

# Part IV — Energy Conservation

## CHAPTER 11

# ENERGY EFFICIENCY

### SECTION N1101 GENERAL

**N1101.1 Scope.** This chapter sets forth energy-efficiency-related requirements for the design and construction of buildings regulated by this code.

**Exception:** Provided that they are separated by building envelope assemblies from the remainder of the building, portions of the building that do not enclose conditioned space shall be exempt from the building envelope provisions, but shall comply with the provisions for building mechanical and service water heating systems.

**N1101.2 Compliance.** Compliance with this chapter shall be demonstrated by meeting the requirements of the applicable sections and tables of this chapter. Where applicable, provisions are based on the climate zone where the building is located. The climate zone where the building is located shall be based on zone assignments in Table N1101.2 for the county and state in which the building is being constructed. The climate zone where the building is located shall be based on zone assignments in Table 1101.2 for the county and state in which the building is being constructed. RESCheck 3.6 Release 2 for the 2003 International Energy Conservation Code® (IECC®) shall be permitted to demonstrate compliance, except that solar heat gain coefficient (SHGC) of 0.4 is required for all locations and that envelope requirements may not be traded off against the use of high efficiency heating and cooling equipment. No trade-off calculations are required for termite inspection and treatment gaps required for slabs and basement walls.

**N1101.2.1 Detached one- and two-family dwellings.** Compliance shall be demonstrated by either:

1. Meeting the requirements of this chapter for buildings; or
2. Meeting the requirements of the North Carolina Energy Conservation Code for detached one- and two-family dwellings.

**N1101.2.2 Townhouses.** Compliance shall be demonstrated by either:

1. Meeting the requirements of this chapter for buildings; or
2. Meeting the requirements of the North Carolina Energy Conservation Code for residential buildings of Group R-2, R-4 or townhouses.

**N1101.3 Materials and equipment.** Materials and equipment shall be identified in a manner that will allow a determination of their compliance with the provisions of this chapter. Materials

and equipment used to conform to the applicable provisions of this chapter shall be installed in accordance with the manufacturer's installation instructions.

**N1101.3.1 Insulation.** The thermal resistance (*R*-value) shall be indicated on all insulation and the insulation installed such that the *R*-value can be verified during inspection, or a certification of the installed *R*-value shall be provided at the job site by the insulation installer. Where blown-in or sprayed insulation is applied in walls, the installer shall provide a certification of the installed density and *R*-value. Where blown-in or sprayed insulation is applied in the roof-ceiling assembly, the installer shall provide a certification of the initial installed thickness, settled thickness, coverage area, and number of bags of insulating material installed. Markers shall be provided for every 300 square feet (28 m<sup>2</sup>) of attic area, attached to the trusses, rafters, or joists, and indicate in 1-inch-high (25.4 mm) numbers the installed thickness of the insulation.

**N1101.3.2 Fenestration.** The *U*-factor of fenestration shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. The solar heat gain coefficient (SHGC) of fenestration shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer.

**N1101.3.2.1 Default fenestration performance.** When a manufacturer has not determined a fenestration product's *U*-factor in accordance with NFRC 100, compliance shall be determined by assigning such products a default *U*-factor from Tables 102.5.2(1) and 102.5.2(2) in the *International Energy Conservation Code*. When a manufacturer has not determined a fenestration product's SHGC in accordance with NFRC 200, compliance shall be determined by assigning such products a default SHGC from Table 102.5.2(3) of the North Carolina Energy Conservation Code.

**N1101.3.2.2 Air leakage.** The air leakage of prefabricated fenestration shall be determined in accordance with AAMA/WDMA 101/I.S.2, 101/I.S.2/NAFS, or NFRC 400 by an accredited, independent laboratory, and labeled and certified by the manufacturer and shall not exceed the values in Table 502.1.4.1 of the *International Energy Conservation Code*. Alternatively, the manufacturer shall certify that the fenestration is installed in accordance with Section 502.1.4 of the North Carolina Energy Conservation Code.

