

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
6B 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 C) 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. Alternatively, 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*.

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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.

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).

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 acrylic/polycarb	U-1.58 U-1.52	U-1.51 U-1.45	U-1.40 U-1.34	U-1.18 U-1.11
Double Glazing air argon	U-1.05 U-1.02	U-0.89 U-0.86	U-0.84 U-0.80	U-0.67 U-0.64
Double Glazing, $e=0.20$ air argon	U-0.96 U-0.91	U-0.80 U-0.75	U-0.75 U-0.70	U-0.59 U-0.54
Double Glazing, $e=0.10$ air argon	U-0.94 U-0.89	U-0.79 U-0.73	U-0.74 U-0.68	U-0.58 U-0.52
Double Glazing, $e=0.05$ air argon	U-0.93 U-0.87	U-0.78 U-0.71	U-0.73 U-0.66	U-0.56 U-0.50
Triple Glazing air argon	U-0.90 U-0.87	U-0.70 U-0.69	U-0.67 U-0.64	U-0.51 U-0.48
Triple Glazing, $e=0.20$ air argon	U-0.86 U-0.82	U-0.68 U-0.63	U-0.63 U-0.59	U-0.47 U-0.43
Triple Glazing, $e=0.20$ on 2 surfaces air argon	U-0.82 U-0.79	U-0.64 U-0.60	U-0.60 U-0.56	U-0.44 U-0.40
Triple Glazing, $e=0.10$ on 2 surfaces air argon	U-0.81 U-0.77	U-0.62 U-0.58	U-0.58 U-0.54	U-0.42 U-0.38
Quadruple Glazing, $e=0.10$ on 2 surfaces air argon krypton	U-0.78 U-0.74 U-0.70	U-0.59 U-0.56 U-0.52	U-0.55 U-0.52 U-0.48	U-0.39 U-0.36 U-0.32

Notes for Table C303.1.3(4)

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

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**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 panes 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 non-metallic 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 this table or Equations 1-3 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)

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

Aluminum with Thermal Break

(Equation 3-2)

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

Structural Glazing

(Equation 3-3)

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

TABLE C303.1.5
U-FACTORS FOR SPANDREL PANELS AND GLASS CURTAIN WALLS

Frame Type	Spandrel Panel		Rated R-Value of Insulation Between Framing Members							
			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.

CHAPTER 4 [CE]

COMMERCIAL ENERGY EFFICIENCY

SECTION C401 GENERAL

C401.1 Scope. The provisions in this chapter are applicable to commercial buildings and their building sites.

C401.2 Application. Commercial buildings shall comply with one of the following:

1. **Prescriptive Path.** The requirements of ~~((Sections C402, C403, C404, C405, C406, C408, C409, C410 and C411))~~ all of Chapter 4, other than Sections C401.3 and C407.
2. **Total Building Performance Path.** The requirements of Section C407.
3. ~~((When adopted by the local jurisdiction, the requirements of Appendix F, Outcome Based Energy Budget, Sections C408, C409, C410, C411 and any specific section in Table C407.2 as determined by the local jurisdiction. The Proposed Total UA of the proposed building shall be no more than 20 percent higher than the Allowed Total UA as defined in Section C402.1.5.))~~ Appendix F is not adopted by The City of Seattle.
4. **Target Performance Path.** The requirements of Section C401.3.

C401.2.1 Application to existing buildings. Work on existing buildings shall comply with Chapter 5 in addition to the applicable provisions of Chapter 4.

C401.3 Target Performance Path.

C401.3.1 Scope. Buildings of the following occupancy types, including their initial tenant improvements, are permitted to conform to the Target Performance Path as described in this section and are not required to comply with Seattle Energy Code requirements other than the mandatory measures listed in Section C401.3.3.

