follow or interpret.

The Simple Answer

Let's begin with a 30,000-foot view of the solution. The simple answer is to set system controls to call for equipment airflow and capacity at maximum operating conditions, or a lower level if the design provides that information. The design specifications are found in the engineering documents and specified by the designer.

Www Contractingbusiness Com Sites Contractingbusiness com Files Airflowhood 2If specifications are not provided with the required airflow or operating capacity, defaults (Such as 400 cfm per ton) can be used.

This allows you to bring the system to the full capacity with the required fan speed and number of stages calling. Once the system has reached full capacity, test, adjust, and

balance the system as a constant volume system. As you proceed with the air balance, assure the system remains consistent throughout testing. You can track any change in fan speed by placing a static pressure probe in the system to verify changes in pressure during testing.

Track staging changes by measuring equipment amp draw and verifying constant volume operation. Verify constant-volume operation by making sure there is no change in the system Amp draw. You hold a system at constant state by adjusting the control setting, or simply setting the thermostat to 55 degrees in cooling mode. This prevents the system from shutting off during testing.

If measuring temperatures to calculate system delivered capacity, be sure to measure and record the temperatures of the system when the occupied space is between 70 F and 75F or normal occupied conditions.

Constant or Variable Volume HVAC System Balancing Procedure

Here are the steps required to balance a typical constant volume HVAC system. Remember, non-typical systems with varying configurations and accessories will require additional air balancing procedures.

NOTE: The additional steps required to balance a variable volume system are italicized.

Balancing Preparation – Before starting, do the following to prepare the system for an effective air balance.

1. Prepare the air balancing report with the design information from the plans and specifications. This includes equipment model numbers, capacity, fan data, specified pressures and fan speeds, as well as the required airflow (cfm) for each supply and return grille. If no plans are available, determine design requirements using equipment specifications, or other approved standards.

2. Gather design documents, equipment specifications, and installation instructions to reference during the balancing.

3. Determine the mode of operation to be tested and assure fan and control settings are correct.

4. Inspect the system to assure it is 100% complete and operational. If testing the system as-found, make note of deficiencies identified on the balancing report and recommend repairs.

5. Install needed temperature, pressure, and traverse test ports in the system.

6. Assure all air filters are clean and that fans are in good condition. Verify all dampers are in the open position and that the distribution system is sound.

7. Start the system with the settings and controls calling for full system capacity, or if lower than full capacity, adjust to meet design conditions. Then, allow the system to stabilize to required operating conditions. **Set controls on variable volume systems to meet design intent and hold the system at steady conditions throughout the balancing. Refer to ASHRAE 111, section 9.7. It includes an excellent description of a test procedure to verify controller set-points to assure the settings meet design intent.*

"Failing to assure system airflow remains unchanged will result in constantly changing delivered airflow values and inconsistent balancing"

Testing Procedure – This is a basic balancing procedure for smaller systems. Additional detailed balancing procedures are available.

1. Determine fan airflow by plotting it using the manufacturer's fan data (by measuring total external static pressure and fan speed) or by traverse. Adjust to required airflow as needed.

2. Using a calibrated commercial balancing hood, measure and record airflow from each supply register in the order appearing on the balancing report. If the hood cannot reach certain registers, an airflow traverse may be required.

3. Then, measure and record the return grille airflow in the order appearing on the balancing report. Traverse any grilles where necessary.

4. Total the supply register airflow readings and then compare individual register airflow and total system airflow to the design values.

5. Divide the design airflow into the measured airflow of each register or grille to determine the percent of airflow delivered. For example: The measured airflow from a register is 104 cfm and the design airflow of the register is 150 cfm. Do the math: 104 cfm divided by150 cfm

equals 69%. In other words, this register is 31% below design (100%-69%=31%.)

6. Inspect the duct installation to any registers or grilles with airflow below 60% and make, or specify repairs for damaged or poorly installed ducts.

7. Reduce airflow to registers and grilles with measured airflow exceeding 100% by closing dampers. This will increase airflow to the lower registers and grilles.

8. **Make sure the variable-volume system remains in a constant operating condition by verifying unchanged static pressure and voltage readings.*

9. Pass through the system again, and adjust each damper to deliver airflow+/-10% of design. Take and record readings on the balancing report.

10. Pass through the system one final time, trim dampers to deliver +/-10% of design and record final measured airflow.

11. Finally, assure the fan speed has not changed from the damper adjustment during balancing by verifying unchanged static pressure readings.

Final Testing and Reporting

1. Record the control settings used during balancing in the report

2. During balancing, when room temperatures are under normal occupied mode settings (between 70F and 75F), read and record temperatures and calculate temperature changes.

3. With a balanced system, mark final damper settings

4. Record the final static pressure, fan speed, motor amperage, and voltage measurements in the balancing report.

5. If calculating equipment or system delivered Btu capacities, make needed calculations and record results in the report.

6. Record any deficiencies found and make needed repair recommendations.

7. Complete and submit the final balancing report.

As you can tell, this article could fill the entire HotMail newsletter. Hopefully this short and simple procedure will invite you into the world of balancing or provide a hint for improving your next constant-volume or variable-volume balancing project.

Rob "Doc" Falke serves the industry as president of National Comfort Institute – an HVAC-based training company and membership organization. If you're an HVAC contractor or technician interested in more information about any step mentioned in this balancing procedure, contact Doc at robf@ncihvac.com or call him at 800-633-7058. Go to NCI's website at nationalcomfortinstitute.com for free information, articles, and downloads.