# Insulated Siding as Home Insulation

## *Guide for Users and Energy Raters*

VINYL SIDING INSTITUTE
VSI

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# Foreword

Vinyl siding was first introduced to the exterior cladding market in the early 1960s. The product grew in popularity over the next four decades because of its durability, versatility, value and ease of maintenance. Vinyl siding is manufactured primarily with polyvinyl chloride (PVC), a material that gives it impact resistance, rigidity and strength.

Since 1995, vinyl siding has been the number one choice of exterior cladding across the United States and Canada. U.S. Census Bureau statistics show that for the past 20 years, more homeowners have sided their homes with vinyl than any other cladding.[1] Vinyl siding is available in a broad palette of colors, profiles and architectural trim to assist builders, remodelers, architects, designers and homeowners in designing new construction and renovation projects. Insulated siding provides the extra benefit of home insulation with accompanying energy savings.

Introduced in the late 1990s, insulated siding has experienced substantial growth due to an increased focus on energy efficiency in residential construction. In recent years, organizations have worked to develop product standards, validate product testing and ensure insulated siding is recognized in national programs such as:

- ENERGY STAR® Qualified Homes Version 3
- The U.S. Department of Energy's *Standard Work Specifications for Single-Family Home Energy Upgrades*
- Both the *2012* and *2015 International Energy Conservation Code*

As this product category continues to grow, it is important to understand how insulated siding helps to increase energy efficiency, as well as the proper installation techniques necessary to achieve optimum performance. Additionally, now that various national building energy performance programs clearly recognize insulated siding as an energy-efficient exterior cladding, specifiers and energy specialists need guidance on how insulated siding can be applied to meet the energy efficiency requirements of these programs.

The Vinyl Siding Institute (VSI) developed this *Insulated Siding as Home Insulation Guide* as a resource for:

- Builders and remodelers
- Architects and designers
- Specifiers
- Energy specialists, including
  - Home Energy Rating System (HERS) raters and other energy raters
  - Building Performance Institute (BPI) certified professionals
- Community planners and others interested in improving energy efficiency in construction

VSI designed this guide as the go-to resource on insulated siding. It explains how insulated siding products are tested to establish R-value and describes the correct installation techniques to ensure their home insulation properties. It also explains how insulated siding complies with various energy-related requirements and voluntary programs, including the *International Energy Conservation Code* and ENERGY STAR. The guide also shows how insulated siding can be used to help achieve compliance in specific climate zones and with certain types of building assemblies. Finally, the document addresses product performance related to moisture and other factors.

[1] U.S. Census Bureau, *Principal Types of Exterior Wall Material of New Single-Family Homes Completed,* 2012; http://www.census.gov/construction/chars/pdf/exwallmat.pdf.

# User's Guide to Insulated Siding as Home Insulation

*The following section is meant to educate insulated siding users and specifiers about the benefits of insulated siding as home insulation, how it helps to increase energy efficiency, how it is tested to establish its R-value, and how insulated siding complies with energy-related requirements and voluntary programs.*

*This section also includes information on the proper installation techniques for insulated siding, to ensure it functions as home insulation.*

# Chapter 1: Vinyl Siding Institute

The Vinyl Siding Institute, Inc. (VSI) is located in Washington, DC, and represents manufacturers of vinyl siding, insulated siding and other polymeric siding and suppliers to the industry. Among the objectives of VSI are to further the development and growth of the vinyl and polymeric siding industry by: helping to develop material, product and performance standards in cooperation with standards-setting organizations and code bodies; engaging in product stewardship and outreach activities to enhance the image of the industry and its products; and serving as an information resource to planners, builders, remodelers, elected officials, architects, designers, building code officials, distributors, homeowners and other exterior cladding decision-makers.

## VSI Certification Programs

Vinyl siding, including insulated vinyl siding, is the only exterior cladding with: 1) a product certification program administered by an independent, accredited quality control agency that ensures products and colors meet or exceed ASTM standards; and 2) a certified installer program with validation by an independent, third-party administrator to ensure that installers demonstrate knowledge of ASTM-accepted application techniques.

VSI sponsors two certification programs—the *VSI Product Certification Program* and the *VSI Certified Installer Program*. The *VSI Product Certification Program* allows manufacturers to certify, with independent third-party verification, that their insulated siding meets or exceeds the *ASTM D7793 Standard Specification for Insulated Vinyl Siding* and ASTM standards for color retention. The *VSI Certified Installer Program*, administered by an independent, third-party administrator, is based on the *ASTM D4756 Standard Practice for Installation of Rigid Poly(VinylChloride) (PVC) Siding and Soffit* and offers three different levels of certification: Certified Installers, Certified Trainers and Certified Installer Companies.

The *2015 International Residential Code (IRC)* requires that insulated vinyl siding be certified to ASTM D7793 by an approved quality control agency. Customers can look for the VSI certification Program Label or Program Logo when specifying insulated siding or visit www.vinylsiding.org to verify whether a particular insulated siding product is certified. At this time, the *VSI Certified Installer Program* does not certify installers with regard to their knowledge on insulated siding installation techniques, but because many of the important installation concepts apply to vinyl siding in general, it is a good idea to ask if the applying installer has been certified through VSI's *Program*.

# Chapter 2: Insulated Siding: An Introduction

Insulated vinyl siding, which is a form of and is commonly referred to as insulated siding,  is vinyl siding that is engineered to incorporate a substantial thickness of insulation. More specifically, insulated vinyl siding is a vinyl cladding with manufacturer-installed rigid foam plastic insulation that is laminated or otherwise permanently attached to the cladding product.

The most commonly used insulation is expanded polystyrene (EPS), a material manufactured to the specifications of *ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*. Manufacturers employ profile-cutting and shape-molding techniques to ensure proper fit of the insulation to each siding profile. Lamination tooling is specific to each siding design, which allows for correct alignment and consistent bond strength. Adhesives used in insulated siding are permanently flexible, allowing for the normal expansion and contraction that occurs in vinyl siding.

The first field tests on insulated siding occurred in the early 1990s in the southern United States. In the years following, the product was developed through improvements in both the design and manufacturing processes. These improvements increased functionality and durability and set the path for insulated siding to enter the marketplace. Insulated siding and siding used with drop-in backers are different products. This guide has been developed specifically for insulated siding. For information on the energy performance and R-values of drop-in backers, contact the product manufacturer. Although vinyl siding with drop-in backers can be used to give dimensional support and improve thermal performance just as insulated siding can, the insulation used for insulated siding is integral to that specific panel. Insulated siding is a building product designed to reach higher levels of rigidity, dimensional stability and thermal performance through specific R-value testing.

The first commercial insulated siding was introduced in 1997. Over the past decade, product developments have allowed insulated siding to experience consistent growth and recognition as a premium residential cladding.

Government agencies acknowledge the ability of rigid or board insulation to improve the energy efficiency of homes.[2,3,4] Research shows that construction techniques and/or material applications of rigid or board insulation, including insulated siding, reduce the "thermal bridging" effect, or energy transfer through framing members and/or other conductive building materials. The ENERGY STAR program, cosponsored by the U.S. Environmental Protection Agency (EPA), includes insulated siding as an option to comply with thermal bridging reduction requirements to earn the ENERGY STAR label for new homes. All applications of materials to reduce thermal bridging must meet the climate-specific R-value and installation requirements for the program.

Any company involved in the marketing of home insulation must follow regulations set by the Federal Trade Commission (FTC) (16 C.F.R. 460; see Appendix C). Insulation refers to any material whose main purpose is to slow down the flow of heat. The ability of a material to resist the flow of heat is expressed as an R-value. A product's "R-value" is a measure of thermal resistance; the higher the R-value, the better the insulation's effectiveness. The claimed or labeled R-value for any product must be based on tests conducted with a standard specified in FTC regulations. For insulated siding, *ASTM C1363 Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus* is the current version of the appropriate specified standard for determining the R-value of insulated siding.

2 ENERGY STAR Qualified Homes, Version 3 Inspection Checklist for National Program Requirements.

3 U.S. Department of Energy (DOE), *Strategies for Energy-Efficient Remodeling Report*, October 31, 2004.

4 DOE, *Standard Work Specifications for Single-Family Home Energy Upgrades*, 2013: https://sws.nrel.gov/sites/sws/files/sws_singlefamily_0.pdf.

# Chapter 3: Technical Information

Because the energy performance of insulated siding is key to its qualification as home insulation, there are a number of regulations, standards and tests that determine how insulated siding is manufactured, tested and marketed. This section describes those regulations, standards and tests. More detailed information on energy and other performance characteristics and regulations for marketing insulated siding can be found later in this guide.

## R-value Testing

**Note: Full text of FTC Regulation Part 460—*Labeling and Advertising of Home Insulation*—can be found in Appendix C.**

FTC regulations govern home insulation marketing claims, including claims regarding the thermal insulation value provided by the product or material.[5] The FTC regulations also specify the means by which the R-value of home insulation is determined. The claimed or rated R-value must be based on actual testing conducted in accordance with one of the test methods specified in the regulations. For products such as insulated siding, the appropriate standard is *ASTM C1363 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus*. This testing method for R-value is referenced in ASTM D7793.

In this test, the assembly, including the insulating material, is placed between two instrumented chambers: a "climatic chamber" and a "metering chamber." The chambers are maintained at a specific temperature difference. The climatic chamber is usually cooler than the metering chamber, representing the temperature difference between the inside and outside of a building in winter. Wind is directed at the material in the climatic chamber to simulate outdoor winter conditions.

During the test, heat flows through the insulating material from the metering chamber to the climatic chamber, and the amount of energy needed to maintain the temperature in the metering chamber is measured. Calculations are done to convert this measured heat flow to the R-value of the assembly. The R-value of any mounting structure or other material that is not part of the insulation product is subtracted, leaving the net R-value of the insulation itself.

ASTM D7793 specifies sample configuration and installation details used in the ASTM C1363 tests to produce an accurate and consistent R-value for insulated siding. The siding is installed over an 8-foot by 8-foot base wall in the same manner specified by the manufacturer for actual field installation. The installation includes overlap joints between sections of siding and other accessories to replicate normal installation. No artificial sealing of the assembly is allowed, unless specified by the manufacturer for a normal installation. During the test, wind is directed against the surface of the siding, perpendicular to the plane of the wall.

The test is conducted according to the normal procedures specified in ASTM C1363. The base wall is tested by itself (without siding attached), and then with the siding installed. The R-value of the insulated siding is determined by subtracting the measured R-value of the base wall from that of the entire assembly. This procedure ensures that the R-value claimed for an insulated siding product represents the actual thermal insulation value that will be delivered to the home. ASTM D7793 requires insulated siding to demonstrate a minimum R-value of 2.0.

[5] See 16 C.F.R. Part 460: http://www.access.gpo.gov/nara/cfr/waisidx_10/16cfr460_10.html.


This minimum R-value and testing requirement is also required by the *2015 International Energy Conservation Code (IECC)*[6] in order for the product to qualify as insulated siding. Additionally, this minimum R-value is consistent with the minimum R-value required for insulated sheathing in the *IECC*. The R-value determined for insulated siding through testing under *ASTM D7793* can be used to meet the insulation requirements of the *IECC*. The R-value for insulated siding must be published in the manufacturer's specifications and on the outside of the product package.[7] Chapter 6 of this guide provides detailed information on how tested R-values can be used to calculate a wall assembly's U-factor.

## Application of Standards

Building codes generally require that products meet certain standards appropriate for the product category. Insulated vinyl siding meets the requirements of the *2015 IRC*[8] through third-party certification based on ASTM D7793. Because of the credible thermal resistance value produced by testing specified in ASTM D7793, insulated siding can be used as an option for meeting the R-value[9] and/or U-factor[10] requirements of the *2012* and *2015 IECC*. Furthermore, the testing of insulated siding is consistent with the intent of the FTC regulations for home insulation, referenced in the *IECC*, when properly tested and labeled.

The *ASTM D7793 Standard Specification for Insulated Vinyl Siding* includes requirements for both the vinyl siding component and the foam plastic component, as well as performance requirements for the product as a whole. The requirements for the vinyl siding component are based on those in ASTM D3679, ensuring that the siding component meets the same stringent requirements as vinyl siding without integral insulation. The foam plastic requirements are based on existing requirements for foam plastics in other ASTM standards, as well as any additional code requirements.

## Moisture Performance, Air Movement and R-value

Insulated siding is designed to be a form of continuous insulation and an exterior cladding, not a water-resistive barrier. It is a superior cladding option for moisture management while also providing significant improvement to the energy performance of the wall assembly.

Insulated siding is designed to allow the material underneath it to breathe; therefore, it is not a watertight covering. Because of its design and application, it provides a supplemental rain screen that enhances the water-resistive barrier system by reducing the amount of water that reaches the underlying water-resistive barrier. The ability of insulated siding to allow moisture to both drain and evaporate has been demonstrated in controlled laboratory testing, as well as through field observations.

During the R-value test specified in ASTM D7793, no artificial sealing of the assembly is allowed, unless specified by the manufacturer for a normal installation, so real world conditions are replicated. Wind is directed against the surface of the siding, perpendicular to the plane of the wall, during the R-value test. There have been questions raised regarding the performance of insulated siding relative to wind-washing, or the diminish-

6 International Code Council, *2015 International Energy Conservation Code*, Section R202, R303.1.4.1 (N1101.12.4.1).

7 International Code Council, *2015 International Energy Conservation Code*, Section R303.1.1 (N1101.12.1).

8 International Code Council, *International Residential Code*, 2015, Section R703.13.

9 International Code Council, *2012 International Energy Conservation Code*, Section 402.1.1, footnote h.

10 International Code Council, *2009 International Energy Conservation Code*, Section 402.

ment of R-value due to the movement of surrounding air. During the early stages of product evaluation, assemblies were to be in unsealed test configurations and include application of wind. These initial results showed a modest reduction in R-value. As a result, the tested and published R-values are required to be in unsealed test configurations, including the application of wind.

The Home Innovation Research Labs (formerly NAHB Research Center) conducted a 22-month field investigation of nine different North- and South-oriented wood framed wall assemblies to determine the moisture performance of various wall construction types, most of which incorporated absorptive cladding.[11] The study was conducted 20 miles east of Washington, DC, in a mixed-humid climate. Moisture content of the sheathing and wall cavity temperatures were measured at various points in each wall section. The primary performance measure was moisture content of the wood-based structural sheathing. Walls with insulated siding had among the lowest sheathing moisture contents recorded in the study; this was the case for walls that faced either north or south. See Appendix A for more information on this subject.

[11] NAHB Research Center, *Effect of Cladding Systems on Moisture Performance of Wood Frame Walls in a Mixed-Humid Climate*, Thermal Performance of the Exterior Envelopes of Whole Buildings XI International Conference, December 2010.

# Chapter 4: Energy Code and Building Energy Performance Program Recognition

Because insulated siding provides insulating value that can lead to reduced energy use, building and energy efficiency programs have recognized insulated siding as home insulation.

## Energy Code

The *IECC* serves as the major regulatory tool for energy-efficient residential construction. Insulated siding is listed in the *2012* and *2015 IECC* among the building materials that can be used as continuous insulation outside of the building framing to provide the required total wall R-value for buildings in the coldest climate zones. Generally speaking, builders and remodeling contractors are able to use insulated siding to meet the R-value/U-factor requirements of the *IECC*. The following sections of the *IECC* apply when insulated siding is used as an option for compliance:

- Chapter 2 of the *2015 IECC* defines insulated siding as a form of continuous insulation, as long as it exhibits an R-value of 2.0.[12]
- Section R402.1.2 (N1102.1.2) of the *2015 IECC* allows for the R-value of insulated siding to be used as part of the prescriptive R-value computation approach (see Appendix B for more information on the application of R-value in this section of the *2015 IECC)*.[13]
- Under the *2012* and *2015 IECC*, the R-value of insulated siding may be used to satisfy the R-value insulation requirements of Table 402.1.1 when insulated siding is used as continuous insulation.[14]
- Per Section 402 of the *2009, 2012* and *2015 IECC*, Building Thermal Envelope, the rated R-value of insulated siding can be used to calculate a whole wall U-factor when insulated siding is applied.[15]
- Because insulated siding is recognized under the *2012* and *2015 IECC* as continuous insulation, local building officials may also permit the R-value of insulated siding to satisfy the R-value insulation requirements of Table 402.1.1 of the *2009* and *2015 IECC*.

## ENERGY STAR Qualified Homes Version 3

In order to earn the ENERGY STAR label, a new home must meet EPA's guidelines for energy efficiency. According to the program's website, "ENERGY STAR Qualified Homes can include a variety of 'tried-and-true' energy-efficient features that contribute to improved home quality and homeowner comfort, and to lower energy demand and reduce air pollution."[16]

Due to its ability to reduce thermal bridging, insulated siding has been added to the checklist of building products or methodologies that can help qualify homes under ENERGY STAR Qualified Homes Version 3. Builders who want to earn the ENERGY STAR label for homes can use insulated siding to comply with the thermal bridging requirements for above-grade walls in Item 4.4.1 of the Thermal Enclosure System Rater Checklist.

12 International Code Council, *2015 International Energy Conservation Code,* Section R202.

13 International Code Council, *2015 International Energy Conservation Code,* Section R402.1.2 (N1102.1.2).

14 International Code Council, *2012 International Energy Conservation Code* Table R402.1.1, footnote h, and *2015 International Energy Conservation Code.*

15 International Code Council, *2009 International Energy Conservation Code*, Section 402, and *2015 International Energy Conservation Code.*

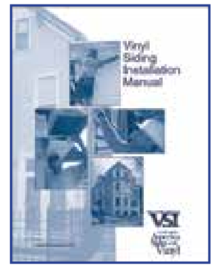
16 *Features and Benefits of ENERGY STAR Qualified New Homes,* http://www.energystar.gov/index.cfm?c=new_homes.nh_features.

Climate zones are geographic regions that exhibit similar weather conditions during the course of a typical year. The U.S. Department of Energy (DOE) has identified eight major climate zones for the United States, with Zone 1 being the warmest (e.g., Miami and Hawaii) and Zone 8 being the coldest (e.g., Alaska). Zones 1 through 3 tend to be in the deep South and Southwestern United States, and Zones 4 through 7 cover the northern half of the continental United States, including the more mountainous regions. These climate zones are further classified as being humid, dry or marine. A map of the climate zones can be found in Chapters 6 and 7.

