2014 NEBB Annual Conference

Delivering Building Performance and Energy Efficiency

Fort Lauderdale, FL
April 3-5, 2014 – Hyatt Regency Pier 66
Measurements to Achieve Building Performance Objectives
Agenda

+ **Building Performance**
  - What is it
  - Goals
  - Challenges

+ **NEBB Firms**
  - What do you do
  - Goals
  - Challenges

+ **Common Measurement Applications**
  - Duct traverse “Tips and Tricks”
  - Outlet flow
Building Performance

+ What is it?

• Comprehensive approach
  - Focus on building as a whole
  - Not the sum of various components

• Regarding HVAC system balancing:
  - Meet design intent
    + Mechanical schedule
    + Sequence of operations
  - Ensure comfort and energy efficiency
  - Identify and correct system deficiencies
Building Performance

+ Who defines it and sets goals?

• Building owner and design team address...
  - Planning
  - Design
  - Financing
  - Construction
  - Installation
  - TAB
  - Commissioning
  - Operations and maintenance
Building Performance

+ What prevents goals from being achieved?

• Planning
  - Not specifying performance expectations clearly

• Design
  - If performance expectations are not specified, designers:
    • Cannot document intent
    • Wrong design and equipment selection
    • Cannot refer to clear documentation of project goals
      o Used to optimize their design decisions

• Installation
  - Not following plans
  - Undersize/oversize piping and ducts
  - Bad mechanical contractor
Building Performance

+ What prevents goals from being achieved?

• TAB
  - Non-NEBB firm

• Commissioning
  - Difficult to document performance testing based on the above
  - Can only reference drawings and schedules
  - Lack of commissioning

• Other
  - Poor communication between all parties involved
  - Parties not involved in the process in the early stages
Building Performance: NEBB Firms

Where do NEBB firms fit in?

- **Testing, Adjusting and Balancing (TAB)**
- Building Enclosure Testing (BET)
- Building Systems Commissioning (BSC)
- Cleanroom Performance Testing (CPT)
- Fume Hood Testing (FHT)
- Retro-Commissioning (RCx)
- Sound & Vibration Measurement (S&V)
Building Performance: NEBB Firms

+ What do NEBB certified firms do?
  • Bid jobs
  • Provide TAB services
  • Mainly commercial applications
    - General industry
    - Critical environments
  • Use tools and equipment
    - Adjust and balance per mechanical schedules
    - Ensure sequence of operations
  • In business to make $$$
What is the goal of a NEBB firm when on a job?

- Meet or exceed the objectives
- Meet mechanical schedule requirements
- Get done in the time allotted or bid timeframe
- No call backs
- *Get the work done - get paid*$ - move on to the next job
Building Performance: NEBB Firms

+ How do you perform TAB?

- Qualitative testing:
  - “Feels” hot-cold-humid-dry-drafty-stuffy-stagnant
  - Make adjustments to make it “feel” right

- Quantitative testing:
  - Use building plans and mechanical schedule
  - Measure temp and RH
  - Measure supply and return flows
  - Measure room delta P
  - Measure %OA
What challenges do you face?

- HVAC systems rely on control systems
  - BAS
    + Communications (LON, BACnet, N2, ...)
    + Installed sensors

- Familiarity with various control systems and providers in the market
  - To interface with them
  - Learn system
    + Review documentation and instruction
    + Dedicated time required

- Make changes
  - May require special software, licensing and communications cable

- Test and verify affects of change
Common Measurement Applications

- Increase productivity
- Improve efficiency
- Maintain performance
Duct Traverse: Tips and Tricks

1. Traditional

2. Fan laws

3. Center point measurement
   - Calculated CF
   - 0.9 CF
Duct Traverse: Tips and Tricks

1. Traditional
   • Log T
   • Equal area
   + Accurate
      • Takes some time
   + Used to generate correction factor
      • Characterizing a hood to an outlet
      • Back pressure compensation
   + Location impacts measurement
   + Products used
      • Micromanometer with pitot probe
         - Ideal for high temperature airstreams
      • Thermoanemometers
         - Measure air velocity, temperature and humidity
         - Calculate air flow, wet bulb and dewpoint temperature
Duct Traverse:
Tips and Tricks