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

County	Zone	County	Zone	County	Zone	County	Zone
Alamance	8	Cumberland	7	Johnston	7	Randolph	8
Alexander	8	Currituck	7	Jones	6	Richmond	7
Alleghany <sup>a</sup>	11	Dare	6	Lee	7	Robeson	7
Anson	7	Davidson	8	Lenoir	7	Rockingham	8
Ashe <sup>a</sup>	11	Davie	8	Lincoln	7	Rowan	7
Avery <sup>a</sup>	11	Duplin	6	Macon	9	Rutherford	7
Beaufort	6	Durham	8	Madison	9	Sampson	6
Bertie	7	Edgecombe	7	Martin	7	Scotland	7
Bladen	6	Forsyth	8	McDowell	8	Stanly	7
Brunswick	6	Franklin	8	Mecklenburg	7	Stokes	9
Buncombe	9	Gaston	7	Mitchell <sup>a</sup>	11	Surry	9
Burke	8	Gates	7	Montgomery	7	Swain	9
Cabarrus	7	Graham	9	Moore	7	Transylvania	9
Caldwell	8	Granville	8	Nash	7	Tyrrell	6
Camden	7	Greene	7	New Hanover	6	Union	7
Carteret	6	Guilford	8	Northampton	7	Vance	8
Caswell	8	Halifax	7	Onslow	6	Wake	7
Catawba	8	Harnett	7	Orange	8	Warren	8
Chatham	8	Haywood	9	Pamlico	6	Washington	7
Cherokee	9	Henderson	9	Pasquotank	7	Watauga <sup>a</sup>	11
Chowan	7	Hertford	7	Pender	6	Wayne	7
Clay	9	Hoke	7	Perquimans	7	Wilkes	9
Cleveland	7	Hyde	6	Person	8	Wilson	7
Columbus	6	Iredell	8	Pitt	7	Yadkin	8
Craven	6	Jackson	9	Polk	7	Yancey <sup>a</sup>	11

a. A moisture vapor retarder is required in these counties. See Section R318.1.

**N1101.3.3 Maintenance.** Where mechanical or plumbing system components require preventive maintenance for efficient operation, regular maintenance requirements shall be clearly stated and affixed to the component, or the source for such information shall be shown on a label attached to the component.

## SECTION N1102 BUILDING ENVELOPE

**N1102.1 Thermal performance criteria.** The minimum required insulation  $R$ -value or the area-weighted average maximum required fenestration  $U$ -factor (other than opaque doors which are governed by Section N1102.1.3) for each element in the building thermal envelope (fenestration, roof/ceiling, opaque wall, floor, slab edge, crawl space wall and basement wall) shall be in accordance with the criteria in Table N1102.1.

Any residential building in climates with heating degree days equal to or greater than 13,000; shall determine compliance using the building envelope requirements of Chapter 4 or 5 of the North Carolina Energy Conservation Code.

**N1102.1.1 Exterior walls.** The minimum required  $R$ -value in Table N1102.1 shall be met by the sum of the  $R$ -values of the insulation materials installed in framing cavities and/or insulating sheathing applied, and not by framing, drywall, structural sheathing, or exterior siding materials. Insulation separated from the conditioned space by a vented space shall not be counted towards the required  $R$ -value.

**N1102.1.1.1 Mass walls.** Mass walls shall be permitted to meet the mass wall criteria in Table N1102.1.1.1(1), based on the insulation position and the climate zone where the building is located. Other mass walls shall meet the frame wall criteria for the building type and the climate zone where the building is located, based on the sum of interior and exterior insulation. Walls with exterior insulation position have the entire effective mass layer interior to an insulation layer. Walls with integral insulation position have either insulation and mass materials well mixed as in wood (logs); or substantially equal amounts of mass material on the interior and exterior of insulation as in concrete masonry units with insulated cores or masonry cavity walls. Walls with interior insulation position have the mass material located exterior to the insulating material. Walls not meeting either of the above descriptions for exterior or integral positions shall meet the requirements for “Other mass walls” in Table N1102.1.1.1(1). The  $R$ -value of the mass assembly for typical masonry constructions shall be taken from Table N1102.1.1.1(2). The  $R$ -value for a solid concrete wall with a thickness of 4 inches (102 mm) or greater is R-1.1.  $R$ -values for other assemblies are permitted to be based on hot box tests referenced in ASTM C 236 or ASTM C 976, two dimensional calculations or isothermal planes calculations.

**N1102.1.1.2 Steel-frame walls.** The minimum required  $R$ -values for steel-frame walls shall be in accordance with Table N1102.1.1.2.

