SETTING A HIGHER STANDARD

UNIT VENTILATOR CONTROL APPLICATIONS

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ZONING SOLUTIONS FOR TODAY'S CUSTOMERS

ASHRAE standards drive the HVAC industry. Yet some of the most important demands you face are those of your customers, who are continually seeking better solutions for comfort, energy efficiency, indoor air quality and acoustics.

Through research and development, Carrier strives to not only meet your customers' expectations, but exceed them. To understand how, let's focus on Unit Ventilators (UVs).

PROVIDING FOR INDOOR AIR QUALITY, ENERGY EFFICIENCY AND COMFORT

Industry requirements for ventilation air control have evolved over the past several years to meet the requirements of ASHRAE-62-1989 – the Ventilation for Acceptable Indoor Air Quality standard – and its addendum, 62a-1990.

Detailed descriptions of today's indoor air quality requirements are included in the ASHRAE standard publication, available directly from ASHRAE (see "Sources" for contact information).

Minimum Outdoor Air

The traditional method of achieving the required minimum ventilation (outdoor air, or OA) is to provide a minimum damper actuator position for the outdoor air intake damper.

This is accomplished by calculating the total outside air requirement based on expected occupancy and the values shown in ASHRAE Table 2.2, which states:

Occupancy x OA CFM/Person = Minimum OA Ventilation

Since Unit Ventilators are primarily used in schools and small healthcare facilities, we'll use a typical classroom as an example. To arrive at the minimum outdoor air ventilation, multiply the classroom occupancy by the OA CFM:

20 students x 15 CFM/Person = 300 CFM OA

Based on this calculated value, the control would be adjusted to provide a minimum OA damper actuator position, which is the percentage of the ventilation requirement to the unit's total airflow. If the unit is rated for a nominal flow of 1500 CFM, the damper actuator minimum position would be adjusted to 20%:

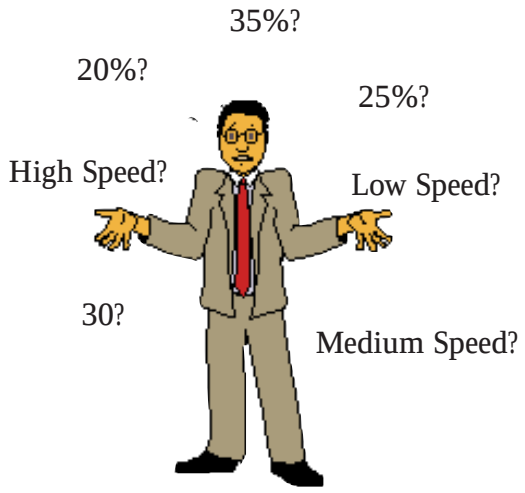
300 CFM/1500 CFM = .20 or 20%

Please note that this assumes there is a linear relationship between the control output that drives the damper and the amount of outdoor air delivered. In actuality, there is *no relationship between airflow and damper actuator position*.

There is another problem in obtaining the required minimum outdoor air. If the Unit Ventilator is capable of delivering 1500 CFM, and there are 20 occupants at 15 CFM of outdoor air per person, the total outside air supplied to the space should be 300 CFM.

During setup, the outside air damper actuator is positioned at 20% to maintain this CFM. But what happens when the fan operates at high speed? Is the amount of outdoor air delivered by the unit the same as when the fan operates at low speed?

▲ Figure 1 - Carrier Unit Ventilator



The answer is no.

So even though the traditional method of calculating minimum outdoor air meets the current ASHRAE requirements for Unit Ventilator Cycles II and III, it does not meet ASHRAE's Ventilation for Acceptable Indoor Air Quality standard.

Carrier's ECM Control Solution

To comply with ASHRAE, a minimum of 15 CFM per person of outdoor air must be supplied to the space during occupied periods. If the fan speed is reduced, the algorithm that controls the minimum outside air damper position must increase the minimum damper percentage to maintain proper ventilation.

▲ Figure 2 - Unit Ventilator Control Panel

This avoids relying on assumptions when using calculated percentages of minimum ventilation; actual amounts of airflow must be known.

