



NORTHEAST HOME ENERGY
RATING SYSTEM ALLIANCE

TRAINING & REFERENCE MANUAL

v.4.0

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Northeast Home Energy Rating System Alliance

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4.5 INSULATION ASSESSMENT GUIDELINES

4.5.a GENERAL INSTRUCTIONS

When insulation is inspected to determine its R-value, the rater or data collector must determine the type and thickness of the insulation that exists (or the R-value markings on the product) in every component of the building. In the absence of R-value markings or some other form of reliable information from the insulation manufacturer, use the default R-values listed in Table 4.5(1). Nominal R-values printed on the back of insulation batts and the R-values provided in Table 4.5(1) are accurate only for near “perfect” (Grade I) installations. These R-values do not account for variations often found in the real world, such as compression, voids, air movement, and gaps.

Table 4.5 (1): R-values for Different Types of Insulation That Are Installed According to Grade I Standards.

Insulation Type and Description	R-value per inch
Fiberglass batts, different R-values available, new Grade I installation (use R-values labeled on insulation when present; use default R-values only when a label or marking does not exist to indicate R-value)	3.1 (normal) 3.7 (high density)
Fiberglass, new installation, verified correct density installed according to manufacturer’s specs	2.5 open attics 3.1 enclosed cavities
Typical older blown fiberglass or rock wool	1.8
Vermiculite, loose-fill	2.2
Cellulose, loose fill, open blown	3.7
Cellulose, dense pack, spray or cavity fill	3.5
Isocyanurate, rigid board, foil-faced (aged R-value)	6.0
Urethane foam (high density), or sprayed isocyanurate foam	6.0
Low density urethane foam (e.g., Icynene®)	3.6
Extruded polystyrene (usually blue, green or pink)	5.0
Expanded polystyrene (usually white, “bead” board)	4.0

*If you have manufacturers *test data* that shows higher R-values than these, you may create a custom library using the manufacturer’s data. However, beware of marketing cutsheets and other information that often represents particular products as having higher R-values than they really do. “Equivalent” R-value is a term that is often used, and it’s usually not legitimate. Ask your HERS provider if you aren’t sure.

This caution particularly applies to materials that are not listed above, such as “radiant” /reflective products, or to systems (such as structural insulated panels, insulating concrete forms, or special concrete products) that claim to have added “equivalent” R-value due to some added quality, such as air tightness or thermal mass, that should not be included in the actual R-value used in the analysis.

Do not associate any thermal benefit to wet insulation. Instruct the homeowner to have it removed and replaced once the affected area has had time to dry out. If there are signs of mold or structural damage, the homeowner or contractor should seek professional help with remediation. Any water intrusion problem should be repaired before replacing insulation. Wet insulation will not only lose its thermal resistance qualities but may cause a building component to be cooler than if no insulation existed at all. In addition, mold or other biological contaminants can grow in the cavity, producing unsafe conditions for occupant health and building integrity.

When batt insulation is installed in building cavities that are not deep enough to accommodate the full thickness of the insulation, the insulation will be compressed and the rated R-value will be reduced. In some cases, the R-value per inch will actually increase but the increase is always offset by the reduction in thickness. In assigning R-values to insulation that is compressed, manufacturer’s data (that accounts for compression) is preferred. In the absence of this information, use the formulas in the following table to estimate the R-value.

Table 4.5(2): Adjusting the R-value of Compressed Insulation*

Extent of Compression	R-value
10%	Rated R-value x 0.93
20%	Rated R-value x 0.86
30%	Rated R-value x 0.79
40%	Rated R-value x 0.70
50%	Rated R-value x 0.61
60%	Rated R-value x 0.51

**From ACCA Manual J, 8th edition, as cited in the RESNET standards.*

In the absence of data from the manufacturer, the following table can be used when fiberglass batts are compressed.

Table 4.5 (3): R-values for Building Insulation Compressed in Cavities

R-values for Building Insulation Compressed in Cavities														
Nominal Framing Size	Depth of Cavity (inches)	Rated R-value and full cavity depth of insulation												
		6	8	11	13	15	19	21	22	25	30	30	38	38
		1¾"	2½"	3½"	3½"	3½"	6¼"	5½"	6½"	8"	8½"	10"	10"	12"
1x2	¾	3.1												
2x2	1½	5.4	5.6	5.6	6.6	7.7								
2x3	2½	6.0	8.0	8.7	10.3	11.9	9.7	11.8						
2x4	3½	"	"	11.0	13.0	15.0	12.5	15.6	14.4	14.0	15.3			
2x4 (Full)	4	"	"	"	"	"	14.1	16.6	15.7	15.3	17.4	15.3	19.4	
2x6	5½	"	"	"	"	"	17.6	21.0	19.7	19.7	22.4	19.7	24.9	21.3
2x8	7¼	"	"	"	"	"	19.0	"	22.0	23.3	26.9	23.7	30.0	26.6
2x10	9¼	"	"	"	"	"	"	"	"	25.0	30.0	28.0	35.5	32.5
2x12	11¼	"	"	"	"	"	"	"	"	"	"	30.0	38.0	37.0

This information in this section – by itself - is not sufficient to determine the effectiveness of the insulation; it also is critical to inspect the quality of installation. The following sections describe how to inspect various building shell components for the presence of insulation and its effective R-value, common anomalies that occur in different parts of the building, and trouble-shooting tips.

