Insulated Siding Provides CONTINUOUS Insulation

According to the U.S. Census Bureau, vinyl siding is already the top-selling exterior cladding in the United States. The vinyl siding industry, however, would like more people to think of it as a cladding product with benefits—not just as exterior cladding. Insulated siding, for example, can help homeowners save energy.

Recognized by energy codes and government programs alike as continuous insulation, insulated siding is the latest trend in home insulation. But to convince builders that the product will reduce thermal bridging, it's important to understand how it is tested for R-value, and how it should be applied for best performance.

Cladding with Benefits

First introduced commercially in 1997, insulated siding is vinyl siding that incorporates a substantial thickness of rigid-foam plastic insulation, which is laminated or otherwise permanently attached to the vinyl. The insulation that is most commonly used for the purpose is expanded polystyrene (EPS), which is covered under ASTM C578 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation." Insulated siding should not be confused with vinyl siding with a drop-in backer that is not integral to the panel. Insulated siding is more rigid and more stable dimensionally, and is designed to achieve higher levels of thermal performance. All of these qualities are verified through specific R-value testing.

Both DOE and EPA recognize that insulated siding can improve a home's energy efficiency. For example, when correctly installed, insulated siding that meets the R-value levels specified by EPA can help meet the performance guidelines of an Energy Star-qualified new home. All applications of materials to reduce thermal bridging, however, must meet the climate-specific R-value and installation requirements for the program.

The Federal Trade Commission (FTC) also has regulations governing home insulation claims, including the manufacturer's claims regarding its thermal insulation value. According to the FTC regulation, the claimed or rated R-value must be based on actual testing conducted in accordance with approved standards; for 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."

VSI?

In a side-by-side comparison, a study commissioned by VSI found this New York home could save significant resources by specifying insulated siding over fiber cement siding.

Real-World R-values

Everyone knows that the higher the R-value, the more effective the insulation. For that reason, raters must be sure that the advertised R-value truly indicates how the product will perform on a wall. Like many other home insulation providers, vinyl siding manufacturers are required to perform tests in accordance with an ASTM standard on their insulated siding products before they can make any claims concerning R-value.

However, because ASTM C1363 does not include installation details, the Vinyl Siding Institute (VSI) Technical Committee has determined test installation configurations, environmental conditions, and procedures to simulate real-world conditions. Insulated siding is installed over an 8-foot x 8-foot base wall according to the manufacturer's instructions, in a manner that replicates field installation. Wind is directed against the surface of the siding, perpendicular to the wall. This ensures that the R-value claimed for the siding represents the actual thermal insulation value that will be delivered to the

home. R-values identified through these testing methods can be used to comply with the requirements of the International Energy Conservation Code (IECC).

Another approach to consider—one that is important to raters evaluating insulated siding—is the U-factor. The U-factor of a wall assembly takes into account the combined insulating effects of all the wall's elements, including air film, interior gypsum, siding, structural sheathing, and insulation. Insulated siding can help builders and designers meet or exceed IECC requirements for whole-wall U-factors, which are climate zone dependent. The established R-value of the insulated siding is still necessary, however, to plug into the overall equation for establishing the U-factor of the wall.

VSI is working with ASTM International to develop a standard specification for insulated siding and is proposing a minimum R-value of 2.0. This R-value would be consistent with the minimum R-value required for insulated sheathing in the IECC.

Complying with Energy Codes

Insulated siding meets the requirements of vinyl siding and foam plastic insulation in the International Residential Codes and the International Building Code. The 2012 IECC recently added insulated siding to the building materials that can be used as continuous insulation outside of the framing to provide the required total wall value for buildings in the coldest climate zones. Insulated siding can be used to comply with previous versions of the IECC.

Per Section 402 of the 2009 IECC, the rated R-value of insulated siding can be used to calculate a whole-wall U-factor. When properly installed, insulated siding can also meet the definition of continuous insulation in ASHRAE 90.1, which is referenced in the 2009 IECC. And under the 2012 IECC, the R-value of insulated siding may be used to satisfy the insulation requirements of Table 402.1.1 when it is used as continuous insulation.

