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 one 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.
3. Heated or cooled detached *accessory structures* that are not habitable shall meet the following envelope requirements without any additional measures: Walls: R-21/U-0.064; Heated floor slab: R-10 under slab; Raised floor: R-30; Roofs: R-38/U-0.027 (attic) or R-20 continuous insulation/U-0.048 (above deck); Windows: U-0.35; Opaque doors: U-0.70; Roll-up doors: U-0.50.
4. New buildings using Section N1105.3, Exception 3, shall select two additional measures from Table N1101.1(2).

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-0.059[c]	R-21 Intermediate[c]	Note d	Note d
Wall insulation—below grade[e]	C-0.063	R-15 c.i./R-21	C-0.063	R-15/R-21
Flat ceilings[f]	U-0.021	R-49	U-0.020	R-49 A[h]
Vaulted ceilings[g]	U-0.033	R-30 Rafter or R-30A[g, h] Scissor Truss	U-0.027	R-38A[h]
Underfloors	U-0.033	R-30	U-0.033	R-30
Slab-edge perimeter[m]	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-0.27	U-0.27	U-0.27	U-0.27
Skylights	U-0.50	U-0.50	U-0.50	U-0.50
Exterior doors[k]	U-0.20	U-0.20	U-0.54	U-0.54
~~Exterior doors with > 2.5 ft² glazing[l]~~	~~U-0.40~~	~~U-0.40~~	~~U-0.40~~	~~U-0.40~~

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2, 1 degree = 0.0175 rad, n/a = not applicable.

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*-factor standards. Calculations to document equivalent heat loss shall be performed using the procedure and approved *U*-factors 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. Nominal compliance with R-21 insulation and Intermediate Framing (N1104.5.2) with insulated headers.

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

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 above grade. R-21 for insulation in framed cavity; R-15 continuous insulation.

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 in area may be reduced to not less than R-21. When reduced, the cavity shall be filled (except for required ventilation spaces). R-49 insulation installed to minimum 6-inches depth at top plate at exterior of structure to achieve *U*-factor.

g. Vaulted ceiling surface area exceeding 50 percent of the total heated space floor area shall have a *U*-factor no greater than *U*-0.026 (equivalent to R-38 rafter or scissor truss with R-38 advanced framing).

h. A = Advanced frame construction. See Section N1104.6.

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 g~~Glass doors ~~with over 10 ft² glazing~~ shall comply with window performance requirements. Windows exempt from testing in accordance with Section ~~NF1111.2, Item 3~~ NF1114.4, Item 1 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. A maximum of 28 square feet of exterior door area per dwelling unit can have a *U*-factor of 0.54 or less.

l. Glazing that is either double pane with low-e coating on one surface, or triple pane shall be deemed to comply with this U-0.30 requirement.

m. Minimum 24-inch horizontal or vertical below-grade.

TABLE N1101.1(2)
ADDITIONAL MEASURES

1	**HIGH EFFICIENCY HVAC SYSTEM[a]** a. Gas-fired furnace or boiler AFUE 94 percent, or b. Air source heat pump HSPF 10.0/~~14.0~~ 16.0 SEER cooling or 8.5 HSPF2 / 15.0 SEER2, or c. Ground source heat pump COP 3.5 or Energy Star rated
2	**HIGH EFFICIENCY WATER HEATING SYSTEM** a. Natural gas/propane water heater with minimum 0.90 UEF, or b. Electric heat pump water heater with minimum ~~2.0 COP~~ 3.45 UEF, or c. Natural gas/propane tankless/instantaneous heater with minimum 0.80 UEF and Drain Water Heat Recovery Unit installed on minimum of one shower/tub-shower
3	**WALL INSULATION UPGRADE** Exterior walls—U-0.045/R-21 conventional framing with R-5.0 continuous insulation
4	**ADVANCED ENVELOPE** Windows—U-0.21 (Area weighted average), and Flat ceiling[b]—U-0.017/R-60, and Framed floors—U-0.026/R-38 or slab edge insulation to F-0.48 or less (R-10 for 48"; R-15 for 36" or R-5 fully insulated slab)
5	**DUCTLESS HEAT PUMP (Dwelling units with all-electric heat)** a. Provide ductless heat pump of minimum HSPF 10.0 or HSPF2 9.0 in primary zone replaces zonal electric heat sources, and b. Provide programmable thermostat for all heaters in bedrooms
6	**HIGH EFFICIENCY THERMAL ENVELOPE UA[c]** Proposed UA is 8 percent lower than the code UA
~~7~~	~~**GLAZING AREA**~~ ~~Glazing area, measured as the total of framed openings is less than 12 percent of conditioned floor area~~
7 ~~8~~	~~3~~ 2.75 **ACH AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION** Achieve a maximum of ~~3.0~~ 2.75 ACH50 whole-house air leakage when third-party tested and provide a whole-house ventilation system including heat recovery with a minimum sensible heat recovery efficiency of not less than 66 percent and total fan efficacy of 1.6 CFM/Watt (combined input for supply and exhaust).

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

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

b. 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.

c. In accordance with Table N1104.1(1), the Proposed UA total of the Proposed Alternative Design shall be a minimum of 8 percent less than the Code UA total of the Standard Base Case.

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.

