

# TECHNICAL BULLETIN

Bulletin TB01  
10/3/2022

## HOW TO CALCULATE R-VALUES OF INSULATION

### What Is R-Value?

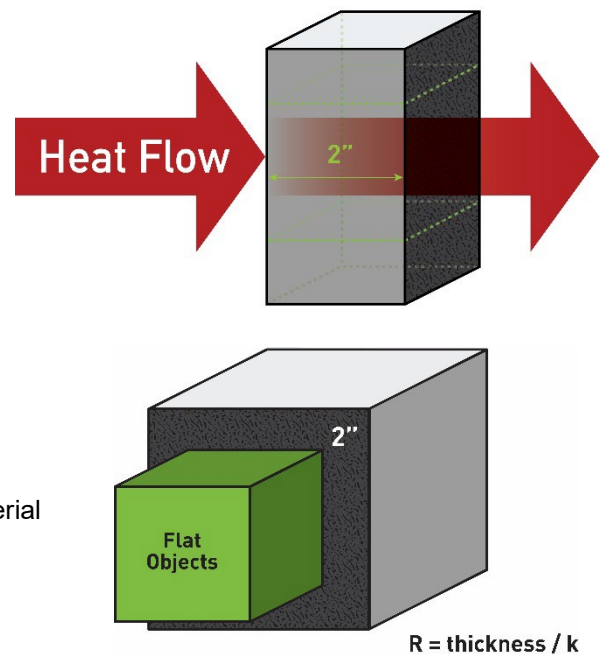
“R” value is used to designate the thermal **Resistance** of an object. The higher the R-Value, the higher thermal resistance and thus, insulating value.

### FLAT OBJECTS

R-Values for flat objects such as for sheet insulation are easy to calculate. It is simply the thickness of the insulation in inches divided by the thermal conductivity of the insulation. For example, a 2" thick sheet of insulation with a thermal conductivity<sup>1</sup> of 0.25 Btu•in/h•ft<sup>2</sup>•°F has an R-Value equal to 2 divided by 0.25 or 8.0.

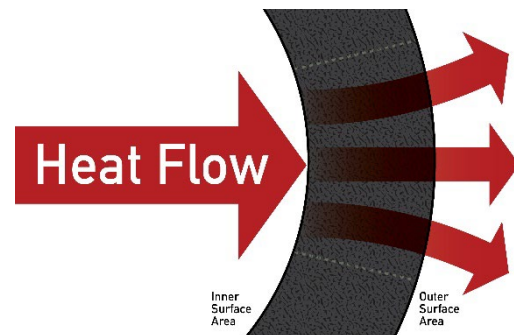
**R = Thickness / k**  
**Example: 2 / 0.25 = 8.0**

This simple equation is true for any flat, homogeneous material with parallel surfaces and means the R-Value increases proportionally to the thickness.



### CYLINDRICAL OBJECTS

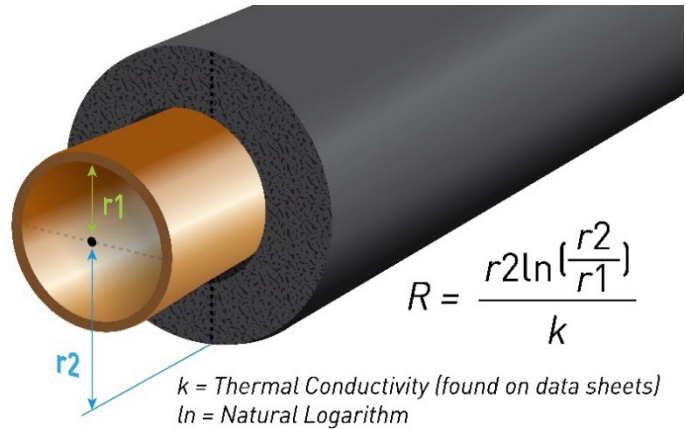
The simple equation for R-Value does not hold true for cylindrical objects like pipe insulation. For these objects, the heat flow is not the simple straight-through heat flow found with flat objects. Instead, the heat flow is radial because the inner surface area is much smaller than outer surface area and the R-Value calculation must take this into account.



**As a result, the equation for the R-Value of cylindrical objects is as follows:**

Where **r1** = uninsulated pipe radius in inches  
**r2** = insulated pipe radius in inches  
**k** = thermal conductivity  
**ln** = Natural Logarithm<sup>2</sup>

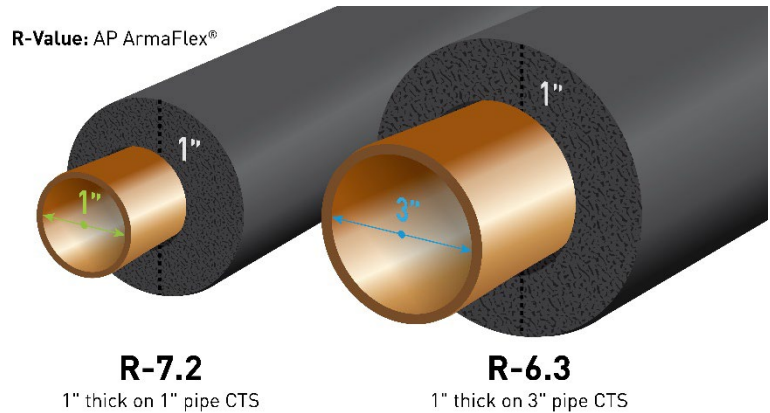
$$R = r2 \ln (r2/r1) / k$$



Based on this equation, the R-Value gets larger as the insulation thickness increases **but also** as the pipe sizes gets smaller.

For example, 1" thick insulation will have a higher R-Value on a 1" pipe than it will on a 3" pipe.

As a result, one must always consider the pipe size and insulation thickness to determine the R-Value of insulation on a pipe.



<sup>1</sup> The thermal conductivity (**k**) of every Armacell insulation material is found on the technical data sheet.

<sup>2</sup> Natural Logarithm (**ln**) is found on most scientific calculators and in excel spreadsheet calculations.

For more information, please visit:  
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