What is Insulation R-value? (Definition & Applications)

URL: ...blog/insulation-r-value-definition

Insulation products are used r to make a home more energy-efficient, in an effort to reduce utility bills and make the indoor environment more comfortable. But how can you tell which products are the best insulators for a particular baby application?

An “R-value” rating is used to determine the energy saving value of different products. R-value is defined as **“the capacity of an insulating material to resist heat flow. The higher the r-value, the greater the insulating power.”** (Google Dictionary)

In this article we will help determine how much r-value is desired for particular applications by exploring:

1. How insulation works
2. How insulation “r-value” is determined
3. Applications and recommendations for insulationfiber2.2

How does insulation

In physics, the second law of thermodynamics says that heat naturally flows towards cold until there is no longer a temperature difference. There are three main ways heat transfers - through conduction, convection, and radiation.

Conduction is the transfer of heat through materials contacting each other, such as a skillet on top of a stove.

Convection is the way heat moves through liquids and gasses, such as a stove that warms the air around your food, thereby also warming the food.

Radiation is the movement of heat from any source, warming objections around it. One example is the heat emitted from a campfire.

The majority of insulation products in remodeling and new construction reduce the **conduction** of heat flow. An example of this is thermal bridging through wooden studs, which you can learn more about here>

At a high level, thermal bridging is the movement of heat across an object that is more conductive than the materials around it. The walls of a home might have fiberglass batt

insulation in the cavities, but the wooden studs have a much lower r-value and generally aren't covered in insulation. These studs serve as the bridge for heat to travel across through the process of conduction, whether it's summer heat moving towards an indoor air conditioned space, or heat on the inside moving towards a cold winter exterior.

How R-value is Determined

"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. R-value 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. Simply put, the greater the "R"-value the better the insulation.

FTC regulations govern home insulation marketing claims, including claims regarding the thermal insulation value provided by the product or material. The FTC regulations also specify the means by which the R-value 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.

Insulated Vinyl Siding R-value Testing

Some rigid insulation products are contoured, and therefore cannot accurately be tested with the hot plate method to determine r-value.

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.

In the hot box test, a wall assembly with insulated siding is placed between two instrumented chambers: a "climatic chamber" and a "metering chamber." The chambers are maintained at a specific temperature difference. They climatic chamber is usually cooler than the metering chamber, representing winter conditions. Wind is directed at the material in the climatic chamber to simulate true 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. 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.

Applications and Recommendations Insulation

Now that we know how heat is transferred in a home and how insulation is rated for energy efficiency, let's look at common products that are used to insulate some parts of a home.

Rigid Foam – Outside walls of homes and below grade. Roughly up to 5.0 per inch.

Spray Foam – Sprayed into the wall cavity, typically in new construction before drywall. Roughly up to 6.5 per inch.

Fiberglass Batt – Rolled into the wall cavity between studs, typically in new construction. Roughly up to R-3.8 per inch.

Blown In Cellulose – Popular in remodeling projects; holes are cut in the wall to fill the cavity with insulation, or it is sprayed into the attic. Roughly up to R-3.8 per inch.

Foundation and Basement Insulation

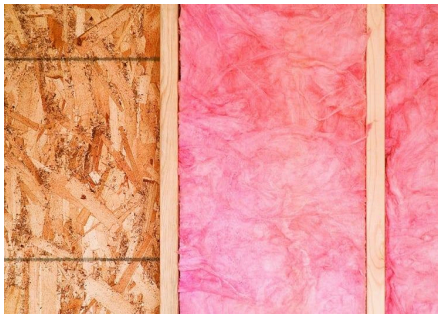
Adding insulation to a foundation and basement can help save money on utilities to heat the space. In new construction, rigid insulation can be added before the foundation is poured, and to the exterior walls before it is backfilled with gravel or dirt. In remodeling, insulation can be added to the floor and interior walls before they are covered with the appropriate finishing materials.

