

Part IV—Energy Conservation

CHAPTER 11 ENERGY EFFICIENCY

N1101.1 Scope. This chapter regulates the energy efficiency for the design and construction of buildings regulated by this code.

Exception: Portions of the building envelope that do not enclose *conditioned space*.

N1101.4 Above code programs. The *building official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this chapter. Buildings *approved* in writing by such an energy efficiency program shall be considered in compliance with this chapter.

N1101.7.1 Warm humid counties. Warm humid counties are identified in Table N1101.7 by an asterisk.

Figure 1101.7 Climate Zones

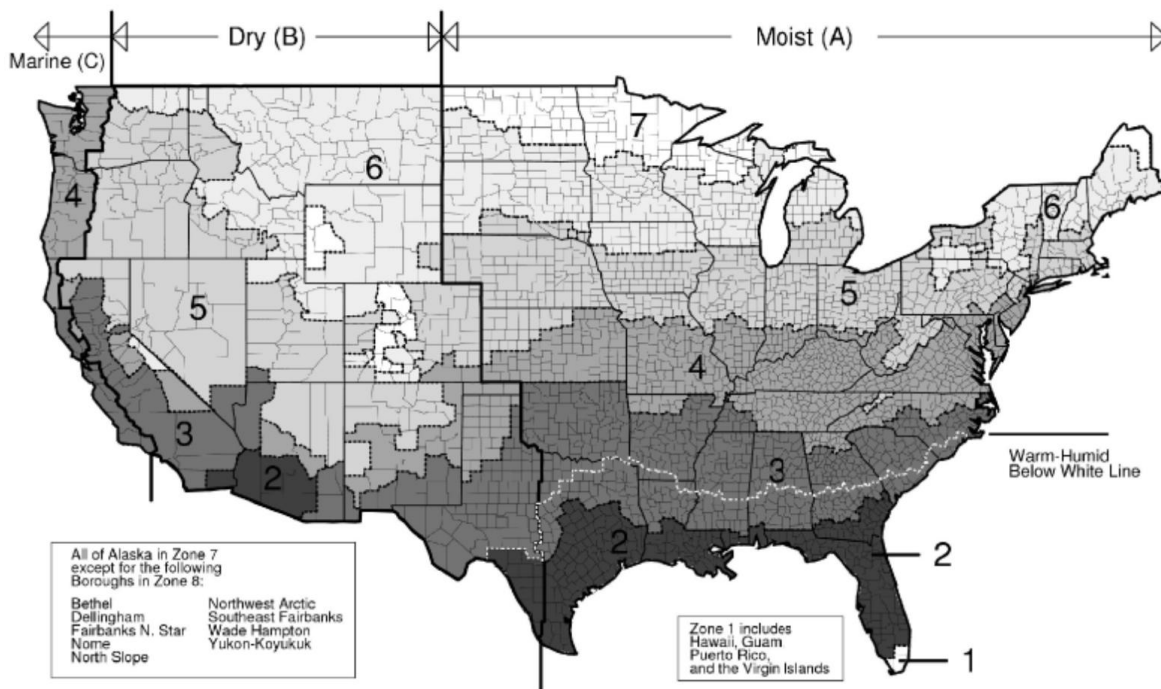


Table N1101.7 Climate zones, moisture regimes and warm humid designations by state, county and territory.

OKLAHOMA key: A – moist, B – dry, C – marine. Absence of moisture designation indicates moisture regime is irrelevant. Asterisk (*) indicates a warm humid location.

All counties in Oklahoma are in climate zone 3A EXCEPT Beaver, Cimarron and Texas which are 4B.

3A: Adair, Alfalfa, Atoka, Beckham, Blaine, Bryan, Caddo, Canadian, Carter, Cherokee, Choctaw, Cleveland, Coal, Comanche, Cotton, Craig, Creek, Custer, Delaware, Dewey, Ellis, Garfield, Garvin, Grady, Grant, Greer, Harmon, Harper, Haskell, Hughes, Jackson, Jefferson, Johnston, Kay, Kingfisher, Kiowa, Latimer, Le Flore, Lincoln, Logan, Love, Major, Marshall, Mayes, McClain, McCurtain, McIntosh, Murray, Muskogee, Noble, Nowata, Okfuskee, Oklahoma, Okmulgee, Osage, Ottawa, Pawnee, Payne, Pittsburg, Pontotoc, Pottawatomie, Pushmataha, Roger Mills, Rogers, Seminole, Sequoyah, Stephens, Tillman, Tulsa, Wagoner, Washington, Washita, Woods, Woodward

N1101.10 Identification. Materials, systems and *equipment* shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

N1101.10.1 Building thermal envelope insulation. An R-value identification *mark* shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or more wide. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and R-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the area covered and R-value of installed thickness shall be listed on the certificate. The insulation installer shall sign, date and post the certificate in a conspicuous location on the job site.

