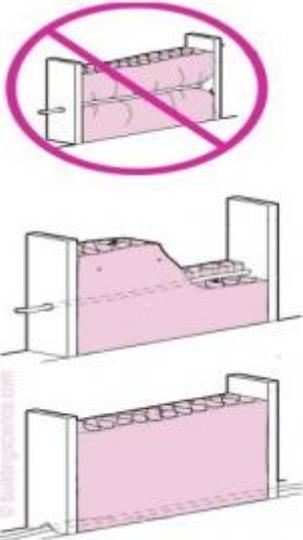


# Insulation Installation (RESNET Grade 1)

Last Updated: 05/09/2014

## Scope



Install insulation without misalignments, compressions, gaps, or voids in all wall cavities along the thermal barrier of the house.

### ENERGY STAR Notes:

[ENERGY STAR Certified Homes National Program Requirements](#) specifies that insulation levels shall meet or exceed 2009 IECC levels and achieve Grade 1 installation per standards set by the Residential Energy Services Network (RESNET)

The ENERGY STAR Thermal Enclosure System Rater Checklist further specifies:

- 2.2 All ceiling, wall, floor, and slab insulation must achieve RESNET-defined Grade I installation or, alternatively, Grade II for surfaces that contain a layer of continuous air-impermeable insulation that is greater than or equal to R-3 in Climate Zones 1 to 4 and greater than or equal to R-5 in Climate Zones 5 to 8.

Insulation levels in a home shall meet or exceed the component insulation requirements in the 2009 IECC - Table 402.1.1. For additional information on ENERGY STAR insulation level requirements, see the guide [2009 IECC Code Level Insulation-ENERGY STAR Requirements](#).

### DOE Zero Energy Ready Home Notes:

[DOE Zero Energy Ready Home National Program Requirements](#) specifies that insulation levels shall meet the 2012 IECC levels and achieve Grade 1 installation per RESNET standards. For additional information on DOE Zero Energy Ready Home insulation level requirements, see the guide [2012 IECC Code Level Insulation – DOE Challenge Home Requirements](#).

## 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 flow 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.

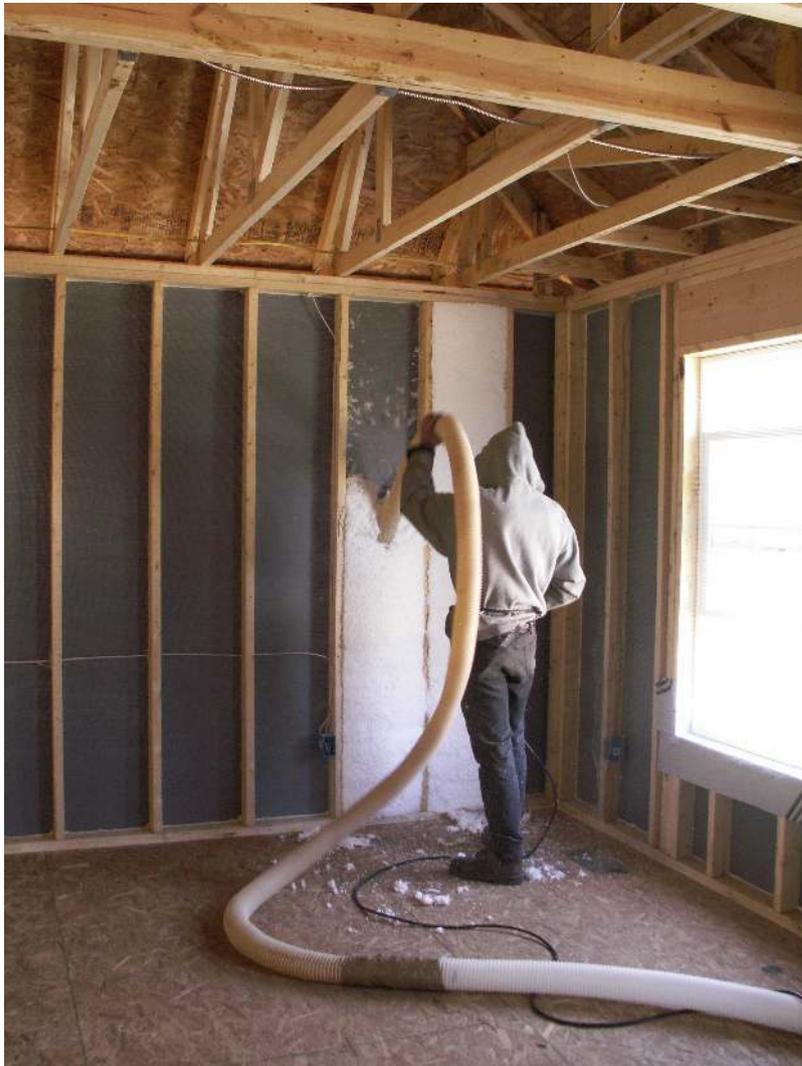


**Figure 1** - Unfaced fiberglass batt insulation is installed to completely fill the wall cavities and is sliced to fit around wiring, piping, and other obstructions in the wall cavities. [i](#)



**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. [i](#)

2. Install wall insulation so that it is enclosed on all six sides in each wall cavity. 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. 

