

CHAPTER 3 [CE]

GENERAL REQUIREMENTS

SECTION C301 CLIMATE ZONES

C301.1 General. *Climate zones* from Table C301.1 shall be used in determining the applicable requirements from Chapter 4. Seattle is in Zone 4-C (4-Marine).

**TABLE C301.1
CLIMATE ZONES, MOISTURE REGIMES, AND
WARM-HUMID DESIGNATIONS BY STATE AND COUNTY**

Key: A – Moist, B – Dry, C – Marine		
Absence of moisture designation indicates moisture regime is irrelevant		
WASHINGTON		
5B Adams	4C Grays Harbor	4C Pierce
5B Asotin	4C Island	4C San Juan
5B Benton	4C Jefferson	4C Skagit
5B Chelan	4C King	5B Skamania
4C Clallam	4C Kitsap	4C Snohomish
4C Clark	5B Kittitas	5B Spokane
5B Columbia	5B Klickitat	5B Stevens
4C Cowlitz	4C Lewis	4C Thurston
5B Douglas	5B Lincoln	4C Wahkiakum
5B Ferry	4C Mason	5B Walla Walla
5B Franklin	5B Okanogan	4C Whatcom
5B Garfield	4C Pacific	5B Whitman
5B Grant	5B Pend Oreille	5B Yakima

SECTION C302 DESIGN CONDITIONS

C302.1 Interior design conditions. The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

C302.2 Exterior design conditions. The heating or cooling outdoor design temperatures shall be ~~((selected from Appendix~~ €)) 24°F for heating and 86°F dry bulb and 67°F wet bulb for cooling.

SECTION C303 MATERIALS, SYSTEMS AND EQUIPMENT

C303.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

C303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or greater in width. 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 areas covered and *R*-value of installed thickness shall be *listed* on the certification. For insulated siding, the *R*-value shall be labeled on the product's package and shall be listed on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

Exception: For roof insulation installed above the deck, the *R*-value shall be labeled as required by the material standards specified in Table 1508.2 of the *International Building Code*.

GENERAL REQUIREMENTS

C303.1.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown-in or sprayed fiberglass and cellulose roof/ceiling insulation shall be written in inches (mm) on markers for every 300 square feet (28 m²) of attic area throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers of not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be *listed* on certification provided by the insulation installer.

C303.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer’s *R*-value mark is readily observable upon inspection. For insulation materials that are installed without an observable manufacturer’s *R*-value mark, such as blown or draped products, an insulation certificate complying with Section C303.1.1 shall be left immediately after installation by the installer, in a conspicuous location within the building, to certify the installed *R*-value of the insulation material.

C303.1.3 Fenestration product rating. *U*-factors of fenestration shall be determined as follows:

1. For windows, doors and skylights, *U*-factor ratings shall be determined in accordance with NFRC 100.
2. Where required for garage doors and rolling doors, *U*-factor ratings shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined 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 Table C303.1.3(1), C303.1.3(2) or C303.1.3(4). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) 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 or VT shall be assigned a default SHGC or VT from Table C303.1.3(3). For tubular daylighting devices, VT_{annual} shall be measured and rated in accordance with NFRC 203.

Exception: Units without NFRC ratings produced by a small business may be assigned default *U*-factors from Table C303.1.3(5) for vertical fenestration.

**TABLE C303.1.3(1)
DEFAULT GLAZED WINDOW, GLASS DOOR AND SKYLIGHT *U*-FACTORS**

FRAME TYPE	Window and Glass Door		SKYLIGHT
	SINGLE PANE	DOUBLE PANE	
Metal	1.20	0.80	See Table C303.1.3(4)
Metal with Thermal Break ^a	1.10	0.65	
Nonmetal or Metal Clad	0.95	0.55	
Glazed Block	0.60		

^a Metal Thermal Break = A metal thermal break framed window shall incorporate the following minimum design characteristics:

- 1) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/ft²/°F;
- 2) The thermal break material must produce a gap in the frame material of not less than 0.210 inches; and
- 3) All metal framing members of the products exposed to interior and exterior air shall incorporate a thermal break meeting the criteria in 1) and 2) above.

