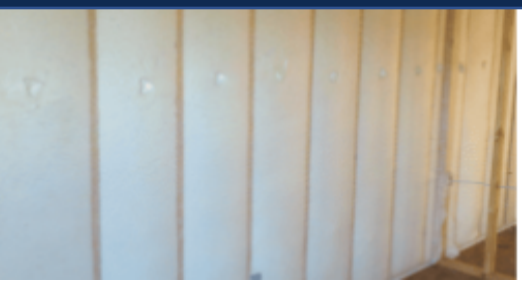
Insulation & Air Barrier

Virginia 2015 IECC (w/ Amendments) Inspection Guide



Insulation and Air Barrier:

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, Per N1101.5.1, envelope must 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 meets industry best practices as specified for Grade 1 installation by the Residential Energy Services Network (RESNET). This includes no gaps, voids, compression, or misalignment with air barriers; complete air barriers; and minimal thermal bridging. Following best practices for insulation installation creates conditioned spaces that require very little heating and cooling, along with even temperatures and a quieter environment throughout the house.[1]

Per RESNET, "When installing batt, or loose-fill insulation, no more than 2% of the total insulated area shall be compressed below the thickness required to attain the labeled R-Value or contain gaps or voids in the insulation. These areas shall not be compressed more than 3/4 inch of the specified insulation thickness in any given location. Voids extending from the interior to exterior of the intended insulation areas shall not be permitted."[2] An important distinction between manufacturer recommendations, as stated in code, and RESNET Grade 1, is that RESNET Grading allows for minor defects while manufacturers recommended install **does not**.

Notes:

* *Specific Blown Fiberglass systems, High Density Fiberglass/Mineral Wool Batts, and Spray Foam Insulation are materials typically used in wall assemblies 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 installed 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.*

[1] https://basc.pnnl.gov/building-science-measures/insulation-quality-installation
[2] https://www.resnet.us/wp-content/uploads/ANSIRESNETICC-301-2014-Addendum-F-2018-Appendix-A-Inspection-Procedures-for-Insulation-Grading-and-Assessment.pdf

* *Most common insulation materials work by slowing conductive heat flow and--to a lesser extent--convective heat flow. Radiant Barriers and reflective insulation systems work by reducing radiant heat gain. To be effective, the reflective surface must face an air space.*[3]
* *Heat flows from hot to cold until 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..*

Visual Reference:

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	38	15 or 13+1[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

Table 1: Table R402.1.2 from Virginia Residential Energy Code, Chapter 4[4]

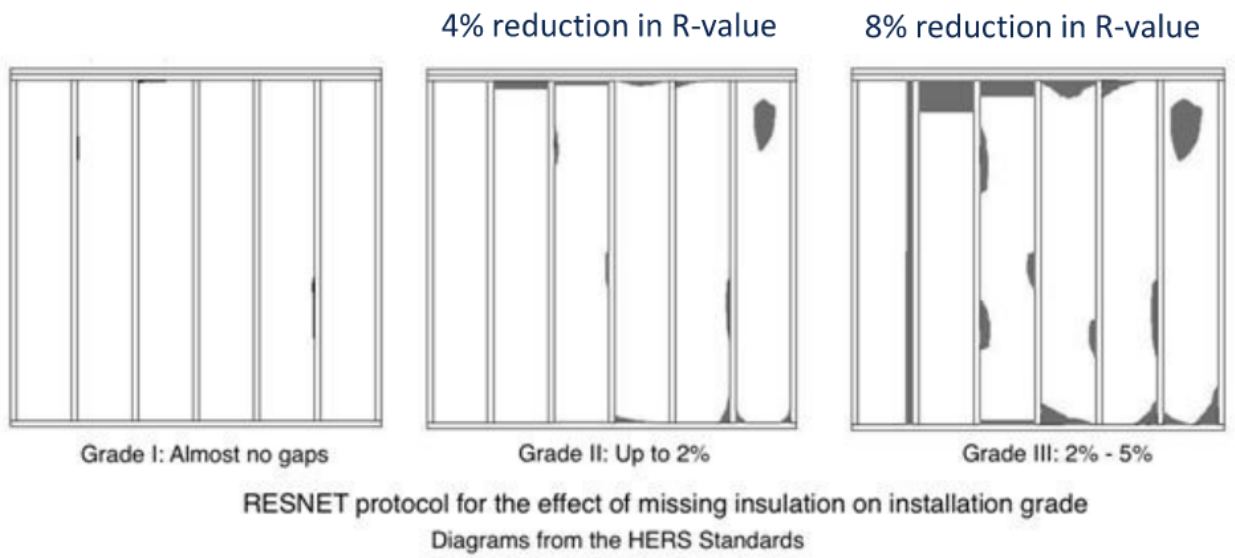


Figure 1: RESNET Insulation Grading Diagram

[3] https://www.energy.gov/energysaver/weatherize/insulation#:~:text=Insulation%20in%20your%20home%20provides,costs%2C%20but%20also%20improves%20comfort.
[4] https://codes.iccsafe.org/content/VECC2015/chapter-4-re-residential-energy-efficiency

