

Part IV — Energy Conservation

CHAPTER 11 ENERGY EFFICIENCY

This chapter has been revised in its entirety; there will be no marginal markings

SECTION N1101 GENERAL

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.

N1101.2 Compliance. Compliance shall be demonstrated by either meeting the requirements of the *International Energy Conservation Code* or meeting the requirements of this chapter. Climate zones from Figure N1101.2 or Table N1101.2 shall be used in determining the applicable requirements from this chapter.

N1101.2.1 Warm humid counties. Warm humid counties are listed in Table N1101.2.1.

N1101.3 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.

N1101.4 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.

N1101.4.1 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.

N1101.4.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.

N1101.5 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 N1101.5(1) and N1101.5(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 N1101.5(3).

N1101.6 Installation. All materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions and the provisions of this code.

N1101.6.1 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.

N1101.7 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.

N1101.8 Certificate. A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall be completed by the builder or registered design professional. The certificate shall list the predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor) and ducts outside conditioned spaces; *U*-factors for fenestration; and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the type and efficiency of heating, cooling and service water heating equipment.

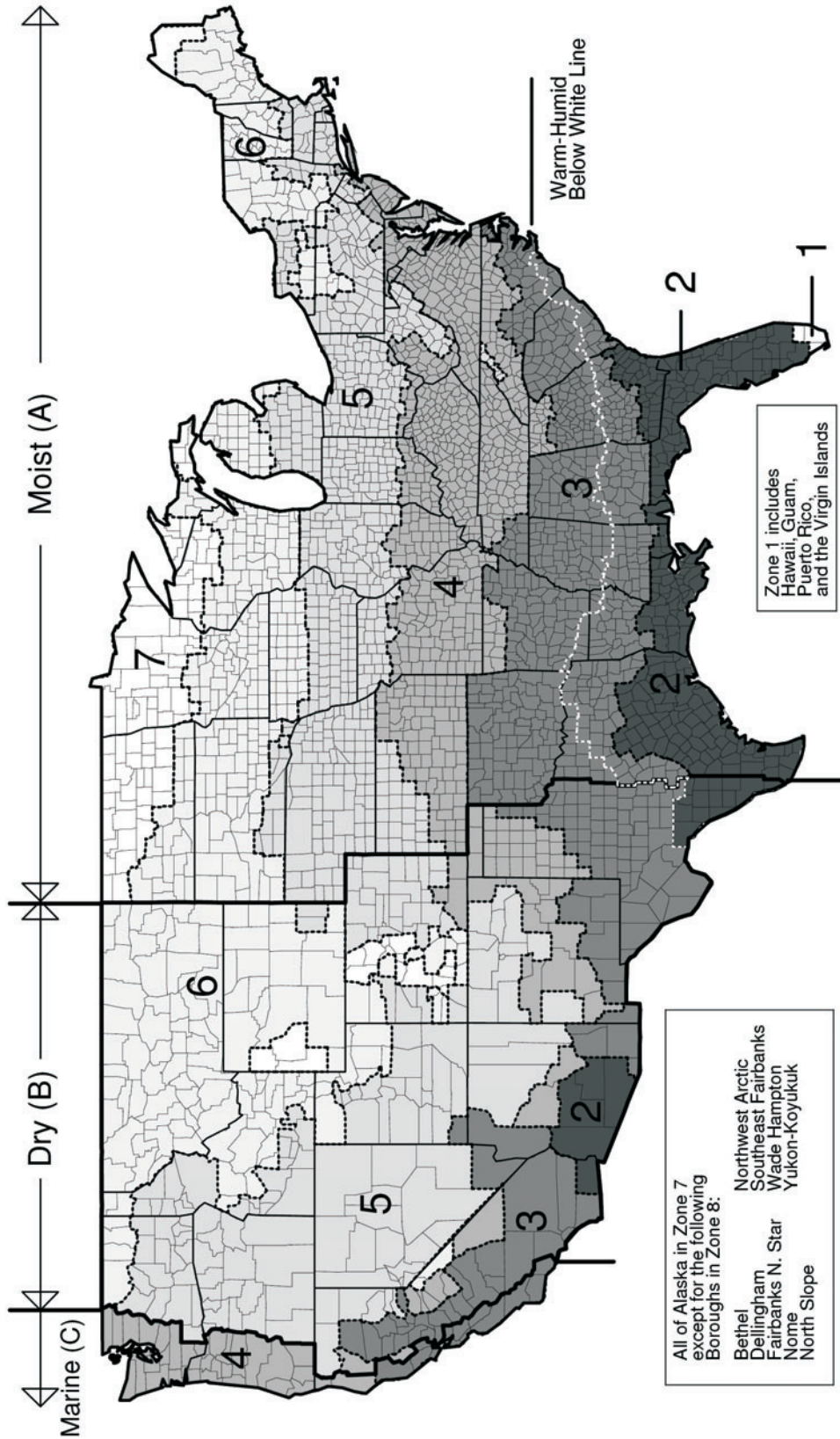


FIGURE N1101.2
CLIMATE ZONES

**TABLE N1101.2
CLIMATE ZONES BY STATES AND COUNTIES**

Alabama	Mendocino	Gunnison	Mitchell	Washington
Zone 3 except	Monterey	Hinsdale	Pierce	
Zone 2	Napa	Jackson	Seminole	Illinois
Baldwin	San Benito	Lake	Tattnall	Zone 5 except
Mobile	San Francisco	Mineral	Thomas	Zone 4