In order for insulated siding to meet the intent of Item 4.4.1 of the ENERGY STAR Qualified Homes Program, it must exhibit a minimum R-value of 3.0 (Climate Zones 1 through 4) or a minimum R-value of 5.0 (Climate Zones 5 through 8) by itself, or be used in combination with insulated sheathing. Additionally, ENERGY STAR notes in its Thermal Enclosure System Rater Checklist footnotes that the product shall provide the required R-value as demonstrated through either testing in accordance with ASTM C1363 or by attaining the required R-value at the minimum thickness of the insulation.[17] VSI believes that ASTM C1363 testing produces an R-value more representative of what will be achieved in the field and discourages the use of the calculated method, which may produce unrealistic R-values.

[17] ENERGY STAR Qualified Homes Checklists, http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Inspection_Checklists.pdf?add3-df48, pages 3, 6.

# Chapter 5: Installation



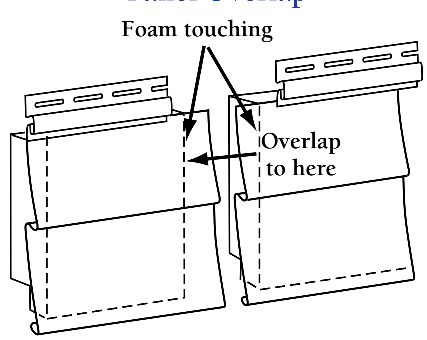

Many of insulated siding's attributes and installation techniques are the same as those of vinyl siding. The information contained in this section should be used as a supplement to information available in installation instructions included with insulated siding manufacturers' materials and in the VSI *Vinyl Siding Installation Manual*,[18] which was developed using the *ASTM D4756 Standard Practice for Installation of Rigid Poly(Vinyl Chloride) (PVC) Siding and Soffit*. The *2015 IRC* provides prescriptive requirements for installing insulated vinyl siding.

## General Installation Instructions

Installing insulated siding requires many of the same techniques as vinyl siding. Before getting started, it is important to review several rules of thumb for insulated siding installation. For more specific details and illustrations of proper vinyl siding installation, including vertical panels, please consult the VSI *Vinyl Siding Installation Manual* at www.vinylsiding.org/installation/manual. While the insulated siding manufacturer's installation instructions should always be consulted, the following rules are critical for proper installation:

- The installation of specific products may differ in detail from the instructions provided in this guide. Always follow the manufacturer's instructions, using accessories specified by the manufacturer, to ensure proper installation.
- When cutting insulated siding, use a circular saw with a fine-tooth (plywood) blade inserted backwards and cut slowly. Do not attempt to cut materials other than vinyl siding or insulated siding with a reversed direction saw blade.
- Do not drive the head of the fastener tightly against the siding nail hem; allow approximately 1/32" clearance (the thickness of a dime) between the fastener head and the vinyl siding.
- When installing a panel, it is critical that the lock is fully engaged with the piece below it. Without stretching the panel, reach up and fasten it into place.
- No gap is needed between the foam at the ends of insulated siding panels; be sure to butt each piece of foam together when installing panels, unless installing in cold weather (see Figure 5.1 and consult the product manufacturer's instructions).
- Fasten nails or other fasteners in the center of the nailing slot; make sure the fastener penetrates through a minimum of 3/4" into framing, furring or another approved nailable substrate (see "Remodeling Considerations," page 9). Use the same type of fasteners as used for vinyl siding installation, but longer lengths may be needed. Consult manufacturer's instructions for fastener specifications.

**Figure 5.1 Insulated Siding Panel Overlap**




### *Panel Installation*

Insulated siding installers should always consult the manufacturer's instructions, but the following general panel installation instructions apply:

- Because of the foam material integral to the panel, insulated siding is thicker than vinyl siding alone. Be sure to purchase accessories that will accommodate the full thickness of the insulated siding. Consult the manufacturer's instructions for specific accessories (e.g., J-channel, corner posts) or techniques that work best with a given product.

[18] See http://www.vinylsiding.org/installation/manual.

- Use the starter strip specified by the insulated siding manufacturer to ensure proper performance.
- A water-resistive barrier should be installed under all insulated siding. Insulated siding is not a water-tight covering; therefore, it allows the material underneath it to breathe. It functions as an initial barrier to rain and significantly reduces the amount of water that reaches the underlying water-resistive barrier.
- On the factory-cut ends of insulated siding panels, the foam is set back from both ends of the panel. This set-back is required to ensure correct overlapping of adjacent panels. To correctly overlap the panels, insert the vinyl tab at the end of one panel in between the foam and the vinyl of the adjacent panel. Slide the panels together until the ends of the foam touch. It is recommended to have a gap of 1/8" during installation under cold weather conditions (i.e., 40° Fahrenheit or 4.4° Celsius). For best appearance, lap factory ends only. If you must lap a non-factory end, create the required foam set-back and siding panel notches following the siding manufacturer's instructions.
- When determining the length of the final panel of a course, measure from the edge of the foam on the installed panel to the corner, allowing 1/4" for expansion. Apply this measurement to the final panel, measuring the foam instead of the panel. This will ensure foam-to-foam contact, with the necessary amount of room for expansion of the siding.
- Using a circular saw with the fine-toothed plywood blade turned backwards, cut slowly with the vinyl face up. Be sure to cut all the way through the foam.
- Avoid using panels shorter than 24".

## *Around Windows and Doors*

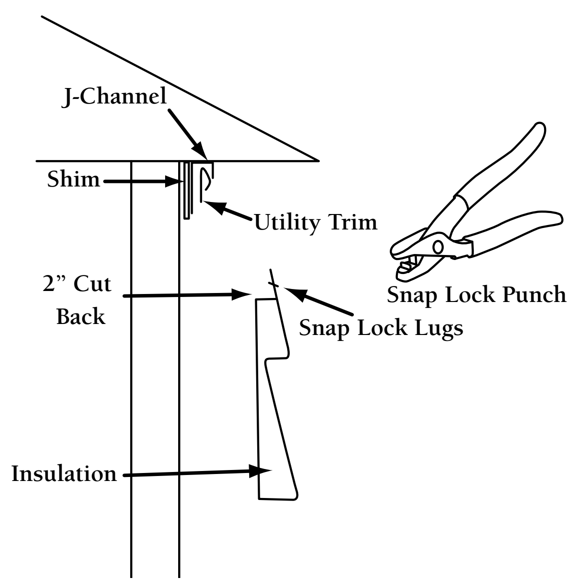
Because insulated siding is thicker than vinyl siding, windows, doors and openings may have to be built out. Installers should use wood shims and either aluminum trim coil or vinyl lineals to build out openings.

## *Final Course*

To complete the final course of insulated siding at the top of a wall, installers should:

- Take the height measurement of the remaining open section in several locations and subtract 1/4" from each location to allow for movement.
- Cut the panel to the required measurement and cut back the foam 2".
- Using a snap lock punch, punch the vinyl siding along the cut edge every 6", so the raised lug is on the outside face.
- Install utility trim along the top of the wall to receive the top edge of the siding. Use shims under the utility trim to match the angle or distance from the wall of the siding edge.
- Push the siding into the utility trim. The raised lugs will catch and hold the siding firmly in place.

**Figure 5.2 Completing the Final Course of Insulated Siding**



## Remodeling Considerations

Before installing insulated siding, inspect walls for evidence of moisture damage. If the condition of the existing siding, sheathing or interior wall finish indicates an existing moisture problem, no insulated siding should be installed until the moisture problem has been identified and corrected. Seal gaps in external window trim and other areas that may admit rain water into the wall. Level the exterior wall by removing existing siding or sheathing or add surface leveling foam such as fan-fold over a water-resistive barrier.

In order for insulated siding to qualify as home insulation, it must be installed directly over a water-resistive barrier and sheathing. When insulated siding is installed over furring strips, the space between the furring strips must be filled in with rigid insulation or another appropriate building material. Insulated siding installed over furring strips alone would not be considered home insulation.

# Energy Rater's Guide to Insulated Siding as Home Insulation

*The following sections were developed in consultation with Newport Ventures as a resource for energy raters interested in the details of insulated siding's thermal performance and application within building energy performance programs. Chapter 6 describes the thermal performance for insulated siding. Chapter 7 details the role of insulated siding in building energy performance programs for both new and existing homes.*

*Newport Ventures of Schenectady, New York, performs technical, regulatory and market research and analysis related to the built environment, with a specific focus on the energy performance of buildings and building systems. Newport Ventures and its sister firm, Newport Partners, support several federal and state agencies, as well as private companies and trade associations, with their efforts to improve the energy efficiency and indoor air quality of buildings.*

> *Note: As previously mentioned in this guide, the* 2015 IECC *provides significant recognition of insulated siding as a form of continuous insulation, including a definition, prescriptive path compliance information, and testing and labeling information. However, because the* 2015 IECC *will not be adopted by states for several years, information on complying with that code has not been provided in this section at this time.*

# Chapter 6: Insulated Wall Assembly Thermal Performance

Energy efficiency has become more important, energy codes have become increasingly stringent, and awareness is growing about the effects of greenhouse gas emissions. As a result, builders and designers are looking for cost-effective ways to specify and build walls with higher thermal performance. Understanding the thermal performance of insulated siding is especially important for compliance with the *IECC*, which has been adopted widely by states and jurisdictions across the country.[19]

When properly installed, insulated siding can meet the definition of “continuous insulation” in *ASHRAE 90.1*, which is referenced in the *IECC*.[20] When used as a component of a high performance wall, insulated siding can help builders and designers meet or exceed *IECC* requirements for continuous insulation and/or whole wall U-factors. The U-factor of a wall assembly takes into account the combined insulating effects of air films, interior gypsum, siding, structural sheathing, framing and insulation.

To help validate insulated siding’s performance in home retrofits, VSI commissioned Newport Ventures to conduct the *Insulated Siding Energy Performance Study*.[21] The study examined the energy performance of insulated siding in five home re-siding projects in four different climate zones of the country, including one project funded in part by DOE’s Building America program. As part of this retrofit study, which took place from fall 2010 through spring 2013, Newport Ventures examined air tightness, modeled the homes’ Home Energy Rating System (HERS) Index, and analyzed utility bills for two years prior and two years following the installation of insulated siding. Findings show:

- An average air tightness improvement of 11 percent across the five homes after the insulated siding was installed.
- Energy savings at all five sites, with an average savings of 5.5 percent, based on analysis of pre- and post-retrofit utility bill data.
- An improvement (reduction) of 2.0 to 8.0 points in the homes’ HERS Index through the installation of a water-resistive barrier and insulated siding, based on building energy simulation results.

## Meeting Energy Code Requirements

The *IECC* requires builders to demonstrate compliance by following either a prescriptive or a performance-based approach. The prescriptive approach sets specific requirements for the thermal characteristics of the wall, such as the R-values of continuous and cavity insulation, or the U-factor of the entire wall assembly. The performance-based approach provides more latitude in designing the building by requiring the entire building to achieve a minimum performance level, regardless of the thermal performance of any one component.

[19] States receiving state building energy performance program grants from DOE under the American Reinvestment and Recovery Act (ARRA) are required to adopt and enforce the *2009 IECC* or equivalent construction and to demonstrate 90 percent compliance with the *2009 IECC* within eight years of accepting the funding. Source: Title IV, Section 410 of ARRA (Pub.1., 11-5), Feb. 17, 2009.

[20] ASHRAE, *ASHRAE 90.1-2007 Energy Standard for Buildings Except Low-Rise Residential Buildings*.

[21] Newport Ventures, Inc., *Insulated Siding as Home Insulation: Insulated Siding Energy Performance Study*, June 2013: http://www.vinylsiding.org/ABOUTSIDING/insulated/study/index.asp

Whether using a prescriptive or performance-based approach to comply with the *IECC*, it is necessary to know either the R-value of the insulated siding, or the U-factor of the entire wall assembly. Table 6.1 provides guidance for designers on how to receive credit for the thermal performance of insulated siding based on the designer's selected compliance approach in the *2009* or *2012 IECC*.

Prescriptive approach U-factor requirements of the *IECC* vary by climate zone and wall type. The prescriptive U-factor requirements of frame walls (e.g., wood frame or steel frame) are shown in the upper right hand corner of Figure 6.1. Figure 6.1 includes a map with the climate zones that are used to identify the U-factor requirement of the building site. Please note that portions of Climate Zone 4 known as marine areas are required to comply with the insulation requirements of Climate Zone 5. To determine if a jurisdiction is in a marine area, refer to the energy code or contact local building officials.

The *2012 IECC* prescriptive approach R-value requirements for frame walls have increased from the 2009 requirements. In Climate Zones 6 through 8, the *2012 IECC* prescriptive R-value approach now requires continuous insulation (i.e., insulated siding and/or insulated sheathing) for frame walls. Additionally, in Climate Zones 3 through 5 of the *2012 IECC* and Climate Zones 5 through 6 of the *2009 IECC*, the prescriptive R-value approach recognizes cavity insulation combined with continuous insulation as an alternative compliance method to a cavity-only approach. For example, R-13 cavity insulation combined with R-5 continuous insulation may be installed in lieu of R-20 cavity insulation in Climate Zones 5 and 6 to meet the *2009 IECC* prescriptive R-value compliance approach.

***Note:*** As previously mentioned in this guide, the 2015 IECC provides significant recognition of insulated siding as a form of continuous insulation, including a definition, prescriptive path compliance information, and testing and labeling information. However, because the 2015 IECC will not be adopted by states for several years, information on complying with that code has not been provided in this section at this time.

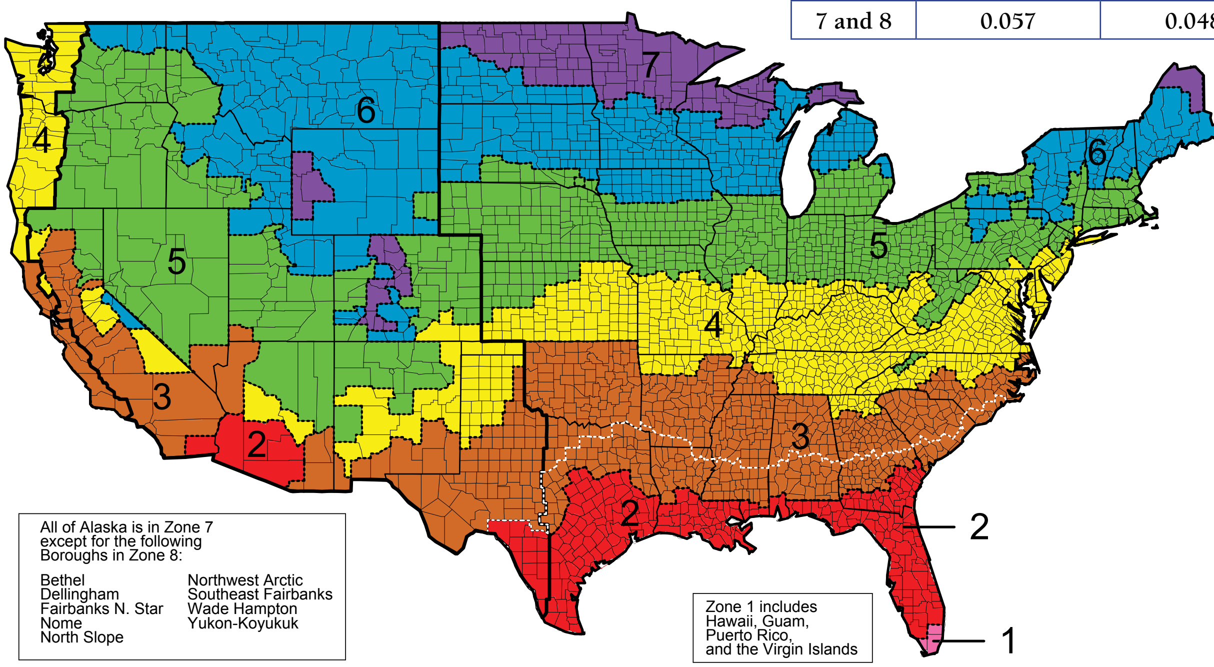
### Table 6.1 Recognition of Insulated Siding's Thermal Performance in Various *IECC* Compliance Approaches

| *IECC* Compliance Approach | *IECC* Section | Documentation Required | Notes |
|---|---|---|---|
| Prescriptive R-value | 402.1.1 | R-value of insulated siding (see Chapter 3 of this guide for more information on determining the R-value) | *2009 IECC:* Table 402.1.1 recognizes "insulated sheathing." To determine if "insulated siding" is approved for compliance with Table 402.1.1, check with the local building official.<br>*2012 IECC:* In footnote h of Table 402.1.1, insulated siding is considered to be interchangeable with other forms of continuous insulation. |
| Prescriptive U-factor | 402.1.3 | U-factor of wall assembly, including insulated siding* | In computing wall U-factors, the designer can use the thermal benefit of insulated siding. |
| Prescriptive UA (U-factor times the area of the wall) | 402.1.4 | U-factor of wall assembly, including insulated siding* | |
| Performance | 405 | U-factor of wall assembly, including insulated siding* | |

*Note: See Tables 6.3 and 6.4 for pre-calculated U-factors of wall assemblies incorporating insulated siding.

**Figure 6.1 Climate Zones of the United States**

| Climate Zone | Frame Wall U-factor requirements | |
|---|---|---|
| | *2009 IECC* | *2012 IECC* |
| 1-2 | 0.082 | 0.082 |
| 3 | 0.082 | 0.057 |
| 4 except Marine | 0.082 | 0.057 |
| 5 and Marine 4 | 0.057 | 0.057 |
| 6 | 0.057 | 0.048 |
| 7 and 8 | 0.057 | 0.048 |




Source: U.S. Department of Energy

# Using the U-factor Tables

Tables 6.3 and 6.4 contain U-factors calculated for various frame wall assemblies that can be used to demonstrate compliance with the *IECC* or to determine the improvement of a wall beyond minimum code requirements. The values in the tables were calculated using a methodology consistent with the ASHRAE *Handbook of Fundamentals* and include the thermal bridging effects of framing materials, as required by *IECC* Section 402.1.4.

