CHAPTER 11
ENERGY EFFICIENCY

PART I
ENERGY CONSERVATION

SECTION N1101
SCOPE

N1101.1 General. The provisions of this chapter regulate the exterior envelope, as well as the design, construction and selection of heating, ventilating and air-conditioning systems, lighting and piping insulation required for the purpose of effective conservation of energy within a building or structure governed by this code.

All conditioned spaces within residential buildings shall comply with Table N1101.1(1) and two additional measure from Table N1101.1(2).

Exceptions:

1. Application to existing buildings shall comply with Section N1101.2.
2. Application to additions shall comply with Section N1101.3.

N1101.2 Application to existing buildings. Alteration and repairs, historic buildings and change of use or occupancy to buildings, structures or portions thereof shall comply with the requirements in Sections N1101.2.1 through N1101.2.3.

N1101.2.1 Alteration and repair. Alterations and repairs affecting energy conservation measures shall conform to the requirements specified in this chapter.

Alterations or repairs which affect components of existing conditioned spaces regulated in this chapter, those components shall comply with this chapter.

Exception: The minimum component requirements as specified in Table N1101.2 may be used to the maximum extent practical.

N1101.2.2 Historic buildings. The building official may modify the specific requirements of this chapter for historic buildings and require in lieu thereof alternative requirements that will result in a reasonable degree of energy efficiency. This modification may be allowed for those buildings specifically designated as historically significant by the state historic preservation office(r) or by official action of a local government.

N1101.2.3 Change of occupancy or use. Definition of "Change of use" for purposes of N1101.2.3 is a change of use in an existing residential building and shall include any of the following: any unconditioned spaces such as an attached garage, basement, porch, or canopy that are to become conditioned spaces; any unconditioned, inhabitable space that is to become conditioned space, such as a large attic.

N1101.2.3.1 Change of use. A building that changes use, without any changes to the components regulated in this chapter, is required to comply with Table N1101.2 to the greatest extent practical.

N1101.2.3.2 Change of occupancy. Alteration and repair of nonresidential buildings, such as a small church or school, that are changing occupancy to residential shall use Table N1101.2 to the greatest extent practical.

Exception: The minimum component requirements shall be disregarded when thermal performance calculations are completed for change of use to Group R occupancy.

TABLE N1101.2
EXISTING BUILDING COMPONENT REQUIREMENTS

BUILDING COMPONENTS	REQUIRED PERFORMANCE	EQUIV. VALUE
Wall insulation	U-0.80	R-15
Flat ceiling	U-0.025	R-49
Vaulted ceiling > 10 inches nominal rafter depth	U-0.040	R-25
Vaulted ceiling > 8 inches nominal rafter depth	U-0.047	R-21
Underfloor > 10 inches nominal joist depth	U-0.028	R-30
Underfloor > 8 inches nominal joist depth	U-0.032	R-25
Slab edge perimeter	F-0.52	R-15
Windows	U-0.35	U-0.35
Skylights	U-0.60	U-0.60
Exterior doors	U-0.20	R-5
Exterior doors w/> 2.5 ft^2 glazing	U-0.40	R-2.5
Forced air ducts	n/a	R-8

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2.

N1101.3 Additions. Additions to existing buildings or structures may be made without making the entire building or structure comply if the new additions comply with the requirements of this chapter.

N1101.3.1 Large additions. Additions that are equal to or more than 40 percent of the existing building heated floor area or 600 square feet (55 m^2) in area, whichever is less, shall be required to comply with Table N1101.1(2).

N1101.3.2 Small additions. Additions that are less than 40 percent of the existing building heated floor area or less than 600 square feet in area, whichever is less, shall be required to select one measure from Table N1101.1(2) or comply with Table N1101.3.

Exception: Additions that are less than 15 percent of existing building heated floor area or 200 square feet (18.58 m^2) in area, whichever is less, shall not be required to comply with Table N1101.1(2) or Table N1101.3.

TABLE N1101.1(1)
PRESCRIPTIVE ENVELOPE REQUIREMENTS[a]

BUILDING COMPONENT	STANDARD BASE CASE		LOG HOMES ONLY	
	Required Performance	Equiv. Value[b]	Required Performance	Equiv. Value[b]
Wall insulation-above grade	U-0.060	R-21[c]	Note d	Note d
Wall insulation-below grade[e]	F-0.565	R-15	F-0.565	R-15
Flat ceilings[f]	U-0.031	R-38	U-0.025	R-49
Vaulted ceilings[g]	U-0.042	R-38[g]	U-0.027	R-38A[h]
Underfloors	U-0.028	R-30	U-0.028	R-30
Slab edge perimeter	F-0.520	R-15	F-0.520	R-15
Heated slab interior[i]	n/a	R-10	n/a	R-10
Windows[j]	U-0.35	U-0.35	U-0.35	U-0.35
Window area limitation[j, k]	n/a	n/a	n/a	n/a
Skylights[l]	U-0.60	U-0.60	U-0.60	U-0.60
Exterior doors[m]	U-0.20	U-0.20	U-0.54	U-0.54
Exterior doors w/ > 2.5 ft^2 glazing[n]	U-0.40	U-0.40	U-0.40	U-0.40
Forced air duct insulation	n/a	R-8	n/a	R-8

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2, 1 degree = 0.0175 rad.

a. As allowed in Section N1104.1, thermal performance of a component may be adjusted provided that overall heat loss does not exceed the total resulting from conformance to the required *U*-value standards. Calculations to document equivalent heat loss shall be performed using the procedure and approved *U*-values contained in Table N1104.1(1).

b. *R*-values used in this table are nominal for the insulation only in standard wood framed construction and not for the entire assembly.

c. Wall insulation requirements apply to all exterior wood framed, concrete or masonry walls that are above grade. This includes cripple walls and rim joist areas. R-19 Advanced Frame or 2 × 4 wall with rigid insulation may be substituted if total nominal insulation *R*-value is 18.5 or greater.

d. The wall component shall be a minimum solid log or timber wall thickness of 3.5 inches (90 mm).

e. Below-grade wood, concrete or masonry walls include all walls that are below grade and do not include those portions of such wall that extend more than 24 inches (609.6 mm) above grade.

f. Insulation levels for ceilings that have limited attic/rafter depth such as dormers, bay windows or similar architectural features totaling not more than 150 square feet (13.9 m^2) in area may be reduced to not less than R-21. When reduced, the cavity shall be filled (except for required ventilation spaces).

g. The maximum vaulted ceiling surface area shall not be greater than 50 percent of the total heated space floor area unless area has a *U*-factor no greater than U-0.031. The *U*-factor of 0.042 is representative of a vaulted scissor truss. A 10-inch (254 mm) deep rafter vaulted ceiling with R-30 insulation is U-0.033 and complies with this requirement, not to exceed 50 percent of the total heated space floor area.

h. A = Advanced frame construction, which shall provide full required insulating value to the outside of exterior walls.

i. Heated slab interior applies to concrete slab floors (both on and below grade) that incorporate a radiant heating system within the slab. Insulation shall be installed underneath the entire slab.

j. Sliding glass doors shall comply with window performance requirements. Windows exempt from testing in accordance with Section NF1111.2, Item 3 shall comply with window performance requirements if constructed with thermal break aluminum or wood, or vinyl, or fiberglass frames and double-pane glazing with low-emissivity coatings of 0.10 or less. Buildings designed to incorporate passive solar elements may include glazing with a *U*-factor greater than 0.35 by using Table N1104.1(1) to demonstrate equivalence to building envelope requirements.

k. Reduced window area may not be used as a trade-off criterion for thermal performance of any component.

l. Skylight area installed at 2 percent or less of total heated space floor area shall be deemed to satisfy this requirement with vinyl, wood or thermally broken aluminum frames and double-pane glazing with low-emissivity coatings. Skylight *U*-factor is tested in the 20 degree (0.35 rad) overhead plane in accordance with NFRC standards.

m. A maximum of 28 square feet (2.6 m^2) of exterior door area per dwelling unit can have a *U*-factor of 0.54 or less.

n. Glazing that is either double pane with low-e coating on one surface, or triple pane shall be deemed to comply with this U-0.40 requirement.

TABLE N1101.1(2)
ADDITIONAL MEASURES

Envelope Enhancement Measure (Select One)	**1**	**High efficiency walls & windows:** Exterior walls—U-0.047/R-19+5 (insulation sheathing)/SIPS, and one of the following options: Windows—Max 15 percent of conditioned area; or Windows—U-0.30
	2	**High efficiency envelope:** Exterior walls—U-0.058/R-21 Intermediate framing, and Vaulted ceilings—U-0.033/R-30A[d,e], and Flat ceilings—U-0.025/R-49, and Framed floors—U-0.025/R-38, and Windows—U-0.30; and Doors—All doors U-0.20, or Additional 15 percent of permanently installed lighting fixtures as high-efficacy lamps or Conservation Measure D and E
	3	**High efficiency ceiling, windows & duct sealing:** (Cannot be used with Conservation Measure E) Vaulted ceilings—U-0.033/R-30A[d,e], and Flat ceilings—U-0.025/R-49, and Windows—U-0.30, and Performance tested duct systems[b]
	4	**High efficiency thermal envelope UA:** Proposed UA is 15% lower than the Code UA when calculated in Table N1104.1(l)
	5	**Building tightness testing, ventilation & duct sealing:** A mechanical exhaust, supply, or combination system providing whole-building ventilation rates specified in Table N1101.1(3), or ASHRAE 62.2, and The dwelling shall be tested with a blower door and found to exhibit no more than: 1. 6.0 air changes per hour[f], or 2. 5.0 air changes per hour[f] when used with Conservation Measure E, and Performance tested duct systems[b]
	6	**Ducted HVAC systems within conditioned space:** (Cannot be used with Conservation Measure B or C) All ducts and air handler are contained within building envelope[i]
Conservation Measure (Select One)	**A**	**High efficiency HVAC system:** Gas-fired furnace or boiler with minimum AFUE of 90% a, or Air-source heat pump with minimum HSPF of 8.5 or Closed-loop ground source heat pump with minimum COP of 3.0
	B	**Ducted HVAC systems within conditioned space:** All ducts and air handler are contained within building envelope[i]
	C	**Ductless heat pump:** Replace electric resistance heating in at least the primary zone of dwelling with at least one ductless mini-split heat pump having a minimum HSPF of 8.5. Unit shall not have integrated backup resistance heat, and the unit (or units, if more than one is installed in the dwelling) shall be sized to have capacity to meet the entire dwelling design heat loss rate at outdoor design temperature condition. Conventional electric resistance heating may be provided for any secondary zones in the dwelling. A packaged terminal heat pump (PTHP) with comparable efficiency ratings may be used when no supplemental zonal heaters are installed in the building and integrated backup resistant heat is allowed in a PTHP
	D	**High efficiency water heating & lighting:** Natural gas/propane, on-demand water heating with min EF of 0.80, and A minimum 75 percent of permanently installed lighting fixtures as CFL or linear fluorescent or a min efficacy of 40 lumens per watt as specified in Section N1107.2[c]
	E	**Energy management device & duct sealing:** Whole building energy management device that is capable of monitoring or controlling energy consumption, and Performance tested duct systems[b], and A minimum 75 percent of permanently installed lighting fixtures as high-efficacy lamps
	F	**Solar photovoltaic:** Minimum 1 watt/sq ft conditioned floor space[g]
	G	**Solar water heating:** Minimum of 40 ft^2 of gross collector area[h]