Where alterations or repairs 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.~~
The minimum existing component requirements as specified in Table N1101.2 shall be used to the maximum extent technically practical due to existing site constraints, which may include but are not limited to, the available cavity depth, matching existing features, and similar restrictions.

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 Section 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. Changes of use that are greater than 30 percent of the existing building heated floor area or more than 400 square feet (37 m^2) in area, whichever is less, shall be required to select one measure from Table N1101.3.2.

N1101.2.3.2 Change of occupancy. Alteration and repair of conditioned nonresidential buildings, such as a small church or school that are changing occupancy to residential dwellings shall use Table N1101.2 to the greatest extent practical and select one measure from Table N1101.1(2) or Table N1101.3.2.

Exception: The minimum component requirements shall be disregarded when thermal performance calculations are completed for change of use to Group R-3 occupancy, when such calculations demonstrate similar performance to the requirements of Table N1101.2.

TABLE N1101.2
EXISTING BUILDING COMPONENT REQUIREMENTS

BUILDING COMPONENTS	REQUIRED PERFORMANCE	EQUIVELENT VALUE
Wall insulation	U-0.083	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~~ ≤10 inches nominal joist depth	U-0.039	R-25
Slab-edge perimeter	~~F-0.52~~ n/a	~~R-15~~ n/a
Windows and glazed doors	U-0.30	U-0.30
Skylights	U-0.50	U-0.50
Exterior doors	U-0.20	R-5
~~Exterior doors with > 2.5 ft^2 glazing~~	~~U-0.40~~	~~R-2.5~~
~~Forced air ducts~~	~~n/a~~	~~R-8~~

For SI: 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 600 square feet (55 m^2) in area shall be required to ~~comply with~~ select one measure from Table N1101.1(2).

N1101.3.2 Small additions. Additions that are less than 600 square feet (55 m^2) in area shall be required to select one measure from Table N1101.1(2) or comply with Table N1101.3.2.

Exception: Additions that are less than 225 square feet (20.9 m^2) in area shall not be required to comply with Table N1101.1(2) or Table N1101.3.2.

TABLE N1101.3.2
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-factor as specified in Table N1101.2
3	Insulate the existing floor, crawl space or basement wall systems as specified in Table N1101.2 and install 100 percent of permanently installed lighting fixtures as CFL, LED or linear fluorescent, or a minimum 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 4.5 air changes per hour @ 50 Pascals.
5	Seal and performance test the duct system.
6	Replace existing 80-percent AFUE or less gas furnace with a 94 ~~92~~-percent AFUE or greater system.
7	Replace existing electric radiant space heaters with a ductless mini split system with a minimum HSPF of 10.0 or HSPF2 of 9.0.
8	Replace existing electric forced air furnace with an air source heat pump with a minimum HSPF of 9.5 or HSPF2 of 8.1.
9	Replace existing water heater with a water heater meeting: Natural gas/propane water heater with minimum UEF 0.90, or Electric heat pump water heater with minimum ~~2.0 COP~~ 3.45 UEF.

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; fenestration U-factors; HVAC equipment efficiency performance and system controls; lighting; an additional measure from Table N1101.1(2); and the other pertinent data to indicate compliance with the requirements of the chapter.

SECTION N1102
DEFINITIONS

AFUE (ANNUAL FUEL UTILIZATION EFFICIENCY). 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 US Department of Energy test procedures (10 CFR Part 430).

AUTOMATIC. 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 "*Manual*.")

BASEMENT WALL. The opaque portion of any wall which encloses a basement and is partially or totally below grade.

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

BTU (British Thermal Unit). The amount of heat required to raise the temperature of 1 pound (0.454 kg) of water (about 1 pint) from 59°F to 60°F (15°C to 16°C).

BUILDING THERMAL ENVELOPE. 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. A space within the building, separated from unconditioned space by the *building thermal 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 *conditioned space*.)

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

EXTERIOR DOOR. 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 thermal envelope*."

EXTERIOR WALL. 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. 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. Windows and doors in the exterior envelope. See "*Exterior door*" and "*Exterior window*."

FLOOR AREA. The area included within the surrounding exterior walls of a building or portion thereof, exclusive of 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. 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. 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. 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-EFFICIENCY LIGHT SOURCE. Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, LED lamps, fixture-integrated illumination devices, or lamps with an efficacy not less than 65 lumens per watt for each lamp or luminaires with an efficacy not less than 45 lumens per watt per each luminaire.

HSPF (HEATING SEASONAL PERFORMANCE FACTOR). 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. 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. All buildings and structures, or portions thereof, that are not defined as residential buildings (see "*Residential buildings*").

PERM RATING (DRY CUP). 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 (grain/hr-ft^2-in Hg (0 °C)). Permeance may be measured by using ASTM E96~~-72~~ or other approved dry cup method. The closer the dry cup perm rating approaches zero, the better the vapor retarder. Permeability is defined as the permeance of a material for specified unit length (perm/in).

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

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

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

THERMAL CONDUCTANCE (*C*). 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 × °F) [W/(m^2 × K)].

It is the reciprocal of thermal resistance (see "*Thermal resistance*").

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

THERMAL RESISTANCE (*R*). The measure of the resistance of a material or building component to the passage of heat, has the value of ($h \times ft^2 \times °F/Btu$) [($m^2 \times K)/W$], and is the reciprocal of thermal conductance.

