



This document pertains to Lennox's line of Energence™ 20-50 ton variable air volume packaged rooftop units. This document defines variable air volume units as those that include a variable frequency drive on the supply fan. For additional information regarding factory options, field installed accessories and sequence of operations please consult Lennox's engineering handbooks or a Lennox field sales representative.

### OUTDOOR AIR CFM CONTROL OVERVIEW:

ASHRAE standard 62.1-2004 requires that packaged rooftop units provide a minimum amount of fresh outdoor air. The standard states that:

The Outdoor Air CFM Control option allows Lennox's variable air volume packaged rooftop units meet the required minimum fresh outdoor air volume (CFM) regardless of supply fan speed.

### CHALLENGES ASSOCIATED WITH MEETING THIS REQUIREMENT

Meeting the minimum outdoor air requirement for constant air volume units remains relatively easy because the unit's supply fan operates at a constant speed. Because the unit supplies the occupied space with a fixed amount of total supply air volume, the addition of an outdoor air damper set at a fixed minimum position will by default provide a fixed amount of outdoor air. Assuming the outdoor air needs have been calculated correctly and the damper position has been set correctly, the unit should provide enough fresh outdoor air to meet the occupied space requirements.

Meeting this requirement for variable air volume units is more complex. A variable air volume unit supplies varying amounts of total supply air volume (CFM) at a fixed discharge air temperature to meet the combined needs of the individual zones. While some zones may call for full cooling, other zones may require only partial cooling to satisfy their respective temperature demands.

As more zones call for increased cooling, the variable air volume unit increases the speed of the supply fan and delivers a larger quantity of total supply air volume (CFM) to the combined zones. As the cooling demand for these zones decreases, the variable air volume unit will then decrease the supply fan speed and deliver a smaller quantity of total supply air CFM to the combined zones.

As the supply fan slows down, the unit will draw in less outdoor air at the same damper position versus if the supply fan were operating at 100% capacity. The net effect is that the unit will now provide less than the required volume (CFM) of minimum fresh outdoor air.

Setting the outdoor air damper for a variable air volume unit to a minimum position as determined by the slowest supply fan speed and lowest total supply air CFM will solve this issue. However, this solution can dramatically increase the amount of fresh outdoor air introduced into the occupied space when the unit is in full mechanical cooling operation and delivering 100% supply air volume.

Because the outdoor air damper has been set to deliver the minimum amount of required fresh outdoor air at the lowest supply air volume, when the supply fan operates at higher than minimum capacity the unit will bring in additional fresh outdoor air. By default, this will increase the amount of mechanical cooling or heating required to condition the air and will almost certainly result in additional operating costs, energy usage and a lowered equipment life expectancy.

## VARIABLE AIR VOLUME FRESH OUTDOOR AIR SOLUTION

Lennox offers two simple solutions to solve the minimum fresh outdoor air requirement for variable air volume units. The first option, The Outdoor Air CFM Control factory or field installed option provides a way to accurately measure the incoming outdoor air flow and adjust the outdoor air damper position as needed to meet the minimum fresh outdoor air requirement. The second option, Demand Control Ventilation, modulates the outdoor air damper according to CO<sup>2</sup> levels in the space. If there's little or no occupancy, there would be no call for outside air, and the outside air damper would be at its minimum position. However as occupancy rises, CO<sub>2</sub> levels rise, and the outside air damper would open accordingly to meet the demand.

The initial setting for the outdoor air damper position will equal that of a constant air volume unit. The outdoor air damper will maintain a minimum position to deliver the appropriate amount of outdoor air when the variable air volume unit's supply fan is operating at full capacity. As the supply fan slows down, Lennox's Prodigy Controller will receive information from the airflow measurement device located in the packaged rooftop unit's outdoor air section or from the CO<sub>2</sub> sensor located in the space and will change the economizer's outdoor air damper position to compensate for the reduced total supply air CFM.

Please note, when selecting a fresh outdoor air solution, select either Outside Air CFM Control or Demand Control Ventilation, but do not select both.

### **Example: Standard Variable Air Volume Unit**

For example, let's assume the packaged rooftop unit's outdoor damper position has been set to a 20% fixed minimum position and will deliver 2,000 outdoor air CFM when the unit's supply fan is operating at 100% capacity (20,000 CFM). If the supply fan slows down and only delivers 80% of full capacity (16,000 CFM), the unit will reduce the overall outdoor air volume intake as well.

In this case, the outdoor air volume will fall to approximately 80% (1,600 CFM). In this scenario, the unit will fail to bring in the required minimum fresh outdoor air volume of 2,000 CFM to fulfill the ASHRAE 62.1 requirement.

### **Example: Standard Variable Air Volume Unit with Outdoor Air CFM Control**

Now let's assume the outdoor damper position for a packaged rooftop unit featuring the Outdoor Air CFM Control option has been set to 20%. This will deliver 2,000 CFM of fresh outdoor air at 100% supply fan capacity (20,000 CFM). In this scenario if the supply fan slows down and only delivers 80% of full capacity (16,000 CFM), the Prodigy Controller will automatically increase the outdoor air damper position to ensure the unit will continue to bring in 2,000 CFM of fresh outdoor air.

For instance, the Prodigy Controller may have to increase the outdoor air damper to 23% to bring in the same 2,000 CFM at 80% of supply fan capacity versus the original setting of 20%, which resulted in 2,000 CFM at 100% of supply fan capacity.