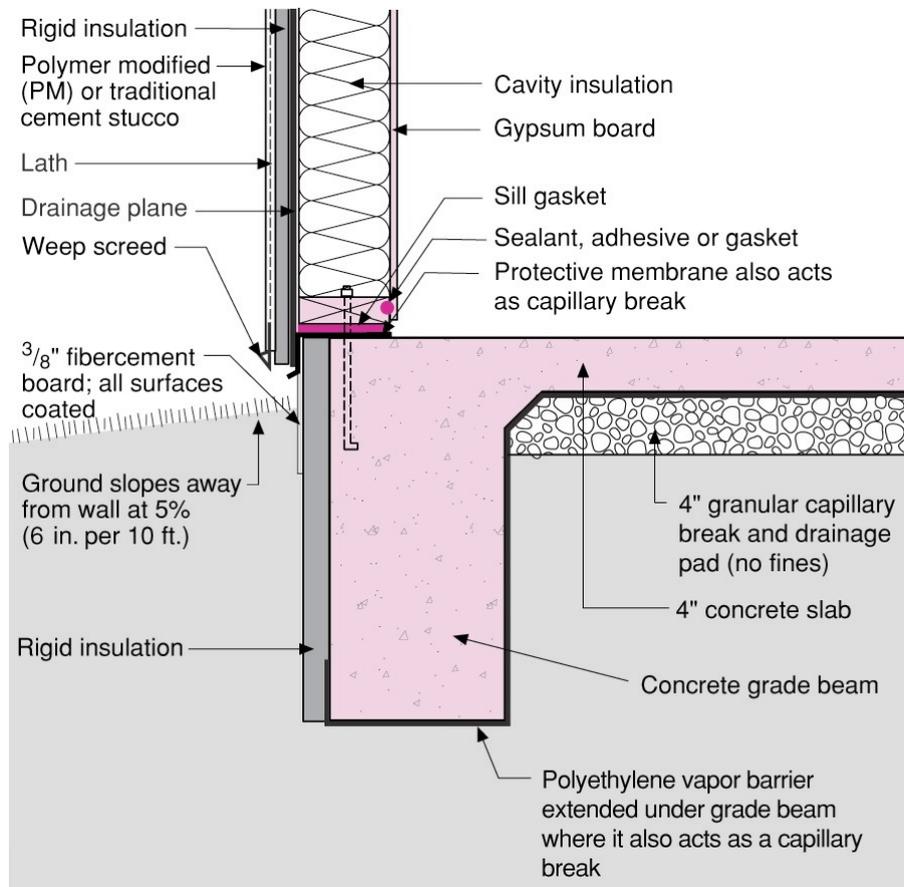
3. Faced batt insulation should be stapled to the surface of framing. Side-stapling is permitted, provided the tabs are stapled neatly (no buckling), the batt is only compressed at the edges of each cavity to the depth of the tab itself, and the batt meets the other requirements of Grade I.



**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. 

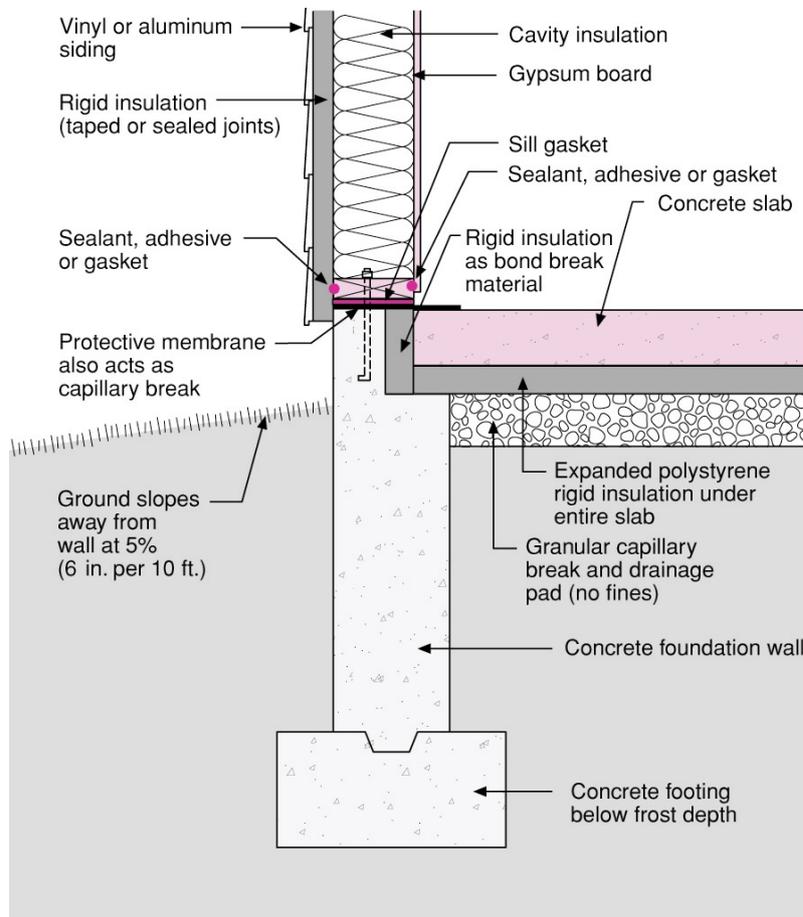
4. Install slab edge insulation for slab-on-grade floors if the floor surface is less than 12 inches below grade and if required by code in your climate zone. Slab insulation should extend to the top of the slab to provide a complete thermal break. If the insulation is installed between the exterior 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 9), which provides more protection from the elements. When the insulation is between the foundation wall and the slab, it forms a bond break and also extends 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.

