

The EnergyComplete™ System Enhances Building Energy Efficiency

Introduction

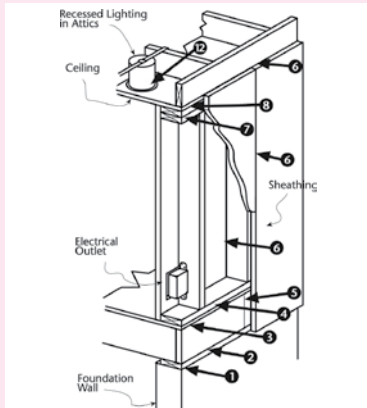


Figure 1*

1. Sill plate/foundation wall interface **2.** Sill plate/band joist interface **3.** Band joist/subfloor interface **4.** Bottom plate/subfloor interface **5.** Band joist **6.** Sheathing joists/stud/cavity **7.** Double top plate interface **8.** Top plate/ceiling interface **9.** Windows and doors (not shown) **10.** Window and door frames/rough opening surface (not shown) **11.** Electrical/telephone/plumbing/cable intrusions (not shown) **12.** Recessed lighting in attics

It's well known today that a properly insulated building uses less energy for heating and cooling than the same uninsulated building. And most people know that the higher the R-values of ceiling and wall insulation, the greater the energy savings. What is less known is that the leakiness of a home, known as air infiltration (See Figure 1), is also a major factor in how much energy a building uses for heating and cooling. Since air infiltration is crucial to a building's energy use, what can a builder or building owner do to reduce it?

To reduce air infiltration and achieve an energy-efficient building, the builder or building owner must seal any gaps in the building's thermal enclosure. Installing high-quality, tightly sealed windows and doors is a good start. It's equally important to seal all gaps between the walls and ceiling, the walls and flooring, wall-to-wall sections, wall-to-window junctions, and wall-to-door junctions. Penetrations through the walls and ceiling for electrical wiring and for plumbing also need to be sealed.

To address these needs, Owens Corning developed the EnergyComplete™ System, which is a whole-home insulation and air sealing solution. It combines a revolutionary Spray Foam with Flexible Seal Technology with proven Owens Corning PINK Fiberglas™ Insulation. Applied to a new home or other building prior to the installation of wall and ceiling insulation, EnergyComplete™ Spray Foam reduces air infiltration and thereby reduces a building's energy use—beyond what the thermal insulation would do by itself.

What follows is detailed information about what the EnergyComplete™ System technology is, how it is applied to a new home or other building, and how it enhances the energy efficiency of a properly insulated building in a cost-effective manner.



What is EnergyComplete™ Spray Foam?

EnergyComplete™ Spray Foam is a latex-based foam sealant—applied by a certified contractor into the building wall cavities, ceiling junctions, foundation junctions, and wall and ceiling penetrations—that prevents air infiltration through those same walls and ceilings. Within 20 minutes of its application, the walls and ceiling can be insulated with proven insulation materials such as fiber glass batts or fiber glass blowing wool, which will thereby provide their maximum possible R-value. That is because EnergyComplete™ Spray Foam effectively seals the building



against unconditioned outside air leaking in and conditioned indoor air leaking out. That air infiltration, in either a heated or cooled building, silently increases energy use for the life of the home. The EnergyComplete™ System minimizes that air infiltration and does so in a very cost-effective manner.

Why use the EnergyComplete™ System?

The EnergyComplete™ System reduces a building's energy use for both heating and cooling. The EnergyComplete™ System makes a building more comfortable in winter by reducing drafts caused by cold outside air flowing into the building through gaps; these drafts tend to make people in the building feel colder than they would otherwise.

Likewise, in cooling conditions, the EnergyComplete™ System helps eliminate moisture problems by reducing the infiltration of humid outdoor air. The higher humidity caused by air infiltration leads to more discomfort as well as greater air conditioning energy use.

Additionally, the EnergyComplete™ System contributes to the requirements and credits for the green and energy-efficiency building programs of LEED® for Homes, NAHB National Green Building Certification, *Environments For Living*® and ENERGY STAR®. ENERGY STAR® Qualified New Homes is a program offered by the U.S. Environmental Protection Agency (EPA). Under this qualification program, homes must be at least 15% more energy-efficient than homes constructed to the 2004 International Residential Code (IRC) and must include additional energy-saving features that typically make them 20–30% more efficient than standard homes. The EnergyComplete™ System can reduce the energy used for heating and cooling by up to one-third, depending on geographic location.

To demonstrate that a building meets the ENERGY STAR® requirements and achieves low air infiltration requirements, the builder or building owner can choose either a prescriptive or performance solution. Either way, the areas required to be sealed include all penetrations throughout the enclosure to minimize, or eliminate, air infiltration as required by the ENERGY STAR® New Homes program. In doing this, the building must meet certain thermal barrier (i.e., insulation) and air barrier (i.e., sealing) requirements, both of which are dependent on the building's geographic location.