4.5.b INSTALLATION GRADE ASSESSMENT

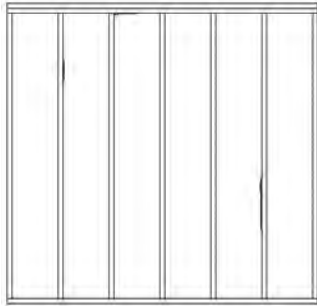
RESNET standards specify grades of insulation installation quality that must be assigned during an inspection and rating. These grades are put input into the software program as follows:

- *Grade I:* Highest quality. Full loft, no voids or gaps around obstructions, split around pipes or wires, and complete contact with all required surfaces in the cavity;
- *Grade II:* Most common installation, with moderate to frequent defects (gaps around obstructions, clear gaps across cavity of not more than 2% of area, and some compression); or
- *Grade III:* Lowest quality, with substantial gaps and voids amounting to 2-5% of the area, open on one side to a vented cavity or not in contact with one surface.

**GUIDE TO MAXIMUM COMPRESSION AND GAPS PERMITTED IN INSULATION
BY GRADE OF INSTALLATION QUALITY**

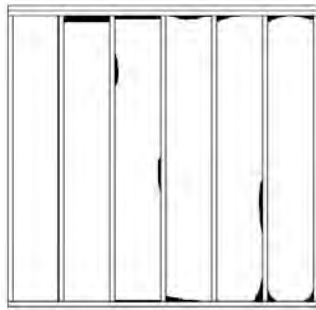
(Black indicates area of gap • Gray indicates area of compression)

Grade 1 Installation



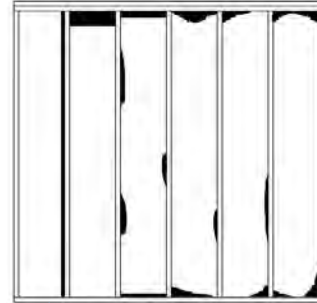
Gaps

Grade 2 Installation

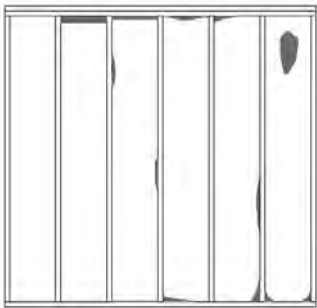


Gaps

Grade 3 Installation



Gaps



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These grades apply to all types of insulation and in all thermal boundary applications.

Installations that can not be inspected shall receive a Grade III quality rating unless the rater has previous direct experience with the installing contractor's workmanship.

Any insulation that has greater than 5% gaps or voids shall be modeled as two separate boundary areas (one insulated area and one uninsulated area).

Refer to the "Building Element: Walls / Rated Feature: Insulation Installation" section in Appendix A of the RESNET HERS standards for in-depth guidelines on assigning insulation grades. The inspection checklist (on the next page) can also be used as a resource, particularly in making assessments in the field.

INSULATION INSPECTION CHECKLIST

ALL items in a category must be checked to assign that category for an insulation rating

WALLS		
Grade I <input type="checkbox"/> Negligible void area <input type="checkbox"/> Compression or incomplete fill <= 2% <input type="checkbox"/> Fitted neatly around all obstructions <input type="checkbox"/> Insulation in substantial contact with sheathing <input type="checkbox"/> Insulation enclosed on all 6 sides <input type="checkbox"/> Face- or neatly side-stapled tabs (no buckling) (Faced batt only) <input type="checkbox"/> Tightly fitted joints (rigid foam only) <input type="checkbox"/> Insulation springs back when compressed (blown- or sprayed-in materials only)	Grade II <input type="checkbox"/> Void area <=2% <input type="checkbox"/> Compression or incomplete fill <= 10% <input type="checkbox"/> Insulation in substantial contact with sheathing <input type="checkbox"/> Insulation enclosed on all 6 sides	Grade III <input type="checkbox"/> Void area <=5%*