N1101.10.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 ft² (28 m²) throughout the *attic* space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) high. Each marker shall face the *attic* access opening. Spray polyurethane foam thickness and installed R-value shall be listed on the certificate provided by the insulation installer.

N1101.10.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's R-value *mark* is readily observable upon inspection.

N1101.10.3 Fenestration product rating. U-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Products lacking such a *labeled* U-factor shall be assigned a default U-factor from Tables N1101.10.3(1) and N1101.10.3(2). The solar heat gain coefficient (SHGC) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Products lacking such a *labeled* SHGC shall be assigned a default SHGC from Table N1101.10.3(3).

N1101.10.4 Insulation product rating. The thermal resistance (R-value) of insulation shall be determined in accordance with the CFR Title 16, Part 460, in units of h · ft² · °F/Btu at a mean temperature of 75°F (24°C).

N1101.11 Installation. All materials, systems and *equipment* shall be installed in accordance with the manufacturer's installation instructions and the provisions of this code.

N1101.11.1 Protection of exposed foundation insulation. Insulation applied to the exterior of *basement* walls, crawl space walls, and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (152 mm) below *grade*.

N1101.13 Compliance. Compliance shall be demonstrated by either meeting the requirements of the 2009 *International Energy Conservation Code*[®] or meeting the requirements of this chapter. Climate zones from Figure N1101.7 or Table N1101.7 shall be used in determining the applicable requirements from this chapter.

TABLE N1101.10.3(1) DEFAULT GLAZED FENESTRATION U-FACTORS

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE N1101.10.3(2) DEFAULT DOOR U-FACTORS

DOOR TYPE	U-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

TABLE N1101.10.3 (3) DEFAULT GLAZED FENESTRATION SHGC

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6

SECTION N1102 BUILDING THERMAL ENVELOPE

N1102.1.2 Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Table N1102.1.2 based on the climate zone specified in Table N1101.7.

N1102.1.3 R-value computation. Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-value. The manufacturer's settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films.

N1102.1.4 U-factor alternative. An assembly with a U-factor equal to or less than that specified in Table N1102.1.4 shall be permitted as an alternative to the R-value in Table N1102.1.2.

N1102.1.5 Total UA alternative. If the total *building thermal envelope UA* (sum of U-factor times assembly area) is less than or equal to the total UA resulting from using the U-factors in Table N1102.1.4, (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table N1102.1.2. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

TABLE N1102.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^{a,m}

Climate Zone	Fenestration U-factor ^b	Skylight U-factor ^b	Glazed Fenestration SHGC	Ceiling R-value	Wood Frame Wall R-value	Mass wall R-value ^j	Floor R-value	Basement wall R-value ^c	Slab R-value and depth ^d	Crawl space wall R-value ^c
3	0.40 ⁱ	0.55	0.35 ^{e,j}	30	13	8/13	19	5/13 ^f	0 ^l	5/13
4	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2ft	10/13

For SI: 1 foot = 304.8 mm.