**TABLE C303.1.3(2)
DEFAULT OPAQUE DOOR *U*-FACTORS**

See Appendix A, Section A107

**TABLE C303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT**

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.40	0.40	0.40	0.40	0.40
VT	0.6	0.3	0.6	0.3	0.6

TABLE C303.1.3(4)
DEFAULT U-FACTORS FOR SKYLIGHTS

FENESTRATION TYPE	FRAME TYPE			
	ALUMINUM WITHOUT THERMAL BREAK	ALUMINUM WITH THERMAL BREAK	REINFORCED VINYL/ALUMINUM-CLAD WOOD OR VINYL	WOOD OR VINYL-CLAD WOOD/VINYL WITHOUT REINFORCING
Single Glazing glass	U-1.58	U-1.51	U-1.40	U-1.18
	U-1.52	U-1.45	U-1.34	U-1.11
Double Glazing air	U-1.05	U-0.89	U-0.84	U-0.67
	U-1.02	U-0.86	U-0.80	U-0.64
Double Glazing, $e=0.20$ air	U-0.96	U-0.80	U-0.75	U-0.59
	U-0.91	U-0.75	U-0.70	U-0.54
Double Glazing, $e=0.10$ air	U-0.94	U-0.79	U-0.74	U-0.58
	U-0.89	U-0.73	U-0.68	U-0.52
Double Glazing, $e=0.05$ air	U-0.93	U-0.78	U-0.73	U-0.56
	U-0.87	U-0.71	U-0.66	U-0.50
Triple Glazing air	U-0.90	U-0.70	U-0.67	U-0.51
	U-0.87	U-0.69	U-0.64	U-0.48
Triple Glazing, $e=0.20$ air	U-0.86	U-0.68	U-0.63	U-0.47
	U-0.82	U-0.63	U-0.59	U-0.43
Triple Glazing, $e=0.20$ on 2 surfaces air	U-0.82	U-0.64	U-0.60	U-0.44
	U-0.79	U-0.60	U-0.56	U-0.40
Triple Glazing, $e=0.10$ on 2 surfaces air	U-0.81	U-0.62	U-0.58	U-0.42
	U-0.77	U-0.58	U-0.54	U-0.38
Quadruple Glazing, $e=0.10$ on 2 surfaces air	U-0.78	U-0.59	U-0.55	U-0.39
	U-0.74	U-0.56	U-0.52	U-0.36
	U-0.70	U-0.52	U-0.48	U-0.32

Notes for Table C303.1.3(4)

- U-factors are applicable to both glass and plastic, flat and domed units, all spacers and gaps.
- Emissivities shall be less than or equal to the value specified.
- Gap fill shall be assumed to be air unless there is a minimum of 90% argon or krypton.
- Aluminum frame with thermal break is as defined in footnote 1 to Table C303.1.3(1).

**TABLE C303.1.3(5)
SMALL BUSINESS COMPLIANCE TABLE
DEFAULT U-FACTORS FOR VERTICAL FENESTRATION**

Vertical Fenestration Description				Frame Type		
Panes	Low-e ¹	Spacer	Fill	Any Frame	Aluminum Thermal Break ²	Wood/Vinyl/Fiberglass
Double ³	A	Any	Argon	0.48	0.41	0.32
	B	Any	Argon	0.46	0.39	0.30
	C	Any	Argon	0.44	0.37	0.28
	C	High Performance	Argon	0.42	0.35	Deemed to comply ⁵
Triple ⁴	A	Any	Air	0.50	0.44	0.26
	B	Any	Air	0.45	0.39	0.22
	C	Any	Air	0.41	0.34	0.20
	Any double low-e	Any	Air	0.35	0.32	0.18

¹ Low-eA (emissivity) shall be 0.24 to 0.16.
 Low-eB (emissivity) shall be 0.15 to 0.08.
 Low-eC (emissivity) shall be 0.07 or less.

² Aluminum Thermal Break = An aluminum thermal break framed window shall incorporate the following minimum design characteristics:
 a) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/ft²/°F;
 b) The thermal break material must produce a gap in the frame material of not less than 0.210 inches; and
 c) All metal framing members of the products exposed to interior and exterior air shall incorporate a thermal break meeting the criteria in a) and b) above.

³ A minimum air space of 0.375 inches between panes of glass is required for double glazing.

⁴ A minimum air space of 0.25 inches between panes of glass is required for triple glazing.

⁵ Deemed to comply glazing shall not be used for performance compliance.

C303.1.4 Insulation product rating. The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (C.F.R. Title 16, Part 460) in units of h × ft² × °F/Btu at a mean temperature of 75°F (24°C).

C303.1.4.1 Insulated siding. The thermal resistance (*R*-Value) shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer’s installation instructions.

C303.1.5 Spandrel panels in glass curtain walls. Table C303.1.5 provides default *U*-factors for the spandrel section of glass and other curtain wall systems. Design factors that affect performance are the type of framing, the type of spandrel panel and the *R*-value of insulation. Four framing conditions are considered in the table. The first is the common case where standard aluminum mullions are used. Standard mullions provide a thermal bridge through the insulation, reducing its effectiveness. The second case is for metal framing members that have a thermal break. A thermal break frame uses a urethane or other nonmetallic element to separate the metal exposed to outside conditions from the metal that is exposed to interior conditions. The third case is for structural glazing or systems where there are no exposed mullions on the exterior. The fourth case is for the condition where there is no framing or the insulation is continuous and uninterrupted by framing. The columns in the table can be used for any specified level of insulation between framing members installed in framed curtain walls or spandrel panels.

