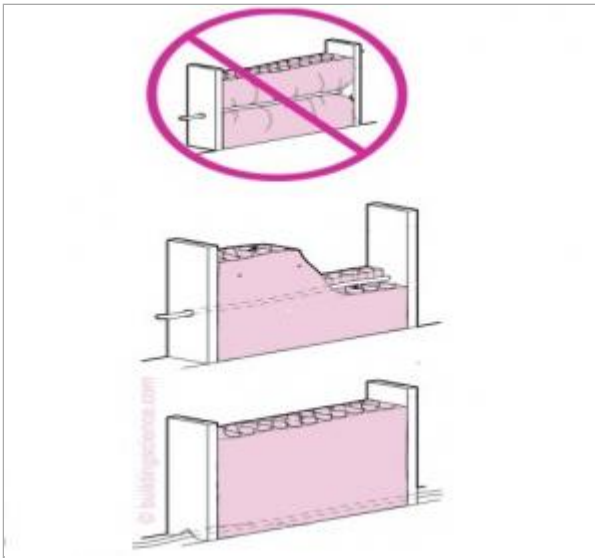
Insulation Installation Achieves RESNET Grade 1

Last Updated: 03/14/2016

Scope



Batt insulation should be cut to fit around wiring so that insulation can completely fill the wall cavity

Install insulation without misalignments, compressions, gaps, or voids along the thermal envelope of the house.

All ceiling, wall, floor, and slab insulation should achieve Grade I level insulation installation criteria as defined by the Residential Energy Services Network (**RESNET**).

See the **Compliance Tab** for related codes and standards requirements, and criteria to meet national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.

Description

Gaps, voids, and compressions that cause the insulation to lose contact with the surface it is intended to insulate can cause cold spots in walls, ceilings, and floors. These cold spots may encourage the formation of condensation in the wall cavity, floors, or ceilings.

The Residential Energy Services Network (RESNET) grades insulation installation quality in its Home Energy Rating System Standards, with Grade 1 being the best installation (**RESNET 2013**).

Grade 1 Installation requires that insulation material should uniformly fill wall cavities, filling each cavity from side to side and top to bottom, without substantial gaps or voids around obstructions. Batt insulation should be cut to fit around any wiring or piping installed in the wall cavities.

Blown insulation, such as loose fiberglass, cellulose, or mineral wool fibers, flows easily around obstructions, such as wiring and piping, to provide complete coverage in the cavities. To install blown insulation, the open cavities are first covered with a netting that is stapled to the stud faces. A slit is cut in the netting in each cavity and the insulation is installed with a hose inserted through the slit. The installer can easily see where the insulation is going to ensure that each cavity is completely filled without voids.

Spray foam is another option that readily fills areas around obstructions in wall cavities, and it has the advantage of providing both air sealing and insulation. The foam completely fills the open wall cavities and is trimmed flush with the stud faces before installing dry wall. Spray foam insulation is made of petroleum, soy, or castor oil-based polyurethane and is available in open-cell, low-density products or closed-cell, high-density products. Both insulate and air seal; high-density products can also provide a vapor barrier. Another option is sprayed-on cellulose or mineral wool that is mixed with adhesive and water then sprayed into the open cavities and allowed to dry before drywalling.

Additional information about insulation, including descriptions of the many types of insulation available, their R-values, applications and advantages and disadvantages of each kind, and installation guidance can be found in the ***Building America Best Practices Series Volume 17: Insulation, A Guide for Contractors to Share with Homeowners***.

How to Install Insulation to RESNET-Defined Grade I

1. Install insulation without misalignments, compressions, gaps, or voids in all wall cavities along the thermal barrier of the house. Figure 1 shows proper installation of batt insulation without gaps or voids. Figure 2 shows incorrect installation; the insulation was not cut to fit around wiring so the insulation will not be in full contact with the drywall along the length of the wall cavities.

Figure 1 - Unfaced fiberglass batt insulation is installed to completely fill the wall cavities and is sliced to fit around wiring, piping, and other obstructions in the wall cavities.

Figure 2 - This faced fiberglass batt insulation was incorrectly installed; it should be cut to fit around wiring and obstructions so that it can completely fill the wall cavity without compressions and voids.