**N1102.1.2 Ceilings.** The required “Ceiling  $R$ -value” in Table N1102.1 assumes standard truss or rafter construction and shall apply to all roof/ceiling portions of the building thermal envelope, including cathedral ceilings. Where the construction technique allows the required  $R$ -value of ceiling insulation to be obtained over the wall top plate, R-30 shall be permitted to be used where R-38 is required and R-38 shall be permitted to be used where R-49 is required.

**N1102.1.3 Opaque doors.** Opaque doors separating conditioned and unconditioned space shall have a maximum  $U$ -factor of 0.35. One opaque door shall be permitted to be exempt from this  $U$ -factor requirement.

**N1102.1.4 Floors.** The required  $R$ -value in Table N1102.1 shall apply to all floors, except any individual floor assembly with over 25 percent of its conditioned floor area exposed directly to outside air shall meet the  $R$ -value requirement in Table N1102.1 for “Ceilings.”

**N1102.1.5 Basement walls.** When the basement is a conditioned space, the basement walls shall be insulated in accordance with Table N1102.1. When the basement is not a conditioned space, either the basement walls or the ceilings separating the basement from conditioned space shall be insulated in accordance with Table N1102.1. When insulating basement walls, the required  $R$ -value shall be applied from the top of the basement wall to a depth of 10 feet (3048 mm) below grade or to the top of the basement floor, whichever is less.

**N1102.1.6 Slab-on-grade floors.** For slabs with a top edge above finished grade or 12 inches (305 mm) or less below finished grade, the required  $R$ -value in Table N1102.1 shall be applied to the outside of the foundation or the inside of the foundation wall. The insulation shall extend downward from the top of the slab, or downward to the bottom of the slab and then horizontally in either direction, until the distance listed in Table N1102.1 is reached.

When installed between the exterior wall and the edge of the interior slab, the top edge of the insulation shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Insulation extending horizontally away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil.

In locations of 500 HDD or greater, R-2 shall be added to the values in Table N1102.1 where uninsulated hot water pipes, air distribution ducts or electric heating cables are installed within or under the slab.

**Exception:** Slab perimeter insulation is not required for unheated slabs in areas of moderate to heavy termite infestation probability as shown in Figure R301.2(6). Where this exception is used, building envelope compliance shall be demonstrated by (a) using North Carolina Energy Conservation Code Section 502.2.2 or International Energy Conservation Code Chapter 4 with the actual slab insulation  $R$ -value in Table N1102.1, or (b) using Section 502.2.4 of the International Energy Conservation Code.

**TABLE N1102.1  
SIMPLIFIED PRESCRIPTIVE BUILDING ENVELOPE THERMAL COMPONENT CRITERIA  
MINIMUM REQUIRED THERMAL PERFORMANCE (U-FACTOR AND R-VALUE)**

BUILDING LOCATION		MAXIMUM GLAZING U-FACTOR [Btu/(hr·ft <sup>2</sup> ·°F)]	MINIMUM INSULATION R-VALUE [(hr · ft <sup>2</sup> · °F) / Btu]					
Climate Zone	HDD		Ceilings	Walls	Floors	Basement walls	Slab perimeter R-value and depth	Crawl space walls
1	0-499	Any	R-13	R-11	R-11	R-0	R-0	R-0
2	500-999	0.90	R-19	R-11	R-11	R-0	R-0	R-4
3	1,000-1,499	0.75	R-19	R-11	R-11	R-0	R-0	R-5
4	1,500-1,999	0.75	R-26	R-13	R-11	R-5	R-0	R-5
5	2,000-2,499	0.65	R-30	R-13	R-11	R-5	R-0	R-6
6	2,500-2,999	0.40	R-30	R-13	R-19	R-6	R-0	R-7
7	3,000-3,499	0.40	R-30	R-13	R-19	R-7	R-0	R-8
8	3,500-3,999	0.40	R-30	R-13	R-19	R-8	R-5, 2 ft.	R-10
9	4,000-4,499	0.40	R-38	R-13	R-19	R-8	R-5, 2 ft.	R-11
10	4,500-4,999	0.45	R-38	R-16	R-19	R-9	R-6, 2 ft.	R-17
11	5,000-5,499	0.40	R-38	R-18	R-19	R-9	R-6, 2 ft.	R-17
12	5,500-5,999	0.40	R-38	R-18	R-21	R-10	R-9, 4 ft.	R-19
13	6,000-6,499	0.35	R-38	R-18	R-21	R-10	R-9, 4 ft.	R-20
14	6,500-6,999	0.35	R-49	R-21	R-21	R-11	R-11, 4 ft.	R-20
15	7,000-8,499	0.35	R-49	R-21	R-21	R-11	R-13, 4 ft.	R-20
16	8,500-8,999	0.35	R-49	R-21	R-21	R-18	R-14, 4 ft.	R-20
17	9,000-12,999	0.35	R-49	R-21	R-21	R-19	R-18, 4 ft.	R-20