The tables contain the whole wall U-factor. The left-most column of each table contains the continuous insulation R-value, which is the sum of insulated siding's R-value and any additional continuous insulation (e.g., including foam sheathing, but excluding other sheathing products, which are accounted for elsewhere in the calculation).[22] Yellow-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2009 IECC* for wall assemblies in Climate Zones 1 through 4 and the *2012 IECC* for wall assemblies in Climate Zones 1 and 2 (i.e., U-factor ≤ 0.082). Blue-shaded cells represent those in compliance with the *2009 IECC* in Climate Zones 5 through 8 and the *2012 IECC* in Climate Zones 3 through 5 (i.e., U-factor ≤ 0.057). Green-shaded cells represent those in compliance with the *2012 IECC* in Climate Zones 6

[22] Assumptions and methodologies used in calculating assembly U-factors for all walls include: Outside air film of R-0.25, fully sheathed with wood sheathing of R-0.83, interior gypsum board of R-0.45 and an inside air film of R-0.68. DOE REScheck methodology was used as the basis to calculate U-factors for various assemblies. For steel framed walls in particular, DOE REScheck and ASHRAE correction factor methods were employed. For wood framed walls, a 25 percent framing factor for 16" on center studs was used (22 percent for 24" on center), and a parallel-path U-factor calculation method was employed.

through 8. Illustrations of wall assemblies that meet or exceed 2009 or 2012 IECC prescriptive requirements can be found in Figures 6.2 through 6.6.

While the tables provide an easily referenced source for assembly U-factors, they can also be reproduced by doing hand calculations consistent with the ASHRAE *Handbook of Fundamentals*. Within the example of a wood framed wall at 16" on center with R-15 cavity insulation, structural wood sheathing and R-2.5 insulated siding, the following parallel-path equation can be used to calculate the assembly's U-factor:

$$U = \left[\frac{F}{Rs} + \frac{(1-F)}{Rc}\right]$$

where F = the framing factor, Rs = the R-value through the stud path and Rc = the R-value through the cavity path. Values for Rs, Rc and F for this example are provided in Table 6.2, based on an analysis of the thermal resistance of each component of the assembly. By plugging these values into the U-factor equation given above, a value of U-0.066 is derived for this wall assembly.

## Table 6.2 Component R-values for a 16" on Center Wood Framed Wall with R-15 Cavity Insulation, Structural Wood Sheathing and R-2.5 Insulated Siding

| Component | R-value Through Stud Path | R-values Through Cavity Path |
|---|---|---|
| **Framing Factor (F)** | 25% | N/A |
| **Outside Air Film** | 0.25 | 0.25 |
| **Insulated Siding** | 2.5 | 2.5 |
| **Wood Sheathing** | 0.83 | 0.83 |
| **Wood Studs (R-4.38 for 2x4, R-6.88 for 2x6)** | 4.38 | N/A |
| **Cavity Insulation** | N/A | 15 |
| **Interior Gypsum** | 0.45 | 0.45 |
| **Inside Air Film** | 0.68 | 0.68 |
| **Total Path R-value** | Rs=9.09 | Rc=19.71 |

| Table 6.3 Wood Framed Wall, Whole Wall U-factors | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Continuous Insulation R-value | Cavity Insulation R-value | | | | | | | |
| | 16" on Center | | | | 24" on Center | | | |
| | 2"x4" Construction | | 2"x6" Construction | | 2"x4" Construction | | 2"x6" Construction | |
| | R-13 | R-15 | R-19 | R-21 | R-13 | R-15 | R-19 | R-21 |
| R-0 (No Continuous) | 0.082 | 0.077 | 0.060 | 0.057 | 0.080 | 0.074 | 0.059 | 0.056 |
| R-2.0 | 0.073 | 0.068 | 0.056 | 0.052 | 0.071 | 0.066 | 0.055 | 0.051 |
| R-2.5 | 0.070 | 0.066 | 0.055 | 0.051 | 0.068 | 0.064 | 0.053 | 0.049 |
| R-3.0 | 0.067 | 0.063 | 0.053 | 0.049 | 0.066 | 0.062 | 0.052 | 0.048 |
| R-3.5 | 0.065 | 0.061 | 0.051 | 0.048 | 0.063 | 0.059 | 0.050 | 0.047 |
| R-4.0 | 0.063 | 0.059 | 0.050 | 0.047 | 0.061 | 0.058 | 0.049 | 0.045 |
| R-4.5 | 0.061 | 0.057 | 0.049 | 0.045 | 0.059 | 0.056 | 0.048 | 0.044 |
| R-5.0 | 0.059 | 0.055 | 0.047 | 0.044 | 0.058 | 0.054 | 0.047 | 0.043 |

Continuous insulation R-values are calculated either from the value provided for insulated siding or insulated sheathing or as the sum of insulated siding and insulated sheathing (i.e., foam sheathing).

Yellow-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2009 IECC* for wall assemblies in Climate Zones 1 through 4 (except for Marine 4) and the *2012 IECC* for wall assemblies in Climate Zones 1 and 2 (i.e., U-factor ≤ 0.082).

Blue-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2009 IECC* for wall assemblies in Climate Zones 5 through 8 and Marine 4 (i.e., U-factor ≤ 0.057) and the *2012 IECC* for wall assemblies in Climate Zones 3 through 5.

Green-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2012 IECC* for Climate Zones 6 through 8.

Here's an example of how to use the table above: Say a new home is located in Climate Zone 5 and needs to comply with the *2009 IECC* using the prescriptive U-factor approach. If the builder used 16" on center, 2"x6" wood construction and R-19 batt insulation, it would require R-2.0 insulated siding to provide a U-factor (0.056) that is less than or equal to the *2009 IECC* required U-factor of 0.057 for Climate Zone 5.

| Table 6.4 Steel Framed Wall, Whole Wall U-factors | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Continuous Insulation R-value | Cavity Insulation R-value | | | | | | | |
| | 16" on Center | | | | 24" on Center | | | |
| | 2"x4" Construction | | 2"x6" Construction | | 2"x4" Construction | | 2"x6" Construction | |
| | R-13 | R-15 | R-19 | R-21 | R-13 | R-15 | R-19 | R-21 |
| R-0 (No Continuous) | 0.114 | 0.109 | 0.101 | 0.098 | 0.100 | 0.094 | 0.088 | 0.085 |
| R-2.0 | 0.090 | 0.087 | 0.082 | 0.080 | 0.081 | 0.077 | 0.073 | 0.071 |
| R-2.5 | 0.086 | 0.083 | 0.079 | 0.077 | 0.078 | 0.075 | 0.070 | 0.069 |
| R-3.0 | 0.083 | 0.080 | 0.076 | 0.074 | 0.075 | 0.072 | 0.068 | 0.066 |
| R-3.5 | 0.079 | 0.077 | 0.073 | 0.071 | 0.072 | 0.069 | 0.066 | 0.064 |
| R-4.0 | 0.076 | 0.074 | 0.070 | 0.069 | 0.070 | 0.067 | 0.064 | 0.062 |
| R-4.5 | 0.073 | 0.071 | 0.068 | 0.067 | 0.067 | 0.065 | 0.062 | 0.060 |
| R-5.0 | 0.071 | 0.069 | 0.066 | 0.065 | 0.065 | 0.063 | 0.060 | 0.059 |
| R-5.5 | 0.068 | 0.067 | 0.064 | 0.062 | 0.063 | 0.061 | 0.058 | 0.057 |
| R-6.0 | 0.066 | 0.064 | 0.062 | 0.061 | 0.061 | 0.059 | 0.056 | 0.055 |
| R-6.5 | 0.064 | 0.062 | 0.060 | 0.059 | 0.059 | 0.057 | 0.055 | 0.054 |
| R-7.0 | 0.062 | 0.061 | 0.058 | 0.057 | 0.058 | 0.056 | 0.053 | 0.052 |
| R-7.5 | 0.060 | 0.059 | 0.056 | 0.056 | 0.056 | 0.054 | 0.052 | 0.051 |
| R-8.0 | 0.058 | 0.057 | 0.055 | 0.054 | 0.055 | 0.053 | 0.051 | 0.050 |
| R-8.5 | 0.057 | 0.056 | 0.053 | 0.053 | 0.053 | 0.052 | 0.049 | 0.049 |
| R-9.0 | 0.055 | 0.054 | 0.052 | 0.051 | 0.052 | 0.050 | 0.048 | 0.047 |
| R-9.5 | 0.054 | 0.053 | 0.051 | 0.050 | 0.050 | 0.049 | 0.047 | 0.046 |
| R-10.0 | 0.052 | 0.051 | 0.049 | 0.049 | 0.049 | 0.048 | 0.046 | 0.045 |

Continuous insulation R-values are calculated either from the value provided for insulated siding or insulated sheathing or as the sum of insulated siding and insulated sheathing (i.e., foam sheathing).

Yellow-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2009 IECC* for wall assemblies in Climate Zones 1 through 4 (except for Marine 4) and the *2012 IECC* for wall assemblies in Climate Zones 1 and 2 (*i.e.*, U-factor ≤ 0.082).

Blue-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2009 IECC* for wall assemblies in Climate Zones 5 through 8 and Marine 4 (i.e., U-factor ≤ 0.057) and the *2012 IECC* for wall assemblies in Climate Zones 3 through 5.

Green-shaded cells represent wall assemblies that are in compliance with the residential U-factor requirements of the *2012 IECC* for Climate Zones 6 through 8.

Here's an example of how to use the table above: Say a new home is located in Climate Zone 3 and needs to comply with the *2009 IECC* using the prescriptive U-factor approach. If the builder used 24" on center, 2"x4" steel framed construction and R-13 batt insulation, it would require R-2.0 insulated siding to provide a U-factor (0.081) that is less than or equal to the *2009 IECC* required U-factor of 0.082 for Climate Zone 3.

## Sample Wall Assemblies to Meet or Exceed the *IECC*

As shown previously, insulated siding can be used to help meet or exceed minimum energy code requirements. Following are illustrations of typical wall assemblies and their U-factors that will assist in achieving energy code compliance or exceeding energy code minimum requirements.

**Figure 6.2 Cross Section of Wood Framed Wall with R-2.0 Insulated Siding and R-13 Cavity Insulation**

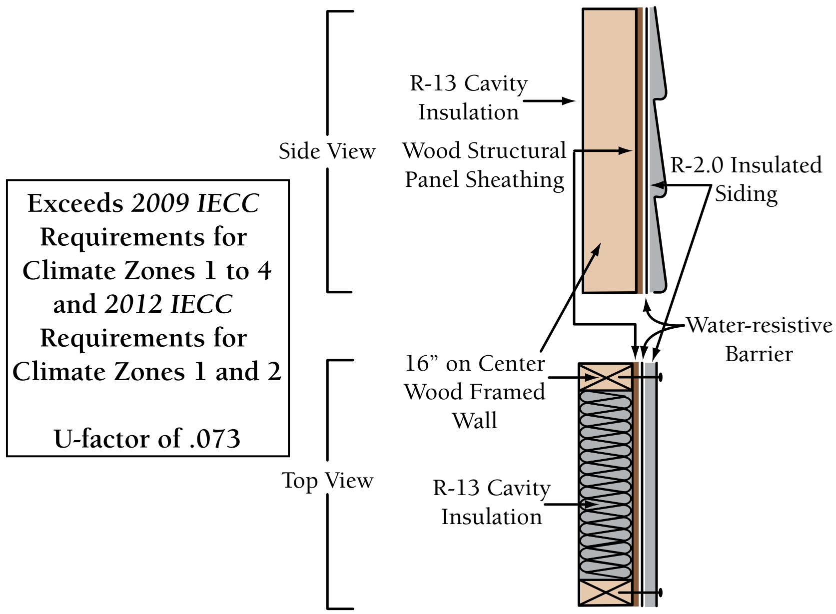



**Figure 6.3 Cross Section of Wood Framed Wall with R-2.0 Insulated Siding and R-19 Cavity Insulation**

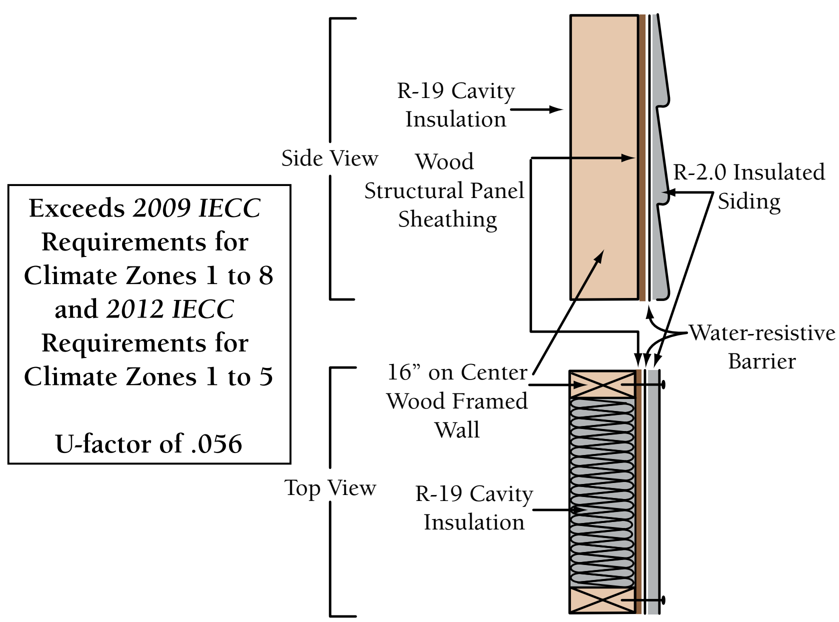


**Figure 6.4 Cross Section of Wood Framed Wall with R-3.5 Insulated Siding and R-21 Cavity Insulation**

Exceeds *2009* and *2012 IECC* Requirements for Climate Zones 1 to 8

U-factor of .048

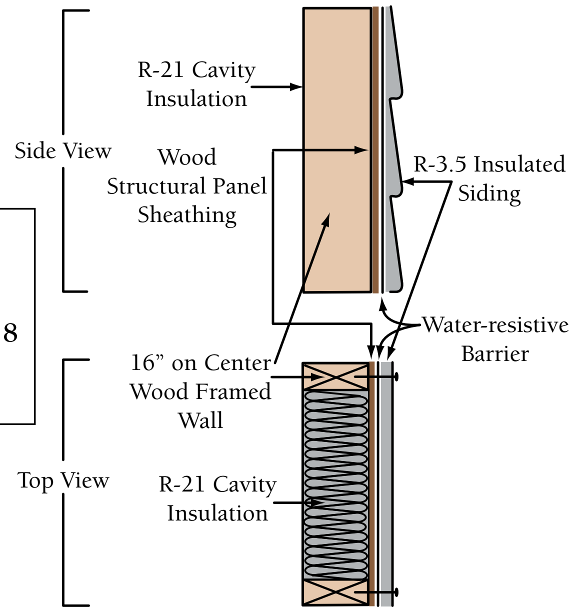
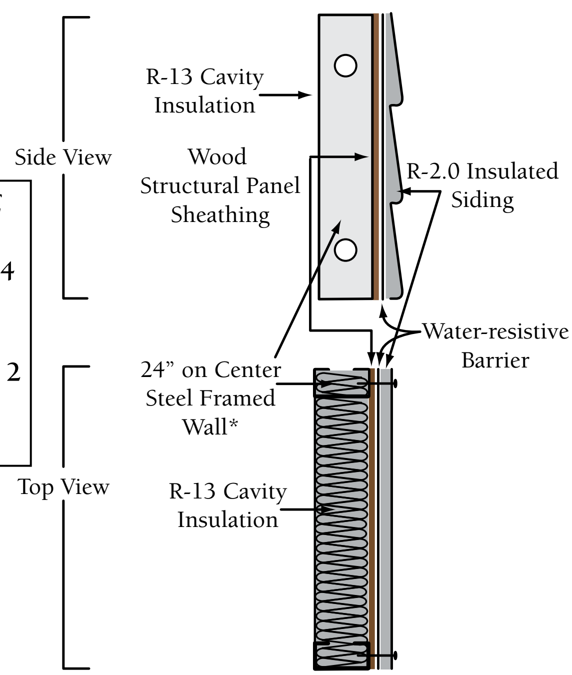



**Figure 6.5 Cross Section of Steel Framed Wall with R-2.0 Insulated Siding and R-13 Cavity Insulation**

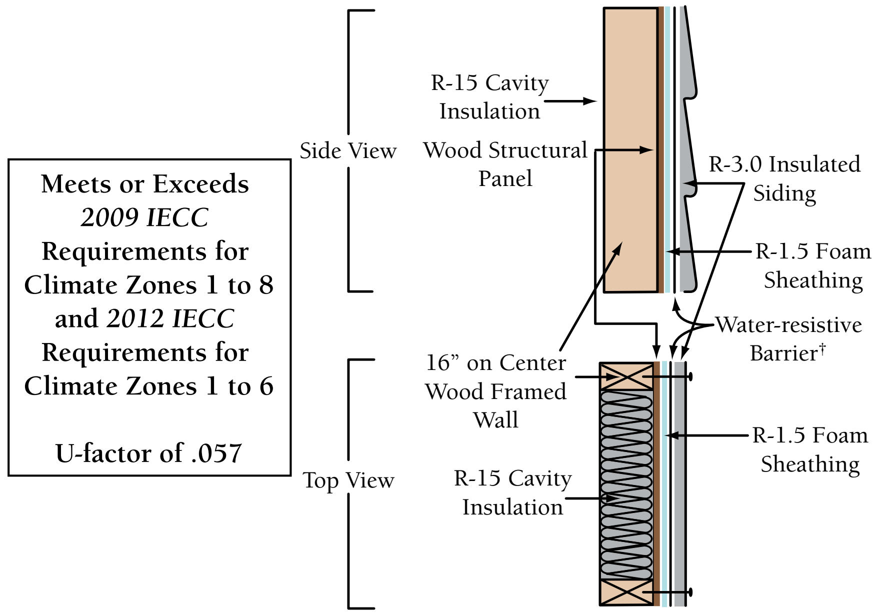
Exceeds *2009 IECC* Requirements for Climate Zones 1 to 4 and *2012 IECC* Requirements for Climate Zones 1 and 2

U-factor of .081




* For installation of insulated siding 24" on center, the manufacturer must provide building officials or specifiers with instructions or a test report.