2. Install wall insulation so that it is enclosed on all six sides in each wall cavity. It should completely fill the wall cavities as shown with the blown fiberglass insulation in Figure 3, the blown cellulose in Figure 4, and the spray foam in Figure 5. It should be in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity.

Figure 3 - Blown fiberglass insulation fills netted wall cavities and flows easily around wiring and other obstructions to provide a uniform insulating layer without gaps or voids.

Figure 4 - Blown cellulose insulation completely fills the netted wall and ceiling cavities and flows easily around wiring and other obstructions to provide a uniform insulating layer without gaps or voids.

Figure 5 - Spray foam insulation is installed in open wall cavities to air seal and insulate.

3. Faced batt insulation should be stapled to the surface of framing (Figure 6). Side-stapling is permitted, provided the tabs are stapled neatly (no buckling), the batt is only compressed at the edges of each cavity to the depth of the tab itself, and the batt meets the other requirements of Grade I.

Figure 6 - Faced fiberglass batt insulation can be stapled to the stud faces or slightly inset, but avoid compressing the batts and slit the insulation to fit around wiring and other obstructions.

4. Install slab edge insulation for slab-on-grade floors if the floor surface is less than 12 inches below grade and if required by code in your climate zone. Slab insulation should extend to the top of the slab to provide a complete thermal break (Figure 7). If the insulation is installed between the exterior wall and the edge of the interior slab, the insulation may be cut at a 45-degree angle away from the exterior wall, allowing the poured slab concrete to cover and protect the top edge of the insulation.

Insulating the slab edge will keep the floor warmer and reduce the potential for condensation and elevated relative humidity by allowing the inside surface temperature of the slab perimeter to more closely track the home's interior temperature. If the slab is monolithic with a grade beam (Figure 8), the insulation is installed on the exterior of the slab edge/grade beam and continues vertically to the bottom of the grade beam. Use insulation material that is appropriate for ground contact such as XPS, rigid fiberglass, or rigid rock wool and use insect controls appropriate for the region. The above-ground portion of the rigid foam should be protected from UV and impact damage with coated fiber cement board.

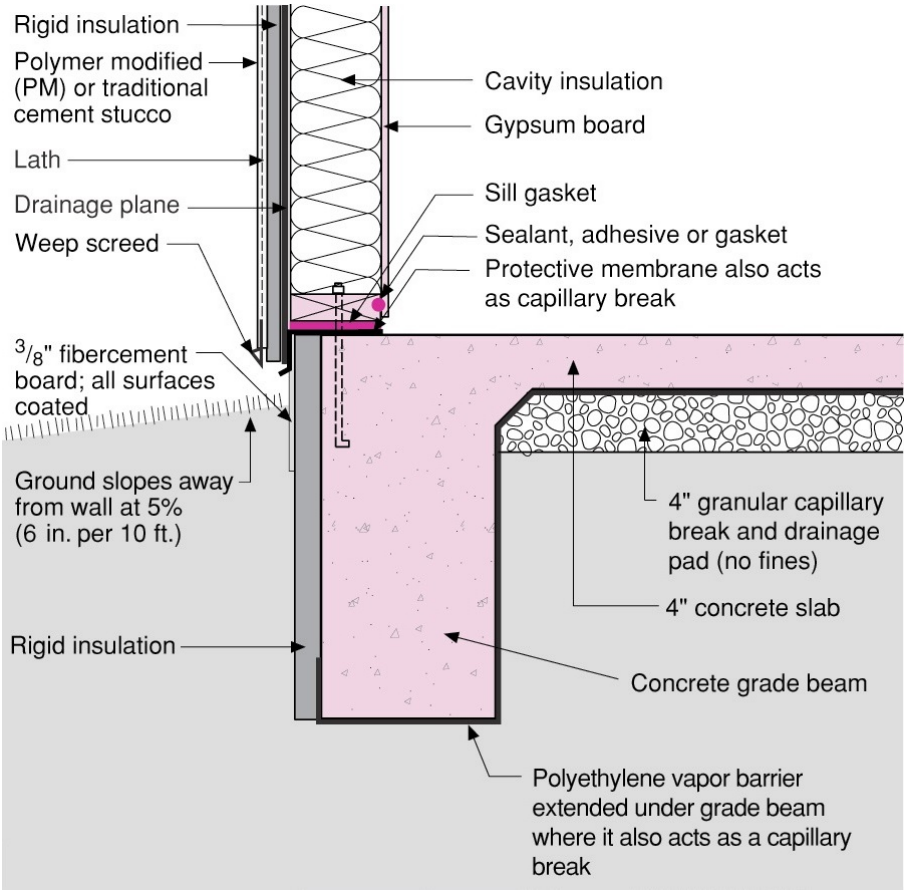


Figure 7 - Rigid foam slab edge insulation is installed along the exterior edge of a monolithic slab foundation.