For SI: 1 Btu/(hr·ft<sup>2</sup>·°F) = 5.68W/m<sup>2</sup>·K, 1 (hr·ft<sup>2</sup>·°F)/Btu = 0.176m<sup>2</sup>·K/W.

**N1102.1.7 Crawl space walls.** Where the floor above a closed crawl space is not insulated, the exterior walls shall be insulated as required by Section R409.8.1. The required insulation value can be determined from Table N1102.1.

Wall insulation can be located on any combination of the outside and inside wall surfaces and within the structural cavities or materials of the wall system. Wall insulation requires that the exterior wall band joist area of the floor frame be insulated. Wall insulation shall begin 3 inches (76 mm) below the top of the masonry foundation wall and shall extend down to 3 inches (76 mm) above the top of the footing or concrete floor; 3 inches (76 mm) above the interior ground surface or 24 inches (610 mm) below the outside finished ground level, whichever is less.

Termite inspection, clearance and/or wicking gaps are allowed in wall insulation systems. Insulation may be deleted in the gap area without energy penalty. The allowable insulation gap widths are listed in Table N1102.1.7<sup>a</sup>. If gap widths exceed the allowances, one of the following energy compliance options shall be met.

1. Wall insulation is not allowed and the required insulation value shall be provided in the floor system.
2. Compliance shall be demonstrated with energy trade-off methods provided by MecCheck version 3.0 or higher, or Chapter 4 or 5 of the North Carolina Energy Code.

**N1102.1.8 Masonry veneer.** For exterior foundation insulation, that horizontal portion of the foundation that supports a masonry veneer shall not be required to be insulated.

**N1102.1.9 Protection.** Exposed insulating materials applied to the exterior of foundation walls shall be protected. The protection shall extend at least 6 inches (152 mm) below finished grade level.

**N1102.1.10 Air leakage.** All joints, seams, penetrations; site-built windows, doors, and skylights; openings between window and door assemblies and their respective jambs and framing; and other sources of air leakage (infiltration and exfiltration) through the building thermal envelope shall be caulked, gasketed, weatherstripped, wrapped, or otherwise sealed to limit uncontrolled air movement.

**N1102.1.11 Recessed lighting fixtures.** When installed in the building envelope, recessed lighting fixtures 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 sealed or gasketed to prevent air leakage into the unconditioned space.
2. Type IC or non-IC rated, installed inside a sealed box constructed from a minimum 0.5-inch-thick (12.7 mm) gypsum wallboard or constructed from a pre-formed polymeric vapor barrier, or other air-tight as-

**TABLE N1102.1.1.1(1)**  
**MASS WALL PRESCRIPTIVE BUILDING ENVELOPE REQUIREMENTS**

BUILDING LOCATION		MASS WALL ASSEMBLY R-VALUE <sup>a</sup> (hr · ft <sup>2</sup> · °F) / Btu	
Zone	HDD	Exterior or integral insulation	Other mass walls
1	0-499	R-3.8	R-9.7
2	500-999	R-4.8	R-9.7
3	1,000-1,499	R-4.8	R-9.7
4	1,500-1,999	R-8.1	R-10.8
5	2,000-2,499	R-8.9	R-10.8
6	2,500-2,999	R-8.9	R-10.8
7	3,000-3,499	R-8.9	R-10.8
8	3,500-3,999	R-8.9	R-10.8
9	4,000-4,499	R-8.9	R-10.9
10	4,500-4,999	R-10.4	R-12.3
11	5,000-5,499	R-11.9	R-15.2
12	5,500-5,999	R-11.9	R-15.2
13	6,000-6,499	R-11.9	R-15.2
14	6,500-6,999	R-15.5	R-18.4
15	7,000-8,499	R-15.5	R-18.4
16	8,500-8,999	R-18.4	R-18.4
17	9,000-12,999	R-18.4	R-18.4

For SI: 1 (hr · ft<sup>2</sup> · °F)/Btu = 0.176 m<sup>2</sup> · K/W.

a. The sum of the value in Table N1102.1.1.1(2) and additional insulation layers.