**Figure 6.6 Cross Section of Wood Framed Wall with R-3.0 Insulated Siding, R-1.5 Foam Sheathing and R-15 Cavity Insulation**




* For installation of insulated siding 24” on center, the manufacturer must provide building officials or specifiers with instructions or a test report.

† In some cases, the foam sheathing can be a water-resistive barrier when used in combination with tape to seal the seams. Consult the manufacturer’s instructions.

# Chapter 7: Insulated Siding in Building Energy Performance Programs

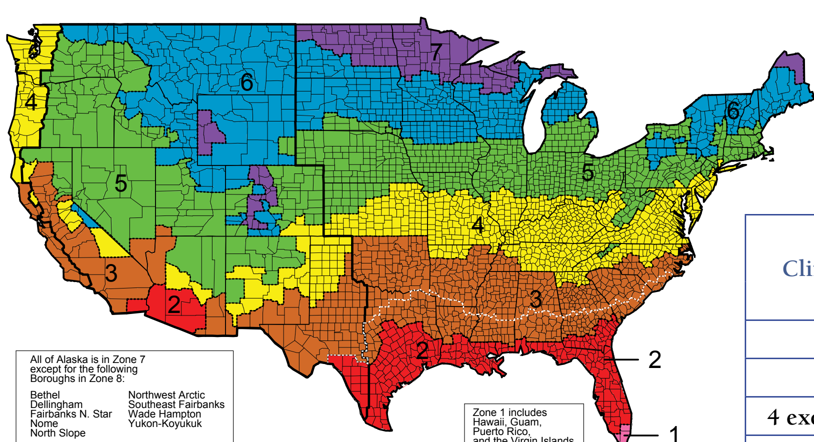
## New Homes

Two of the most popular energy efficiency programs for residential builders—EPA's ENERGY STAR Qualified Homes and DOE's Builder's Challenge—use a home energy rating system to develop a score, referred to as a HERS Index.[23] The HERS Index serves as the metric for ranking and rating homes' energy performance and is developed by creating a building energy simulation model of the home. The model takes into account the thermal performance of the building envelope, among other factors. The lower the HERS Index, the better the building's expected energy performance. Specifying and installing insulated siding can improve a home's energy performance and lower its HERS Index. This, in turn, helps homes qualify for these programs and any incentives available for qualifying energy-efficient homes.

To estimate the energy efficiency impact of insulated siding on a typical new home in the context of building energy performance programs, a prototypical new home was first modeled using EnergyGauge® USA software. The home was configured to meet the minimum prescriptive and mandatory requirements of the *IECC*, with details such as foundation type and conditioned floor area selected based on typical regional or national characteristics. Characteristics might include two stories, 2,400 square feet of above-grade conditioned floor area, basement foundation in northern climates, slab-on grade in southern climates, etc. The prototypical home was modeled in each *IECC* climate zone (see Figure 7.1), using one representative city for each zone. A table of key building energy simulation assumptions can be found in Appendix B. The HERS Index and projected heating, cooling and domestic water heating energy use were recorded.

After calculating the HERS Index and projected energy use of each home, the simulations were then run again with insulated siding installed, at insulation ratings of R-2.0, R-2.5 and R-3.0. Results of the simulations are shown in Tables 7.1 and 7.3 (*2009 IECC* baseline) and in Tables 7.2 and 7.4 (*2012 IECC* baseline). Table 7.1 shows that insulated siding can provide a 1 to 3 point improvement in the HERS Index of a *2009 IECC* mini-

### Figure 7.1 Climate Zones of the United States




Source: U.S. Department of Energy

| Climate Zone | Frame Wall U-factor requirements | |
|---|---|---|
| | *2009 IECC* | *2012 IECC* |
| 1-2 | 0.082 | 0.082 |
| 3 | 0.082 | 0.057 |
| 4 except Marine | 0.082 | 0.057 |
| 5 and Marine 4 | 0.057 | 0.057 |
| 6 | 0.057 | 0.048 |
| 7 and 8 | 0.057 | 0.048 |

[23] Residential Energy Services Network (RESNET), http://www.resnet.us/home-energy-ratings.

mally compliant home. This improvement accounts for up to 21 percent of the total HERS Index improvement necessary to achieve compliance with ENERGY STAR Qualified Homes Version 3.[24]

### Table 7.1 Expected HERS Index Improvements on *2009 IECC* Compliant Homes That Can Be Achieved with Insulated Siding

| Climate Zone | City | *2009 IECC* Minimum Home | | *2009 IECC* Minimum Home + R-2.0 Insulated Siding | | *2009 IECC* Minimum Home + R-2.5 Insulated Siding | | *2009 IECC* Minimum Home + R-3.0 Insulated Siding | | ENERGY STAR V3 HERS Index Target |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Wall U-factor | HERS Index | Wall U-factor | HERS Index Improvement v. *2009 IECC* | Wall U-factor | HERS Index Improvement v. *2009 IECC* | Wall U-factor | HERS Index Improvement v. *2009 IECC* | |
| 1 | **Miami** | 0.082 | 85 | 0.073 | 1 | 0.070 | 1 | 0.067 | 1 | 70 |
| 2 | **Phoenix** | 0.082 | 87 | 0.073 | 2 | 0.070 | 3 | 0.067 | 3 | 71 |
| 3 | **Dallas** | 0.082 | 85 | 0.073 | 1 | 0.070 | 2 | 0.067 | 2 | 70 |
| 4 | **Baltimore** | 0.082 | 84 | 0.073 | 2 | 0.070 | 2 | 0.067 | 3 | 70 |
| 5 | **Denver** | 0.059 | 85 | 0.054 | 1 | 0.052 | 1 | 0.050 | 2 | 69 |
| 6 | **Burlington** | 0.059 | 86 | 0.054 | 1 | 0.052 | 1 | 0.050 | 2 | 65 |
| 7 | **Duluth** | 0.057 | 87 | 0.052 | 2 | 0.051 | 2 | 0.049 | 2 | 63 |
| 8 | **Fairbanks** | 0.057 | 85 | 0.052 | 2 | 0.051 | 2 | 0.049 | 2 | 59 |

### Table 7.2 Expected HERS Index Improvements on *2012 IECC* Compliant Homes That Can Be Achieved with Insulated Siding

| Climate Zone | City | *2012 IECC* Minimum Home | | *2012 IECC* Minimum Home + R-2.0 Insulated Siding | | *2012 IECC* Minimum Home + R-2.5 Insulated Siding | | *2012 IECC* Minimum Home + R-3.0 Insulated Siding | | ENERGY STAR V3 HERS Index Target |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Wall U-factor | HERS Index | Wall U-factor | HERS Index Improvement v. *2012 IECC* | Wall U-factor | HERS Index Improvement v. *2012 IECC* | Wall U-factor | HERS Index Improvement v. *2012 IECC* | |
| 1 | **Miami** | 0.082 | 80 | 0.073 | 1 | 0.070 | 2 | 0.067 | 2 | 70 |
| 2 | **Phoenix** | 0.082 | 78 | 0.073 | 2 | 0.070 | 3 | 0.067 | 3 | 71 |
| 3 | **Dallas** | 0.059 | 72 | 0.054 | 0 | 0.052 | 1 | 0.050 | 1 | 70 |
| 4 | **Baltimore** | 0.059 | 71 | 0.054 | 1 | 0.052 | 1 | 0.050 | 1 | 70 |
| 5 | **Denver** | 0.059 | 74 | 0.054 | 1 | 0.052 | 2 | 0.050 | 2 | 69 |
| 6 | **Burlington** | 0.044 | 70 | 0.041 | 0 | 0.040 | 1 | 0.039 | 1 | 65 |
| 7 | **Duluth** | 0.044 | 69 | 0.041 | 1 | 0.040 | 1 | 0.039 | 1 | 63 |
| 8 | **Fairbanks** | 0.044 | 67 | 0.041 | 1 | 0.040 | 1 | 0.039 | 1 | 59 |

Table 7.3 reports results on the basis of percent energy savings compared a *2009 IECC* minimally compliant home. Table 7.4 shows savings compared to a *2012 IECC* minimally compliant home. Energy savings include the savings associated with heating and cooling, which are the two categories of home energy use affected by insulated siding. The results of the simulations show that a 2 to 7 percent reduction can be achieved in the home's projected heating and cooling energy use compared to a home built to the *2009 IECC* by specifying insulated siding with an R-value of 2.0 to 3.0. Similar results were found when comparing a home built to the *2012 IECC*—savings of 3 to 6 percent of the home's heating and cooling energy use. To put these savings in perspective, across the eight climate zones, the average annual site energy savings associated with R-2.5 insulated siding versus a *2009 IECC* minimally compliant wall assembly are 10 times the savings of installing a new ENERGY STAR qualified refrigerator versus a new standard refrigerator.[25]

[24] Actual results will vary based on climate zone, individual housing composition and finalized guidelines. Assumptions for the homes used to derive these numbers can be found in Appendix B.

[25] Assumes an 18 cubic foot refrigerator-freezer with automatic defrost and top-mounted freezer without through-the-door ice service. Sources: 10 C.F.R. Part 430.32, ENERGY STAR 2010 qualifying criteria for refrigerators.

## Table 7.3 Expected Heating and Cooling Improvements Over the *2009 IECC* That Can Be Achieved with Insulated Siding

| Climate Zone | City | *2009 IECC* Minimum Home Wall U-factor | *2009 IECC* Minimum Home + R-2.0 Insulated Siding | | *2009 IECC* Minimum Home + R-2.5 Insulated Siding | | *2009 IECC* Minimum Home + R-3.0 Insulated Siding | |
|---|---|---|---|---|---|---|---|---|
| | | | Wall U-factor | Percent Heating and Cooling Energy Savings Improvement over *2009 IECC* | Wall U-factor | Percent Heating and Cooling Energy Savings Improvement over *2009 IECC* | Wall U-factor | Percent Heating and Cooling Energy Savings Improvement over *2009 IECC* |
| 1 | **Miami** | 0.082 | 0.073 | 2% | 0.070 | 3% | 0.067 | 2% |
| 2 | **Phoenix** | 0.082 | 0.073 | 2% | 0.070 | 3% | 0.067 | 4% |
| 3 | **Dallas** | 0.082 | 0.073 | 3% | 0.070 | 4% | 0.067 | 6% |
| 4 | **Baltimore** | 0.082 | 0.073 | 4% | 0.070 | 6% | 0.067 | 7% |
| 5 | **Denver** | 0.059 | 0.054 | 3% | 0.052 | 4% | 0.050 | 5% |
| 6 | **Burlington** | 0.059 | 0.054 | 2% | 0.052 | 3% | 0.050 | 4% |
| 7 | **Duluth** | 0.057 | 0.052 | 3% | 0.051 | 3% | 0.049 | 4% |
| 8 | **Fairbanks** | 0.057 | 0.052 | 2% | 0.051 | 3% | 0.049 | 3% |

## Table 7.4 Expected Heating and Cooling Improvements Over the *2012 IECC* That Can Be Achieved with Insulated Siding

| Climate Zone | City | *2012 IECC* Minimum Home Wall U-factor[26] | *2012 IECC* Minimum Home + R-2.0 Insulated Siding | | *2012 IECC* Minimum Home + R-2.5 Insulated Siding | | *2012 IECC* Minimum Home + R-3.0 Insulated Siding | |
|---|---|---|---|---|---|---|---|---|
| | | | Wall U-factor | Percent Heating and Cooling Energy Savings Improvement over *2012 IECC* | Wall U-factor | Percent Heating and Cooling Energy Savings Improvement over *2012 IECC* | Wall U-factor | Percent Heating and Cooling Energy Savings Improvement over *2012 IECC* |
| 1 | **Miami** | 0.082 | 0.073 | 2% | 0.070 | 3% | 0.067 | 4% |
| 2 | **Phoenix** | 0.082 | 0.073 | 3% | 0.070 | 4% | 0.067 | 5% |
| 3 | **Dallas** | 0.059 | 0.054 | 2% | 0.052 | 3% | 0.050 | 4% |
| 4 | **Baltimore** | 0.059 | 0.054 | 1% | 0.052 | 4% | 0.050 | 5% |
| 5 | **Denver** | 0.059 | 0.054 | 4% | 0.052 | 5% | 0.050 | 6% |
| 6 | **Burlington** | 0.044 | 0.041 | 2% | 0.040 | 2% | 0.039 | 3% |
| 7 | **Duluth** | 0.044 | 0.041 | 2% | 0.040 | 3% | 0.039 | 3% |
| 8 | **Fairbanks** | 0.044 | 0.041 | 1% | 0.040 | 2% | 0.039 | 3% |

[26] Minimum U-factors listed for the *2012 IECC* are derived from U.S. DOE REScheck Version 4.4.2 based on the R-values prescribed in Table 402.1.1 of the *2012 IECC*. The cavity R-value used for Climate Zones 3 through 8 is R-20. In Climate Zones 3 through 8, this results in a slightly different U-factor than that listed in Table R402.1.3 of the *2012 IECC*.

## Existing Homes

Replacing a home's exterior cladding with insulated siding can improve the thermal performance of the walls while reducing heating and cooling energy costs. Whether participating in a weatherization program (e.g., ENERGY STAR or state or utility programs) or pursuing energy and utility savings on an individual basis, insulated siding can help achieve a homeowner's energy savings targets:

- Specifying insulated siding can improve the R-value of existing walls, resulting in energy and utility bill savings.
- In order to optimize the thermal performance of insulated siding, any existing siding that would produce voids or air gaps behind the new siding should be removed. The wall surface should be prepared so that the insulated siding rests flush against a flat, continuous surface.
- For energy efficiency retrofit programs that are based on simulated energy savings or energy ratings (e.g., California's CHF Energy Retrofit Program) of homes, insulated siding can be specified as part of a whole house solution to increase a home's energy performance.
- For programs requiring compliance with the Building Performance Institute's (BPI)[27] Envelope Professional Standard, "minimum insulation levels shall be determined based on local codes." Installation of insulated siding on existing homes can help satisfy this requirement of the standard.
- Insulated siding can be an effective energy conservation measure in weatherization programs that require calculation of savings-to-investment ratios for approved measures.

Although the energy savings from installing insulated siding will depend on a host of factors, such as heating and cooling equipment efficiency, climatic conditions and home construction, estimates of energy savings that could be expected on typical homes are provided here for general reference. Table 7.5 displays the results from building energy simulations for a 1950s to 1970s era home that is a likely candidate for an energy efficiency upgrade (e.g., has 10-year-old, minimum efficiency heating and cooling equipment; average levels of air infiltration; and low levels of wall and attic insulation).[28] This reference home is assumed to have R-9 cavity insulation in a 16" on center, wood framed wall (U-factor=0.094, using REScheck[29] software). By adding insulated siding to this reference home, the wall's U-factor improves to 0.086 for R-2, 0.082 for R-2.5 or 0.079 for R-3.0 insulated siding.

Based on building energy simulations and depending on climate zone and housing characteristics, adding insulated siding was projected to reduce heating and cooling energy use of a typical existing home by 1 to 4 percent. When compared to other typical energy conservation measures that are specified for existing homes, insulated siding can be an attractive energy savings measure. For example, replacing a refrigerator from 1993 or later with a new, ENERGY STAR qualified model should save about 281 kilowatt hours (kWh) of electricity per year (nearly 1 million British thermal units [Btu] of site energy).[30] However, re-siding a home with R-3.0

[27] BPI is an organization that develops technical standards and provides training related to residential building weatherization and energy efficiency. See http://www.bpi.org.

[28] Assumptions for representative energy performance ratings for individual building assemblies and mechanical equipment of the 1950s to 1970s era reference home were based on four major sources: 1) Huang, J., and Gu, L., Prototype Residential Buildings to Represent the U.S. Housing Stock, Draft LBNL Report, Berkeley, CA, Lawrence Berkeley National Laboratory, 2002; 2) Hendron, R., Building America Performance Analysis Series for Existing Homes, NREL 550-38238, 2006; 3) RESNET, Mortgage Industry National Home Energy Rating Systems Standards, 2006; and 4) ASHRAE, *ASHRAE Handbook of Fundamentals,* IP Version, 2009. See Appendix C for more details.

[29] REScheck™ software was used to compute the U-factors for all reference walls, since this software uses the same methodology and assumptions that were originally used to calculate the U-factors for the *2004 IECC*. Using other software to calculate the expected thermal performance of wall assemblies may yield different U-factors and expected performance benefits. REScheck software is available for free online from DOE at www.energycodes.gov/rescheck/download.stm.

[30] Assumes an 18 cubic foot refrigerator-freezer with automatic defrost and top-mounted freezer without through-the-door ice service. Sources: 10 C.F.R. Part 430.32, ENERGY STAR 2010 qualifying criteria for refrigerators.

insulated siding is expected to save an average of approximately 5.5 times this amount of energy across the eight climate zones (average of more than 5.2 million Btu of site energy).

### Table 7.5 Expected Heating and Cooling Energy Savings for a Typical 1950s to 1970s Era Home That Is Re-sided with Insulated Siding[31]

| 1950s to 1970s Era Reference Home, U=0.094 | | 1950s to 1970s Era Reference Home + R-2.0 Insulated Siding | 1950s to 1970s Era Reference Home + R-2.5 Insulated Siding | 1950s to 1970s Era Reference Home + R-3.0 Insulated Siding |
|---|---|---|---|---|
| | | U=0.086 | U=0.082 | U=0.079 |
| Climate Zone | City | Percent Heating and Cooling Energy Savings v. Reference | Percent Heating and Cooling Energy Savings v. Reference | Percent Heating and Cooling Energy Savings v. Reference |
| 1 | **Miami** | 1% | 2% | 2% |
| 2 | **Phoenix** | 1% | 2% | 2% |
| 3 | **Dallas** | 2% | 3% | 3% |
| 4 | **Baltimore** | 2% | 2% | 3% |
| 5 | **Denver** | 2% | 3% | 4% |
| 6 | **Burlington** | 2% | 2% | 3% |
| 7 | **Duluth** | 1% | 2% | 3% |
| 8 | **Fairbanks** | 1% | 2% | 3% |

If the home is participating in an incentive-based energy retrofit program (e.g., Home Performance with ENERGY STAR or weatherization programs), it is often necessary to evaluate all candidate energy conservation measures (including insulated siding) based on their savings-to-investment ratio (SIR). If the SIR is high enough to meet a program's qualification criteria (generally 1.0 or higher for weatherization programs), then the energy conservation measure is considered eligible for funding and installation.