Figure 2: Various examples of good and bad installations

Figure 3: Insulated floor over garage

Figure 4: Blown cellulose insulation installation

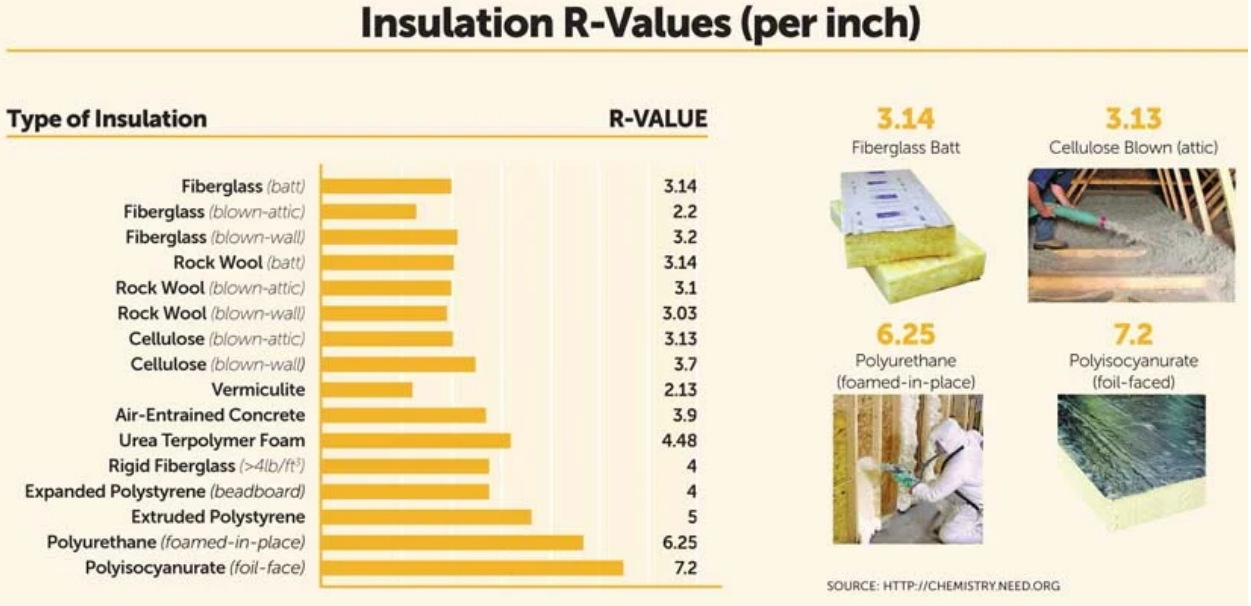


Figure 5: R-Value per inch tables

Insulation Installation Code Reference:

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 R402.4.1.3/N1102.4.1.3 Leakage Rate (Prescriptive). The building or dwelling unit shall have an air leakage rate less than 5 changes per hour as verified in accordance with Section N1102.4.1.2.

Section R402.4.1.2.1(N1102.4.1.2.1) & R402.4.1.2.2(N1102.4.1.2.2) provides the compliance options for air sealing – Testing via blower door or Visual Inspection.

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 sq. ft.

Section R303.2/N1101.11 Installation. All 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 installed on exterior foundation walls should have a rigid, opaque, and weather-resistant covering that covers the exposed insulation and extends 6 inches below grade to prevent degradation.

Retrofit

Section R501.1.1/N1107.1.1 Additions, alteration, or repairs: General. Additions, alterations, or repairs to an existing building or portion thereof shall comply with Section N1108, N1109 or N11010. Unaltered portions of the existing building or building supply system shall not be required to comply with this chapter.

**Note: Alterations, repairs, etc. are able to comply with the VEBC if so desired by the applicant.*

Insulation Installation Field Inspection Focus:

Inspections should provide verification in the following areas:[5]

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.

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[5] https://basc.pnnl.gov/code-compliance/air-sealing-and-insulating-attic-knee-walls-code-compliance-brief