1. Group B office.
2. Group B medical office.
3. Group R-2 multi-family over three stories.
4. Group S-1 & S-2 warehouse (non-refrigerated).
5. Group E school.
6. Group M retail.
7. Group I-2 hospital.
8. Other occupancy type, where specific permission is granted by the *code official*. Any such permission, if granted, shall be made on the basis of an energy use target *approved by the code official* for that occupancy based on the best-performing local examples of that occupancy, adjusted to recognize the additional stringency of the current energy code.
9. Mixed use: A mixed use building is any building containing more than one of the occupancies listed in items 1 through 8 above.

C401.3.1.1 Increased building performance factor. Each building conforming to this section is permitted to have a building performance factor (BPF) no greater than 1.12 times the maximum BPF permitted by Table C407.3(2).

C401.3.1.2 Conversion of energy use to carbon emissions. Energy use in Target Performance Path calculations shall be converted to carbon emissions according to Table C407.3(1).

C401.3.2 Data center energy. Anticipated total *data center* energy use is permitted to be added to the overall building energy usage target in accordance with this section. The anticipated *IT energy* usage shall be multiplied by a factor of 1.45 to determine the anticipated total *data center* energy use. The *IT energy* usage shall be separately sub-metered in a secure manner *approved by the code official* and automatically exported to the *code official* showing daily, monthly and annual totals during the operational energy use demonstration period set forth in Section C401.3.6. Actual *IT energy* shall be adjusted in accordance with Section C401.3.7.

C401.3.3 Mandatory measures. Buildings using the Target Performance Path shall:

1. Not exceed the building performance factor (BPF) permitted by Section C401.3.1.1;
2. Not use fossil fuel combustion or electric resistance appliances for purposes of space heating or domestic water heating;
3. Have a building envelope with a Proposed Total UA no greater than the Allowable Total UA as determined by Section C407.3.1; and
4. Comply with the mandatory measures listed in Table C407.2.

C401.3.4 Energy modeling methodology. Energy use shall be modeled according to the requirements of Section C407, Total Building Performance:

Schedules, internal loads and other assumptions related to the operation of the building are permitted to be developed at the discretion of the design team and the energy modeler. For occupancy types listed in Appendix B of this code, where any of the following operating loads or schedules of operating hours used in modeling calculations is less than 80 percent of that listed in Appendix B, or where the occupant density in square feet per occupant is more than 120 percent of that listed in Appendix B, such deviations shall be clearly documented in the final analysis report and are subject to approval by the *code official*.

1. Occupant density and schedule
2. Lighting operation schedule
3. Receptacle loads and schedule
4. Elevator and escalator schedule
5. Water heating quantity and schedule

In addition to documenting modeling assumptions, the application documentation required by Section G1.3.2 of ASHRAE 90.1, Appendix G, shall include the following:

1. Summary of principal building characteristics that are above or below prescriptive energy code requirements.
2. Sensitivity analysis of principal internal load and other building operational assumptions that demonstrate a range of expected energy performance in the context of typical meteorological year (TMY) conditions. The following sensitivity analyses shall be reported, in tabular format:
 - 2.1. Occupant density +/- 20 percent (except residential occupancies)
 - 2.2. Lighting Power Density +/- 20 percent
 - 2.3. Miscellaneous Load Power Density +/- 20 percent
 - 2.4. Infiltration Rates +/- 20 percent
 - 2.5. Temperature Setpoints +/- 2 degrees F

**TABLE C401.3.4
EXAMPLE OF SENSITIVITY ANALYSIS REPORT FORMAT**

Allowable EUI: 45 kBTU/ft ²		
Predicted EUI: 40 kBTU/ft ²		
INPUT	EUI (LOW RANGE)	EUI (HIGH RANGE)
Occupant Density	35	42
Lighting Power Density	38	41
Misc. Load Power Density	35	45
Infiltration	38	44
Temperature Setpoints	36	48

The building performance factor (BPF) carbon emissions derived from the modeled building energy use, under nominal conditions, shall be no greater than 1.12 times the BPF listed in Table C407.3(2).