THERMAL RESISTANCE TOTAL (*Rt*). The sum of the resistance for all of the individual components of the assembly, including framing members, multiple layer connections, insulation and air films expressed in ($Btu/h \times ft^2 \times °F$) [$W/(m^2 \times K)$].

THERMAL TRANSMITTANCE (*U*). 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, ($Btu/h \times ft^2 \times °F$).

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

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*-FACTOR (THERMAL TRANSMITTANCE).** See "*Thermal transmittance*."

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

WINDOW. See "*Exterior window*."

ZONE. 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 thermal envelope* components.

Proposed alternative designs submitted as requests for exception to the standard design criteria shall 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.

The *exterior building envelope* shall comply with Table N1101.1(1) or shall 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 thermal envelope* requirements in this code, in addition to requirements specified in Table N1101.1(2).

N1104.2 Insulation materials. Insulation materials shall be installed in accordance with manufacturer's listing and installation instructions and this code. 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. 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). Foam plastic shall be as specified in Section R316.

N1104.2.1 Insulation clearance restriction. Blown, poured, batt and spray-on type insulation applied from above the ceiling level shall be limited to vented attic spaces where the 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.) Netted or other applications that allow for verification of insulation application shall be allowed for low-slope roofs.

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 be IC-labeled for direct insulation contact.

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.

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

N1104.2.5 Baffles. Baffles of a durable rigid material shall be provided to prevent obstruction of vent openings and to deflect incoming air above the surface of porous insulation so as to prevent wind-washing and blowing of loose material. Thermal insulation shall not be installed in a manner that would obstruct openings required for attic ventilation.

N1104.2.6 Below-grade exterior insulation. Below-grade exterior insulation shall meet the following conditions:

1. The insulation shall be a material 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) in accordance with manufacturer's specifications.
4. The top of the insulation shall be installed in a manner to allow water runoff and prevent pooling.

TABLE N1104.1(1)
RESIDENTIAL THERMAL PERFORMANCE CALCULATIONS

BUILDING COMPONENTS[b]	STANDARD BASE CASE[a]			PROPOSED A		ALTERNATIVE	
	Areas[c]	*U*-factor	Areas × *U*	*R*-value[d]	Areas[c]	*U*-factor[e]	Areas x *U*
Flat ceilings		0.021					
Vaulted ceilings[f]		0.033					
Conventional wood-framed walls		0.059					
Underfloor		0.033					
Slab-edge		F = 0.52[g]					
Below-grade walls		C = 0.063[g]					
Windows		0.27					
Skylights		0.50					
Exterior doors[h]		0.2					
Doors with > 2.5 ft^2 glazing		0.4					
CODE UA =				Proposed UA[i] =			

a. Base path 1 represents Standard Base Case from Table N1101.1(1). *U*-factors shall be adjusted to match selected Envelope Measure [Table N1101.1(2)].

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 must 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 roof areas in excess of 50 percent for Base Case must be entered at U-0.021 (R-49) with "Flat ceilings" area.

d. Minimum component requirements insofar as practicable: Walls R-15/U-0.080; Floors R-21/U-0.047; Flat Ceilings R-38/U-0.031; Vaults R-21/U-0.055; Below-Grade Wood, Concrete or Masonry Walls R-15/C-0.069; Slab Edge R-10/F-0.52; 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). A single door not to exceed 28 square feet (2.6 m^2) per dwelling unit is permitted to be excluded from the thermal performance calculations. All other Door-values shall not exceed 0.54 (Nominal R-2).

e. *U*-factors for wood-framed ceilings, walls and floor assemblies shall be as specified in Table N1104.1(2). *U*-factors for other assemblies, which include steel framing, brick or other masonry, stucco, etc., shall be calculated using ASHRAE *Handbook of Fundamentals* procedures.

f. Vaulted area, unless insulated to R-38, 0.027, shall not exceed 50 percent of the total heated space floor area.

g. F = The heat loss coefficient, Btu/ h ×·ft^2 ×ºF per foot of perimeter. C = the heat loss coefficient Btu/ h ×·ft^2 ×ºF per square foot of underground wall.

h. A maximum of 28 square feet 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.

i. Proposed UA must be less than or equal to CODE UA. For compliance with Envelope Measure 6, the Proposed UA must be a minimum of 8 percent less than the CODE UA.

