Dewberry

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

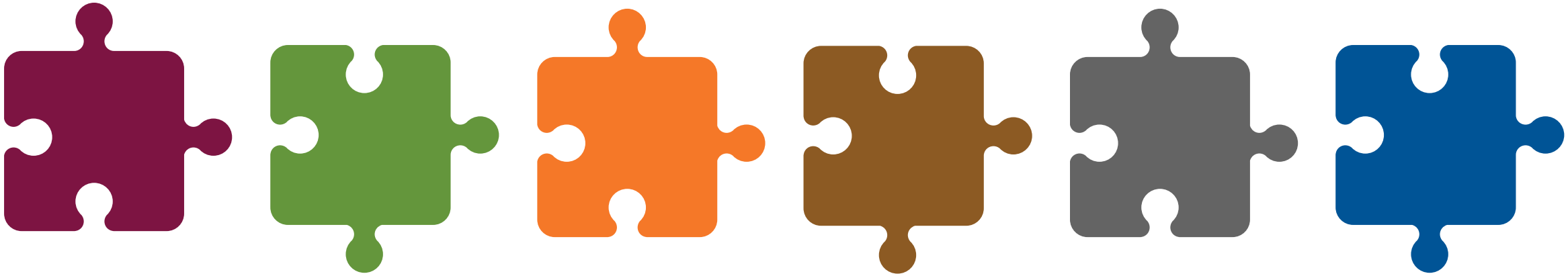
2019 NCHEA Annual Conference

July 31, 2019

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

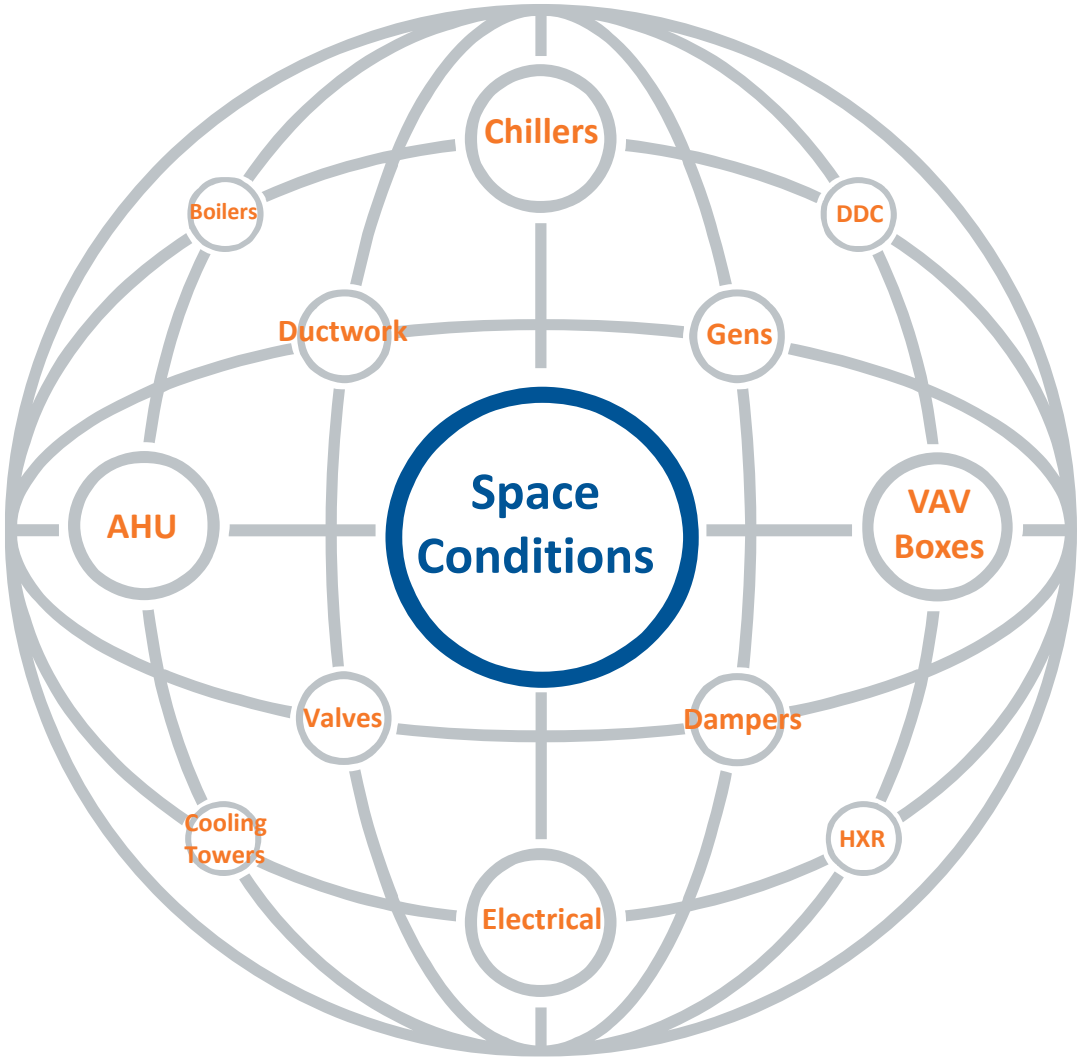
6 Flexibility

Ability of System to
Adapt to Changes

Highest Importance →

Big Picture Thinking – System View

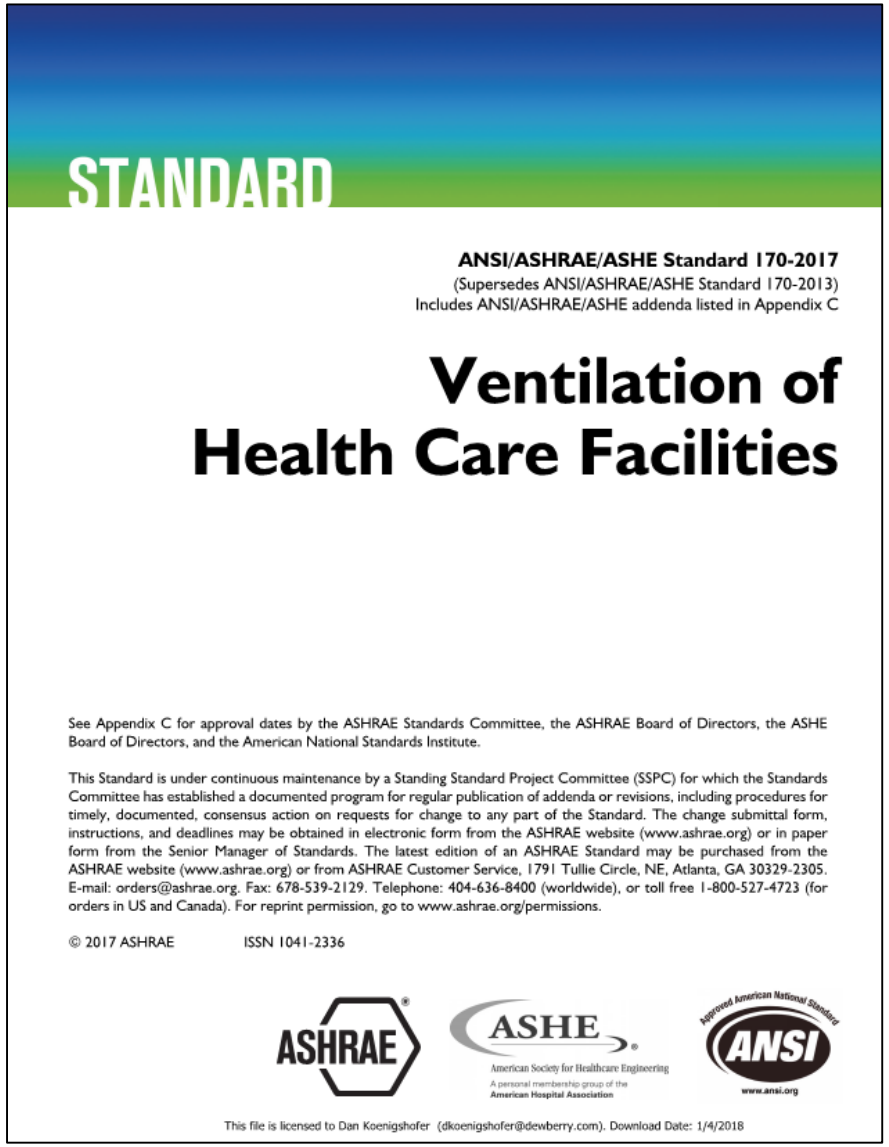
- Space conditions for infection prevention, comfort, & compliance
  - Temperature
  - Humidity
  - Pressurization – both building & space
  - Air changes
  - Air quality
- The AHU is an integral piece of the puzzle
  - This is where the majority of the conditioning happens



Dewberry

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)



STANDARD

ANSI/ASHRAE/ASHE Standard 170-2017
(Supersedes ANSI/ASHRAE/ASHE Standard 170-2013)
Includes ANSI/ASHRAE/ASHE addenda listed in Appendix C

Ventilation of Health Care Facilities

See Appendix C for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the ASHE Board of Directors, and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Senior Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

© 2017 ASHRAE ISSN 1041-2336

ASHRAE ASHE American Society for Healthcare Engineering A personal membership group of the American Hospital Association ANSI www.ansi.org

This file is licensed to Dan Koenigshofer (dkoenigshofer@dewberry.com). Download Date: 1/4/2018