C401.3.5 Energy modeler qualifications. Energy models shall be created only by persons qualified by education and training to perform such work and who have at least two years' experience modeling buildings of similar scale and complexity. The modeling documentation submitted shall be signed either by a licensed professional engineer who is qualified by training and experience to perform energy modeling or by an individual with an active certification from ASHRAE as a Building Energy Modeling Professional (BEMP).

C401.3.6 Demonstration of operating energy use. Metered energy data shall be supplied directly via automated reporting from utilities to the *code official* using Portfolio Manager, and adjusted for the percentage of the *conditioned floor area* intended for occupancy that is occupied during the recording period. While more than 95 percent occupied, the building shall be considered fully occupied. While no less than 85 percent occupied, the building shall operate at or below its assigned building performance factor established in Section C401.3.2 or Item 8 of Section C401.3.1 for any recording period of 12 consecutive months that is completed within three years of the date of the Certificate of Occupancy, as adjusted under this Section C401.3. The owner shall notify the *code official* when this 12-month period has been successfully completed.

C401.3.6.1 Extension of demonstration period. For good cause, including conditions where less than 75 percent of the building is occupied, the *code official* may extend the three-year period for one additional year, but in no case for more than three additional one-year periods. If the building is not at least 75 percent occupied after three additional one-year

periods, the *code official* shall evaluate compliance with Section C401.3.6 based on the most recent one-year period and adjusted for the actual occupancy rate during that period.

C401.3.7 Adjustment for data center energy usage. Where *data center IT energy* usage during the demonstration period, multiplied by a factor of 1.45, is higher than the total *data center* energy use as calculated according to Section C401.3.2, that additional energy shall be added to the total allowable energy use. Where *data center IT energy* use, multiplied by a factor of 1.45, is lower than the total *data center* energy use as calculated according to Section C401.3.2, that shortfall shall be subtracted from the total allowable energy use.

C401.3.8 Adjustment for change in occupancy. When the occupancy of the building or a portion of the building changes from that assumed in the permit submittal, the assigned energy performance target shall be adjusted to reflect the new occupancy. If the new occupancy is not listed in Section C401.3.2, either the *code official* shall assign it an energy use target based on the best-performing local examples of that occupancy type, or a metering system shall be provided that excludes the energy loads for the additional occupancy.

C401.3.9 Adjustment for unusually cold years. If the heating degree days (HDD) recorded by the National Weather Service for the Seattle-Tacoma International Airport exceeds 4885 HDD for the 12-month demonstration period (4 percent above the average 4697 HDD at 65°F base), the assigned energy performance target is permitted to be increased by 1 percent for that period.

C401.3.10 Adjustment for retail operating hours. If the annual number of hours that a retail occupancy is open to the public during the 12-month recording period exceeds the hours assumed in the energy model by more than 4 percent, the annual energy use target for the retail space use only is permitted to be increased by 1 percent for each 4 percent increase in such hours. This claim shall be documented by publicly available published hours of operation.

C401.3.11 Adjustment for commercial kitchens and other large process loads. Where the building includes a commercial kitchen, commercial laundry, hospital central sterile processing facility, or similar large process load, and where *approved* by the *code official*, the energy use of the process equipment and exhaust fans and relief air fans and air tempering associated with the use of that equipment is permitted to be separately sub-metered and subtracted from the overall building energy usage. Energy use of typical HVAC, lighting, and miscellaneous electrical loads within such spaces shall not be included in this adjustment. An *approved* plan shall be submitted with the permit documents detailing how the sub-metered process load energy will be automatically deducted from the total building energy use and the adjusted total reported to the *code official*.