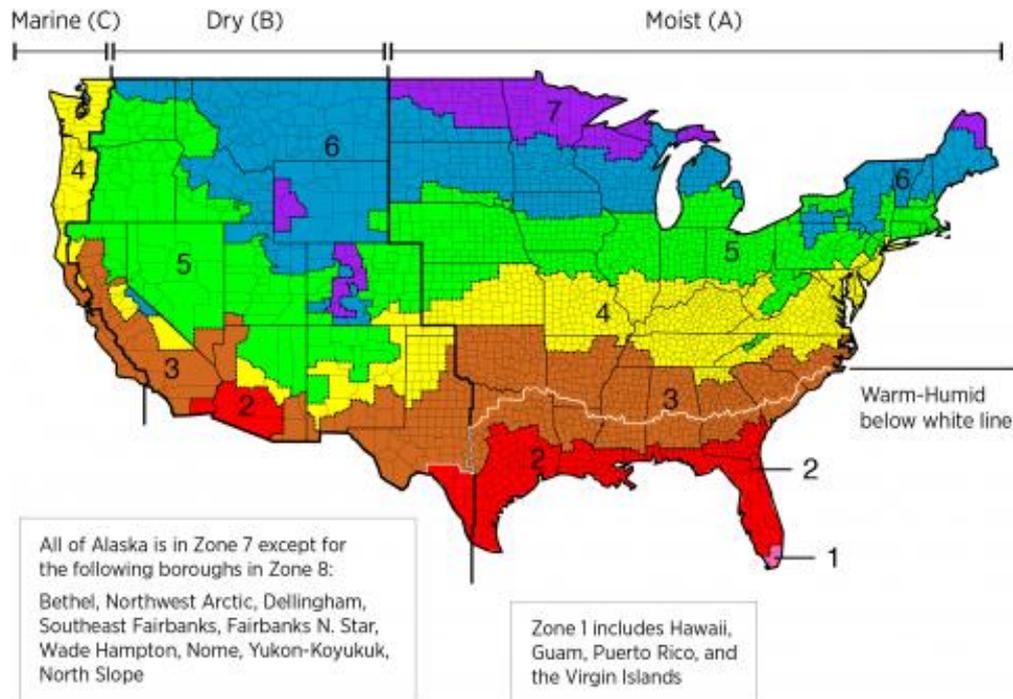
## Ensuring Success

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.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.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.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.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 17c 102811.jpg](#)

Reference: [Thermal Enclosure System Rater Checklist Guidebook](#)

Author(s): EPA

Organization(s): EPA

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Display Image: [ES TESRC 2.2 PG52 17c 102811.jpg](#)

Reference: [Thermal Enclosure System Rater Checklist Guidebook](#)

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Organization(s): EPA

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Display Image: [ES TESRC 2.2 PG52 17c 102811.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.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 19e 102811.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 20f 102811.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 21g\\_102811.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 22h\\_102811.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\\_23i\\_1028112.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.*

# CAD

None Available

# Compliance

## [ENERGY STAR Version 3, \(Rev. 07\)](#)

Thermal Enclosure Checklist, Quality-Installed Insulation. All ceiling, wall, floor, and slab insulation shall achieve RESNET-defined Grade I installation or, alternatively, Grade II for surfaces that contain a layer of continuous, air impermeable insulation  $\geq$  R-3 in Climate Zones 1 to 4,  $\geq$  R-5 in Climate Zones 5 to 8.

## [DOE Zero Energy Ready Home \(Rev 04\)](#)

Exhibit 1: Mandatory Requirements: Homes must be certified under ENERGY STAR Qualified Homes Version 3.

Exhibit 2: DOE Zero Energy Ready Home Target Home: Insulation levels shall meet the 2012 IECC and achieve Grade 1 installation, per RESNET standards.

## [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.\*

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

## More Info.

### 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 low as 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:** April, 2014  
*Standard requirements for DOE's Zero Energy Ready Home national program certification.*
4. [ENERGY STAR Certified Homes, Version 3 \(Rev. 07\) Inspection Checklist for National Program Requirements](#)  
**Author(s):** EPA  
**Organization(s):** EPA  
**Publication Date:** June, 2013  
*Standard document containing the rater checklists and national program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 7).*
- 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.

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**Source URL (retrieved on 2014-10-21 09:57):** <https://basc.pnnl.gov/resource-guides/insulation-installation-resnet-grade-1>