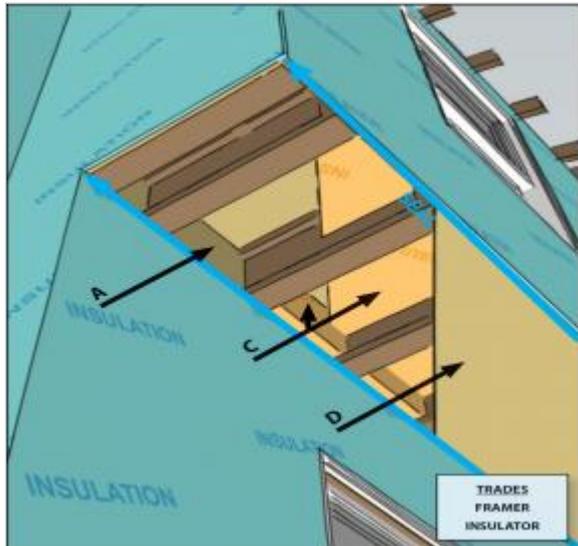


Cantilevered Floor

Last Updated: 03/14/2016

Scope



Air seal the top, bottom, and sides of a cantilevered floor cavity and ensure that insulation is in full contact with all sides without voids.

Air seal the top, bottom, and sides of a cantilevered floor cavity and ensure that insulation is in full contact with all sides without voids.

- Install a rigid air barrier or other supporting blocking to separate the cantilever from the conditioned space above. Seal all seams, gaps, and holes in the air barrier with caulk or foam.
- Block and seal any open floor joists abutting the cantilever floor cavities.
- Install insulation without misalignments, compressions, gaps, or voids to fill the cantilever floor cavity, making full contact with the top, bottom, and sides of a cantilevered floor cavity
- Cover the bottom of the insulated cantilever floor cavities with a rigid, weather-resistant solid blocking material such as plywood or house siding.

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

A cantilevered floor is a floor that sticks out past the foundation or supporting wall below. It may be a first- or second-story bump-out, a bay window, or a room over an open porch. Floor joist bays that extend from the house out under the cantilevered floor are sometimes left unsealed and uninsulated by the builder, allowing outside air to flow through the home and conditioned air to escape (Figure 1). Sometimes cantilevered floors are insulated but not air sealed. Air barriers must be put in place across any open floor joist bays to form an air barrier between the cantilever and the rest of the house to prevent air from blowing through the insulation, which renders the insulation ineffective. Blocking material (rigid foam, OSB, plywood, or drywall) should be installed (Figure 2). Plywood subflooring above the cantilever should be caulked at the edges and seams. The cantilever floor cavity must be filled with insulation that completely touches the underside of the floor. Insulating foam sheathing and/or house sheathing or siding should be attached to the underside of the cantilever floor joists as a protective covering. Air sealing and insulation materials may be installed by framers, insulators, and/or siding installers. This task should be included in the contract for the appropriate trade depending on the workflow at specific job sites.

Air barrier effectiveness is measured at the whole-house level. High-performance branding programs and the IECC code require that builders meet specified infiltration rates at the whole house level. See the “compliance” tab for these specified infiltration rates.

When designing the home, HVAC ducts and plumbing pipes should not be located in cantilevered floors.



Figure 1. If these floor joist bays remain open, cold air can flow between the floors of the house. 



Figure 2. These floor joist bays have

been properly air sealed with caulked rigid foam insulation. 

How to Air Seal and Insulate a Cantilevered Floor

1. Create an air barrier between the house and the cantilever by cutting a rectangle of rigid foam to fit into each floor joist bay cavity (Figure 3). Make a backstop for the foam by tacking furring strips to the joists at the plane with the foundation or house wall.
2. Insert rigid foam pieces into each joist bay, nail in place and caulk to air seal all four edges (Figure 4).



Figure 3. Rigid foam and caulk are used to seal each joist bay cavity beneath a cantilevered floor. 

