



## PRODUCT APPLICATION GUIDE | CONTROLS



# SINGLE ZONE VARIABLE AIR VOLUME (VAV) CONTROL

**With ever-evolving efficiency standards and changing commercial building energy codes, HVAC equipment needs to continue to increase operational performance while maintaining space comfort. Building spaces that have varying occupancy loads can improve efficiency with a Single Zone VAV control sequence.**

## WHAT IS SINGLE ZONE VAV

Single Zone VAV is a control strategy used in air handling equipment serving a single HVAC zone or space that creates energy savings and improves occupant comfort compared to traditional constant air volume control strategies. The Single Zone VAV sequence keeps the unit supply fan operating at the lowest speed possible while maintaining the desired space temperature and/or humidity. As the space conditions vary from the setpoint, the fan will ramp up or down to ensure occupant comfort.

Energy savings come from reduced fan, cooling, and heating energy at part load conditions. Additional cost savings and comfort improvements come from the ability to properly dehumidify the supply air at part load conditions, which is difficult for constant volume units.

## HOW DOES IT WORK

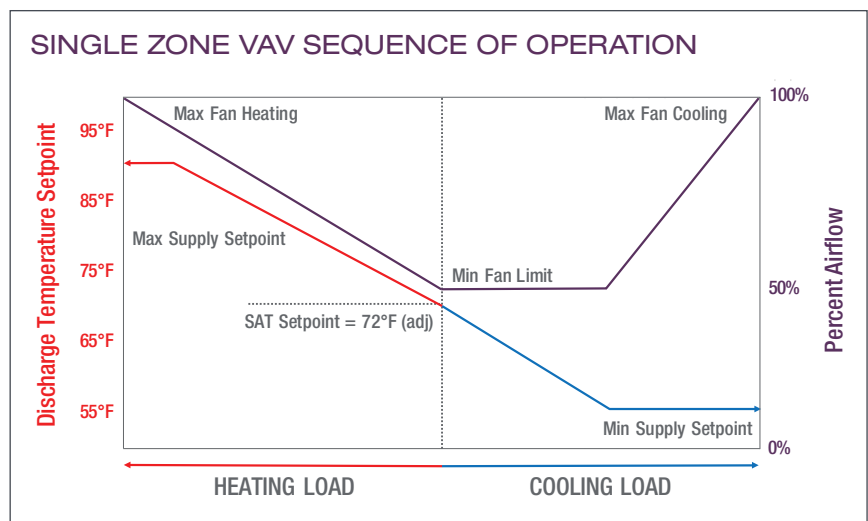
This sequence references a space sensor and its associated space setpoint and varies fan speed in order to maintain desired space conditions. Space temperature sensors are required in the HVAC zone or in the return air ductwork to implement the Single Zone VAV control strategy.

The default minimum supply fan speed for Single Zone VAV is 50%. When there is a variance between the desired setpoint and the actual space temperature, the Single Zone VAV sequence engages as follows, depending on whether the system is in cooling mode or heating mode.

## COOLING MODE

As the space temperature increases, the Discharge Air Setpoint decreases to deliver cooler air to the space while the fan speed remains at 50%.

When the Discharge Air Setpoint reaches the minimum value, if the space temperature is still above setpoint, the supply fan speed is increased until the desired space conditions are met.



## HEATING MODE

If the Discharge Air Setpoint is  $\geq$  to the space heating setpoint, the Discharge Air Setpoint and the supply fan speed increase together. The sequence operates differently in heating mode vs. cooling mode to avoid temperature stratification in the space.

## DEHUMIDIFICATION MODE

The Single Zone VAV sequence should operate in concert with a dehumidification sequence in order to ensure that both the space temperature and humidity setpoints are achieved. Dehumidification mode will require a space or return humidity sensor in addition to the space or return temperature sensor. At part load conditions, where the fan is running at minimum, dehumidification control with hot gas reheat is especially important to avoid clammy or overcooled spaces.

## OUTSIDE AIR DAMPER CONTROL

Because the supply fan speed varies, the amount of outside air the unit brings in will increase and decrease relative to the speed. To maintain the proper amount of ventilation air, a modulating damper control strategy needs to be utilized. The outside air damper could simply be modulated based on space CO<sub>2</sub> levels, or a dedicated airflow measuring device could be utilized to provide a minimum outside airflow.

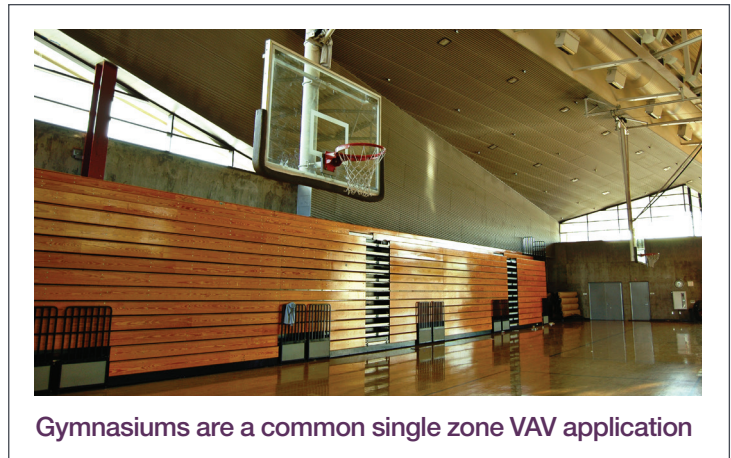
## OCCUPIED/UNOCCUPIED

The Single Zone VAV sequence is typically only used in an “occupied” state. If the space is in an “unoccupied” state, a user would typically choose a Night Setback sequence with unoccupied space setpoints and wider temperature values. During Night Setback mode, the outdoor air dampers are closed and the unit is cycled on and off to meet the unoccupied setpoints.

## WHERE IS IT USED

Single Zone VAV works best in one room spaces with large variations in occupancy such as:

- Gymnasiums, arenas, or ice rinks
- Theaters or lecture halls
- Cafeterias
- Meeting rooms
- Religious facilities



## WHY IS IT USED

In some states, local energy codes are requiring HVAC units that recirculate air to use a Single Zone VAV sequence instead of constant volume operation due to the energy savings that accompany lower fan speeds. In addition, varying the volume of air delivered to a space can provide several benefits:

- Improved efficiency of the HVAC system, resulting in reduced energy costs
- Increased longevity of the equipment and its components, which are not always running at full load
- Improved part load dehumidification

### ENERGY SAVINGS

Cooling Load	AHRI 340/360 Seasonal Weighting Factor	Constant Volume Fan Power Consumption	Single Zone VAV Fan Power Consumption*
100%	2%	100%	100%
75%	61.7%	100%	52%
50%	23.8%	100%	21%
25%	12.5%	100%	18%

Based on ANSI/AMCA standard 207-17 Fan System Efficiency and Input Power.

\*Example based on a 1.5 HP supply fan motor with cooling capacity balancing from a representative 15 ton air-cooled DX unit.



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