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

FLAT CEILINGS[a]		
Insulation	**Type**	***U*-Factor**
R-38	Conventional framing	0.027
R-38	Advanced framing [c]	0.026
R-49	Conventional framing	0.021
R-49	Advanced framing [c]	0.020
R-60	Conventional framing	0.017
VAULTED CEILINGS[a]		
Insulation	**Type**	***U*-Factor**
R-21	Rafter framings	0.050
R-30	Rafter framing	0.032
R-38	Rafter framing	0.026
R-21	Scissors truss	0.052
R-30	Scissors truss	0.034
R-38	Scissors truss	0.027
R-49	Scissors truss	0.021
R-30	Advanced scissors truss [c]	0.032
R-38	Advanced scissors truss [c]	0.026
R-49	Advanced scissors truss [c]	0.020
EPS FOAM CORE PANEL VAULTED CEILINGS		
Insulation	**Type**	***U*-Factor**
R-29	$8^1/_4$″ EPS foam core panel	0.034
R-37	$10^1/_4$″ EPS foam core panel	0.027
R-44	$12^1/_4$″ EPS foam core panel	0.023
FLOORS [a]		
Insulation	**Type**	***U*-Factor**
R-21	Underfloor	0.046
R-25	Underfloor	0.039
R-30	Underfloor	0.033
R-38	Underfloor	0.026
SLAB-ON-GRADE		
Insulation	**Type**	***F*-Factor [f]**
R-10	Slab edge 24″	0.54
R-5	Under slab continuous	0.46
R-15	Slab edge 24″	0.52
R-7.5	Under slab continuous	0.41
R-10	Under slab continuous	0.36
EPS FOAM CORE PANEL EXTERIOR WALLS		
Insulation	**Type**	***U*-Factor**
R-14.88	$4^1/_2$″ EPS foam core panel	0.059
R-22.58	$6^1/_4$″ EPS foam core panel	0.040
R-29.31	$8^1/_4$″ EPS foam core panel	0.031
BELOW GRADE WALLS		
Insulation	**Type**	***C*-Factor**
R-10 c.i.	R-10 continuous insulation	0.085
R-15 c.i.	R-15 continuous insulation	0.063
R-13	R-13 cavity and air space	0.080
R-21	R-21 cavity and air space	0.063

EXTERIOR WALLS[a]			
Insulation	**Insulation Sheathing**	**Framing**	***U*-Factor**
R-15	0	Conventional framing	0.083
R-15	0	Intermediate framing[b]	0.078
R-19	0	Conventional framing	0.067
R-19	0	Intermediate framing[b]	0.063
R-19	0	Advanced framing[d]	0.062
R-21	0	Conventional framing	0.063
R-21	0	Intermediate framing[b]	0.059
R-21	0	Advanced framing[d]	0.057
R-23	0	Conventional framing	0.059
R-23	0	Intermediate framing	0.055
R-23	0	Advanced framing	0.053
R-13	3.5[e]	Conventional framing	0.065
R-13	5[e]	Conventional framing	0.059
R-13	7[e]	Conventional framing	0.053
R-13	3.5[e]	Advanced framing [d]	0.062
R-13	5[e]	Advanced framing [d]	0.056
R-13	7[e]	Advanced framing [d]	0.050
R-15	3.5[e]	Conventional framing	0.062
R-15	5[e]	Conventional framing	0.056
R-15	7[e]	Conventional framing	0.050
R-15	3.5[e]	Advanced framing [d]	0.057
R-15	5[e]	Advanced framing [d]	0.052
R-15	7[e]	Advanced framing [d]	0.047
R-19	3.5[e]	Conventional framing	0.052
R-19	5[e]	Conventional framing	0.048
R-19	7[e]	Conventional framing	0.044
R-19	3.5[e]	Advanced framing [d]	0.049
R-19	5[e]	Advanced framing [d]	0.046
R-19	7[e]	Advanced framing [d]	0.042
R-21	3.5[e]	Conventional framing	0.049
R-21	5[e]	Conventional framing	0.045
R-21	7[e]	Conventional framing	0.041
R-21	3.5[e]	Advanced framing [d]	0.046
R-21	5[e]	Advanced framing [d]	0.043
R-21	7[e]	Advanced framing [d]	0.039
R-23	3.5[e]	Conventional framing	0.046
R-23	5[e]	Conventional framing	0.042
R-23	7[e]	Conventional framing	0.038
R-23	3.5[e]	Advanced framing [d]	0.043
R-23	5[e]	Advanced framing [d]	0.040
R-23	7[e]	Advanced framing [d]	0.036

For SI: 1 inch = 25.4 mm.

a. *U*-factors are for wood-framed construction. *U*-factors for other assemblies which include steel framing, brick or other masonry, stucco, etc., shall be calculated using standard ASHRAE *Handbook of Fundamentals* procedures.
b. Intermediate framing consists of wall studs placed at a minimum 16 inches 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 ×·ft^2 ×ºF per lineal foot of concrete slab perimeter for 24 inches below-grade.

N1104.2.7 Recessed lighting fixtures. Recessed lighting fixtures installed within the building thermal 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 cutout 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 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 retarder or other air-tight assembly manufactured for this purpose.

N1104.2.8 Doors and pull-down stairs to unconditioned spaces. Service doors between unconditioned and *conditioned spaces* shall meet the thermal requirements of Sections N1104.2.9.1 and N1104.2.9.2.

N1104.2.8.1 Vertical doors. *U*-factors for vertical doors providing access from conditioned to unconditioned spaces shall comply with the exterior door provisions of Table N1101.1(1).

N1104.2.8.2 Pull-down stairs. Horizontal pull-down stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces shall have a maximum average *U*-factor of U-0.10 or an *R*-value of not less than R-10, have a net area of the framed opening not exceeding 13.5 square feet, and have the perimeter of the hatch weatherstripped.

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. Doors shall meet the air leakage requirements of Section N1104.8.

