



## Town of Eagle

### Residential Energy Code Guidelines

#### **BUILDING DEPARTMENT**

**200 Broadway Street, Eagle, CO 81631**

[www.townofeagle.org](http://www.townofeagle.org)

Web page – <https://www.townofeagle.org/138/building>

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**STATEMENT OF PURPOSE** The Town of Eagle adopted a resolution in July of 2021 to achieve net zero emissions in the Eagle community by 2030. This Net Zero Action Plan was developed for the Town of Eagle in collaboration with the Adam Palmer Sustainability Fund. This plan outlines a pathway to achieving net zero by 2030 by providing strategies, policies, and initiatives to reduce greenhouse gas emissions to zero and limit the impacts of climate change. While reducing greenhouse gas emissions is the primary objective, how Eagle gets there matters. Climate action provides an opportunity to recognize additional benefits for our community, environment, and economy.

The adoption of the 2021 International Energy Code, including regional amendments, represents an integral component of achieving the objective set forth. The Town's participation in the Eagle County Code Cohort demonstrates our commitment to regional uniformity for reducing carbon emissions in Eagle County.

**APPLICABILITY** The information provided herein applies to residential buildings including detached one-and-two-family dwellings, townhouses, and multi-family dwelling units three stories or less. This document is NOT all-inclusive of Energy Code requirements and only represents highlights of the IECC.

#### **ENERGY CODE CONSTRUCTION DOCUMENT SUBMITTALS**

Where applicable to the Energy Code, all projects require electronic submittal of construction documents per subset A thru D shown below. Incomplete plans, submittals, and/or missing documents can create delays.

A. Energy Code Compliance Worksheet (Click [HERE](#))

B. Information on Construction Documents [R103.2]

- Submit separate plan or detail on construction documents which identifies the building thermal envelope
- Energy compliance path
- Insulation materials and their R-values
- Fenestration U-factors and solar heat gain coefficients
- Area-weighted U-factor and solar heat gain coefficients (where applicable)
- Mechanical system design criteria
- Mechanical and service water heating systems and equipment types, sizes, efficiencies, and fuel source
- Equipment and system controls
- Duct sealing, duct and pipe insulation and location
- Air sealing details
- Additional electric infrastructure (for mixed-fuel buildings)
- Solar ready pathway location(s)
- Location of applicable EV parking spaces

C. Mechanical Plan

- Floor plan which identifies appliance locations of HVAC and water heating equipment
- For equipment located in crawl spaces or attics, demonstrate compliance with the following:

- 1) Maximum 20-foot distance from the access opening to any unit(s)
- 2) Unobstructed walkway with minimum clear dimensions of five feet (5') in height and three feet (3') in width
- 3) Compartmentalization of equipment with 5/8" Type X sheetrock at ceilings and all sides

**BUILDING THERMAL ENVELOPE** [R402] **(See Tables 402.1.2 and 402.1.3 on Pages 10-11; Air barrier page 12)**

**VAPOR BARRIERS** [IRC702.7 or IBC1404.3] **(See pages 8-9 below)**

**SYSTEMS** [R403]

**CONTROLS** [R403.1]

- Programmable thermostat required
- Heat pump controls to prevent supplemental heat operation when compressor can meet heating load
- Automatic temperature reset integral on all hot water boilers (installed by manufacturer)

**DUCTS** [R403.3]

- Ducts shall be pressure tested by an approved tester at either the rough-in stage or mechanical final
- Supply and return ducts  $>/=$  3 inches in diameter located outside conditioned space shall be insulated to minimum R-8
- Supply and return ducts  $<$  3 inches in diameter located outside conditioned space shall be insulated to minimum R-6
- Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with the IRC or IMC, as applicable
- Building framing cavities shall NOT be used as ducts or plenums
- Mechanical system piping shall be insulated to minimum R-3 (unless otherwise exempted)
- Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance, and wind. Adhesive tape is prohibited