When siding needs to be replaced, the "investment" portion of insulated siding's SIR should be calculated as the *incremental* cost of the insulated siding versus vinyl siding alone (i.e., the cost of insulated siding minus the cost of vinyl siding without integral insulation). This method will reveal the cost of the insulation itself, which will enable a clear comparison between insulated siding and other energy conservation measures under consideration. For example, suppose insulated siding is being considered as an energy conservation measure on a home that has 2,000 square feet of above-grade wall area. For this example, assume that the cost of vinyl siding is $2.59 per square foot, and the cost of insulated siding is $3.74 per square foot. The incremental cost of this energy conservation measure may be found as: ($3.74 - $2.59)*2,000 = $2,300.

[31] Projected savings do not include any air sealing benefit that can be gained by installing a water-resistive barrier as an air barrier during the re-siding job (see the water-resistive barrier manufacturer's instructions for details). The preliminary results of the Insulated Siding Energy Performance Study by Newport Ventures (see page 9) showed an average improvement in air tightness of 12 percent across four homes. For the existing homes modeled in Table 7.5, as an example, a 10 percent improvement in air tightness would increase the expected energy savings of an R-2.5 insulated siding retrofit from 1 to 4 percent up to 2 to 8 percent.

## Existing Homes' Sample Wall Assemblies

When it's time to re-side a home, insulated siding can be used to help meet or exceed the thermal performance of the walls of existing homes, even though existing homes are not required to meet the current *IECC*. Following are illustrations of typical wall assemblies that will assist the designer, remodeler or building energy analyst in identifying the thermal performance of walls incorporating insulated siding and bringing an older home "up to code."

**Figure 7.2 Cross Section of Wood Framed Wall with R-2.5 Insulated Siding and R-9 Cavity Insulation**

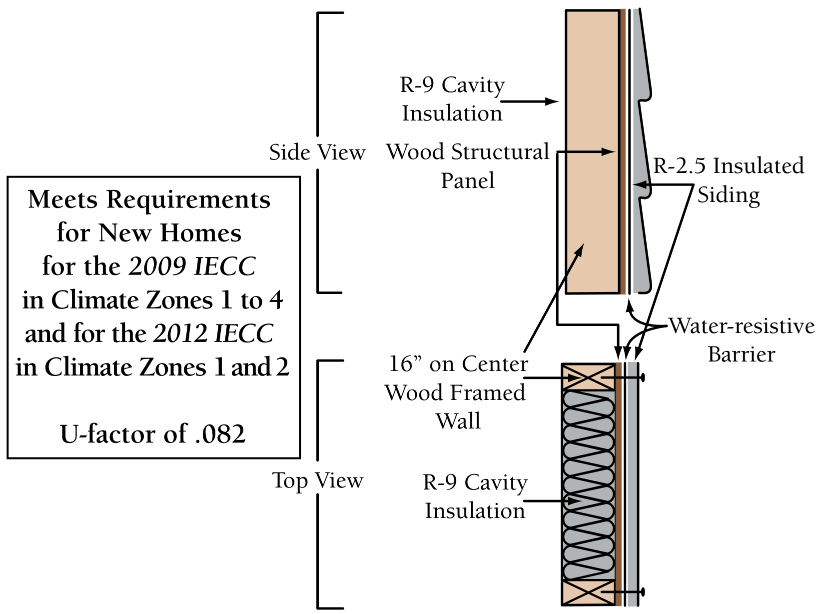



**Figure 7.3 Cross Section of Wood Framed Wall with R-2.5 Insulated Siding and R-11 Cavity Insulation**

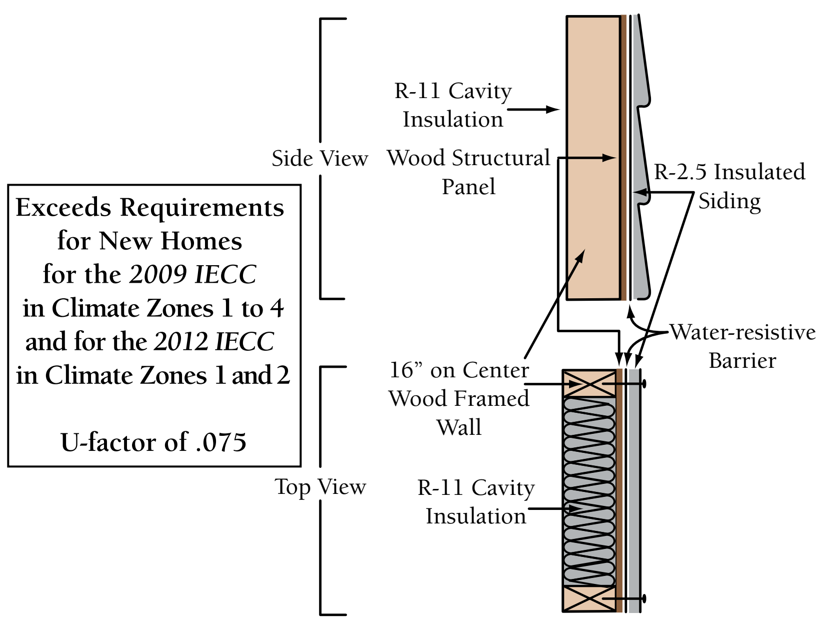


**Figure 7.4 Cross Section of Wood Framed Wall with R-2.0 Insulated Siding and R-13 Cavity Insulation**

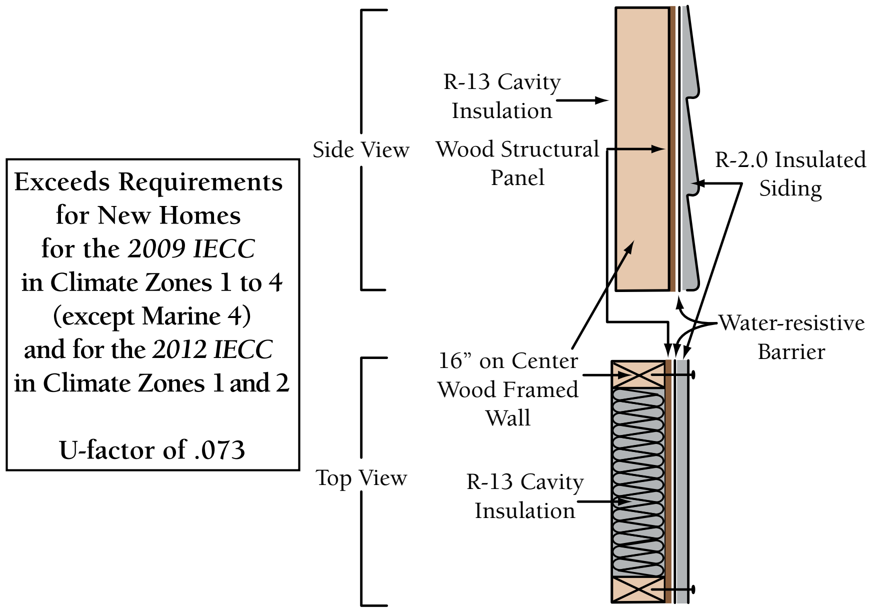



**Figure 7.5 Cross Section of Wood Framed Wall with R-2.5 Insulated Siding and R-19 Cavity Insulation**

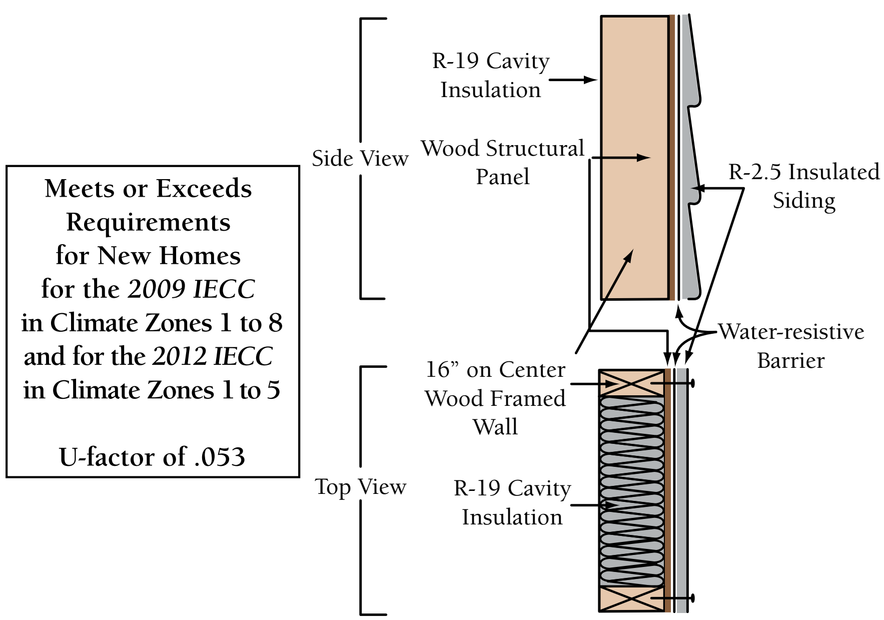


**Figure 7.6 Cross Section of Wood Framed Wall with R-2.5 Insulated Siding, R-3.0 Foam Sheathing, and R-13 Cavity Insulation**

Meets or Exceeds Requirements for New Homes for the *2009 IECC* in All Climate Zones and for the *2012 IECC* in Climate Zones 1 to 5

U-factor of .057

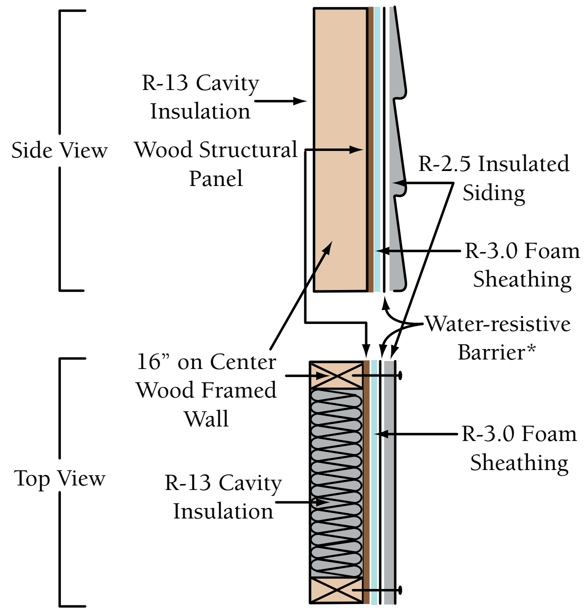
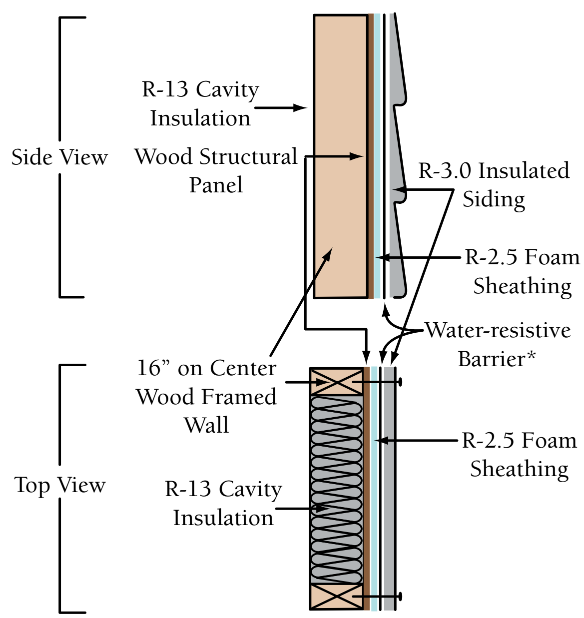



**Figure 7.7 Cross Section of Wood Framed Wall with R-3.0 Insulated Siding, R-2.5 Foam Sheathing, and R-13 Cavity Insulation**

Meets or Exceeds Requirements for New Homes for the *2009 IECC* in All Climate Zones and for the *2012 IECC* in Climate Zones 1 to 5

U-factor of .057




* In some cases, the foam sheathing can be a water-resistive barrier when used in combination with tape to seal the seams. Consult the manufacturer’s instructions.

# Appendices

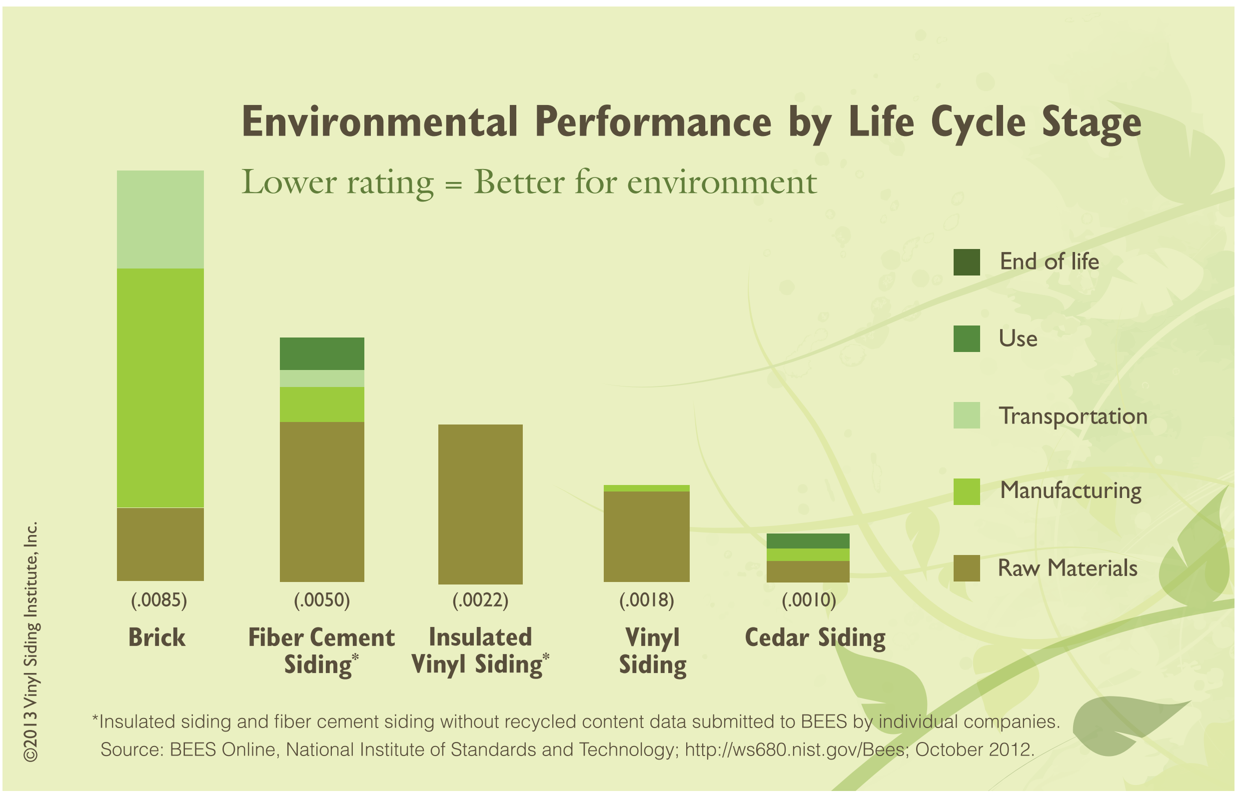
# Appendix A: Other Insulated Siding Performance Characteristics

## *Green Building Performance of Insulated Vinyl Siding*

Throughout its manufacture, transportation, installation, service life and waste management, insulated vinyl siding scores well on tough environmental measures. What's more, insulated vinyl siding has the potential to contribute to achieving more points than other exterior cladding in the leading green building certification programs, including the U.S. Green Building Council's LEED® for New Construction and LEED® Homes rating systems and the ANSI-approved ICC 700 National Green Building Standard.™

Vinyl starts with two simple building blocks: 57 percent from common salt, from which chlorine is extracted, and 43 percent from natural gas, from which ethylene is made. According to the U.S. Energy Information Agency's *2008 Short-term Energy Outlook*, most natural gas is utilized to manufacture ethylene is domestically produced, which reduces consumption of imported oil products.

Using recognized life cycle assessment tools and fact-based data, vinyl siding and insulated siding demonstrate remarkably better environmental performance than other exterior cladding materials.




## *Fire Safety Performance*

Insulated siding is composed of polyvinyl chloride, more commonly known as vinyl or PVC, and foam plastic. Insulated siding complies with building code requirements for rigid PVC siding and foam plastics.

Due to vinyl's chlorine base, the siding portion of insulated siding does not readily ignite and burn and resists flame spread. Vinyl siding routinely demonstrates a Class A flame spread rating (that is, a flame spread index of 25 or less when tested under ASTM E84). Rigid vinyl will not sustain combustion without an external source of heat and will tend to self-extinguish if that heat is removed.

Foam plastics used in the insulation portion contain a flame retardant designed to limit rapid flame spread. Foam plastic insulation products are tested and classified for flame spread and smoke-development under ASTM E84/UL 723 by Underwriters Laboratories and other certified agencies. All foam plastics used in insulated siding meet or exceed the requirements of the nation's building codes and applicable federal, state and industrial requirements. For results pertaining to a specific foam plastic insulation product, consult the manufacturer's technical data.

All organic materials (that is, anything containing carbon) can be made to ignite. Both rigid PVC and EPS foam are relatively ignition-resistant, especially compared with wood. The table below shows the ranges of ignition temperatures cited by a variety of published sources for the three materials. A piloted ignition temperature is the temperature at which a material will ignite in the presence of an external spark or flame; the self-ignition temperature is what is needed for ignition without an external ignition source (this distinction is not applicable to wood). Clearly, both of the major components of insulated siding resist ignition at temperatures significantly higher than needed for the ignition of wood.

### Range of Ignition Temperatures

| | Rigid PVC | EPS Foam | Wood Framing Lumber[32] |
|---|---|---|---|
| **Piloted Ignition** | 720° to 750°F (380° to 400°C) | 650° to 700°F (340° to 370°C) | **480° to 660°F (250° to 350°C), depending on rate of heating** |
| **Self-ignition** | 840° to 1020°F (450° to 550°C) | 840° to 930°F (450° to 500°C) | |

Additionally, ASTM D2863 tests show that both rigid PVC (at 45 percent) and EPS insulation (minimum 24 percent) need higher amounts of oxygen than the 21 percent found in normal atmospheric conditions in order to sustain combustion. Therefore, insulated siding is more difficult to ignite and less likely to sustain independent burning than most combustible building materials such as wood.

