Ins and Outs of Testing and Balancing

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Learning Objectives

• Understanding the Basics of Testing and Balancing.
• Understanding why testing and balancing is performed.
• Understanding how testing and balancing is performed.
• Learn the benefits of testing and balancing.
Why do we Test and Balance?

- Occupant Comfort
- Occupant Safety
- Energy Efficiency
- Ensure systems are performing as you designed them.

QUALITY ASSURANCE
Adjusting mechanical systems to operate as designed.

- Air and Water Flows
- Pressures

Certifications

- TABB – Testing, Adjusting, and Balancing Bureau
- NEBB – National Environmental Balancing Bureau
Basis of Air Balancing – Equalizing Pressures

Fan Size:
6,000 CFM @ .459”

Duct – 70 ft. × 0.19/100 = 0.133 in.w.g.
Elbow – C × V_p = 0.23 × 0.20 = 0.046 in.w.g.
Fitting – C × V_p = 0.07 × 0.20 = 0.014 in.w.g.
Duct AC’Total = 0.193 in.w.g.

b) Duct CD – 4000 cfm, 20 × 16 inches
Table 21-2, Circular Equivalent = 19.5 in.
Figure 21-1, Friction Loss = 0.22 in.w.g./100 ft.
Velocity = Q/A = 4000/20 × 16/144 = 1800 fpm

\[ V_p = \left( \frac{1800}{4005} \right)^2 = 0.202 \text{ in.w.g.} \]

Table 21-11 (A), 45° entry fitting (Main flow loss)
branch velocity = 1125 fpm

\[ V_p/V_f = \frac{1125}{1800} = 0.625 \]
Fitting, C = 0.07 (Main)

Duct – 25 ft. × 0.22/100 = 0.055 in.w.g.
Fitting – C × V_p = 0.07 × 0.20 = 0.014 in.w.g.
Duct CD Total = 0.069 in.w.g.

c) Duct DF – 2000 cfm, 16×16 inches
Table 21-2, Circular Equivalent = 17.5 in.
Figure 21-1, Friction Loss = 0.11 in.w.g./100 ft.
Velocity = 1125 fpm (from above)

\[ V_p = \left( \frac{1125}{4005} \right)^2 = 0.079 \text{ in.w.g.} \]

Table 21-9 (F), Elbow, C = 0.26
Table 21-13 (B), Damper, C = 0.04 (open)
Balancing Procedure – Low Pressure (CV)

- Pre-read total on fan to ensure enough airflow
- All balancing dampers open
- Proportion Branches – MVDs!
- Proportion outlets
- Final Setup of Unit
Balancing Procedure – Medium Pressure (VAV System)

• Take Static Pressure Reading in Duct (System should be set for minimum 1.5” SP
• Read total flow from VAV box
• If it differs from BAS, make correction to calibration factor on system
• Balance outlets
• Once all VAVs are balanced, dump whole system and finalize units
Balancing Procedure – Chilled Beams
Finalizing A System

- Fan tracking and pressures
- Setup MA dampers, setpoints, outdoor airflow, AFMS
What defines a properly balanced system?

- Regardless of the method, the objectives remain the same and the system will be considered balanced in accordance with NEBB procedural standards when the following conditions are satisfied:
  
  - All measured airflow quantities are within +/- 10% of the design airflow quantities unless there are reasons beyond the control of the NEBB Certified TAB firm. Deficiencies shall be noted in the TAB report summary.
  
  - There is at least one path with fully open dampers from the fan to an air inlet/outlet. Additionally if a system contains branch dampers, there will be at least one wide-open path downstream of every adjusted damper.
Existing System Balancing – Special Considerations

- What conditions are we balancing to?
- Pre-Reads
- Does this affect other areas “NIC?”
  - During construction
  - Final product
- Sound vs comfort
• What to look for in the spec
• Procedures w/ references
• Durations based on zoning
• Sequencing – work backwards
• GC buy-in and accountability
• Document and sign-off of deviations
• Consistent balancer between projects

High Rise Chilled Water System
Equipment: HRCHW1-CHP-1A, B, C; HRCHW1-HX-4A, B, C – System consists of (3) pumps and HXs sized for 50% of the respective chilled water flow. Each pump is designed for 50% of the total design chilled water flow.
System Serves: High Rise FCUs G-Pent, AHU-1, AHU-2, AHU-3, AHU-4, AHU-8

1) System readiness checks of the following : (NEBB Procedure 9.2a-e), Spec 230594 3.2B3
   i) System is installed in its entirety.
   ii) Systems are started and operating in a safe and normal condition.
   iii) Temperature control systems are installed, complete, and operational.
   iv) Proper thermal overload protection is in place for electrical equipment.
   v) System is flushed, filled, and vented.
   vi) Pumps are rotating correctly
   vii) Proper strainers are clean and in place
   viii) Expansion tank pressures verified
   ix) Pump alignment and bearings verified
   x) Vibration isolation in place
   xi) Service and balance valves are open
   xii) All related systems are operating.
2) Open all manual and control valves in system for normal operation
3) Check Pump Operation – (1) Pump on at a time.
   i) Record pump data such as:
      (1) Motor data
      (2) Starter data
      (3) Pump data
      (4) Block tight data
   ii) Verify impeller size by comparing discharge valve and reading pressure differential across pump and converting reading to feet of head
   iii) Verify reading matches pump curve in submittal
4) Command System to Full Cooling Mode
   a) For purposes of balancing, command (2) CHWP1s on, (2) HXs, and all chilled water valves open.
   b) Initial DP set point for system will be 15 PSID (per spec section 23 09 93 3.10.1E.1)
5) Begin water flow balancing based on either proportional balancing method or Stepwise balancing methods. (NEBB Procedure 6.4.1 or 2). Regardless of the method, the system will be considered balanced when all flows are within design tolerances (+/- 10% per spec 230594 3.1 B) and there is at least one path with fully open balancing valves from pump to terminal device. (NEBB Procedure 9.4b)
   a) Record flow at all balancing devices. The balancing valve serving the terminal unit with the lowest percentage of design is not adjusted. Continue working backward toward the pumps using balancing method
Coordination/Construction

Close Doors and Install Visqueen Zipper Partition, Area of AHU-103 Return needs to be cleaned and dust creating activities removed from area.

North Stairwell

Remove Visqueen Partitions after AHU-103 areas of floors are cleaned. The only partitions on floors 6, 7, 8 will be off of the stairs and at the east side of elevators.
System Balancing With Static and MVDs
Report Review / Common Issues

- Numbers that look too good.
- Need to be honest with the issues and work to correct them.
- “Hood” for everything
- Same calibration factors on VAVs/FPBs
- Balancing box without outlets

- TAB is 100% labor and is the smallest
Automated Reporting

Diagram showing the flow of data export and import for different stakeholders such as Owner, GC, Comm. Agent, Design Engineer, BIM Model, Report Program, TAB, Startup, Commissioning, and Maintenance Management System.
Tools
• Executing a good balance project takes a unique understanding of design, service and construction management.

• Proper preparation and coordination is key to providing a quality balancing project.
  • Submittal Approval – Setting Expectations
  • Scheduling
  • Contractor Buy-In
  • Communication!

• Balancing is an extension of commissioning and quality assurance.

• There will be issues on projects. Balancers are there to identify and work through these issues.
Questions?

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