

The following blue, underlined text identifies new clarifying language. The green, underlined, crossed-out text identifies an improved window U-factor proposed by Jeff Harris for window-to-wall ratio greater than 30%, up to 40% via Optional Efficiency column (OE) approach.

When the OE for high efficiency HVAC equipment is used as a trade-off for up to 40% windows, up from 30% windows, the OE cannot be used for any another mechanical trade-off. When the OE is not used to comply for up to 40% windows, the OE can be taken for any number of HVAC compliance alternatives.

1311.2. Optional compliance approach. All buildings, except occupancy group R, four stories and greater in height, with up to 40 percent window area (as a relationship to total exterior wall area) may demonstrate compliance with this approach by following the appropriate values in Table 1312.2(1) for Climate Zone 1 and Table 1312(2) for Climate Zone 2. The mechanical system efficiency shall be from the Optional Efficiency column in Tables 1317.5.1(1), 1317.5.1(2), 1317.5.1(3), 1317.5.1(5), 1317.5.1(6), and 1317.5(7). When the Optional Efficiency column is used for building envelope compliance, it shall not be used for other compliance alternatives as specified in either section 1317.2 exception 2, 1317.4.1, 1317.3.1 exception 1, 1317.3.6 exception 4, or 1318.2.2.2 exception. If a nonstandard condition, water-cooled, centrifugal chilling package that is not designed for operation at ARI Standard 550/590 test conditions is installed, the full load kW/ton rating and NPLV rating shall be 10 percent better than the required calculation. If packaged terminal units are installed, they shall be packaged terminal heat pumps.

Occupancy group R buildings, four stories and greater in height, with up to 40 percent window area (as a relationship to total exterior wall area) may demonstrate compliance with this approach by following the appropriate values in Table 1312.2(1) for Climate Zone 1 and Table 1312.2(2) for Climate Zone 2. The mechanical system efficiency shall be from the Optional Efficiency column in Tables 1317.5.1(1), 1317.5.1(2), 1317.5.1(3), 1317.5.1(5), 1317.5.1(6), and 1317.5.1(7). When the Optional Efficiency column is used for building envelope compliance, it shall not be used for other compliance alternatives as specified in either section 1317.2 exception 2, 1317.4.1, 1317.3.1, 1317.3.6 exception 4, or 1318.2.2.2 exception. If a nonstandard condition, water-cooled, centrifugal chilling package that is not designed for operation at ARI Standard 550/590 test conditions is installed, the full load kW/ton rating and NPLV rating shall be 10 percent better than the required calculation. If packaged terminal units are installed, they shall be packaged terminal heat pumps. For HVAC systems not listed above, or HVAC does not provide conditioning for entire building, the lighting power density for dwelling units and guest rooms shall not exceed 0.7 watts per square foot of floor area.

TABLE 13-E1312.3.1 (1)
ENVELOPE PRESCRIPTIVE PATH, OTHER BUILDINGS – CLIMATE ZONE 1

COMPONENT¹	COMPLIANCE CRITERIA
Windows up to 30% glazing fraction¹ <u>Maximum overall thermal transmittance</u> <u>Maximum overall SHGC</u>	U-0.460 ² or <u>Fixed: Double-glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating of 0.20 or less.</u> <u>Curtainwall/storefront & operable: Double glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating of 0.50 or less.</u> SHGC-0.40 ^{2, 3, 4}
Windows up to 40% glazing fraction¹ <u>Maximum overall thermal transmittance</u> <u>Maximum overall SHGC</u>	U-0.350 ² or <u>Fixed: Vinyl or fiberglass frame, double-glazed with minimum 0.5 inch airspace between panes, and a low emissivity coating <0.10.</u> <u>Curtainwall/storefront & operable: Vinyl or fiberglass frame, double-glazed with minimum 0.5 inch airspace between panes, and a low emissivity coating <0.50.</u> SHGC-0.40 ^{2, 3, 4}
Doors, with and without glazing, maximum overall thermal transmittance⁵	U-0.850 ² or <u>Doors with glazing: Double-glazed doors with minimum 0.5 inch air space between panes and a low emissivity coating of 0.10 or less.</u>
Opaque overhead doors, maximum overall thermal transmittance	U-200 ² or insulated to a min R-5, measured at center-of-panel
Skylights and glazed smoke vents⁶ <u>Manufactured, maximum overall thermal transmittance</u> <u>Manufactured, maximum overall SHGC</u> <u>Site-assembled glazing, maximum overall thermal transmittance</u> <u>Site-assembled glazing, maximum overall SHGC</u>	U-1.17 or Double glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating not greater than 0.05. SHGC-0.40 ^{2, 3, 4} U-0.69 or Double glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating not greater than 0.20. SHGC-0.40 ^{2, 3, 4}