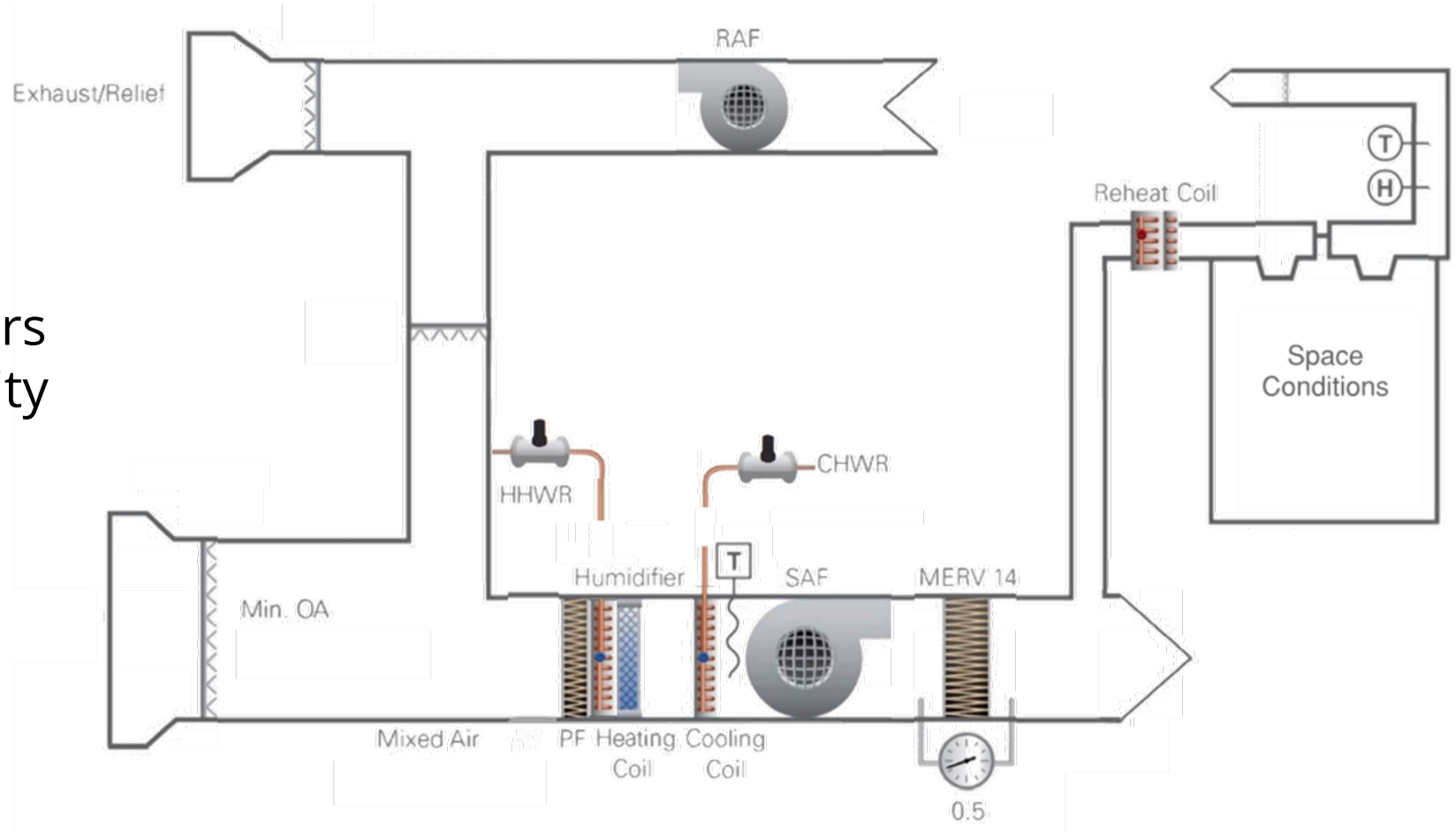
Not All AHUs Are The Same

- Within all your facilities there are a vast range of different AHUs
  - Dual Duct (Hot Deck Cold Deck)
  - Return with Supply Air Reheat
  - 100% Outside Air
- They operate under different conditions
- What drives these differences?
  - Performance Requirements (space conditions, etc.)
  - Age
- Why is this important? What does it affect?
  - Creates complexity that must be understood, in order to be maintained