3. Caulk the subfloor to the floor joists at the perimeter of the cantilevered floor and at any seams in the subfloor (Figure 4). Seal any wiring or piping holes through perimeter joists or subfloor with caulk or spray foam.

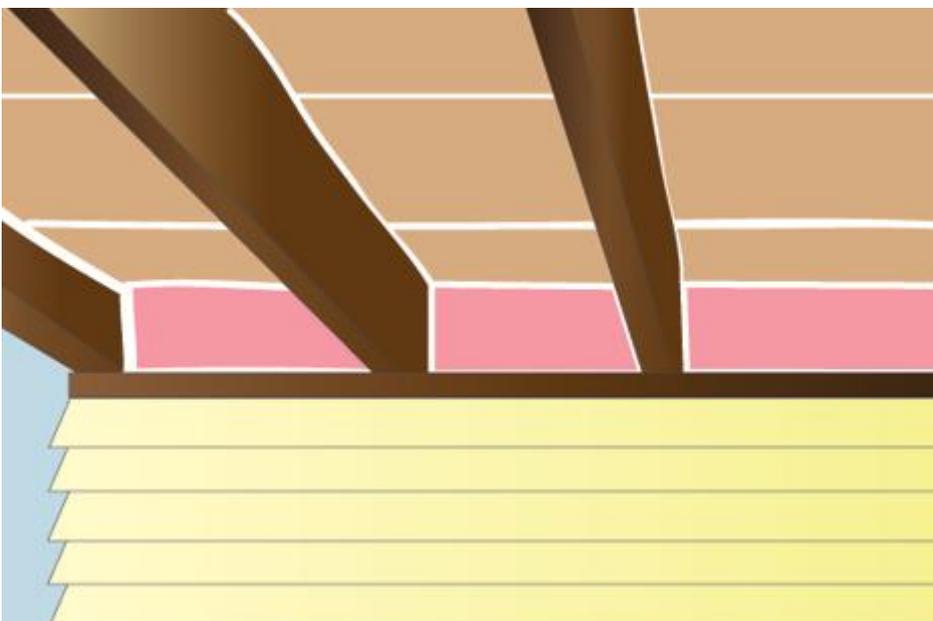


Figure 4. All seams are caulked to completely air seal the subfloor of the cantilever. 

4. Install unfaced batt insulation in each floor joist bay (Figure 5). Use a thickness that will completely fill the cavity; it must be in contact with the top and bottom air barrier (i.e., the subfloor above and rigid sheathing below) with no compressions or voids. Alternatively, insulate each cavity with open- or closed-cell spray foam that is aligned with the underside of the subfloor above. Install to a depth equivalent to the required exterior wall R-value. In cold climates, use closed-cell foam.



Figure 5. Fill the joist bays of the

cantilevered floor with fiberglass batt or spray foam. [i](#)

5. Cover the underside of the cantilever with rigid foam insulation (Figure 6). Use caulk and fasteners to attach rigid foam to joists and to air seal at the edges. Tape foam at seams.

