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tion, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed.

Construction documents include all documentation required to be submitted in order to issue a building permit.

SECTION R102
ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

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PART 2—ADMINISTRATION AND ENFORCEMENT

SECTION R103
CONSTRUCTION DOCUMENTS

TABLE R301.3(2)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
1	9000 < CDD50°F	5000 < CDD10°C
2	6300 < CDD50°F ≤ 9000	3500 < CDD10°C ≤ 5000
3A and 3B	4500 < CDD50°F ≤ 6300 AND HDD65°F ≤ 5400	2500 < CDD10°C ≤ 3500 AND HDD18°C ≤ 3000
4A and 4B	CDD50°F ≤ 4500 AND HDD65°F ≤ 5400	CDD10°C ≤ 2500 AND HDD18°C ≤ 3000
3C	HDD65°F ≤ 3600	HDD18°C ≤ 2000
4C	3600 < HDD65°F ≤ 5400	2000 < HDD18°C ≤ 3000
5	5400 < HDD65°F ≤ 7200	3000 < HDD18°C ≤ 4000
6	7200 < HDD65°F ≤ 9000	4000 < HDD18°C ≤ 5000
7	9000 < HDD65°F ≤ 12600	5000 < HDD18°C ≤ 7000
8	12600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F)-32]/1.8.

SECTION R302
DESIGN CONDITIONS

SECTION ~~R303~~
~~MATERIALS, SYSTEMS AND EQUIPMENT~~

~~**R303.1 Identification.** Materials, systems and equipment shall be identified in a manner that will a~~llow a determination of compliance with the applicable provisions of this code.

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TABLE R303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE	DOUBLE	SKYLIGHT
			Double

TABLE R303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR

TABLE R303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

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R303.3 Maintenance information. Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. ~~Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.~~

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CHAPTER 4 [RE]

RESIDENTIAL ENERGY EFFICIENCY

SECTION R401
GENERAL

SECTION R402
BUILDING THERMAL ENVELOPE

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TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	.65	.65	.40	30	15	5	19	0	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	.35	.60	NR	38	19 or 13+5[h]	13	30[g]	10/13	10, 2 ft	10/13
6	.35	.60	NR	49	19 or 13+5[h]	15	30[g]	10/13	10, 4 ft	10/13
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

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 Climate 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 R301.1 and Table R301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

"j. Log walls complying with ICC400 and with a minimum average wall thickness of 5" or greater shall be permitted in Zones 5-8 when overall window glazing is .31 U-factor or lower, minimum heating equipment efficiency is 90 AFUE (gas) or 84 AFUE (oil), and all other component requirements are met."

TABLE R402.1.3
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
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	.65	.65	.035	.082	.141	0.047	.360	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	.35	.60	.030	.060	0.082	0.033	.059	.065
6	.35	.60	0.026	.060	0.060	0.033	.059	.065
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

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 Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

~~the *U*-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.~~

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R402.2.1 Ceilings with attic spaces. When Section R402.1.1 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. ~~This reduction shall not apply to the *U*-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.~~

R402.2.2 Ceilings without attic spaces. Where Section R402.1.1 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 R402.1.1 shall be limited to 500 square feet (46 m^2) or 20 percent of the total insulated ceiling area, whichever is less. ~~This reduction shall not apply to~~

TABLE R402.2.6
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION
(*R*-VALUE)

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R402.3.3 Glazed fenestration exemption. Up to 15 square feet (1.4 m^2) of glazed fenestration per dwelling unit shall be permitted to be exempt from *U*-factor and SHGC requirements in Section R402.1.1. ~~This exemption shall not apply to the *U*-factor alternative approach in Section R402.1.3 and the Total UA alternative in Section R402.1.4.~~

R402.3.4 Opaque door exemption. One side-hinged opaque door assembly up to 24 square feet (2.22 m^2) in area is exempted from the *U*-factor requirement in Section R402.1.1. ~~This exemption shall not apply to the *U*-factor alternative approach in Section R402.1.3 and the total UA alternative in Section R402.1.4.~~

The following parties shall be approved to conduct testing: Parties certified by BPI or RESNET, or licensed contractors who have completed training provided by Blower Door Test equipment manufacturers or other comparable training.

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1 or R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation. The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction.