For SI: 1 square foot = 0.093 m^2, 1 watt per square foot = 10.8 W/m^2.

a. Furnaces located within the building envelope shall have sealed combustion air installed. Combustion air shall be ducted directly from the outdoors.

b. Documentation of Performance Tested Ductwork shall be submitted to the building official upon completion of work. This work shall be performed by a contractor certified by the Oregon Department of Energy's (ODOE) Residential Energy Tax Credit program and documentation shall be provided that work demonstrates conformance to ODOE duct performance standards.

c. Section N1107.2 requires 50 percent of permanently installed lighting fixtures to contain high efficacy lamps. Each of these additional measures adds an additional percent to the Section N1107.2 requirement.

d. A = advanced frame construction, which shall provide full required ceiling insulation value to the outside of exterior walls.

e. The maximum vaulted ceiling surface area shall not be greater than 50 percent of the total heated space floor area unless vaulted area has a *U*-factor no greater than *U*-0.026.

f. Building tightness test shall be conducted with a blower door depressurizing the dwelling 50 Pascal's from ambient conditions. Documentation of blower door test shall be submitted to the Building Official upon completion of work.

g. Solar electric system size shall include documentation indicating that Total Solar Resource Fraction is not less than 75 percent.

h. Solar water heating panels shall be Solar Rating and Certification Corporation (SRCC) Standard OG-300 certified and labeled, with documentation indicating that Total Solar Resource Fraction is not less than 75 percent.

i. A total of 5 percent of an HVAC systems ductwork shall be permitted to be located outside of the conditioned space. Ducts located outside the conditioned space shall have insulation installed as required in this code.

TABLE 1101.1(3)
VENTILATION AIR REQUIREMENTS, cfm

FLOOR AREA (ft^2)	BEDROOMS				
	0-1	2-3	4-5	6-7	> 7
< 1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
> 7501	105	120	135	160	185

For SI: 1 square foot = 0.0929 m^2.

TABLE N1101.3
SMALL ADDITION ADDITIONAL MEASURES (Select one)

1	Increase the ceiling insulation of the existing portion of the home as specified in Table N1101.2.
2	Replace all existing single-pane wood or aluminum windows to the *U*-value as specified in Table N1101.2.
3	Insulate the floor system as specified in Table N1101.2 & install 50 percent of permanently installed lighting fixtures as CFL or linear fluorescent or a min. efficacy of 40 lumens per watt as specified in Section N1107.2.
4	Test the entire dwelling with a blower door and exhibit no more than 7.0 air changes per hour @ 50 Pascals.
5	Seal and performance test the duct system.
6	Replace existing 78 percent AFUE or less gas furnace with a 92 percent AFUE or greater system.
7	Replace existing electric radiant space heaters with a ductless mini split system with a minimum HSPF of 8.5.
8	Replace existing electric forced air furnace with an air source heat pump with a minimum HSPF of 8.5.
9	Replace existing water heater for a natural gas/propane water heater with a minimum EF of 0.67.
10	Install a solar water heating system with a minimum of 40 ft^2 of gross collector area.

N1101.4 Information on plans and specifications. Plans and specifications shall show in sufficient detail all pertinent data and features of the building and the equipment and systems as herein governed, including, but not limited to: exterior envelope component materials; *R*-values of insulating materials; HVAC equipment efficiency performance and system controls, lighting and other pertinent data to indicate conformance with the requirements of this chapter.

SECTION N1102
DEFINITIONS

AFUE (ANNUAL FUEL UTILIZATION EFFICIENCY) is the energy output divided by the energy input, calculated on an annual basis and including part load and cycling effects. AFUE ratings shall be determined using the U.S. Department of Energy test procedures (10 CFR Part 430) and listings in the Gas Appliance Manufacturers Association (GAMA) Consumer Directory of Certified Furnace and Boiler Efficiency Ratings.

ASHRAE is the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc.

AUTOMATIC is self-acting, operating by its own mechanism when actuated by some impersonal influence, such as a change in current strength, pressure, temperature or mechanical configuration. (See also "Manual.")

BASEMENT WALL is the opaque portion of walls which encloses a basement and is partially or totally below grade walls.

BELOW GRADE WALLS are the walls or the portion of walls entirely below the finished grade or which extend 2 feet (610 mm) or less above the finish grade.

BTU (British Thermal Unit) is the amount of heat required to raise the temperature of 1 pound (0.454 kg) of water (about 1 pint) from 59ºF to 60ºF (15ºC to 16ºC).

BUILDING ENVELOPE is that element of a building which encloses conditioned spaces through which thermal energy may be transmitted to or from the exterior or to or from unconditioned spaces.

C (Thermal Conductance). See "Thermal conductance."

CONDITIONED SPACE is a space within the building, separated from unconditioned space by the exterior envelope which by introduction of conditioned air, by heated and/or cooled surfaces, or by air or heat transfer from directly conditioned spaces is maintained at temperatures of 55ºF (13ºC) or higher for heating and/or 85ºF (29.4ºC) or below for cooling. (Enclosed corridors between conditioned spaces shall be considered as conditioned space. Spaces where temperatures fall between this range by virtue of ambient conditions shall not be considered as conditioned space.)

COOLED SPACE is a space within a building provided with a mechanical cooling supply.

ENERGY MANAGEMENT DEVICE is a device which is installed within a dwelling that can provide near real-time data on whole dwelling energy consumption or an integrated control system that is intended to operate energy consuming appliances and/or devices for a dwelling in order to reduce energy consumption. Consumption control systems are also known as Building Automation Control (BAC) or Building Management Control Systems (BMCS).

EXTERIOR DOOR is a permanently installed operable barrier by which an entry is closed and opened. Exterior doors

include doors between conditioned and unconditioned spaces, such as a door between a kitchen and garage.

EXTERIOR ENVELOPE. See "Building envelope."

EXTERIOR WALL is any member or group of members, which defines the exterior boundaries of the conditioned space and which has a slope of 60 degrees (1.05 rad) or greater with the horizontal plane.

EXTERIOR WINDOW is an opening, especially in the wall of a building, for admission of light or air that is usually closed by casement or sashes containing transparent material (such as glass) and in some cases capable of being opened and shut. All areas, including frames, in the shell of a conditioned space that let in natural light, including skylights, sliding glass doors, glass block walls and the glazed portions of the doors.

When calculating the energy performance of the exterior envelope, the area of the window shall be the total area of glazing measured using the rough opening dimensions, and including the glass, sash and frame.

FENESTRATION is windows and doors in the exterior envelope. See the definitions for "Exterior door" and "Exterior window."

FLOOR AREA is the area included within the surrounding exterior walls of a building or portion thereof, exclusive courts. The floor area of a building or portion thereof, not provided with surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above.

GLAZING is all areas including frames in the shell of a conditioned space that let in natural light, including windows, clerestories, skylights, sliding glass doors, glass block walls and the glazed portion of doors.

GROSS AREA OF EXTERIOR WALLS consists of wall areas, as measured on the exterior, including foundation walls above grade; peripheral edges of floors; window areas, including sash; and door areas, where such surfaces are exposed to outdoor air and enclose a heated or mechanically cooled space.

HEATED SPACE is a space within a building served by a mechanical, electrical or combustion source of heat. Spaces within a basement shall be defined as heated when any of the following apply: the space is finished, or has heating registers or contains heating devices.

HIGH-EFFICACY LAMPS. Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts.
2. 50 lumens per watt for lamps over 15 watts to 40 watts.
3. 40 lumens per watt for lamps 15 watts or less.

HSPF (HEATING SEASONAL PERFORMANCE FACTOR) is the total heating output of a heat pump during its normal annual usage period for heating divided by the total electric power input in watt–hours during the same period.

HUMIDISTAT is an instrument which measures changes in humidity and controls a device or devices to maintain a desired humidity.

HVAC (HEATING, VENTILATING AND AIR-CONDITIONING) SYSTEM refers to the equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, and/or air-conditioning processes to a building.

***K* (THERMAL CONDUCTIVITY).** See "Thermal conductivity."

MANUAL (nonautomatic) action requires human intervention as the basis for control (see "Automatic").

OTHER BUILDINGS are all buildings and structures, or portions thereof, that are not defined as residential buildings (see "Residential buildings").

PERM RATING (DRY CUP) is the measure of the ability of a material of specific thickness to transmit moisture in terms of the amount of moisture transmitted per unit time for a specified area and differential pressure. Dry cup perm rating is expressed in grains/hr/ft^2, inches of Hg. Permeance may be measured by using ASTM E 96-72 or other approved dry cup method. The closer the dry cup perm rating approaches zero, the better the vapor barrier. Permeability is defined as the permeance of a material for specified unit length (perm/in).