Table 1 gives an example of whole-wall U-factors for a wood-framed wall 16 inches on center. The left column shows the continuous insulation R-value of insulated siding and any other foam sheathing. Yellow-shaded cells represent wall assemblies that are in compliance with 2009 IECC residential U-factor requirements for wall assemblies in climate zones 1 through 4, and blue-shaded cells represent those in compliance in climate zones 5 through 8. Figure 1 shows a schematic drawing of the installed siding on an exterior wall.

Table 1. Whole-Wall U-Factors for a Wood-Framed Wall, 16 inches on Center

Continuous Insulation R-value	Cavity Insulation R-value							
	2" x 4" Construction				2" x 6" Construction			
	R-0	R-11	R-13	R-15	R-19	R-20	R-21	R-25
R-2.0	0.176	0.078	0.073	0.068	0.055	0.054	0.052	0.048
R-2.5	0.161	0.075	0.070	0.066	0.053	0.052	0.051	0.047
R-3.0	0.149	0.072	0.067	0.063	0.052	0.050	0.049	0.046
R-3.5	0.138	0.070	0.065	0.061	0.050	0.049	0.048	0.044
R-4.0	0.129	0.067	0.063	0.059	0.049	0.048	0.047	0.043
R-4.5	0.121	0.065	0.061	0.057	0.048	0.046	0.045	0.042
R-5.0	0.114	0.063	0.059	0.055	0.046	0.045	0.044	0.041
R-5.5	0.108	0.061	0.057	0.054	0.045	0.044	0.043	0.040
R-6.0	0.102	0.059	0.055	0.052	0.044	0.043	0.042	0.039
R-6.5	0.097	0.057	0.054	0.051	0.043	0.042	0.041	0.038
R-7.0	0.093	0.056	0.052	0.049	0.042	0.041	0.040	0.037
R-7.5	0.088	0.054	0.051	0.048	0.041	0.040	0.039	0.037
R-8.0	0.085	0.052	0.049	0.047	0.040	0.039	0.039	0.036
R-8.5	0.081	0.051	0.048	0.046	0.039	0.039	0.038	0.035
R-9.0	0.078	0.050	0.047	0.045	0.039	0.038	0.037	0.035
R-9.5	0.075	0.049	0.046	0.044	0.038	0.037	0.036	0.034
R-10.0	0.072	0.047	0.045	0.043	0.037	0.036	0.036	0.033

Insulated Siding and Energy Star-Qualified Homes

Because it can reduce thermal bridging, insulated siding has been added to the list of building products that can help qualify new homes under Energy Star-Qualified Homes Version 3, which began implementation in 2011 and will be required for new homes seeking to earn the Energy Star label by January 1, 2012. Both Energy Star-Qualified Homes and DOE's Builder's Challenge use a HERS index created from a building energy simulation model of a home to rate the home's energy performance. To demonstrate how insulated siding can improve a new home's energy performance and lower its HERS index, Newport Ventures, a research firm with expertise in the housing industry, created a model for a typical new home cladded with insulated siding.

How to Calculate Whole-Wall U-Factors

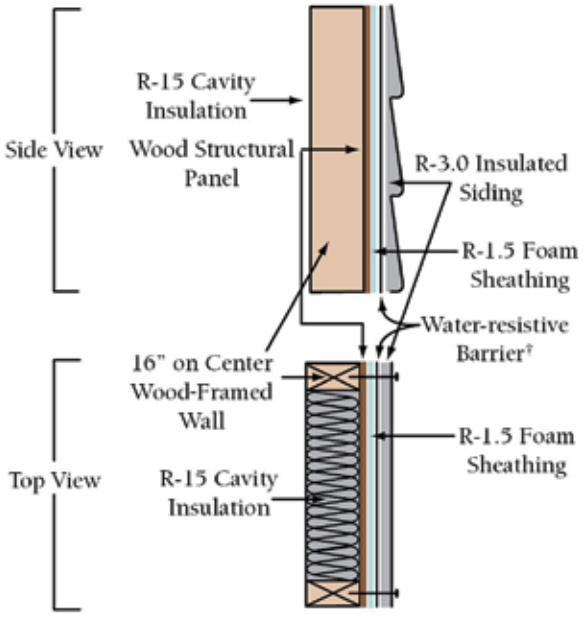

Figure 1. The illustration shows a sample wall assembly in which insulated siding helps meet or exceed the 2009 IECC for climate zones 1 through 8 with a U-factor of .057. This illustration depicts a wood-framed wall assembly with R-3.0 insulated siding, R-1.5 foam sheathing, and R-15 cavity insulation.