Exterior cladding is involved in only a fraction of all residential fires. Indeed, most house fires start on the insides of homes and are contained within their structures of origin. The National Fire Protection Association's (NFPA) February *2007 Home Structures Fires* report shows that fewer than 3 percent of all fires go beyond the structure of origin, and fewer than 2 percent of all home fires' sources of origin are related to the exterior wall surface.[33] In fact, only 4 percent of all residential fires start on the outside of the structure but do not necessarily originate with the exterior cladding. The report does not cite any exterior wall coverings (including insulated siding, brick and stucco) as the cause of residential fires.

The manufacturers of insulated siding are committed to keeping their products a low fire risk. Insulated siding is made from materials that have inherently favorable fire performance characteristics and are tested to confirm adherence to all applicable building and fire code requirements.

## *Moisture Performance, Air Movement and R-value*

Insulated siding is designed to be a form of continuous insulation and an exterior cladding, not a water-resistive barrier. It is a superior cladding option for moisture management while also providing significant improvement to the energy performance of the wall assembly.

[32] Babrauskas, V., Ignition of Wood: A Review of the State of the Art, pp. 71-88 in Interflam 2001, Interscience Communications Ltd., London, 2001.

[33] National Fire Protection Association, Fire Analysis and Research Division. *Home Structures Fires*. February 2007.

Insulated siding is designed to allow the material underneath it to breathe; therefore, it is not a watertight covering. Because of its design and application, it provides a supplemental rain screen that enhances the water-resistive barrier system by reducing the amount of water that reaches the underlying water-resistive barrier. The ability of insulated siding to allow moisture to both drain and evaporate has been demonstrated in controlled laboratory testing, as well as through field observations.

During the R-value test specified in ASTM D7793, no artificial sealing of the assembly is allowed, unless specified by the manufacturer for a normal installation, so real world conditions are replicated. Wind is directed against the surface of the siding, perpendicular to the plane of the wall, during the R-value test. There have been questions raised regarding the performance of insulated siding relative to wind-washing, or the diminishment of R-value due to the movement of surrounding air. During the early stages of product evaluation, assemblies were tested in a sealed configuration, as well as in an unsealed configuration. These initial results showed a modest reduction in R-value. As a result, the tested and published R-values are required to be in unsealed test configurations, including the application of wind.

A water-resistive barrier system is a system that includes water shedding materials and water diversion materials. Water-resistive barrier systems commonly consist of a combination of exterior cladding; flashed wall openings and penetrations; water-resistive barrier material; and sheathing. Effective water-resistive barrier systems will shed the water initially, control moisture flow by capillary and diffusion action and minimize absorption into the wall structure. The level of water resistance required is determined by the applicable building code and structure.

Besides improving a structure's ability to keep heat in, insulated siding does not inhibit efforts to keep moisture out. Insulated siding provides a supplemental rain screen that reduces the amount of water that reaches the underlying water-resistive barrier. With a properly applied water-resistive barrier, insulated siding minimizes moisture penetration from the exterior into the wall assembly and provides a way for moisture to readily drain and dry. The presence of a layer of thermal insulation filling the space between the insulated siding and the wall sheathing also aids in the moisture management system.

Studies of foam sheathing and insulated siding make the case for insulated siding's moisture management:

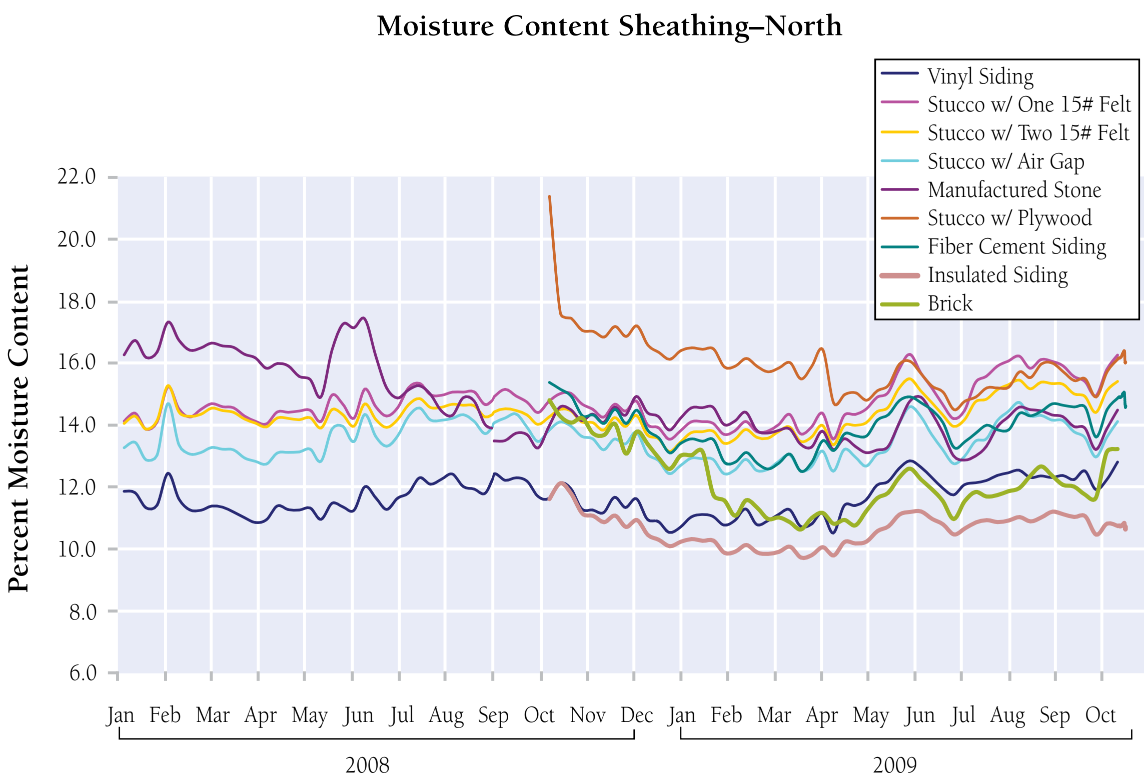
- A technical bulletin published by the EPS Molders Association highlighted third-party testing conducted by SGS US Testing Company Inc. to evaluate EPS's resistance to fungi and mold growth.[34] Using *ASTM C1338-08 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings*, the research indicates that under a 28-day incubation period, the EPS had no trace of mold growth. EPS insulation is a closed-cell foam, and exposure to moisture has little, if any, effect on its thermal performance and dimensional stability.
- A field study conducted on 20 multi-family structures in Minneapolis, Minnesota, examined nearly 90 percent of the buildings' exterior structural sheathing after seven years of use with insulated siding.[35] No instances of moisture problems relating to insulated siding were found in any areas inspected, including the siding, the water-resistive barrier and the sheathing.
- Third-party, in situ testing to evaluate EPS foam insulation in below-grade applications found that, following a 15-year period, the EPS performed as required by ASTM C578 with regard to R-value and moisture absorption.[36]

[34] EPS Molders Association, EPS *Insulation Mold Resistance*, prepared by SGS US Testing Company Inc., Report No. 110170, November 2004.

[35] Progressive Foam Technologies, Inc., *Vinyl Siding and Sheathing Inspection Report*, prepared by Architectural Testing Inc., Report No. 74575.01-201-27, October 11, 2007.

[36] EPS Molders Association , *Thermal Resistance and Moisture Content Testing of Foam Plastic Insulation*, prepared by Stork Materials Technology, Saint Paul, MN, Job No. 30160 08-95863.5, October 31, 2008.

- The Home Innovation Research Labs, formerly the NAHB Research Center, conducted a 22-month field investigation of nine different north- and south-oriented wood framed wall assemblies to determine the moisture performance of various wall construction types, most of which incorporated absorptive cladding.[37] The study was conducted 20 miles east of Washington, DC, in a mixed-humid climate. Moisture content of the sheathing and wall cavity temperatures were measured at various points in each wall section. The primary performance measure was moisture content of the wood-based structural sheathing. Walls with non-absorptive cladding (i.e., vinyl siding and insulated siding) had among the lowest sheathing moisture contents recorded in the study; this was the case for walls that faced either north or south. The chart below shows the results for north-facing walls.




[37] NAHB Research Center, *Effect of Cladding Systems on Moisture Performance of Wood Frame Walls in a Mixed-Humid Climate*, Thermal Performance of the Exterior Envelopes of Whole Buildings XI International Conference, December 2010.

# Appendix B: *2015 IECC* and Building Energy Simulation Modeling Inputs

## *2015 IECC*

Section R402.1.2 (N1102.1.2) of the *2015 IECC* allows the R-value for insulated siding to be used as part of the prescriptive R-value computation approach. As a part of this calculation, the prescriptive approach uses preset values for other building components, including items such as air film, interior sheathing and exterior cladding. The value for exterior cladding applied with this prescriptive approach (and this approach only) is an R-value of 0.6. For this reason, when insulated siding's R-value is part of the prescriptive path for compliance, its tested R-value must be reduced by 0.6. When using other compliance approaches in the energy code, such as the U-factor approach, the tested and labeled R-value should be used.

## *Building Energy Simulations*

Building energy simulations require dozens of inputs related to the characteristics of the building envelope, mechanical systems, lighting and appliances. The assumptions for existing homes (1950s to 1970s era) used in the simulations conducted for this guide were primarily sourced from the following four references:

- Huang, J., and Gu, L., Prototype Residential Buildings to Represent the U.S. Housing Stock. Draft LBNL Report, Berkeley, CA: Lawrence Berkeley National Laboratory, 2002;
- Hendron, R., Building America Performance Analysis Series for Existing Homes, NREL 550-38238, 2006;
- RESNET, Mortgage Industry National Home Energy Rating Systems Standards, 2006; and
- ASHRAE, *ASHRAE Handbook of Fundamentals*, IP Version, 2009.

Assumptions for the *2009* and *2012 IECC* minimum compliant homes used in the simulations conducted for this guide were primarily sourced from the prescriptive requirements of the *2009* and *2012 IECC*, with some assumptions also sourced from the defining characteristics of the reference home within the performance path of the *2009* and *2012 IECC* (i.e., Table 405.5.2(1)).

All simulations were conducted using RESNET-approved EnergyGauge USA software, which is based on the DOE 2.1-E hourly building energy simulation engine. Modeling assumptions were made to be representative of typical building stock, and actual results will vary based on the condition and performance rating of individual homes' building systems and equipment.

| New Homes—Circa 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Miami, FL | Phoenix, AZ | Dallas, TX | Baltimore, MD | Denver, CO | Burlington, VT | Duluth, MN | Fairbanks, AK |
| | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* |
| Climate zone, *IECC* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Cooling employed (Yes=1, No=0) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| House orientation for front of home | South | South | South | South | South | South | South | South |
| Above-grade square feet (sq ft) | 2434 | 2434 | 2434 | 2434 | 2434 | 2434 | 2434 | 2434 |
| Aspect ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| First floor ceiling height (ft) | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| Second floor ceiling height (ft) | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| Conditioned area (sq ft) | 2434 | 2434 | 2434 | 3651 | 3651 | 3651 | 3651 | 3651 |
| Conditioned volume (cu ft) | 20689 | 20689 | 20689 | 31034 | 31034 | 31034 | 31034 | 31034 |
| Housing type | SFD | SFD | SFD | SFD | SFD | SFD | SFD | SFD |
| Number of stories (floors on or above-grade) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Number of bedrooms | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Conditioned floors (including basement where applicable) | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| Foundation | | | | | | | | |
| Slab on grade (Yes=1, No=0) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Crawl (Yes=1, No=0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Basement (Yes=1, No=0) | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Conditioned basement (Yes=1, No=0) | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Crawl/frame floor area (sq ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Floor covering, frame floor only | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Joist spacing, frame floor only (inches on center) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Joist depth, frame floor only (in) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| First floor R-value in case of unconditioned basement or ventilated crawl | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| First floor insulation thickness in case of unconditioned basement or ventilated crawl (in) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Basement slab area (sq ft) | N/A | N/A | N/A | 1217 | 1217 | 1217 | 1217 | 1217 |
| Slab on grade area (sq ft) | 1217 | 1217 | 1217 | N/A | N/A | N/A | N/A | N/A |
| Slab on grade vertical insulation R-value (assumed grade I) | 0 | 0 | 0 | N/A | N/A | N/A | N/A | N/A |
| Slab on grade vertical insulation depth (ft) | 0 | 0 | 0 | N/A | N/A | N/A | N/A | N/A |
| Slab on grade floor covering (carpet or none) | 80 or 20 | 80 or 20 | 80 or 20 | N/A | N/A | N/A | N/A | N/A |
| Foundation full perimeter (ft) | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 |
| Basement slab or slab on grade total exposed perimeter (ft) | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 |

| New Homes—Circa 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Miami, FL | Phoenix, AZ | Dallas, TX | Baltimore, MD | Denver, CO | Burlington, VT | Duluth, MN | Fairbanks, AK |
| | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* |
| Basement floor covering | N/A | N/A | N/A | 80/20 | 80/20 | 80/20 | 80/20 | 80/20 |
| Basement wall U-factor | N/A | N/A | N/A | 0.059 | 0.059 | 0.050 | 0.050 | 0.050 |
| Basement blanket insulation height (ft) | N/A | N/A | N/A | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| Basement wall average height above-grade (ft) | N/A | N/A | N/A | 2 | 2 | 2 | 2 | 2 |
| Basement wall floor to ceiling height (ft) | N/A | N/A | N/A | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| Basement wall type (UB=block, un-insulated cores; SC=solid concrete) | N/A | N/A | N/A | UB | UB | UB | UB | UB |
| Basement slab depth below grade (ft) | N/A | N/A | N/A | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |
| Band joist | | | | | | | | |
| Band joist area (sq ft) | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 | 139.5 |
| Cavity insulation R-value (assumed grade I) | 13 | 13 | 13 | 13 | 20 | 20 | 21 | 21 |
| Cavity insulation thickness (in) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Above-grade wall | | | | | | | | |
| Stud depth and insulation depth (in) | 3.5 | 3.5 | 3.5/5.5 | 3.5/5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| Stud spacing (inches o.c.) | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. |
| Cavity insulation R-value (assumed grade I) | 13 | 13 | 13 | 13 | 20 | 20/20+5 | 21/20+5 | 21/20+5 |
| Assembly U-factor | 0.082 | 0.082 | 0.082 /0.059 | 0.082 /0.059 | 0.059 | 0.059 /0.044 | 0.057 /0.044 | 0.057 /0.044 |
| Gross area (sq ft) | 2372 | 2372 | 2372 | 2372 | 2372 | 2372 | 2372 | 2372 |
| Length (ft) | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 |
| Width (ft) | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 | 34.9 |
| Solar absorptance | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Solar emittance | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Windows | | | | | | | | |
| Window U-value | 1.20 /0.40 | 0.65 /0.40 | 0.50 /0.35 | 0.35 | 0.35 /0.32 | 0.35 /0.32 | 0.35 /0.32 | 0.35 /0.32 |
| Window SHGC | 0.30 /0.25 | 0.30 /0.25 | 0.30 /0.25 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Window area (sq ft) | 365.1 | 365.1 | 365.1 | 467.7 | 467.7 | 467.7 | 467.7 | 467.7 |
| NW | 91.3 | 91.3 | 91.3 | 116.9 | 116.9 | 116.9 | 116.9 | 116.9 |
| SE | 91.3 | 91.3 | 91.3 | 116.9 | 116.9 | 116.9 | 116.9 | 116.9 |
| NE | 91.3 | 91.3 | 91.3 | 116.9 | 116.9 | 116.9 | 116.9 | 116.9 |
| SW | 91.3 | 91.3 | 91.3 | 116.9 | 116.9 | 116.9 | 116.9 | 116.9 |
| Interior shading, winter | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Interior shading, summer | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 |
| Overhang depth (ft) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Overhang to top of window (ft) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Overhang to bottom of window (ft) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| New Homes—Circa 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Miami, FL | Phoenix, AZ | Dallas, TX | Baltimore, MD | Denver, CO | Burlington, VT | Duluth, MN | Fairbanks, AK |
| | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* |
| Doors | | | | | | | | |
| Orientation (one front, one back) | | | | | | | | |
| Total area for all doors (sq ft) | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| U-factor | 1.2 | 0.65 | 0.5 | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| Attic/ceiling | | | | | | | | |
| Gross area (sq ft) | 1217 | 1217 | 1217 | 1217 | 1217 | 1217 | 1217 | 1217 |
| Ceiling U-factor (assumed grade I) | 0.035 | 0.035 /0.030 | 0.035 /0.030 | 0.030 /0.026 | 0.030 /0.026 | 0.026 | 0.026 | 0.026 |
| Roof | | | | | | | | |
| Construction type | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing |
| Venting ratio | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 |
| Solar absorptance | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Emittance | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Radiant barrier (0 = none) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mechanical equipment | | | | | | | | |
| ASHP heating season performance factor/seasonal energy efficiency rating (HSPF & SEER) | 7.7 & 13 | 7.7 & 13 | 7.7 & 13 | N/A | N/A | N/A | N/A | N/A |
| Gas-fired forced air furnace + AC annual fuel utilization efficiency (AFUE) & SEER | N/A | N/A | N/A | 78 AFUE & 13 SEER | 78 & 13 | 78 & 13 | 78 & 13 | 78 & 13 |
| Gas-fired water heater, 40 gallons energy factor (EF) | 0.59 | 0.59 | 0.59 | 0.59 | 0.59 | 0.59 | 0.59 | 0.59 |
| Location of space heating and cooling equipment (CA=conditioned area) | Attic | Attic | Attic | CA | CA | CA | CA | CA |
| Location of water heater (F=first floor, G=garage, B=basement) | F | F | F | F | F | F | F | F |
| Heating set point (°F) | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 |
| Cooling set point (°F) | 78 | 78 | 78 | 78 | 78 | 78 | 78 | 78 |
| Programmable T-stat (Yes=1, No=0) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Offsets | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Duct system—set areas by EnergyGauge default | | | | | | | | |
| Conditioned areas | | | | | | | | |
| Supply duct | 456 | 456 | 456 | 456 | 456 | 456 | 456 | 456 |
| Return duct | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 |
| Attic | | | | | | | | |
| Supply duct | 152 | 152 | 152 | 456 | 456 | 456 | 456 | 456 |
| Return duct | 30 | 30 | 30 | 91 | 91 | 91 | 91 | 91 |