***R* (THERMAL RESISTANCE).** See "Thermal resistance."

***R_t* (THERMAL RESISTANCE TOTAL).** See "Thermal resistance total."

RESIDENTIAL BUILDINGS are buildings and structures, or portions thereof, housing Group R, occupancies which are three stories or less in height.

THERMAL CONDUCTANCE (*C*) is the constant time rate of heat flow through a unit area of a body induced by a unit temperature difference between the surfaces [Btu/(h · ft^2 · ºF)]. It is the reciprocal of thermal resistance (see "Thermal resistance").

THERMAL CONDUCTIVITY (*K*) is the rate of heat flow through 1 square foot (0.0929 m^2) of a homogeneous material 1-inch (25.4 mm) thick when there is a temperature difference of 1ºF (-17.2ºC) between the opposite faces of the material, expressed as Btu/h per square foot per ºF temperature difference. Thermal conductivity is similar to thermal conductance (*C*), except thermal conductance applies to the actual thickness of the material.

THERMAL RESISTANCE (*R*) is the measure of the resistance of a material or building component to the passage of heat, has the value of (hr · ft^2 · ºF)/Btu, and is the reciprocal of thermal conductance.

THERMAL RESISTANCE TOTAL (R_t) is the sum of the resistance for all of the individual components of the assembly, including framing members, multiple layers connections, insulation and air films expressed in (ºF · ft^2 · Btu/h).

THERMAL TRANSMITTANCE (*U*) is the coefficient of heat transfer. It is the time rate of heat flow per unit area under steady state conditions from the fluid on the warm side of the barrier to the fluid on the cold side, per unit temperature difference between the two fluids, Btu/(h · ft^2 · ºF).

THERMOSTAT is an instrument that measures changes in temperature and controls a device or devices to maintain a desired temperature.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS[b]	STANDARD BASE CASE[a]			PROPOSED ALTERNATIVE			
	Areas[c]	*U*-factor	Areas × *U*	*R*-value[d]	Areas[c]	*U*-factor[e]	Areas × *U*
Flat ceilings Vaulted ceilings[f] Conventional wood-framed walls Underfloor Slab edge		0.031 0.042 0.060 0.028 (perimeter ft =) F=0.52[g]					
Windows Skylights < 2%[h] Skylights > 2%[h]		0.35 0.75 0.60					
Exterior doors[i] Doors with > 2.5 ft^2 glazing		0.20 0.40					
		CODE UA =				Proposed UA [j] =	

a. Base path 1 represents Standard Base Case from Table N1101.1(1).
b. Performance trade-offs are limited to those listed in column 1. Heat plant efficiency, duct insulation levels, passive and active solar heating, air infiltration and similar measures including those not regulated by code may not be considered in this method of calculation.
c. Areas from plan take-offs. All areas must be the same for both Standard Base Case and Proposed Alternate. The vaulted ceiling surface area for Standard Base Case must be the actual surface area from the plan take-off not to exceed 50 percent of the total heated space floor area. Any areas in excess of 50 percent for Base Case must be entered at U-0.031 (R-38) with "Flat Ceilings" area.
d. Minimum Component Requirements: Walls R-15; Floors R-21; Flat Ceilings R-38; Vaults R-21; Below-Grade Wood, Concrete or Masonry Walls R-15; Slab Edge R-10; Duct Insulation R-8. *R*-values used in this table are nominal, for the insulation only and not for the entire assembly. Window and skylight *U*-values shall not exceed 0.65 (CL65). Door *U*-values shall not exceed 0.54 (Nominal R-2). A maximum of 28 square feet (2.6 m^2) of exterior door area per dwelling unit can have a *U*-factor of 0.54 or less and shall not be included in calculations.
e. *U*-values for wood frame ceilings, walls and floor assemblies shall be as specified in Table N1104.1(2). *U*-values for other assemblies, which include steel framing, brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE procedures.
f. Vaulted area, unless insulated to R-38, U-0.031, may not exceed 50 percent of the total heated space floor area.
g. F = The heat loss coefficient, Btu/h/ft^2/°F per foot of perimeter.
h. Whenever skylight area for Proposed Alternative exceeds 2 percent of the total heated space floor area, enter 2 percent of area under Standard Base Case at U-0.75, then the remaining area under Standard Base Case at U-0.60. For Proposed Alternative skylights, enter the actual skylight area and *U*-factor of those to be installed in residence.
i. A maximum of 28 square feet (2.6 m^2) of exterior door area per dwelling unit can have a *U*-factor of 0.54 or less. Default *U*-factor for an unglazed wood door is 0.54.
j. Proposed UA must be less than or equal to CODE UA.

TABLE N1104.1(2)
APPROVED DEFAULT *U*-FACTORS

FLAT CEILINGS[a]		
Insulation	**Type**	***U*-Factor**
R-38	Conventional framing	0.031
R-38	= > $^{8}/_{12}$ roof pitch	0.028
R-38	Advance framing[c]	0.026
R-49	Conventional framing	0.025
R-49	= > $^{8}/_{12}$ roof pitch	0.024
R-49	Advance framing[c]	0.020
VAULTED CEILINGS[a]		
Insulation	**Type**	***U*-Factor**
R-21	Rafter framings	0.047
R-30	Rafter framing	0.033
R-38	Rafter framing	0.027
R-21	Scissors truss	0.055
R-30	Scissors truss	0.046
R-38	Scissors truss	0.042
R-49	Scissors truss	0.039
R-30	Advance scissors truss[c]	0.032
R-38	Advance scissors truss[c]	0.026
R-49	Advance scissors truss[c]	0.020
EPS FOAM CORE PANEL VAULTED CEILINGS		
Insulation	**Type**	***U*-Factor**
R-29	$8^{1}/_{4}$" EPS foam core panel	0.037
R-37	$10^{1}/_{4}$" EPS foam core panel	0.030
R-44	$12^{1}/_{4}$" EPS foam core panel	0.025
FLOORS[a]		
Insulation	**Type**	***U*-Factor**
R-21	Underfloor	0.035
R-25	Underfloor	0.032
R-30	Underfloor	0.028
SLAB-ON-GRADE		
Insulation	**Type**	***F*-Factor[f]**
R-10	Slab edge	0.54
R-15	Slab edge	0.52
EPS FOAM CORE PANEL EXTERIOR WALLS		
Insulation	**Type**	***U*-Factor**
R-14.88	$4^{1}/_{2}$" EPS foam core panel	0.065
R-22.58	$6^{1}/_{4}$" EPS foam core panel	0.045
R-29.31	$8^{1}/_{4}$" EPS foam core panel	0.035

EXTERIOR WALLS[a]			
Insulation	**Insulation Sheathing**	**Framing**	***U*-Factor**
R-15	0	Conventional framing	0.080
R-15	0	Intermediate framing[b]	0.075
R-19	0	Conventional framing	0.065
R-19	0	Intermediate framing[b]	0.063
R-19	0	Advance framing[d]	0.061
R-21	0	Conventional framing	0.060
R-21	0	Intermediate framing[b]	0.058
R-21	0	Advance framing[d]	0.055
R-11	3.5[e]	Conventional framing	0.069
R-11	5[e]	Conventional framing	0.063
R-11	7[e]	Conventional framing	0.055
R-11	3.5[e]	Advance framing[d]	0.067
R-11	5[e]	Advance framing[d]	0.061
R-11	7[e]	Advance framing[d]	0.054
R-13	3.5[e]	Conventional framing	0.064
R-13	5[e]	Conventional framing	0.058
R-13	7[e]	Conventional framing	0.052
R-13	3.5[e]	Advance framing[d]	0.062
R-13	5[e]	Advance framing[d]	0.056
R-13	7[e]	Advance framing[d]	0.050
R-15	3.5[e]	Conventional framing	0.060
R-15	5[e]	Conventional framing	0.055
R-15	7[e]	Conventional framing	0.049
R-15	3.5[e]	Advance framing[d]	0.057
R-15	5[e]	Advance framing[d]	0.052
R-15	7[e]	Advance framing [d]	0.047
R-19	3.5[e]	Conventional framing	0.052
R-19	5[e]	Conventional framing	0.047
R-19	7[e]	Conventional framing	0.043
R-19	3.5[e]	Advance framing[d]	0.049
R-19	5[e]	Advance framing[d]	0.045
R-19	7[e]	Advance framing[d]	0.041
R-21	3.5[e]	Conventional framing	0.048
R-21	5[e]	Conventional framing	0.044
R-21	7[e]	Conventional framing	0.040
R-21	3.5[e]	Advance framing[d]	0.044
R-21	5[e]	Advance framing[d]	0.042
R-21	7[e]	Advance framing[d]	0.038

For SI: 1 inch = 25.4 mm.

a. *U*-factors are for wood frame construction. *U*-factors for other assemblies which include steel framing, brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE procedures.

b. Intermediate framing consists of wall studs placed at a minimum 16 inches (406 mm) on center with insulated headers. Voids in headers shall be insulated with rigid insulation having a minimum *R*-value of 4 per 1-inch (25.4 mm) (W/m^3-k) thickness.

c. Advanced framing construction for ceilings as defined in Section N1104.6.

d. Advanced framing construction for walls as defined in Section N1104.5.1

e. Insulation sheathing shall be rigid insulation material, installed continuously over entire exterior or interior of wall (excluding partition walls).

f. *F*-Factor is heat loss coefficient in Btu/h/°F per lineal foot of concrete slab perimeter.

TOTAL SOLAR RESOURCE FRACTION. The fraction of usable solar energy that is received by the solar panel/collector throughout the year. This accounts for the impacts due to external shading, collector tilt and collector orientation.

***U* (THERMAL TRANSMITTANCE).** See "Thermal transmittance."

VAPOR BARRIER is a film, duplex paper, aluminum foil, paint coating or other material which restricts the movement of water vapor from an area of high vapor pressure to one of lower vapor pressure.

