



Verify Before Rating

Proposed Insulation Procedures

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Insulation inspection procedures

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- Assess insulation quality
 - Good, Fair, Poor
 - "Good" based on industry published standards
- Provide specific modeling guidance
 - Based on assessment
- Other details
 - Installation practices, framing, compression



Inspection Requirement ?

- Yes—to take full credit for thermal performance of properly installed product
- No—not required for a rating
 - Parallel to other HERS requirements
 - Accept defaults if you don't inspect
 - Inspected performance can be worse than default



Manufacturers Spec's:

- Fully lofted
- Completely fill framing cavity
- No voids or gaps--continuous
- Cut to fit neatly around all obstructions

See: www.naima.org





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Assessment: Good

- Installed according to manufacturers instructions and/or industry standards
- Fills each cavity side-to-side and top-to-bottom
- No substantial gaps or voids around obstructions (i.e. blocking or bridging)
- Split and/or fitted tightly around wiring and other services
- No exterior sheathing is visible through gaps in the material



Assessment: Fair

- Moderate to frequent defects:
- Gaps around wiring, electrical outlets, plumbing, other intrusions
- Rounded edges or "shoulders"
- Incomplete fill amounting to 10% or more of the area with less than 70% of intended thickness; or
- Gaps/spaces clear through the insulation amounting to more no more than 2% of total surface area covered by the insulation.



2% Area

10% Area





Conditions for Wall Insulation

- To attain a rating of "fair" or "good":
- Must be enclosed on all six sides
 Sheathing wrap is acceptable
- Must be in substantial contact with the sheathing material on at least one side of the cavity
 - Interior or exterior



Assessment: Poor

- Gaps and voids amounting to greater than 2% percent of the surface area it is intended to occupy
- Compression greater than 10% of the area compressed (70% or less of rated thickness)



Wall insulation that is:

- Not in substantial contact with the sheathing on at least one side of the cavity
- OR, wall that is open (unsheathed) on one side and exposed to the exterior conditions or a vented attic or crawlspace;
- Shall be rated "Poor"





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Additional for Ceilings

- Must be in complete contact with the surface it's intended to insulate for "good" rating
- Inspectors need to note whether the framing is covered, and by how much
 Modeled differently than if covered



Additional for Floors:

- Must be in complete contact with the surface it's intended to insulate for "good" rating
- Need not be enclosed on 6 sides, IF in enclosed, unconditioned basement
 Vented, or outdoors does



Missing insulation

- Or substantial areas differently assessed (G,F,P):
- Treat as SEPARATE areas
 - Insulation R-values may *not* be averaged over areas
 - Example: If 50 square feet of wall has no insulation, must be counted as separate wall area with no insulation
 - Example: if 100 s.f. of an attic has ½ the R-value of loose fill, must be input as 100 s.f. with ½ the R-value



Modeling (Software, not Rater)

- Impact
 - Good: theoretical (labeled) performance
 - Fair: as if 2% of cavity with 0 insulation in cavity
 - Still use interior, exterior sheathing, air films, etc.
 - Poor: as if 5% of cavity with 0 insulation
- Compression
 - Performance chart



Example of impact

| | Includes gypsum and exterior sheathing, framing, and air films | | | | | | | | | |
|------------------|--|----------|---------|----------|----------|-----|----------|----------|--------------|------------|
| walls | good | net R | fair | net R | % u-fac | tor | poor | net R | % u-factor | increase f |
| r11 | 0.093 | 10.8 | 0.101 | 9.9 | 109% | | 0.113 | 8.8 | 122% | |
| r13 | 0.085 | 11.8 | 0.094 | 10.6 | 111% | | 0.106 | 9.4 | 125% | |
| r19 | 0.063 | 15.9 | 0.070 | 14.3 | 111% | | 0.083 | 12.0 | 132% | |
| r21 | 0.058 | 17.2 | 0.067 | 14.9 | 116% | | 0.080 | 12.5 | 138% | |
| r30 | 0.041 | 24.4 | 0.050 | 20.0 | 122% | | 0.063 | 15.9 | 154% | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| ceilings (2 x 4 | bottor | n chord, | open at | tic; inc | ludes gy | psi | um, fran | ning and | d air films) | |
| | good | net R | fair | net R | % | | poor | net R | % u-factor | increase f |
| r19 | 0.064 | 15.6 | 0.072 | 13.9 | 113% | | 0.084 | 11.9 | 131% | |
| r30 | 0.05 | 20.0 | 0.058 | 17.2 | 116% | | 0.070 | 14.3 | 140% | |
| r38 | 0.045 | 22.2 | 0.053 | 18.9 | 118% | | 0.064 | 15.6 | 142% | |
| r38, joists cove | 0.028 | 35.7 | | | | | | | | |
| (for reference) | | | | | | | | | | |

