VAV SYSTEMS: GROUND CONTROL TO MAJOR TOM

*CHOOSING THE RIGHT EQUIPMENT FOR YOUR VAV SYSTEM IS CRITICAL, BUT IT IS ONLY PART OF CREATING THE RIGHT SOLUTION. THE SPECIFIED CONTROL SEQUENCES FOR EACH TERMINAL UNIT WILL ULTIMATELY HAVE THE LARGEST IMPACT ON ELIMINATING ANY **SPACE ODDITIES**.*

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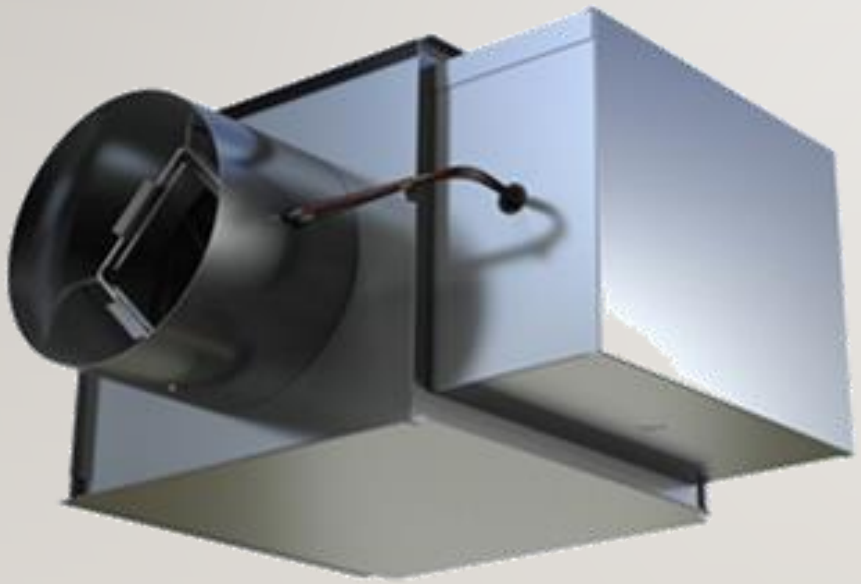
BACKGROUND

- Choosing the right equipment for a VAV system is only part of the solution.
- Specified control sequences will have the largest impact on eliminating any **SPACE ODDITIES**.
- ASHRAE Guideline 36: High-Performance Sequences of Operation for HVAC Systems.
  - Guideline Goal: provide uniform sequences to optimize HVAC system performance.
- Selection of control sequence of equipment affects overall performance of the system.

AIR HANDLING UNIT (AHU) CONTROL OVERVIEW

- AHUs in VAV systems controlled using Trim and Respond control logic.
- Static pressure sensor in primary ductwork monitors pressure delivered to the system by AHU.
- System will have a static pressure set-point (SP0), minimum point (SPm), and maximum point (SPx),
  - Directs where the unit will start and operate between.
- Additional static pressure **trim** (SPtrim) and static pressure **respond** (SPres)
  - unit trims the supply during **TRIM** operation,
  - unit increases the static during **RESPONSE**.