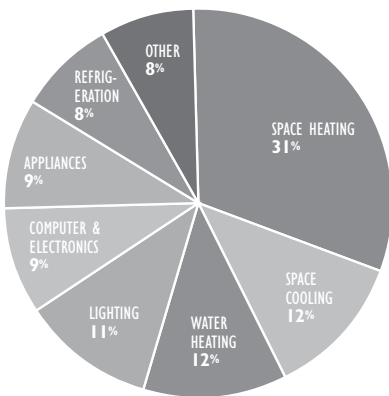
While the results of a blower door test are also dependent on building components that are unaffected by the EnergyComplete™ System (such as doors and windows), it is typical to achieve less than 0.3 Natural Air Changes per Hour in a home with the EnergyComplete™ System when running this blower door test.

Whether using the prescriptive or performance solution, the building must be tested with a blower door apparatus. This is a whole-building air-infiltration test and hence a test for the building's air tightness. Since this test is run on a completed building, the builder and/or the building owner will want to be assured that the building will meet the requirements on the first try. Failure to meet the requirements on the first try requires additional tests to identify the locations of the air infiltration and then steps to remediate that infiltration, possibly requiring the walls and/or ceiling be opened up and eventually reconstructed. These steps are both time consuming and costly. Using the EnergyComplete™ System gives the builder and/or building owner better confidence that the building will meet the blower door test requirements on the first try. For someone who wants an ENERGY STAR® rated building, the application of the EnergyComplete™ System is simply money well spent.

Background

How much of a typical home's energy use is for heating and cooling?

The pie chart, taken from the U.S. Department of Energy web site (http://www.eere.energy.gov/consumer/tips/home_energy.html), gives a typical home's energy use in percentages. Space heating and cooling account for almost half of a home's total energy use. The remainder is used for water heating, lighting, electronics, appliances, refrigerators and freezers, and other.



Energy use for a typical home

How important is air infiltration in building energy use?

According to the North American Insulation Manufacturers Association (NAIMA) web site (<http://www.naima.org/pages/resources/library/pdf/BI480.PDF>), air infiltration through a home can account for as much as 35% of the home's energy use. On the same web site, NAIMA points out that a study in 1996, conducted by the Union Electric Company in St. Louis, MO, concluded that a sealant package can decrease air infiltration by more than 50% compared to a home that does not have one. Further, Union Electric concluded that air infiltration does not depend on the type of thermal insulation used. The conclusion is that air infiltration is a major contributor to a typical home's annual energy use for space heating and cooling.

Features and benefits of the EnergyComplete™ System:

Why not just use EnergyComplete™ Spray Foam to seal the building?

Other spray foams, such as spray polyurethane foam (SPF), claim to both insulate and air seal, but the reality is that, depending on their application, they sometimes fail to seal. Several manufacturers of such materials claim that the use of their SPF results in significant reductions in air infiltration and hence significant energy savings when compared to fibrous and cellulosic insulation materials. They also generally don't point out that SPF insulation materials are very expensive, costing several



For more information on using spray foam insulations for sealing buildings, see the Owens Corning publication, *The Truth About Traditional Spray Foam*, available online at ocenergycomplete.com/resources.



For more detailed information on installing EnergyComplete™ Spray Foam, see the Owens Corning publication, *EnergyComplete™ Spray Foam with Flexible Seal Technology Installation Guide*, available online at ocenergycomplete.com/resources.

times more, on an installed dollar-per-square-foot-per-R-value basis, than fiber glass insulation materials.

Trying to simultaneously insulate and seal with just one of the materials currently available on the market doesn't optimize the home's energy package. To optimize both performance and economics, it is best practice to select your insulation material to insulate and your building enclosure seal to seal. Fiber glass insulation has a long track record as an effective wall and ceiling insulation. EnergyComplete™ Spray Foam, as an effective high-performance sealant system, enhances that thermal performance in a cost-effective manner. Furthermore, its performance has been verified in numerous homes with blower door testing.

How is the EnergyComplete™ Spray Foam installed?

EnergyComplete™ Spray Foam is installed by a certified contractor using a specially designed spray gun and machine. It is sprayed as liquid foam that sets in less than 20 minutes, so it does not hinder the schedule for insulating the walls and ceilings. When the job is complete, the likely locations of air infiltration will have been effectively sealed with this PINK foam sealant.

EnergyComplete™ Spray Foam with Flexible Seal Technology is a two-part, non-allergenic, high-performance latex-based foam used to seal cracks and penetrations through a building enclosure and from floor to floor in a house or building. These two components are used in the EnergyComplete™ Sprayer by Graco, specifically designed for this foam.