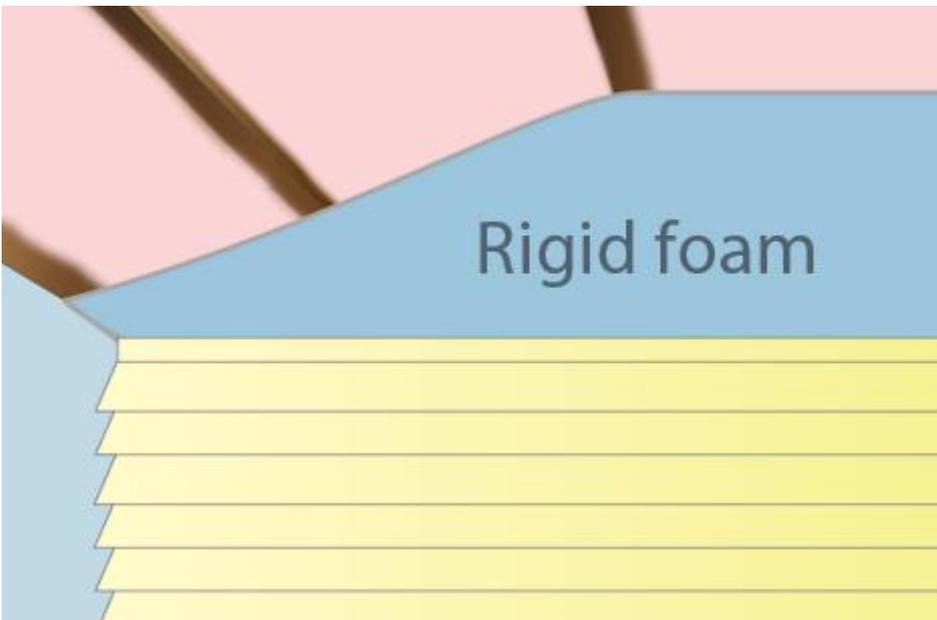


Figure 6. Cover the cantilever floor cavity insulation with rigid foam. [i](#)

6. Cover the rigid foam with siding or with 3/8-inch exterior plywood that is pressure-treated, painted, or primed on all exposed sides (Figure 7).

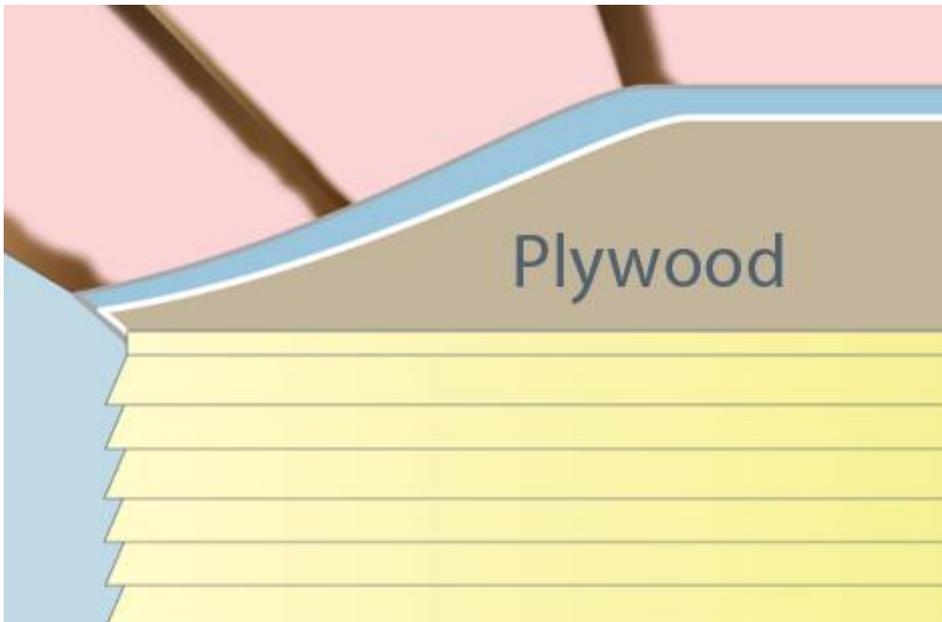


Figure 7. Cover the rigid foam on the underside of the cantilever with painted plywood. i

7. If you have plumbing pipes in the cantilevered floor (not recommended) and live in a cold climate, ensure adequate insulation on the exterior side of the pipes to protect them from freezing. One option is to box in the pipes with a rigid foam box that is caulked to the subfloor to allow warmth from the house to reach the pipes.