ASSEMBLY	MAXIMUM ASSEMBLY FACTOR		MINIMUM INSULATION R-VALUE
Floors, over unconditioned spaces <u>Wood joist/framing</u> <u>Steel framing >4' on-center, and other</u> <u>Concrete slab above-grade⁷</u>	U-0.034 U-0.038 U-0.083	or or or	R-30 R-30 9 c.i. ⁸
Concrete slab-on-grade <u>Unheated slab</u> <u>Heated slab⁹</u>	NR F-0.56	or	NR R-7.5
Roofs¹⁰ <u>Continuous insulation</u> <u>Engineered metal building</u> <u>Attic, non-continuous and other</u>	U-0.048 U-0.055 U-0.035	or or or	R-20 c.i. ⁸ R-13+13+5 thermal blocks R-38
Walls⁷ <u>Masonry or concrete, with interior insulation-steel frame</u> <u>Masonry or concrete, with interior insulation-wood frame</u> <u>Masonry or concrete, with continuous exterior insulation¹¹</u> <u>Framed¹²</u> <u>Wood</u> <u>Steel</u>	U-0.083 U-0.083 U-0.104 U-0.083 U-0.083	or or or or or	R-13+4 c.i. ⁸ R-15 R-9.5 c.i. ⁸ R-15 ¹³ R-13+4 c.i. ^{8, 14}

<u>Engineered metal building</u>	<u>U-0.084</u>	<u>or</u>	<u>R-19</u>
<u>Other</u>	<u>U-0.088</u>	<u>or</u>	<u>R-10 c.i.⁸</u>
<u>Below-grade walls</u>	<u>C-0.146¹⁵</u>	<u>or</u>	<u>R-5 c.i. exterior⁸</u>

For SI: 1 inch = 25.4 mm.

- ¹ The glazing fraction installed in exterior walls shall not exceed 30% in order to comply with this prescriptive path. Percent of glazing fraction for windows is based on total exterior window area divided by the total exterior wall area including demising walls. For exterior window area up to 40 percent, see 1311.2 for an Optional Compliance Approach.
- ² Windows and doors that are contained within an unconditioned vestibule are exempt from U-factor and solar heat gain coefficient requirements.
- ³ The solar heat gain coefficient is an overall value of the fenestration assembly.
- ⁴ Street-level windows for retail display or compliance with local planning ordinance are exempt from solar heat gain coefficient requirements.
- ⁵ Where a fire-rated door is required, it is exempt from U-factor.
- ⁶ Maximum skylight area = 5 percent of total roof area. Manufactured skylights are installed on an insulated curb. Site-assembled glazing is integrated into the roof assembly and not on installed on a curb. Percent area for skylights is based on total skylight and glazed smoke vent rough frame area divided by the total roof area.
- ⁷ The exterior perimeter of all above grade floors shall be insulated to the same value as the exterior wall above that floor.
- ⁸ Continuous insulation (c.i.) is insulation applied so the R-value specified is uncompressed and uninterrupted by framing across the entire surface.
- ⁹ Insulation is required at the slab-edge perimeter and underneath the entire slab per 1312.7.
- ¹⁰ Opaque smoke vents are exempt from U-factor requirements.
- ¹¹ Minimum weight of masonry and concrete walls = for this category shall be at least 45 lbs./ft² (220 kg/m²) of wall face area.
- ¹² Batt insulation installed in metal or wood framed walls with continuous exterior insulation shall be installed in substantial contact with exterior sheathing. Batt insulation installed in metal or wood framed walls without continuous exterior insulation shall be insulated to the full depth of the cavity, up to 6 inches (150 mm) in depth.
- ¹³ R-8.5 continuous exterior insulation shall be permitted when wall has no cavity insulation.
- ¹⁴ R-9.5 continuous exterior insulation shall be permitted when wall has no cavity insulation.
- ¹⁵ A C-factor of 0.110 can be achieved with an assembly that is furred-out on the interior side with 2x4 steel framing, with R-13 batt insulation.