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 ~~with glazed area exceeding 10 square feet (0.93 m^2)~~ 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) and less than 10 square feet (0.93 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 does not need to be included in Table N1104.1(1) 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 thermal 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. All fenestrations shall have labels. The labels shall be a National Fenestration Rating Council (NFRC) certified product or a state-approved label for windows produced in low volume. All labeling shall conform to the following requirements:

1. Be imprinted and not handwritten.
2. Face the interior of the room.
3. List the U-factor.
4. Be attached to the window until the building inspector inspects and verifies the labeling.

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.** Air infiltration rates for all exterior windows, swinging doors and sliding glass doors shall be certified in accordance with ASTM E283, *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.~~

~~**Exception:** Site-built windows.~~

N1104.4.3 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of not greater than 0.3 cfm per square foot (1.5 L/s/m^2), and for swinging doors, not greater than 0.5 cfm per square foot (2.6 L/s/m^2) when tested in accordance with NFRC 400-2020 or AAMA/WDMA/CSA 101/I.S.2/A440-17 by an accredited, independent laboratory and listed and labeled by the manufacturer.

Exception: Site-built windows, *skylights* and doors.

N1104.4.4 Alterations. New windows shall have a maximum *U*-factor as required by Table N1101.1(1).

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 2 × studs at 24 inches (406 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) to 2 inches (51 mm) in thickness shall be insulated with insulation that has a value of R-4 or greater per 1-inch (25.4 mm) thickness. Voids in headers greater than 2 inches (51 mm) in depth shall be insulated to a minimum level of R-10. ~~Nonstructural headers (such as in gable-end walls) shall be eliminated and replaced with insulation to achieve thermal performance levels equivalent to 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 2 × 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) to 2 inches (51 mm) in thickness shall be insulated with insulation that has a value of R-4 or greater per 1 inch (25.4 mm) thickness. Voids in headers greater than 2 inches (51 mm) in depth shall be insulated to a minimum level of R-10. ~~Nonstructural headers (such as in gable-end walls) shall be eliminated and replaced with insulation to achieve thermal performance levels equivalent to 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 subfloor 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 shall 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 building thermal envelope shall be constructed to limit air leakage in accordance with this section.

N1104.8.1 Air barriers. A continuous air barrier shall be installed and fully aligned with the building thermal envelope on every vertical portion of air-permeable insulation and on the warm side of horizontal, air-permeable insulation. Air-permeable insulation shall not be used as a sealing material.

Exception: Unvented attics, continuous insulation walls and similar conditions where an impermeable insulation layer forms an air barrier.

N1104.8.2 Sealing required. Exterior joints around window and door frames, between wall cavities and window or door frames, between walls and foundation, between walls 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*.

Sealing for the purpose of creating a continuous air barrier shall be in accordance with the applicable requirements of Table N1104.8, or the *dwelling* shall be tested to demonstrate a blower door result not greater than ~~4.0~~ 3.25 ACH50.

N1104.8.2.1 Top plate sealing. At all walls in contact with vented attics, the wall covering (gypsum board or other) shall be sealed to the top plate with caulk, sealant, gasket or other *approved* material.

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. Vapor retarders shall be installed in accordance with Section R318.

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 installed in accordance with Chapter 4.

TABLE N1104.8
AIR BARRIER INSTALLATION AND AIR SEALING REQUIREMENTS

COMPONENT	AIR BARRIER CRITERIA
General requirements	A continuous air barrier shall be installed in alignment with the building thermal envelope.
	Breaks or joints in the air barrier shall be sealed.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed.
	Access openings, drop-down stairs, or knee wall doors to unconditioned attic spaces shall be gasketed and sealed.
Walls	The junction of the foundation and sill plate shall be sealed.
	The junction of the top plate and the top of interior walls shall be sealed between wall cavities and windows or door frames.
	All penetrations or utility services through the top and bottom plates shall be sealed.
	Knee walls shall be sealed.
Windows, skylights and doors	The annular space between framing and skylights, and the jambs of windows and doors shall be air sealed. Framing cavities around windows, skylights and doors shall contain continuous insulation or be installed per the fenestration manufacturer's instructions.
Rim/band joists	Rim/band joists shall be a part of the thermal envelope and have a continuous air barrier.
Floors Including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations and flue shafts opening to exterior or unconditioned space shall be sealed.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.
Shower/tub on exterior walls	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

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 of duct systems exposed to unconditioned spaces, and buried ductwork within insulation that meets the exception to Section N1105.3, shall be insulated to minimum R-8.

Exceptions:

1. The replacement or addition of a furnace, air conditioner or heat pump shall not require existing ducts to be insulated to current code.
2. Exhaust and intake ductwork.

N1105.3 Installation of ducts and air handling equipment. For new construction and *additions*, all new duct systems and air handling equipment and appliances shall be located fully within the *building thermal envelope*.

Exceptions:

1. Ventilation intake ductwork and exhaust ductwork.
2. Up to ~~5 percent of the length of an~~ 10 feet (2438 mm) of HVAC ~~system~~ ductwork.
3. Where two measures are selected from Table N1101.2(2) and HVAC supply and return ductwork is installed in accordance with either Section N1105.3.1, N1105.3.2 or N1105.3.3.

