

Insulation & Air Barriers

2018 VRC/VECC Inspection Guide



Insulation and Air Barriers:

Summary: The thermal envelope is the most important system relating to the performance of the home. Properly aligned air barrier and thermal insulation systems provide long lasting benefits to both the home and its occupants. Thermal components of the building's thermal envelope may be required by the building official to be represented on the construction drawings.

Why: Poorly installed insulation can result in higher heating and cooling costs, comfort problems, mold, and other moisture related issues including long-term durability and structural issues. Professionally installed insulation should follow the manufacturer's installation instructions. These typically stipulate no gaps, voids, compression of the insulation material; alignment of the insulation with the continuous air barrier; complete air barriers; and minimal thermal bridging. Best practices for insulation installation lead to conditioned spaces that require less heating and cooling, have even temperatures, and a quieter environment throughout the house.¹

Notes:

- * *Specific blown fiberglass systems, high-density fiberglass/mineral wool batts, and spray foam insulation are materials that can achieve R-15 in a 2x4 stud cavity. Most other products will need to be installed in conjunction with exterior continuous insulation and/or in a 2x6 wall assembly.*
- * *In order to be effective, insulation must be continuous and contiguous. All insulated surfaces – ceilings, walls, and floors – must be insulated and in contact with one another and the continuous air barrier.*
- * *Most common insulation materials work primarily by slowing conductive heat flow and--to a lesser extent--convective heat flow. Radiant barriers and reflective insulation systems reduce radiant heat transfer. To be effective, the reflective surface must face an air space and stay clean.²*
- * *Heat flows from hot to cold and will do so until there is no longer a temperature difference. In practice, this means that in winter, heat flows directly from heated living spaces to adjacent unheated attics, garages, basements, and the outdoors. Heat flow can also move indirectly through interior ceilings, walls, and floors--wherever there is a difference in temperature. Poor insulation installation will lead to increased heat flow into/out of the building.*

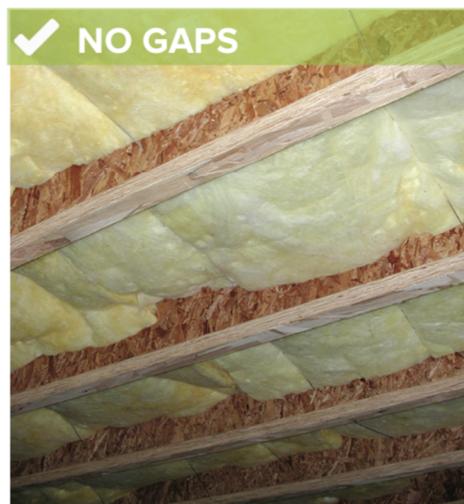
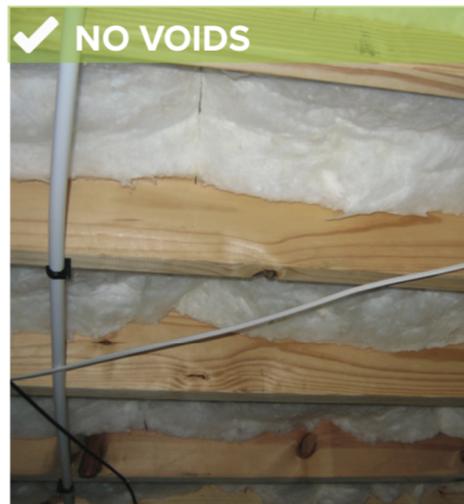
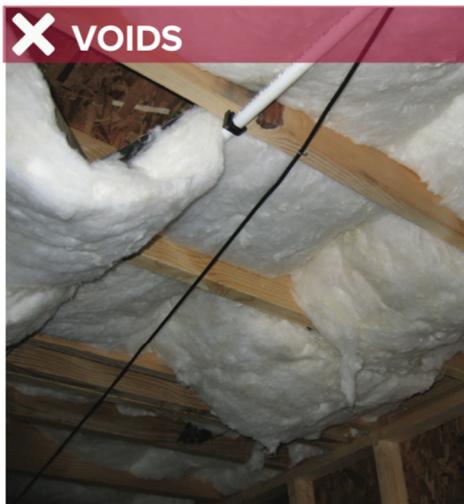
¹ <https://basel.pnnl.gov/building-science-measures/insulation-quality-installation>

² <https://www.energy.gov/energysaver/weatherize/insulation#:~:text=Insulation%20in%20your%20home%20provides, costs%2C%20but%20also%20improves%20comfort.>

2018 VECC TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	GLAZED FENESTRATION SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.4	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32	0.55	0.25	38	20 or 13+5	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.32	0.55	0.4	49	15 or 13+1	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.3	0.55	NR	49	20 or 13+5	13/17	30g	15/19	10, 2 ft	15/19
6	0.3	0.55	NR	49	20+5h or 13+10	15/20	30g	15/19	10, 4 ft	15/19
7 and 8	0.3	0.55	NR	49	20+5h or 13+10	19/21	38g	15/19	10, 4 ft	15/19

Best Practice: Install insulation to completely fill floor framing cavity or to maintain permanent contact with the subfloor without voids or compression.