When the slab is independent from the perimeter foundation wall, insulation may be installed either on the exterior of the foundation wall or between the foundation wall and the slab (Figure 8), which provides more protection for the insulation from the elements. When the insulation is between the foundation wall and the slab, it forms a bond break and it should also extend horizontally under the slab either at the perimeter or under the entire slab.

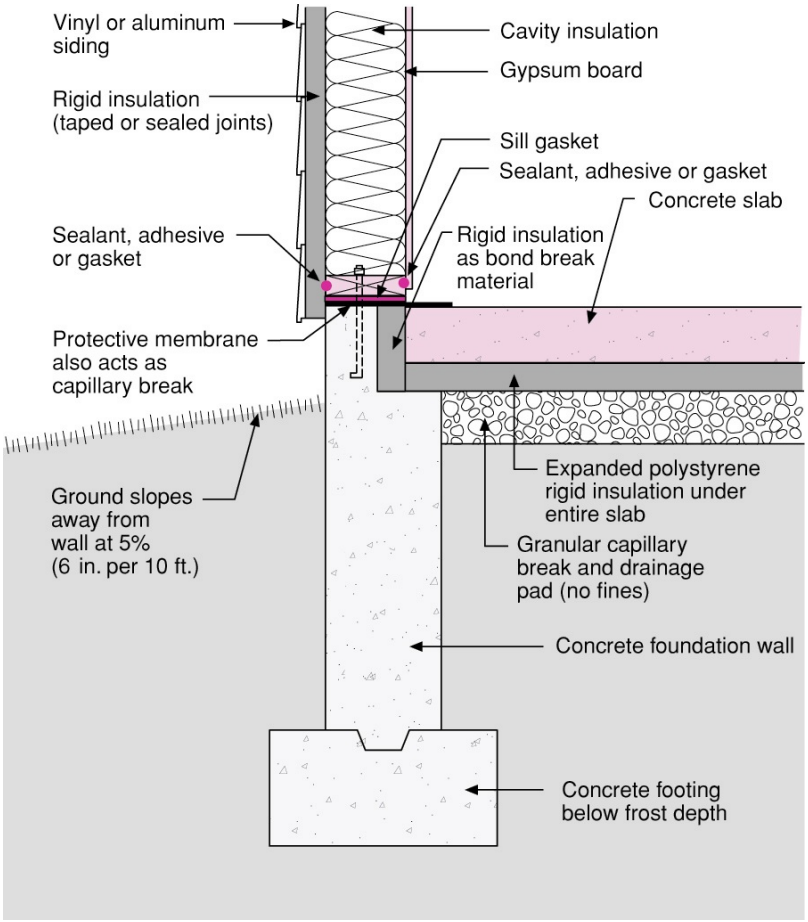


Figure 8 - Rigid foam forms an insulating bond break between the foundation wall and the slab.

5. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the house, install slab insulation to provide a thermal break between the conditioned and unconditioned slab. Where specific details cannot meet this ENERGY STAR Ver. 3, Rev 6. requirement, provide the detail to EPA to request an exemption prior to the home's qualification.