**SERVICE HOT WATER SYSTEMS** [R403.5]

- Hot water piping, regardless of size, shall be insulated to a minimum R-3 including conditioned spaces. Exception: interior walls located in conditioned spaces with insulated cavity spaces
- Fuel-fired water heaters shall be installed in space compliant with ALL three requirements below:
  - a) Minimum dimensions of 3 feet by 3 feet by 7 feet in height
  - b) Minimum volume of 760 cubic feet, or the equivalent of one 16-inch by 24-inch grill to a heated space and one 8-inch duct of no more than 10 feet in length for cool exhaust air
  - c) Contains a condensate drain that no more than 2 inches higher than the base of the installed water heater and allows natural draining without pump assistance. The drain shall be installed within 3 feet of the water heater. Exception: Water heaters with an input capacity of greater than 300,000 Btu/h that serve multiple family dwelling units or sleeping units
- All fuel-fired or electric powered appliances installed under floors or in attic spaces shall be provided with an opening and a clear unobstructed passageway large enough to allow removal of the largest appliance, but not less than 60 inches high and 36 inches wide and not more than 20 feet long measured along the centerline of the passageway from the opening to the appliance

**MECHANICAL VENTILATION:** [R403.6]

- Buildings and dwelling units shall be provided with mechanical ventilation that complies with the IRC or IMC
- Mechanical ventilation systems shall be tested to verify minimum flow rates
- Fans used to provide whole-dwelling mechanical ventilation shall comply with the efficacy requirements of Table 403.6.2

**TABLE 403.6.2 WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY**

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)
HRV/ERV	Any	1.2 cfm/watt
In-line supply or exhaust fan	Any	3.8 cfm/watt
Other exhaust fan	< 90	2.8 cfm/watt
Other exhaust fan	≥ 90	3.5 cfm/watt
Air handler integrated	Any	1.2 cfm/watt

**EQUIPMENT SIZING AND EFFICIENCY** [R403.7]

- Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies
- Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the IECC

**ROOF AND GUTTER DE-ICING CONTROLS** [R403.9]

- Roof and gutter de-icing systems, including without limitation self-regulating cable, shall include automatic controls configured to shut off the system when the outdoor temperature is above 40 F maximum and shall include ONE of the following:
  - 1) A moisture sensor configured to shut off the system in the absence of moisture
  - 2) A programmable timer configured to shut off the system for 8 hours minimum during the day

**SNOW MELT SYSTEM CONTROLS** [RE103.2]

- Snow melt systems shall include automatic controls capable of shutting off the system when the pavement temperature is greater than 50 degrees F and precipitation is not falling
- Snow melt systems shall include an automatic control that will limit operation to when the outdoor temperature is between 20 and 40 degrees F
- Snowmelt heating appliances such as, but not limited to, condensing boilers shall have a minimum efficiency of 92% AFUE. Electric resistance and heat pump heaters shall be permitted. Where condensing boilers are used, the boiler supply water temperature shall be a maximum of 130 F to allow for efficient boiler operation
- R-15 insulation shall be installed under all areas of snowmelt
- The maximum area of snowmelt shall be capped at 6,000 square feet per parcel
- The first 200 square feet are exempt from the above-code requirements of Section R403.9
- Snow melt and ice melt systems greater than 200 square feet shall offset the additional energy used in accordance with the adopted Appendix RE (Exterior Energy Offset Program)

**EXTERIOR POOLS AND SPAS** [R403.10 and RE103.3 + RE103.4]

- Pool covers with a minimum R-2 value are required for all pools
- Pool heating appliances shall have a minimum efficiency of 92% AFUE. Electric resistance and heat pump heaters shall be permitted. Where condensing boilers are used, the boiler supply water temperature shall be a maximum of 130 F to allow for boiler operation

- Electric power to heaters shall be controlled by an on-off switch that is an integral part of the heater mounted on the exterior of the heater in a location with ready access, or external to and within 3 feet of the heater
- Time switches or other control methods that can automatically turn heaters and pump motors off and on according to a preset schedule shall be installed for heaters and pump motors.

## **ELECTRICAL POWER AND LIGHTING** [R404]

### **INTERIOR LIGHTING CONTROLS** [R404.2]

Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture

Exception: lighting controls are NOT required for the following:

- Bathrooms
- Hallways
- Exterior lighting fixtures
- Lighting designed for safety or security

### **EXTERIOR LIGHTING CONTROLS** [R404.3]

Where the total permanently installed exterior lighting power is greater than 30 watts, the permanently installed exterior lighting shall comply with the following:

- 1) Lighting shall be controlled by a manual on and off switch which permits automatic shut-off actions. Exception: lighting serving multiple dwelling units
- 2) Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs
- 3) Controls that override automatic shut-off actions shall not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours

### **ADDITIONAL ELECTRIC INFRASTRUCTURE** [R404.1.4]

At each location where fuel-fired equipment is installed, a junction box shall be provided that connects to the electric panel by continuous raceways that meet the following requirements:

- 1) The junction box, raceway, and bus bar in the electric panel and conductors serving the electric panel shall be sized to accommodate electric equipment that is sized to serve the same load as the combustion equipment
- 2) The panel shall have reserved physical space for a dual-pole circuit breaker
- 3) The junction box and electrical panel directory entry for the dedicated circuit breaker space shall have labels stating: "For Future Electric Equipment"
- 4) The junction box shall allow for the electric equipment to be installed within the same place as the combustion equipment that it replaces.

