**How Insulation Works**

Conventional building insulation works by its ability to trap air. To reduce conductive and convective forces, insulation must have a low thermal conductivity and create dead air space. The more air pockets, the higher the resistance to heat flow.

In most insulating materials, dead air space is created by numerous tiny air pockets. Fiberglass, for example, relies on the air trapped between the glass fibers. Foam insulation relies on the millions of tiny air bubbles in it. Each air pocket decreases the temperature difference between each surface. In essence, the air pockets interrupt the conductive force. The thicker the insulation, the more trapped air you have and the greater the insulation value.

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| **R-Values for Standard Fiberglass Batts** | |
| R-38 | 12 in. |
| R-30 | 9 1/2 in. |
| R-25 | 8 in. |
| R-19 | 6 1/4 in. |
| R-13 | 3 5/8 in. |
| R-11 | 3 1/2 in. |

The R-Value of any insulation is related to its thickness.

"Dead air space" is a key term here. Still air prevents heat loss through convection. In foam, the air in each bubble is effectively sealed, eliminating any movement of air from one pocket to the next. With zero air movement, there is zero convection. However, wind within the insulation cavity can seriously reduce the insulation’s performance. This effect is called "windwashing" — a term that describes the erosion of R-value due to convection losses. When there is wind flowing through the insulation cavity, the insulation only starts to work where the dead air space begins. Stopping airflow and preventing windwashing is one of the important reasons for using an air barrier such as Tyvek® on the exterior of a building.

**R-Value**

The effectiveness of an insulating material is measured by R-value — its resistance to heat flow. When insulation is rated for its R-value, certain assumptions are implied:

The R-value of a material is determined independently of convective forces. Insulation only works when the air within the insulation or stud cavity is still.

Batt insulation should not be compressed in building cavities. Compression can lower the rated R-value.

Typical fiberglass-batt insulation values for residential building assemblies:

* 2x4 walls: R-11, R-13, R-15 (batts available in various densities)
* 2x6 walls: R-19, R-21, R-22 (batts available in various densities)
* Floors = R-19
* Attic = R-30+