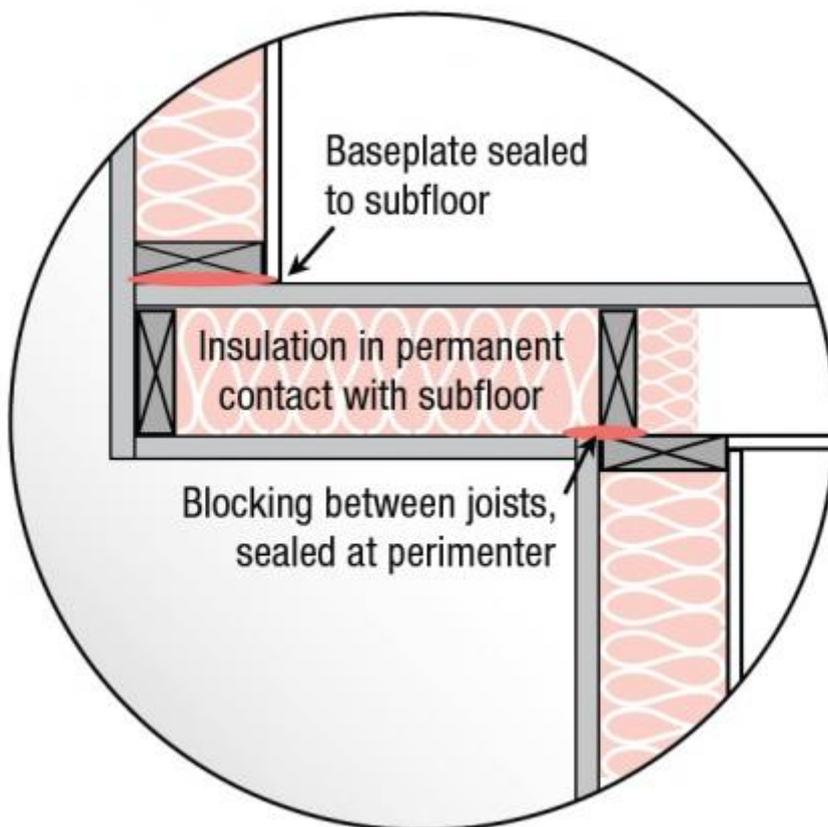


Figure 8. Cantilever floor construction detail showing where caulk should be installed in connection with framing and rigid air barriers to provide continuous air blocking. i

Ensuring Success

Air sealing of cantilever floor joist bays should be inspected by the site supervisor before the insulation and covering are installed. Blower door testing conducted as part of whole-house energy performance testing may indicate whether air leakage at cantilever floors has been successfully sealed. An infrared camera may also be used to detect air leakage.