**TABLE N1102.1.1.1(2)**  
**MASS ASSEMBLY R-VALUES**

ASSEMBLY TYPE	UNGROUTED CELLS NOT INSULATED (hr · ft <sup>2</sup> · °F) / Btu	UNGROUTED CELLS INSULATED (hr · ft <sup>2</sup> · °F) / Btu		
		No grout	Vertical cells grouted at 10 feet o.c. or greater	Vertical cells grouted at less than 10 feet o.c.
6" Light weight concrete block	2.3	5.0	4.5	3.8
6" Medium weight concrete block	2.1	4.2	3.8	3.2
6" Normal weight concrete block	1.9	3.3	3.1	2.7
8" Light weight concrete block	2.6	6.7	5.9	4.8
8" Medium weight concrete block	2.3	5.3	4.8	4.0
8" Normal weight concrete block	2.1	4.2	3.8	3.3
12" Light weight concrete block	2.9	9.1	7.9	6.3
12" Medium weight concrete block	2.6	7.1	6.4	5.2
12" Normal weight concrete block	2.3	5.6	5.1	4.3
Brick cavity wall	3.7	6.7	6.2	5.4
Hollow clay brick	2.0	2.7	2.6	2.4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 (hr · ft<sup>2</sup> · °F)/Btu = 0.176 m<sup>2</sup> · K/W.

sembly manufactured for this purpose, while maintaining required clearances of not less than 0.5 inch (12.7 mm) from combustible material and not less than 3 inches (76 mm) from insulation material.

- Type IC rated, in accordance with ASTM E 283 admitting no more than 2.0 cubic feet per minute (cfm) (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. The lighting fixture shall

be tested at 1.57 psi (75 Pa) pressure difference and shall be labeled.

**N1102.2 Maximum solar heat gain coefficient for fenestration products.** The area-weighted-average solar heat gain coefficient (SHGC) for glazed fenestration installed in the building envelope shall not exceed 0.40. Fifteen square feet (1.39 m<sup>2</sup>) of the total glazed fenestration shall be exempt from

**TABLE N1102.1.1.2  
STEEL-FRAME WALL MINIMUM PERFORMANCE REQUIREMENTS (R-VALUE)**

CLIMATE ZONES	HDD	EQUIVALENT STEEL-FRAME WALL CAVITY AND SHEATHING R-VALUE <sup>a</sup> (hr · ft <sup>2</sup> · °F) / Btu
1-4	0-1999	R-11+R-5, R-15+R-4, R-21+R-3
5-8	2,000-3,999	R-11+R-5, R-15+R-4, R-21+R-3
9-12	4,000-5,999	R-11+R-9, R-15+R-8, R-21+R-7
13-15	6,000-8,499	R-13+R-10, R-19+R-9, R-25+R-8
16 and 17	8,500-12,999	R-13+R-10, R-19+R-9, R-25+R-8

For SI: 1 (hr · ft<sup>2</sup> · °F)/Btu = 0.176 m<sup>2</sup> · K/W.

a. The cavity insulation R-value requirement is listed first, followed by the sheathing R-value requirement.

**TABLE N1102.1.7<sup>a</sup>  
WALL INSULATION ALLOWANCES FOR TERMITE INSPECTION AND WICKING GAPS**

MAXIMUM GAP WIDTH (INCHES)	INSULATION LOCATION	GAP DESCRIPTION
3	Outside	Above grade inspection between top of insulation and bottom of siding
6	Outside	Below grade treatment
4 <sup>a</sup>	Inside	Wall inspection between top of insulation and bottom of sill
4 <sup>a</sup>	Inside	Clearance/wicking space between bottom of insulation and top of ground surface, footing, or concrete floor

a. No insulation shall be required on masonry walls of 9 inches height or less.

the SHGC requirement. In addition, all door glazing shall be exempt from the SHGC requirement.

**N1102.3 Fenestration exemption.** Fifteen square feet (1.39 m<sup>2</sup>) of the total glazing area shall be exempt from the glazing *U*-factor requirement in Table N1102.1. In addition, impact glazing in wind-borne debris regions meeting the requirements of the Large Missile Test of ASTM E 1996 and of ASTM E 1886 shall be exempt from the *U*-factor requirement.

