Oregon Non-Residential Building Energy Code

OREGON DEPARTMENT OF ENERGY

Economizers

Economizers are control systems that save cooling energy by using outside air as a first stage of cooling. The Oregon Energy Code requires that economizers be installed on systems that use mechanical cooling (such as packaged rooftop units and outdoor air handlers). The economizer must be capable of adjusting outside air and return air dampers to provide up to 100 percent outside air. Economizers are especially effective in temperate climates, when outdoor conditions often allow for "free cooling."

There are several exceptions to this requirement. Exceptions are given to small direct-expansion (DX) units that have a total cooling capacity of 54,000 Btu/hr (4.5 tons) or less each. However the total cooling capacity of units per building that can qualify for this exception is limited to 240,000 Btu/hr (20 tons) or 10 percent of the building total cooling capacity, whichever is greater. An exception is provided for systems with water side economizers (which use evaporative cooling), and ground-coupled heat pumps. Systems that use heat recovery between interior and exterior zones also qualify as an exception. For instance, a heat recovery chiller for a large office building can recover rejected condenser heat for use in heating perimeter offices. An economizer would reduce the amount of time when the compressor would operate in cooling mode during cool outdoor conditions. This would reduce the effectiveness of heat recovery.

Building Pressurization

The introduction of high amounts of outside air through a mechanical system can lead to building overpressurization unless there is some means to relieve that air. Overpressurization of the interior space can make it difficult to open or close doors and cause non-compliance with the American Disabilities Association's accessibility requirements. For that reason, the code requires some method of pressure relief.

The pressure can be relieved mechanically using a return or exhaust fan. Passive relief using a barometric relief damper may be sufficient for some applications.

Integrated Economizers

Integrated economizers allow outside air to be used as a partial source of cooling, even if mechanical cooling is required. An example of when this is most useful is a mild sunny day (65°F). The space may require air-conditioning during such conditions, but the return air (75°F) will likely be warmer than the outside air (65°F). Therefore, even though mechanical cooling is required, it

Continues on **page 2**

Code Language

1317.3 Economizer Cooling. Each fan system with mechanical cooling shall have an air economizer system capable of modulating outside air and return dampers to provide up to 100 percent of the design supply air quantity as outdoor air.

Exceptions:

1. Systems at locations where the air quality is so poor as to require extensive treatment of the air.
2. Systems serving only residential spaces and hotel or motel guest rooms.
3. Cooling equipment with direct expansion coils rated at less than 54,000 Btu/hr (15,827 W) total cooling capacity. The total capacity of all such units without economizers shall not exceed 240,000 Btu/hr (70,342 W) per building area served by one utility meter or service, or 10 percent of its total installed cooling capacity, whichever is greater. That portion of the equipment dwelling units and guest rooms is not included in determining the total capacity of units without economizers.
4. Systems having a water economizer system capable of cooling air by direct and/or indirect evaporation and providing 100 percent of the expected systems cooling load at outside temperatures of 50°F (10°C) dry bulb and 45°F (7°C) wet bulb and below.
5. Ground-coupled heat pumps with cooling capacity of 54,000 Btu/hr or less.
6. Internal/external zone heat recovery is used.

1317.3.1 Pressure Relief. The fan or building envelope shall provide a means of preventing overpressuring the building envelope during air economizer operation. Drawings shall specifically identify the pressure relief mechanism for each fan system.

1317.3.2 Integration. Economizer systems shall be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

Documentation:

Economizer cooling is documented on compliance Form 4a, line 7. Check the "Complies" box if fan systems have economizers.

Building pressure relief controls and integration of economizers is documented by checking the appropriate boxes on line 8 of Form 4a.

Code Language continued from page 1

Exceptions:

1. Direct-expansion systems may include controls to reduce the quantity of outdoor air as required to prevent coil frosting, but not less than required by this code, at the lowest step of compressor unloading.
2. Individual direct-expansion units that have a cooling capacity of 15 tons (53 kW) (nominal) or less may use economizer controls that preclude economizer operation whenever mechanical cooling is required simultaneously.

Examples

Q My building includes a large computer server room in the basement with a 15 ton cooling load and precise temperature and humidity requirements. I would like to use a split system air conditioning unit that only recirculates air, Is this allowed?

A No, an economizer is required by code. Cooling energy savings will normally outweigh any additional energy requirements for humidification or dehumidification. Your choices are to either provide enough outside air for 100 percent of the design supply capacity, or as an alternative you could use recirculated air only combined with a waterside economizer.

Find Out More

Copies of Code:

Oregon Building Officials Association
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Technical Support:

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Northwest Energy Efficiency Alliance
www.nwalliance.org

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12/05 ODOE CF-125/Fact Sheet 16

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

will be more energy-efficient to cool outside air (65°F) vs return air (75°F). For an integrated economizer, the controller for the HVAC unit would use economizer cooling first. If the space cannot be maintained at the setpoint with outside air, mechanical cooling would be used in conjunction with economizer cooling. Integrated economizers are required on units with a cooling capacity of 15 tons or greater.

With integrated economizers, special attention should be given to operation under low load conditions. A packaged HVAC unit with a single compressor could encounter problems with coil frosting during cool outdoor conditions. For this reason, integrated economizers are more common for systems with multiple compressors or other means of capacity control. Dual-compressor systems are widely available for systems with a cooling capacity of 8 tons or greater and integrated economizers are encouraged for any systems with multiple compressors.

Economizer Control Options

Economizers can be controlled in one of several ways: outside air dry-bulb temperature, differential dry-bulb temperature, or differential enthalpy. An outside air dry-bulb controller is the simplest form of control: economizer cooling is used whenever the outside air is below a set limit. Differential dry-bulb control uses economizer cooling whenever the outside air is cooler than the return air. This is a more energy-efficient (though more complicated) strategy. Differential enthalpy controllers restrict the use of economizer cooling to times when the enthalpy (heat content) of the outside air is less than the enthalpy of the return air. This helps to maintain indoor humidity levels at design levels during cool to mild, humid outdoor conditions. The Oregon climate rarely has high humidity at the economizer changeover temperature, so differential dry-bulb is the recommended option. Enthalpy-based sensors are also more prone to false readings and failure.

Economizers have controls and components (dampers, linkages, actuators, temperature sensors, and logic controllers) that are prone to failure and require continued maintenance. Successful economizer installation means careful selection of quality components and functional testing to ensure that economizer controls are set correctly. Over time, dirt and corrosion can cause dampers to become stuck in a fixed position. If the outside air damper is stuck closed, poor air quality will result. If the damper is stuck open, the building will require excess energy for heating and cooling. To prevent corrosion of dampers, particularly in coastal areas, stainless steel dampers can be specified. Damper operations can also be improved by selecting ball bearing or nylon bushings. Direct-drive actuators are less prone to failure than dampers connected using linkage arms. Sensors may need periodic testing and recalibration to ensure that accurate temperature readings are obtained. Functional testing and commissioning of economizer controls is important to ensure proper operation. As a minimum, economizers should be tested to verify that low lockout and high-limit temperatures are adjusted properly. These temperatures disable the economizer when the outdoor temperature gets too low (50°F) or too high (75°F) and resets the damper to the minimum ventilation air setting.