Oregon Non-Residential Building Energy Code

OREGON DEPARTMENT OF ENERGY

Simple vs Complex HVAC Systems

This fact sheet distinguishes between simple and complex HVAC systems and describes major code requirements for each type of system.

Simple HVAC Systems

The Oregon Energy Code distinguishes between "simple" and "complex" HVAC systems. Simple HVAC systems include single-package constant volume unitary equipment, small split systems, packaged terminal air conditioners and heat pumps and ground-coupled heat pumps. Single-packaged systems include an evaporator coil and supply fan, compressor, condenser coil and condenser fan in a single package. The system may include gas heating, electric resistance heating or use a reverse refrigeration cycle in a heat pump configuration. Split systems consist of an outdoor unit that includes the compressor, condenser coil and fan, and an indoor section that contains the evaporator coil and indoor fan. A packaged terminal air conditioner or heat pump is specifically designed for a through-the-wall installation, and provides cooling for a single area.

Some larger constant-volume systems can be configured to serve multiple zones through a set of zone dampers and special controls. This type of control system is often referred to as a variable volume and temperature (VVT) control. When a VVT control system is installed on a constant-volume packaged unit, the HVAC unit is considered a complex system.

Control requirements for simple HVAC systems are documented in Section 1317.4 of the code. Requirements include deadband control and automatic setback or shutdown controls during unoccupied periods. Outdoor air shutoff dampers are required for unoccupied periods as well. Simple systems must meet minimum efficiency requirements, which are documented on applicable Worksheets 4a, 4c, 4e, 4f and 4j. The Worksheets specify minimum steady-state and seasonal efficiency requirements for a specific system type. Efficiency of certain equipment, such as electric resistance and radiant (gas and electric) heaters, is not regulated.

Complex HVAC Systems

Any systems that do not meet the requirements of simple HVAC systems under section 1317.9 of the code are considered complex systems. These include variable air volume systems, large split systems, any multizone systems, water-cooled systems and central cooling with chilled water systems. Code requirements for complex systems are found in Sections 1317 and 1318.

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Code Language

1317.9 Simple HVAC Systems. To qualify as a simple system, systems shall be one of the following:

1. Air cooled, constant volume packaged unitary equipment, packaged terminal air conditioners and packaged terminal heat pumps which provide heating, cooling or both and which requires only external connection to ductwork and energy services.

2. Air cooled, constant volume split systems, which provide heating, cooling or both, with cooling capacity of 54,000 Btu/hr (15,827 W) or less.

3. Ground-coupled heat pumps with cooling capacity of 54,000 Btu/hr (15,827 W) or less.

4. Heating only systems which have a capacity of less than 5,000 cubic feet per minute (2,360 L/s) or which have a minimum outside air supply of less than 70 percent of the total air circulated.

1317.10 Complex HVAC systems. Complex HVAC systems shall be all field-fabricated systems and systems constructed of subsystem components and systems not qualifying under Section 1317.9 (Simple Systems).

1317.3.1 Controls. Complex systems shall provide controls as specified in Sections 1317.4 and 1318.2.

1317.3.2 Equipment performance. In addition to the requirements of Section 1317.5, equipment in complex systems shall also comply with Section 1318.3.

1317.10.3 Motor efficiency of electric motors serving built-up HVAC systems (fans, compressors, chillers and pumps). Electric motors, which are NEMA Design A & B squirrel-cage T-frame induction permanently wired poly-phase motors of 1 horsepower or more and which serve built-up HVAC systems, shall have a nominal full-load motor efficiency no less than corresponding values for energy

Documentation:
The type of system (simple or complex) is designated on line 2 of Form 4a. For simple systems, only form 4a and equipment efficiency Worksheets are required. Depending on the specific HVAC system(s), one or more of Worksheets 4a, 4c, 4e and 4f will need to be completed. For packaged units that include gas heating, Worksheet 4j must also be completed.

For complex systems, Forms 4a and 4b are required, along with relevant equipment efficiency Worksheets.

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efficient motors provided in Table 13-T.

Exceptions:

1. Motors used in systems designed to use more than one speed of a multispeed motor.
2. Factory-installed motors for HVAC equipment meeting the equipment efficiency requirements of Section 1317.1.4.

Examples

Q My building design specifies a 10 ton packaged rooftop air conditioner, with gas heating. It also will include a field-installed economizer and powered exhaust. Since this has a field-installed component, does it fall into the complex system category?

A No. The unit is a constant-volume packaged unitary system and meets all requirements for simple systems. The field installation of the powered exhaust does not make it a complex system.

Q Can a constant volume system serving four classrooms, each with its own thermostat controlling bypass dampers, qualify as a simple HVAC system?

A No. Even though the HVAC system has a constant speed fan, separate controls for each space requires adjustment of the air volume to each space by bypassing some of the supply air back to the unit. Any multizone system is considered a complex HVAC system.

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

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Northwest Energy Efficiency Alliance
www.nwalliance.org

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Non-residential code HVAC fact sheets include:

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

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The table below summarizes compliance documentation requirements for common HVAC systems.

HVAC System Designation

HVAC System Type	Type	Worksheets
Small Unitary Equipment	Simple	4a, 4j
Large Unitary Equipment (constant volume)	Simple	4a, 4j
Unitary Heat Pump	Simple	4c
Unitary Equipment, Water-Cooled	Complex	4b 4l
Water-Source Heat Pump	Complex	4d 4l
Ground-Coupled Heat Pump	Simple (<54kBtu/h) Complex	4d
Packaged-Terminal Heat Pumps, PTACs	Simple	4f
Large Split System	Complex	4a, 4h, (*4k, 4l)
Air-Cooled Chiller	Complex	4g, 4h (*4k, 4l)
Water-Cooled Chiller	Complex	4g , 4h (*4k, 4l)
Central Boiler	Complex	4i
Small Furnace	Simple	4j
Large Furnace (>5000 cfm) *worksheet may be needed	Complex	4j

Efficiency of complex systems is documented on applicable Worksheet(s) 4a – 4j. Equipment must meet both steady-state and part-load efficiency requirements, as listed on the appropriate Worksheet. Efficiency information must be specified at ARI rating conditions. Ratings can be obtained either from the Air Conditioning and Refrigeration Institute (ARI) or from manufacturer's cut sheets. Multizone systems that use terminal units with reheat coils will require Worksheet 4k to demonstrate compliance. Large fan systems may require Worksheet 4l to demonstrate that fan power complies with Code – see Air Transport Energy fact sheet.

For More Information

Air Conditioning and Refrigeration Institute, 4100 N. Fairfax Drive, Suite 200, Arlington, VA 22203.

Consortium for Energy Efficiency, Inc., 98 North Washington St., Suite 101, Boston MA 02114-1918. See http://www.ceehvacdirectory.org/ for a listing of ARI-certified unitary equipment that exceed minimum federal efficiency requirements.

Simple Systems – see related fact sheets on Economizers, and Ventilation Controls for High Occupancy Areas.

Complex Systems – see related fact sheets on Airside Design, Airside Control, Hydronic Design and Control, Large Volume Fan Systems, and Air Transport Energy.

Q A small office building is served by two 15-ton variable air volume packaged units with gas heating. Which forms need to be filled out?

A The systems are classified as complex systems since they are not constant volume. Forms 4a and 4b are filled out, along with Equipment Efficiency Worksheets 4a and 4j, and Air Transport Energy (4l) and Simultaneous Heating & Cooling (4k).