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| R-Values for Building Insulation Compressed in Cavities | | | | | | | | | | | | | | | | | |
|---|----------|---|--|-------------|-------------|------------|-------------|-------|-----|-----|-------------|-----|-----|-----|-----|-----|-----|
| Nominal | Depth of | Rated R-value and full cavity depth of insulation | | | | | | | | | | | | | | | |
| Framing Ca Size (in | Cavity | Cavity | Cavity | R | R6 | R8 | R11 | 1 R13 | R15 | R19 | R21 | R22 | R25 | R30 | R30 | R38 | R38 |
| | (inches) | 1¾" | 2 ¹ / ₂ " | 3 ½" | 3½ " | 3½" | 6 ¼" | 5½" | 6½" | 8" | 8 ½" | 10" | 10" | 12" | | | |
| 1x2 | 3⁄4 | 3.5 | | | | | | | | | | | | | | | |
| 2x2 | 11/2 | 5.5 | 5.6 | 6 | | | | | | | | | | | | | |
| 2x3 | 21/2 | 6 | 8 | 9 | 10 | 12 | | | | | | | | | | | |
| 2x4 | 31/2 | " | " | 11 | 13 | 15 | 14 | 15 | 15 | | | | | | | | |
| 2x4 (Full) | 4 | " | " | " | " | " | 15 | 17 | 16 | 16 | 17 | | | | | | |
| 2x6 | 5½ | " | " | " | " | " | 18 | 21 | 20 | 20 | 23 | 21 | | | | | |
| 2x8 | 71⁄4 | " | " | " | " | " | 19 | 66 | 22 | 24 | 28 | 26 | 30 | 28 | | | |
| 2x10 | 9¼ | " | " | " | " | " | 66 | 66 | 66 | 25 | 30 | 29 | 36 | 33 | | | |
| 2x12 | 11¼ | " | " | 66 | " | 66 | " | " | 66 | 66 | 66 | 30 | 38 | 37 | | | |

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Fiberglass Batts (Real World)





Why is it So Bad?

- The gaps and spaces dominate the heat loss
 - No matter how much insulation you pile up next to a gap, the heat loss through the gap is not reduced at all
- The larger the initial R-value, the greater the effect



Average R-value Calculation Example: 1000 s.f. of R-38 ceiling, 5 s.f. @ R-1 (i.e. attic hatch):

The easy way: area-weighted average Rvalue

> $(38 \bigcirc 995) + (1 \bigcirc 5) = 37,815$ 37,815 $\boxed{=}$ 1000 sq. ft. = $\overrightarrow{R-37.8}$ *The easy way is wrong!*



Area weighted average U-value:

 $UA = area \times U = area = R$ (995 = 38) + (5 = 1) = 31.2 (total UA)

> U = UA / area 31.2 $\boxed{=}$ 1000 = 0.031 (U-value) R = 1/U = 1 $\boxed{=}$ 0.031 = **R-32**

At 1%, it's R-28, at 2% it's R-22!!!!!



| standard | R38 ba | tt example | : | gap exam | | |
|------------------|--------|------------|--------|----------|--------|-------|
| | | Framing | Cavity | Framing | Cavity | gaps |
| inside air film | | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 |
| Gyp board | | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Cavity | | 26.00 | 38.00 | 26.00 | 38.00 | 0.00 |
| thermal break | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| outside air film | | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 |
| total r | | 27.79 | 39.79 | 27.79 | 39.79 | 1.79 |
| relative area | | 0.11 | 0.89 | 0.11 | 0.87 | 2% |
| UA | | 0.004 | 0.022 | 0.004 | 0.022 | 0.011 |
| | | | | | | |
| total U | | 0.026 | | 0.037 | | |
| total R | | 38.0 | | 27.0 | | -29% |



| standard | R38 ba | tt example | gap exam | | | |
|------------------|--------|------------|----------|---------|--------|-------|
| | | Framing | Cavity | Framing | Cavity | gaps |
| inside air film | | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 |
| Gyp board | | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Cavity | | 4.38 | 38.00 | 4.38 | 38.00 | 0.00 |
| thermal break | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| outside air film | | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 |
| total r | | 6.17 | 39.79 | 6.17 | 39.79 | 1.79 |
| relative area | | 0.11 | 0.89 | 0.11 | 0.87 | 2% |
| UA | | 0.018 | 0.022 | 0.018 | 0.022 | 0.011 |
| | | | | | | |
| total U | | 0.040 | | 0.051 | | |
| total R | | 24.9 | | 19.7 | | -21% |