**N1102.4 Replacement fenestration.** Where an entire fenestration product, including frame, sash and glazed portion, is being replaced, the replacement fenestration product shall have a *U*-factor in that does not exceed the fenestration *U*-factor requirement in Table N1102.1 applicable to the climate zone Heating Degree Days (HDD) where the building is located. The replacement fenestration product(s) must also satisfy the air leakage requirements per Section N1102.1.10 and SHGC of Table N1102.4, respectively.

**Exception:** Replacement skylights shall have a maximum *U*-factor of 0.50 when installed in any location above 1,999 HDD.

**TABLE N1102.4  
REPLACEMENT FENESTRATION REQUIREMENTS**

HEATING DEGREE DAYS	MAXIMUM	
	Fenestration <i>U</i> -factor	Fenestration SHGC
0 – 1,999	0.75	0.40
2,000 – 3,999	0.40	0.40 <sup>a</sup>
4,000 – 5,999	0.40	0.40
6,000 – 8,499	0.35	Any
8,500 – 12,999	0.35	Any

## SECTION N1103 MECHANICAL SYSTEMS

**[E] N1103.1 Heating and air conditioning appliance and equipment performance.** Performance of equipment listed in Table N1103.1 is covered by preemptive Federal law. Appliances and equipment not listed in Table N1103.1 shall meet the minimum efficiency requirements of Section 503.2 of the North Carolina Energy Conservation Code.

**N1103.2 Controls.** At least one thermostat shall be provided for each separate heating, cooling, or combination heating and cooling system. Heat pumps shall have controls that prevent supplementary electric resistance heater operation when the heating load can be met by the heat pump alone. Supplementary heater operation shall be permitted during outdoor coil defrost cycles not exceeding 15 minutes.

**TABLE N1103.1**  
**MINIMUM EQUIPMENT PERFORMANCE**

EQUIPMENT CATEGORY	SUB-CATEGORY <sup>e</sup>	REFERENCED STANDARD	MINIMUM PERFORMANCE
Air-cooled heat pumps heating mode < 65,000 Btu/h cooling capacity	Split systems	ARI 210/240	6.8 HSPF <sup>a,b</sup>
	Single package		6.6 HSPF <sup>a,b</sup>
Gas-fired or oil-fired furnace < 225,000 Btu/h	—	DOE 10 CFR Part 430, Subpart B, Appendix N	AFUE 78% <sup>b</sup> E <sup>1</sup> 80% <sup>c</sup>
Gas-fired or oil-fired steam and hot-water boilers < 300,000 Btu/h	—	DOE 10 CFR Part 430, Subpart B, Appendix N	AFUE 78% <sup>b,d</sup>
Air-cooled air conditioners and heat pumps cooling mode < 65,000 Btu/h cooling capacity	Split systems	ARI 210/240	10.0 SEER <sup>b</sup>
	Single package		9.7 SEER <sup>b</sup>

For SI: 1 Btu/h = 0.2931 W.

- For multicapacity equipment, the minimum performance shall apply to each capacity step provided. Multicapacity refers to manufacturer-published ratings for more than one capacity mode allowed by the product's controls.
- This is used to be consistent with the National Appliance Energy Conservation Act (NAECA) of 1987 (Public Law 100-12).
- These requirements apply to combination units not covered by NAECA (three-phase power or cooling capacity greater than 65,000 Btu/h).
- Except for gas-fired steam boilers, for which the minimum AFUE shall be 75 percent.
- Seasonal rating.

**TABLE N1103.3**  
**MINIMUM DUCT INSULATION<sup>a</sup>**

ANNUAL HEATING DEGREE DAYS	INSULATION R-VALUE (h · ft <sup>2</sup> · °F.)/Btu <sup>d</sup>			
	Ducts in unconditioned attics or outside building		Ducts in unconditioned basements, crawl spaces, garages, and other unconditioned spaces <sup>e</sup>	
	Supply	Return	Supply	Return <sup>b</sup>
< 1,500	8	4	4	0
1,500 to 3,500	8	4	6	2
3,501 to 7,500	8	4	8	2
> 7,500	11	6	11	2

For SI: °C = [(°F) - 32]/1.8, 1 (h·ft<sup>2</sup>·°F)/Btu = 0.176 (m<sup>2</sup>·K)/W, 1 foot = 304.5 mm.