VAULTED CEILING in a residential building is a ceiling with a minimum slope of 2 in 12.

WINDOW. See "Exterior window."

ZONE is a space or group of spaces within a building with heating or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

SECTION N1103
ALTERNATIVE SYSTEMS

Alternative designs may be approved by the building official when it can be demonstrated that the proposed annual energy consumption will not exceed that of a similar building with similar forms of energy requirements designed in accordance with the provisions of this chapter. The only allowed trade-offs in this analysis are between building envelope components.

Proposed alternative designs submitted as requests for exception to the standard design criteria must be accompanied by an energy analysis prepared in accordance with criteria specified in Part II, Alternative Systems Analysis.

N1103.1 Design parameters. For calculations under this section, the following design parameters shall apply:

The outside temperature shall be taken from the 99-percent winter temperature values and the 1 percent summer temperature values listed in ASHRAE *Handbook of Fundamentals*. For areas not listed, the designer should obtain the most reliable design temperatures available. Selected values are subject to approval of the building official.

SECTION N1104
EXTERIOR ENVELOPE REQUIREMENTS

N1104.1 General. This section provides, minimum requirements for exterior envelope construction.

Exterior building envelope shall comply with Table N1101.1(1) or may be demonstrated using Table N1104.1(1). The requirements specified in Table N1101.1(2) shall apply to both Tables N1101.1(1) and N1104.1(1).

Buildings designed to incorporate passive solar elements may use Table N1104.1(1) to demonstrate building envelope requirements in this code, in addition to requirements specified in Table N1101.1(2).

N1104.2 Insulation materials. Insulation materials shall be installed per manufacturer's listing and specifications and this section. Insulation R-values shall be specified as required in 16 CFR Ch. I (1-1-91 Edition) Part 460—Labeling and Advertising of Home Insulation. Some general requirements for insulation are:

N1104.2.1 Loose-fill insulation. Blown, poured and spray-on type insulation complying with Section R320 may be used in attic spaces where roof slope is 4 units vertical in 12 units horizontal (33.3-percent slope) or greater and there is at least 44 inches (1118 mm) of headroom at the roof ridge. (Clear headroom is defined as the distance from the top of the bottom chord of the truss or ceiling joists to the underside of the roof sheathing.) Adequate baffling of the vent opening shall be provided so as to deflect the incoming air above the surface of the blown or poured insulation. Baffles shall be of weather-resistant, rigid material capable of retaining the insulation and shall be in place at the time of framing inspection.

N1104.2.2 Batt-type insulation. Batt-type insulation shall be installed flush against the warm side of the cavity insofar as practicable.

N1104.2.3 Insulation protection. Insulation exposed to the exterior shall be protected from physical and solar damage.

N1104.2.4 Clearances. Recessed light fixtures shall not be installed in cavities intended to be insulated.

Exception: Fixtures designed and labeled as suitable for being installed in direct contact with insulation; i.e., insulation coverage (IC) rated.

Thermal insulation shall not be installed within 3 inches (76 mm) of any metal chimney or gas vent that is not listed for insulation clearances.

Thermal insulation shall not be installed in a manner that would obstruct openings required for attic ventilation.

A permanent sleeve of fine wire mesh screen, sheet metal or other noncombustible material shall be installed to maintain the required clearances.

Cellulose insulation shall conform to Interim Safety Standard for Cellulose Insulation (16 CFR Part 1209) issued by the Consumer Product Safety Commission July 6, 1979 (44FR 39938). For other insulation, see Section R320.

Foam plastic shall be as specified in Section R318.

N1104.2.5 Below grade exterior insulation. Below grade exterior insulation shall meet the following conditions:

1. The insulation shall be a materials that is approved for below grade applications in wet environments
2. Insulation shall be installed from the top of the footing to the top of the concrete basement wall.
3. Insulation shall be adequately protected from the elements (ultraviolet and mechanical) per manufacturer's specifications.
4. The top of the insulation shall be installed in a manner to allow water run-off and prevent pooling.

N1104.2.6 Recessed lighting fixtures. Recessed lighting fixtures installed within the building envelope shall meet one of the following requirements.

1. Type IC-rated, manufactured with no penetrations between the inside of the recessed fixture and ceiling cavity, and the annular space between the ceiling cut-out and lighting fixture shall be sealed.
2. Type IC-rated in accordance with ASTM E283-with no more than 2.0 cubic feet per minute (cfm) (0.944 L/s) air movement from the conditioned space to the ceiling cavity, at 1.57 psi pressure (75 Pa) difference and shall be labeled and the annular space between the ceiling cutout and lighting fixture shall be sealed.
3. Type IC-rated installed inside a sealed box constructed from a minimum 0.5-inch-thick (12.7 mm) gypsum wallboard or constructed from a preformed polymeric vapor barrier, or other air-tight assembly manufactured for this purpose.

N1104.3 Exterior doors. Doors shall be tested according to the requirements of Section N1104.4. When calculating the energy performance of the exterior envelope, the area of doors shall be the actual unit size.

Exceptions:

1. Unglazed doors that are not tested according to the requirements of Section N1104.4 shall be assigned a default *U*-value of 0.54.
2. Sliding glass doors and swinging glass doors shall meet the specifications for windows and shall be treated as such.
3. Doors that incorporate glazed areas more than 2.5 square feet (0.23 m^2) in area shall be considered exterior doors with greater than or equal to 2.5 square feet (0.23 m^2) glazing. Doors shall meet the air leakage requirements of Section N1104.8.

N1104.4 Windows. All windows installed in Oregon shall meet the requirements of Part III, Fenestration Standard.

1. Decorative or unique architectural feature glazing not exceeding 1 percent of the heated space floor area is exempt from thermal performance requirements and do not need to be included in Table N1104.1(1) thermal performance calculations.
2. Glass block assemblies may use a *U*-factor of 0.51.
3. The *U*-factor for windows may be a weighted average of total window area when all other building envelope measures are in compliance with performance requirements specified in this code. This calculation shall be provided to the building official and the windows that are less than required for prescriptive compliance shall be identified on the plans.

N1104.4.1 Thermal performance labeling. Labels shall be either:

1. National Fenestration Rating Council (NFRC) certified product; or
2. State-approved for windows produced in low volume. All windows shall have labeling:
   2.1. That is imprinted, not handwritten,
   2.2. Facing the interior of the room,
3. Attached to the window until the building inspector inspects and verifies the labeling, and
4. List the *U*-factor.

Exceptions:

1. Labeling is not required for decorative or unique architectural feature glazing not exceeding 1 percent of the heated space floor area.
2. Portions of labels for windows produced in low volume may be handwritten.

N1104.4.2 Combined products. When different window types are combined, mulled together by the manufacturer or manufactured to fit a framed rough opening, a single label may be used.

Exception: A solarium shall have one label providing a description of each of the glazed surfaces, such as the front, overhead and each side.

N1104.4.3 Air leakage requirements. Windows shall comply with the air leakage requirements of Section N1104.8.

Exception: Site-built windows.

N1104.4.4 Alterations. New windows shall have a maximum *U*-factor of 0.40.

Exceptions:

1. Decorative or unique architectural feature glazing not exceeding 1 percent of the heated space floor area may be exempt from thermal performance requirements and Table N1104.1(1) calculations.
2. Where necessary to retain architectural consistency with remaining windows in the building, new windows shall have a maximum *U*-value of 0.65.

N1104.5 Walls.

N1104.5.1 Advanced framing for walls. Advanced framing for walls is an optional construction method. Advanced framing, when used to qualify a design under the requirements of Table N1104.1(1), shall meet the following requirements:

1. **Walls.** Walls shall be framed with 2X studs at 24 inches (610 mm) on center and shall include the following, as detailed in Items 2 and 3.
2. **Corners and intersections.** Exterior wall and ceiling corners shall be fully insulated through the use of three-stud corners configured to allow full insulation into the corner, or two-stud corners and drywall backup clips or other approved technique. Intersections of interior partition walls with exterior walls shall be fully insulated through the use of single backer boards, mid-height blocking with drywall clips or other approved technique.
3. **Headers.** Voids in headers 1 inch (25.4 mm) or greater in thickness shall be insulated with rigid insulation that has a value of R-4 per 1 inch (25.4 mm) or greater. Nonstructural headers (such as in gable end

walls) can be eliminated and replaced with insulation to achieve equivalent levels as the surrounding area.

N1104.5.2 Intermediate framing for walls. Intermediate framing for walls is an optional construction method. Intermediate framing, when used to achieve improved wall performance under the requirements of Table 1101.1(1) or Table N1104.1(2), shall meet the following requirements:

1. **Walls.** Walls shall be framed with 2X studs at 16 inches (610 mm) on center and shall include the following, as detailed in Items 2 and 3.
2. **Corners and intersections.** Exterior wall and ceiling corners shall be fully insulated through the use of three-stud corners configured to allow full insulation into the corner, or two-stud corners and drywall backup clips or other approved technique. Intersections of interior partition walls with exterior walls shall be fully insulated through the use of single backer boards, mid-height blocking with drywall clips or other approved technique.
3. **Headers.** Voids in headers 1 inch (25.4 mm) or greater in thickness shall be insulated with rigid insulation that has a value of R-4 or greater per 1 inch (25.4 mm) thickness. Nonstructural headers (such as in gable end walls) can be eliminated and replaced with insulation to achieve equivalent levels as the surrounding area.

N1104.5.3 Below-grade walls. Walls enclosing heated spaces below grade shall be insulated from the bottom of the above-grade sub-floor downward to the top of the below-grade finished floor.

N1104.6 Roof/ceiling: advanced framing for ceilings. Advanced framing for ceilings is an optional construction method. Advanced framing, when used to qualify a design under the requirements of Section N1104.1, shall meet the following requirements:

Framing techniques shall be used in attics and ceilings to provide full insulating value to the outside of exterior walls. This may be accomplished through the use of extra-depth or oversized trusses, double rafters, special insulation components installed at the edge of the wall, or other approved combinations of framing and insulation. The entire surface of the exterior ceiling shall be insulated to the required value including attic hatches, structural members, electrical fixtures (where allowed by the code) and plumbing penetrations.