C401.3.12 Financial security. The applicant shall provide a financial security to be used as a penalty for failing to achieve an operating energy use lower than the building's energy use target according to Section C401.3.6. The penalty shall be administered as provided in Section C110, except that the amount of the penalty shall be determined using Table C401.3.13 and not Section C107. The financial security shall be submitted to and *approved* by the *code official* prior to issuance of the building's Certificate of Occupancy. The financial security requirement shall be fulfilled by one of the following methods:

1. An irrevocable letter of credit from a financial institution authorized to do business in Seattle, in an amount equal to \$4.00 per square foot of gross conditioned floor area.
2. A bond secured by the applicant to ensure compliance with this section, in an amount equal to \$4.00 per square foot of gross conditioned floor area.
3. A binding pledge that within 3 years of receipt of the Certificate of Occupancy, adjusted as allowed under Section C401.3.6.1, the applicant will comply with the requirements of this section.
 - 3.1 A binding pledge pursuant to item 3 of this subsection shall be recorded as a covenant in the land records of King County between the applicant and The City of Seattle in a form that is satisfactory to the Seattle City Attorney. The covenant shall bind the applicant and any successors in title to pay any fines levied pursuant to this section. A lien will be placed on the property in cases of non-payment.

If the owner provides evidence that the building has operated at or below its target energy performance level as provided in Section C401.3.6, the financial security provided by the applicant shall be returned to the applicant, or the pledge and covenant shall be released, and the applicant will have no further obligations under this section.

C401.3.13 Procedure for non-compliance. If the owner fails to provide evidence that the building has operated as required under Section C401.3.6, the *code official* shall, as applicable, either:

1. Draw down on a financial security provided in the form of an irrevocable letter of credit or a bond, in whole, or in part, or
2. Levy a fine against an applicant that provided a financial security in the form of a binding pledge as set forth in Section C401.3.12(3). The fine shall be issued as a civil penalty.

The amount of the fine levied or the amount drawn down from a financial security shall be determined according to Table C401.3.13.

C401.3.14 Reimbursements. Where a financial security has been drawn down pursuant to item 1 in Section C401.3.13, or a fine has been levied pursuant to item 2 in Section C401.3.13, the *code official* shall reimburse the owner for documented

expenses incurred to lower the operating energy use of the building, including commissioning, repairs or improvements to the existing energy-consuming systems, or provision of additional energy efficiency measures, up to the maximum reimbursement amounts listed in Table C401.3.13. Such expenditures shall be *approved* in advance by the *code official*, and the work shall be fully completed within one year of the date when a financial security has been drawn down pursuant to item 1 in Section C401.3.13, or a fine has been levied pursuant to item 2 in Section C401.3.13.

**TABLE C401.3.13
FINANCIAL SECURITY AND ENERGY EFFICIENCY REIMBURSEMENTS**

Energy use exceeding target	Amount of fine or draw-down from financial security, per square foot of gross conditioned floor area	Maximum reimbursement per square foot of gross conditioned floor area for work <i>approved</i> under Section C401.3.12
Less than 10%	\$1.00	\$0.50
10% to less than 20%	\$2.00	\$1.00
20% to less than 30%	\$3.00	\$1.50
30% or greater	\$4.00	\$2.00

**SECTION C402
BUILDING ENVELOPE REQUIREMENTS**

C402.1 General. Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis, in accordance with the compliance path described in Item 1 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value based method of Section C402.1.3, the U-, C- and F-factor based method of Section C402.1.4, or the component performance alternative of Section C402.1.5.
2. Fenestration in the building envelope assemblies shall comply with Section C402.4, or the component performance alternative of Section C402.1.5.
3. Air leakage of building envelope assemblies shall comply with Section C402.5.

SDCI Informative Note: For the application of the building envelope requirements to elevator shafts and stair enclosures, see the definition of *conditioned space* in Chapter 2 and the exception to Section C402.1.3.

C402.1.1 Low energy buildings, semi-heated buildings and greenhouses. Low energy buildings shall comply with Section C402.1.1.1. Semi-heated buildings and spaces shall comply with Section C402.1.1.2, Greenhouses shall comply with Section C402.1.1.3.

C402.1.1.1 Low energy buildings. The following buildings, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this code shall be exempt from all thermal envelope provisions of this code:

1. Those that are heated and/or cooled with a peak design rate of energy usage less than 3.4 Btu/h × ft² (10.7 W/m²) or 1.0 watt/ft² (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain conditioned space.
3. Unstaffed equipment shelters or cabinets used solely for personal wireless service facilities.