Photo Source : https://www.naturefresh.ca/types-of-tomatoes-guide/

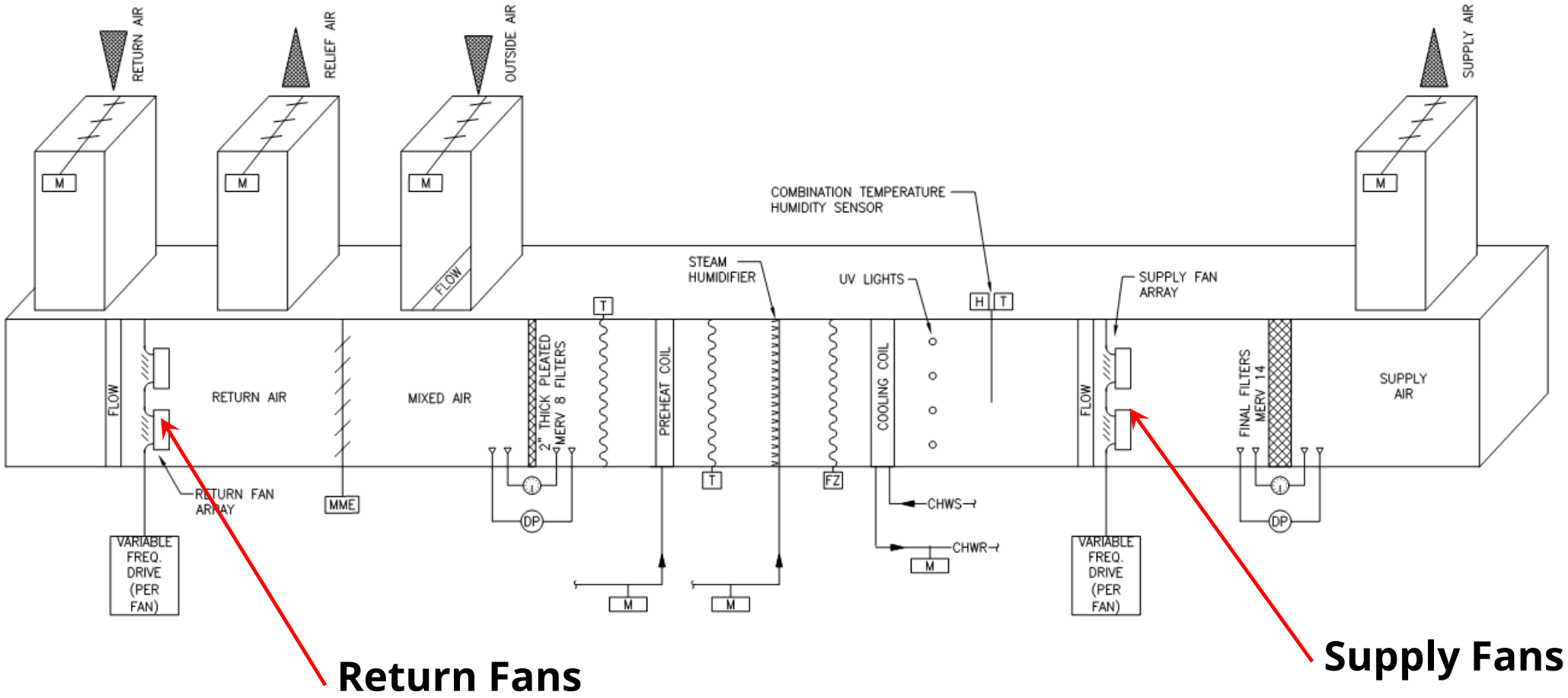
Air Handling Unit Basics

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



Dewberry

Basic AHU Construction - Fans



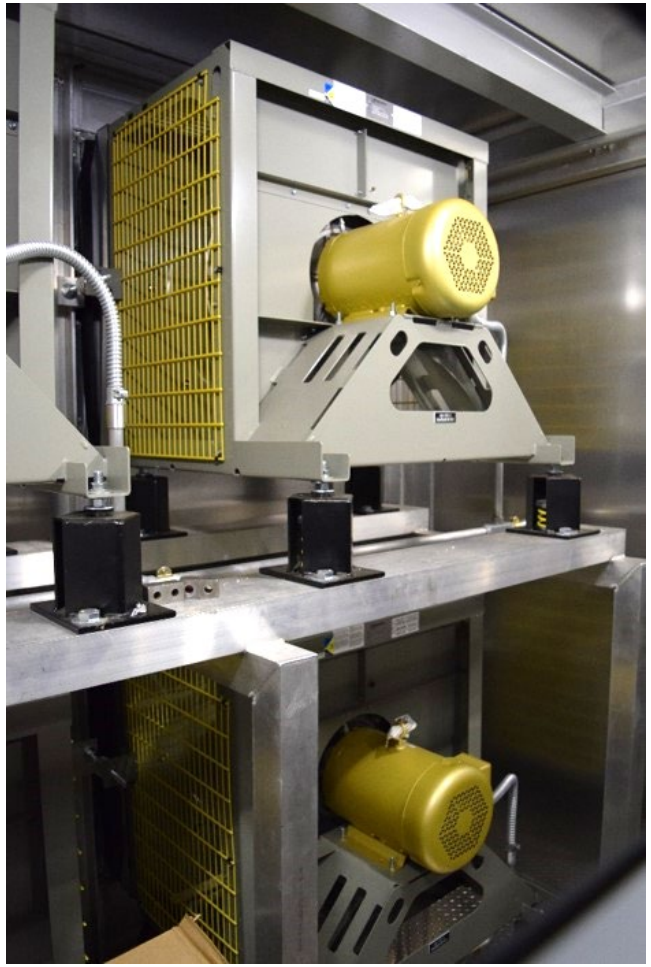
Return Fans

Supply Fans

Dewberry

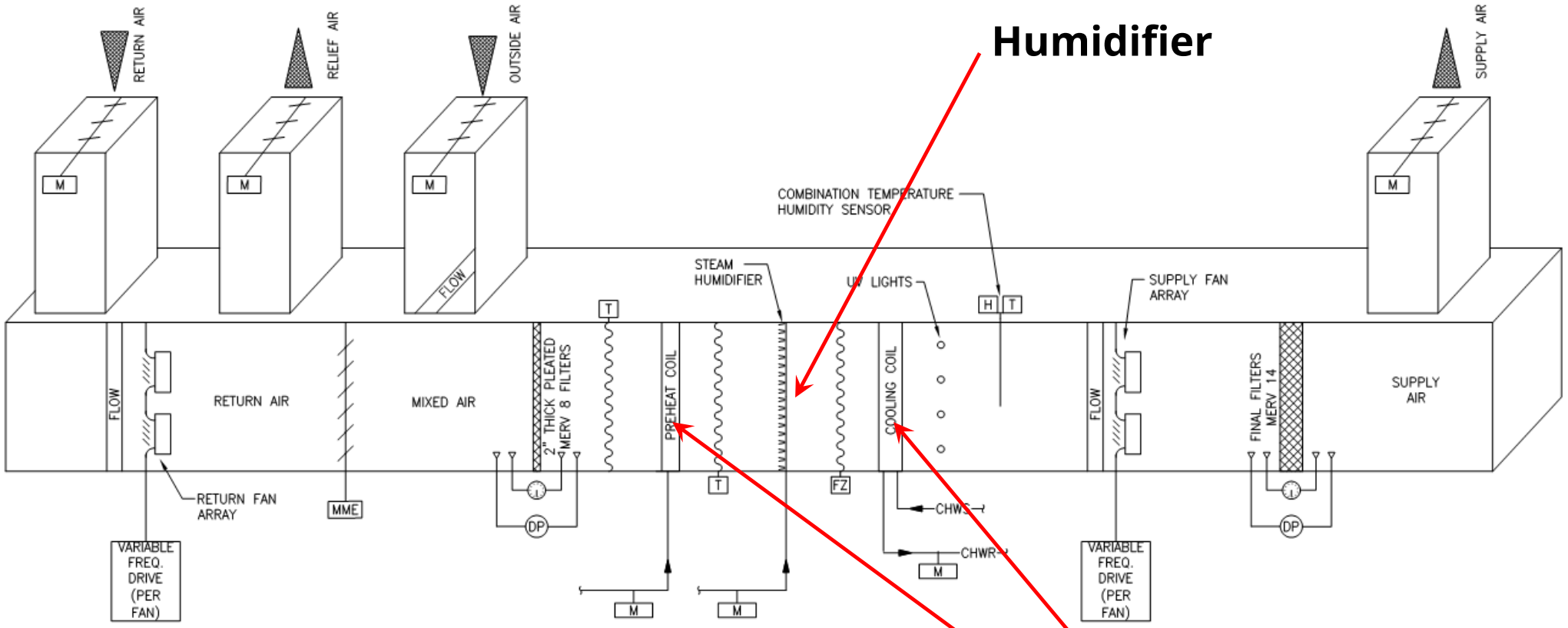
AHU Fans & Volume Control

- Fans
  - Centrifugal
  - Plenum
- Fan Volume Control
  - VFD
  - Inlet Vanes
  - Discharge Dampers
- Fan Arrays