Where allowed by the building official, the builder may certify compliance to components criteria for items which may not be inspected during regularly scheduled inspections

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in ~~Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8~~. Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). ~~Where required by the *code official*~~, testing shall be conducted by an *approved* ~~third~~ party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

R402.4.4 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 having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. ~~All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.~~

SECTION R403
SYSTEMS

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R403.2.2 Sealing (Mandatory). Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply

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Duct tightness shall be verified by either of the following:

1. Postconstruction test: Total leakage shall be less than or equal to 10 cfm (283L/min) per 100 square feet (9.29 m^2) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2. Rough-in test: Total leakage shall be less than or equal to 10 cfm (283L/min) per 100 square feet (9.29 m^2) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure. All registers 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 7.5 cfm (212L/min) per 100 square feet (9.29 m^2) of conditioned floor area.

Exception: The total leakage test is not required for systems with all air handlers and at least 50% of all ducts (measured by length) located entirely within the building thermal envelope

R403.2.3 Building cavities (Mandatory). Building framing cavities shall not be used as ducts ~~or plenums.~~

R403.3 Mechanical system piping insulation (Mandatory). Mechanical system piping capable of carrying fluids

R403.4.2 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:

1. Piping larger than $^3/_4$ inch nominal diameter.
2. Piping serving more than one dwelling unit.
3. ~~Piping from the water heater to kitchen outlets.~~
4. Piping located outside the conditioned space.
5. Piping from the water heater to a distribution manifold.
6. Piping located under a floor slab.
7. Buried piping.
8. Supply and return piping in recirculation systems other than demand recirculation systems.
9. ~~Piping with run lengths greater than the maximum run lengths for the nominal pipe diameter given in Table R403.4.2.~~

~~All remaining piping shall be insulated to at least R-3 or meet the run length requirements of Table R403.4.2.~~

~~**TABLE R403.4.2**~~
~~**MAXIMUM RUN LENGTH (feet)[a]**~~

Nominal Pipe Diameter of Largest Diameter Pipe in the Run (inch)	~~$^3/_8$~~	~~$^1/_2$~~	~~$^3/_4$~~	~~> $^3/_4$~~
~~Maximum Run Length~~	~~30~~	~~20~~	~~10~~	~~5~~

~~For SI: 1 inch = 25.4 mm, 1 foot 304.8 mm.~~

~~a. Total length of all piping from the distribution manifold or the recirculation loop to a point of use.~~

R403.5 Mechanical ventilation (Mandatory). ~~The building shall be provided with ventilation that meets the requirements~~

TABLE R403.5.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)

For SI: 1 cfm = 28.3 L/min.

~~of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other approved means of ventilation.~~ Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

SECTION R404
ELECTRICAL POWER AND LIGHTING SYSTEMS (MANDATORY)

~~**R404.1 Lighting equipment (Mandatory).** A minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high efficacy lamps or a minimum of 75 percent of the permanently installed lighting fixtures shall contain only high efficacy lamps.~~

~~**Exception:** Low voltage lighting shall not be required to utilize high efficiency lamps.~~

R404.1 **Lighting equipment (Mandatory).** Fuel gas lighting systems shall not have continuously burning pilot lights.

SECTION R405
SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)

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TABLE R405.5.2(1)—continued
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Air leakage rate of 5 air changes per hour ~~in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8~~ at a pressure of 0.2 inches w.g (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area N_{br} = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested, the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[c]. The mechanical ventilation rate[d] shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation		
Internal gains		
Internal mass		
Structural mass		
Heating systems[f, g]	Fuel type: same as proposed design Efficiencies: Electric: air source heat pump with prevailing federal minimum efficiencies Nonelectric furnaces: natural gas furnace with prevailing federal minimum efficiencies Nonelectric boilers: natural gas boiler with prevailing federal minimum efficiencies Capacity: sized in accordance with N1103.6	As proposed
Cooling systems[f, h]	Fuel type: Electric Efficiency: in accordance with federal minimum standards Capacity: sized in accordance with Section R403.6.	As proposed
Service water Heating[f, g, h, i]	Fuel type: same as proposed design Efficiency: in accordance with federal minimum standards Tank temperature: 120 F Use: same as proposed design	As proposed gal/day = $30 + (10 \times N_{br})$
Thermal distribution systems	Thermal distribution system efficiencies (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies	Thermal distribution system efficiency shall be as tested or as specified in Table R405.5.2(2) if not tested. Duct insulation shall be as proposed.
Thermostat		

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(continued)

TABLE R405.5.2(1)—continued
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

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TABLE R405.5.2(2)
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS[b]
Distribution system components located in unconditioned space	.80	0.95
Untested distribution systems entirely located in conditioned space[c]	0.88	1
"Ductless" systems[d]	1	—

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093m^2, 1 pound per square inch = 6895 Pa, 1 inch water gauge = 1250 Pa.

a. Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.

c. Entire system in conditioned space shall mean that no component of the distribution system, including the air-handler unit, is located outside of the conditioned space.

d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air-handler enclosure.