EnergyComplete™ Spray Foam is safe to install and does not require a chemical mask or fresh air ventilation suit, and other trades can work in the house while the spray foam is being applied. Insulators can install fiber glass in the walls shortly after the foam is applied.



Advantages of the EnergyComplete™ System over conventional building enclosure sealants

Traditionally, contractors have used caulk to seal building enclosures. While appropriately selected caulks can be effective as air infiltration barriers, they must be carefully applied and inspected to assure that all potential leak locations have been fully plugged. Applying sufficient quantities of caulk to effectively seal all potential sources of air infiltration is labor intensive, difficult to do well, and can yield unpredictable results. Builders have also expressed concerns about cracking and the overall long-term durability of caulk.

By contrast, EnergyComplete™ Spray Foam can be installed as an effective sealant in the first application—in a typical North American home, in just several hours—making it a cost-effective sealant. Furthermore, due to its PINK color, its application is easy to verify visually.

How safe is EnergyComplete™ Spray Foam?

The EnergyComplete™ Spray Foam is safe to install. It does not require a chemical mask or fresh air ventilation suit, so other trades can work in the building while the spray foam is being applied. Plus, insulation contractors can install fiber glass or other types of insulation in the walls shortly after the foam is applied. Owens Corning recommends that installers of EnergyComplete™ Spray Foam use chemical gloves, goggles or a face shield, wear a long-sleeved shirt and, if the installation site is dusty, a dust mask. Additionally, unlike with spray polyurethane foam, there is no need to quarantine the work area. Other trades are welcome to work in and around the home during the installation of EnergyComplete™ Spray Foam.

EnergyComplete™ Spray Foam performance

EnergyComplete™ Spray Foam has been tested for physical properties that are generally recognized by the construction industry for materials used in residential and commercial buildings. Following is a list of those properties with the associated test standard and the results of testing EnergyComplete™ Spray Foam.

- *Flame Spread & Smoke Developed*—Testing for flame spread and smoke developed indices per ASTM E 84. Results: flame spread index < 25, smoke developed index < 50.
- *Air Infiltration*—Testing of wall sections for air leakage rate per ASTM E 283. Results: air leakage rate <0.01 cfm/ft.²

For more information on comparing EnergyComplete™ Spray Foam to conventional sealants, see the Owens Corning publication, *Spray Foam: Better Coverage and Performance Than Caulk*, available online at ocenergycomplete.com/resources.



- **Long-Term Performance**—EnergyComplete™ Spray Foam maintains its flexibility, air sealant properties and adhesion to common building material substrates over time, as demonstrated through accelerated aging tests designed to represent typical wood frame movement and climatic changes throughout the United States over a 50-year period. EnergyComplete™ Spray Foam also maintains an air seal after being subjected to the pressure from three-second gust hurricane windspeeds of up to 150 MPH. EnergyComplete™ Spray Foam adheres to and is noncorrosive to typical materials found in residential construction such as wood, cardboard, PVC, ABS, steel, galvanized steel, concrete, masonry block and expanded polystyrene.
- **Water Vapor Permeability**—Testing for water vapor permeability per ASTM E 96 for water vapor transmission. Results: Wet cup—113 perms; dry cup—41 perms.
- **Low-Pressure, Flexible Seal**—Testing for pressure-build per AAMA 812-04. Results: Expansion force is less than 0.1 psi and will not cause door or window frames to warp. In addition, the foam remains flexible when cured, and will not transfer structural load to window or door framing.

For more information about the performance of EnergyComplete™ Spray Foam, see the *Energy Complete™ Product Data Sheet*, available online at ocenergycomplete.com/resources.

How should you ventilate a tightly sealed building?

The expression “seal tight, ventilate right” summarizes in four words what needs to be done. The first step is to tightly seal the building during construction or retro-fit. The next step is to add energy-efficient mechanical ventilation. This can be done by having the heating and cooling system contractor add an air-to-air heat exchanger into the air handling ductwork. Such a heat exchanger allows for removal of a certain amount of air and the simultaneous introduction of fresh outdoor air into the ducts. These two air paths cross one another in the air-to-air heat exchangers, allowing the recovery of as much as 80% of the energy in the conditioned air.



How do energy savings vary with geographic location?

To answer this question, Owens Corning ran a series of computer simulations for the energy use of a particular 3,100-sq.-ft. house in different cities around the United States. They considered a typical new house of a particular floor layout and size, both with and without the EnergyComplete™ System. The computer program used was the same one that is recommended for demonstrating compliance to the ENERGY STAR® program by the performance method. The following table summarizes the technical findings for the different cities around the United States. Note that the energy savings, compared to a typical new house, vary from a low of 5% (Miami) to a high of 40% (Minneapolis). The predicted dollar savings vary from a low of \$44 (Miami) to a high of \$1,082 (Portland, ME). For more details, see the Owens Corning Regional Case Study Reports, available online at ocenergycomplete.com/resources.