Dewberry

Basic AHU Construction – Coils & Humidifier



Humidifier

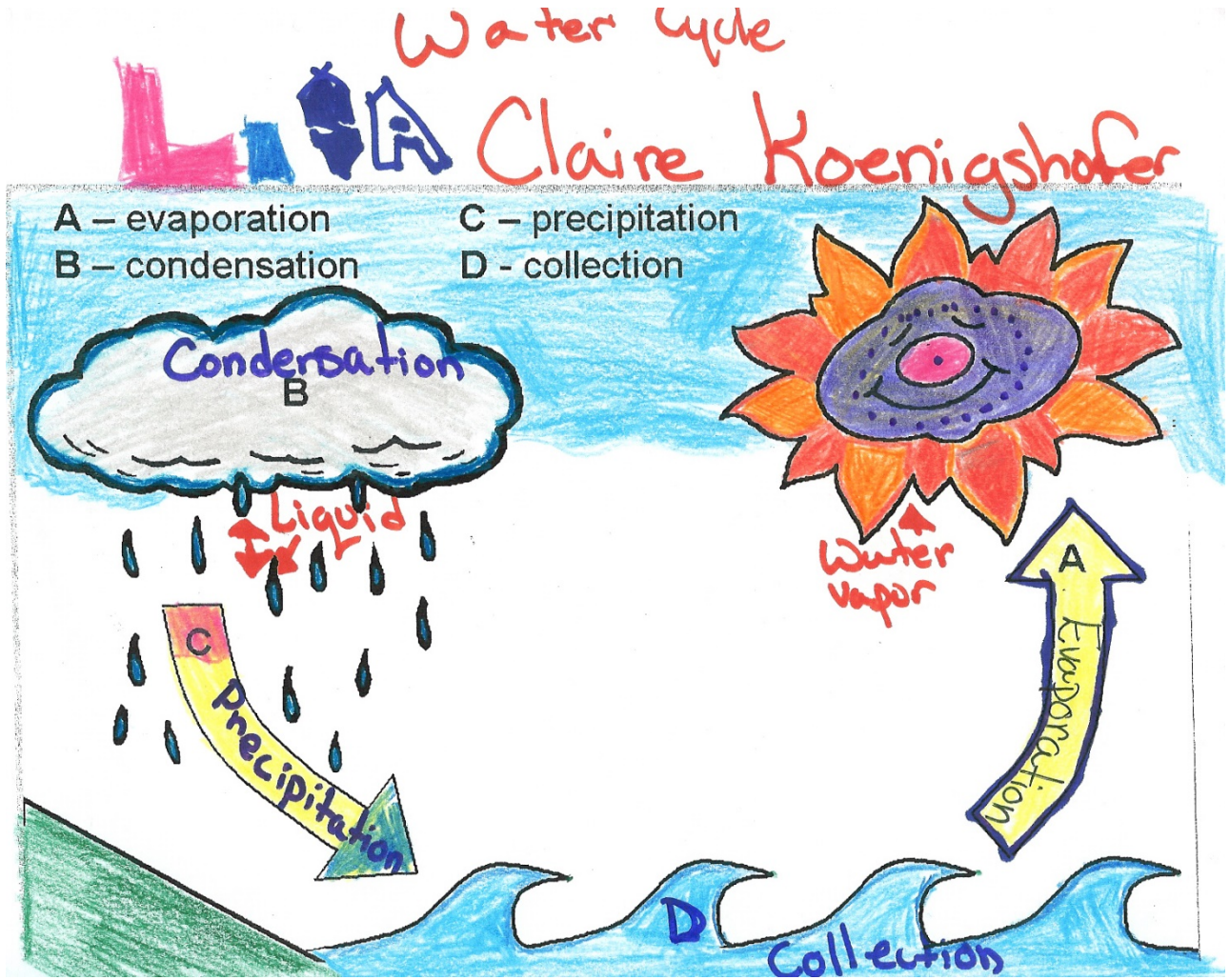
Cooling Coil

Heating Coil

Dewberry

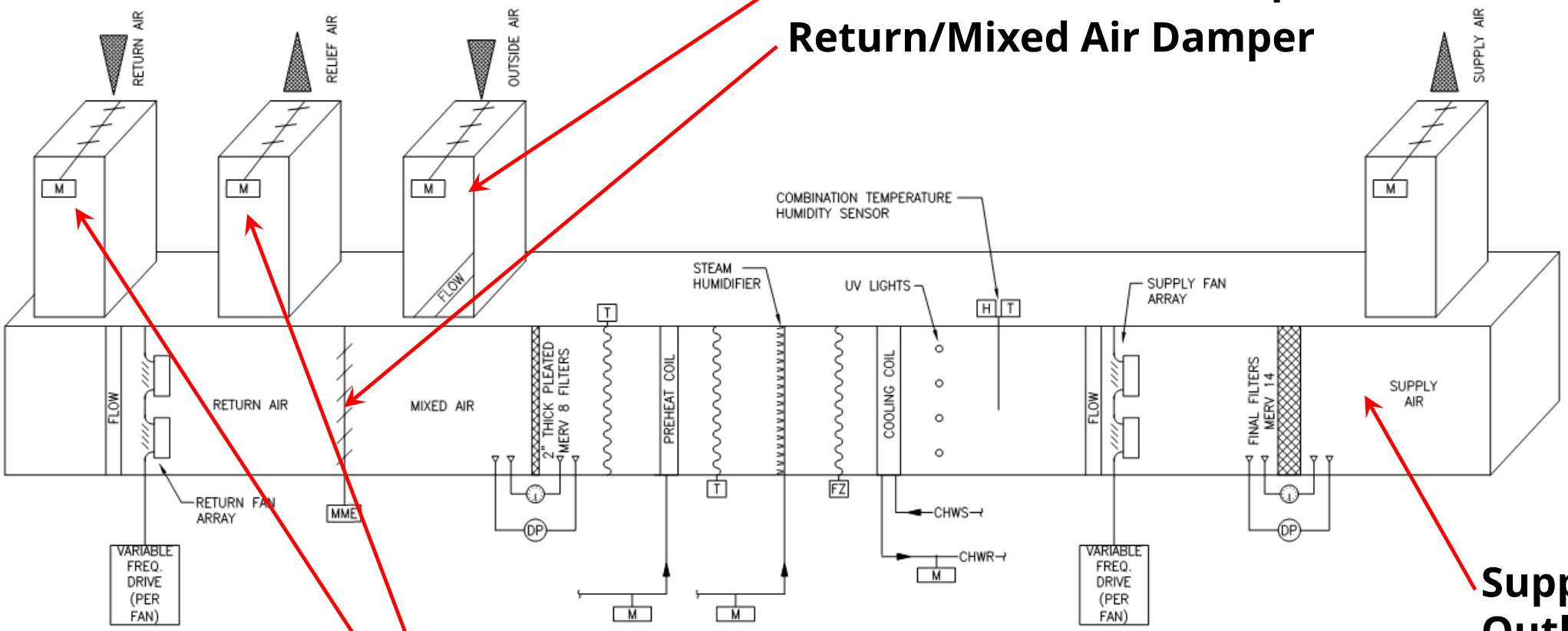
AHU Coils & Humidifiers

- Cooling Coil (Chilled Water, Glycol, DX)
- Heating Coils (Pre & Reheat)
- Direct Steam Humidifiers
- Clean Steam Generators
- Energy Recovery Systems



Dewberry