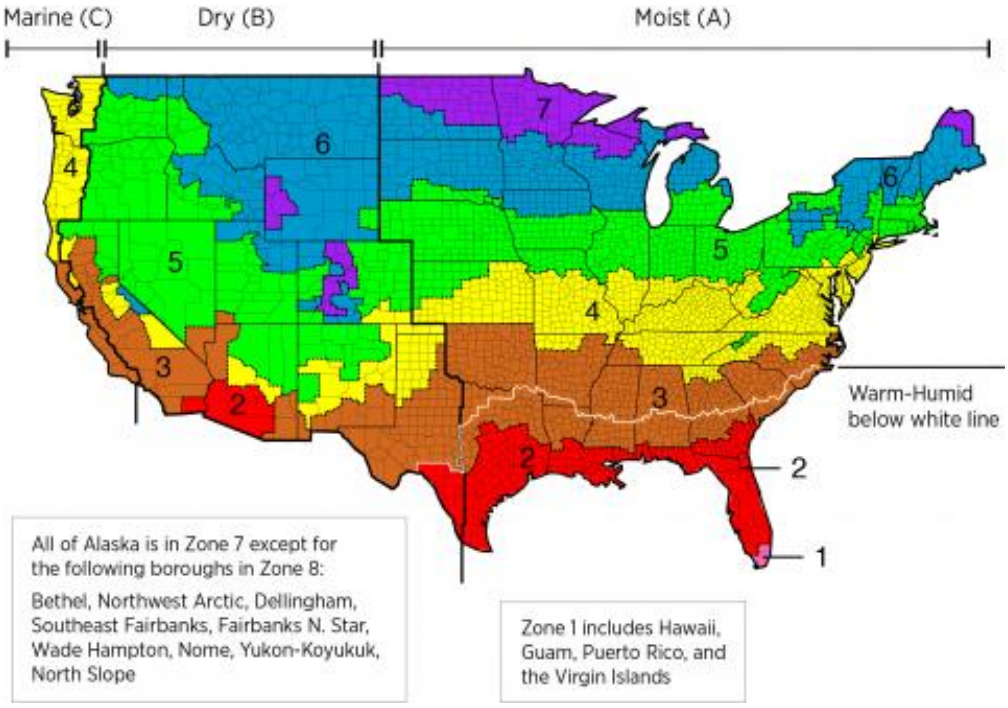
Ensuring Success

Home energy raters are required to inspect and probe in, around, or through the insulation and/or vapor retarder in several places to see whether insulation is installed to RESNET Grade 1 standards. . During inspection, insulation and vapor retarders may be cut or pulled away so raters can see installation details. The raters should replace or repair the vapor retarder and insulation as necessary. During inspection (typically before drywall is installed), if the exterior sheathing is visible from the building interior through gaps in the cavity insulation material, it is not considered a Grade I installation.

Climate

The amounts of insulation that must be installed in various building components are specified by code and vary by climate. The U.S. Department of Energy **Building Energy Code Program** identifies the building codes currently in force for each state.

For more information on the insulation levels required in the 2009 and 2012 International Energy Conservation Code (IECC), which are specified by climate zone, see the **2009 IECC Code Level Insulation–ENERGY STAR Requirements** and **2012 IECC Code Level Insulation – DOE Zero Energy Ready Home Requirements**.



International Energy Conservation Code (IECC) Climate Regions

Training

Right and Wrong Images

Display Image: ES_TESRC_2.2_PG52_16b_102811_2.jpg

Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

Display Image: ES_TESRC_2.2_PG52_16b_102811_2.jpg

Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

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Organization(s): EPA

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

Display Image: ES_TESRC_2.2_PG52_17c_102811_1.jpg

Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

Display Image: ES_TESRC_2.2_PG52_17c_102811_1.jpg

Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

Display Image: ES_TESRC_2.2_PG52_18d_102811_0.jpg

Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

Display Image: ES_TESRC_2.2_PG52_18d_102811_0.jpg

Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

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Reference: Thermal Enclosure System Rater Checklist Guidebook

Author(s): EPA
Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

CAD

None Available

Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

ENERGY STAR Certified Homes

ENERGY STAR Certified Homes (Version 3/3.1, Revision 08), Rater Field Checklist

Thermal Enclosure System:

1. High-Performance Fenestration & Insulation:

1.3 All insulation achieves RESNET-defined Grade I installation. See Footnote 4 for alternatives.[4]

Footnotes:

(4) Two alternatives are provided: a) Grade II cavity insulation is permitted to be used for assemblies that contain a layer of continuous, air impermeable insulation ? R-3 in Climate Zones 1 to 4, ? R-5 in Climate Zones 5 to 8; b) Grade II batts are permitted to be used in floors if they fill the full depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving Grade I is the compression caused by the excess insulation.

ENERGY STAR Revision 08 requirements are required for homes permitted starting 07/01/2016.

DOE Zero Energy Ready Home (Rev 04)

Exhibit 1: Mandatory Requirements: Item 1, Homes must be certified under ENERGY STAR Qualified Homes Version 3.
Item 2, Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 or 2015 IECC levels.