	San Luis Obispo	Park	Toombs	Alexander
	San Mateo	Pitkin	Ware	Bond
Alaska	Santa Barbara	Rio Grande	Wayne	Christian
Zone 7 except	Santa Clara	Routt	Zone 4	Clay
Zone 8	Santa Cruz	San Juan	Banks	Clinton
Bethel	Sonoma	Summit	Catoosa	Crawford
Dellingham	Ventura		Dade	Edwards
Fairbanks North Star	Zone 4 Dry	Connecticut	Dawson	Effingham
Nome	Amador	Zone 5	Fannin	Fayette
North Slope	Calaveras		Floyd	Franklin
Northwest Arctic	El Dorado	Delaware	Franklin	Gallatin
Southeast Fairbanks	Inyo	Zone 4	Gilmer	Hamilton
Wade Hampton	Lake		Gordon	Hardin
Yukon-Koyukuk	Mariposa	Dist. of Columbia	Habersham	Jackson
	Trinity	Zone 4	Hall	Jasper
Arizona	Tuolumne		Lumpkin	Jefferson
Zone 3 except	Zone 4 Marine	Florida	Murray	Johnson
Zone 2	Del Norte	Zone 2 except	Pickens	Lawrence
La Paz	Humboldt	Zone 1	Rabun	Macoupin
Maricopa	Zone 5	Broward	Stephens	Madison
Pima	Lassen	Dade	Towns	Marion
Pinal	Modoc	Monroe	Union	Massac
Yuma	Nevada		Walker	Monroe
Zone 4	Plumas	Georgia	White	Montgomery
Gila	Sierra	Zone 3 except	Whitfield	Perry
Yavapai	Siskiyou	Zone 2		Pope
Zone 5	Zone 6	Appling	Hawaii	Pulaski
Apache	Alpine	Atkinson	Zone 1 Moist	Randolph
Coconino	Mono	Bacon		Richland
Navajo		Baker	Idaho	Saline
	Colorado	Berrien	Zone 6 except	Shelby
Arkansas	Zone 5 except	Brantley	Zone 5	St Clair
Zone 3 except	Zone 4	Brooks	Ada	Union
Zone 4	Baca	Bryan	Benewah	Wabash
Baxter	Las Animas	Camden	Canyon	Washington
Benton	Otero	Charlton	Cassia	Wayne
Boone	Zone 6	Chatham	Clearwater	White
Carroll	Alamosa	Clinch	Elmore	Williamson
Fulton	Archuleta	Colquitt	Gem	
Izard	Chaffee	Cook	Gooding	Indiana
Madison	Conejos	Decatur	Idaho	Zone 5 except
Marion	Costilla	Echols	Jerome	Zone 4
Newton	Custer	Effingham	Kootenai	Brown
Searcy	Dolores	Evans	Latah	Clark
Stone	Eagle	Glynn	Lewis	Crawford
Washington	Moffat	Grady	Lincoln	Daviess
	Ouray	Jeff Davis	Minidoka	Dearborn
California	Rio Blanco	Lanier	Nez Perce	Dubois
Zone 3 Dry except	Saguache	Liberty	Owyhee	Floyd
Zone 2	San Miguel	Long	Payette	Gibson
Imperial	Zone 7	Lowndes	Power	Greene
Zone 3 Marine	Clear Creek	Mcintosh	Shoshone	Harrison
Alameda	Grand	Miller	Twin Falls	Jackson
Marin				