#### **EXCEPTIONS:**

- Fossil fuel space heating equipment where a 208/240-volt electrical circuit with a minimum capacity of 40 amps exists for space cooling equipment
- Water heating equipment with an input capacity greater than 300,000 Btu/h that serves multiple dwelling units or sleeping units

## **ELECTRICAL AND COMMUNICATIONS BOXES (air-sealed boxes)** [R402.4.6]

Electrical and communications outlet boxes installed in the building thermal envelope shall be **NEMA OS 4 or OS 4** type sealed boxes

**RD101. Purpose and intent.** The purpose and intent of this Appendix RD is to accommodate the growing need for EV charging infrastructure, in particular meeting preferences for charging at home. Including these measures during initial construction substantially reduces the costs and difficulty of installing EV infrastructure at a later date.

**RD102. Applicability.** This Appendix RD shall apply to all new residential construction to which the IRC applies.

**RD103. Definitions.**

**AUTOMOBILE PARKING SPACE.** A space within a building or private or public parking lot, exclusive of driveways, ramps, columns, office, and work areas, for the parking of an automobile.

**DIRECT CURRENT FAST CHARGING (DCFC) EVSE.** EV power transfer infrastructure capable of fast charging on a 100A or higher 480VAC three-phase branch circuit. AC power is converted into a controlled DC voltage and current within the EVSE that will then directly charge the EV.

**EV LOAD MANAGEMENT SYSTEM.** A system designed to allocate charging capacity among multiple EVSE and that complies with the current National Electric Code.

**ELECTRIC VEHICLE (EV).** An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and electric motorcycles, primarily powered by an electric motor that draws current from an electric source.

**EV SUPPLY EQUIPMENT (EVSE).** Equipment for plug-in power transfer including the ungrounded, grounded, and equipment grounding conductors, and the EV connectors, attachment plugs, personal protection system and all other fittings, devices, power outlets or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the EV.

**EV SUPPLY EQUIPMENT INSTALLED SPACE (EVSE space).** An automobile parking space that is provided with a dedicated EVSE connection.

**EV CAPABLE SPACE.** A designated automobile parking space that is provided with electrical infrastructure, such as raceways, cables, electrical capacity, and panelboard or other electrical distribution equipment space, necessary for the future installation of an EVSE.

**EV READY SPACE.** An automobile parking space that is provided with a branch circuit and receptacle that will support an installed EVSE.

**UNIVERSAL VEHICLE CHARGING STATION.** A charging station installed in a parking space for a minimum vehicle width of 120 inches with 36 inch access aisles on each side.

**RD104. One- and two- family dwellings and townhouses.** One EV ready space shall be provided for each dwelling unit. The branch circuit shall be identified as EV ready in the service panel or subpanel directory, and the termination location shall be marked as EV ready.

**Exceptions:**

1. Dwelling units where no parking spaces are either required or provided.
2. ADUs.

**RD105. Residential multifamily dwellings, 3-stories or less.** New dwelling units for residential multifamily buildings, other than duplexes and townhomes, shall be provided with EV power transfer infrastructure in compliance with Sections RD105.1-RD105.6 and Sections RD106-RD107.

**RD105.1. Quantity.** The number of required EVSE spaces, EV ready spaces, and EV capable spaces shall be determined in accordance with this Section and Table RD105.1 based on the total number of automobile parking spaces and shall be rounded up to the nearest whole number. For multifamily

buildings, the Table requirements shall be based on the total number of dwelling units or the total number of automobile parking spaces, whichever is less.