N1104.7 Slab-on-grade floors. For slab-on-grade floors, the perimeter of the floor shall be insulated.

The insulation shall extend downward from the top of the slab for a minimum of 24 inches (610 mm) or downward to the bottom of the slab, then horizontally beneath the slab for a minimum total distance of 24 inches (610 mm).

Exception: For monolithic slabs, the insulation shall extend downward from the top of the slab to the bottom of the thickened edge.

N1104.7.1 Slab-on-grade floors with hydronic heat. For slab-on-grade floors that incorporate hydronic heating, in addition to perimeter insulation, the entire underside of slab shall be insulated to R-10.

N1104.8 Air leakage. The requirements of this subsection shall apply only to those locations separating outdoor ambient conditions from interior spaces that are heated or mechanically cooled and are not applicable to separation of interior spaces from each other. Compliance with the criteria for air leakage shall be determined by tests based on applicable engineering principles.

N1104.8.1 Acceptance criteria. Where specified, compliance with air infiltration rates for all exterior windows, swinging doors and sliding glass doors shall be certified using ASTM E 283 "Standard Test Methods for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen." Tests shall be conducted at a differential pressure of 1.57 pounds per square foot (75 Pa) [equivalent to 25 mph (40 km/h) wind condition].

1. Windows — 0.37 cubic feet per minute (cfm) per foot (0.17 L/s per m) of sash crack.
2. Swinging doors — 0.37 cfm per square foot (0.17 L/s per m^2) of door area.
3. Sliding doors — 0.37 cfm per square foot (0.17 L/s per m^2) of door area.

N1104.8.2 Sealing required. Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations or utility services through walls, floors and roofs and all other openings in the exterior envelope shall be sealed in a manner approved by the building official.

N1104.9 Moisture control. To ensure the effectiveness of insulation materials and reduce the hazard of decay and other degradation due to condensation within the structure, moisture-control measures shall be included in all buildings and structures or portions thereof regulated by this chapter.

N1104.9.1 Vapor retarders. A one-perm, dry cup rating vapor retarder shall be installed on the warm side (in winter) of all insulation.

Exceptions:

1. When insulation is installed in ceilings in an existing structure and ventilation is provided as specified in Section R806, a vapor retarder need not be installed.
2. Below grade walls are not required to have a vapor retarder.
3. Slab-on-grade floors need not have a warm-side vapor retarder.

N1104.9.2 Ground cover. A ground cover shall be installed in the crawl space for both new and existing buildings when

insulation is installed. Ground cover shall be 6-mil (0.15 mm) black polyethylene or other approved material of equivalent perm rating. Ground cover shall be lapped 12 inches (305 mm) at all joints and cover the entire surface area extending full width and length of the crawl space and turn 12 inches (305 mm) up the foundation wall. Ground cover of 6-mil (0.15 mm) polyethylene or an approved equal (that is as durable) shall be installed on the ground beneath concrete floor slabs located in conditioned spaces.

SECTION N1105
HEATING, VENTILATING AND AIR-CONDITIONING SYSTEMS

N1105.1 General. This section provides minimum requirements for heating, ventilating and air-conditioning systems.

N1105.2 Insulation of ducts. All new duct systems, or new portions thereof, exposed to unconditioned spaces shall be insulated according to Table N1101.1(1).

Exception: The replacement or addition of a furnace, air conditioner or heat pump shall not require existing ducts to be insulated to current code.

N1105.3 HVAC controls. All heating, ventilating and air–conditioning systems shall be provided controls as specified herein.

N1105.3.1 Temperature. Each heating, ventilating and air-conditioning system shall be provided with at least one thermostat for the regulation of temperature. Each thermostat shall be capable of being set from 55ºF to 75ºF (13ºC to 24ºC) where used to control heating only and from 70ºF to 85ºF (21ºC to 29ºC) where used to control cooling only. Where used to control both heating and cooling, it shall be capable of being set from 55ºF to 85ºF (13ºC to 29ºC) and shall be capable of operating the system heating and cooling in sequence. It shall be capable of providing a temperature range of at least 5ºF (-15ºC) within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

N1105.3.2 Humidity. If a heating, ventilating and air-conditioning system is equipped with a means for adding moisture to maintain specific selected relative humidity in spaces or zones, a humidistat shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 30 percent. Where a humidistat is used in a heating, ventilating and air-conditioning system for controlling moisture removal to maintain specific selected relative humidity in spaces or zones, it shall be capable of being set to prevent new energy from being used to produce a space-relative humidity below 60 percent.

N1105.3.3 Temperature zoning. Each separate heating, ventilating and air-conditioning system shall be provided at least one thermostat for regulation of space temperature. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating or cooling input to each zone or floor, excluding unheated or noncooled basements and garages.

N1105.3.4 Setback and shutoff. The thermostat, or an alternative means such as switch or clock, shall provide a readily accessible manual or automatic means for reducing the energy required for heating and cooling during periods of nonuse or reduced need.

Exceptions:

1. Where it can be shown that setback or shutdown will not result in a decrease in overall building energy.
2. Equipment with full load demand of 2 kilowatt (6.826 Btu/h) or less may be controlled by readily accessible off-hour controls.

Lowering thermostat set points to reduce energy consumption of heating system shall not cause energy to be expended to reach the reduced setting.

N1105.3.4.1 Heat pump controls. All heat pump system thermostats shall be capable of manual setback and limiting the use of supplemental heat during warm-up periods.

N1105.3.4.1.1 Outdoor thermostat required. An outdoor thermostat or factory installed temperature sensor with electronic controls shall be used to lock-out supplemental heat based on outdoor air temperature. The lock-out temperature shall be set at 400ºF (40ºC). There shall be no compressor lock-out temperature.

N1105.4 Outside combustion air. See Section R1006 for required outside combustion air for masonry fireplaces, factory-built fireplace(s) and factory-built stoves.

N1105.5 Equipment performance requirements.

N1105.5.1 Heat pumps. Single phase, air-cooled split and packaged system heat pumps of less than 65,000 Btu/h capacity shall have a heating seasonal performance factor (HSPF) of not less than 7.7 and seasonal energy efficiency ratio (SEER) of not less than 13.

N1105.5.2 Air conditioners. Single phase, air-cooled split and packaged system air conditioners of less than 65,000 Btu/h capacity shall have a SEER of not less than 13.0.

N1105.5.3 Furnaces.

N1105.5.3.1 Oil-fired furnaces. Oil-fired furnaces shall have an annual fuel utilization efficiency (AFUE) of not less than 78 percent.

N1105.5.3.2 Gas-fired furnaces. Gas-fired furnaces shall have an AFUE of not less than 78 percent.

N1105.5.4 Boilers. Gas-fired boilers shall have an AFUE not less than 80 percent, and gas-fired steam boilers shall have an AFUE of not less than 75 percent.

N1105.5.5 Packaged terminal air conditioners. Packaged terminal air conditioners shall meet performance requirements as specified in Table N1105.5.5.

N1105.5.6 Packaged terminal heat pumps. Packaged terminal heat pumps shall meet performance requirements as specified in Table N1105.5.5.

TABLE N1105.5.5
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS (PTAC) AND PACKAGED TERMINAL HEAT PUMPS (PTHP) – MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATINGS CONDITIONS	MINIMUM EFFICIENCY REQUIRED	TEST PROCEDURE
PTAC (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.5–(0.213 × Cap/1000) EER[a]	ARI 310/380–93
PTAC (Cooling Mode) Replacements[b]	All Capacities	95°F db Outdoor Air	10.9–(0.213 × Cap/1000) EER[a]	
PTHP (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.3–(0.213 × Cap/1000) EER[a]	ARI 310/380–93
PTHP (Cooling Mode) Replacements[b]	All Capacities	95°F db Outdoor Air	10.8–(0.213 × Cap/1000) EER[a]	
PTHP (Heating Mode) New Construction	All Capacities	—	3.2 - (0.026 × Cap/1000) COP[a]	—
PTHP (Heating Mode) Replacements[b]	All Capacities	—	2.9 - (0.026 × Cap/1000) COP[a]	—

For SI: 1 Btu/h = 0.2931 W, ºF = 1.8ºC + 32, 1 ton = 3517 W.

a. Cap means the rated cooling capacity of the product in Btu/h. If the unit capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

b. Replacement efficiencies shall apply only to units with existing sleeves less than 16 in. (406 mm) high and less than 42 in. (1067 mm) wide. Replacement units shall be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS."

N1105.6 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. Cooling equipment rated at less than 54,000 Btu/h (15 827 W) total cooling capacity.
2. HVAC systems serving guest rooms or dwelling units.
3. One- and two-family dwellings.

SECTION N1106
PIPING INSULATION

N1106.1 Heating and cooling systems. All piping serving as part of a heating or cooling system shall be thermally insulated as shown in Table N1106.1.

N1106.2 Domestic and service hot water systems. All piping serving as part of a domestic or service hot water system shall be thermally insulated as shown in Table N1106.1.

Exception: One- and two-family dwellings.

N1106.3 Minimum thickness. Insulation thicknesses shall be no less than specified in Table N1106.1. However, a greater thickness insulation may be required for freeze protection where piping is exposed to subfreezing ambient temperatures.

N1106.4 Water vapor transmission. The minimum insulation thicknesses specified do not consider water vapor transmission and condensation. Additional insulation, vapor retarders, or both, may be required to limit water vapor transmission and condensation.

Exception: Piping insulation, except when needed to prevent condensation, is not required in any of the following cases:

1. Factory-installed piping within HVAC equipment.
2. Piping that conveys fluids that have a design operating temperature range between 55ºF and 105ºF (13ºC and 40.5ºC).
3. Piping installed in basements, cellars or unventilated crawl spaces with insulated walls.

SECTION N1107
LIGHTING

N1107.1 General. The provisions of this section apply to lighting equipment, related controls and electric circuits serving all conditioned and unconditioned interior floor space and exterior building facades of all dwelling units and guest rooms within residential buildings and structures, or portions thereof.