~~Ducts deeply buried in insulation in accordance all of the following:~~

~~3.1. Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the duct between the duct and unconditioned attic.~~

~~3.2. Insulation depth marker flags shall be installed on the ducts every 10 feet (3048 mm) or as *approved* by the *building official*.~~

N1105.3.1 Deeply buried duct in attic. Ducts deeply buried in *attic* insulation shall be in accordance with all of the following when using Section N1105.3, Exception 3:

1. Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the duct between the duct and unconditioned *attic*.
2. All ductwork in the *attic* shall be insulated to R-8.
3. Insulation depth marker flags shall be installed on the ducts every 10 feet (3048 mm) or as *approved* by the *building official*.

Exception: HVAC ductwork shall be permitted to be located outside of the *building thermal envelope* where the duct is insulated to a minimum of R-27 with a Class II or III vapor retarder.

N1105.3.2 Ducts in unvented crawlspace. Ducts located in unvented crawlspace shall be in accordance with all of the following when using Section N1105.3, Exception 3:

1. In addition to meeting Section R408.3, all seams of the vapor barrier shall overlap minimum 12 inches (305 mm) and be sealed with tape or other *approved* method.
2. All ductwork in the crawlspace shall be insulated to R-8.
3. The floor between the crawlspace and the dwelling shall be insulated with minimum R-30. ~~or the walls of the crawlspace shall be insulated with R-15 continuous insulation and R-21 insulation at vertical framed cavity locations.~~

N1105.3.3 Deeply buried duct in vented crawlspace. Ducts deeply buried in crawlspace insulation shall be in accordance all of the following when using Section N1105.3, Exception 3:

1. Insulation shall be installed to fill gaps and voids between the duct and the floor above, and a minimum of R-19 insulation shall be installed between the duct between the duct and unconditioned crawlspace.
2. All ductwork in the crawlspace shall be insulated to R-8.

Exception: HVAC ductwork shall be permitted to be located outside of the *building thermal envelope* where the duct is insulated to a minimum of R-27 with a Class II or III vapor retarder.

N1105.4 HVAC controls. All heating, ventilating and air-conditioning systems shall be provided controls as specified herein.

N1105.4.1 Temperature controls. 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.

N1105.4.1.1 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 kilowatts (6.826 Btu/h) or less may be controlled by readily accessible off-hour controls.

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

N1105.4.1.2 Smart thermostat. For new construction the thermostat shall meet Energy Star Smart Thermostat criteria with minimum control feature of either integral occupancy sensing or geofencing or *approved* equivalent.

Exception: Individual heating or cooling units with capacity of 2 kilowatts (6,826 Btu/h) or less heating capacity or with cooling capacity of less than 18,000 Btu/h.

N1105.4.1.3 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.~~ Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

~~**N1105.4.4.1.1 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 4ºF (40ºC). There shall be no compressor lock-out temperature.~~

N1105.4.2 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.

N1105.4.3 Temperature zoning. Each separate heating, ventilating and air-conditioning system shall be provided with 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.

N1105.5 Outside combustion air. See Section R1006 for required outside combustion air for masonry fireplaces, factory-built fireplace and factory-built stoves.

N1105.6 Ventilation fan efficiency. Bathroom exhaust fans and outdoor ventilation air supply fans shall be Energy Star certified. A fan that is the air mover for a heating or cooling system that serves an individual *dwelling unit* shall not be used to provide outdoor air except where its fan efficacy is not less than 1.2 cfm of outdoor airflow per watt when there is no demand for heating or cooling.

N1105.7 Furnace fan efficiency. New central furnaces shall have electronically commutated fan motors with a fan efficiency rating meeting 10 CFR 430.32(y).

SECTION N1106
PIPING INSULATION

N1106.1 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105ºF (40.5ºC) or below 55ºF (13ºC) shall be insulated to a minimum of R-3.

N1106.2 Domestic and service hot water systems. Domestic hot water piping shall be insulated to a minimum of R-3 at the following locations:

1. Pipe not located fully within the *conditioned space* ~~outside the building thermal envelope~~.
2. The first 8 feet (2438 mm) of pipe into and out of a water heater.
3. Recirculating water piping.

N1106.3 Protection of piping insulation. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind. The protection shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be used for protection system.

SECTION N1107
LIGHTING AND POWER

N1107.1 General. The provisions of this section apply to power and 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-efficiency interior lighting. All permanently installed lighting fixtures shall be *high efficiency light sources*.

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

Exception: Two permanently installed lighting fixtures are not required to be *high-efficiency light sources* when controlled by a dimmer or automatic control.

N1107.3 High-efficiency exterior lighting. All exterior lighting fixtures affixed to the exterior of the building shall be *high-efficiency light sources*.

Exception: Two permanently installed lighting fixtures are not required to be *high-efficiency light sources* when controlled by automatic control.

~~**N1107.4 Solar interconnection pathway.**~~

~~**N1107.5 Electric vehicles.** Reserved. This section will be updated with an interim amendment. See Oregon.gov/bcd.~~

SECTION N1108
PLUMBING FIXTURE EFFICIENCY

N1108.1 General. This section shall apply to plumbing fixture efficiency.

N1108.1.1 Fixture efficiency. Fixture efficiency shall be per the *Plumbing Code*.

SECTION NA1109
ENERGY RATING INDEX (ERI) COMPLIANCE

NA1109.1 Scope. This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

NA1109.2 ERI compliance. Compliance based on the ERI requires that the *rated design* meets the *building thermal envelope* requirements in Section N1104 and shall be shown to have a score less than or equal to the values in Table NA1109.1 when compared to the *ERI reference design* determined in accordance with RESNET/ICC 301, excluding onsite power production (OPP).