CEILINGS		
Grade I <input type="checkbox"/> Negligible void area <input type="checkbox"/> Compression or incomplete fill <= 2% <input type="checkbox"/> Fitted neatly around all obstructions <input type="checkbox"/> Installed in complete contact with the drywall or plywood surfaces it is intended to insulate <input type="checkbox"/> Eave baffles or equivalent construction to prevent wind washing <input type="checkbox"/> Face- or neatly side-stapled tabs (no buckling) (Faced batt only) <input type="checkbox"/> Tightly fitted joints (rigid foam only)	Grade II <input type="checkbox"/> Void area <=2% <input type="checkbox"/> Compression or incomplete fill <= 10% <input type="checkbox"/> Insulation in substantial contact with sheathing	Grade III <input type="checkbox"/> Void area <=5%*

FLOORS		
Grade I <input type="checkbox"/> Negligible void area <input type="checkbox"/> Compression or incomplete fill <= 2% <input type="checkbox"/> Fitted neatly around all obstructions <input type="checkbox"/> Installed in complete contact with the subfloor <input type="checkbox"/> Face- or neatly side-stapled tabs (no buckling) (Faced batt only) <input type="checkbox"/> Tightly fitted joints (rigid foam only)	Grade II <input type="checkbox"/> Void area <=2% <input type="checkbox"/> Compression or incomplete fill <= 10% <input type="checkbox"/> Installed in complete contact with the subfloor	Grade III <input type="checkbox"/> Void area <=5%*
Additional for floors over outdoor air		
<input type="checkbox"/> Insulation enclosed on all 6 sides	<input type="checkbox"/> Insulation enclosed on all 6 sides	
* NOTE: If void area is more than 5%, uninsulated areas must be measured and input as separate, uninsulated assemblies		

All software packages account for insulation installation quality by assigning insulation grades that are based on the RESNET standards described in this section.

Table 4.5(4): Software Insulation Library Selection

REM/Rate	The building component summary screens include library choices for various insulation types and configurations. The cavity insulation installation quality (Grade I, II or III) must be selected when creating a library and should be incorporated into the library name.
TREAT	Choose a library entry that correctly reflects the insulation found in the surface.

Component libraries are handled differently by various software packages. Refer to the software manuals for further detail. Some utility/state programs may require the use of specific libraries and/or component characteristics.

Table 4.5.(5): Software Libraries

REM/Rate	REM/Rate libraries are broken up into numerous categories that correspond to different building components (floors, walls, ceilings, mechanical systems etc.) These library sets can be edited by the user (existing libraries can be modified; new ones can be added, etc.) Library sets can also be transferred from one user to another. The sets of libraries that come with REM/Rate by default are small. Established HERS Providers may be able to provide you with expanded library sets. You may also opt to purchase an expanded library set from Conservation Services Group (CSG). A description of CSG's libraries is included in Appendix B of this manual.
TREAT	Libraries of surfaces and windows are not user-editable. The components are defined in software in terms of their thermal pathways and the specific heat (thermal mass) properties. The software developer updates new library entries, and the rater should request specific entries when comparable entries can-not be found. Make suggestions and requests at www.treatsoftware.com

4.5.c ***BUILDING COMPONENT-SPECIFIC INSULATION ASSESSMENT GUIDELINES***

Note: This section is intended as a supplement to Appendix A of the RESNET National Home Energy Rating Guidelines, On-Site Inspection Procedures for Minimum Rated Features (included in Appendix E of this manual)

4.5.c.1 **Basement or Crawlspace Insulation**

Depending on whether the basement is intended for use as a conditioned or unconditioned space, insulation may be found in the floor, the walls, or the ceiling. When evaluating the thermal shell of an existing building, all of these areas should be checked for the presence of insulation.

- ***Interior Wall Insulation***

If the walls are insulated on the interior, determine the type and thickness of the insulation. If the walls of the basement are finished with drywall, try to find an unfinished area of the basement, such as a utility room, where the wall insulation may be inspected. If an unfinished area does not exist and the insulation cannot be viewed, probe an inconspicuous spot to determine the type and thickness of insulation.

- ***Exterior Wall Insulation***

Basement walls also may be insulated on the exterior of the foundation walls. The (rigid foam) insulation may only be installed below grade level or it may be an integral part of the foundation wall (such as insulated concrete block). If this is the case, you may not be able to inspect the insulation. If possible, dig down a couple of inches on an exterior foundation wall and inspect for foam insulation. Indicate the type of insulation on a data collection form only if you can physically verify its presence or have reliable documentation from the customer.

- ***Basement or Crawlspace
Ceiling Insulation***

In most cases basement ceiling insulation can be inspected by simply recording the type of insulation and measuring its depth. If the ceiling is finished, probe the cavity to determine the insulation level. It is important to ensure that the insulation is installed so that it is in contact with the floor above. If an airspace exists between the heated floor and the insulation, the effective R-value is greatly reduced and should be

assigned a Grade III installation quality. This procedure is the same for garage ceilings, cantilevered floors, and overhangs.

