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Understanding Thermal Resistance

R-Value and RSI

Thermal resistance is the measure of a given material's ability to resist heat flow across it. The better/higher the resistance, the better insulator the material is. Thermal resistance is a similar measurement to length or temperature, all of which have both imperial units (IP units) and metric units (International System of Units (SI)).

What is commonly referred to as R-Value in reality should be written and verbally said as RIP or R-imperial, meaning that it is the measurement of thermal resistance with imperial units (hr ft^2F/Btu). When speaking of RSI, it means that thermal resistance is measured with metric units (m^2K/W). This is the same when measuring length and that a given measurement can be expressed in either inches or millimeters, miles or kilometers, etc.

It is common to find products listed as R10 which indicates a thermal resistance of 10. The lack of units in this instance can technically mean that R10 can be either 10 m^2K/W or 10 hr ft^2F/Btu. Professionals in the AEC (Architecture, Engineering and Construction) industry generally assume that a R10 labels refer to imperial units while a RSI10 labels refer to metric units.

Thermal Resistance (Abbreviated to R-Value)		**Length**	
R**IP** or R-imperial is the thermal resistance measured in imperial units.	R**SI** = Thermal resistance measured in metric units.	Length measured in imperial units.	Length measured in metric units.
Units are: hr ft^2F/Btu	Units are: m^2K/W	Units are: inches (in or “) feet (ft or ‘) yards (yd) miles (m)	Units are: millimeters (mm) centimeters (cm) meters (m) kilometers (km)
Example			
R18 (18 hr ft^2F/Btu)	RSI 3.17 (3.17 m^2K/W)	16in on center spacing	406mm on center spacing

**It is important to remember that R-Value (thermal resistance) is always a measurement of the resistance of heat flow across a specific thickness of a material. Some materials might require additional thickness to achieve a similar R-Value (thermal resistance).*

**To convert from imperial R-Value to RSI divide by 5.678*

**To convert from RSI to imperial R-Value multiply by 5.678*

The United States uses US Customary units which are identical for length and area with Imperial units (except for surveying) while volume and weight are different between the two.

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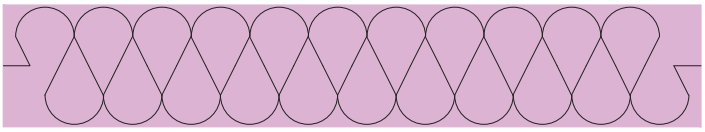
Nominal and Effective R-Values

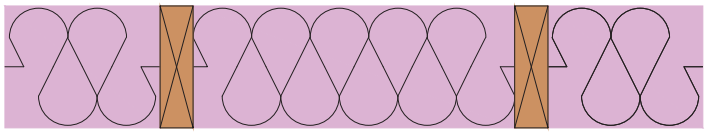
The thermal performance of the walls is often discussed in terms of its thermal resistance (R-Value). When doing so, there are two primary methodologies, nominal and effective. The nominal R-Value (thermal resistance) of a wall refers to the clear wall only, without taking into account the effect of thermal bridging (e.g. studs) since the framing components have much lower thermal resistance than insulation.

Effective R-Value (thermal resistance) can sometimes be called actual R-Value since it takes into account reductions from thermal bridging in the wall providing for a more accurate representation. In some cases, the effective R-Value only takes into account the insulation and framing components while in other cases it incorporates all of the wall components making it more of a total or assembly R-Value.

Both nominal and effective approaches are measured with thermal resistance (R-Value) which can either be in imperial or metric units. In order to differentiate these more easily, they can be written as Effective R-Value and Nominal R-Value or $R\text{-Value}_{Eff}$ and $R\text{-Value}_{Nom}$.



Nominal



Effective