TABLE NA1109.1
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX (Not including OPP)
4C	54
5C	55

NA1109.3 Verification by approved agency. Verification of compliance with Section NA1109 as outlined in Section NA1109.1 shall be completed by the authority having jurisdiction or an *approved* third-party inspection agency in accordance with Section R109.2.

NA1109.4 Documentation. Documentation of the software used to determine the ERI and the parameters for the *residential building* shall be in accordance with Sections NA1109.4 through NA1109.8.

NA1109.4.1 Compliance software tools. Software tools used for determining ERI shall be Approved Software Rating Tools in accordance with RESNET/ICC 301.

NA1109.4.2 Compliance report. Compliance software tools shall generate a report that documents that the home and the ERI score of the *rated design* complies with Section NA1109.1. Compliance documentation shall be created for the proposed design and shall be submitted with the application for the building *permit*. Confirmed compliance documents of the built *dwelling unit* shall be created and submitted to the *building official* for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections NA1109.6 and NA1109.8.

NA1109.4.2.1 Proposed compliance report for permit application. Compliance reports submitted with the application for a building *permit* shall include the following:

1. Building street address, or other *building site* identification.
2. Declare ERI on title page and building plans.
3. The name of the individual performing the analysis and generating the compliance report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table NA1109.1 when compared to the *ERI reference design*. The certificate shall document the building component energy specifications that are included in the calculation, including: component level insulation *R*-values or *U*-factors; assumed duct system and building envelope air leakage testing results; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system.
7. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

NA1109.4.2.2 Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other *building site* identification.
2. Declaration of ERI on title page and on building plans.
3. The name of the individual performing the analysis and generating the report.
4. The name and version of the compliance software tool.
5. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
6. A final confirmed certificate indicating that the confirmed *rated design* of the built home complies with Section NA1109.1. The certificate shall report the energy features that were confirmed to be in the home, including: component-level insulation *R*-values or *U*-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed. Where on-site renewable energy systems have been installed on or in the home, the certificate shall report the type and production size of the installed system.

NA1109.4.4 Additional documentation. The *building official* shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the *ERI reference design*.
2. A certification signed by the builder providing the building component characteristics of the *rated design*.
3. Documentation of the actual values used in the software calculations for the *rated design*.

NA1109.4.5 Specific approval. Performance analysis tools meeting the applicable subsections of Section NA1109 shall be *approved*. Documentation demonstrating the approval of performance analysis tools in accordance with Section N1109.4 shall be provided.

NA1109.4.6 Input values. Where calculations require input values not specified by Sections N1101, N1104, N1105, N1106, N1107 and N1108, those input values shall be taken from RESNET/ICC 301.

~~**NA1109.1 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/m^2 per year). The annual energy use of the proposed building shall be 8 percent less than the code baseline prescriptive requirements without the application of additional measures in accordance with Table N1101.1(2).~~

~~**NA1109.2 Basis for comparison.** Both baseline and proposed alternative designs shall include parameters as specified in Table NA1109.2.~~

~~**NA1109.2.1 Internal heat gain.** The total internal heat gain shall be calculated by Equation NA1109.2.1(1). For single-zone calculations, the daily total sensible internal gains (Btu/day) shall be determined by Equation NA1109.2.1(2). For multiple-zone HVAC systems, the daily total sensible internal gains (Btu/day) shall be determined by Equation NA1109.2.1(2) for the living zone and Equation NA1109.2.1(3) for the sleeping zone. The daily total latent load for each zone shall be determined using Equation NA1109.2.1(4).~~

~~Internal heat gains shall be distributed over the day according to the profile in Table NA1109.2.~~

~~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 NA1109.2.1(1)**~~

~~Total Heat Gains = Sensible Heat Gains + Latent Heat Gains~~

~~**Equation NA1109.2.1(2)**~~

~~Single Zone or Living Zone: Sensible Heat Gains = (Floor Area of Zone 15 Btu/day ft^2) + (Number of living units 20,000 Btu/day)~~

~~**Equation NA1109.2.1(3)**~~

~~Sleeping Zone: Sensible Heat Gains = Floor Area of Zone 15 Btu/day ft^2~~

~~**Equation NA1109.2.1(4)**~~

~~Latent Heat Gains = 0.2 Sensible Heat Gains~~

~~**NA1109.2.2 Thermostat setpoints.** In the analysis for both the baseline and proposed designs, all conditioned spaces shall be maintained at the specified thermostat setpoints 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 NA1109.2.2. For multiple zone designs, the multiple zone thermostat settings in Table NA1109.2.2 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 NA1109.2**~~
~~**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~~	~~0.3 ACH Natural~~	~~Same as proposed~~
~~**HVAC Systems**~~		
~~HVAC system type(s)~~	~~As designed~~	~~Same as proposed~~
~~HVAC efficiency~~	~~As designed~~	~~Same as proposed Federal minimum[b]~~
~~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 Code minimum WHV~~
~~**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. Code baseline skylight area shall be same as proposed up to a maximum of two percent of the heated space floor area.~~

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

NA1109.3 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:

TABLE NA1109.2.2
THERMOSTAT SETTINGS (°F)

TIME OF DAY	SINGLE ZONE		MULTIPLE ZONE			
			Zone 1 Living		Zone 2 Sleeping	
	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

NA1109.3.1 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 and shape, and transfer characteristics of mass, air, moisture and heat) and hourly climatic data.