TABLE 13-F1312.3.1 (2)
ENVELOPE PRESCRIPTIVE PATH, OTHER BUILDINGS – CLIMATE ZONE 2

<u>COMPONENT¹</u>	<u>COMPLIANCE CRITERIA</u>
<u>Windows up to 30% glazing fraction¹</u> <u>Maximum overall thermal transmittance</u> <u>Maximum overall SHGC</u>	<u>U-0.460² or</u> <u>Fixed: Double-glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating of 0.20 or less.</u> <u>Curtainwall/storefront & operable: Double glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating of 0.50 or less.</u> <u>SHGC-0.40^{2, 3, 4}</u>
<u>Windows up to 40% glazing fraction¹</u> <u>Maximum overall thermal transmittance</u> <u>Maximum overall SHGC</u>	<u>U-0.350² or</u> <u>Fixed: Vinyl or fiberglass frame, double-glazed with minimum 0.5 inch airspace between panes, and a low emissivity coating <0.10.</u> <u>Curtainwall/storefront & operable: Vinyl or fiberglass frame, double-glazed with minimum 0.5 inch airspace between panes, and a low emissivity coating <0.50.</u> <u>SHGC-0.40^{2, 3, 4}</u>
<u>Doors, with and without glazing,</u> <u>maximum overall thermal transmittance⁵</u>	<u>U-0.850² or</u> <u>Doors with glazing: Double-glazed doors with minimum 0.5 inch air space between panes and a low emissivity coating of 0.10 or less.</u>
<u>Opaque overhead doors, maximum overall thermal transmittance</u>	<u>U-200² or insulated to a min R-5, measured at center-of-panel</u>

Skylights and glazed smoke vents⁶	
<u>Manufactured, maximum overall thermal transmittance</u>	<u>U-1.17 or Double glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating not greater than 0.05.</u>
<u>Manufactured, maximum overall SHGC</u>	<u>SHGC-0.40^{2, 3, 4}</u>
<u>Site-assembled glazing, maximum overall thermal transmittance</u>	<u>U-0.69 or Double glazed with minimum 0.5 inch airspace between panes, thermal break frame, and a low emissivity coating not greater than 0.20.</u>
<u>Site-assembled glazing, maximum overall SHGC</u>	<u>SHGC-0.40^{2, 3, 4}</u>

ASSEMBLY	MAXIMUM ASSEMBLY FACTOR		MINIMUM INSULATION R-VALUE
Floors, over unconditioned spaces			
<u>Wood joist/framing</u>	<u>U-0.034</u>	<u>or</u>	<u>R-30</u>
<u>Steel framing >4' on-center, and other</u>	<u>U-0.038</u>	<u>or</u>	<u>R-30</u>
<u>Concrete slab above-grade⁷</u>	<u>U-0.083</u>	<u>or</u>	<u>9 c.i.⁸</u>
Concrete slab-on-grade			
<u>Unheated slab</u>	<u>NR</u>		<u>NR</u>
<u>Heated slab⁹</u>	<u>F-0.56</u>	<u>or</u>	<u>R-7.5</u>
Roofs¹⁰			
<u>Continuous insulation</u>	<u>U-0.048</u>	<u>or</u>	<u>R-20 c.i.⁸</u>
<u>Engineered metal building</u>	<u>U-0.055</u>	<u>or</u>	<u>R-13+13+5 thermal blocks</u>
<u>Attic, non-continuous and other</u>	<u>U-0.035</u>	<u>or</u>	<u>R-38</u>
Walls⁷			
<u>Masonry or concrete, with interior insulation-steel frame</u>	<u>U-0.069</u>	<u>or</u>	<u>R-13+4 c.i.⁸</u>
<u>Masonry or concrete, with interior insulation-wood frame</u>	<u>U-0.063</u>	<u>or</u>	<u>R-15</u>
<u>Masonry or concrete, with continuous exterior insulation¹¹</u>	<u>U-0.090</u>	<u>or</u>	<u>R-9.5 c.i.⁸</u>
<u>Framed¹²</u>			
<u>Wood</u>	<u>U-0.063</u>	<u>or</u>	<u>R-15¹³</u>
<u>Steel</u>	<u>U-0.069</u>	<u>or</u>	<u>R-13+4 c.i.^{8, 14}</u>
<u>Engineered metal building</u>	<u>U-0.072</u>	<u>or</u>	<u>R-21+5 c.i.⁸</u>
<u>Other</u>	<u>U-0.075</u>	<u>or</u>	<u>R-12 c.i.⁸</u>
<u>Below-grade walls</u>	<u>C-0.110¹⁵</u>	<u>or</u>	<u>R-7.5 c.i. exterior⁸</u>

For SI: 1 inch = 25.4 mm.