2. Using Fan Laws

+ When performing a duct traverse
  - Measure the static pressure

+ If system changes, rather than redoing the entire traverse again
  - Take a SP measurement

  - Use fan laws and input CFM1, SP1 and SP2 to calculate CFM2
Duct Traverse: Tips and Tricks

2. Using Fan Laws

+ Example: 12” x 12” Duct
  • Initial traverse (CFM1) = 335 cfm
  • Initial SP (SP1) = 0.02814

  • Duct flow changes....
  • SP2 now = 0.03618

\[
CFM2 = \sqrt{\frac{SP2}{SP1}} \times CFM1
\]

\[
CFM2 = \sqrt{\frac{0.03618}{0.02814}} \times 335
\]

\[
CFM2 = 380
\]
Duct Traverse: Tips and Tricks

3. Center point measurement & calculated CF
   • Measure in center of duct
   • Compare to duct traverse AVG
     - CALC CF = TRV1 AVG/TRV1 CTR

   + TRV1 = 335 CFM
   + CTR1 = 367 CFM
   + CALC CF = 0.913
Duct Traverse: Tips and Tricks

3. Center point measurement and 0.9 CF

+ For a *quick look of flow performance*
  - Place probe in center of duct
  - Take flow measurement
  - Apply 0.9 correction factor

• NOTE:
  - If conditions are very good an accuracy of ±5 or ±10 percent may be obtained
  - This method should only be used where small duct size or other conditions do not permit a full traverse
Duct Traverse: Tips and Tricks Summary

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<tr>
<th>Standard</th>
<th>Pitot</th>
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<tr>
<td></td>
<td>12.0 in X 12.0 in</td>
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<tr>
<td>TRV1</td>
<td>335 CFM</td>
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<tr>
<td>SP1</td>
<td>0.02814 &quot;H2O</td>
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<tr>
<td>CTR1</td>
<td>367 CFM</td>
</tr>
<tr>
<td>CTR1</td>
<td>330 CFM</td>
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<tr>
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<tr>
<td>SP2</td>
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<td>Fan law for CFM2</td>
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<tr>
<td>CTR2 * 0.913 CALC CF</td>
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Outlet Measurements
Without Capture Hoods...

+ Pitot traverse

+ Diffuser probe
  • Multi-point
  • Requires diffuser manufacturer-specific Kfactors
  • Hand calculations
  • 2-man job
Outlet Measurements
Without Capture Hoods...

+ Diffuser with pressure taps
  - Kf supplied by manufacturer
  - Adjust flow with “strings”

+ Common in EU
  - Nordics
Outlet Measurements
Early Capture Hoods...

+ Analog hoods

+ “Multi-man” job!!
Outlet Measurements
Current Capture Hoods...

+ Multi-use product designed for TAB
  - Back pressure compensation
  - Data logging and download
    - Report generation
  - Auto density correction
  - Detachable micromanometer
    - Optional probes
  - Bluetooth communications
    - LogDat™ Mobile

+ Enhanced productivity and efficiency
Outlet Measurements

Swirl or Twist Diffusers

+ Have you encountered these in the US???
  • Common in EU

+ Turbulent air pattern exits swirl diffuser

+ Creates uniform temperature gradients
  • Better mixing with room air

+ Inaccuracy caused by the non-uniform air patterns
Outlet Measurements
Swirl or Twist Diffusers

+ Swirl-X Flow Conditioner
+ Why use it?
  • Hood measurements can be 55% greater than true flow
  • Inaccuracy caused by the non-uniform air patterns
Outlet Measurements
Swirl or Twist Diffusers

What is it?
• Consists of two light weight partitions that are connected together
• Fits on top of the plastic base
• Straightens turbulent airflow
Swirl X Flow Conditioner

+ Performance testing

EBT731 Performance Data
(Swirl Diffuser on 200mm Dia. Duct)

EBT731 Performance Data
(Swirl Diffuser on 300mm Dia. Duct)
Swirl X Flow Conditioner

Swirl X Performance Video

Capture Hood Swirl-X Flow Conditioner — Installation and Benefits In Use
Summary?

+ Time is money

+ Many unforeseen challenges arise on the job
  • Often affects time frame for completion

+ Using today’s product offerings
  • Help make up time
  • Ensure optimum performance
  • Increase efficiency