1. Where more than one parking facility is provided on a building site, the number of required automobile parking spaces required to have EV power transfer infrastructure shall be calculated separately for each parking facility.
2. Installed EVSE spaces that exceed the minimum requirements of this section may be used to meet minimum requirements for EV ready spaces and EV capable spaces.
3. Installed EV ready spaces that exceed the minimum requirements of this section may be used to meet minimum requirements for EV capable spaces.
4. Where the number of EV ready spaces allocated for multifamily occupancies is equal to the number of dwelling units or to the number of automobile parking spaces allocated to multifamily occupancies, whichever is less, requirements for EVSE spaces shall not apply.
5. In multifamily complexes that contain multiple buildings, required EV spaces shall be dispersed throughout parking areas so that each building has access to a similar number of spaces per dwelling unit.

TABLE RD105.1  
REQUIRED EV POWER TRANSFER INFRASTRUCTURE FOR MULTIFAMILY

BUILDING TYPE	MINIMUM EV INSTALLED SPACES	MINIMUM EV READY SPACES	MINIMUM EV CAPABLE SPACES
Multifamily	5%	10%	40%

- a. Where 100% of the parking serving multifamily occupancies are EV ready spaces, requirements for EVSE spaces shall not apply.

RD105.2. EV capable spaces. Each EV capable space used to meet the requirements of Section RD105.1 shall comply with all of the following:

1. A continuous raceway or cable assembly shall be installed between an enclosure or outlet located within 3 feet of the EV capable space and a suitable panelboard or other onsite electrical distribution equipment.
2. Installed raceway or cable assembly shall be sized and rated to supply a minimum circuit capacity in accordance with RD105.5
3. The electrical distribution equipment to which the raceway or cable assembly connects shall have sufficient dedicated space and spare electrical capacity for a 2-pole circuit breaker or set of fuses.
4. The electrical enclosure or outlet and the electrical distribution equipment directory shall be marked: "For future electric vehicle supply equipment (EVSE)."
5. Reserved capacity shall be no less than 4.1 kVA (20A 208/240V) for each EV capable space.

RD105.3. EV ready spaces. Each branch circuit serving EV ready spaces used to meet the requirements of Section RD105.1 shall comply with all of the following:

1. Terminate at a receptacle with overcurrent protection and GFCI protection as required by NFPA 70, located within 3 feet of each EV ready space it serves.
2. Have a minimum circuit capacity in accordance with RD105.5.
3. Have a branch circuit on the panelboard or other electrical distribution equipment directory designated as "For electric vehicle supply equipment (EVSE)" and the outlet or enclosure shall be marked "For electric vehicle supply equipment (EVSE)."

RD105.4. EVSE spaces. An installed EVSE with multiple output connections shall be permitted to serve multiple EVSE spaces. Each EVSE installed to meet the requirements of Section RD105.1, serving either a single EVSE space or multiple EVSE spaces, shall comply with all of the following:

1. Have a minimum circuit capacity in accordance with RD105.5.
2. Have a minimum charging rate in accordance with RD105.4.1.
3. Be located within 3 feet of each EVSE space it serves.
4. Be installed in accordance with Section RD105.6 and RD105.7

RD105.4.1. EVSE minimum charging rate. Each installed EVSE shall comply with one of the following:

1. Be capable of charging at a minimum rate of 6.2 kVA (or 30A at 208/240V).
2. When serving multiple EVSE spaces and controlled by an energy management system providing load management, be capable of simultaneously charging each EVSE space at a minimum rate of no less than 3.3 kVA.
3. When serving EVSE spaces allowed to have a minimum circuit capacity of 2.7 kVA in accordance with RD105.5.1 and controlled by an energy management system providing load management, be capable of simultaneously charging each EVSE space at a minimum rate of no less than 2.1 kVA.

RD105.5. Circuit capacity. The capacity of electrical infrastructure serving each EV capable space, EV ready space, and EVSE space shall comply with one of the following:

1. A branch circuit with a rated capacity not less than 8.3 kVA (or 40A at 208/240V) for each EV ready space or EVSE space it serves.
2. The requirements of RD105.5.1.

RD105.5.1. Circuit capacity management. The capacity of each branch circuit serving multiple EVSE spaces, EV ready spaces or EV capable spaces designed to be controlled by an energy management system providing load management in accordance with NFPA 70, shall comply with one of the following:

1. Have a minimum capacity of 4.1 kVA per space.
2. Have a minimum capacity of 2.7 kVA per space when serving EV ready spaces or EVSE spaces for a building site when 100% of the automobile parking spaces are EV ready or EVSE spaces.

RD105.6. EVSE installation. EVSE shall be installed in accordance with NFPA 70 and shall be listed and labeled in accordance with UL 2202 or UL 2594.

RD105.7. EVSE ENERGY STAR. All EVSE shall be ENERGY STAR certified.