| New Homes—Circa 2010 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Miami, FL | Phoenix, AZ | Dallas, TX | Baltimore, MD | Denver, CO | Burlington, VT | Duluth, MN | Fairbanks, AK |
| | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* | *2009/2012 IECC* |
| Location (attic vs. conditioned) | 75% vs. 25% | 75% vs. 25% | 75% vs. 25% | 50% vs. 50% | 50% vs. 50% | 50% vs. 50% | 50% vs. 50% | 50% vs. 50% |
| Leakage: Qn (cfm25out divided by floor area) | 0.08 /0.04 | 0.08 /0.04 | 0.08 /0.04 | 0.08 /0.04 | 0.08 /0.04 | 0.08 /0.04 | 0.08 /0.04 | 0.08 /0.04 |
| Insulation for ducts in unconditioned space | R-8 | R-8 | R-8 | R-8 | R-8 | R-8 | R-8 | R-8 |
| 2009: Infiltration, effective leakage area (SLA)/ 2012: Air changes per hour (ACH50) | 0.00036 /5ACH50 | 0.00036 /5ACH50 | 0.00036 /3ACH50 | 0.00036 /3ACH50 | 0.00036 /3ACH50 | 0.00036 /3ACH50 | 0.00036 /3ACH50 | 0.00036 /3ACH50 |
| Mechanical ventilation | | | | | | | | |
| Rate (cfm) | 0/60 | 0/60 | 0/60 | 0/60 | 0/60 | 0/60 | 0/60 | 0/60 |
| Daily run time (hours) | 0/24 | 0/24 | 0/24 | 0/24 | 0/24 | 0/24 | 0/24 | 0/24 |
| Power draw (watts) | 0/21 | 0/21 | 0/21 | 0/21 | 0/21 | 0/21 | 0/21 | 0/21 |
| Type (supply or exhaust [exh]) | 0/exh | 0/exh | 0/exh | 0/exh | 0/exh | 0/exh | 0/exh | 0/exh |
| Cooling season ventilation (natural ventilation [nat]) | nat | nat | nat | nat | nat | nat | nat | nat |
| Lighting, percent fluorescent | 50% /75% | 50% /75% | 50% /75% | 50% /75% | 50% /75% | 50% /75% | 50% /75% | 50% /75% |
| Refrigerator (kWh/yr) | 775 | 775 | 775 | 775 | 775 | 775 | 775 | 775 |
| Dishwasher (EF) | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 |
| Ceiling fan (cfm/watt) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Existing Home Assumptions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| City | Miami | Phoenix | Dallas | Baltimore | Denver | Burlington | Duluth | Fairbanks |
| State | FL | AZ | TX | MD | CO | VT | MN | AK |
| Climate zone, *IECC* | 1 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| Cooling employed (Yes=1, No=0) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| House orientation for front of home | SE | SE | SE | SE | SE | SE | SE | SE |
| Above-grade sq ft | 1660 | 1660 | 1660 | 1660 | 1660 | 1660 | 1660 | 1660 |
| Aspect ratio | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Length (ft) | 46.5 | 46.5 | 46.5 | 46.5 | 46.5 | 46.5 | 46.5 | 46.5 |
| Width (ft) | 35.7 | 35.7 | 35.7 | 35.7 | 35.7 | 35.7 | 35.7 | 35.7 |
| First floor ceiling height (ft) | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Second floor ceiling height (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Conditioned area (sq ft) | 1660 | 1660 | 1660 | 3320 | 3320 | 3320 | 3320 | 3320 |
| Conditioned volume (cu ft) | 13280 | 13280 | 13280 | 24900 | 24900 | 24900 | 24900 | 24900 |
| Housing type | SFD | SFD | SFD | SFD | SFD | SFD | SFD | SFD |
| Number of stories (floors on or above-grade) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Number of bedrooms | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Conditioned floors (including basement where applicable) | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| Foundation | | | | | | | | |
| Slab on grade (Yes=1, No=0) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Crawl (Yes=1, No=0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Basement (Yes=1, No=0) | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Conditioned basement (Yes=1, No=0) | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| Crawl/frame floor area (sq ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Floor covering, frame floor only | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Joist spacing, frame floor only (inches o.c.) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Joist depth, frame floor only (in) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| First floor R-value in case of unconditioned basement or ventilated crawl | 0 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| First floor insulation thickness in case of unconditioned basement or ventilated crawl (in) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Basement slab area (sq ft) | N/A | N/A | N/A | 1660 | 1660 | 1660 | 1660 | 1660 |
| Slab on grade area (sq ft) | 1660 | 1660 | 1660 | N/A | N/A | N/A | N/A | N/A |
| Slab on grade vertical insulation R-value (assumed grade III) | 0 | 0 | 0 | N/A | N/A | N/A | N/A | N/A |
| Slab on grade vertical insulation depth (ft) | 0 | 0 | 0 | N/A | N/A | N/A | N/A | N/A |
| Foundation full perimeter (ft) | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 |
| Basement slab or slab on grade total exposed perimeter (ft) | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 |
| Basement blanket insulation R-value (assumed grade III) | N/A | N/A | N/A | 9 | 9 | 9 | 9 | 9 |
| Basement blanket insulation height (ft) | N/A | N/A | N/A | 7 | 7 | 7 | 7 | 7 |

| Existing Home Assumptions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| City | Miami | Phoenix | Dallas | Baltimore | Denver | Burlington | Duluth | Fairbanks |
| State | FL | AZ | TX | MD | CO | VT | MN | AK |
| Basement wall average height above-grade (ft) | N/A | N/A | N/A | 2 | 2 | 2 | 2 | 2 |
| Basement wall floor to ceiling height (ft) | N/A | N/A | N/A | 7 | 7 | 7 | 7 | 7 |
| Basement wall type (UB=block, un-insulated cores; SC=solid concrete) | N/A | N/A | N/A | UB | UB | UB | UB | UB |
| Basement slab depth below grade (ft) | N/A | N/A | N/A | 5 | 5 | 5 | 5 | 5 |
| Roof | | | | | | | | |
| Construction type | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing | Comp shingle on wood sheathing |
| Venting ratio | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 | 1:300 |
| Solar absorptance | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Radiant barrier? | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Attic/ceiling | | | | | | | | |
| Gross area (sq ft) | 1660 | 1660 | 1660 | 1660 | 1660 | 1660 | 1660 | 1660 |
| Total insulation R-value (assumed grade III) | 7 | 7 | 7 | 7 | 11 | 22 | 7 | 22 |
| Cavity insulation R-value (assumed grade III) | 7 | 7 | 7 | 7 | 11 | 19 | 7 | 19 |
| Cavity insulation thickness (in) | 2.3 | 2.3 | 2.3 | 2.3 | 3.7 | 5.5 | 2.3 | 5.5 |
| Continuous insulation R-value (assumed grade III) | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| Bottom chord/rafter spacing (in o.c.) | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Bottom chord/rafter size, wxh (in) | 1.5x5.5 | 1.5x5.5 | 1.5x5.5 | 1.5x5.5 | 1.5x5.5 | 1.5x5.5 | 1.5x5.5 | 1.5x5.5 |
| Above-grade wall | | | | | | | | |
| Stud depth and insulation depth (in) | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Stud spacing (in o.c.) | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. | 16" o.c. |
| Cavity insulation R-value (assumed grade III) | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Above-grade wall U-factor | 0.094 | 0.094 | 0.094 | 0.094 | 0.094 | 0.094 | 0.094 | 0.094 |
| Adding R-2.0 insulated siding | 0.086 | 0.086 | 0.086 | 0.086 | 0.086 | 0.086 | 0.086 | 0.086 |
| Adding R-2.5 insulated siding | 0.082 | 0.082 | 0.082 | 0.082 | 0.082 | 0.082 | 0.082 | 0.082 |
| Gross area (sq ft) | 1315 | 1315 | 1315 | 1315 | 1315 | 1315 | 1315 | 1315 |
| Band joist | | | | | | | | |
| Band joist area (sq ft) | N/A | N/A | N/A | 164.4 | 164.4 | 164.4 | 164.4 | 164.4 |
| Cavity insulation R-value (assumed grade III) | N/A | N/A | N/A | 9 | 9 | 9 | 9 | 9 |
| Cavity insulation thickness (in) | N/A | N/A | N/A | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |

| Existing Home Assumptions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| City | Miami | Phoenix | Dallas | Baltimore | Denver | Burlington | Duluth | Fairbanks |
| State | FL | AZ | TX | MD | CO | VT | MN | AK |
| Doors: Assumed 2 1/4" wood, solid core, R-2.8, 20 sq ft; two locations (front, rear) | | | | | | | | |
| Windows | | | | | | | | |
| Type (Al = aluminum, Wd = wood) | Al | Al | Al | Al | Wd | Wd | Wd | Wd |
| Number of Panes | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| Proxy city for type (reference LBNL study: Prototype Residential Buildings to Represent the U.S. Housing Stock) | Miami | Phoenix | Fort Worth | Washington, D.C. | Denver | Boston | Minneapolis | Boston |
| U-value | 1.27 | 1.27 | 1.27 | 1.27 | 0.89 | 0.55 | 0.89 | 0.55 |
| SHGC | 0.75 | 0.75 | 0.75 | 0.75 | 0.64 | 0.56 | 0.64 | 0.56 |
| Area (sq ft) | 118.4 | 118.4 | 118.4 | 118.4 | 118.4 | 118.4 | 118.4 | 118.4 |
| NW | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 |
| SE | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 | 39.5 |
| NE | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 |
| SW | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 |
| Interior shading, winter | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Interior shading, summer | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 |
| Overhang depth (ft) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Overhang to top of window (ft) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Overhang to bottom of window (ft) | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Infiltration | Miami | Phoenix | Dallas | Baltimore | Denver | Burlington | Duluth | Fairbanks |
| Prior to insulated siding installation (ACH 50) | 9.84 | 9.84 | 9.84 | 10.49 | 10.49 | 10.49 | 10.49 | 10.49 |
| Post installation (ACH 50) | 8.86 | 8.86 | 8.86 | 9.44 | 9.44 | 9.44 | 9.44 | 9.44 |
| Mechanical equipment | See worksheet for details | | | | | | | |
| Age of equipment (years) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Maintenanace | Rare | Rare | Rare | Rare | Rare | Rare | Rare | Rare |
| Efficiencies decline according to DOE Building America algorithm (Yes=1, No=0) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Efficiency at time of install | Fed Min | Fed Min | Fed Min | Fed Min | Fed Min | Fed Min | Fed Min | Fed Min |
| ASHP (HSPF/SEER)? | 5.0/7.4 | 5.0/7.4 | 5.0/7.4 | 0 | 0 | 0 | 0 | 0 |
| Gas-fired forced air furnace + AC (AFUE/SEER)? | 0 | 0 | 0 | 67/7.4 | 67/7.4 | 67/7.4 | 67/7.4 | 67/7.4 |
| Electric water heater, 50 gallons (EF) | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Location of space heating and cooling equipment | Attic | Attic | Attic | Basement | Basement | Basement | Basement | Basement |
| Location of water heater | Attic | Attic | Attic | Basement | Basement | Basement | Basement | Basement |
| Heating set point (°F) | HERS 2006 Reference | HERS 2006 Reference | HERS 2006 Reference | HERS 2006 Reference | HERS 2006 Reference | HERS 2006 Reference | HERS 2006 Reference | HERS 2006 Reference |

| Existing Home Assumptions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| City | Miami | Phoenix | Dallas | Baltimore | Denver | Burlington | Duluth | Fairbanks |
| State | FL | AZ | TX | MD | CO | VT | MN | AK |
| **Cooling set point (°F)** | | | | | | | | |
| **Programmable T-stat (Yes=1, No=0)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Duct system** | | | | | | | | |
| **Leakage** | Default | Default | Default | Default | Default | Default | Default | Default |
| **Location** | Attic | Attic | Attic | Base-ment | Base-ment | Basement | Base-ment | Basement |
| **Duct insulation R-value (unconditioned space only; no insulation in conditioned space)** | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

For existing homes, many of the assumptions related to U-factors and R-values were sourced from Source 1. The methodology used to adjusted equipment efficiency was derived from Source 2. All modeling was done using Energy Gauge USA software.

Source 1: Huang, J., and Gu, L., Prototype Residential Buildings to Represent the U.S. Housing Stock, Draft LBNL Report, Berkeley, CA, Lawrence Berkeley National Laboratory, 2002.

Source 2: Hendron, R., Building America Performance Analysis Procedures for Existing Homes, DOE, NREL/TP-550-38238, 2006.

# Appendix C: FTC Regulation—Current as of November 1, 2010[38]

## *Part 460—Labeling and Advertising of Home Insulation*

Section



AUTHORITY: 38 Stat. 717, as amended (15 U.S.C. 41 et seq.).
SOURCE: 44 FR 50242, Aug. 27, 1979, unless otherwise noted.

### § 460.1 What this regulation does.

This regulation deals with home insulation labels, fact sheets, ads, and other promotional materials in or affecting commerce, as "commerce" is defined in the Federal Trade Commission Act. If you are covered by this regulation, breaking any of its rules is an unfair and deceptive act or practice or an unfair method of competition under section 5 of that Act. You can be fined heavily (up to $11,000 plus an adjustment for inflation, under § 1.98 of this chapter) each time you break a rule. [70 FR 31274, May 31, 2005]

### § 460.2 What is home insulation.

Insulation is any material mainly used to slow down heat flow. It may be mineral or organic, fibrous, cellular, or reflective (aluminum foil). It may be in rigid, semirigid, flexible, or loose-fill form. Home insulation is for use in old or new homes, condominiums, cooperatives, apartments, modular homes, or mobile homes. It does not include pipe insulation. It does not include any kind of duct insulation except for duct wrap.

### § 460.3 Who is covered.

You are covered by this regulation if you are a member of the home insulation industry. This includes individuals, firms, partnerships, and corporations. It includes manufacturers, distributors, franchisors, installers, retailers, utility companies, and trade associations. Advertisers and advertising agencies are also covered. So are labs doing tests for industry members. If you sell new homes to consumers, you are covered.

### § 460.4 When the rules apply.

You must follow these rules each time you import, manufacture, distribute, sell, install, promote, or label home insulation. You must follow them each time you prepare, approve, place, or pay for home insulation labels, fact sheets, ads, or other promotional materials for consumer use. You must also follow them each time you supply anyone covered by this regulation with written information that is to be used in labels, fact sheets, ads, or other promotional materials for consumer use. Testing labs must follow the rules unless the industry members tell them, in writing, that labels, fact sheets, ads, or other promotional materials for home insulation will not be based on the test results.

### 460.5 R-value tests.

R-value measures resistance to heat flow. R-values given in labels, fact sheets, ads, or other promotional materials must be based on tests done under the methods listed below. They were designed by the American Society of Testing and Materials (ASTM).

[38] See 16 C.F.R. Part 460: http://www.access.gpo.gov/nara/cfr/waisidx_10/16cfr460_10.html.

The test methods are:

(a) All types of insulation except aluminum foil must be tested with *ASTM C177–04*, "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus;" *ASTM C518–04*, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus;" *ASTM C1363–97*, "Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus;" or *ASTM C1114–00*, "Standard Test Method for Steady- State Thermal Transmission Properties by Means of the Thin-Heater Apparatus." The tests must be done at a mean temperature of 75 [degrees] Fahrenheit and with a temperature differential of 50 [degrees] Fahrenheit plus or minus 10 degrees Fahrenheit. The tests must be done on the insulation material alone (excluding any airspace). R-values ("thermal resistance") based upon heat flux measurements according to *ASTM C177–04* or *ASTM C518–04* must be reported only in accordance with the requirements and restrictions of *ASTM C1045–01*, "Standard Practice for Calculating Thermal Transmission Properties from Steady-State Conditions."

(1) For polyurethane, polyisocyanurate, and extruded polystyrene, the tests must be done on samples that fully reflect the effect of aging on the product's R-value. To age the sample, follow the procedure in paragraph 4.6.4 of GSA Specification HH–I–530A, or another reliable procedure.

(2) For loose-fill cellulose, the tests must be done at the settled density determined under paragraph 8 of *ASTM C739–03*, "Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation."

(3) For loose-fill mineral wool, self-supported, spray-applied cellulose, and stabilized cellulose, the tests must be done on samples that fully reflect the effect of settling on the product's R-value.

(4) For self-supported spray-applied cellulose, the tests must be done at the density determined pursuant to *ASTM C1149–02*, "Standard Specification for Self-Supported Spray Applied Cellulosic Thermal Insulation."

(5) For loose-fill insulations, the initial installed thickness for the product must be determined pursuant to *ASTM C1374–03*, "Standard Test Method for Determination of Installed Thickness of Pneumatically Applied Loose-Fill Building Insulation," for R-values of 13, 19, 22, 30, 38, 49 and any other R-values provided on the product's label pursuant to § 460.12.

(b) Single sheet systems of aluminum foil must be tested with *ASTM E408–71* (Reapproved 2002), "Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques," or *ASTM C1371–04a*, "Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers." This tests the emissivity of the foil—its power to radiate heat. To get the R-value for a specific emissivity level, air space, and direction of heat flow, use the tables in the most recent edition of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) Fundamentals Handbook, if the product is intended for applications that meet the conditions specified in the tables. You must use the R-value shown for 50 [degrees] Fahrenheit, with a temperature differential of 30 [degrees] Fahrenheit.

(c) Aluminum foil systems with more than one sheet, and single sheet systems of aluminum foil that are intended for applications that do not meet the conditions specified in the tables in the most recent edition of the ASHRAE Fundamentals Handbook, must be tested with *ASTM C1363–97*, "Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," in a test panel constructed according to *ASTM C1224–03*, "Standard Specification for Reflective Insulation for Building Applications," and under the test conditions specified in *ASTM C1224–03*. To get the R-value from the results of those tests, use the formula specified in *ASTM C1224–03*. (d) For insulation materials with foil facings, you must test the R-value of the material alone (excluding any air spaces) under the methods listed in paragraph (a) of this section. You can also determine the R-value of the material in conjunction with an air space. You can use one of two methods to do this:

(1) You can test the system, with its air space, under *ASTM C1363–97*, "Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," which is incorporated by reference in paragraph (a) of this section. If you do this, you must follow the rules in paragraph (a) of this section on temperature, aging and settled density.