¹ The glazing fraction installed in exterior walls shall not exceed 30% in order to comply with this prescriptive path. Percent of glazing fraction for windows is based on total exterior window area divided by the total exterior wall area including demising walls. For exterior window area up to 40 percent, see 1311.2 for an Optional Compliance Approach.

² Windows and doors that are contained within an unconditioned vestibule are exempt from U-factor and solar heat gain coefficient requirements.

³ The solar heat gain coefficient is an overall value of the fenestration assembly.

⁴ Street-level windows for retail display or compliance with local planning ordinance are exempt from solar heat gain coefficient requirements.

⁵ Where a fire-rated door is required, it is exempt from U-factor.

⁶ Maximum skylight area = 5 percent of total roof area. Manufactured skylights are installed on an insulated curb. Site-assembled glazing is integrated into the roof assembly and not on installed on a curb. Percent area for skylights is based on total skylight and glazed smoke vent rough frame area divided by the total roof area.

⁷ The exterior perimeter of all above grade floors shall be insulated to the same value as the exterior wall above that floor.

⁸ Continuous insulation (c.i.) is insulation applied so the R-value specified is uncompressed and uninterrupted by framing across the entire surface.

⁹ Insulation is required at the slab-edge perimeter and underneath the entire slab per 1312.7.

¹⁰ Opaque smoke vents are exempt from U-factor requirements.

¹¹ Minimum weight of masonry and concrete walls = for this category shall be at least 45 lbs./ft² (220 kg/m²) of wall face area.

¹² Batt insulation installed in metal or wood framed walls with continuous exterior insulation shall be installed in substantial contact with exterior sheathing. Batt insulation installed in metal or wood framed walls without continuous exterior insulation shall be insulated to the full depth of the cavity, up to 6 inches (150 mm) in depth.

¹³ R-8.5 continuous exterior insulation shall be permitted when wall has no cavity insulation.

¹⁴ R-9.5 continuous exterior insulation shall be permitted when wall has no cavity insulation.

¹⁵ A C-factor of 0.110 can be achieved with an assembly that is furred-out on the interior side with 2x4 steel framing, with R-13 batt insulation.

1317.1 General. . . .

1317.2 Additions and alterations. The requirements of Sections 1317 and 1318 apply to new HVAC systems and replaced system components.

Either Section ~~1317.7~~ 1317.8 or ~~1317.8~~ 1317.9 as appropriate, applies to the insulation of new ductwork installed in existing buildings, and to new insulation installed on existing ductwork in existing buildings.

Sections ~~1317.4~~ 1317.5 and 1318.2 apply to controls for all new HVAC equipment or systems installed in an existing building.

Exceptions:

1. Transport energy requirements of Section 1318.4.2 do not apply when any of the following is true:
 - 1.1. Less than 50 percent of the air distribution system is altered.
 - 1.2. The air handler is not replaced.
 - 1.3. It can be demonstrated to the building official that space constraint in an existing building makes this requirement impractical.
2. New cooling systems that meet one of the following conditions shall be exempt from the economizer requirements of Section 1317.4 providing the mechanical cooling system efficiency meets the Optional Compliance Efficiency column in Tables 1317.6.1(1), 1317.6.1(2), and 1317.6.1(3). When the Optional Efficiency column is used for compliance, it shall not be used for compliance with 1311.2, Optional compliance approach.

2.1 . . .

1317.3 Mechanical ventilation. Ventilation shall be provided as specified in the *Oregon Mechanical Specialty Code* and this section.

~~1317.3.1. Fume hoods Design Ventilation and Exhaust Rates. Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm (7 m³/s) shall include at least one of the following features: Design outdoor air ventilation and exhaust rates shall not exceed the minimum requirements specified in the Oregon Mechanical Specialty Code or other governing code by more than 15 percent.~~

Exceptions:

1. ~~Variable air volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values; or Heating and cooling unitary systems or primary sources complying with the Optional Compliance Efficiency column in Tables 1317.6.1(1), 1317.6.1(2), 1317.6.1(3), 1317.6.1(5), and 1317.6.1(6). When the Optional Efficiency column is used for~~

compliance, it shall not be used for compliance with 1311.2, Optional compliance approach.