- a) R-values are minimums. U-factors and SHGC are maximums. R-19 batts compressed in to nominal 2x6 framing cavity such that the R-Value is reduced by R-1 or more shall be marked with the compressed batt R-Value in addition to the full thickness R- value.
- b) The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- c) The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.
- d) R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
- e) There are no SHGC requirements in the Marine Zone.
- f) Basement wall insulation is not required in warm-humid locations as defined by Figure N1101.7 and Table N1101.7.
- g) Or insulation sufficient to fill the framing cavity, R-19 minimum.
- h) "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
- i) For impact-rated fenestration complying with Section R301.2.1.2, the maximum U-Factor shall be 0.75 in zone 2 and 0.65 in zone 3.
- j) For impact-resistant fenestration complying with Section R301.2.1.2 of the 2015 IRC, the maximum SHGC shall be 0.40.
- k) The second R-value applies when more than half the insulation is on the interior.
- l) If foundation/slab insulation is used and slab ledge exists, ½" insulation in vertical position is allowed as thermal break between slab edge and foundation wall so that slab can still bear on horizontal ledge.
- m) In addition to the requirements in Table N1102.1 one of the following improvements are required:
 1. Fenestration U Factors to be .35
 2. Wood Frame Wall R-Value to be R15
 3. Slab R-Value and Depth to be 5, 2ft reference N1102.2.8 for installation details
 4. Ceiling R-Value to be R38

Exception: If duct testing is performed and passed in accordance with N1103.2.2 by either the Post-construction test or Rough-in test no further upgrade is required from the values in Table N1102.1.2.

TABLE N1102.1.4 EQUIVALENT U-FACTORS^a

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091 ^c	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065

- a) Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- b) When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except Marine, and the same as the frame wall *U*-Factor in Marine Zone 4 and in zones 5 through 8.
- c) Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure N1101.7 and Table N1101.7.

N1102.2 Specific insulation requirements.

N1102.2.1 Ceilings with attic spaces. When Section N1102.1.2 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the *U*-factor alternative approach in Section N1102.1.4 and the Total *UA* alternative in Section N1102.1.5.

N1102.2.2 Ceilings without attic spaces. Where Section N1102.1.2 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section N1102.1.2 shall be limited to 500 ft² (46 m²) or 20 percent of the total insulated ceiling area, whichever is less. Where Section N1102.1.2 would require insulation level R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-19. This reduction of insulation from the requirements of Section N1102.1.2 shall be limited to 500 ft² (46 m²) or 20 percent of the total insulated ceiling area, whichever is less.

N1102.2.4 Access hatches and doors. Access doors from *conditioned spaces* to unconditioned spaces such as attics and crawl spaces shall be weather-stripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all *equipment* which prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the *attic* access is opened and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.

N1102.2.5 Mass walls. Mass walls, for the purposes of this chapter, shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs.

N1102.2.6 Steel-frame ceilings, walls and floors. Steel frame ceilings, walls and floors shall meet the insulation requirements of Table N1102.2.6 or shall meet the *U*-factor requirements in Table N1102.1.4. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

Exception: In climate zones 1 and 2, the continuous insulation requirements in Table N1102.2.5 shall be permitted to be reduced to R-3 for steel frame wall assemblies with studs spaced at 24 inches (610 mm) on center.

N1102.2.8 Floors. Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

N1102.2.9 Basement walls. *Exterior walls* associated with conditioned basements shall be insulated from the top of the *basement wall* down to 10 feet (3048 mm) below *grade* or to the *basement* floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections N1102.1.2 and N1102.2.8.

N1102.2.10 Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 12 inches below *grade* shall be insulated in accordance with Table N1102.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below *grade* shall be extended the distance provided in Table N1102.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. The top edge of the insulation installed between the *exterior wall* and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away

from the *exterior wall*. Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

N1102.2.11 Crawl space walls. As an alternative to insulating floors over crawl spaces, insulation of crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished *grade* level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder. All joints of the vapor retarder shall overlap by 6 inches (152 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (152 mm) up the stem wall and shall be attached to the stem wall.

TABLE N1102.2.6 STEEL-FRAME CEILING, WALL AND FLOOR INSULATION (R-VALUE)

WOOD FRAME R- VALUE	COLD-FORMED STEEL EQUIVALENT R-VALUE ^a
Steel Truss Ceilings^b	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings^b	
R-30	R-38 in 2 x 4 or 2 x 6 or 2 x 8 R-49 in any framing
R-38	R-49 in 2 x 4 or 2 x 6 or 2 x 8 or 2 x 10
Steel-Framed Wall	
R-13	R-13 + 5 or R-15 + 4 or R-21 + 3 or R-0 + 10
R-19	R-13 + 9 or R-19 + 8 or R-25 + 7
R-21	R-13 + 10 or R-19 + 9 or R-25 + 8
Steel Joist Floor	
R-13	R-19 in 2x6, R-19+R-6 in 2x8 or 2x10
R-19	R-19+R-6 in 2x6 or R-19+R-12 in 2x8 or 2x10

a) Cavity insulation R-value is listed first, followed by continuous insulation R-value.

b) Insulation exceeding the height of the framing shall cover the framing.