C402.1.1.2 Semi-heated buildings and spaces. The building envelope of *semi-heated* buildings, or portions thereof, shall comply with the same requirements as that for conditioned spaces in Section C402, except as modified by this section. The total installed output capacity of mechanical space conditioning systems serving a *semi-heated* building or space shall comply with Section C202, except as modified by this section. Building envelope assemblies separating conditioned space from semi-heated space shall comply with the exterior envelope insulation requirements. Semi-heated spaces heated by mechanical systems that do not include electric resistance heating equipment are not required to comply with the opaque wall insulation provisions of Section C402.2.3 for walls that separate semi-heated spaces from the exterior or low energy spaces. Fenestration that forms part of the *building thermal envelope* enclosing semi-heated spaces shall comply with Section C402.4. Semi-heated spaces shall be calculated separately from other conditioned spaces for compliance purposes.

Opaque walls in semi-heated spaces shall be calculated as fully code compliant opaque walls for both the target and proposed for the Target UA calculations for the component performance alternative in Section C402.1.5, and for the ((~~Standard Reference~~)) Baseline Building Design for Total Building Performance compliance per Section C407. The capacity of heat trace temperature maintenance systems complying with Section C404.7.2 that are provided for freeze protection of piping and equipment only, shall not be included in the total installed output capacity of mechanical space conditioning systems.

Exception: Building or space may comply as *semi-heated* when served by ((~~one or more of~~)) the following system ((~~alternatives~~)) alternative:

1. Electric infrared heating equipment for localized heating applications, but not for general area heating, insulated in compliance with Section C402.2.8 and controlled by occupant sensing devices in compliance with Section C403.11.1.
 ((2. Heat pumps with cooling capacity permanently disabled, as pre-approved by the jurisdiction.))

SDCI Informative Note: There is no separate “freeze protection” space conditioning category for unoccupied utility buildings. Spaces with no cooling and less than 3.4 BTU/h-ft² heating capacity are not required to be insulated. The opaque walls of spaces that meet the definition of “semiheated” in Chapter 2 are not required to be insulated, but otherwise the thermal envelope of semiheated spaces must meet all requirements for *conditioned space*. Spaces with any mechanical cooling or with more than 8 BTU/h-ft² heating capacity must meet all the *building thermal envelope* requirements for *conditioned space*.

C402.1.1.3 Greenhouses. *Greenhouse* structures or areas that comply with all of the following shall be exempt from the building envelope requirements of this code:

1. Exterior opaque envelope assemblies complying with Sections C402.2 and C402.4.4.
Exception: Low energy greenhouses that comply with Section C402.1.1.1.
2. Interior partition *building thermal envelope* assemblies that separate the *greenhouse* from conditioned space complying with Sections C402.2, C402.4.3 and C402.4.4.
3. Non-opaque envelope assemblies complying with the thermal envelope requirements in Table C402.1.1.3. The U-factor for the non-opaque roof shall be for the roof assembly or a roof that includes the assembly and an internal curtain system.
Exception: Unheated greenhouses.
4. No mechanical cooling is provided.
5. For heated greenhouses, heating is provided by a radiant heating system, a condensing natural gas-fired or condensing propane-fired heating system, or a heat pump with cooling capacity permanently disabled as pre-approved by the jurisdiction.

**TABLE C402.1.1.3
NON-OPAQUE THERMAL ENVELOPE MAXIMUM REQUIREMENTS**

COMPONENT U-FACTOR BTU/H-FT ² -°F	CLIMATE ZONE 5 AND MARINE 4
Non-opaque roof	0.5
Non-opaque SEW wall	0.7
Non-opaque N wall	0.6

C402.1.2 Equipment buildings. Buildings that comply with all of the following shall be exempt from the building thermal envelope provisions of this code:

1. Are separate buildings with floor area no more than 500 square feet (50 m²).
2. Are intended to house electronic equipment with installed equipment power totaling at least 7 watts per square foot (75 W/m²) and not intended for human occupancy.
3. Are served by mechanical cooling and heating systems sized in accordance with Sections C403.1.2 and C403.3.1.
4. Have a heating system capacity not greater than 17,000 Btu/hr (5 kW) and a heating thermostat set point that is restricted to not more than 50°F (10°C).
5. Have an average wall and roof U-factor less than 0.200.