Exhibit 2: Design the home to meet the HERS index of the DOE Zero Energy Ready Home Target Home, for which insulation levels must meet the 2012 IECC and achieve Grade 1 installation, per RESNET standards.

Footnotes:

(9) For states where ENERGY STAR Certified Homes Version 3.1 is in effect, DOE Zero Energy Ready Homes shall be certified under ENERGY STAR Certified Homes Version 3.1. The implementation timeline for Version 3.1 is located online at: **http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v3_1.**

Consistent with the ENERGY STAR for Homes V3 allowance for sampling, the Thermal Enclosure System Rater Checklist and the HVAC System Quality Installation Rater Checklist shall be permitted to be completed for a batch of homes using a RESNET-approved sampling protocol. The Indoor airPLUS Verification Checklist may also be completed using a RESNET-approved sampling protocol. Sampling shall not be permitted to complete the HVAC System Quality Installation Contractor Checklist.

With respect to Provision 2.2 within the ENERGY STAR Qualified Homes, Version 3 (REV07) Thermal Enclosure System Rater Checklist: where ceiling, wall, or floor assembly insulation is installed "blind" between layers of sheathing and therefore cannot be visually inspected, such assemblies are deemed equivalent to a RESNET-defined Grade 1 installation if the assembly insulation level is at least 50% greater than the specified value for the DOE Zero Energy Ready HomeTarget Home, based on nominal R-value.

(14) Insulation levels in a home shall meet or exceed the component insulation requirements in the 2012 International Energy Conservation Code (IECC) - Table R402.1.1. The following exceptions apply:

a. Steel-frame ceilings, walls, and floors shall meet the insulation requirements of the 2012 IECC – Table 402.2.6.

b. For ceilings with attic spaces, R-30 shall satisfy the requirement for R-38 and R-38 shall satisfy the requirement for R-49 wherever the full height of uncompressed insulation at the lower R-value extends over the wall top plate at the eaves. This exemption shall not apply if the alternative calculations in d) are used;

c. For ceilings without attic spaces, R-30 shall satisfy the requirement for any required value above R-30 if the design of the roof / ceiling assembly does not provide sufficient space for the required insulation value. This exemption shall be limited to 500 sq. ft. or 20% of the total insulated ceiling area, whichever is less. This exemption shall not apply if the alternative calculations in d) are used;

d. An alternative equivalent U-factor or total UA calculation may also be used to demonstrate compliance, as follows: An assembly with a U-factor equal or less than specified in 2012 IECC Table 402.1.3 complies. A total building thermal envelope UA that is less than or equal to the total UA resulting from the U-factors in Table 402.1.3 also complies. The insulation levels of fenestration, ceilings, walls, floors, and slabs can be traded off using the UA approach under both the Prescriptive and the Performance Path. Also, note that while ceiling and slab insulation can be included in trade-off calculations, Items 4.1 through 4.3 of the ENERGY STAR for Homes Ver 3 (Rev 07) Thermal Enclosure System Rater Checklist [Items 3.1-3.3 or the ENERGY STAR Ver 3 Rev 08 Rater Field Checklist] shall be met regardless of the UA tradeoffs calculated. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of

framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method.

(15) In states where the residential provisions of the 2012 International Energy Conservation Code (IECC) have been adopted, qualifying homes must instead meet the envelope insulation requirements of the 2015 IECC, effective 12 months after the effective date of the 2012 IECC in that state. The exact date at which time a state will migrate to 2015 IECC envelope compliance may vary based on the timing of RESNET rating software updates, but will not be any sooner than 12 months following the effective date of the 2012 IECC in that state.

Note that sub-items A through D of the previous end note all still apply for 2015 IECC envelope compliance.

2009 IECC

Section 303.1.1 Install insulation that has R-value marked on it or provide a certification listing the type, manufacturer and R value of insulation installed in each element of the building envelope.

Section 303.1.1.1 For blown or sprayed in ceiling insulation the height of the insulation should be indicated on marker installed at least one for every 300 square feet in the space.

Section 303.2 Installation. All materials, systems, and equipment are to be installed per the manufacturer's instructions and the International Building Code.