Climate

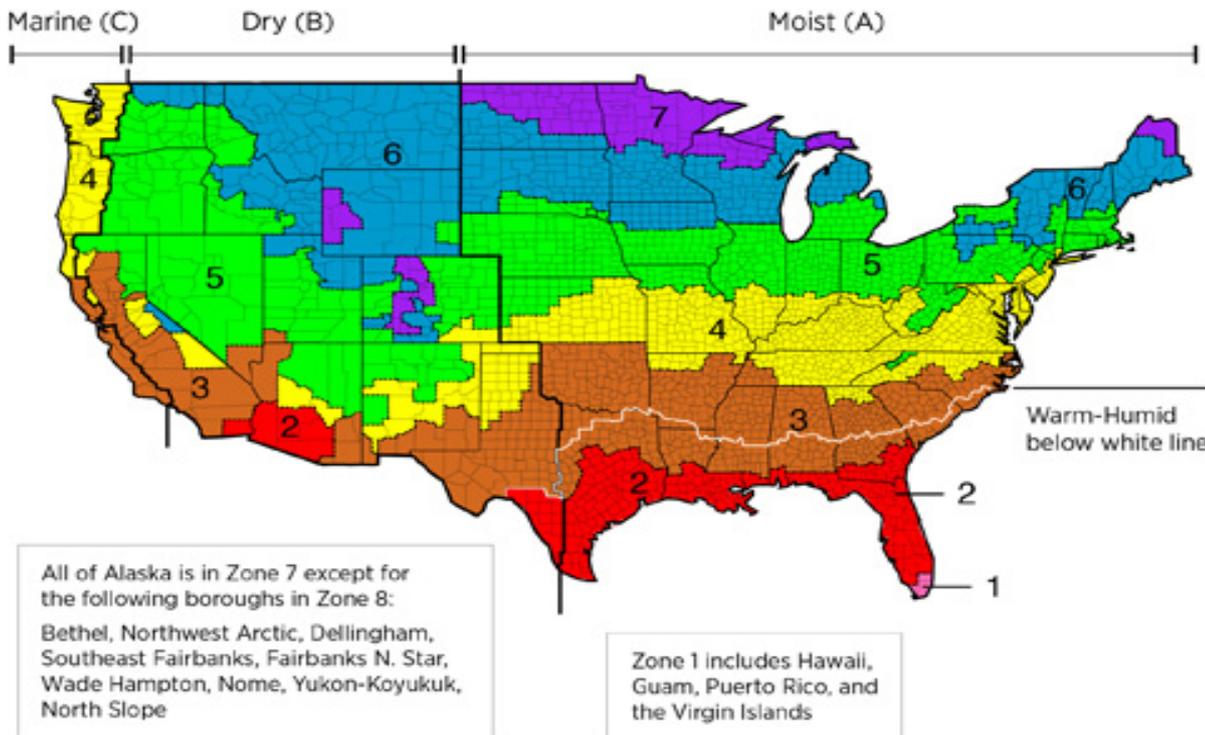
Install insulation in amounts that meet or exceed code-required levels for your climate zone. See for example Table R402.1.1 in the International Energy Conservation Code ([2009 IECC](#), [2012 IECC](#) or Table R402.1.2 in the [2015 IECC](#)).

[ENERGY STAR Certified Homes](#)

ENERGY STAR Certified Homes (Ver. 3/3.1 Ver 08) Rater Field Checklist, A complete air barrier that is fully aligned with insulation is installed at the exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at the interior horizontal surface.

[DOE Zero Energy Ready Home](#)

DOE Zero Energy Ready Home (Rev 05) Exhibit 2: Infiltration: Climate Zones 1-2: 3 ACH50; Zones 3-4: 2.5 ACH50; Zones 5-7: 2 ACH50; Zone 8: 1.5 ACH50. Building envelope leakage shall be determined by an approved verifier using a RESNET-approved testing protocol.



International Energy Conservation Code (IECC) Climate Regions

Training

Right and Wrong Images



Display Image: [ES_TESRC_3.2.2_PG76_115b_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_3.2.2_PG76_115b_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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Author(s): EPA

Organization(s): EPA

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

Author(s): EPA

Organization(s): EPA

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Display Image: [ES_TESRC_3.2.2_PG76_122i_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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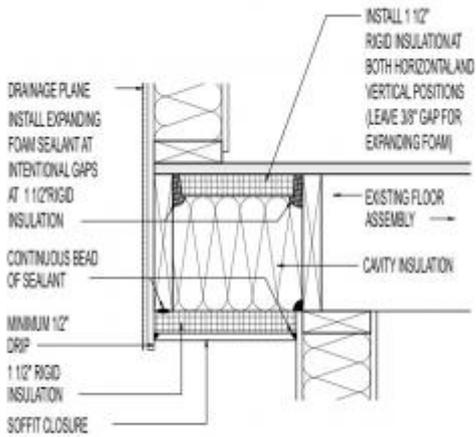
Reference: [Thermal Enclosure System Rater Checklist Guidebook](#)

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.