Carrier's new Unit Ventilator uses an electronically commutated motor, or ECM, to provide constant airflow by compensating for pressure drops caused by dirty filters or partially blocked discharge grills.

If a student should place a book over one of the discharge grills, or a teacher decides that a plant will grow best sitting on the unit near the window, the Carrier Unit Ventilator will automatically maintain the proper unit airflow by measuring the fan shaft torque and adjusting the fan shaft speed.

A preprogrammed algorithm contained in the new ECM increases or decreases the speed (rpm) of the fan based on three separate airflow setpoints entered at the factory. This means a nominal 1500 CFM unit will provide 1500 CFM at high speed, 1200 CFM at medium speed and 1050 CFM at low speed.

Whenever the Unit Ventilator is in the occupied mode, Carrier's UV control automatically calculates the percentage of unit airflow required to provide minimum ventilation at the current fan speed. Instead of relying on assumptions, it actually measures outdoor air and return air temperatures, positions the OA damper, and verifies the resulting mixed air temperature is correct.

REDUCING SOUND LEVELS

One of the major complaints about traditional Unit Ventilators is the noise level. Carrier reduces noise by actively controlling the fan speed.

While some unit ventilators start at high speed, Carrier's UV controller maintains the lowest operating fan speed possible to supply the heating or cooling capacity required. It also starts the UV at low speed and slowly increases speed only when necessary, eliminating unnecessary and annoying speed changes while providing an inherent Peak Demand Limiting feature.

IMPROVING INDOOR AIR QUALITY

Direct digital controls can provide improved indoor air quality in many ways, including:

- Constant Ventilation

  Whenever the Unit Ventilator is operating in an occupied mode, the control modulates the OA damper to provide the minimum outdoor air ventilation required at any fan operating speed. This insures adequate ventilation.

  Once the minimum ventilation setpoint is entered directly as a CFM value, the control continuously calculates the actual amount of outdoor air ventilation being supplied. As load changes cause the fan speed to vary, it recalculates the percentage of outdoor air needed to maintain the required minimum ventilation setpoint, then repositions the dampers to maintain the ventilation setpoint.

  The control also provides a safety, should the outdoor air temperature fall to extremes, by increasing the fan operating speed – this maintains the mixed air temperature above 55°F, while meeting the minimum ventilation requirements.

- Demand Controlled Ventilation (DCV)

  DCV makes it possible to maintain proper ventilation and improve air quality while saving energy.

  ASHRAE has determined that "It is consistent with the Ventilation rate procedure that Demand Control be permitted for use to reduce the total outdoor air supply during periods of less occupancy." That means the Carrier unit – using CO_2 sensors and a CO_2 setpoint selected for the required ventilation rate – will control the amount of ventilation for the actual number of occupants.

  Please note that during design occupancy, a unit with the Carrier DCV system will deliver the same amount of outdoor air as a unit using the ventilation-rate procedure. However, DCV can generate substantial energy savings whenever the space is occupied below the design level.

- Improved Dehumidification

  Carrier's UV control operates the fan to maintain the desired cooling setpoint at the lowest speed possible, substantially increasing the amount of moisture removed from the space (latent heat) and minimizing the chance of overcooling.

  On Face and Bypass units, the cooling valve remains open for some time after the damper repositions to the coil bypass position. This effectively reduces the amount of moisture evaporated back into the space during light load conditions, when the damper is operating near the full-bypass position.

- Filters

  Well-maintained filters are important to improved indoor air quality. The controller monitors the fan's status and accumulates the operating hours, and will provide a maintenance alarm when the accumulated run hours exceed the value programmed for the filter's rated life or maintenance interval.

- Mold Growth

  When the control determines that the fan is no longer required to operate – such as when transitioning into or operating during an unoccupied period – the control determines whether the previous mode provided mechanical cooling.

  If so, it will close the cooling valve and operate the fan for a period of time in order to evaporate the condensate from the cooling coil, reducing the potential for mold and bacteria growth.

SATISFYING CUSTOMER NEEDS

Carrier's new Unit Ventilator controller was designed with your customers' needs in mind. For valuable assistance and information about UV control applications, please refer to the sources listed below.

SOURCES

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ASHRAE-62-1989 and Addendum 62a-1990

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