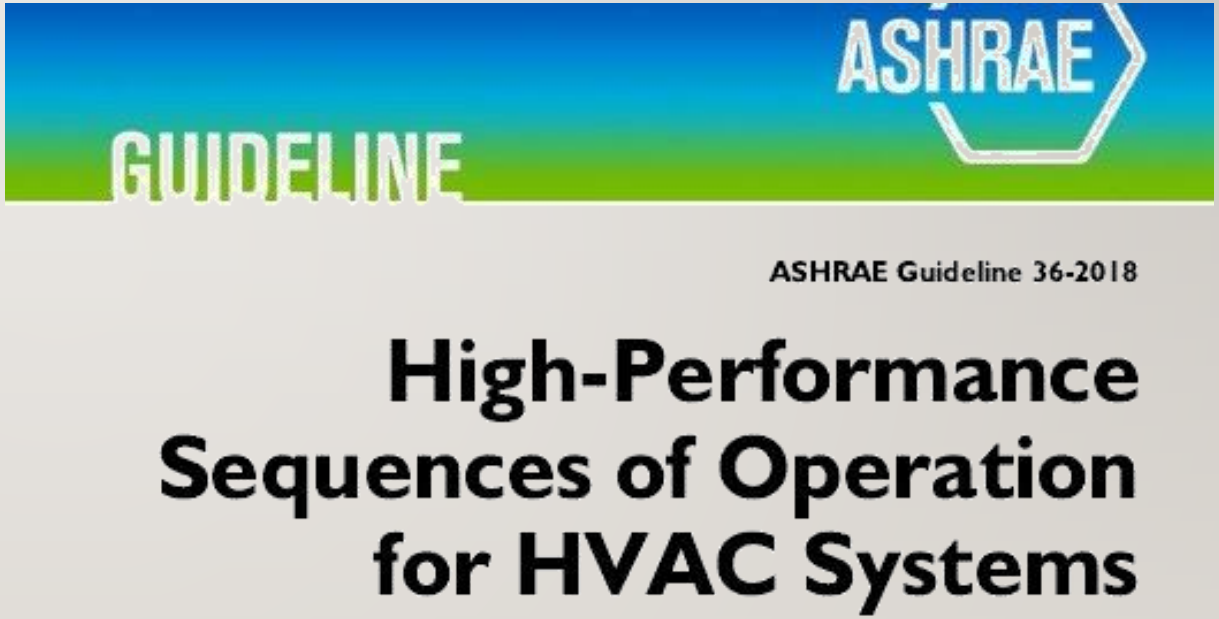
AIR HANDLING UNIT (AHU) CONTROL:
VAV COMMUNICATION WITH AHU: RESPONSE



- Individual terminal units communicate their needs to AHU.
- Damper in the terminal unit will open and close to control the temperature in the space.
- Once damper is open to at least 95%, unit will communicate to AHU in the following manner:
  - 50% of airflow setpoint for 1 minute - send 3 requests
  - 75% of airflow setpoint for 1 minute - send 2 requests
  - send 1 request until the damper position is at 85%
- Requests from individual terminal units determine if a AHU response is necessary.

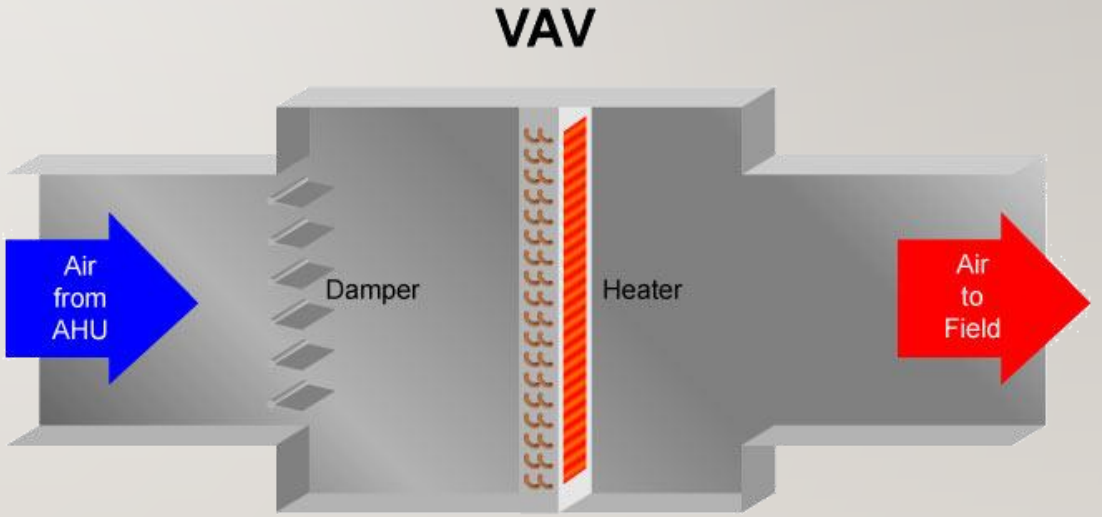
AIR HANDLING UNIT (AHU) CONTROL:
VAV COMMUNICATION WITH AHU: RESPONSE

- ASHRAE Guideline 36 Example:
  - System is set up to ignore 2 requests.
  - All things being equal:
    - only 2 requests from terminal units
      - System will continue it's trim function.
    - More than 2 requests
      - System will respond by increasing the static pressure, by SPres.
    - Variable response max (SPres-max)
      - Unit will respond if there is an excess of requests.
    - Continues to be more than 2 requests
      - Unit will increase pressure in the ductwork until SPx (maximum setpoint) is reached.