(continued)

TABLE N1101.2—continued
CLIMATE ZONES BY STATES AND COUNTIES

Jefferson	Webster	Morehouse	Oceana	Harrison
Jennings	Winnebago	Natchitoches	Ogemaw	Jackson
Knox	Winneshiek	Ouachita	Osceola	Pearl River
Lawrence	Worth	Red River	Oscoda	Stone
Martin	Wright	Richland	Otsego	
Monroe		Sabine	Presque Isle	Missouri
Ohio	Kansas	Tensas	Roscommon	Zone 4 except
Orange	Zone 4 except	Union	Sanilac	Zone 5
Perry	Zone 5	Vernon	Wexford	Adair
Pike	Cheyenne	Webster	Zone 7	Andrew
Posey	Cloud	West Carroll	Baraga	Atchison
Ripley	Decatur	Winn	Chippewa	Buchanan
Scott	Ellis		Gogebic	Caldwell
Spencer	Gove	Maine	Houghton	Chariton
Sullivan	Graham	Zone 6 except	Iron	Clark
Switzerland	Greeley	Zone 7	Keweenaw	Clinton
Vanderburgh	Hamilton	Aroostook	Luce	Daviess
Warrick	Jewell		Mackinac	De Kalb
Washington	Lane	Maryland	Ontonagon	Gentry
	Logan	Zone 4 except	Schoolcraft	Grundy
Iowa	Mitchell	Zone 5		Harrison
Zone 5 except	Ness	Garrett	Minnesota	Holt
Zone 6	Norton		Zone 6 except	Knox
Allamakee	Osborne	Massachusetts	Zone 7	Lewis
Black Hawk	Phillips	Zone 5	Aitkin	Linn
Bremer	Rawlins		Becker	Livingston
Buchanan	Republic	Michigan	Beltrami	Macon
Buena Vista	Rooks	Zone 5 except	Carlton	Marion
Butler	Scott	Zone 6	Cass	Mercer
Calhoun	Sheridan	Alcona	Clay	Nodaway
Cerro Gordo	Sherman	Alger	Clearwater	Pike
Cherokee	Smith	Alpena	Cook	Putnam
Chickasaw	Thomas	Antrim	Crow Wing	Ralls
Clay	Trego	Arenac	Grant	Schuyler
Clayton	Wallace	Benzie	Hubbard	Scotland
Delaware	Wichita	Charlevoix	Itasca	Shelby
Dickinson		Cheboygan	Kanabec	Sullivan
Emmet	Kentucky	Clare	Kittson	Worth
Fayette	Zone 4	Crawford	Koochiching	
Floyd		Delta	Lake of the Wood	Montana
Franklin	Louisiana	Dickinson	Mahnomen	Zone 6
Grundy	Zone 2 except	Emmet	Marshall	
Hamilton	Zone 3	Gladwin	Mille Lacs	Nebraska
Hancock	Bienville	Grand Traverse	Norman	Zone 5
Hardin	Bossier	Huron	Otter Tail	
Howard	Caddo	Iosco	Pennington	Nevada
Humboldt	Caldwell	Isabella	Pine	Zone 5 except
Ida	Catahoula	Kalkaska	Polk	Zone 3
Kossuth	Claiborne	Lake	Red Lake	Clark
Lyon	Concordia	Leelanau	Roseau	
Mitchell	De Soto	Manistee	St Louis	New Hampshire
O'Brien	East Carroll	Marquette	Wadena	Zone 6 except
Osceola	Franklin	Mason	Wilkin	Zone 5
Palo Alto	Grant	Mecosta		Cheshire
Plymouth	Jackson	Menominee	Mississippi	Hillsborough
Pocahontas	La Salle	Missaukee	Zone 3 except	Rockingham
Sac	Lincoln	Montmorency	Zone 2	Stafford
Sioux	Madison	Newaygo	Hancock	

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TABLE N1101.2—continued
CLIMATE ZONES BY STATES AND COUNTIES

