



MULTI-STAGE AIR VOLUME SUPPLY FAN OVERVIEW:

A constant air volume rooftop unit is a perfect match to cool a space at full load capacity. When the space demands full capacity from a rooftop unit, a correctly sized constant air volume unit can provide the necessary cooling capacity to meet the demand. However, the space is not always at full load conditions. Throughout much of the year, the space only demands part load capacity from a rooftop unit. A constant air volume rooftop unit has no choice but to bring the maximum amount of air it has been designed to provide. If the space only requires a percentage of the maximum air available from a rooftop unit, a constant air volume unit has no way to vary the airflow to match the space's demand.

Units equipped with a variable frequency drive (VFD) have the ability to vary the amount of air they deliver to a space (or spaces). The VFD alters the frequency and voltage delivered by the power supply to the supply fan. This can lead to energy savings, enhanced space comfort, and sound benefits.

This document will focus on Lennox' new multi-stage air volume (MSAV) supply fan option. The application guide will define the option, provide applications to target, and give some general guidelines to use when selecting the MSAV option.

DEFINITION

The multi-stage air volume (MSAV) supply fan option is available exclusively on the Strategos™ 10, 20 and 24 ton packaged rooftop units. The MSAV option uses a variable frequency drive to vary the airflow provided by the unit to match the cooling load required. The VFD alters the frequency and voltage delivered by the power supply to run the supply fan at up to seven different speeds. An MSAV supply fan can have up to four cooling stage speeds, one heating stage speed, one ventilation stage speed, and an extra speed for when one of the smoke alarm options is used. As the unit switches from different stages of cooling, the supply fan will either slow down or speed up to match the cooling demand. For example, if a unit only requires first stage cooling to satisfy the space's cooling load, the supply fan will reduce the airflow delivered to the space. If the space demand requires second stage cooling, the unit will then increase the supply fan's airflow to match the cooling demand.

The fan stages are set in the factory as percentages of the fan's maximum RPM. For example, the first stage cooling supply fan speed is set at 35%. This means the supply fan will run at 35% of the supply fan's maximum RPM. These set points can be increased up to 100% of the supply fan's maximum RPM. These percentages can be field modified to fit the specific application.

The number of fan stages available differs depending on which control mode the unit is setup for. For example, a 20 ton unit with a standard one stage heating and two stage cooling thermostat can only run five supply fan speeds: two speeds for cooling, one for heating, one for ventilation, and an extra speed for when one of the smoke alarm options are used. When zone sensor mode is used, the 20-ton MSAV unit can take advantage of all seven available supply fan speeds.

Applications

MSAV units are designed to maximize the IPLV or part load efficiency of the Strategos™ packaged rooftop units. Applications that require the unit to run at part load capacity for long periods of time are ideal for an MSAV unit. An example would be climate areas that have a broad range of temperatures throughout the year that might require part load capacity for months at a time. Not only can an MSAV unit meet the full cooling demands during the extreme ambient conditions, but it can also provide the correct amount of cooling to match part load conditions by reducing the supply fan speed. This allows the MSAV unit to provide the necessary amount of cooling capacity to meet the cooling demand without wasting energy.

Buildings where the load may fluctuate greatly during the day or week are also applications that are ideal for MSAV units. Retail and restaurant environments are perfect examples of buildings where the load isn't always constant. While the store is unoccupied, the load may be significantly less than peak store hours when many customers and employees are present. MSAV units are not only able to meet the peak cooling capacity needs during busy hours, but also reduce capacity and fan energy use to match the cooling demand when the store is unoccupied.

MSAV Units and Minimum Fresh Air Requirements

MSAV units equipped with an economizer option should also have a CO₂ sensor to assure proper ventilation at all times. This allows the equipment to bring in the required amount of fresh outdoor air while still minimizing energy costs. The installer can set the outdoor air damper to the minimum outdoor air position when the unit runs at the full supply fan air speed. As the supply fan slows down, the outdoor air quantity may also be reduced. Using a CO₂ sensor will help ensure the unit will meet the minimum ventilation requirements by opening the outdoor air damper if CO₂ levels rise above the desired set point. If a CO₂ sensor is not used, the economizer will work to maximize energy efficiency without regard for ventilation requirements. This can lead to potential problems when the supply fan is operating at low speeds. A CO₂ sensor will take precedence over all other unit operations, assuring proper ventilation at all times. It is possible to tie multiple units into one CO₂ sensor, but this can cause different areas in larger buildings to be under ventilated. The opposite problem can also arise if an MSAV unit is not paired with a CO₂ sensor. Without a CO₂ sensor to assure proper ventilation, MSAV units might bring in too much outside air and over-ventilate the space. This can potentially reduce the overall efficiency of the unit.