Exception: Where the cooling and heating system is a heat pump, the heating system capacity is allowed to exceed 17,000 Btu/h provided the heat pump cooling efficiency is at least 15 percent better than the requirements in Table C403.3.2(2).

C402.1.2.1 Standalone elevator hoistways. Elevator hoistways that comply with all of the following shall be exempt from the building thermal envelope and envelope air barrier provisions of this code:

1. Are separate from any other conditioned spaces in the building (do not serve or open into any conditioned, semi-heated or indirectly conditioned space).
2. Have heating and/or cooling equipment sized only to serve the expected elevator loads with thermostat set points restricted to heating to no higher than 40° F and cooling to no lower than 95° F.
3. Have an area-weighted average wall, roof, and floor (where applicable) U-factor of less than or equal to 0.20. Calculations must include any floor-slab-edges that penetrate the hoistway and thus are considered part of the above-grade walls.

C402.1.3 Insulation component R-value method. Building thermal envelope opaque assemblies shall comply with the requirements of Section C402.2 based on the climate zone specified in Chapter 3. For opaque portions of the building thermal envelope intended to comply on an insulation component R-value basis, the R-values for insulation shall not be less than that specified in Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the R-values from the “Group R” column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the R-values from the “All other” column of Table C402.1.3.

Exception: For stair and elevator shafts that do not comply with Section C402.1.2.1 and that are located within enclosed garages or other enclosed non-conditioned spaces and without conditioned supply air or cooling or heating appliances rated higher than 2 kW in any shaft, walls enclosing the shafts are permitted to be:

1. Concrete or masonry with minimum R-5 continuous insulation;
2. Metal studs with R-15 cavity insulation and without continuous insulation; or
3. Other assemblies with a maximum U-value of 0.120.

Slab floors, intermediate mass floor edges and elevator pits within shafts using this exception are excluded from envelope insulation requirements. Shaft surfaces using this exception shall not be included in the gross exterior wall area for purposes of maximum fenestration area calculations in Section C402.4.1 component performance calculations in Section C402.1.5, or for the total building performance calculation of Section C407.

**TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD^{a,1}**

CLIMATE ZONE	5 AND MARINE 4	
	All Other	Group R
Roofs		
Insulation entirely above deck	R-38 ci	R-38 ci
Metal buildings ^b	R-25 + ((R-4)) R-22 LS	R-25 + ((R-4)) R-22 LS
Attic and other	R-49	R-49
Walls, Above Grade		
Mass ^h	((R-9.5 ^e ei)) Exterior: R-16 ci Interior: R-13 + R-6 ci wood stud, or R-13 + R-10 ci metal stud	((R-13.3 ei)) Exterior: R-16 ci Interior: R-13 + R-6 ci wood stud, or R-13 + R-10 ci metal stud
Mass transfer deck slab edge	((R-5)) N/R	((R-5)) N/R
Metal building	R-19 ci or R-13 + 13 ci	R-19 ci or R-13 + 13 ci
Steel framed	R-13 + R-10 ci	R-19 + R-8.5 ci
Wood framed and other	((R-21 int or R-15 + 5 ci std)) R-13 + R-7.5 ci	R-13 + 7.5 ci std or R-20 + 3.8 ci std or R-25 std
Walls, Below Grade		
Below-grade wall ^{d, h}	((Same as above grade)) Exterior: R-10 ci Interior: R-19 wood stud, or R-13 + R-6 ci metal stud	((Same as above grade)) Exterior: R-10 ci Interior: R-19 wood stud, or R-13 + R-6 ci metal stud
Floors		
Mass ^f	R-30 ci	R-30 ci
Joist/framing	((R-30 ^e) Steel frame: R-38 + R-10 ci Wood frame: R-38	((R-30 ^e) Steel frame: R-38 + R-10 ci Wood frame: R-38
Slab-on-Grade Floors		
Unheated slabs	R-10 for 24" below	R-10 for 24" below
Heated slabs ^d	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab
Opaque Doors^g		
Swinging	U-0.37	U-0.37
Nonswinging	R-4.75	R-4.75