New Jersey	Hamilton	Rockingham	Oklahoma	Bon Homme
Zone 4 except	Herkimer	Rutherford	Zone 3 Moist except	Charles Mix
Zone 5	Jefferson	Stokes	Zone 4 Dry	Clay
Bergen	Lewis	Surry	Beaver	Douglas
Hunterdon	Madison	Swain	Cimarron	Gregory
Mercer	Montgomery	Transylvania	Texas	Hutchinson
Morris	Oneida	Vance		Jackson
Passaic	Otsego	Wake	Oregon	Mellette
Somerset	Schoharie	Warren	Zone 4 Marine except	Todd
Sussex	Schuyler	Wilkes	Zone 5 Dry	Tripp
Warren	St Lawrence	Yadkin	Baker	Union
	Steuben	Zone 5	Crook	Yankton
	Sullivan	Alleghany	Deschutes	
New Mexico	Tompkins	Ashe	Gilliam	Tennessee
Zone 4 except	Ulster	Avery	Grant	Zone 4 except
Zone 3	Warren	Mitchell	Harney	Zone 3
Chaves	Wyoming	Watauga	Hood River	Chester
Dona Ana		Yancey	Jefferson	Crockett
Eddy	North Carolina		Klamath	Dyer
Hidalgo	Zone 3 except	North Dakota	Lake	Fayette
Lea	Zone 4	Zone 7 except	Malheur	Hardeman
Luna	Alamance	Zone 6	Morrow	Hardin
Otero	Alexander	Adams	Sherman	Haywood
Zone 5	Bertie	Billings	Umatilla	Henderson
Catron	Buncombe	Bowman	Union	Lake
Colfax	Burke	Burleigh	Wallowa	Lauderdale
Harding	Calwell	Dickey	Wasco	Madison
Los Alamos	Caswell	Dunn	Wheeler	McNairy
McKinley	Catawba	Emmons		Shelby
Mora	Chatham	Golden Valley	Pennsylvania	Tipton
Rio Arriba	Cherokee	Grant	Zone 5 except	
San Juan	Clay	Hettinger	Zone 4	Texas
San Miguel	Cleveland	La Moure	Bucks	Zone 2 Moist except
Sandoval	Davie	Logan	Chester	Zone 2 Dry
Santa Fe	Durham	McIntosh	Delaware	Bandera
Taos	Forsyth	McKenzie	Montgomery	Dimmit
Torrance	Franklin	Mercer	Philadelphia	Edwards
	Gates	Morton	York	Frio
New York	Graham	Oliver	Zone 6	Kinney
Zone 5 except	Granville	Ransom	Cameron	La Salle
Zone 4	Guilford	Richland	Clearfield	Maverick
Bronx	Halifax	Sargent	Elk	Medina
Kings	Harnett	Sioux	McKean	Real
Nassau	Haywood	Slope	Potter	Uvalde
New York	Henderson	Stark	Susquehanna	Val Verde
Queens	Hertford		Tioga	Webb
Richmond	Iredell	Ohio	Wayne	Zapata
Suffolk	Jackson	Zone 5 except		Zavala
Westchester	Lee	Zone 4	Rhode Island	Zone 3 Dry
Zone 6	Lincoln	Adams	Zone 5	Andrews
Allegany	Macon	Brown		Baylor
Broome	Madison	Clermont	South Carolina	Borden
Cattaraugus	McDowell	Gallia	Zone 3	Brewster
Chenango	Nash	Hamilton		Callahan
Clinton	Northampton	Lawrence	South Dakota	Childress
Delaware	Orange	Pike	Zone 6 except	Coke
Essex	Person	Scioto	Zone 5	Coleman
Franklin	Polk	Washington	Bennett	Collingsworth
Fulton				

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TABLE N1101.2—continued
CLIMATE ZONES BY STATES AND COUNTIES

