

## Technical INSIGHTS

Below Grade, Number 6

## **R-Values Explained**

R-value is expressed as rate of heat loss per hour per square foot per inch of thickness of material per degree Fahrenheit. R-values can be expressed in metric units (SI units) as well as Imperial (or Inch-Pound) units. The metric thermal resistance is sometimes referred to as the "RSI value." The R-value in I-P units per inch is obtained from the RSI value by multiplying the RSI value by 5.678 / (W/m K) and then by 0.0254 meters/inch to obtain the R-value per inch.



Figure 1: Two inches of XPS insulates as well as 30 inches of snow.

As an example, the thermal conductivity of ice (at -1 °C is 2.24 W/(m·K). The RSI value of thermal resistance is (1/2.24) = 0.446. R-value per inch in I-P units equals 5.678 times (0.0254 meters/inch) times 0.446 RSI = 0.06.

Material	Thermal Conductivity (W/m·K)	Thermal Resistance, R-value for 1 in. thickness (ft <sup>2</sup> °Fh/BTU)
XPS	0.029	5.0
fresh snow	0.19	0.76
compact snow	0.43	0.34
ice –1°C	2.24	0.06
ice -20°C	2.45	0.06
water 20°C	0.6	0.24
soil dry	0.8	0.18
soil damp	2	0.07
still air	1.2	0.12
concrete	1.4	0.10
concrete	2.6	0.06
wood	0.115	1.25

**Table 1:** Values of thermal conductivity and R-value per inch for select materials. Values adapted from John Straube, "High Performance Building Enclosures," Building Science Press, 2012, Appendix A.

## References

https://www.buildingscience.com/bookstore/books/high-performance-enclosures
https://www.amazon.com/High-Performance-Enclosures-John-Straube/dp/0983795398



XPSA represents all major extruded polystyrene (XPS) foam insulation manufacturers in North America. The association and its members are committed to the safety and integrity of XPS products. They invite interested parties seeking additional information to visit XPSA online at www.xpsa.com