Oregon Non-Residential Building Energy Code

OREGON DEPARTMENT OF ENERGY

Ventilation Controls

Ventilation Controls for High Occupancy Areas

Ventilation controls both ensure that required ventilation air is delivered to the space and that excess air isn't delivered to the space when the space is partially occupied. The strategy of reducing ventilation air when the space is partially occupied is commonly referred to as Demand Controlled Ventilation. Ventilation requirements are included under Section 403.3 of the 2004 edition of the Oregon Mechanical Specialty Code (OMSC).

A special requirement pertains to HVAC systems that serve spaces with high occupant densities. If the system provides at least 1,500 cfm of outside ventilation air, and has an average occupant load factor of 20 ft^2 per person or less, code Section 1317.2.2 applies. The occupant density is determined by Table 1004.1.2 of the Oregon Structural Specialty Code (OSSC). Typically, this will only apply to spaces such as conference rooms, auditoriums, gymnasiums, and school classrooms. It is important to note that this requirement is based on the **average** occupant load of spaces served by a system. If a large HVAC system serves multiple space types, some of which have occupant load factors greater than 20 ft^2 per person and others with occupant load factors less than 20 ft^2 per person, the requirement may not apply.

Code Language

1317.2 Mechanical Ventilation. Ventilation shall be provided as specified in the Oregon Mechanical Specialty Code and this section.

1317.2.2 Ventilation Controls for high occupancy areas. HVAC systems with ventilation air capacities of at least 1,500 cfm and serving areas having an average occupant load factor of 20 or less (as established in Table 1004.1.2) shall include a means to automatically reduce outside air intake below design rates when spaces are partially occupied. Large rooms served by multiple systems with a combined air capacity of 1,500 cfm and an occupant load factor of 20 or less must also meet this requirement.

Exception: System equipped with an energy recovery device with at least 50 percent recovery effectiveness.

Documentation: To document compliance with this section of code, fill out Compliance Form 4a, line 14.

In addition:

- If the ventilation control requirement applies, specify the location of control sensors and indicate the control sequence used to control ventilation levels.

The code provides an exception for systems that include energy recovery devices. Energy recovery is used to recover either sensible heat, or in the case of an enthalpy wheel, both sensible and latent heat from the exhaust stream. The recovered heat is used to pre-cool outside ventilation air in the summer and pre-heat ventilation air in the winter. The energy recovery device should be able to recover at least 50 percent of the energy from the exhaust air stream.

How Ventilation Air Is Controlled

The code requires that the amount of ventilation air is automatically controlled by the HVAC system, but is not specific about how that should be accomplished. A common means of controlling ventilation air for variable-occupancy spaces is to use carbon dioxide as an indicator of the amount of outside air delivered to the space. Chapter 4 of the OMSC and ASHRAE 62.1-2004, Ventilation Requirements for Indoor Air Quality, define ventilation requirements for various spaces. The recommended minimum outside air ventilation rate corresponds to the amount required to maintain an indoor CO_2 level that is no greater than 700 ppm above the ambient concentration. For typical outdoor conditions, this amounts to an indoor maximum of about 1,100 ppm. The demand-controlled ventilation system includes a sensor to monitor CO_2 levels, and a control to adjust the outside air intake. If the CO_2 level is well below the limit, the outside air dampers modulate to close towards the minimum position to save energy. If the CO_2 level is above the limit, the outside air dampers modulate open to increase the rate that outside ventilation air is introduced to the space. The sensor signal is fed back to the building energy management system or to the economizer of a packaged HVAC unit. CO_2 sensors used to control ventilation should have accuracy to at least +/- 30 to 50 ppm. Sensors typically cost $300 each. Sensors should be verified as part of commissioning and may require periodic calibration.

The sensor should be located in an occupied zone of the space, at a height of 3 to 6 ft. A good sensor location is 6 to 10 ft

Continues on **page 2**

Examples

Q My building includes a large air handler serving twelve offices, with 300 ft² of floor area each, and six 400-ft² conference rooms Does my space require ventilation controls?