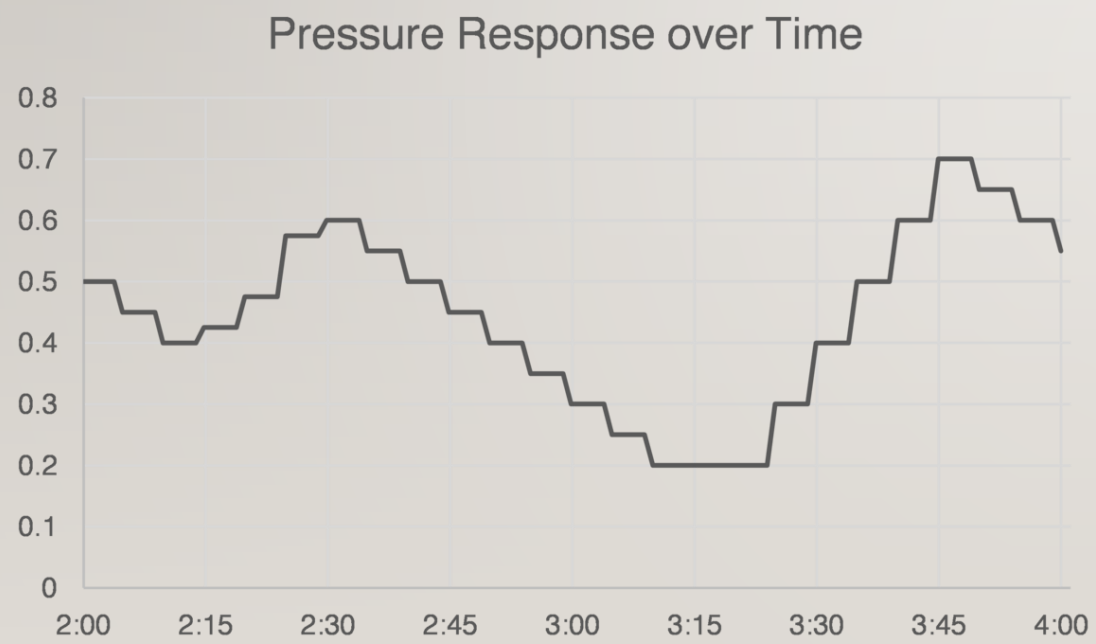
AIR HANDLING UNIT (AHU) CONTROL:
TRIM

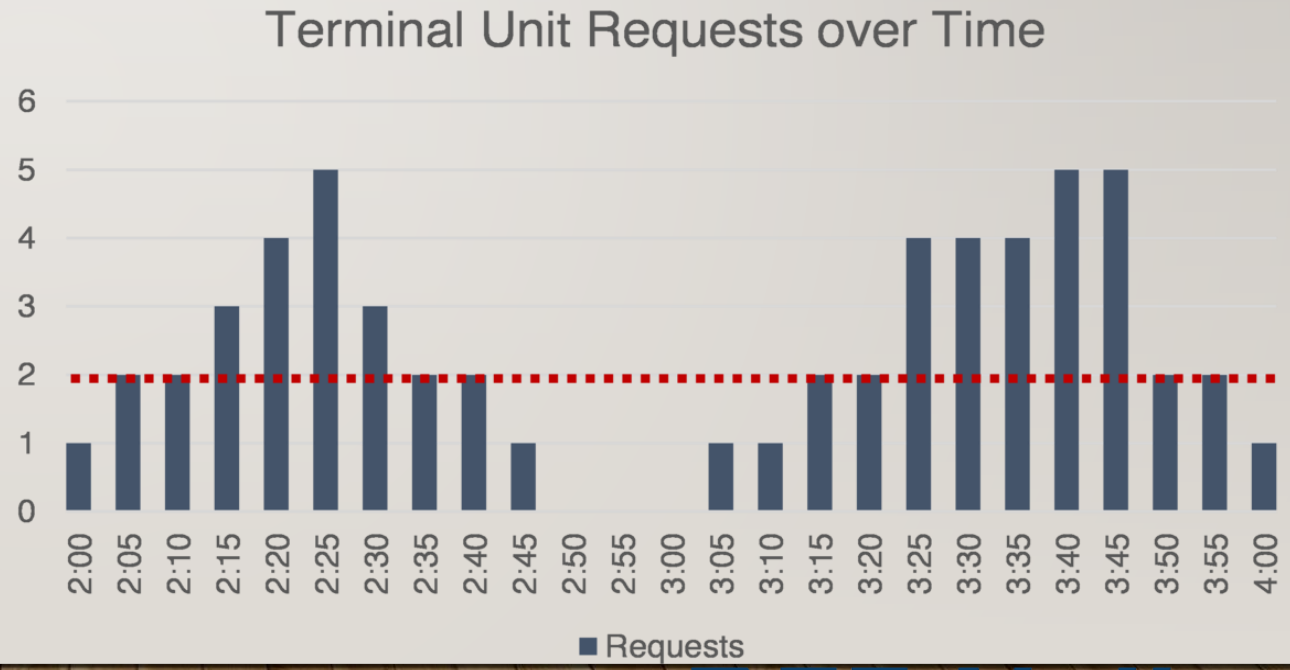
- When number of requests from the terminal units is below the number the AHU is programmed to ignore:
  - Unit will reduce (trim) the static pressure at a set time interval.
- If no requests arise:
  - AHU reduces the pressure in the ductwork to SPm.
- When requests are received, AHU will respond accordingly.
  - Hence the name Trim & Respond.
- AHU delivers requested airflow to the terminal units in most efficient way possible.
- The terminal units have their control sequences for delivering the air to the zone.