The prototypical new home was modeled using EnergyGauge USA software, configured to meet the minimum prescriptive and mandatory requirements of the 2009 IECC. The

Table 2. Insulated Siding and HERS Index of a 2009 IECC Minimally Compliant Home

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 2011 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	86	0.073	2	0.070	2	0.067	2	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	71
5	Denver	0.059	85	0.054	1	0.052	1	0.050	2	70
6	Burlington	0.059	86	0.054	1	0.052	1	0.050	2	68
7	Duluth	0.057	87	0.052	2	0.051	2	0.049	2	66
8	Fairbanks	0.057	85	0.052	2	0.051	2	0.049	2	61

prototypical home was modeled for each IECC climate zone and its HERS index was recorded. Simulations were then run with insulated siding installed at insulation ratings of R-2, R-2.5, and R-3. Results showed that insulated siding could provide a 1- to 3-point improvement in the HERS index of a 2009 IECC minimally compliant home, accounting for 23% of the total improvement necessary to comply with Energy Star-Qualified Homes Version 3. Insulated siding was also found to reduce the heating and cooling energy use in an existing home by 1–4%, with a HERS index of up to 6 points less than the typical home.

NYSERDA Study Cements Results

As part of its High-Performance Residential Development Challenge, designed to examine affordable energy efficiency, the New York State Energy Research and Development Authority (NYSERDA) conducted a study on two single-family homes built with insulated siding in New York State in 2008 and 2009. The goal of the study was to achieve 50–60% energy savings from typical homes built to the already stringent energy codes in New York by including affordable, energy-efficient systems. Building energy simulations conducted for both homes used an R-value of 2.6 for the insulated siding (based on a sample product tested using ASTM C1363).

As part of this study, VSI commissioned Newport Ventures to evaluate the environmental performance of insulated siding against fiber cement siding. Newport focused on one of the homes in the study, a two-story colonial in Burnt Hills, New York. Using both insulated siding and James Hardie fiber cement siding, Newport cladded a two-story section of a south-facing wall with no openings. Cavities were insulated to ensure that the overall thermal performance of the wall far exceeded code minimum requirements.

Newport used infrared imagery to measure the surface temperature of the wall. The exterior temperature of the insulated siding section turned out to be colder than that of the fiber cement siding. This shows that insulated siding minimizes heat loss through the wall assembly, especially through the studs, which have the lowest R-value in the overall assembly. Based on a building energy simulation, Newport projected that the Burnt Hills home could save significant resources by builders specifying insulated siding over fiber cement siding. Specifically, doing so would save 3.2 million Btu of energy consumed annually, 488 lb of CO_2 emissions associated with that energy use, and $56 per year in natural-gas and electric utility costs.

Because the benefits of insulated siding vary across climate zones in the United States, Newport conducted building energy simulations on the same home across the eight IECC climate zones. The simulations were based on a typical 2,280 ft^2 two-story home with energy efficiency equipment that complied with the minimum prescriptive path of 2006 IECC, except vinyl windows and basement insulation, Newport determined that using insulated siding in lieu of fiber cement siding across all eight climate zones would produce energy savings of 0.6–6.2 MMBtu (average 3.3 MMBtu); a decrease in the HERS index of 1 to 2 points (average 1.9 points); a decrease in CO_2 emissions of 167–755 lb (average 497 lb); and utility cost savings of 2–5% (average 3%), based on total heating, cooling, and water-heating costs.

—Matt Dobson

>> learn more

For the FTC regulations governing home insulation claims, including claims regarding the thermal insulation value provided by the manufacturer, see 16 C.F.R. Part 460. Go to www.access.gpo.gov/nara/cfr/waisidx_10/16cfr460_10.html).

Additional information about insulated siding and U-factor calculations is available in VSI's Insulated Siding as Home Insulation: Guide for Users and Energy Raters. To download a free copy, go to www.insulatedsiding.info.

VSI also offers a free webinar on insulated siding as home insulation. To learn more, go to www.vinylsiding.org.

To learn more about the NYSERDA study mentioned at the end of the article, visit www.vinylsiding.org/aboutsiding/insulated/nyserda/index.asp.

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