RD106. Universal vehicle charging stations. Where EV charging stations are provided for public use, or where EV charging stations are shared by multiple multifamily dwelling units, the number of universal EV charging stations shall be provided in accordance with Table RD106.1. When multiple stalls are required, access aisles may be shared.

**TABLE RD106.1 - UNIVERSAL EV SPACE REQUIREMENTS**

TOTAL # OF EV CHARGING STATIONS	MINIMUM # OF UNIVERSAL VEHICLE CHARGING STATIONS
1 or more	25%

RD107. Identification. Construction documents shall designate all EV capable spaces, EV ready spaces, and EVSE spaces and indicate the locations of conduit and termination points serving them. The circuit breakers or circuit breaker spaces reserved for the EV capable spaces, EV ready spaces, and EVSE spaces shall be clearly identified in the panel board directory. The conduit for EV capable spaces shall be clearly identified at both the panel board and the termination point at the parking space.

**VAPOR RETARDERS** [R702.7 and IBC1404.3]

**R702.7 Vapor retarders.** Vapor retarder materials shall be classified in accordance with Table R702.7(1). A vapor retarder shall be provided on the interior side of frame walls of the class indicated in Table R702.7(2), including compliance with Table R702.7(3) or R702.7(4) where applicable. An approved design using accepted engineering

practice for hygrothermal analysis shall be permitted as an alternative. The climate zone shall be determined in accordance with Section N1101.7.

**Exceptions:**

1. Basement walls.
2. Below-grade portion of any wall.
3. Construction where accumulation, condensation or freezing of moisture will not damage the materials.
4. A vapor retarder shall not be required in Climate Zones 1, 2 and 3.

**TABLE R702.7(1) - VAPOR RETARDER MATERIALS AND CLASSES**

<b>CLASS ACCEPTABLE MATERIALS</b>	
I	Sheet polyethylene, nonperforated aluminum foil or other approved materials with a perm rating less than or equal to 0.1
II	Kraft-faced fiberglass batts, vapor retarder paint or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 0.1 and less than or equal to 1.0.
III	Latex paint, enamel paint or other approved materials applied in accordance with the manufacturer's installation instructions for a perm rating greater than 1.0 and less than or equal to 10.0.

**TABLE R702.7(2) - VAPOR RETARDER OPTIONS**

<b>CLIMATE ZONE</b>	<b>VAPOR RETARDER CLASS</b>	<b>Class I (a)</b>	<b>Class II (a)</b>	<b>Class III</b>
6	Permitted (b)	Permitted (c)	See Table R702.7(3)	

**(a)** Class I and II vapor retarders with vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B) shall be allowed on the interior side of any frame wall in all climate zones.

**(b)** Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an approved design.

**(c)** Where a Class II vapor retarder is used in combination with foam plastic insulating sheathing installed as continuous insulation on the exterior side of frame walls, the continuous insulation shall comply with Table R702.7(4) and the Class II vapor retarder shall have a vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B).

**TABLE R702.7(3) - CLASS III VAPOR RETARDERS**

<b>CLIMATE ZONE</b>	<b>CLASS III VAPOR RETARDERS PERMITTED FOR: (a, b)</b>
	Vented cladding over fiberboard.
6	Vented cladding over gypsum.
	Continuous insulation with R-value $\geq 7.5$ over $2 \times 4$ wall.
	Continuous insulation with R-value $\geq 11.25$ over $2 \times 6$ wall.

**(a)** Vented cladding shall include vinyl, polypropylene, or horizontal aluminum siding, brick veneer with a clear airspace as specified in Table R703.8.4(1), and other approved vented claddings.

**(b)** The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class III vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

<b>TABLE R702.7(4) - CONTINUOUS INSULATION WITH CLASS II VAPOR RETARDER</b>	
<b>CLIMATE ZONE</b>	<b>CLASS II VAPOR RETARDERS PERMITTED FOR: (a)</b>
4, 5 and 6	Continuous insulation with R-value $\geq 3$ over 2 x 4 wall
	Continuous insulation with R-value $\geq 5$ over 2 x 6 wall

**(a)** The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class II vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

**R702.7.1 Spray foam plastic insulation for moisture control with Class II and III vapor retarders.**

For purposes of compliance with Tables R702.7(3) and R702.7(4), spray foam with a maximum permeance of 1.5 perms at the installed thickness applied to the interior side of wood structural panels, fiberboard, insulating sheathing or gypsum shall be deemed to meet the continuous insulation moisture control requirement in accordance with one of the following conditions:

1. The spray foam R-value is equal to or greater than the specified continuous insulation R-value.
2. The combined R-value of the spray foam and continuous insulation is equal to or greater than the specified continuous insulation R-value.

