

"R"-value of Fullback®

As new building and insulation materials have entered the market, confusion over the nature and meaning of "R"-value has raised questions among building professionals and consumers alike. What exactly is "R"-value? Is it an effective and objective measure of the thermal performance of an insulation product or construction system? And how should the marketplace use it to compare the benefits of one insulation material over another?

Defining "R"-value

During the 1970s, as demand for quality building insulation soared, an oil crisis sent heating and cooling costs skyward. With many new products on the market – and with so many conflicting claims pertaining to the insulating abilities of those products – the Federal Trade Commission, with the participation and support of the insulation industry, created an objective method for reporting the performance of residential insulation materials. This method is called the "R"-value Rule.

The Rule provides requirements for product labeling ("R"-value) and advertising, and mandates specific ASTM methods for thermal testing. The "R"-value Rule has been helpful in comparing different brands of the same type of insulating material. However, as more sophisticated materials and higher technology construction systems are introduced into the building industry, we find that the "R"-value of a material does not tell the whole story.

"R"-value is based on a mathematical term known as "R"-factor. The term "R"-value was developed to represent the ability of an insulation material to restrict heat flow. It is determined by placing test specimens between two plates in a laboratory apparatus and measuring heat-flow through the insulation. The test specimen usually consists of a square foot of material exactly one inch thick whose surfaces have a temperature differential of 1-degree Fahrenheit. The thermal conductivity (k) of a material is expressed as the rate of heat flow in BTUs per hour.

Thermal resistance (R) of a material is its resistance to heat flow, and "R"-value is expressed as the reciprocal of the material's thermal conductivity. Simply put, the greater the "R"-value the better the insulation.

Why Standard "R"-value Testing is Insufficient

Fullback contoured EPS foam products cannot be tested under ASTM C177 or 518, which are prescribed for testing only flat (consistent thickness) sheets. Fullback must be tested using the "Guarded Hot Box Test" outlined in ASTM C236. This same test method is used to test windows, etc., where various thicknesses and components are involved.

These tests can only be conducted by a government approved, third party, testing laboratory. Progressive uses ATI, located in York, Pennsylvania.

Guarded Hot Box Test

By way of explanation, when "R"-values are required, ATI, with Progressive's input, builds a specific base wall to depict a new construction or residing wall and mounts it in an 8' x 8' test fixture. The fixture is closed and sealed. A heat source is located on the input side of the wall and a cooling chamber is located on the output side of the wall to control temperature.

Prior to sealing the fixture, the lab personnel affix a large number of thermocouples to designated locations on both sides of the test wall. These thermocouples are used to measure the surface temperature in their immediate area. This and other bits of information are transmitted into a computer. It reads the data, stores it and later processes it through a program, which measures the wall's resistance to heat flow.

The heating and cooling systems are then turned on. The cold side is brought to 0°F and the warm side is brought to 70°F. These temperatures are allowed to stabilize for a period of twenty-four (24) hours. The computer program is then started and the measurement of energy input is measured against the time the heat takes to pass through the wall and be measured on the output side.

This test produces an "R"-value for the base wall. For explanation purposes, let's say that the wall produces an "R"-value of 5.0. The fixture is opened on the input side, the thermocouples are removed and our Fullback product is installed with the respective vinyl siding, exactly as it would be on the house. Thermocouples are once again affixed to the input side and the fixture is closed and sealed.

The temperature stabilization process referred to above is again completed. The test is then run on the combination of the old wall and the new product. For example, let's say that the "R"-value produced from this test is an R-9. In order to determine the system "R"-value you simply subtract the base wall 5.0 from the composite wall of 9.0 and you have a system "R"-value of 4.0.

The system "R"-value takes into consideration the differences in thickness of the foam and gives you an average, which is fully accepted by the insulation industry and the government.

The Problem with Some Other Foam Insulating Materials

There are other factors that affect the performance of insulation products after they are installed in a building, including thermal drift.

Depending on the insulation material used, the "R"-value can slowly be reduced over time as the material ages. Some foam plastic insulation materials use blowing agents that have a high resistance to heat flow, causing the insulation to have an abnormally high "R"-value at the time of manufacture. It is now known that these blowing agents diffuse the cellular structure of the foam until a level of equilibrium is reached many years after it is manufactured. As the high "R"-value gases diffuse out of the cellular structure, the ability of the insulation to prevent thermal flow is reduced, losing up to 30 percent of its original insulating ability.

Fullback does not use these types of blowing agents; therefore, its insulation performance remains stable over its entire life.

Wall System "R"-value

When the "R"-value Rule was instituted, most homes and buildings were constructed and insulated using dimensional lumber, two-by-fours, and fiberglass insulation. To increase a home's insulation, generally, a builder would have selected a fiberglass insulation product that had a higher "R"-value, but today we have learned that it isn't necessarily the "R"-value of the insulation that makes the wall more efficient. It is a combination of insulation materials, construction details and installation care that provide ultimate thermal performance.

Today we understand that to insulate the space between the studs with fiberglass is not the same as insulating an entire exterior wall. We must consider the wall as a system. The lumber creates thermal bridging and air infiltration within the wall. Now we know that it is important to insulate the entire "Wall System" and not just the area between the framing members.

Energy Efficiency

Fullback® Thermal Support Systems provide the long-term efficiency now demanded by the construction industry. Heating and cooling a home account for 50 to 70 percent of the energy costs experienced in the average home. In monetary terms, the U.S. consumes almost \$40 billion in air conditioning alone according to the EPA. The stable thermal performance of EPS insulation results in heating and cooling savings that add up over the life of the structure. In addition, a reduction of energy use also helps to conserve nonrenewable fuel supplies.

The decreased use of fuel and energy translates into reduced air pollution. The EPA also reports that household electricity accounts for 35 percent of all U.S. emissions of carbon dioxides, 75 percent of sulfur dioxide and 38 percent of nitrogen oxides. By utilizing more energy efficient materials and products in our homes, we can reduce the amount of air pollution.