Basic AHU Construction – Dampers & Inlets/Outlets



Outside Air Inlet & Damper

Return/Mixed Air Damper

Relief/Exhaust Air Outlet & Damper

Return Air Inlet & Damper

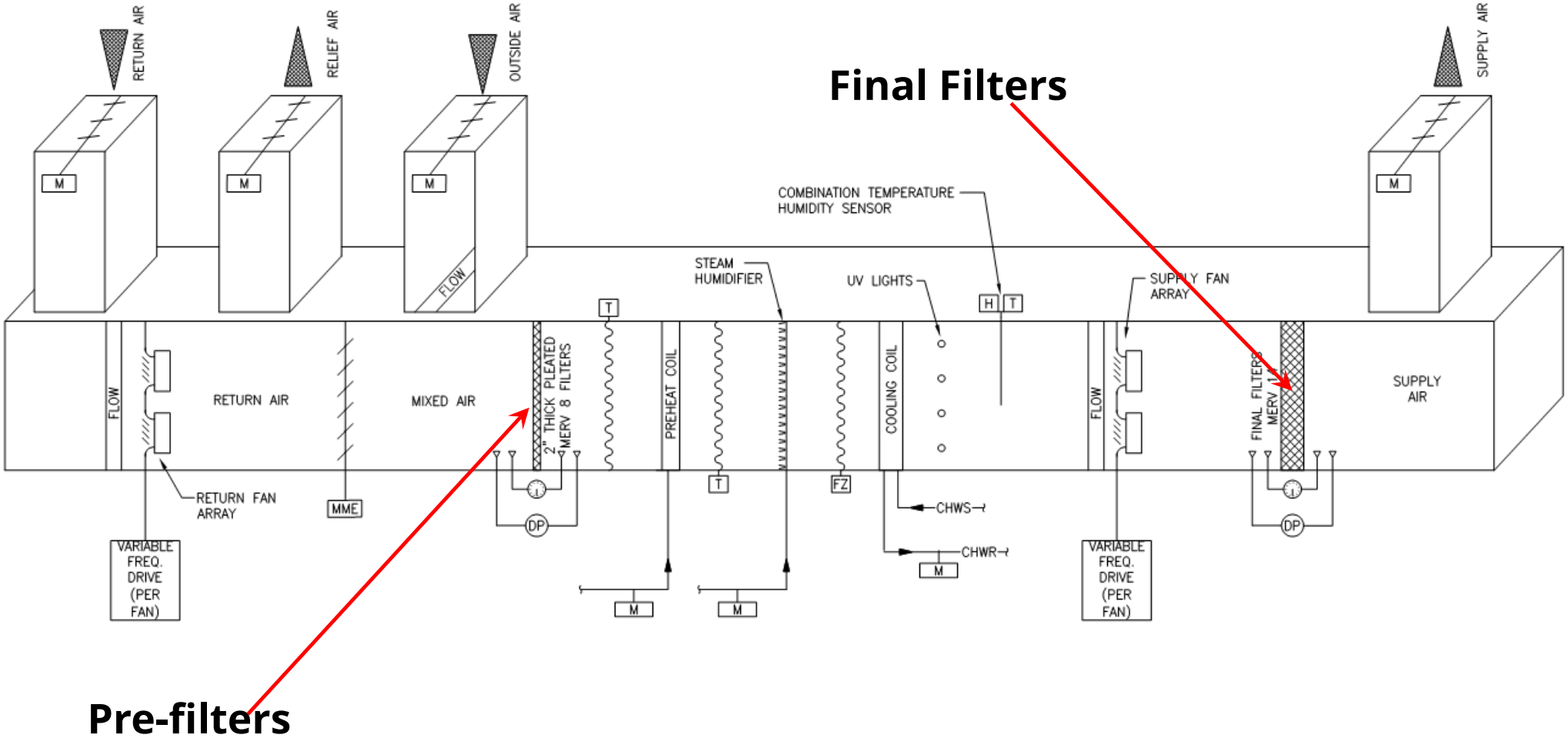
Supply Air Outlet & Damper

Dewberry

AHU Dampers & Inlets/Outlets

- Mixed/Return Air
- Outside Air
  - Min / Max
- Relief/Exhaust Air
- Supply Air
- Isolation Dampers
- Damper Controls