Concho	Wheeler	Stephens	Virginia	Wyoming
Cottle	Wilbarger	Tarrant	Zone 4	
Crane	Winkler	Titus		Wisconsin
Crockett	Zone 3 Moist	Upshur	Washington	Zone 6 except
Crosby	Archer	Van Zandt	Zone 4 Marine except	Zone 7
Culberson	Bianco	Wichita	Zone 5 Dry	Ashland
Dawson	Bowie	Wise	Adams	Bayfield
Dickens	Brown	Wood	Asotin	Burnett
Ector	Burnet	Young	Benton	Douglass
El Paso	Camp	Zone 4	Chelan	Florence
Fisher	Cass	Armstrong	Columbia	Forest
Foard	Clay	Bailey	Douglas	Iron
Gaines	Collin	Briscoe	Franklin	Langlade
Garza	Comanche	Carson	Garfield	Lincoln
Glasscock	Cooke	Castro	Grant	Oneida
Hall	Dallas	Cochran	Kittitas	Price
Hardeman	Delta	Dallam	Klickitat	Sawyer
Haskell	Denton	Deaf Smith	Lincoln	Taylor
Hemphill	Eastland	Donley	Skamania	Vilas
Howard	Ellis	Floyd	Spokane	Washburn
Hudspeth	Erath	Gray	Walla Walla	
Irion	Fannin	Hale	Whitman	Wyoming
Jeff Davis	Franklin	Hansford	Yakima	Zone 6 except
Jones	Gillespie	Hartley	Zone 6 Dry	Zone 5
Kent	Grayson	Hockley	Ferry	Goshen
Kerr	Gregg	Hutchinson	Okanogan	Platte
Kimble	Hamilton	Lamb	Pend Oreille	Zone 7
King	Harrison	Lipscomb	Stevens	Lincoln
Knox	Henderson	Moore		Sublette
Loving	Hood	Ochiltree	West Virginia	Teto
Lubbock	Hopkins	Oldham	Zone 5 except	
Lynn	Hunt	Parmer	Zone 4	American Samoa
Martin	Jack	Potter	Berkely	Zone 1 Moist
Mason	Johnson	Randall	Boone	
McCulloch	Kaufman	Roberts	Braxton	Guam
Menard	Kendall	Sherman	Cabell	Zone 1 Moist
Midland	Lamar	Swisher	Calhoun	
Mitchell	Lampasas	Yoakum	Clay	Northern Marianas
Motley	Llano		Gilmer	Zone 1 Moist
Nolan	Marion	Utah	Jackson	
Pecos	Mills	Zone 5 except	Jefferson	Puerto Rico
Presidio	Montague	Zone 3	Kanawha	Zone 1 Moist
Reagan	Morris	Washington	Lincoln	
Reeves	Nacogdoches	Zone 6	Logan	U.S. Virgin Islands
Runnels	Navarro	Box Elder	Mason	Zone 1 Moist
Schleicher	Palo Pinto	Cache	McDowell	
Scurry	Panola	Carbon	Mercer	
Shackelford	Parker	Daggett	Mingo	
Sterling	Rains	Duchesne	Monroe	
Stonewall	Red River	Morgan	Morgan	
Sutton	Rockwall	Rich	Pleasants	
Taylor	Rusk	Summit	Putnam	
Terrell	Sabine	Uintah	Ritchie	
Terry	San Augustine	Wasatch	Roane	
Throckmorton	San Saba		Tyler	
Tom Green	Shelby	Vermont	Wayne	
Upton	Smith	Zone 6	Wirt	
Ward	Somervell		Wood	

