

**WAC 51-11C-402121 Table C402.1.3—Opaque thermal envelope assembly R-value requirements.**

**Table C402.1.3  
Opaque Thermal Envelope Insulation Component  
Minimum Requirements, R-value Method<sup>a, j</sup>**

CLIMATE ZONE	5 AND MARINE 4	
	All Other	Group R
<b>Roofs</b>		
Insulation entirely above deck	R-38ci	R-38ci
Metal buildings <sup>b</sup>	R-25 + R-22 LS	R-25 + R-22 LS
Attic and other	R-49	R-49
<b>Walls, Above Grade<sup>i</sup></b>		
Mass <sup>h</sup>	R-9.5ci	R-13.3ci
Mass transfer deck slab edge <sup>g</sup>		
Metal buildings	R-13 + R-14ci	R-13 + R-14ci
Steel framed	R-13 + R-10ci	R-19 + R-8.5ci
Wood framed and other	R-13 + R-7.5ci std or R-20 + R-3.8ci std	R-13 + R-7.5ci std or R-20 + R-3.8ci std or R-25 std
<b>Walls, Below Grade</b>		
Below-grade wall <sup>d,h</sup>	Same as above grade	Same as above grade
<b>Floors</b>		
Mass <sup>f</sup>	R-30ci	R-30ci
Joist/framing	R-30 <sup>e</sup>	R-30 <sup>e</sup>
<b>Slab-on-Grade Floors</b>		
Unheated slabs	R-10 for 24" below	R-10 for 24" below
Heated slabs	R-10 perimeter & under entire slab	R-10 perimeter & under entire slab

- For SI: 1 inch = 25.4 mm. ci = Continuous insulation. NR = No requirement.
- LS = Liner system—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.
- 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 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 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 Component performance in accordance with Section C402.1.5 shall be required for buildings with a mass transfer deck slab.
- 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 <sup>c</sup> 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 C402.1.4.3.
- j For roof, wall or floor assemblies where the proposed assembly would not be *continuous insulation*, alternate nominal R-value compliance options for assemblies with isolated metal fasteners that penetrate otherwise *continuous insulation* are as shown in columns B and C of Table C402.1.3(i):

**Table C402.1.3(i)  
Continuous Insulation Equivalents**

Column A	Column B	Column C
<b>Assemblies with continuous insulation (see definition)</b>	<b>Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%</b>	<b>Alternate option for assemblies with metal penetrations, greater than or equal to 0.08% but less than 0.12%</b>
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-19ci	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

**Notes for Table C402.1.3(j)**

- These alternate nominal *R*-value compliance options are allowed for projects complying with all of the following:
- 1a. 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 0.008 (0.08%), but less than 0.0012 (0.12%), for use of Column C equivalents.
  - 1b. 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.

[Statutory Authority: RCW 19.27A.020, 19.27A.025, 19.27A.160 and chapters 19.27A and 19.27 RCW. WSR 22-14-091, 23-12-101, and 23-20-021, § 51-11C-402121, filed 7/1/22, 6/7/23, and 9/25/23, effective 3/15/24. Statutory Authority: RCW 19.27A.020, 19.27A.025, 19.27A.160 and chapter 19.27 RCW. WSR 19-24-040, § 51-11C-402121, filed 11/26/19, effective 7/1/20. Statutory Authority: RCW 19.27A.025, 19.27A.045, 19.27A.160, and 19.27.074. WSR 16-24-070, § 51-11C-402121, filed 12/6/16, effective 5/1/17. Statutory Authority: RCW 19.27A.025, 19.27A.160, and 19.27.074. WSR 16-03-072, § 51-11C-402121, filed 1/19/16, effective 7/1/16. Statutory Authority: RCW 19.27A.020, 19.27A.025 and chapters 19.27 and 34.05 RCW. WSR 13-04-056, § 51-11C-402121, filed 2/1/13, effective 7/1/13.]