- Insulation R-values shown are for the insulation as installed and do not include film resistance. The required minimum R-values do not consider water vapor transmission and condensation. Where control of condensation is required, additional insulation, vapor retarders or both shall be provided to limit vapor transmission and condensation. For ducts that are designed to convey both heated and cooled air, duct insulation shall be as required by the most restrictive condition. Where exterior walls are used as plenums, wall insulation shall be as required by the most restrictive condition of this section.
- Insulation on return ducts in basements is not required.
- Unconditioned spaces include ventilated crawl spaces and framed cavities in those floors, wall and ceiling assemblies which separate conditioned space from unconditioned space or outside air, and are uninsulated on the side facing away from the condition space.
- Insulation resistance measured on a horizontal plane in accordance with ASTM C 518, at a mean temperature of 75°F.

**N1103.3 Duct insulation.** All portions of the air distribution system shall be installed in accordance with the North Carolina Mechanical Code. All supply and return-air ducts and plenums installed as part of an HVAC air-distribution system shall be thermally insulated in accordance with Table 1103.3, or where such ducts or plenums operate at static pressure greater than 2 inches w.g. (500 PA), in accordance with Section 503.3.3.3.4.1 of the North Carolina Energy Conservation Code. When located within a building envelope assembly, at least R-8 shall be applied between the duct and that portion of the assembly furthest from conditioned space.

**Exceptions:**

- Factory-installed plenums, casings or ductwork furnished as a part of the HVAC equipment tested and rated in accordance with Section N1103.1.
- Ducts within the conditioned space that they serve.

**N1103.4 Duct sealing.** All ducts shall be sealed in accordance with North Carolina Mechanical Code.

**[E] N1103.5 Piping insulation.** All mechanical system piping shall be insulated in accordance with Table N1103.5.

**Exceptions:** Piping installed within appliances and equipment or piping serving fluids between 55°F (13°C) and 120°F (49°C).

**SECTION N1104**  
**SERVICE WATER HEATING**

**[E] N1104.1 Water heating appliance and equipment performance.** Performance of equipment listed in Table N1104.1 is covered by preemptive Federal law. Appliances and equipment not listed in Table N1104.1 shall meet the minimum efficiency requirements of Section 504.2 of the North Carolina Energy Conservation Code.

**TABLE N1103.5  
MINIMUM HVAC PIPING INSULATION THICKNESSES<sup>a</sup>**

PIPING SYSTEM TYPES	FLUID TEMP RANGE (°F)	INSULATION THICKNESS (inches)
<b>Heating systems</b>		
Low pressure/temperature	201-250	1.5
Low temperature	120-200	1.0
Steam condensate (for feed water)	Any	1.5
<b>Cooling systems</b>		
Chilled water, refrigerant or brine	40-55	0.75
	Below 40	1.25

For SI: 1 inch = 25.4 mm, °C = [(°F)-32]/1.8.

a. The pipe insulation thicknesses specified in this table are based on insulation *R*-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an *R*-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

$$\text{New Minimum Thickness} = \frac{4.6 \times \text{Table Thickness}}{\text{Actual } R \text{ - Value}}$$

For materials with an *R*-value less than R-4, the minimum insulation thickness shall be increased as follows:

$$\text{New Minimum Thickness} = \frac{4.0 \times \text{Table Thickness}}{\text{Actual } R \text{ - Value}}$$

b. deleted.

**TABLE N1104.1  
REQUIRED PERFORMANCE OF DOMESTIC HOT WATER HEATING EQUIPMENT  
SUBJECT TO MINIMUM FEDERAL STANDARDS**

CATEGORY	MAXIMUM INPUT RATING	MINIMUM EFFICIENCY
Electric; storage instantaneous	12 kW	0.93 - 0.00132 × V <sup>a</sup>
Gas; storage	75,000 Btu/h	0.62 - 0.0019 × V <sup>a</sup>
Gas; instantaneous	200,000 Btu/h	0.62 - 0.0019 × V <sup>a</sup>
Oil; storage	105,000 Btu/h	0.59 - 0.0019 × V <sup>a</sup>
Oil; instantaneous	210,000 Btu/h	0.59 - 0.0019 × V <sup>a</sup>

For SI: 1 Btu/h = 0.2931 W, 1 gallon = 3.785.

a. *V* is the rated storage volume in gallons as specified by the manufacturer.