**TABLE N1101.2.1
WARM HUMID COUNTIES**

Alabama	Houston	Mississippi	Cass
Autauga	Irwin	All in Zone 2	Collin
Baldwin	Jenkins	Plus	Comanche
Barbour	Johnson	Adams	Dallas
Bullock	Laurens	Amite	Delta
Butler	Lee	Claiborne	Denton
Choctaw	Macon	Copiah	Ellis
Clarke	Marion	Covington	Erath
Coffee	Montgomery	Forrest	Franklin
Conecuh	Peach	Franklin	Gillespie
Covington	Pulaski	George	Gregg
Crenshaw	Quitman	Greene	Hamilton
Dale	Randolph	Hinds	Harrison
Dallas	Schley	Jefferson	Henderson
Elmore	Screven	Jefferson Davis	Hood
Escambia	Stewart	Jones	Hopkins
Geneva	Sumter	Lamar	Hunt
Henry	Taylor	Lawrence	Johnson
Houston	Telfair	Lincoln	Haufman
Lowndes	Terrell	Marion	Kendall
Macon	Tift	Perry	Lamar
Marengo	Treutlen	Pike	Lampasas
Mobile	Turner	Rankin	Llano
Monroe	Twiggs	Simpson	Marion
Montgomery	Webster	Smith	Mills
Perry	Wheeler	Walthall	Morris
Pike	Wilcox	Warren	Nacogdoches
Russell	Worth	Wayne	Navarro
Washington		Wilkinson	Palo Pinto
Wilcox			Panola
	Hawaii	North Carolina	Parker
	All	Brunswick	Rains
		Carteret	Red River
Arkansas	Louisiana	Columbus	Rockwall
Columbia	All in Zone 2	New Hanover	Rusk
Hempstead	Plus	Onslow	Sabine
Lafayette	Bienville	Pender	San Augustine
Little River	Bossier		San Saba
Miller	Caddo	South Carolina	Shelby
Sevier	Caldwell	Allendale	Smith
Union	Catahoula	Bamberg	Somervell
	Claiborne	Barnwell	Tarrant
Florida	De Soto	Beaufort	Tarrant
All	Franklin	Berkeley	Titus
	Grant	Charleston	Upshur
Georgia	Jackson	Colleton	Van Zandt
All in Zone 2	La Salle	Dorchester	Wood
Plus	Lincoln	Georgetown	
Ben Hill	Madison	Hampton	American Samoa
Bleckley	Natchitoches	Horry	All
Bulloch	Ouachita	Jasper	Guam
Calhoun	Red River		All
Candler	Richland	Texas	Northern Marianas
Chattahoochee	Sabine	All in Zone 2	All
Clay	Tensas	Plus	Puerto Rico
Coffee	Union	Blanco	All
Crisp	Vernon	Bowie	U.S. Virgin Islands
Dodge	Webster	Brown	All
Dooly	Winn	Burnet	All
Dougherty		Camp	
Early			
Emanuel			

TABLE N1101.5(1)
DEFAULT GLAZED FENESTRATION U-FACTORS

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.2	0.8	2	1.3
Metal with thermal break	1.1	0.65	1.9	1.1
Nonmetal or metal clad	0.95	0.55	1.75	1.05
Glazed block	0.6			

TABLE N1101.5(2)
DEFAULT DOOR U-FACTORS

DOOR TYPE	U-FACTOR
Uninsulated metal	1.2
Insulated metal	0.6
Wood	0.5
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

TABLE N1101.5(3)
DEFAULT GLAZED FENESTRATION SHGC

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

SECTION N1102 BUILDING THERMAL ENVELOPE

N1102.1 Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Table N1102.1 based on the climate zone specified in Table N1101.2.

N1102.1.1 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.

N1102.1.2 U-factor alternative. An assembly with a U-factor equal to or less than that specified in Table N1102.1.2 shall be permitted as an alternative to the R-value in Table N1102.1.

Exception: For mass walls not meeting the criterion for insulation location in Section N1102.2.3, the U-factor shall be permitted to be:

1. U-factor of 0.17 in Climate Zone 1
2. U-factor of 0.14 in Climate Zone 2
3. U-factor of 0.12 in Climate Zone 3
4. U-factor of 0.10 in Climate Zone 4 except Marine
5. U-factor of 0.082 in Climate Zone 5 and Marine 4

N1102.1.3 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 N1102.1.2 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table N1102.1. 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.

N1102.2 Specific insulation requirements.

N1102.2.1 Ceilings with attic spaces. When Section N1102.1 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.

N1102.2.2 Ceilings without attic spaces. Where Section N1102.1 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 shall be limited to 500 ft² (46 m²) of ceiling area.

**TABLE N1102.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a**

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE AND DEPTH	CRAWL SPACE WALL R-VALUE
1	1.2	0.75	0.40	30	13	3	13	0	0	0
2	0.75	0.75	0.40	30	13	4	13	0	0	0
3	0.65	0.65	0.40 ^e	30	13	5	19	0	0	5/13
4 except Marine	0.40	0.60	NR	38	13	5	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	19 or 13 + 5 ^g	13	30 ^f	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	19 or 13 + 5 ^g	15	30 ^f	10/13	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19	30 ^f	10/13	10, 4 ft	10/13

- a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 insulation shall be permitted to be compressed into a 2 × 6 cavity.
- b. The fenestration *U*-factor column excludes skylights. The solar heat gain coefficient (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.
- e. There are no solar heat gain coefficient (SHGC) requirements in the Marine Zone.
- f. Or insulation sufficient to fill the framing cavity, R-19 minimum.
- g. “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.