Section 303.2.1 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.*

2012 IECC

Section R 303.1.1 Install insulation that has R-value marked on it or provide a certification listing the type, manufacturer, and R value of insulation installed in each element of the building envelope.

Section R303.1.1.1 For blown or sprayed in ceiling insulation the height of the insulation should be indicated on marker installed at least one for every 300 square feet in the space.

Section R303.2 Installation. All materials, systems, and equipment to be installed per the manufacturer's instructions and the International Building Code or International Residential Code, as applicable.

Section R303.2.1 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.*

2015 IECC

Building thermal envelope components to meet or exceed the values in Table R402.1.1, Insulation and Fenestration Requirements by Component. Follow specific insulation requirements in Section R402.2.*

*Due to copyright restrictions, exact code text is not provided. For specific code text, refer to the applicable code.

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

1. **New Whole-House Solutions Case Study: Imagine Homes: Stillwater Ranch, San Antonio, TX**
(893 KB)
Author(s): PNNL
Organization(s): PNNL
Publication Date: April, 2012
Case study about a new home builder that strives to address health, safety, and durability issues in a hot and humid climate.

2. **New Whole-House Solutions Case Study: Pine Mountain Builders, Pine Mountain, Georgia**
(1011 KB)
Author(s): PNNL
Organization(s): PNNL
Publication Date: January, 2013
Case study about a builder in Georgia that designs energy-efficient homes for a green community, yielding homes with HERS scores as lowas 59 and electric bills as low as $50 a month.

3. **New Whole-House Solutions Case Study: Tindall Homes: The Legends at Mansfield, Columbus, NJ**
(898 KB)
Author(s): PNNL
Organization(s): PNNL
Publication Date: April, 2012
Case study about a new construction building project of 20 luxury homes in northern New Jersey that were more energy efficient than ENERGY STAR and met the 50% energy savings requirements of the federal tax credit for new homes.

References and Resources*

1. **Building America Best Practices Series Volume 11: 40% Whole-House Energy Savings in the Marine Climate**
Author(s): Baechler, Gilbride, Hefty, Cole, Williamson, Love
Organization(s): PNNL, ORNL
Publication Date: September, 2010
Report providing builders in marine climates with guidance for building homes that have whole-house energy savings of 40% over the Building America benchmark with no added overall costs for consumers.

2. **Building America Best Practices Series Volume 17: Insulation, A Guide for Contractors to Share with Homeowners**
Author(s): Baechler, Adams, Hefty, Gilbride, Love
Organization(s): PNNL, ORNL
Publication Date: May, 2012
Guide to help contractors and homeowners identify ways to make homes more comfortable, more energy efficient, and healthier to live in.

3. **DOE Zero Energy Ready Home National Program Requirements**
Author(s): DOE
Organization(s): DOE
Publication Date: August, 2015
Standard requirements for DOE's Zero Energy Ready Home national program certification.

4. **ENERGY STAR Certified Homes, Version 3 (Rev. 08) National Program Requirements**
Author(s): EPA
Organization(s): EPA
Publication Date: September, 2015
Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 08).

5.

Introduction and Overview: Proper Installation of Fiber Glass and Rock and Slag Wool Batt Insulation
Author(s): North America Insulation Manufacturers Association
Organization(s): North America Insulation Manufacturers Association
Publication Date: May, 2014
Website providing builders with information about meeting RESNET Grade 1 criteria when installing insulation.

6. **Mortgage Industry National Home Energy Rating Systems Standards**
Author(s): RESNET
Organization(s): RESNET
Publication Date: January, 2013
Standards aimed to ensure that accurate and consistent home energy ratings are performed by accredited home energy rating Providers through their Raters nationwide.

7. **RESNET Insulation Grading Criteria**
Author(s): Cottrell
Organization(s): RESNET, North American Insulation Manufacturers Association
Publication Date: October, 2012
Presentation describing RESNET grading criteria for insulation installation.

8. **Slab Edge Insulation for All Climates, Information Sheet 513**
Author(s): BSC
Organization(s): BSC
Publication Date: May, 2009
Information sheet about insulating slabs.

9. **Thermal Enclosure System Rater Checklist Guidebook**
Author(s): EPA
Organization(s): EPA
Publication Date: October, 2011
Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

The following Building America Teams contributed to the content in this Guide.

Pacific Northwest National Laboratory