Use additional care evaluating the insulation value of overhangs where perforated siding covers the underside of the overhang. If sheathing or another air barrier does not exist, the effectiveness of any insulation in this area is reduced to virtually none.

4.5.c.2 Slab Insulation

Slab insulation may exist at the exterior perimeter of the slab or between the slab and the foundation wall. To check for exterior slab perimeter insulation, move a small amount of dirt away from the slab and look for rigid insulation. Check for insulation at the interior of the foundation wall visually. If wall-to-wall carpeting is present, try probing the area with a sharp needle. If the needle penetrates the area between the slab and the foundation wall, assume the slab perimeter is insulated. It may be possible to view under slab insulation at a sump opening or other penetration.

If it is not possible to positively identify the existence of slab insulation and construction documents are not available, assume the slab is uninsulated.

4.5.c.3 Rim Joist Insulation


From a basement or crawlspace, the rim joist can be visually inspected for the presence of insulation. Record the type of insulation and measure the depth. If the band joist between heated floors is not visible in some part of the house, assume it is uninsulated in existing homes unless the construction documents specify otherwise. An exception to this rule is made for balloon framed buildings, which have had insulation blown into the walls. If you can verify this scenario, assume the band joist is insulated to the same level as the exterior walls.

4.5.c.4 Wall Insulation

Always be prepared to probe for insulation when performing an inspection on an existing home. Although it may be possible to estimate wall cavity thickness by measuring the distance from the inside of the wall to the outside at a window and subtracting the estimated thickness of the siding, sheathing, and interior finish, it is preferable to probe the cavity to get this measurement. In older

construction it is often difficult or even impossible to know what may exist under the siding or drywall. For example, there could be extra layers of lath and plaster, multiple courses of brickwork, or thicker than normal plank sheathing. In these cases it is necessary to probe the walls to determine the presence and type of insulation,

Despite the recommendation that is made in the RESNET standards, you should not check for insulation at electrical boxes. In addition to the obvious risks of working around a live electrical circuit, this area is unreliable as an indicator of insulation throughout the house. Insulation that has been stuffed around an electrical box to eliminate a draft could lead you to incorrectly conclude that the wall is insulated; an insulation void around an electrical box could lead you to incorrectly conclude that the wall is uninsulated.

 When checking for wall insulation, be sure to probe at least three different areas of the house. Check areas where renovations have been made or there have been additions to the original construction, as these parts may be insulated differently than the original structure. Indications of remodeled areas include varying trim details, windows, interior finishes, floors, and foundation materials. Inspection of framing in basement and attic areas also provides substantial clues about the evolution of the building envelope.

The procedure is simple, and most customers will not object to a few small holes being made. Look for a closet on an exterior wall or an inconspicuous corner, and be sure to get approval from the customer. Using an awl or small drill bit, poke a hole in the wallboard or plaster about 1/4" in diameter. Drilling or poking the hole above a shelf in a closet, or just above a baseboard works well, but stay a few inches away from corners or partitions where framing is likely. Using a plastic crochet hook or other hooked probe (a bent insulation rod may be used but use care around electrical circuits or if the house has knob-and-tube wiring), draw a sample out of the cavity to determine the insulation type. The depth of the cavity and the thickness of the insulation can also often be determined when using a probe in this manner. If a flexible probe is used, it may be possible to identify the stud spacing by inserting the probe toward the side and measuring the distance from the hole to the point where the probe hits a stud on either side of the hole. Do this in several places to get an average stud spacing. When finished, you should fill the hole with caulking or a

small amount of glazing compound. The same procedure may be used to inspect finished ceilings or inaccessible attics for insulation.

When wallpaper is present, it is preferable to peel back a small corner before making the hole, and then put it back in place using some caulking.

On the exterior of the house, inspect under the lowest course of siding for the presence of foam insulation. This is particularly common in homes that have been retrofitted with vinyl siding.

4.5.c.5 Ceiling/Attic Insulation

For accessible attic areas, identify the type of insulation, and measure the depth of the insulation in at least 4 places to determine the average depth. Take your measurements at least 6' away from the attic access opening. Do not use the nominal depth of batt insulation printed on the facing. Since batt insulation is rarely installed consistently at full loft, it is just as important to measure the depth of batts as the depth of loose insulation. Be sure to inspect the full depth of the insulation in existing homes; insulation may have been added during the life of the building, and more than one type of insulation may exist. If this is the case, record the type and depth of each layer of insulation.

Check for consistent coverage, and don't be fooled by vaulted or tray ceilings and dropped soffits, where the insulation may have been installed several inches above the actual ceiling surface. As is the case with basement ceiling insulation that is not flush with the floor above, insulation installed in this manner is doing little to insulate the home and should not be considered effective.

Use the probing procedure (described in the wall section above) to check the insulation in true cathedral ceilings and in inaccessible attics.

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