

# Understanding Thermal Resistance

## What is Thermal Resistance?

Thermal resistance is the measurement of a given material's ability to resist heat flow across it. The better/higher the resistance, the better insulator the material is.

## What is R-Value?

R-Value is the same as saying thermal resistance and can be used interchangeably. When calculating thermal resistance, the symbol for resistance is designated as capital "R", thus thermal resistance became abbreviated as R-Value.

## What is RSI?

RSI is thermal resistance (R-Value) measured in metric units (International System of Units (SI)).

## What is the difference between R-Value and RSI?

Although R-Value could be used to describe the thermal resistance in either imperial or metric units, most of the time when talking about R-Value, it is assumed we are talking about imperial units. This is similar to measuring length or temperature, both of which have both imperial and metric (SI) units.

## What are the units for R-Value?

Thermal resistance (R-Value) is a measurement of the resistance to heat flow across a specific thickness of material, so like any measurement it should have units. Just like a door width can be measured in feet and meters (imperial and metric units), so too, can thermal resistance (R-Value). The imperial units for thermal resistance (R-Value) are "hr.ft<sup>2</sup>F/Btu" while the metric (SI) units are "m<sup>2</sup>K/W".

## Example

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

\*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.

| Thermal Resistance (R-Value)                             |  | Length  |   |
|--|--|---|---|
| Thermal Resistance (R-Value) measured in imperial units. | Thermal Resistance (R-Value) measured in metric (SI) units is <b>RSI</b> . | Length measured in imperial units.  | Length measured in metric units.  |
| Units are:<br>hr.ft <sup>2</sup> F/Btu                   | Units are:<br>m <sup>2</sup> K/W   | Units are:<br>inches (in or ")<br>feet (ft or ')<br>yards (yd)<br>miles (m) | Units are:<br>millimeters (mm)<br>centimeters (cm)<br>meters (m)<br>kilometers (km) |

## Example

|  |  |
|--|--|
| R22 means<br>(22 hr ft <sup>2</sup> F/Btu)                 | RSI 3.87 means<br>(3.87 m <sup>2</sup> K/W)                  |
| To convert from imperial R-Value to RSI divide by<br>5.678 | To convert from RSI to imperial R-Value multiply by<br>5.678 |

## Example

|                        |                         |
|------------------------|-------------------------|
| 16in on center spacing | 406mm on center spacing |
|------------------------|-------------------------|

## 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 (R-Value) than the insulation, a more accurate approach is needed.

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  $R\text{-Value}_{\text{Eff}}$  and  $R\text{-Value}_{\text{Nom}}$ .