**TABLE N1102.1.2
EQUIVALENT U-FACTORS^a**

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.75	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.65	0.65	0.035	0.082	0.141	0.047	0.360	0.136
4 except Marine	0.40	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.060	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.060	0.06	0.033	0.059	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.033	0.059	0.065

- a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

N1102.2.3 Mass walls. Mass walls, for the purposes of this chapter, shall be considered 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. The provisions of Section N1102.1 for mass walls shall be applicable when at least 50 percent of the required insulation *R*-value is on the exterior of, or integral to, the wall. Walls that do not meet this criterion for insulation placement shall meet the wood frame wall insulation requirements of Section N1102.1.

Exception: For walls that do not meet this criterion for insulation placement, the minimum added insulation *R*-value shall be permitted to be:

1. *R*-value of 4 in Climate Zone 1
2. *R*-value of 6 in Climate Zone 2
3. *R*-value of 8 in Climate Zone 3
4. *R*-value of 10 in Climate Zone 4 except Marine
5. *R*-value of 13 in climate Zone 5 and Marine 4

N1102.2.4 Steel-frame ceilings, walls and floors. Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table N1102.2.4 or shall meet the *U*-factor requirements in Table N1102.1.2. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

**TABLE N1102.2.4
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION (R-VALUE)**

WOOD FRAME R-VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT R-VALUE ^a
Steel Truss Ceilings^a	
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 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel Framed Wall	
R-13	R-13 + 5 or R-15 + 4 or R-21 + 3
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 2 × 6 R-19 + R-6 in 2 × 8 or 2 × 10
R-19	R-19 + R-6 in 2 × 6 R-19 + R-12 in 2 × 8 or 2 × 10

For SI: 1 inch = 25.4 mm.

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.

N1102.2.5 Floors. Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

N1102.2.6 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 and N1102.2.5.

N1102.2.7 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. 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 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.

N1102.2.8 Crawl space walls. As an alternative to insulating floors over crawl spaces, insulation of crawl space walls when the crawl space is not vented to the outside is permitted.

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 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.

N1102.2.9 Masonry veneer. Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

N1102.2.10 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 solar heat gain coefficient (SHGC) requirements in Section N1102.1.

N1102.3.4 Opaque door exemption. One opaque door assembly is exempted from the *U*-factor requirement in Section N1102.1.

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.

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, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating the garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Other sources of infiltration.

N1102.4.2 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)/m²], and swinging doors no more than 0.5 cubic foot per minute per square foot [2.5(L/s)/m²], 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.

N1102.4.3 Recessed lighting. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces by being:

1. IC-rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space; or
2. IC-rated and labeled as meeting ASTM E 283 when tested at 1.57 pounds per square foot (75 Pa) pressure differential with no more than 2.0 cubic feet per minute (0.944 L/s) of air movement from the conditioned space to the ceiling cavity; or
3. Located inside an airtight sealed box with clearances of at least 0.5 inch (13 mm) from combustible material and 3 inches (76 mm) from insulation.

N1102.5 Moisture control. The building design shall not create conditions of accelerated deterioration from moisture condensation. Above-grade frame walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder. The vapor retarder shall be installed on the warm-in-winter side of the thermal insulation.

Exceptions:

1. In construction where moisture or its freezing will not damage the materials.
2. Frame walls, floors and ceilings in jurisdictions in Zones 1, 2, 3, 4A, and 4B. (Crawl space floor vapor retarders are not exempted.)
3. Where other approved means to avoid condensation are provided.

N1102.5.1 Maximum fenestration *U*-factor. The area weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section N1102.1.3 in Zones 6 through 8 shall be 0.55.

To comply with this section, the maximum *U*-factor for skylights shall be 0.75 in zones 6 through 8.

SECTION N1103 SYSTEMS

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

N1103.1.1 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.

N1103.2 Ducts.

N1103.2.1 Insulation. Supply and return ducts shall be insulated to a minimum of R-8. Ducts in floor trusses 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 M1601.3.1.

N1103.2.3 Building cavities. Building framing cavities shall not be used as supply ducts.

ENERGY EFFICIENCY

N1103.3 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.

N1103.4 Circulating hot water systems. All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

N1103.5 Mechanical ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

N1103.6 Equipment sizing. Heating and cooling equipment shall be sized as specified in Section M1401.3.