N1107.2 High-efficacy lamps. A minimum of 50 percent of the permanently installed lighting fixtures shall contain high-efficacy lamps. Screw-in compact florescent lamps comply with this requirement.

The building official shall be notified in writing at the final inspection that a minimum of 50 percent of the permanently installed lighting fixtures have met this requirement.

TABLE N1106.1
MINIMUM PIPE INSULATION (INCHES)[a, b]

FLUID DESIGN OPERATING TEMPERATURE RANGE, °F	INSULATION CONDUCTIVITY		NOMINAL PIPE DIAMETER (IN.)				
	Conductivity range (Btu-in.)/(h · ft² · °F)	Mean rating temperature, °F	1 and less	1 1/4 to 2	2 1/2 to 4	5 & 6	8 & up
Heating systems (steam, steam condensate and hot water)[c]							
			INSULATION THICKNESS (inches)				
Above 350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251 - 350	0.29-0.31	200	2.0	2.5	3.0	3.5	3.5
201 - 250	0.27-0.30	150	1.5	1.5	2.0	2	3.5
141 - 200	0.25-0.29	125	1.5	1.5	1.5	1.5	1.5
105 - 140	0.24-0.28	100	1.0	1.0	1.0	1.5	1.5
Domestic and Service Hot Water System[d]							
105 and greater	0.24-0.28	100	1[e]	1	1.5	1.5	1.5
Cooling systems (chilled water, brine and refrigerant)[c]							
40-55	0.23-0.27	75	0.5	0.75	1.0	1.0	1.0
Below 40	0.23-0.27	75	1.0	1.5	1.5	1.5	1.5

For SI: 1 inch = 25.4 mm. 1 foot = 304.8 mm, °F = 1.8 °C + 32.

a. For insulation outside the stated conductivity range, minimum thickness (T) shall be determined as follows:
$T = r\{(1 + t/r)^{K/k} - 1\}$
Where T= minimum thickness (in.)
r = actual outside radius of pipe (in.),
t = insulation thickness in this table for applicable fluid temperature and pipe size
K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu-in.[h · ft² · °F]) and
k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.

b. These thicknesses are based on energy efficiency considerations only. Issues such as water vapor permeability, surface condensation, or safety considerations sometimes require vapor retarders or additional insulation.

c. Piping insulation is not required between the control valve and coil on run-outs when control valve is located within 4 feet (1220 mm) of the coil and pipe diameter is 1 inch (25.4 mm) or less.

d. Applies to recirculating sections of service or domestic hot water systems and first 8 feet (2438 mm) from storage tank for noncirculating systems.

e. Piping less than 1 inch (25 mm) in diameter and less than 12 feet (3658 mm) in length shall be insulated with 1/2 inch (12.7 mm) insulation with a minimum conductivity of 0.24 Btu-in/h · ft² · °F.

PART II
ALTERNATIVE SYSTEMS ANALYSIS

SECTION NA1108
ALTERNATIVE SYSTEMS ANALYSIS

This section provides an alternate method of demonstrating code compliance with this chapter by demonstrating that such deviation will result in an annual energy consumption equal to or less than a building that is in compliance with this chapter.

NA1108.1 Equivalent annual energy consumption. The baseline design, conforming to requirements specified in this chapter and the proposed design shall be analyzed using the same procedures. The analyses shall use equal floor area and equal environmental requirements. The comparison shall be expressed in Btu input per gross building square foot of conditioned space per year (MJ/m² per year).

NA1108.2 Basis for comparison. Both baseline and proposed alternative designs shall include parameters as specified in Table NA1108.2.

NA1108.2.1 Internal heat gain. The total internal heat gain shall be calculated by Equation NA1108.2.1(1). For single zone calculations, the daily total sensible internal gains (Btu/day) shall be determined by Equation NA1108.2.1(2). For multiple zone HVAC systems, the daily total sensible internal gains (Btu/day) shall be determined by Equation NA1108.2.1(2) for the living zone and Equation NA1108.2.1(3) for the sleeping zone. The daily total latent load for each zone shall be determined using Equation NA1108.2.1(4).

Internal heat gains shall be distributed over the day according to the profile in Table NA1108.2.

Where multiple zone space conditioning is modeled, the profile shown for Zone 2 shall be used for bedrooms and bathrooms; the profile shown for Zone 1 shall be used for all other conditioned rooms. Where single zone space conditioning is modeled, the hourly profile for single-zone designs shall be used.

Equation NA1108.2.1(1)

Total Heat Gains =
Sensible Heat Gains + Latent Heat Gains

Equation NA1108.2.1(2)
Single Zone or Living Zone:

Sensible Heat Gains =
(Floor Area of Zone · 15 Btu/day · ft²) + (Number of living units · 20,000 Btu/day)

Equation NA1108.2.1(3)
Sleeping Zone:

Sensible Heat Gains =
Floor Area of Zone · 15 Btu/day · ft²

Equation NA1108.2.1(4)

Latent Heat Gains = 0.2 · Sensible Heat Gains

TABLE NA1108.2
BASIS FOR COMPARISON

INPUT PARAMETERS FOR ANALYSIS		
Parameter	**Proposed Building**	**Code Baseline**
Building Envelope		
Opaque construction materials	As designed	Code minimum
Fenestration performance	As designed	Code minimum
Shading devices	As designed	Same as proposed
Window area	As designed	Same as proposed
Skylight area	As designed	Same as proposed[a]
Building orientation	As designed	Same as proposed
Solar gain	As designed	Same as proposed
Building infiltration	0.35 ACH Natural	Same as proposed
HVAC Systems		
HVAC system type(s)	As designed	Same as proposed
HVAC efficiency	Code efficiencies[c]	Same as proposed[c]
Heating fuel	As designed	Same as proposed
Cooling fuel	As designed	Same as proposed
Temperature setpoints	As designed	Same as proposed
Equipment capacity	As designed	Same as proposed
Mechanical ventilation	As designed	Same as proposed
Lighting		
Artificial lighting	As designed	Code required
Daylighting	As designed	Same as proposed
Design Conditions		
Building occupancy	As designed	Same as proposed
Building operational schedules	As designed	Same as proposed
Climatic data	As designed	Same as proposed
Internal loads	As designed	Same as proposed
Cooking fuel	As designed	Same as proposed

a. For a single family dwelling unit, detached or attached (townhouse) only, code baseline window area may be 13 percent of heated space floor area when proposed building has less than 13 percent of heated space floor area in windows.

b. Code baseline skylight area shall be same as proposed up to a maximum of two percent of the heated space floor area.

c. Systems not regulated by code, such as electric heat, shall comply with standard equipment efficiency for such equipment.

NA1108.2.2 Thermostat set-points. In the analysis for both the baseline and proposed designs, all conditioned spaces shall be maintained at the specified thermostat set-points at all times except for minor deviations at thermostat setback and setup and when outdoor conditions exceed normal design conditions.

If the specified equipment in the proposed design is too small to meet the load, its capacity shall be increased in the calculations. If equipment to meet a load is not included in the design, such equipment shall be assumed in the calculations and its energy use included. In no case shall the energy use of proposed design be reduced by not conditioning its spaces.

For central space conditioning systems without zonal control, the entire conditioned floor area shall be on thermostatically controlled zone. The thermostat settings shall be those listed for a single zone in Table NA1108.2.2. For multiple zone designs, the multi-zone thermostat settings in Table NA1108.2.2 shall be used. Zone 1 represents all conditioned spaces other than Zone 2 (bedrooms and bathrooms). The effect of heat transfer between zones, including nonclosable openings shall be included in the calculation.

TABLE NA1108.2.2
THERMOSTAT SETTINGS (°F)

	SINGLE ZONE		MULTIPLE ZONE			
			Zone 1 Living		Zone 2 Sleeping	
TIME OF DAY	Heat	Cool	Heat	Cool	Heat	Cool
6 – 9 a.m.	68	78	68	78	68	78
9 a.m. – 5 p.m.	68	78	68	78	60	85
5 – 11 p.m.	68	78	68	78	68	78
11 p.m. – 6 a.m.	60	78	60	85	60	78

NA1108.3 Analysis procedure. The analysis of the annual energy usage of the standard and the proposed alternative building and system designs shall meet the following criteria:

NA1108.3.1 The building heating/cooling load calculation procedure used for annual energy consumption analysis shall be of sufficient detail to permit the evaluation of effect of building data (such as orientation, size, shape, transfer characteristics of mass, air, moisture, and heat) and hourly climatic data.

NA1108.3.2 The calculation procedure used to simulate the operation of the building and its service systems through a full year operating period shall be of sufficient detail to permit the evaluation of the effect of system design, climatic factors operational characteristics, and mechanical equipment on annual energy usage. Manufacturer's data or comparable field test data shall be used when available in the simulation of all systems and equipment. The calculation procedure shall be based upon 8760 hours of operation of the building and its service systems and shall utilize techniques recommended in the appropriate ASHRAE publications or produce results consistent with such recommended procedures.

NA1108.3.2.1 The calculation procedure shall explicitly cover the following items:

1. **Climatic data:** coincident hourly data for temperatures, solar radiation, wind and humidity of typical days in the year representing seasonal variation.
2. **Building data:** orientation, size, shape, mass, air, moisture and heat transfer characteristics.

3. **Operational characteristics:** temperature, humidity, ventilation, illumination, control mode for occupied and non-occupied hours.
4. **Mechanical equipment:** design capacity, part load profile.
5. **Internal heat generation:** lighting, equipment, number of people during occupied and non- occupied periods.

NA1108.4 Documentation. Proposed alternative designs, submitted as requests for exception to the standard design criteria, shall be accompanied by an energy analysis comparison report prepared by a registered engineer. The report shall provide sufficient technical detail describing the differences between the two building and systems designs and on the data used in and resulting from the comparative analysis.