- ~~2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (-17°C) below room set point, cooled to no cooler than 3°F (-16°C) above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control; or **Systems equipped with a means to automatically reduce outside air intake in proportion to occupancy below design rates when spaces are partially occupied.**~~
- ~~3. Heat recovery systems to precondition makeup air from fume hood exhaust in accordance with Section 1318.3 Exhaust air energy recovery, without using any exception. **Systems equipped with an energy recovery device with at least 50 percent recovery effectiveness.**~~

1317.3.2 Ventilation controls for high occupancy areas. . . .

1317.3.6 Laboratory Exhaust Systems. Buildings with laboratory exhaust systems having a total exhaust rate greater than 5,000 cfm (2,360 L/s) shall include heat recovery systems to precondition makeup air from laboratory exhaust. The heat recovery system shall be capable of increasing the outside air supply temperature at design heating conditions by 25°F (13.9°C) in Climate Zone 1 and 35°F (19.4°C) in Climate Zone 2. A provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 1317.3.

Exceptions:

1. Variable air volume **laboratory** exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values; or
2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) below room set point, cooled to no cooler than 3°F (1.7°C) above room set point, no humidification added, and no simultaneous heating and cooling used for dehumidification control; or
3. Combined Energy Reduction Method: VAV laboratory exhaust and room supply system capable of reducing exhaust and makeup air flow rates—volumes and/or incorporate a heat recovery system to precondition makeup air from laboratory exhaust that shall meet the following:

$$\underline{A + B*(X) \geq 60\%}$$

Where:

A = Percentage that the exhaust and makeup air flow rates can be reduced from design conditions.

B = Percentage *sensible recovery effectiveness* (change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and return air dry-bulb temperatures, expressed as a percentage).

X = Exhaust airflow rate through the heat recovery device at *design conditions*/makeup air flow rate of the *system* at design conditions.

4. Optional Compliance Efficiency Method: Provided that heating and cooling unitary systems or primary sources meet the Optional Compliance Efficiency column in Tables 1317.6.1 (1), 1317.6.1 (2), 1317.6.1 (4), 1317.6.1 (5), and 1317.6.1 (6), apply the combined energy reduction method above so that:

$$\underline{A + B*(X) \geq 50\%}$$

When the Optional Efficiency column is used for compliance, it shall not be used for compliance with 1311.2, Optional compliance approach.

1317.4 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 quality of the outdoor air is so poor as to require extensive treatment of the air.~~
21. Systems with direct expansion coils rated at less than 35,000 Btu/hr 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 serving 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 air 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. (15,827 W) or less.~~
- ~~6. Internal/external zone heat recovery is used.~~
72. Systems used to cool any dedicated computer server room, electronic equipment room or telecom switch room 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 air temperatures of 45°F (70°C) dry bulb and 40°F (80°C) wet bulb and below.

1317.4.1 Optional economizer compliance. When the Optional Efficiency column is used for compliance, it shall not be used for compliance with 1311.2, Optional compliance approach. HVAC systems specified in Tables 1317.6.1(1), 1317.6.1(2), and 1317.6.1(3) that comply with the Optional Compliance Efficiency column requirements are not required to comply with 1317.4 providing the mechanical cooling system meet one of the following conditions:

- (1) 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 serving dwelling units and guest rooms is not included in determining the total capacity of units without economizers.

- (2) 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 air temperatures of 50°F (10°C) dry bulb and 45°F (7°C) wet bulb and below.
- (3) Systems at locations where the quality of the outdoor air is so poor as to require extensive treatment of the air.
- (4) Ground-coupled heat pumps with cooling capacity of 54,000 Btu/hr. (15,827 W) or less.
- (5) Internal/external zone heat recovery is used.

1317.4.2 Pressure relief. . . .

1318.2.2.1 The humidity control ~~This device shall be capable of being set to prevent the use of fossil fuel or electricity to produce relative humidities~~ humidity in excess of 30 percent for comfort purposes. Where a ~~humidistat~~ humidity control device is used for ~~comfort~~ dehumidification, it shall be ~~capable of being~~ set to prevent the use of fossil fuel or electricity to reduce relative humidities humidity below 60 percent. ~~Humidifiers with preheating devices mounted in the air stream shall be provided with an automatic valve to shut off preheat when humidification is not required.~~

Exception: Hospitals, process needs, archives, museums, critical equipment, and other non-comfort situations with specific humidity requirements outside this range.

1318.2.2.2 Humidity controls shall maintain a deadband of at least 10% relative humidity where no active humidification or dehumidification takes place.

Exception: Heating for dehumidification is provided with heat recovery or heat pumping and the mechanical cooling system efficiency shall be from the Optional Compliance Efficiency column in Tables 1317.6.1(1), 1317.6.1(2), and 1317.6.1(3). When the Optional Efficiency column is used for compliance, it shall not be used for compliance with 1311.2, Optional compliance approach.