Keys for Table C402.1.3

For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement. LS = Liner system

Footnotes for Table C402.1.3

a. Assembly descriptions can be found in Chapter 2 and Appendix A.

- b. Where using *R*-value compliance method, a thermal spacer block with minimum thickness of 1/2 inch and minimum *R*-value of R-3.5 shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- c. (Reserved) ((Exception: Integral insulated concrete block walls complying with ASTM C90 with all cores filled and meeting both of the following:
 - 1. At least 50 percent of cores must be filled with vermiculite or equivalent fill insulation; and
 - 2. The building thermal envelope encloses one or more of the following uses: Warehouse (storage and retail), gymnasium, auditorium, church chapel, arena, kennel, manufacturing plant, indoor swimming pool, pump station, water and waste water treatment facility, storage facility, storage area, motor vehicle service facility. Where additional uses not listed (such as office, retail, etc.) are contained within the building, the exterior walls that enclose these areas may not utilize this exception and must comply with the appropriate mass wall *R*-value from Table C402.1.3/U-factor from Table C402.1.4.))
- d. Where heated slabs are below grade, they shall comply with the insulation requirements for heated slabs.
- e. (Reserved) ((Steel floor joist systems shall be insulated to R-38 + R-10ci.))
- f. "Mass floors" shall include floors weighing not less than:
 - 1. 35 pounds per square foot of floor surface area; or
 - 2. 25 pounds per square foot of floor surface area where the material weight is not more than 120 pounds per cubic foot.
- g. Not applicable to garage doors. See Table C402.1.4.
- h. Peripheral edges of intermediate concrete floors are included in the above grade mass wall category and therefore must be insulated as above grade mass walls unless they meet the definition of Mass Transfer Deck Slab Edge. The area of the peripheral edges of concrete floors shall be defined as the thickness of the slab multiplied by the perimeter length of the edge condition. See Table A103.3.7.2 for typical default u-factors for above grade slab edges and footnote c for typical conditions of above grade slab edges.
- i. Where the total area of through-wall mechanical equipment is greater than 1 percent of the opaque above-grade wall area, use of the *R*-value method is not permitted. See Section C402.1.4.2.
- (i) j. For roof, wall or floor assemblies where the proposed assembly would not be continuous insulation, ((~~an~~) alternate nominal *R*-value compliance options for assemblies with isolated metal (~~penetrations of~~) fasteners that penetrate otherwise continuous insulation ((~~is~~) are as shown in Columns B and C of Table C402.1.3(i):

**TABLE C402.1.3(i)
CONTINUOUS INSULATION EQUIVALENTS**

Column A Assemblies with continuous insulation (see definition)	Column B Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%	Column C Alternate option for assemblies with metal penetrations, greater than or equal to 0.08% but less than 0.12%
R-9.5ci	R-11.9ci	R-13ci
R-11.4ci	R-14.3ci	R-15.7ci
R-13.3ci	R-16.6ci	R-18.3ci
R-15.2ci	R-19.0ci	R-21ci
R-30ci	R-38ci	R-42ci
R-38ci	R-48ci	R-53ci
R-13 + R-7.5ci	R-13 + R-9.4ci	R-13 + R-10.3ci
R-13 + R-10ci	R-13 + R-12.5ci	R-13 + R-13.8ci
R-13 + R-12.5ci	R-13 + R-15.6ci	R-13 + R-17.2ci
R-13 + R-13ci	R-13 + R-16.3ci	R-13 + R-17.9ci
R-19 + R-8.5ci	R-19 + R-10.6ci	R-19 + R-11.7ci
R-19 + R-14ci	R-19 + R-17.5ci	R-19 + R-19.2ci
R-19 + R-16ci	R-19 + R-20ci	R-19 + R-22ci
R-20 + R-3.8ci	R-20 + R-4.8ci	R-20 + R-5.3ci
R-21 + R-5ci	R-21 + R-6.3ci	R-21 + R-6.9ci