NA1108.4.1 The documentation shall demonstrate that the analysis used is consistent with the techniques and procedures specified in this section and the following ASHRAE documents:

1. 2001 ASHRAE Handbook of Fundamentals.
2. 2000 ASHRAE Handbook of HVAC Systems and Equipment.
3. ASHRAE Principles of Heating, Ventilating and Air Conditioning.

PART III
FENESTRATION STANDARD

SECTION NF1109
SCOPE

NF1109.1 General. All windows installed in Oregon shall meet the requirements of this section.

SECTION NF1110
ALTERATIONS

NF1110.1 Windows. Windows shall be tested and labeled in accordance with Section N1104.4.

The following information is repeated for the reader's convenience:

N1104.4 Windows. All windows installed in Oregon shall meet the requirements of Part III, Fenestration Standard.

1. Decorative or unique architectural feature glazing not exceeding 1 percent of the heated space floor area is exempt from thermal performance requirements and does not need to be included in Table N1104.1(1) thermal performance calculations.

2. Glass block assemblies may use a *U*-factor of 0.51.

3. The *U*-factor for windows may be a weighted average of total window area when all other building envelope measures are in compliance with performance requirements specified in this code. This calculation shall be provided to the building official and the windows that are less than required for prescriptive compliance shall be identified on the plans.

SECTION NF1111
DEFINITIONS

NF1111.1 General. For purposes of this section the following definitions are provided;

WINDOWS produced in low volume are a manufacturer's product installed in Oregon during a calendar year that does not exceed: 750 windows, 500 glazed doors, 1,000 skylights covered in Section NF1113.2 and 25 complete sunrooms/solariums.

MANUFACTURER produces windows, assembles window components or does both. A "manufacturer" includes its subsidiaries, divisions and all other companies under common control or ownership.

SUNROOM/SOLARIUM is a one-story structure attached to a dwelling with a glazing area in excess of 40 percent of the gross area of that structure's exterior walls and roof.

ALUMINUM with vinyl is fenestration framing material consisting of a composite of both aluminum and vinyl framing constructed in a manner where the aluminum framing is provided a complete thermal break by the vinyl framing.

SECTION NF1112
INSULATED GLASS CERTIFICATION

NF1112.1 General. Sealed insulated glass units shall conform to, or be in test for, ASTM E 774-07 *Standard Practice for Evaluating Solar Absorptive Materials for Thermal Applications,* as Class A under a Sealed Insulated Glass Manufacturers Association (SIGMA) approved certification program and installed in accordance with the SIGMA glazing specifications.

SECTION NF1113
WINDOW THERMAL PERFORMANCE DESIGNATION FOR NEW BUILDINGS AND ADDITIONS

The requirements of this section are not intended to waive or supersede any window thermal performance requirements under state or federal laws.

NF1113.1 Manufactured windows. *U*-factors for manufactured fenestration products (windows, skylights and doors) shall be determined in accordance with the National Fenestration Rating Council (NFRC) 100 2001 Procedure for Determining Fenestration Product *U*-Factors The *U*-factors shall be labeled and certified in accordance with the NFRC Product Certification.

NF1113.2 Windows products exempt from testing. The following products are exempt from thermal performance testing as specified in Section NF1113.1.

1. Windows produced in low volume.
2. Glazing not exceeding 1 percent of the heated space floor area.
3. Solariums and sunrooms.

4. Skylights constituting no more than 10 percent of total glazing in a residential building.
5. Skylights constructed with wood, thermal break aluminum or aluminum with vinyl frames with a glazing configuration of either: A minimum 0.5-inch (12.7 mm) space between the panes and low-*e* glass; or triple layered acrylic.

NF1113.2.1 Thermal performance of exempted products. The thermal performance of window products exempted from testing shall be determined by the following procedures:

1. Windows produced in low volume are assigned default *U*-factors as specified in Section NF1113.3, Item 1.
2. Glazed doors produced in low volume are assigned default *U*-factors as specified in Section NF1113.3, Item 2.
3. Skylights produced in low volume are assigned default *U*-factors as specified in Section NF1113.3, Item 3.
4. Skylights constituting no more than 10 percent of total glazing in a residential building that are exempt from testing are assigned default *U*-factors as specified in Section NF1113.3, Item 3.
5. Vertical and overhead glazing contained in sunrooms/solariums are assigned default *U*-factors as specified in NF1113.3, Items 1, 2 and 4.
6. Skylights specified in Section NF1113.2, Item 5 shall be assigned a default *U*-factor of 0.50.

NF1113.3 Thermal performance validation for windows produced in low volume or site-built. Windows, glazed doors, skylights and sunroom/solariums produced in low volume and meeting the requirements of this subsection may validate default *U*-factors:

1. By using Table NF1113.3(1) for windows,
2. By using Table NF1113.3(2) for glazed doors,
3. By using Table NF1113.3(1) for skylights based on an overall *U*-factor of *U*-0.50.
4. By using Table NF1113.3(1) for overhead glazing installed in sunrooms/solariums based on an overall *U*-factor of *U*-0.35.

SECTION NF1114
THERMAL PERFORMANCE LABELING

The requirements of this section are not intended to waive or supersede any window label or disclosure requirements under state or federal laws.

NF1114.1 Labels. Labels shall be either:

1. National Fenestration Rating Council (NFRC) certified product; or
2. State-approved labels.

Labeling is not required for glazing not exceeding one percent of the heated space floor area and is exempt from Table N1104.1(1) thermal performance calculations.

NF1114.2 Label description. All windows shall have state-approved labeling except as provided in Section NF1114.1, Item 1.

Exceptions:

1. Labeling is not required for glazing not exceeding 1 percent of the heated space floor area.
2. Portions of labels for windows produced in low volume may be handwritten.

NF1114.2.1 Windows produced in low volume labels. Labels for windows produced in low volume under NF1111(1), due to its frame and glazing configuration shall:

1. Specify window components;
2. Show the allowed *U*-factor in the appropriate location;
3. Show a production count number that does not exceed the maximums established in NF1111(1);
4. Imprint "(Manufacturer's name) certifies the attached window is constructed in a manner to obtain the specified *U*-factor" or "(Manufacturer's name) certifies the attached skylight complies with the criteria specified in the Oregon building codes";
5. Be imprinted, not handwritten;
6. Face the interior of the room; and
7. Remain attached to the window until the building inspector inspects and verifies the labeling.

NF1114.3 Labels for skylights exempted from thermal performance standards. Labels for skylights exempt from thermal performance standards under Section NF1113.2, Item 5, due to it's frame and glazing configuration shall:

1. Specify skylight components;
2. State "U-0.50 Default *U*-factor";
3. State "Limited Production Skylight Compliance *U*-factor Label" and "Maximum Allowable Skylight Area Shall Not Exceed Two Percent of the Heated Space Floor Area";
4. Show a production count number that does not exceed the maximums established in Section NF1111.1.
5. Imprint "(Manufacturer's name) certifies the attached skylight complies with the criteria specified in the Oregon building codes;"
6. Contain the statement, "This skylight is not required to be tested or evaluated for thermal performance";
7. State "EXEMPT" in 0.75-inch (20 mm) high letters;
8. Specify "Issued (Date of issue)";
9. Contain the statement, "Under ORS 455.525(4) this skylight is deemed to comply with Oregon's thermal performance standards regardless of *U*-factor."

TABLE NF1113.3(1)
APPROVED WINDOW DEFAULT *U*-VALUES[a, b]

DESCRIPTION[c, d, e, f, g] (inches)	FRAME TYPE[h]		
	ALUM. THERMAL BREAK[i]	WOOD/VINYL	ALUM CLAD WOOD/REINFORCED VINYL[j]
Double, Clear 1/4	N/A	0.56	0.59
Double, Clear 1/4 + argon	0.63	0.53	0.56
Double, Low-*e* 4, 1/4	0.61	0.52	0.54
Double, Low-*e* 2, 1/4	0.58	0.49	0.51
Double, Low-*e* 1, 1/4	0.55	0.47	0.49
Double, Low-*e* 4, 1/4 + argon	0.55	0.47	0.49
Double, Low-*e* 2, 1/4 + argon	0.52	0.43	0.46
Double, Low-*e* 1, 1/4 + argon	0.50	0.41	0.43
Double, Clear 3/8	0.63	0.54	0.57
Double, Clear 3/8 + argon	0.60	0.51	0.54
Double, Low-*e* 4, 3/8	0.57	0.48	0.51
Double, Low-*e* 2, 3/8	0.54	0.45	0.48
Double, Low-*e* 1, 3/8	0.51	0.43	0.46
Double, Low-*e* 4, 3/8 + argon	0.53	0.44	0.47
Double, Low-*e* 2, 3/8 + argon	0.49	0.41	0.44
Double, Low-*e* 1, 3/8 + argon	0.47	0.39	0.41
Double, Clear 1/2	0.60	0.50	0.54
Double, Clear 1/2 + argon	0.58	0.48	0.51
Double, Low-*e* 4, 1/2	0.53	0.44	0.47
Double, Low-*e* 2, 1/2	0.50	0.41	0.44
Double, Low-*e* 1, 1/2	0.47	0.39	0.42
Double, Low-*e* 4, 1/2 + argon	0.50	0.42	0.44
Double, Low-*e* 2, 1/2 + argon	0.46	0.37	0.40
Double, Low-*e* 1, 1/2 + argon	0.43	0.35	0.38
Triple, Clear 1/4	0.52	0.42	0.44
Triple, Clear 1/4 + argon	0.49	0.39	0.42
Triple, Low-*e* 4, 1/4	0.50	0.40	0.40
Triple, Low-*e* 2, 1/4	0.48	0.39	0.41
Triple, Low-*e* 1, 1/4	0.47	0.38	0.40
Triple, Low-*e* 4, 1/4 + argon	0.46	0.37	0.39
Triple, Low-*e* 2, 1/4 + argon	0.43	0.34	0.37
Triple, Low-*e* 1, 1/4 + argon	0.42	0.34	0.36
Triple, Clear 1/2	0.46	0.37	0.40
Triple, Clear 1/2 + argon	0.45	0.36	0.38
Triple, Low-*e* 4, 1/2	0.43	0.35	0.37
Triple, Low-*e* 2, 1/2	0.41	0.32	0.35
Triple, Low-*e* 1, 1/2	0.39	0.31	0.33
Triple, Low-*e* 4, 1/2 + argon	0.41	0.32	0.35
Triple, Low-*e* 2, 1/2 + argon	0.38	030	0.32
Triple, Low-*e* 1, 1/2 + argon	0.37	0.29	0.31