Exterior Walls

Fiberglass or spray foam insulation is typically applied in the wall cavity between studs during new construction. This provides excellent resistance to heat transfer, but it still leaves a major portion of the wall uninsulated.

Nearly 25% of a home’s wall is made of wood studs which aren’t covered in insulation, leaving the perfect opportunity for heat transfer through conduction. This is like having one whole wall of the home with zero insulation.

Adding continuous insulation to the exterior wall of the home before the siding is installed helps stop this energy loss, and can also be done in remodeling applications. The U.S. Department of Energy (DOE) says “when new siding is to be installed it is a good idea to consider adding insulation under new siding.



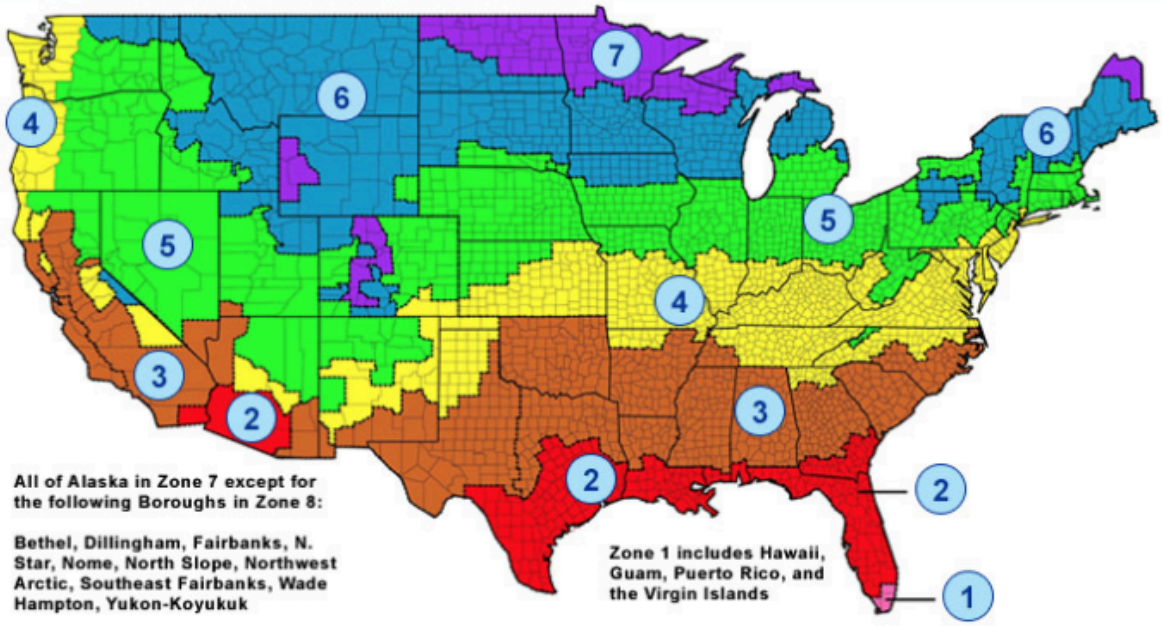
Roofs and Attics

Loose-fill or fiberglass insulation can be added to the floor of the attic to help stop heat from escaping through the unconditioned space. If you plan to inhabit the attic space, rolled fiberglass insulation can be added between rafters, and continuous rigid insulation can be installed over the rafters to break the thermal bridge.

Recommendations

The amount of insulation recommended for each application will vary greatly depending on your climate zone. We recommend exploring the Energy Star Recommendations for Home Insulation for your location and particular application.

Recommended insulation levels for retrofitting existing wood-framed buildings



Zone	Add Insulation to Attic		Floor
	Uninsulated Attic	Existing 3–4 Inches of Insulation	
1	R30 to R49	R25 to R30	R13
2	R30 to R60	R25 to R38	R13 to R19
3	R30 to R60	R25 to R38	R19 to R25
4	R38 to R60	R38	R25 to R30
5 to 8	R49 to R60	R38 to R49	R25 to R30
Wall Insulation: ***Whenever exterior siding is removed*** on an			