N1102.2.12 Masonry veneer. Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

N1102.2.13 Thermally isolated sunroom insulation. The minimum ceiling insulation R-values shall be R-19 in zones 1 through 4 and R-24 in zones 5 through 8. The minimum wall R-value shall be R-13 in all zones. New wall(s) separating the sunroom from *conditioned space* shall meet the *building thermal envelope* requirements.

N1102.3 Fenestration.

N1102.3.1 U-factor. An area-weighted average of fenestration products shall be permitted to satisfy the *U-factor* requirements.

N1102.3.2 Glazed fenestration SHGC. An area-weighted average of fenestration products more than 50 percent glazed shall be permitted to satisfy the solar heat gain coefficient (SHGC) requirements

N1102.3.3 Glazed fenestration exemption. Up to 15 square feet (1.4 m²) of glazed fenestration per *dwelling unit* shall be permitted to be exempt from *U-factor* and SHGC requirements in Section N1102.1.2. This exemption shall not apply to the *U-factor* alternative approach in Section N1102.1.4 and the Total UA alternative in Section N1102.1.5.

N1102.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m²) in area is exempted from the *U-factor* requirement in Section N1102.1.2. This exemption shall not apply to the *U-factor* alternative approach in Section N1102.1.4 and the Total UA alternative in Section N1102.1.5.

N1102.3.5 Thermally isolated sunroom U-factor. For zones 4 through 8 the maximum fenestration *U*-factor shall be 0.50 and the maximum skylight *U*-factor shall be 0.75. New windows and doors separating the sunroom from *conditioned space* shall meet the *building thermal envelope* requirements.

N1102.3.6 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and solar heat gain coefficient (SHGC) in Table N1102.1.2.

N1102.4 Air leakage.

N1102.4.1 Building thermal envelope. The *building thermal envelope* shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film or solid material.

- A. All joints, seams and penetrations.
- B. Site-built windows, doors and skylights.
- C. Openings between window and door assemblies and their respective jambs and framing.
- D. Utility penetrations.
- E. Dropped ceilings or chases adjacent to the thermal envelope.
- F. Knee walls.
- G. Walls and ceilings separating the garage from *conditioned spaces*.
- H. Behind tubs and showers on *exterior walls*.
- I. Common walls between *dwelling units*.
- J. Attic access openings.
- K. Rim joists junction.
- L. Other sources of infiltration.

N1102.4.1.1 Air sealing and insulation. Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options given by Section N1102.4.1.2 or N1102.4.1.3.

N1102.4.1.2 Testing option. Tested air leakage is less than 7 ACH when tested with a blower door at a pressure of 50 pascals (0.007 psi). Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances.

During testing:

- A. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
- B. Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers;
- C. Interior doors shall be open;
- D. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
- E. Heating and cooling system(s) shall be turned off;
- F. HVAC ducts shall not be sealed; and
- G. Supply and return registers shall not be sealed.

N1102.4.1.3 Visual inspection option. The items listed in Table N1102.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an *approved party* independent from the installer of the insulation or contractor, shall inspect the air barrier and insulation. Where no *approved party* inspects these items the air barrier components shall be viewed as a part of the frame inspection or insulation inspection by the Authority having Jurisdiction.

N1102.4.2 Fireplaces. New wood-burning fireplaces shall have outdoor combustion air.

N1102.4.3 Fenestration air leakage. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cubic foot per minute per square foot [$1.5(L/s)/m^2$], and swinging doors no more than 0.5 cubic foot per minute per square foot [$2.5(L/s)/m^2$], when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory, and listed and *labeled* by the manufacturer.

Exception: Site-built windows, skylights and doors.

TABLE 1102.4.1.1 AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows, and doors	The space between window/door jambs and framing are sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of floor.
Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated and sealed to drywall. Exception-fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior	Air barrier extends behind boxes or air-sealed boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplaces	Fireplace walls include an air barrier.