Basic AHU Construction - Filters



Dewberry

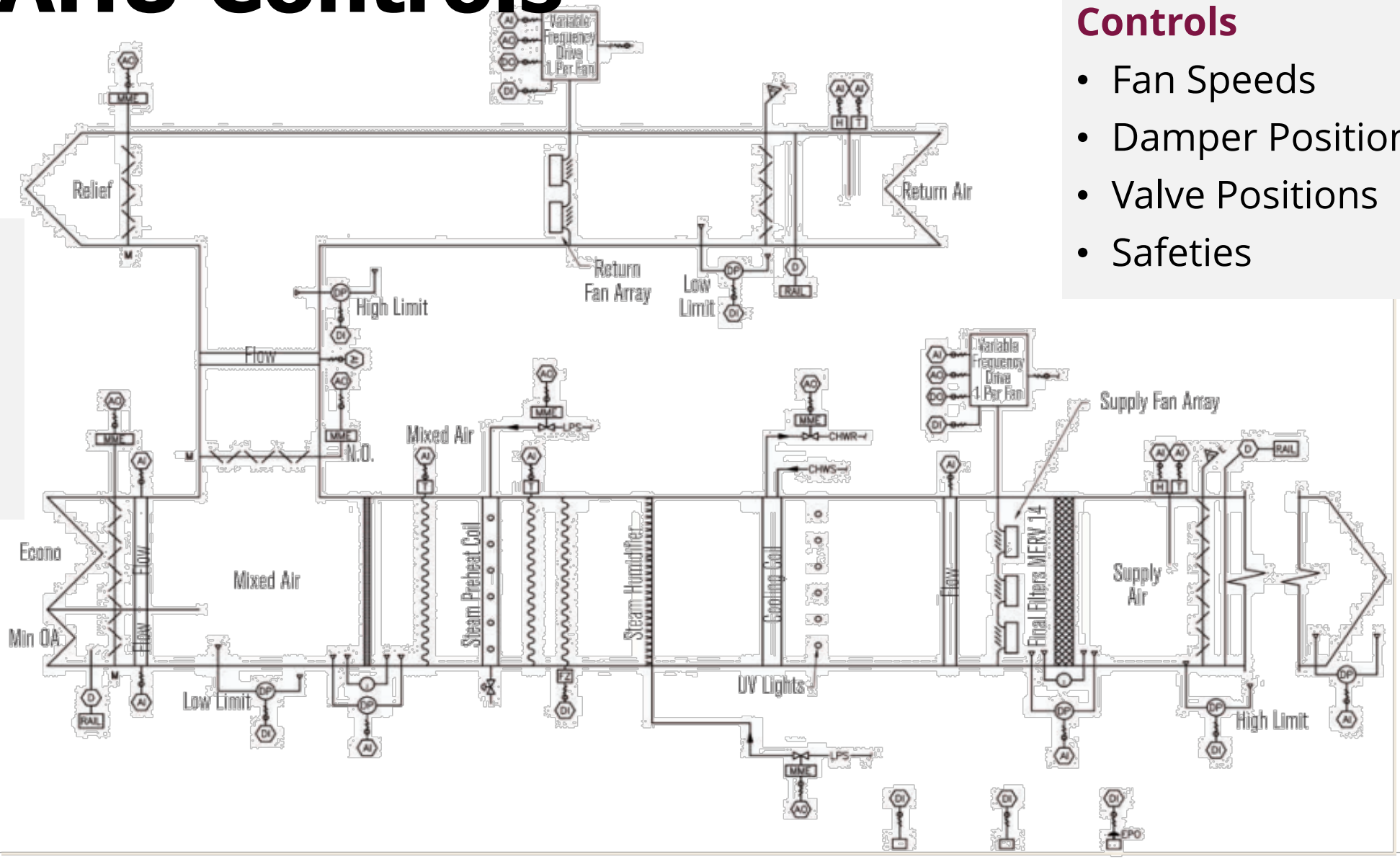
AHU Filters

- Pre-filters
  - Protects AHU equipment
- Final Filters
  - Provides quality air to space
- HEPA filtration
  - Not always required
  - 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

Dewberry

Where Do You *START?*

- Determine what you have
- **Document** operational conditions of each AHU
- **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

Dewberry

EXAMPLE - AHU INFORMATION FORM

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 -	

Understanding Risks

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

Dewberry

Building Automation System (BAS)