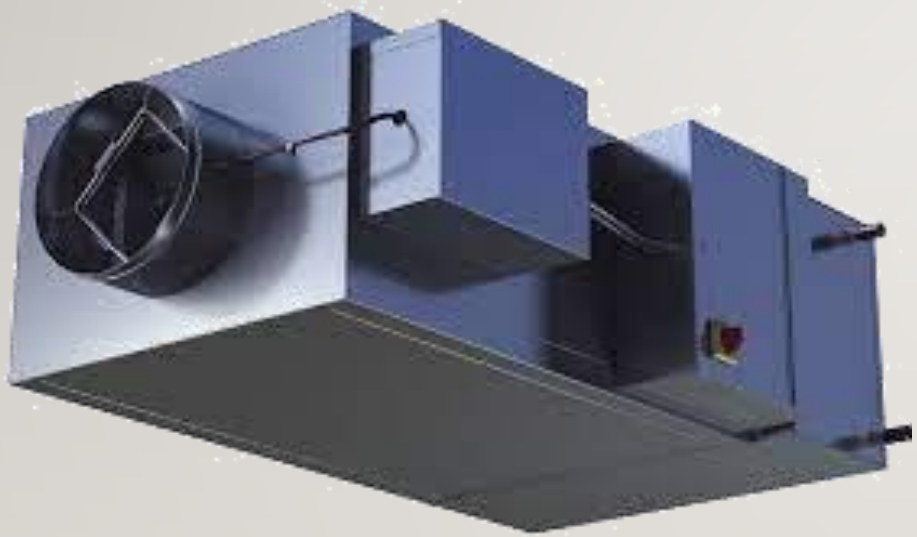
AIR HANDLING UNIT (AHU) CONTROL:
TRIM

How requests from the terminal units can affect pressure and airflow provided by the AHU over time:





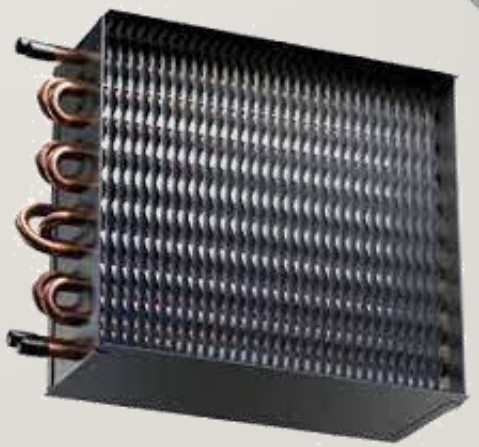
TERMINAL UNIT CONTROL OVERVIEW



- **IF AHU is**
  - Supplying enough pressure & airflow to the terminal unit
- **AND**
  - Terminal unit damper is less than 95% open
- **THEN**
  - The terminal unit control will operate autonomously.

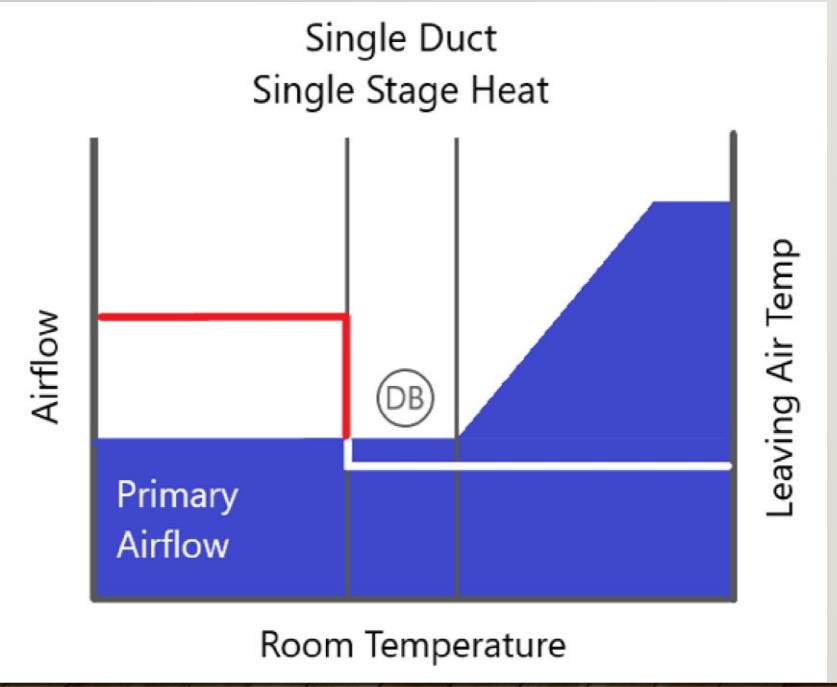
TERMINAL UNIT CONTROL SINGLE DUCT

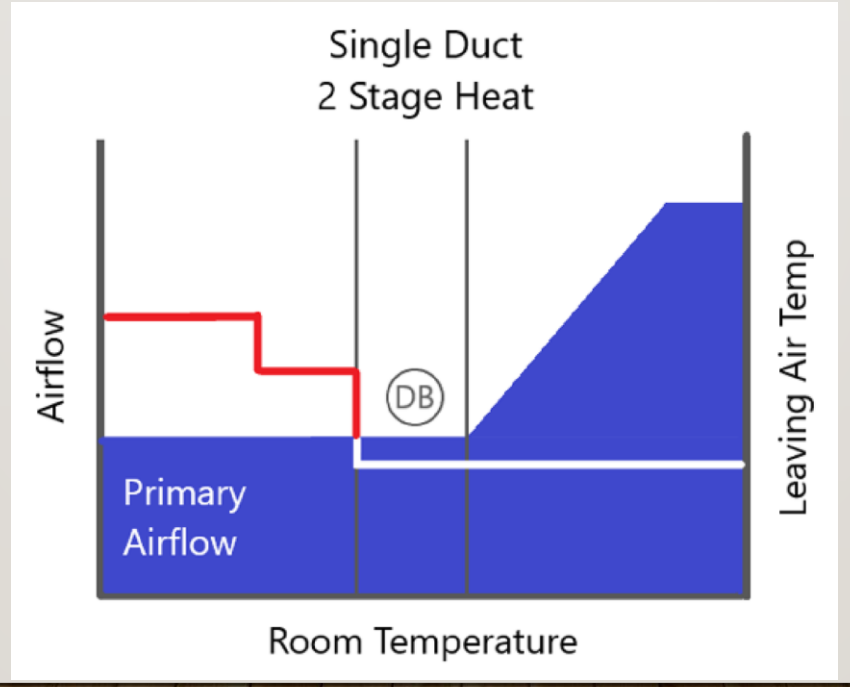
- Single Duct terminal units control airflow/ temperature through:
  - control damper
  - heating coil.
- Heating coils used to maintain occupant comfort when:
  - AHU's minimum ventilation rate over cools the zone.