Table of Predicted Value of Energy Savings for a 3,100-sq.-ft. House

(Typical new house compared to the same house with the EnergyComplete™ System installed)

Home Location	Predicted energy cost per year for space heating and cooling, \$		Predicted \$ Savings per Year	Predicted % Savings per Year
	Typical New House	EnergyComplete™ System House		
Seattle, WA	\$1010	\$706	\$304	31%
Boise, ID	\$1430	\$907	\$523	39%
Portland, OR	\$1075	\$787	\$288	28%
Denver, CO	\$1264	\$841	\$423	38%
Sacramento, CA	\$1128	\$859	\$269	30%
Los Angeles, CA	\$683	\$535	\$148	29%
Las Vegas, NV	\$1507	\$1212	\$295	24%
Phoenix, AZ	\$1200	\$976	\$224	21%
Fargo, ND	\$2306	\$1417	\$889	37%
Minneapolis, MS	\$2208	\$1386	\$822	40%
Omaha, NE	\$1612	\$1143	\$469	31%
Chicago, IL	\$1938	\$1261	\$677	38%
Indianapolis, IN	\$1742	\$1295	\$447	28%
St. Louis, MO	\$1629	\$1190	\$439	29%
Nashville, TN	\$1452	\$1085	\$367	27%
Charlotte, NC	\$1439	\$1043	\$396	29%
Charleston, SC	\$1245	\$936	\$309	27%
Atlanta, GA	\$1816	\$1380	\$436	26%
Orlando, FL	\$1139	\$1009	\$130	13%
Miami, FL	\$882	\$838	\$44	5%
Jacksonville, FL	\$1208	\$932	\$276	25%
Dallas, TX	\$1433	\$1129	\$304	25%
Austin, TX	\$1244	\$1001	\$243	25%
Houston, TX	\$1201	\$947	\$254	26%
Oklahoma City, OK	\$1312	\$999	\$313	26%
New Orleans, LA	\$1059	\$847	\$212	23%
Pittsburgh, PA	\$2100	\$1503	\$597	30%
Syracuse, NY	\$2652	\$1918	\$734	31%
Washington, DC	\$2132	\$1398	\$734	37%
Philadelphia, PA	\$2204	\$1427	\$777	38%
New York, NY	\$2523	\$1707	\$816	37%
Portland, ME	\$2932	\$1850	\$1082	39%



Conclusions

The EnergyComplete™ System enhances the building enclosure to significantly reduce air infiltration while maximizing thermal performance. In so doing, it can reduce the energy use for space heating and cooling by up to one-third,** depending on geographic location. Because EnergyComplete™ Spray Foam is quick to install and visual inspection is easy, the new building is more likely to meet the requirements of the blower door test for air tightness. With a compliant thermal insulation system in the walls and ceiling or roof, along with high-quality windows and doors, the building is better positioned to meet ENERGY STAR® requirements. And the EnergyComplete™ System delivers savings the minute the home is heated or cooled.

The EnergyComplete™ System is the optimal solution for enhancing the energy efficiency of a properly insulated building.

Contact your Owens Corning Area Sales Manager today for complete details about the EnergyComplete™ System and training opportunities.

Learn more at ocenergycomplete.com or by calling 1-800-GET-PINK.™



INNOVATIONS FOR LIVING™

OWENS CORNING INSULATING SYSTEMS, LLC
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO 43659

1-800-GET-PINK™
www.owenscorning.com



Pub. No. 10011648. Printed in U.S.A. November 2009. THE PINK PANTHER™ & © 1964–2009 Metro-Goldwyn-Mayer Studios Inc. All Rights Reserved. The color PINK is a registered trademark of Owens Corning. ©2009 Owens Corning.

Certified by Scientific Certification Systems (SCS), an independent, third-party evaluation and certification service for recycled content.

ENERGY STAR and the ENERGY STAR mark are registered trademarks of the U.S. Environmental Protection Agency.

The GREENGUARD INDOOR AIR QUALITY CERTIFIED Mark is a registered certification mark used under license through the GREENGUARD Environmental Institute.

LEED is a registered trademark of the U.S. Green Building Council.

Environments For Living is a registered trademark of Masco Contractor Services, Inc.

*Illustration from the North American Insulation Manufacturers Association (NAIMA), Pub. No. B1480.

**Air infiltration can account for 30% or more of a home's heating and cooling costs and can contribute to problems with moisture, noise, dust and the entry of pollutants, insects and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability and create a healthier indoor environment. Air Sealing, Office of Building Technology, State and Community Programs, Energy Efficiency and Renewable Energy, U.S. Department of Energy. No. DOE/GO10099-767, 1999.