Footnotes for Table C402.1.3(j)

- ((~~This~~) These alternate nominal *R*-value compliance options ((~~is~~) are allowed for projects complying with all of the following:
 - 1. The ratio of the cross-sectional area, as measured in the plane of the surface, of metal penetrations of otherwise continuous insulation to the opaque surface area of the assembly is greater than 0.0004 (0.04%), but less than 0.0008 (0.08%), for use of Column B equivalents, and greater than or equal to 0.0008 (0.08%), but less than 0.0012 (0.12%), for use of Column C equivalents.
 - a. Where all metal penetrations are stainless steel, Column B is permitted to be used for penetrations greater than 0.12% but less than 0.24% of opaque surface area, and Column C is permitted to be used for penetrations greater than or equal to 0.24% but less than 0.48% of opaque surface area.
 - 2. The metal penetrations of otherwise continuous insulation are isolated or discontinuous (e.g., brick ties or other discontinuous metal attachments, offset brackets supporting shelf angles that allow insulation to go between the shelf angle and the primary portions of the wall structure). No continuous metal elements (e.g., metal studs, z-girts, z-channels, shelf angles) penetrate the otherwise continuous portion of the insulation.
 - 3. Building permit drawings shall contain details showing the locations and dimensions of all the metal penetrations (e.g., brick ties or other discontinuous metal attachments, offset brackets, etc.) of otherwise continuous insulation. In addition, calculations shall be provided showing the ratio of the cross-sectional area of metal penetrations of otherwise continuous insulation to the overall opaque wall area.

For other cases where the proposed assembly is not continuous insulation, see Section C402.1.4 for determination of U-factors for assemblies that include metal other than screws and nails.

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor based method. *Building thermal envelope* opaque assemblies shall meet the requirements of Section C402.2 based on the climate zone specified in Chapter 3. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*-, or *F*-factor basis shall have a *U*-, *C*-, or *F*-factor not greater than that

specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the U -, C -, or F -factor from the “Group R” column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the U -, C -, or F -factor from the “All Other” column of Table C402.1.4. The U -factors for typical construction assemblies are included in Appendix A. These values shall be used for all calculations. Where proposed construction assemblies are not represented in Appendix A, values shall be calculated in accordance with the ASHRAE *Handbook of Fundamentals* using the framing factors listed in Appendix A where applicable and shall include the thermal bridging effects of framing materials.

C402.1.4.1 Thermal resistance of cold-formed steel stud walls. U -factors of walls with cold-formed steel studs shall be permitted to be determined either by using the values in Table C402.1.4.1, or in accordance with Equation 4-1:

$$U = 1/[R_s + (ER)] \quad \text{(Equation 4-1)}$$

where:

R_s = The cumulative R -value of the wall components along the path of heat transfer, excluding the cavity insulation and steel studs.

ER = The effective R -value of the cavity insulation with steel studs.

C402.1.4.2 Thermal resistance of mechanical equipment penetrations. When the total area of penetrations from through-wall mechanical equipment or equipment listed in Table C403.3.2(3) exceeds 1 percent of the opaque above-grade wall area, the mechanical equipment penetration area shall be calculated as a separate wall assembly with a default U -factor of 0.5. Mechanical system ducts and louvers, including those for supply, exhaust and relief, and for condenser air intake and outlet, are not considered to be mechanical equipment for the purposes of this section.

Exception: Where mechanical equipment has been tested in accordance with approved testing standards, the mechanical equipment penetration area is permitted to be calculated as a separate wall assembly using the U -factor determined by such test.