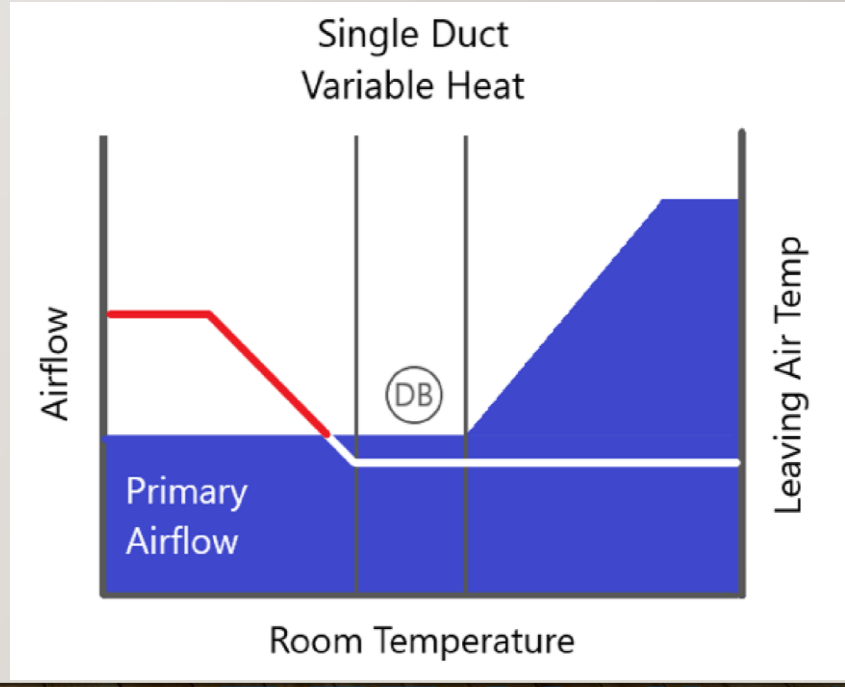


TERMINAL UNIT CONTROL
SINGLE DUCT

Control of the unit is characterized by the graphics below, depending on the type of heat:





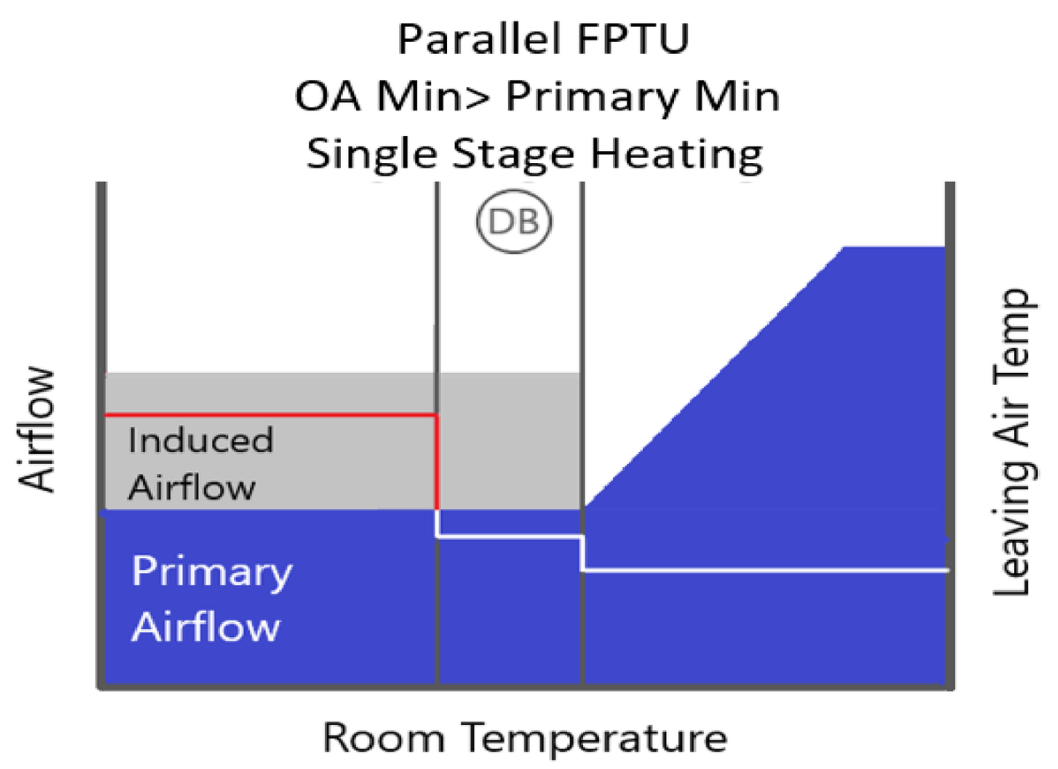


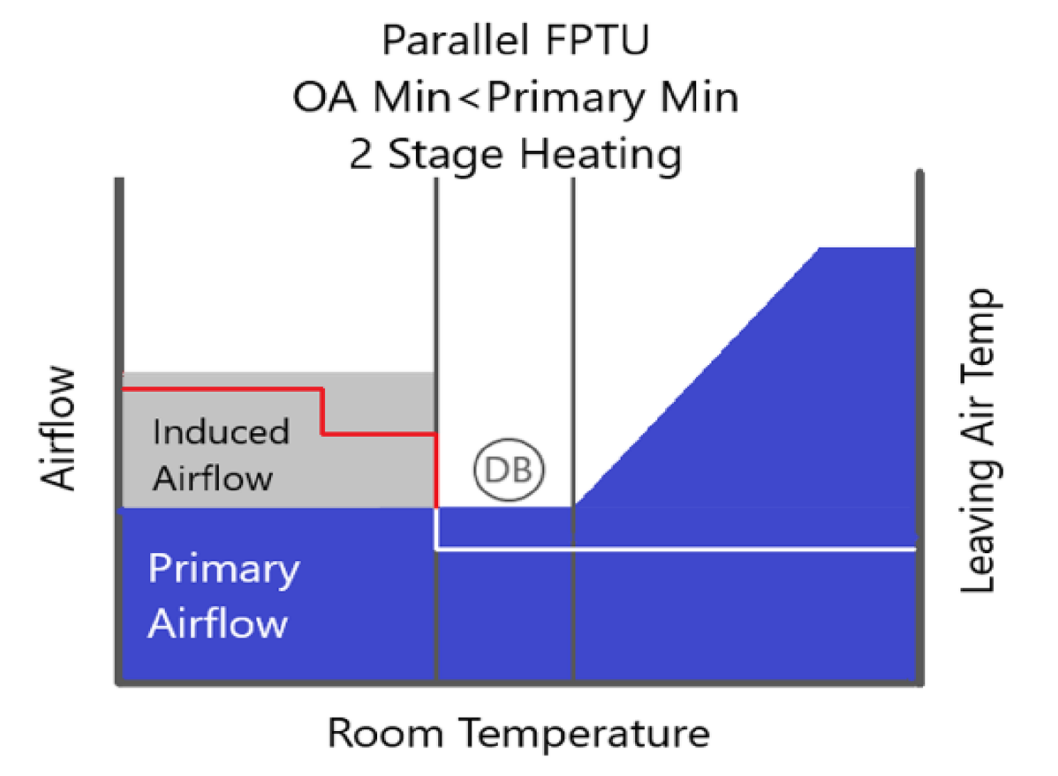
TERMINAL UNIT CONTROL PARALLEL FAN POWERED

- Parallel Fan Powered terminal units:
  - Act as a single duct box until the unit is either in heating or deadband.
- Based on recommendations by ASHRAE Guideline 36:
  - **IF**
    - OA minimum is ≤ minimum primary airflow setpoint for the unit
  - **THEN**
    - the fan shall only operate during heating.
  - **IF**
    - OA minimum setpoint is > the minimum primary airflow
  - **THEN**
    - the fan shall operate during deadband.

TERMINAL UNIT CONTROL
PARALLEL FAN POWERED

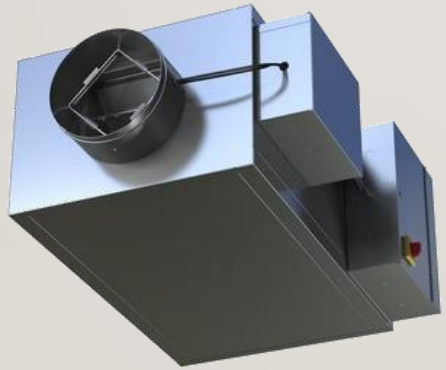
Control sequences for these represented below:



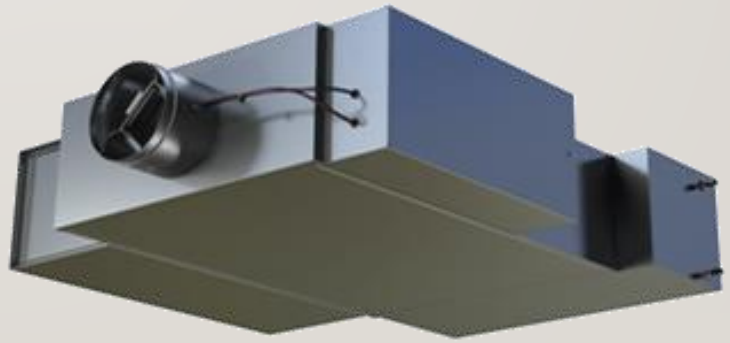


TERMINAL UNIT CONTROL SERIES FAN POWERED

- Fan is in line with the primary airflow.
- Fan must be operational when the AHU is on.
- Units historically operated at constant volume.
  - Fan is set at a specific volume during all periods of operation.