A No. The occupant load factor of the offices (from Table 1004.1.2) is 100 ft² per person or 36 people (12 x 300 ft² / 100 ft² per person). The load factor for the conference rooms is 15 ft² per person or 160 people (6 x 400 ft² / 15 ft² per person). The total floor area served by the system is 6,000 ft². The total occupancy for the system is 196 people (36 +160). Therefore the average load factor is 31 ft² /person (6,000ft² / 196 people). Even though the conference room has a high occupant load, for the entire space, the load factor is greater than 20 ft² /person. Therefore, ventilation controls aren't needed.

Q I have a packaged rooftop unit serving a small cafeteria with a floor area of 1,200 ft² and average peak occupancy of 80. The ventilation requirement is 15 cfm/person. Does the unit require ventilation controls?

A No. Even though the occupant load factor is only 15 ft² /person, the system is designed to bring in a minimum of 1,200 cfm of outside ventilation air. Thus, ventilation controls are not required.

Find Out More

Copies of Code:

Oregon Building Officials Association
phone: 503-873-1157 fax: 503-373-9389

Technical Support:

Oregon Department of Energy
625 Marion Street NE phone: 503-378-4040
Salem, OR 97301-3737 toll free: 800-221-8035
www.oregon.gov/energy fax: 503-373-7806

This fact sheet was developed with funding from the Northwest Energy Efficiency Alliance and the US Department of Energy under contract DE-FG51-02R021378.

Northwest Energy Efficiency Alliance
www.nwalliance.org

Photo on page 1 c/o Warren Gretz, DOE/NREL

12/05 ODOE CF-125/Fact Sheet 15

Non-residential code HVAC fact sheets include:

- Ventilation Controls
- Economizers
- Exhaust Air Heat Recovery
- Airside System Design Req.
- Hydronic Design and Controls
- Airside Controls
- Large Volume Fan Systems
- Air Transport Energy
- Simple vs. Complex HVAC Systems

Continued from page 1

from the occupants. Avoid placing sensors in close proximity to operable windows or supply air outlets. If a single HVAC system serves multiple spaces, a separate CO_2 sensor may be required for each space. For a system that serves several spaces, locating a single sensor in a common return is not a good practice—this will lead to overventilation of some spaces and underventilation of others. If using a single sensor, it should be placed in the space that requires the highest percentage of outdoor air.

An important distinction of this control is that CO_2 measurements are an indication of occupancy levels, so that ventilation rates may be adjusted accordingly. CO_2 is a related factor but not a direct indication of indoor air quality. Outside air ventilation is just one means of treating indoor pollutants, by diluting their concentration with outside air.

Other methods may be used to control ventilation automatically, but any method must be able to reduce ventilation levels for partial occupancy. For instance, an alternate method of ventilation control for a theater could be an occupant counter that tracks entry and exiting of occupants.

Benefits

Automatic control of ventilation levels provides several benefits. It ensures that the correct amount of ventilation air is delivered to the space, which will ensure that indoor air quality meets requirements and the space doesn't "get stuffy." In some cases, it may also save considerable energy, particularly for large spaces with highly variable occupancies such as gymnasiums and theaters. Control of ventilation is recognized by the U.S. Green Building Council in its Leadership in Energy and Environmental Design (LEED) voluntary certification program. Ventilation controls are an effective component of a high-performance HVAC design.

Examples

Q Can occupancy sensors be used for ventilation control?

A No. The control method must be able to automatically vary ventilation for partial occupancy.

Q I have a large conference room that is being served by two packaged rooftop air handling units. Each air handler has 1,000 cfm of ventilation air. Am I required to use demand controlled ventilation in this space?

A Yes. The requirement is for spaces with a minimum of 1,500 cfm. Even though each air handler is sized for 1,000 cfm of ventilation air, the total is greater than 1,500 cfm.