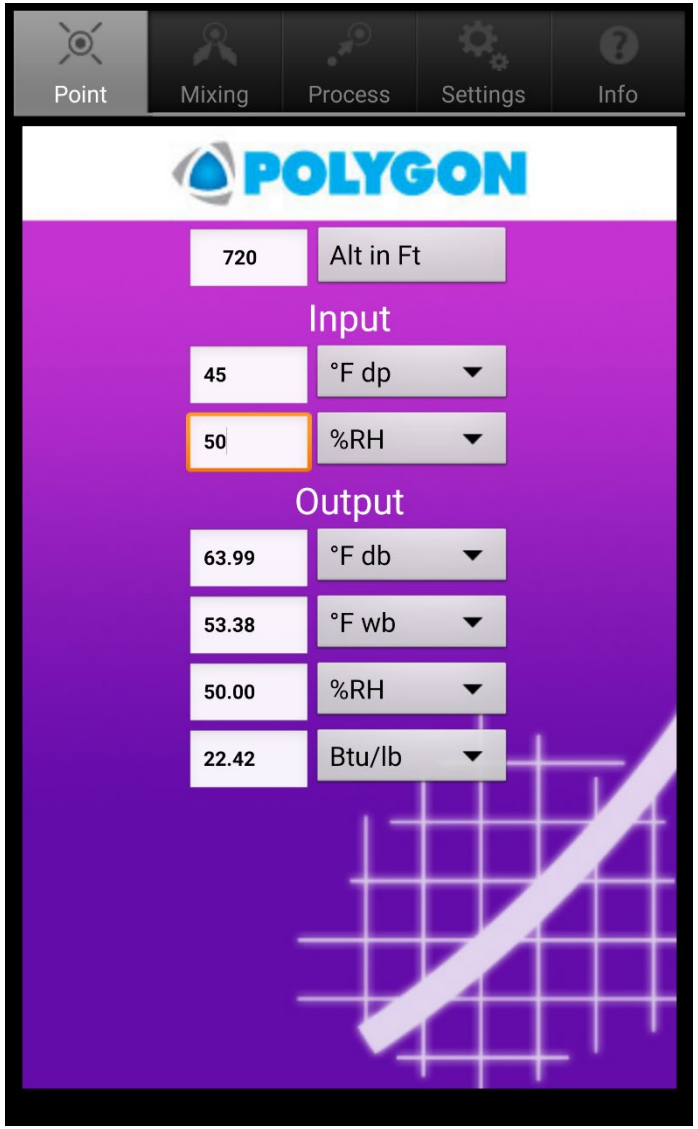
- Confirm your findings are captured in set point limits and alarms within the BAS
- Access control of setpoints and overrides!
- Run reports on overrides
- Stay on top of graphic updates
  - Floor plans & unit graphics
- Controls tune-ups
  - Look at actual equipment when doing tune-ups
  - Confirm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

Training Technicians

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

Psychrometrics

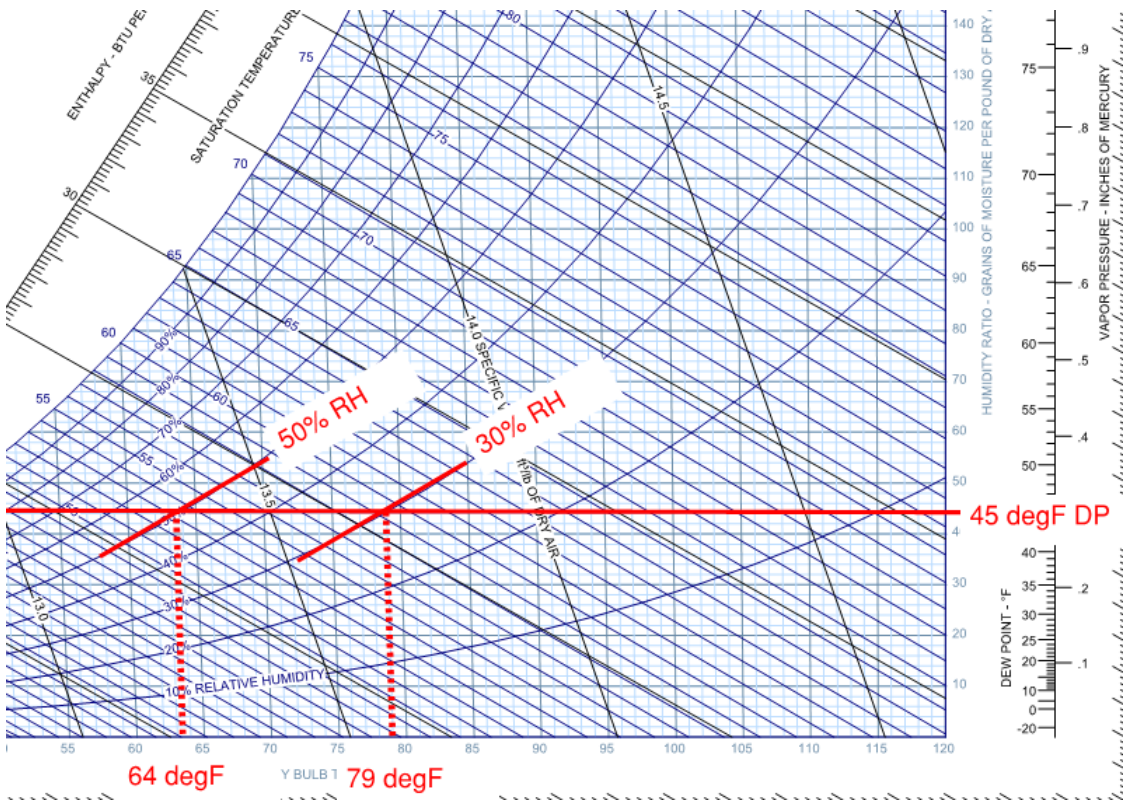
- Understanding psychrometrics is important.
  - Empowers staff to understand conditions at a deeper level
- Relative Humidity (RH) can be confusing. It is relative!
  - This is one of the compliance numbers that becomes an issue.
  - Dry-bulb temperature goes down RH increases. Vice versa.
- Download a psychrometric app on your phone (Munters, PsycIt and others)



Dewberry

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



Dewberry

What To Do When Something Is Wrong

- When troubleshooting, first thing to do is gather all information and validate information
  - Then hunt for root cause
- Identifying that there is a problem is a great start.
  - 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)
  - 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
  - Develop capital improvement plans
- Identify opportunities to upgrade your current system
  - Remember the big picture effect of any changes
  - 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

Nick Walters PE, CHC
Dewberry
Project Manager
704.264.1247
nwalters@dewberry.com

Alex Harwell CHC
Dewberry
Associate, Client & Project Manager
919.424.3769
aharwell@dewberry.com