TABLE R402.1.3  
INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b,1</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b,2</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE <sup>b</sup>	MASS WALL R-VALUE <sup>b</sup>	FLOOR R-VALUE	BASEMENT <sup>c,3</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c,4</sup> WALL R-VALUE
0	NR	0.75	0.25	30	13 or 0 + 10	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 + 10	3/4	13	0	0	0
2	0.40	0.65	0.25	49	13 or 0 + 10	4/6	13	0	0	0
3	.30	0.55	0.25	49	20 or 13 + 5ci or 0 + 15	8/13	19	5ci or 13 <sup>f</sup>	10ci, 2 ft	5ci or 13 <sup>f</sup>
4 except Marine	.30	0.55	0.40	60	20 + 5 or 13 + 10ci or 0 + 15	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
5 and Marine 4	0.30 <sup>i</sup>	0.55	0.40	60	20 + 5 or 13 + 10ci or 0 + 15	13/17	30	15ci or 19 or 13 + 5ci	10ci, 4 ft	15ci or 19 or 13 + 5ci
6	0.30 <sup>i</sup>	0.55	NR	60	20 + 5ci or 13 + 10ci or 0 + 20	15/20	30	15ci or 19 or 13 + 5ci	10ci, 4 ft	15ci or 19 or 13 + 5ci
7 and 8	0.30 <sup>i</sup>	0.55	NR	60	20 + 5ci or 13 + 10ci or 0 + 20	19/21	38	15ci or 19 or 13 + 5ci	10ci, 4 ft	15ci or 19 or 13 + 5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.

ci = continuous insulation.

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not 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:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13 + 5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.

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. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, "13 + 5" means R-13 cavity insulation plus R-5 continuous insulation.

h. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

i. A maximum U-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

TABLE R402.1.2  
MAXIMUM ASSEMBLY U-FACTORS<sup>a</sup> AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>f</sup>	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC <sup>d, e</sup>	CEILING U-FACTOR	WOOD FRAME WALL U-FACTOR	MASS WALL U-FACTOR <sup>b</sup>	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.026	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026	0.060	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.30	0.55	0.40	0.024	0.045	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.40	0.024	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.024	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.024	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

- Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zones 0 and 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.
- In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall *U*-factor shall not exceed 0.360.
- The SHGC column applies to all glazed fenestration.

**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- There are no SHGC requirements in the Marine Zone.
- A maximum *U*-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:
  - Above 4,000 feet in elevation above sea level, or
  - In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the *International Residential Code*.

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

**TABLE R402.4.1.1**  
**AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION<sup>a</sup>**

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope.	Air-permeable insulation shall not be used as a sealing material.
	Breaks or joints in the air barrier shall be sealed.	
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
	Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	
Walls	The junction of the foundation and sill plate shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, <i>R</i> -value, of not less than <i>R</i> -3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
	The junction of the top plate and the top of exterior walls shall be sealed.	
	Knee walls shall be sealed.	
Windows, skylights and doors	The space between framing and skylights, and the jambs of windows and doors, shall be sealed.	—
Rim joists	Rim joists shall include an exterior air barrier. <sup>b</sup>	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board. <sup>b</sup>
	The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	
Floors, including cantilevered floors and floors above garages	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extending from the bottom to the top of all perimeter floor framing members.
Basement crawl space and slab foundations	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10.	Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10.
	Penetrations through concrete foundation walls and slabs shall be air sealed.	Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1.
	Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the <i>International Residential Code</i> .	Slab-on-grade floor insulation shall be installed in accordance with Section R402.2.10.
Shafts, penetrations	Duct and flue shafts to exterior or unconditioned space shall be sealed.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required <i>R</i> -value.
	Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.	
Narrow cavities	Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.	Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.

Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.7.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5.	Recessed light fixtures installed in the building thermal envelope shall be airtight and IC rated, and shall be buried or surrounded with insulation.
Plumbing, wiring or other obstructions	All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.	Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required <i>R</i> -value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.	—
HVAC register boots	HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	—
Concealed sprinklers	Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	—

- a. Inspection of log walls shall be in accordance with the provisions of [ICC 400](#).
- b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.