N1102.4.5 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled as* meeting ASTM E 283 when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the *conditioned space* to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

SECTION N1103 SYSTEMS

N1103.1 Controls. At least one thermostat shall be installed for each separate heating and cooling system.

N1103.1.1 Programmable thermostat. Where the primary heating system is a forced air furnace, at least one thermostat per *dwelling unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

N1103.1.2 Heat pump supplementary heat. 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.

N1103.3 Ducts.

N1103.3.1 Insulation. Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6.

Exception: Ducts or portions thereof located completely inside the *building thermal envelope*.

N1103.2.2 Sealing. Ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.4. For Duct systems with sheet metal plenums, Y's and supply boots only liquid applied sealants complying with 181BM (mastic or similar) or equivalent method, shall be used to seal inner liners and start collars to plenum and any other seams in system. Duct tightness shall be verified by either of the following:

- A. Post-construction test: Leakage to outdoors shall be less than or equal to 8 cfm (3.78 L/s) per 100 ft² (9.29m²) of conditioned floor area or a total leakage less than or equal to 12 cfm (5.66 L/s) per 100 ft² (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler end closure. All register boots shall be taped or otherwise sealed during the test.
- B. Rough-in test: Total leakage shall be less than or equal to 6 cfm (2.83 L/s) per 100 ft² (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm (1.89 L/s) per 100 ft² (9.29 m²) of conditioned floor area.
- C. Visual verification by the Authority Having Jurisdiction or an approved agency,
- D. Exception: Duct tightness test is not required if the air handler and all ducts are located within *conditioned space*.

N1103.3.5 Building cavities. Building framing cavities shall not be used as supply ducts.

N1103.4 Mechanical system piping insulation. Mechanical system piping capable of carrying fluids above 105°F (40°C) or below 55°F (13°C) shall be insulated to a minimum of R-2.

N1103.5 Circulation service hot water systems from N1103.5.1 and N1103.5.2. Energy conservation measures for circulation service potable hot water systems shall be in accordance with sections N1103.5.1 and N1103.5.2.

N1103.5.1 Heated water circulation and temperature systems (Mandatory). Heated water circulation systems shall be in accordance with Section R1103.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R1103.5.1.2. Automatic controls, temperature sensors and pumps shall be *accessible*. Manual controls shall be *readily accessible*.

N1103.5.1.1 Circulation systems. Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

N1103.5.1.2 Heat trace systems. Electric heat trace systems shall comply with IEEE 515.1 or UL 515. Controls for such systems shall automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy.

N1103.5.2 Demand recirculation systems. A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a *demand recirculation water system*. Pumps shall have controls that comply with both of the following:

- A. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.
- B. The control shall limit the temperature of the water entering the cold water piping to 104°F (40°C).

N1103.5.3 Hot water pipe insulation (Prescriptive). Insulation for hot water pipe with a minimum thermal resistance (R-value) of R-3 shall be applied to the following:

- A. Piping 1 inch (25mm) and larger in nominal diameter.
- B. Piping serving more than one dwelling unit.
- C. Piping located outside the conditioned space.
- D. Piping from the water heater to the distribution manifold.
- E. Piping located under a floor slab.
- F. Buried in piping
- G. Supply and return piping in recirculation systems other than demand recirculation systems.

N1103.6 Mechanical ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

N1103.7 Equipment sizing. Heating and cooling *equipment* shall be sized as specified in Section M1401.3.

N1103.9 Snow melt system controls. Snow- and ice-melting systems supplied through energy service to the building shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C) and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (5°C).

N1103.10 Pools. Pools shall be provided with energy conserving measures in accordance with Sections N1103.10.2 through N1103.10.4.

N1103.10.2 Pool heaters. All pool heaters shall be equipped with a *readily accessible* on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas or LPG shall not have continuously burning pilot lights.

N1103.10.3 Time switches. Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exceptions:

- A. Where public health standards require 24-hour pump operation.
- B. Where pumps are required to operate solar- and waste-heat-recovery pool heating systems.

N1103.10.4 Pool covers. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

SECTION N1104 LIGHTING SYSTEMS

N1104.1 Lighting equipment. Not less than 75 percent of the lamps in permanently installed luminaires shall be high-efficacy lamps or not less than 75 percent of the permanently installed luminaires shall contain only high-efficacy lamps.

Exception: Low-voltage lighting.