A Facility Manager’s Guide to Owning & Operating Air Handling Units

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What We Will Cover

• Space condition requirements that affect air handling unit design and operation

• What creates the challenges in owning AHUs

• What makes up an AHU - the basics on how they work

• Strategies in addressing these challenges

• How to plan for the future
Elements of High Performing Systems

1. Performance
   - Infection Control
   - Comfort
   - Patient Outcome

2. Safety
   - Fire, Falls, Injuries
   - Patients & Technicians

3. Reliability
   - Lost Revenue

4. Maintenance Cost
   - Man Power Cost

5. Energy
   - 1%-2% of Hospital's Cost

6. Flexibility
   - Ability of System to Adapt to Changes

Highest Importance
Big Picture Thinking – System View

• Space conditions for infection prevention, comfort, & compliance
  o Temperature
  o Humidity
  o Pressurization – both building & space
  o Air changes
  o Air quality

• The AHU is an integral piece of the puzzle
  o This is where the majority of the conditioning happens
Space Conditions

- ASHRAE Standard 170 (Current)
- Licensure Rules (Legacy)
- AAMI, AORN and Other Standards
- USP 797 and 800
- Accreditation Agencies
- Healthcare System Specific Standards
- Thermal Conditions (Air Changes)
Not All AHUs Are The Same

• Within all your facilities there are a vast range of different AHUs
  o Dual Duct (Hot Deck Cold Deck)
  o Return with Supply Air Reheat
  o 100% Outside Air

• They operate under different conditions

• What drives these differences?
  o Performance Requirements (space conditions, etc.)
  o Age

• Why is this important? What does it affect?
  o Creates complexity that must be understood, in order to be maintained
Air Handling Unit Basics

- Fans, coils, filters, and controls
- Cleans, conditions, distributes, and monitors air throughout the facility
- Maintains pressure relationships, temperature, humidity, and air volume
Basic AHU Construction - Fans

Return Fans

Supply Fans
AHU Fans & Volume Control

• Fans
  o Centrifugal
  o Plenum

• Fan Volume Control
  o VFD
  o Inlet Vanes
  o Discharge Dampers

• Fan Arrays
Basic AHU Construction – Coils & Humidifier

- Cooling Coil
- Heating Coil
- Humidifier
AHU Coils & Humidifiers

- Cooling Coil (Chilled Water, Glycol, DX)
- Heating Coils (Pre & Reheat)
- Direct Steam Humidifiers
- Clean Steam Generators
- Energy Recovery Systems
Basic AHU Construction – Dampers & Inlets/Outlets

- Outside Air Inlet & Damper
- Return/Mixed Air Damper
- Relief/Exhaust Air Outlet & Damper
- Supply Air Outlet & Damper
- Return Air Inlet & Damper
AHU Dampers & Inlets/Outlets

- Mixed/Return Air
- Outside Air
  - Min / Max
- Relief/Exhaust Air
- Supply Air
- Isolation Dampers
- Damper Controls
Basic AHU Construction - Filters

Pre-filters

Final Filters
AHU Filters

• Pre-filters
  o Protects AHU equipment

• Final Filters
  o Provides quality air to space

• HEPA filtration
  o Not always required
  o Can be located in AHU or at remote location (terminal)
**Basic AHU Controls**

**AHU Setpoints**
- Temperature
- Humidity
- Static Pressure
- Air Volumes

**Controls**
- Fan Speeds
- Damper Positions
- Valve Positions
- Safeties
Where Do You \textbf{START}?

- Determine what you have
- \textbf{Document} operational conditions of each AHU
- \textbf{Document} design conditions of all AHUs
  - Discharge Air Conditions, Static Set-point, Required Limits
- Labeling systems (dampers, flow, sections, etc.)
- AHU Information Form
  - Mount on unit
  - Keep copy at BAS