NA1109.3.2 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 on 8,760 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.

NA1109.3.2.1 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 nonoccupied hours.
4. Mechanical equipment: design capacity, part load profile.
5. Internal heat generation: lighting, equipment, number of people during occupied and nonoccupied periods.

NA1109.4 Documentation. Proposed alternative designs, submitted as requests for exceptions 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.

NA1109.4.1 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 2021 ASHRAE *Handbook of Fundamentals*.
2. 2000 2020 ASHRAE *Handbook of HVAC Systems and Equipment*.
3. ASHRAE *Principles of Heating, Ventilating and Air Conditioning, Ninth Edition*.

PART III FENESTRATION STANDARD

SECTION NF1110
SCOPE

NF1110.1 General. All windows installed in Oregon shall meet the requirements of this section.

SECTION NF1111
ALTERATIONS

NF1111.1 Windows. Windows shall be tested and labeled in accordance with Section N1104.4.

The following information is reprinted 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.

The *U*-factor for windows may be a weighted average of total window area when all other building envelope measures comply with the 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 NF1112
DEFINITIONS

NF1112.1 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 NF1114.2 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. 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. 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 NF1113
~~INSULATED~~ INSULATING GLASS CERTIFICATION

NF1113.1 General. Sealed ~~insulated~~ insulating glass units shall conform to~~, or be in test for, ASTM E774–97 *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~~ ASTM E2190 *Standard Specification for Insulating Glass Unit Performance and Evaluation* and shall be certified by an accredited insulating glass unit certification program.

SECTION NF1114
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.

NF1114.1 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.

NF1114.2 Windows products exempt from testing. The following products are exempt from thermal performance testing as specified in Section NF1114.1.

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.

NF1114.2.1 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 NF1114.3, Item 1.
2. Glazed doors produced in low volume are assigned default *U*-factors as specified in Section NF1114.3, Item 2.
3. *Skylights* produced in low volume are assigned default *U*-factors as specified in Section NF1114.3, 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 NF1114.3, Item 3.
5. Vertical and overhead glazing contained in sun-rooms/solariums are assigned default *U*-factors as specified in Section NF1114.3, Items 1, 2 and 4.
6. *Skylights* specified in Section NF1114.2, Item 5 shall be assigned a default *U*-factor of 0.50.

NF1114.3 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 NF1114.3(1) for windows,
2. By using Table NF1114.3(2) for glazed doors,
3. By using Table NF1114.3(1) for *skylights* based on an overall *U*-factor of U-0.50.
4. By using Table NF1114.3(1) for overhead glazing installed in sunrooms/solariums based on an overall *U*-factor of U-0.35.

SECTION NF1115
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.

NF1115.1 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.

NF1115.2 Label description. All windows shall have state-approved labeling except as provided in Section NF1115.1, 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.

NF1115.2.1 Windows produced in low volume labels. Labels for windows produced in low volume under NF1112(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 NF1112(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.

NF1115.3 Labels for skylights exempted from thermal performance standards. Labels for *skylights* exempt from thermal performance standards under Section NF1114.2, Item 5, because of its 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 NF1112.1.
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."

NF1115.4 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 NF1112;
3. Show the *U*-factor determined by Section NF1114.2.1, Item 5 or NF1114.3, 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.

NF1115.5 Labels for skylights exempt from testing. Labels for skylights that are exempt from testing in accordance with Section NF1114.2(4) shall:

1. Specify *skylight* components;
2. State "Calculated *U*-factor Skylight Compliance Label";
3. State *U*-factor determined by Section NF1114.2.1, Item 4; and
4. Show a production count number that does not exceed the maximums established in Section NF1112.

NF1115.6 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.

NF1115.7 Label distribution. Labels provided under Section NF1114.2 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 NF1116
AIR LEAKAGE REQUIREMENTS

NF1116.1 General. Windows shall comply with the air leakage requirements of Section N1104.8.

Exception: Site-built windows.

TABLE NF1114.3(1)
APPROVED WINDOW DEFAULT *U*-VALUES[a, b]

DESCRIPTION[c, d, e, f, g] (inches)	FRAME TYPE[h]		
	ALUMINUM THERMAL BREAK[i]	WOOD/VINYL	ALUMINUM 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	0.30	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, SF6 and argon/SF6 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.

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.*(continued)*

TABLE NF1114.3(1)—continued
APPROVED WINDOW DEFAULT *U*-VALUES[a, b]

i. Aluminum 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 ×·ft^2 ×°F;
   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 Aluminum 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 Aluminum Clad Wood Reinforced Vinyl windows.

TABLE NF1114.3(2)
APPROVED GLAZED DOOR DEFAULT *U*-VALUES[a]

DESCRIPTION[b, c, d, e] (inches)	DOOR MATERIAL			
	INSULATED[f]	WOODg		
	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.

d. *U*-factors listed for argon shall consist of sealed, gas-filled, insulated units for argon, CO^2, SF6 and argon/SF6 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/ft^2/°F; 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.