For SI: 1 inch = 25.4 mm.

a. Subtract 0.02 from the listed default *U*-factor for insulated spacers. Insulated spacer material includes fiberglass, wood and butyl or other material with an equivalent *K*-value.

b. Sunrooms/solariums may subtract 0.03 from the default *U*-factor.

c. 1/4" = a minimum dead air space of 0.25 inch (6.4 mm) between the panes of glass.
3/8" = a minimum dead air space of 0.375 inch (9.5 mm) between the panes of glass.
1/2" = a minimum dead air space of 0.5 inch (12.7 mm) between the panes of glass.
Products with air spaces different than those listed above shall use the value for the next smaller air space; i.e. 3/4-inch = 1/2-inch *U*-factor, 7/16-inch = 3/8-inch *U*-factor, 5/16-inch = 1/4-inch *U*-factor.

d. Low-*e* 4 (emissivity) shall be 0.4 or less.
Low-*e* 2 (emissivity) shall be 0.2 or less.
Low-*e* 1 (emissivity) shall be 0.1 or less.

e. *U*-factors listed for argon shall consist of sealed, gas-filled, insulated units for argon, CO_2, SF_6 and argon/SF_6 mixtures.
The following conversion factor shall apply to Krypton gas-filled units: 1/4-inch (6.4 mm) or greater airspace with Krypton gas fill = 1/2-inch (12.7 mm) airspace with Argon gas-fill.

(continued)

TABLE NF1113.3(1) — NOTES (continued)

f. Dividers placed between glazing: The *U*-factors listed shall be used where the divider has a minimum gap of $^1/_8$ inch (3.2 mm) between the divider and lite of each inside glass surface. Add 0.03 to the listed *U*-factor for True Divided Lite windows.

g. "Glass block" assemblies may use a *U*-factor of 0.51.

h. Insulated fiberglass framed products shall use wood/vinyl *U*-factors.

i. Alum. Thermal Break = An aluminum thermal break framed window shall incorporate the following minimum design characteristics:
   1. The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h · ft² · ºF;
   2. The thermal break material shall not be less than 0.210 inch; and
   3. All metal framing members of the product to interior and exterior air must incorporate a thermal break meeting the criteria in 1 and 2 above.

j. Aluminum clad wood windows shall use the *U*-factors listed for Alum. Clad Wood/Reinforced Vinyl windows. Vinyl clad windows shall use the *U*-factors listed for Wood/Vinyl windows. Any vinyl frame window with metal reinforcement in more than one rail shall use the *U*-factors listed for Alum. Clad Wood Reinforced Vinyl windows.

TABLE NF1113.3(2)
APPROVED GLAZED DOOR DEFAULT U-VALUES[a]

DESCRIPTION[b, c, d, e] (inches)	DOOR MATERIAL			
	INSULATED[f]	WOOD[g]		
	Full-Lite[h, i]	Half-Lite[j, k]	Full-Lite[h]	Half-Lite[j]
Double, Clear $^1/_4$	0.39	0.31	0.47	0.42
Double, Clear $^1/_4$ + argon	0.37	0.30	0.45	0.41
Double, Low-*e* 4,$^1/_4$	0.36	0.30	0.44	0.41
Double, Low-*e* 2,$^1/_4$	0.35	0.29	0.43	0.40
Double, Low-*e* 1,$^1/_4$	0.24	0.28	0.41	0.39
Double, Low-*e* 4,$^1/_4$ + argon	0.33	0.28	0.41	0.39
Double, Low-*e* 2,$^1/_4$ + argon	0.31	0.26	0.39	0.38
Double, Low-*e* 1,$^1/_4$ + argon	0.31	0.26	0.38	0.37
Double, Clear $^3/_8$	0.37	0.30	0.45	0.41
Double, Clear $^3/_8$ + argon	0.36	0.29	0.44	0.41
Double, Low-*e* 4,$^3/_8$	0.34	0.28	0.42	0.40
Double, Low-*e* 2,$^3/_8$	0.33	0.28	0.41	0.39
Double, Low-*e* 1,$^3/_8$	0.21	0.26	0.38	0.37
Double, Low-*e* 4,$^3/_8$ + argon	0.32	0.27	0.40	0.38
Double, Low-*e* 2,$^3/_8$ + argon	0.29	0.25	0.37	0.37
Double, Low-*e* 1,$^3/_8$ + argon	0.29	0.25	0.36	0.36
Double, Clear $^1/_2$	0.36	0.29	0.44	0.41
Double, Clear $^1/_2$ + argon	0.34	0.28	0.42	0.40
Double, Low-*e* 4,$^1/_2$	0.32	0.27	0.40	0.38
Double, Low-*e* 2,$^1/_2$	0.30	0.26	0.38	0.37
Double, Low-*e* 1,$^1/_2$	0.19	0.25	0.36	0.36
Double, Low-*e* 4,$^1/_2$ + argon	0.30	0.26	0.38	0.37
Double, Low-*e* 2,$^1/_2$ + argon	0.28	0.25	0.36	0.36
Double, Low-*e* 1,$^1/_2$+ argon	0.28	0.24	0.34	0.35
Triple, Clear $^1/_4$	0.31	0.26	0.39	0.38
Triple, Clear $^1/_4$ + argon	0.29	0.25	0.37	0.37
Triple, Low-*e* 4,$^1/_4$	0.30	0.26	0.38	0.37
Triple, Low-*e* 2,$^1/_4$	0.29	0.25	0.37	0.36
Triple, Low-*e* 4,$^1/_4$ + argon	0.27	0.24	0.35	0.35
Triple, Low-*e* 2,$^1/_4$ + argon	0.26	0.24	0.34	0.35

For SI: 1 inch = 25.4 mm.

a. Subtract 0.02 from the listed default *U*-factor for insulated spacers. Insulated spacer material includes fiberglass, wood and butyl or other material with an equivalent *K*-value.

b. $^1/_4$" = a minimum dead air space of 0.25 inch (6.4 mm) between the panes of glass.
$^3/_8$" = a minimum dead air space of 0.375 inch (9.5 mm) between the panes of glass.
$^1/_2$" = a minimum dead air space of 0.5 inch (12.7 mm) between the panes of glass.
Products with air spaces different than those listed above shall use the value for the next smaller air space; i.e., $^3/_4$-inch = $^1/_2$-inch *U*-factor, $^7/_{16}$-inch = $^3/_8$-inch *U*-factor, $^5/_{16}$-inch = $^1/_4$-inch *U*-factor.

c. Low-*e* 4 (emissivity) shall be 0.4 or less.
Low-*e* 2 (emissivity) shall be 0.2 or less.
Low-*e* 1 (emissivity) shall be 0.1 or less.

(continued)

TABLE NF1113.3(2) — NOTES (continued)

d. *U*-factors listed for argon shall consist of sealed, gas-filled, insulated units for argon, CO_2, SF_6 and argon/SF_6 mixtures.
The following conversion factor shall apply to Krypton gas-filled units:
$^1/_4$-inch or greater airspace with Krypton gas fill = $^1/_2$-inch airspace with Argon gas-fill.
e. Dividers placed between glazing: The *U*-factors listed shall be used where the divider has a minimum gap of $^1/_8$-inch between the divider and lite of each inside glass surface. Add 0.03 to the listed *U*-factor for true divided lite windows.
f. Insulated = Any urethane insulated foam core door with a thermal break. Thermal Break = A thermal break door shall incorporate the following minimum design characteristics:
1) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/ft²/ºF; and
2) The thermal break material shall not be less than 0.210 inch.
g. Wood = Any wood door.
h. Full lite = A door that consists of more than 35-percent glazing.
i. Add 0.05 to the listed *U*-factor for full-lite values if insulated door does not have a thermal break.
j. Half lite = A door that consists of 35-percent or less glazing.
k. Add 0.06 to the listed *U*-factor for half-lite values if the insulated door does not have a thermal break.

NF1114.4 Labels for sunrooms/solariums produced in low volume or exempted from testing. Labels for solariums and sunrooms produced in low volume or with 0.5-inch (12.7 mm) airspace between the glazing shall:

1. Specify the components for each of the glazed surfaces, such as the front, overhead, and each side;
2. Show a production count number that does not exceed the maximums established in Section NF1111;
3. Show the *U*-factor determined by Section NF1113.2.1, Item 5 or NF1113.3, Item 4 for each of the glazed surfaces;
4. Imprint "(Manufacturer's name) certifies the components of this sunroom or solarium are constructed in a manner to obtain the specified *U*-factor"; and
5. Have one label providing a description of each of the glazed surfaces.

NF1114.5 Labels for skylights exempt from testing. Labels for skylights that are exempt from testing in accordance with Section NF1113.2(4) shall:

1. Specify skylight components;
2. State "Calculated *U*-factor Skylight Compliance Label";
3. State *U*-factor determined by Section NF1113.2.1, Item 4; and
4. Show a production count number that does not exceed the maximums established in Section NF1111.

NF1114.6 Combined products. When different window types are combined, mulled together by the manufacturer or manufactured to fit a framed rough opening, a single label may be used.

Exception: A skylight/solarium shall have one label providing a description of each of the glazed surfaces, such as the front, overhead, and each side.

NF1114.7 Label distribution. Labels provided under Section NF1113.2 shall be designed by the division and sold by persons authorized by the agency and shall not be sold in lots exceeding the maximums for each window type per manufacturer during any calendar year.

SECTION NF1115
AIR LEAKAGE REQUIREMENTS

Windows shall comply with the air leakage requirements of Section N1104.8.

Exception: Site-built windows.