(2) You can add up the tested R-value of the material and the R-value of the air space. To get the R-value for the air space, you must follow the rules in paragraph (b) of this section.

(e) The standards listed above are incorporated by reference into this section. These incorporations by reference were approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be inspected at the Federal Trade Commission, Consumer Response Center, Room 130, 600 Pennsylvania Avenue, NW., Washington, DC 20580, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call (202) 741–6030, or go to: http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. Copies of materials and standards incorporated by reference may be obtained from the issuing organizations listed in this section.

(1) The American Society of Testing and Materials, 100 Barr Harbor Drive, P.O. Box C700, West Conshocken, PA 19428–2959.

(i) *ASTM C177–04,* "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus."

(ii) *ASTM C518–04*, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus."

(iii) *ASTM C739–03*, "Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation."

(iv) *ASTM C1045–01*, "Standard Practice for Calculating Thermal Transmission Properties from Steady-State Conditions."

(v) *ASTM C1114–00*, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus."

(vi) *ASTM C1149–02*, "Standard Specification for Self-Supported Spray Applied Cellulosic Thermal Insulation."

(vii) *ASTM C1224–03*, "Standard Specification for Reflective Insulation for Building Applications."

(viii) *ASTM C1363–97*, "Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus."

(ix) *ASTM C1371–04a*, "Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers."

(x) *ASTM C1374–03*, "Standard Test Method for Determination of Installed Thickness of Pneumatically Applied Loose-Fill Building Insulation."

(xi) *ASTM E408–71* (Reapproved 2002), "Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques."

(2) U.S. General Services Administration (GSA), 1800 F Street, NW., Washington, DC 20405.

(i) GSA Specification HH–I–530A, Federal Specification, Insulation Board, Thermal (Urethane), November 22, 1971.

(ii) [Reserved]

[70 FR 31274, May 31, 2005]

**§ 460.6 "Representative thickness" testing.**
All tests except aluminum foil tests must be done at a representative thickness for every thickness shown in a label, fact sheet, ad, or other promotional material. "Representative thickness" means a thickness at which the R-value per unit will vary no more than plus or minus 2% with increases in thickness. However, if the thickness shown in your label, fact sheet, ad, or promotional material is less than the representative thickness, then you can test the insulation at the thickness shown.

**§ 460.7 Which test version to use.**
Use the version of the ASTM test method that was in effect when this regulation was promulgated. If

ASTM changes a test method, the new version will automatically replace the old one in these rules 90 days after ASTM first publishes the change. However, the Commission's staff or a person affected by the change can petition the Commission during the 90-day period not to adopt the change or to reopen the proceeding to consider it further.

**§ 460.8 R-value tolerances.**

If you are a manufacturer of home insulation, no individual specimen of the insulation you sell can have an R-value more than 10% below the R-value shown in a label, fact sheet, ad, or other promotional material for that insulation. If you are not a manufacturer, you can rely on the R-value data given to you by the manufacturer, unless you know or should know that the data is false or not based on the proper tests.

[70 FR 31275, May 31, 2005]

**§ 460.9 What test records you must keep.**

Manufacturers and testing labs must keep records of each item of information in the "Report" section of the ASTM test method that is used for a test. They must also keep the following records:

(a) The name and address of the testing lab that did each test.

(b) The date of each test.

(c) For manufacturers, the date each test report was received from a lab. For labs, the date each test report was sent to a manufacturer.

(d) For extruded polystyrene, polyurethane, and polyisocyanurate, the age (in days) of the specimen that was tested.

(e) For aluminum foil, the emissivity level that was found in the test.

Manufacturers who own their own testing labs need not keep records of the information in paragraph (c) of this section.

Keep these records for at least three years. If the documents show proof for your claims, the three years will begin again each time you make the claim. Federal Trade Commission staff members can check these records at any time, but they must give you reasonable notice first.

**§ 460.10 How statements must be made.**

All statements called for by this regulation must be made clearly and conspicuously. Among other things, you must follow the Commission's enforcement policy statement for clear and conspicuous disclosures in foreign language advertising and sales materials, 16 CFR 14.9.

[61 FR 13666, Mar. 28, 1996]

**§ 460.11 Rounding off R-values.**

R-values shown in labels, fact sheets, ads, or other promotional materials must be rounded to the nearest tenth. However, R-values of 10 or more may be rounded to the nearest whole number.

**§ 460.12 Labels.**

If you are a manufacturer, you must label all packages of your insulation. The labels must contain:

(a) The type of insulation.

(b) A chart showing these items:

(1) For batts and blankets of any type: the R-value, length, width, thickness, and square feet of insulation in the package.

(2) For all loose-fill insulation: the minimum settled thickness, initial installed thickness, maximum net coverage area, number of bags per 1,000 square feet, and minimum weight per square foot at R-values of 13, 19, 22, 30, 38, and 49. You must also give this information for any additional R-values you list on the chart. Labels for these products must state the minimum net weight of the insulation in the package. You must also provide information about the blowing machine and machine settings used to derive the initial installed thickness information.

(3) For boardstock: the R-value, length, width, and thickness of the boards in the package, and the square feet of insulation in the package.

(4) For aluminum foil: the number of foil sheets; the number and thickness of the air spaces; and the R-value provided by that system when the direction of heat flow is up, down, and horizontal. You can show the R-value for only one direction of heat flow if you

clearly and conspicuously state that the foil can only be used in that application.

(5) For insulation materials with foil facings, you must follow the rule that applies to the material itself. For example, if you manufacture boardstock with a foil facing, follow paragraph (b)(3) of this section. You can also show the R-value of the insulation when it is installed in conjunction with an air space. This is its "system R-value." If you do this, you must clearly and conspicuously state the conditions under which the system R-value can be attained.

(6) For air duct insulation: the R-value, length, width, thickness, and square feet of insulation in the package.

(c) The following statement: "R means resistance to heat flow. The higher the R-value, the greater the insulating power."

(d) If installation instructions are included on the label or with the package, add this statement: "To get the marked R-value, it is essential that this insulation be installed properly. If you do it yourself, follow the instructions carefully."

(e) If no instructions are included, add this statement: "To get the marked R-value, it is essential that this insulation be installed properly. If you do it yourself, get instructions and follow them carefully. Instructions do not come with this package."

[70 FR 31276, May 31, 2005]

**§ 460.13 Fact sheets.**

If you are a manufacturer, you must give retailers and installers fact sheets for the insulation products you sell to them. Each sheet must contain what is listed here. You can add any disclosures that are required by federal laws, regulations, rules, or orders. You can add any disclosures that are required by State or local laws, rules, and orders, unless they are inconsistent with the provisions of this regulation. Do not add anything else.

Each fact sheet must contain these items:

(a) The name and address of the manufacturer. It can also include a logo or other symbol that the manufacturer uses.

(b) A heading: "This is ____ insulation." Fill in the blank with the type and form of your insulation. (c) The heading must be followed by a chart:

(1) If § 460.12(b) requires a chart for your product's label, you must use that chart. For foamed-in-place insulations, you must show the R-value of your product at 3 1/2 inches. You can also show R-values at other thicknesses.

(2) You can put the charts for similar products on the same fact sheet. For example, if you sell insulation boards or batts in three different thicknesses, you can put the label charts for all three products on one fact sheet. If you sell loose-fill insulation in two different bag sizes, you can put both coverage charts on one fact sheet, as long as you state which coverage chart applies to each bag size.

(d) For air duct insulation, the chart must be followed by this statement:

"The R-value of this insulation varies depending on how much it is compressed during installation."

(e) After the chart and any statement dealing with the specific type of insulation, ALL fact sheets must carry this statement, boxed, in 12-point type:

**READ THIS BEFORE YOU BUY**

**What You Should Know About R-values**

The chart shows the R-value of this insulation. R means resistance to heat flow. The higher the R-value, the greater the insulating power. Compare insulation R-values before you buy.

There are other factors to consider. The amount of insulation you need depends mainly on the climate you live in. Also, your fuel savings from insulation will depend upon the climate, the type and size of your house, the amount of insulation already in your house, and your fuel use patterns and family size. If you buy too much insulation, it will cost you more than what you'll save on fuel. To get the marked R-value, it is essential that this insulation be installed properly.

[44 FR 50242, Aug. 27, 1979, as amended at 45 FR 68928, Oct. 17, 1980; 70 FR 31276, May 31, 2005]

**§ 460.14 How retailers must handle fact sheets.**
If you sell insulation to do-it-yourself customers, you must have fact sheets for the insulation products you sell. You must make the fact sheets available to your customers. You can decide how to do this, as long as your insulation customers are likely to notice them. For example, you can put them in a display, and let customers take copies of them. You can keep them in a binder at a counter or service desk, and have a sign telling customers where the fact sheets are. You need not make the fact sheets available to customers if you display insulation packages on the sales floor where your insulation customers are likely to notice them and each individual insulation package offered for sale contains all package label and fact sheet disclosures required by §§ 460.12 and 460.13.

[70 FR 31276, May 31, 2005]

**§ 460.15 How installers must handle fact sheets.**
If you are an installer, you must have fact sheets for the insulation products you sell. Before customers agree to buy insulation from you, you must show them the fact sheet(s) for the type(s) of insulation they want. You can decide how to do this. For example, you can give each customer a copy of the fact sheet(s). You can keep the fact sheets in a binder, and show customers the binder before they agree to buy.

**§ 460.16 What new home sellers must tell new home buyers.**
If you are a new home seller, you must put the following information in every sales contract: The type, thickness, and R-value of the insulation that will be installed in each part of the house. There is an exception to this rule. If the buyer signs a sales contract before you know what type of insulation will be put in the house, or if there is a change in the contract, you can give the buyer a receipt stating this information as soon as you find out.

**§ 460.17 What installers must tell their customers.**
If you are an installer, you must give your customers a contract or receipt for the insulation you install. For all insulation except loose-fill and aluminum foil, the receipt must show the coverage area, thickness, and R-value of the insulation you installed. The receipt must be dated and signed by the installer. To figure out the R-value of the insulation, use the data that the manufacturer gives you. If you put insulation in more than one part of the house, put the data for each part on the receipt. You can do this on one receipt, as long as you do not add up the coverage areas or R-values for different parts of the house. Do not multiply the R-value for one inch by the number of inches you installed. For loose-fill, the receipt must show the coverage area, initial installed thickness, minimum settled thickness, R-value, and the number of bags used. For aluminum foil, the receipt must show the number and thickness of the air spaces, the direction of heat flow, and the R-value.

[70 FR 31276, May 31, 2005]

**§ 460.18 Insulation ads.**
(a) If your ad gives an R-value, you must give the type of insulation and the thickness needed to get that R-value. Also, add this statement explaining R-values: "The higher the R-value, the greater the insulating power. Ask your seller for the fact sheet on R-values."

(b) If your ad gives a price, you must give the type of insulation, the R-value at a specific thickness, the statement explaining R-value in paragraph (a) of this section, and the coverage area for that thickness. If you give the price per square foot, you do not have to give the coverage area.

(c) If your ad gives the thickness of your insulation, you must give its R-value at that thickness and the statement explaining R-values in paragraph (a) of this section.

(d) If your ad compares one type of insulation to another, the comparison must be based on the same coverage areas. You must give the R-value at a specific thickness for each insulation, and the statement explaining R-values in paragraph (a) of this section. If you give the price of each insulation, you must also give the coverage area for the price and thickness shown. However, if you give the price per square foot, you do not have to give the coverage area.

(e) The affirmative disclosure requirements in § 460.18 do not apply to ads on television or radio.

[44 FR 50242, Aug. 27, 1979, as amended at 51 FR 39651, Oct. 30, 1986; 70 FR 31276, May 31, 2005]

**§ 460.19 Savings claims.**

(a) If you say or imply in your ads, labels, or other promotional materials that insulation can cut fuel bills or fuel use, you must have a reasonable basis for the claim. For example, if you say that insulation can "slash" or "lower" fuel bills, or that insulation "saves money," you must have a reasonable basis for the claim. Also, if you say that insulation can "cut fuel use in half," or "lower fuel bills by 30%," you must have a reasonable basis for the claim.

(b) If you say or imply in your ads, labels, or other promotional materials that insulation can cut fuel bills or fuel use, you must make this statement about savings: "Savings vary. Find out why in the seller's fact sheet on R-values. Higher R-values mean greater insulating power."

(c) If you say or imply that a combination of products can cut fuel bills or use, you must have a reasonable basis for the claim. You must make the statement about savings in paragraph (b) of this section. Also, you must list the combination of products used. They may be two or more types of insulation; one or more types of insulation and one or more other insulating products, like storm windows or siding; or insulation for two or more parts of the house, like the attic and walls. You must say how much of the savings came from each product or location. If you cannot give exact or approximate figures, you must give a ranking. For instance, if your ad says that insulation and storm doors combined to cut fuel use by 50%, you must say which one saved more.

(d) If your ad or other promotional material is covered by § 460.18 (a), (b), (c), or (d), and also makes a savings claim, you must follow the rules in §§ 460.18 and 460.19. However, you need not make the statement explaining R-value in § 460.18(a).

(e) Manufacturers are liable if they do not have a reasonable basis for their savings claims before the claim is made. If you are not a manufacturer, you are liable only if you know or should know that the manufacturer does not have a reasonable basis for the claim.

(f) Keep records of all data on savings claims for at least three years. For the records showing proof for claims, the three years will begin again each time you make the claim. Federal Trade Commission staff members can check these records at any time, but they must give you reasonable notice first.

(g) The affirmative disclosure requirements in § 460.19 do not apply to ads on television or radio.

[44 FR 50242, Aug. 27, 1979, as amended at 51 FR 39651, Oct. 30, 1986; 70 FR 31276, May 31, 2005]

**§ 460.20 R-value per inch claims.**

In labels, fact sheets, ads, or other promotional materials, do not give the R-value for one inch or the "R-value per inch" of your product. There are two exceptions:

(a) If an outstanding FTC Cease and Desist Order applies to you but differs from the rules given here, you can petition to amend the order.

(b) You can do this if actual test results prove that the R-value per inch of your product does not drop as it gets thicker.

You can list a range of R-value per inch. If you do, you must say exactly how much the R-value drops with greater thickness. You must also add this statement: "The R-value per inch of this insulation varies with thickness. The thicker the insulation, the lower the R-value per inch."

[44 FR 50242, Aug. 27, 1979, as amended at 70 FR 31276, May 31, 2005]

**§ 460.21 Government claims.**

Do not say or imply that a government agency uses, certifies, recommends, or otherwise favors your product unless it is true. Do not say or imply that your insulation complies with a governmental standard or specification unless it is true.

**§ 460.22 Tax claims.**
Do not say or imply that your product qualifies for a tax benefit unless it is true.

**§ 460.23 Other laws, rules, and orders.**
(a) If an outstanding FTC Cease and Desist Order applies to you but differs from the rules given here, you can petition to amend to order.

(b) State and local laws and regulations that are inconsistent with, or frustrate the purposes of, the provisions of this regulation are preempted. However, a State or local government may petition the Commission, for good cause, to permit the enforcement of any part of a State or local law or regulation that would be preempted by this section.

(c) The Commission's three-day cooling-off rule stays in force.

[44 FR 50242, Aug. 27, 1979, as amended at 70 FR 31276, May 31, 2005]

**§ 460.24 Stayed or invalid parts.**
If any part of this regulation is stayed or held invalid, the rest of it will stay in force.

APPENDIX TO PART 460—EXEMPTIONS

Section 18(g)(2) of the Federal Trade Commission Act, 15 U.S.C. 57a(g)(2), authorizes the Commission to exempt a person or class of persons from all or part of a trade regulation rule if the Commission finds that application of the rule is not necessary to prevent the unfair or deceptive acts or practices to which the rule relates. In response to petitions from industry representatives, the Commission has granted exemptions from specific requirements of 16 CFR part 460 to certain classes of sellers. Some of these exemptions are conditioned upon the performance of alternative actions. The exemptions are limited to specific sections of part 460. All other requirements of part 460 apply to these sellers. The exemptions are summarized below. For an explanation of the scope and application of the exemptions, see the formal Commission decisions in the FEDERAL REGISTER cited at the end of each exemption.

(a) Manufacturers of perlite insulation products that have an inverse relationship between R-value and density or weight per square foot are exempted from the requirements in §§ 460.12(b)(2) and 460.13(c)(1) that they disclose minimum weight per square foot for R-values listed on labels and fact sheets. This exemption is conditioned upon the alternative disclosure in labels and fact sheets of the maximum weight per square foot for each R-value required to be listed. 46 FR 22179 (1981).

(b) Manufacturers of rigid, flat-roof insulation products used in flat, built-up roofs are exempted from the requirements in § 460.12 that they label these home insulation products. 46 FR 22180 (1981).

(c) New home sellers are exempted from:

(1) the requirement in § 460.18(a) that they disclose the type and thickness of the insulation when they make a representation in an advertisement or other promotional material about the R-value of the insulation in a new home;

(2) the requirement that they disclose in an advertisement or other promotional material the R-value explanatory statement specified in § 460.18(a) or the savings explanatory statement specified in § 460.19(b), conditioned upon the new home sellers alternatively disclosing the appropriate explanatory statement in the sales contract along with the disclosures required by § 460.16;

(3) the requirement that they make the disclosures specified in § 460.19(c) if they claim that insulation, along with other products in a new home, will cut fuel bills or fuel use; and

(4) the requirement that they include the reference to fact sheets when they must disclose the R-value explanatory statement or the savings claim explanatory statement under § 460.18(a) or § 460.19(b), respectively. The exemptions for new home sellers also apply to home insulation sellers other than new home sellers when they participate with a new home seller to advertise and promote the sale of new homes, provided that the primary thrust of the advertisement or other promotional material is the promotion of new homes, and not the promotion of the insulation product. 48 FR 31192 (1983).

[61 FR 13666, Mar. 28, 1996]

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