C303.1.5.1 Window wall application. Where “window wall” or similar assembly that is discontinuous at intermediate slab edges is used, the slab edge *U*-value shall be as listed in Appendix Table ((A103.3.7.1(3))) A103.3.7.2 or as determined using an approved calculation.

C303.1.5.2 Table value assumptions. In addition to the spandrel panel assembly, the construction assembly *U*-factors assume an air gap between the spandrel panel (with an *R*-value of 1.39) and one layer of 5/8-inch gypsum board (with an *R*-value of 0.56) that provides the interior finish. The gypsum board is assumed to span between the window sill and a channel at the floor. For assemblies that differ from these assumptions, custom *U*-factors can be calculated to account for any amount of continuous insulation or for unusual construction assemblies using Equations 3-1, 3-2 or 3-3 where appropriate. Spandrel panel *U*-factors for assemblies other than those covered by Table C303.1.5 or Equations 3-1 through 3-3 may be determined using an alternate approved methodology. Equations 3-1 through 3-3 do not calculate the value of any insulation inboard of the curtain wall assembly.

**Aluminum without Thermal Break
(Equation 3-1)**

$$U_{\text{overall}} = \left[(R_{\text{gypsum}} + R_{\text{airgap}}) + \left[\frac{1}{0.2798 + \left(\frac{0.8929}{R_{\text{addedinsulation}} + \left(\frac{1}{U_{\text{centerofglass}}} \right)} \right)} \right] \right]$$

**Aluminum with Thermal Break
(Equation 3-2)**

$$U_{\text{overall}} = \left[(R_{\text{gypsum}} + R_{\text{airgap}}) + \left[\frac{1}{0.1808 + \left(\frac{0.8874}{R_{\text{addedinsulation}} + \left(\frac{1}{U_{\text{centerofglass}}} \right)} \right)} \right] \right]$$

**Structural Glazing
(Equation 3-3)**

$$U_{\text{overall}} = \left[(R_{\text{gypsum}} + R_{\text{airgap}}) + \left[\frac{1}{0.1151 + \left(\frac{0.9487}{R_{\text{addedinsulation}} + \left(\frac{1}{U_{\text{centerofglass}}} \right)} \right)} \right] \right]$$

U-FACTORS FOR SPANDREL PANELS AND GLASS CURTAIN WALLS

		RATED R-VALUE OF INSULATION BETWEEN FRAMING MEMBERS								
		NONE	R-4	R-7	R-10	R-15	R-20	R-25	R-30	
FRAME TYPE	SPANDREL PANEL	A	B	C	D	E	F	G	H	
Aluminum without Thermal Break	Single glass pane, stone or metal panel	1	0.360	0.242	0.222	0.212	0.203	0.198	0.195	0.193
	Double glass with no low-e coatings	2	0.297	0.233	0.218	0.209	0.202	0.197	0.194	0.192
	Triple or low-e glass	3	0.267	0.226	0.214	0.207	0.200	0.196	0.194	0.192
Aluminum with Thermal Break	Single glass pane, stone or metal panel	4	0.350	0.211	0.186	0.173	0.162	0.155	0.151	0.149
	Double glass with no low-e coatings	5	0.278	0.200	0.180	0.170	0.160	0.154	0.151	0.148
	Triple or low-e glass	6	0.241	0.191	0.176	0.167	0.159	0.153	0.150	0.148
Structural Glazing	Single glass pane, stone or metal panel	7	0.354	0.195	0.163	0.147	0.132	0.123	0.118	0.114
	Double glass with no low-e coatings	8	0.274	0.180	0.156	0.142	0.129	0.122	0.117	0.114
	Triple or low-e glass	9	0.231	0.169	0.150	0.138	0.127	0.121	0.116	0.113
No Framing, or Insulation is Continuous	Single glass pane, stone or metal panel	10	0.360	0.148	0.102	0.078	0.056	0.044	0.036	0.031
	Double glass with no low-e coatings	11	0.297	0.136	0.097	0.075	0.054	0.043	0.035	0.030
	Triple or low-e glass	12	0.267	0.129	0.093	0.073	0.053	0.042	0.035	0.030

C303.2 Installation. Materials, systems and equipment shall be installed in accordance with the manufacturer’s instructions and the *International Building Code* or *International Residential Code*, as applicable.

C303.2.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawlspace 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 not less than 6 inches (153 mm) below grade.

C303.2.2 Multiple layers of continuous insulation. Where two or more layers of *continuous insulation* board are used in a construction assembly, the *continuous insulation* boards shall be installed in accordance with Section C303.2. Where the *continuous insulation* board manufacturer’s instructions do not address installation of two or more layers, the edge joints between each layer of *continuous insulation* boards shall be staggered.