\begin{example}{AHU INFORMATION FORM}

\begin{tabular}{|l|}
\hline
Initial Form Date - \\
AHU Name - \\
Type of System (Dual Duct, Single Duct, 100\% OA, etc.) - \\
Location - \\
Area Served (see attached zone map) - \\
Criticality of Shutdown - \\
Clinical Contact for Shutdown - \\
Discharge Air Temperature Limits - \\
Discharge Air Humidity Limits - \\
Supply Duct Static Pressure - \\
Minimum Outside Airflow - \\
Chilled water coil air side dP - \\
Chilled water Delta T - \\
Smoke Control Sequence (Y/N) - \\
Calibration Details - \\
\hline
\end{tabular}
\end{example}
Understanding Risks

• Criticality of Space Served
• Redundancy
  o Do you have adequate redundancy for the criticality of the AHU?
• Emergency Power Capability
  o Does AHU need to operate during an outage?
  o Look at full system – chilled water system, controls, boxes, boilers, pumps
• Single Points of Failure
  o Do you have the spare part available?
  o Do you have a plan if something fails?
• Understanding Risks Helps Future Decisions
  o Potential upgrades to mitigate risks
Calibration

• Temperature Sensors
• Humidity Sensors
• Air Flow Measuring Station
• Pressure Transducers
• Damper Operation
• Controls Tune-up Annually
• In-House Common Sense Checks
Testing & Maintenance

• Checking AHU performance against documentation during PM
• Both in house & external regular checks are value add
• Cross checking sequences of operation during regular PM activities
• Controls & maintenance contracts tasks
Building Automation System (BAS)

- Confirm your findings are captured in set point limits and alarms within the BAS
- Access control of setpoints and overrides!
- Run reports on overrides
- Stay on top of graphic updates
  - Floor plans & unit graphics
- Controls tune-ups
  - Look at actual equipment when doing tune-ups
  - Confirm accurate sequences
  - Confirm calibrations
Training Technicians

• With full awareness of the current technician FTE challenges:
  o Understand system basics
  o Recognize differences in AHUs and where to gather data
  o Calibration and checking of conditions
  o Documentation
Psychrometrics

• Understanding psychrometrics is important.
  o Empowers staff to understand conditions at a deeper level

• Relative Humidity (RH) can be confusing. It is relative!
  o This is one of the compliance numbers that becomes an issue.
  o Dry-bulb temperature goes down RH increases. Vice versa.

• Download a psychrometric app on your phone (Munters, PsyClt and others)
Understanding Space Set-points

- Spaces are designed with set-point limits
- Occupants can only operate space in a certain range
  - This is based on the original design and equipment capability
  - Understand that this is not an AHU problem
  - Train staff to understand this and teach occupants
- **Example:** With supply air dewpoint at 45 degF, Operating Room cannot be set below 64 degF, and still maintain below 50% RH
What To Do When Something Is Wrong

• When troubleshooting, first thing to do is gather all information and validate information
  o Then hunt for root cause

• Identifying that there is a problem is a great start.
  o This is better than finding out other ways (compliance finding)

• Review BAS graphics and confirm accuracy

• Changes in other utility systems can/will affect AHU (steam, chilled water, heating hot water, power)
  o Don’t put on blinders looking only at AHU

Photo Source: https://www.amazon.com/Initech-Jump-Conclusions-Office-Space/dp/B07GL3CBBZ
Plan for the Future

• Self identification of performance gaps

• Identify equipment reaching its’ expected service life
  o Develop capital improvement plans

• Identify opportunities to upgrade your current system
  o Remember the big picture effect of any changes
  o It all goes back to the space condition requirements

• **Document** changes to system (renovations, upgrades, etc.)

• **Document** new AHUs at the start
Takeaways

• Baseline Useful, Site Specific Documentation

• Continuously Update Documentation

• Staff Training & Empowerment Using the Documentation

• Regular Risk Assessments & Function Re-Checks Against the Documentation

• Regular Calibration and Testing Against the Documentation
Questions

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