

### Background

Heat transfer is accomplished by convection; conduction and radiation; or by some combination of the three. With foam plastic insulation, thermally efficient gases are trapped within closed cells, which provide the insulating properties. Rigid foam insulation reduces convection as another mechanism for providing thermal resistance. Heat transfer of a material may be expressed by either, how easily the heat passes through it—conductance—or by its resistance to transfer heat energy—resistance.

### How is insulating value defined?

**Thermal transmittance**, or U-value, is the coefficient of heat transmission (air to air). It is the time rate of heat flow per unit area under steady conditions from the fluid (air) on the warm side of a barrier to the fluid (air) on the cold side, per unit temperature difference between the two fluids. The U factor applies to combinations of different materials used in series along the heat flow path, single materials that comprise a building section, cavity airspaces and surface air films on both sides of a building element, Btu/h·sq ft·°F.

**Thermal resistance**, or R-value, is the temperature difference between two defined surfaces of material or construction that induces unit heat flow through a unit area. It is the inverse of (U-value minus air films) °F·ft<sup>2</sup>·h/Btu.

**Thermal conductance**, or k-value, is the time rate of heat flow through a body (frequently per unit area) from one of its bounding surfaces to the other for a unit temperature difference between the two surfaces under steady conditions. It is the product of the material thickness (in. or ft) and its U-value, Btu·in/h·ft<sup>2</sup>·°F or Btu/h·ft·°F.

### What are typical insulating values?

Insulating values of factory-engineered insulated panels vary, depending on the insulating core material and overall thickness. The following table shows how the insulating value is affected by insulation type. Typical factory-engineered insulated panels use a polyurethane or polystyrene rigid core insulation.

### R-Value Comparison \*

Insulation Type	R-Value / inch
Polyurethane (encapsulated) **	8
Extruded Polystyrene	5
Expanded Polystyrene	4
Mineral Fiber	3
Cellular Glass	3

\* Source: Society of Plastics Industry

\*\* Impermeable panel faces enhanced thermal aging characteristics

### How is the insulating value of factory-engineered insulated panels preserved with metal sheathing?

- The metal face skins contain the insulating foam core and maintain its shape and thickness.
- Installation requires fewer supporting members and fasteners, reducing the amount of thermal shorts in the building envelope.
- The impermeable metal skins protect insulating material from air and moisture which might degrade the insulating properties.
- The metal skins are impervious to gas transmission and therefore prevent the escape of insulating gases from the cellular foam insulation core. This allows the entire panel to maintain its R-value over time.

### How is the insulating value of building panels determined?

The R-value of components can be determined through testing in accordance with ASTM C1363 at 75° F. The Wall Assembly Overall R-value may be determined analytically from the tested values of each component, or, if practical, by testing the entire assembly in accordance with ASTM C1363.

# *Technical Bulletin*

## ***Insulating Values: Factory-Engineered Insulated Panels***

### ***Conclusions***

Factory-engineered insulated panels have superior energy efficiency because of their excellent insulating value as a building component. Thermal properties are enhanced by the closed cell nature of the rigid foam core insulation and, because the shape and thickness of the insulating material is maintained between metal profiled panels. The metal wall skins permit the insulating value to remain unchanged over time, by preventing moisture from coming in contact with the insulation material.

### ***Reference***

1. 1997 ASHRAE Fundamentals Handbook

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