Best Practice: Cut and split insulation around all blocking, plumbing, HVAC, and electrical components to obtain a completely full framing cavity.

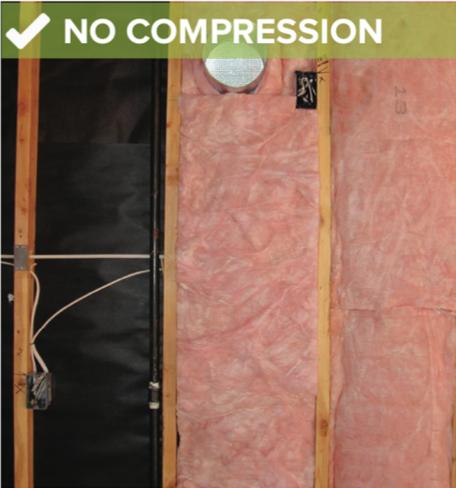


Figure 2: Insulated floor over garage

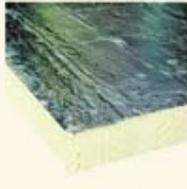


Figure 3: Damp-spray cellulose insulation in wall



Figure 4: R-Value per inch table

Type of Insulation	R-VALUE
Fiberglass (batt)	3.14
Fiberglass (blown-attic)	2.2
Fiberglass (blown-wall)	3.2
Rock Wool (batt)	3.14
Rock Wool (blown-attic)	3.1
Rock Wool (blown-wall)	3.03
Cellulose (blown-attic)	3.13
Cellulose (blown-wall)	3.7
Vermiculite	2.13
Air-Entrained Concrete	3.9
Urea Terpolymer Foam	4.48
Rigid Fiberglass (>4lb/ft ³)	4
Expanded Polystyrene (beadboard)	4
Extruded Polystyrene	5
Polyurethane (foamed-in-place)	6.25
Polyisocyanurate (foil-face)	7.2

<p>3.14 Fiberglass Batt</p> 	<p>3.13 Cellulose Blown (attic)</p> 	<p>6.25 Polyurethane (foamed-in-place)</p> 	<p>7.2 Polyisocyanurate (foil-faced)</p> 
<p>SOURCE: HTTP://CHEMISTRY.NEED.ORG</p>			

2018 VECC and VRC Insulation Installation Code References:

Section R402.4.1/N1102.4.1 Building Thermal Envelope. The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

Section R402.4.1.1/N1102.4.1.1 Installation (Mandatory). The components of the building thermal envelope as listed in Table R402.2.1.1(N1102.4.1.1) shall be installed in accordance with the manufacturer's instruction and the criteria listed in Table R402.2.1.1 (N1102.4.1.1), as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

Section R402.4.1.2/N1102.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zone 4. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). A written report of the results of the test shall be signed by the party conducting the test and provided to the building official. Testing shall be conducted by a Virginia licensed general contractor, a Virginia licensed HVAC contractor, a Virginia licensed home inspector, a Virginia registered design professional, a certified BPI Envelope Professional, a certified HERS rater, or a certified duct and envelope tightness rater. The party conducting the test shall have been trained on the equipment used to perform the test. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

Section R303.1.1/N1101.10.1 An R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches 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.

Section R303.1.1.1/N1101.10.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches on markers that are installed at least one for every 300 square feet throughout the attic space.

Section R303.2/N1101.11 Installation. Materials, systems, and equipment shall be installed in accordance with the manufacturer's instruction and this code.

Section R303.2.1/N1101.11.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawl space 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.

Insulation Installation Field Inspection Focus:

Inspections should provide verification in the following areas:³

1. Cavity insulation, as indicated in approved construction documents, completely fills ALL wall cavities with no compression or gaps, the manufacturer's R-value mark is readily available, and meets the approved R-value per construction documents.
2. Continuous insulation (if applicable) is installed in accordance with manufacturer's installation instructions, the manufacturer's R-value mark is readily available, and meets the approved R-value per construction documents.
3. Batt insulation is cut neatly around any wiring and plumbing, or insulation readily conforms to available space and extends behind piping and wiring.
4. Joints, seams, holes, and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.
5. Continuous air barrier is properly installed as indicated in approved construction documents.
Confirm the insulation is installed in substantial contact and continuous alignment with the air barrier.
6. The junction where the rafters meet the exterior wall top plates and/or the attic floor are sealed.



³ basc.pnnl.gov/code-compliance/air-sealing-and-insulating-attic-knee-walls-code-compliance-brief