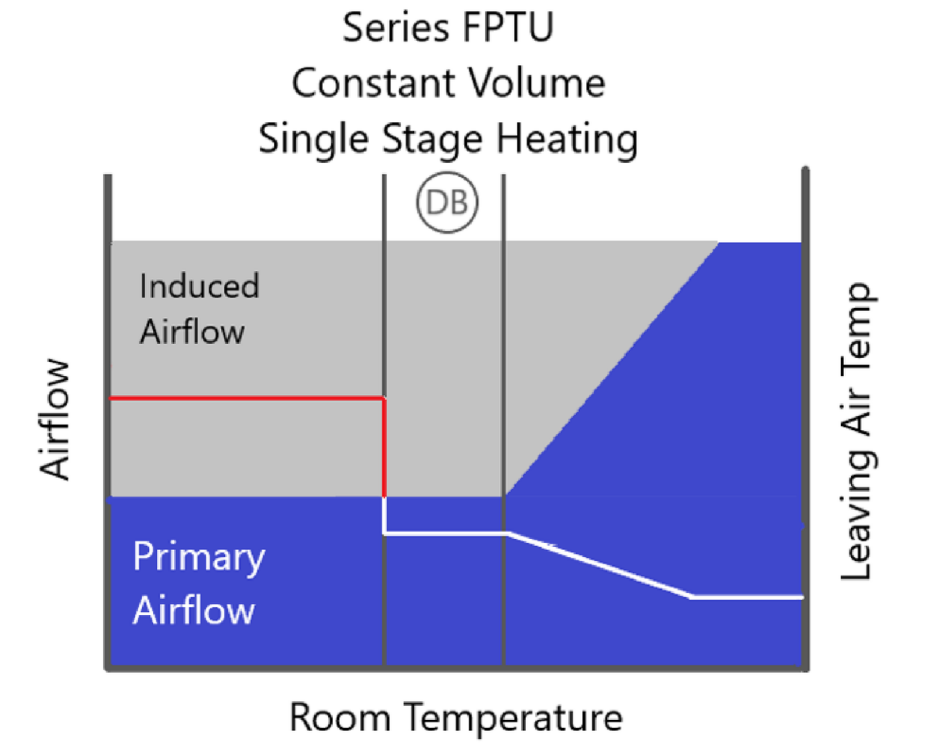


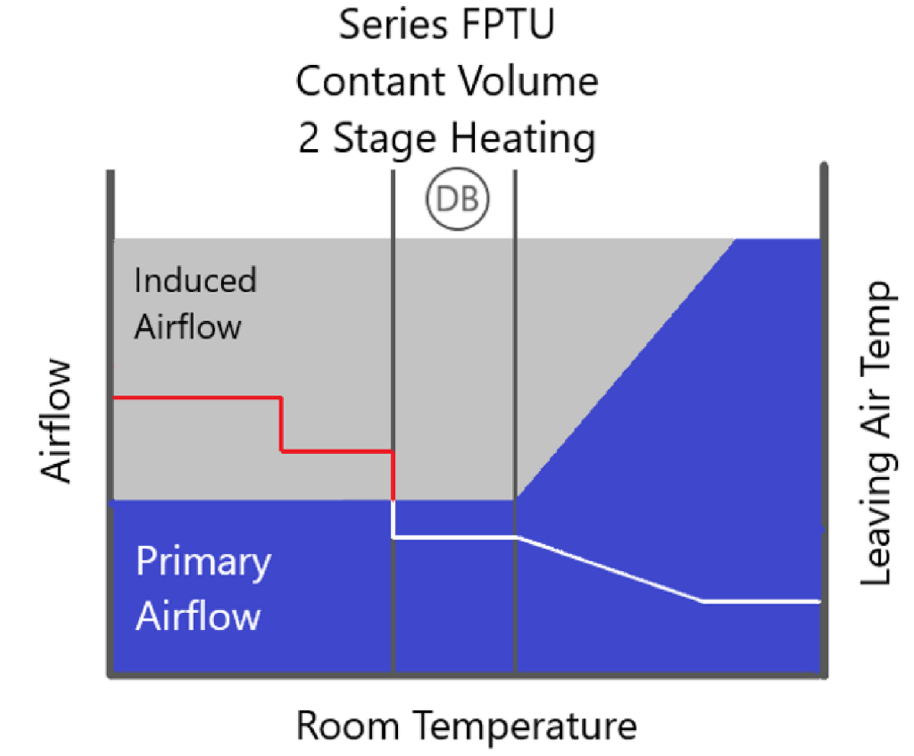
- Thermal comfort is maintained by:
  - Modulating amount of primary air in cooling mode
  - Heater during heating mode.
- Delivers higher comfort through constant airflow in the room
  - Occupants didn't experience any changes to noise or airflow.
- Downfall is the fan must run continuously at the same level, increasing energy use.