CAD



CAD FILE: [322_CAD_3-2_cantilever_floor_1_5_in_rigid_foam_5-01020_GBA_1-31-12.dwg](#)

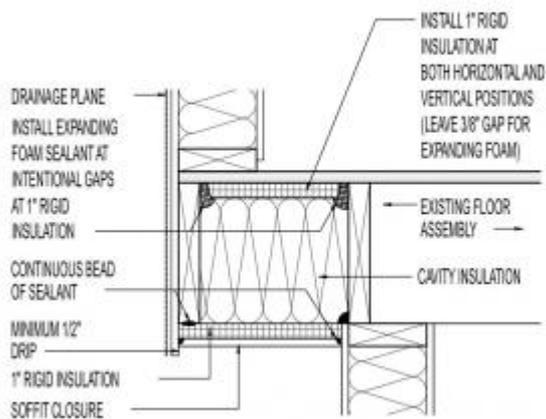
PDF: [322_CAD_3-2_cantilever_floor_1_5_in_rigid_foam_5-01020_GBA_1-31-12.pdf](#)

Reference: [Building Plans for Advanced Framing](#)

Author(s): Green Building Advisor

Organization(s): Green Building Advisor

Website providing CAD files and drawings of advanced framing details.



CAD FILE: [322_CAD_3-2_cantilever_floor_1_in_rigid_foam_5-01019_GBA_1-31-12.dwg](#)

PDF: [322_CAD_3-2_cantilever_floor_1_in_rigid_foam_5-01019_GBA_1-31-12.pdf](#)

Reference: [Building Plans for Advanced Framing](#)

Author(s): Green Building Advisor

Organization(s): Green Building Advisor

Website providing CAD files and drawings of advanced framing details.

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

2. Fully-Aligned Air Barriers.⁵ At each insulated location below, a complete air barrier is provided that is fully aligned as follows:

Floors: At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surface including supports to ensure alignment. See Footnotes 9, 10, 11

2.6 Floors above garages, floors above unconditioned basements or crawlspaces, and cantilevered floors

Footnotes:

(5) For purposes of this Checklist, an air barrier is defined as any durable solid material that blocks air flow between conditioned space and unconditioned space, including necessary sealing to block excessive air flow at edges and seams and adequate support to resist positive and negative pressures without displacement or damage. EPA recommends, but does not require, rigid air barriers. Open-cell or closed-cell foam shall have a finished thickness \geq 5.5 in. or 1.5 in., respectively, to qualify as an air barrier unless the manufacturer indicates otherwise. If flexible air barriers such as house wrap are used, they shall be fully sealed at all seams and edges and supported using fasteners with caps or heads \geq 1 in. diameter unless otherwise indicated by the manufacturer. Flexible air barriers shall not be made of kraft paper, paper-based products, or other materials that are easily torn. If polyethylene is used, its thickness shall be \geq 6 mil.

(9) EPA highly recommends, but does not require, an air barrier at the interior vertical surface of floor insulation in Climate Zones 4-8.

(10) Examples of supports necessary for permanent contact include staves for batt insulation or netting for blown-in insulation. Alternatively, supports are not required if batts 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 the required installation grade is the compression caused by the excess insulation.

(11) Alternatively, an air barrier is permitted to be installed at the exterior horizontal surface of the floor insulation if the insulation is installed in contact with this air barrier, the exterior vertical surfaces of the floor cavity are also insulated, and air barriers are included at the exterior vertical surfaces of this insulation.

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

[DOE Zero Energy Ready Home](#)

DOE Zero Energy Ready Home (Rev 05) Exhibit 2: DOE Zero Energy Ready Home Target Home. Certified under ENERGY STAR Qualified Homes Version 3. Insulation levels shall meet or exceed the 2012 IECC (Table R402.1.1) and achieve Grade 1 installation, per RESNET standards. Infiltration (ACH50): Zones 1-2: 3; Zones 3-4: 2.5; Zones 5-7: 2; Zone 8: 1.5. Envelope leakage shall be determined by an approved verifier using a RESNET-approved testing protocol. Steel-frame ceilings, walls, and floors shall meet the insulation requirements of the 2012 IECC – Table 402.2.6.