TERMINAL UNIT CONTROL SERIES FAN POWERED

Constant volume control sequences for these represented below:



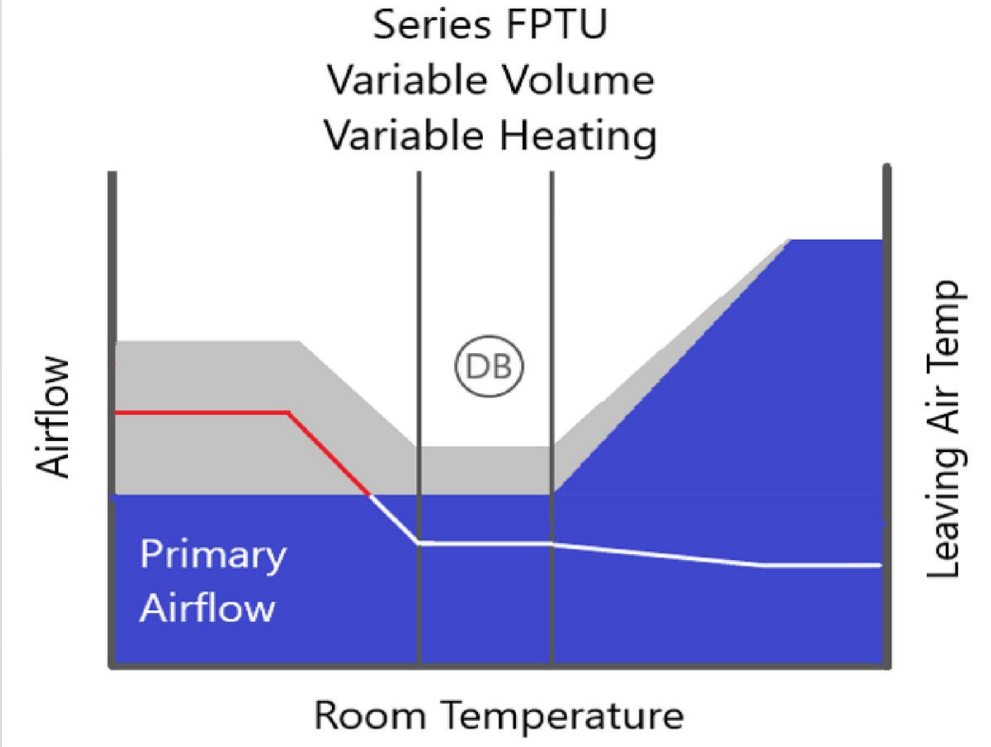


TERMINAL UNIT CONTROL SERIES FAN POWERED

- 2014 ASHARE study 1515-RP proved:
  - Occupants can experience higher comfort at lower airflows.
- To optimize comfort and energy usage:
  - Variable volume control sequence utilized to deliver only the cooling required by the space.
  - In this sequence, terminal unit fan matches the primary airflow.
    - Most time is spent at part load
    - Energy use proportional to the square of motor speed
    - Energy use reduced significantly

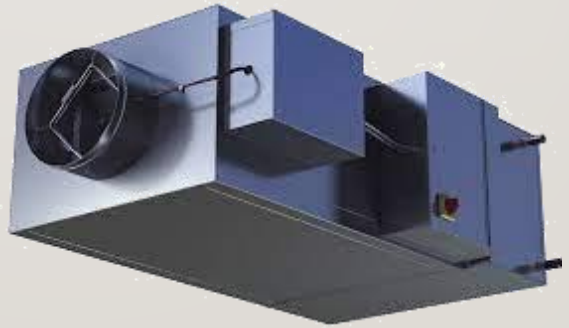
TERMINAL UNIT CONTROL SERIES FAN POWERED

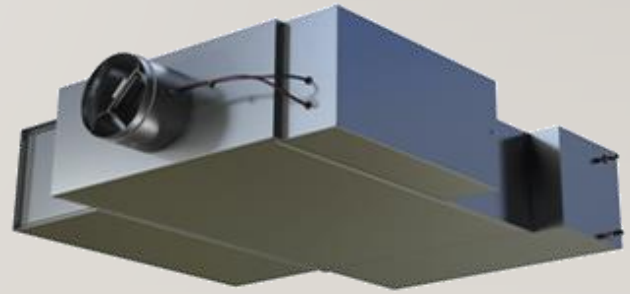
Variable volume control sequences for these represented below:



IMPORTANCE OF CONTROL

- Spending time to carefully select the right equipment to achieve the exact amount of comfort, performance, and or energy savings is only one part of the battle.
- Once the equipment is installed, the control sequences determine how they're used, and people interact with them.





CONTACT THE EXPERTS

- Learn more about Nailor Industries, Inc. Single Duct, Parallel & Series Fan Terminal Units along with their entire air handling/ air distribution line by going to https://nailor.com/products/terminal-units
- Contact the Technical Air Systems' Sales Engineering Team at 973-285-0333 or by email at solutions@technicalair.com

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