[ABAA 07261](#)

Self-Adhered Sheet Air Barrier. 2006. Air Barrier Association of America, Walpole, MA. This specification for self-adhered sheet air barriers is developed by a professional association, the Air Barrier Association of America, to provide guidance to the design professional.

[ABAA 07262](#)

Fluid-Applied Air and Vapor Barrier. 2012. Air Barrier Association of America, Walpole, MA. This specification for air barriers that are fluid-applied and also act as vapor barriers is developed by a professional association, the Air Barrier Association of America, to provide guidance to the design professional.

[ABAA 07263](#)

Closed Cell, Medium-Density Spray Polyurethane Foam Air Barrier. 2011. Air Barrier Association of America, Walpole, MA. This specification for closed cell, medium-density spray polyurethane foam air barriers is developed by a professional association, the Air Barrier Association of America, to provide guidance to the design professional.

[ABAA 07265](#)

Fluid-Applied Vapor Permeable Air Barrier. 2012. Air Barrier Association of America, Walpole, MA. This specification for fluid-applied vapor permeable air barriers is developed by a professional association, the Air Barrier Association of America, to provide guidance to the design professional.

2009, 2012, and 2015 IECC

Table R402.4.1.1 Air Barrier and Insulation Installation, Floors: Insulation in floors (including above garage and cantilevered floors) is installed to maintain permanent contact with underside of subfloor decking. A continuous air barrier is installed in the building envelope including rim joists and exposed edges of insulation. Breaks or joints in the air barrier are sealed. Air permeable insulation is not used as a sealing material. Junction of foundation and wall sill plates, wall top plate and top of wall, sill plate and rim-band, and rim band and subfloor are sealed. Corners, headers, and rim joists making up the thermal envelope are insulated.*

Table R402.1.1 (Table R402.1.2 in 2015 IECC) Insulation and Fenestration Requirements – meet or exceed the insulation levels listed in this table.

2009, 2012, and 2015 IRC

Table N1102.4.2 Air Barrier and Insulation Installation, Floors: Insulation in floors (including above garage and cantilevered floors) is installed to maintain permanent contact with underside of subfloor decking. A continuous air barrier is installed in the building envelope including rim joists and exposed edges of insulation. Breaks or joints in the air barrier are sealed. Air permeable insulation is not used as a sealing material. Junction of foundation and wall sill plates, wall top plate and top of wall, sill plate and rim-band, and rim band and subfloor are sealed. Corners, headers, and rim joists making up the thermal envelope are insulated.*

Table R402.1.1 (Table R402.1.2 in 2015 IECC) Insulation and Fenestration Requirements – meet or exceed the insulation levels listed in this table.

*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: 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 12: 40% Whole-House Energy Savings in the Cold and Very Cold Climates](#)
Author(s): Baechler, Gilbride, Hefty, Cole, Love
Organization(s): PNNL, ORNL
Publication Date: February, 2011
Guide describing measures that builders in the cold and very cold climates can take to build homes that have whole-house energy savings of 40% over the Building America benchmark with no added overall costs for consumers.
2. [Cantilevers, Technical Bulletin F2](#)
Author(s): Advanced Energy
Organization(s): Advanced Energy
Publication Date: March, 2002
Information sheet containing images and descriptions of cantilevers.
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. [How to Insulate Inside the Basement](#)
Author(s): Natural Resources Canada
Organization(s): Natural Resources Canada
Publication Date: October, 2013
Information sheet providing links and resources for insulating basements in cold climates.
6. [Strategy Guideline: Quality Management in Existing Homes](#)
Author(s): Taggart, Sikora, Wiehagen, Wood
Organization(s): NAHB Research Center, NREL
Publication Date: December, 2011
Research study providing a comparison of selected retrofit activity typically done, versus that same retrofit activity approached from an integrated high performance remodeling and quality management perspective.
- 7.

[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.

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