TECHNICAL BULLETIN

Calculation of K-Flex K-Factor and R-Value

K-Factor - Heat is measured in British Thermal Units (BTUs). One BTU is the amount of heat needed to raise the temperature of one pound of water by one degree Fahrenheit. Thermal conductivity (k-factor) is the measure of a material's ability to transfer heat. Materials that transfer heat readily have high k-factors, like steel (228 Btu-in/hr-ft^2-°F @ 75°F mean temperature), and are classified as conductors. On the other hand, substances that do not transfer heat readily (poor conductors), have low k-factors and are classified as insulators, such as elastomeric flexible, closed cell foam insulations (0.242 – 0.27 Btu-in/hr-ft^2-°F @ 75°F mean temperature).

The actual k-factor is based on the number of BTUs per hour that pass through a one inch (1") thick by one foot (1') square section of insulation with a 1°F temperature difference between the two surfaces. Insulation materials usually have k-factors less than one and are reported at what is called a "Mean Temperature". To determine the mean temperature, measure the surface temperatures on both sides of the insulation, add them together and divide by two. When comparing the insulation value of different types of insulation, it is important to look at the k-factor AND the mean temperature. As mean temperature rises, the k-factor on some insulation materials also increases. Technical Bulletin TS12 discusses the effect of mean temperature on the k-factor of closed cell foam insulation.

The specific heat capacity states how much heat energy is required to increase the temperature of 1 kg mass of a material by 1°K. The specific heat capacity of K-FLEX elastomeric insulation will be in the approximate range of 1.2-1.4 kJ/(kg • °K). There will be slight variations dependent on the exact type of K-FLEX in use. Since the specific heat capacity is not generally considered to be an important indicator of thermal performance, K-FLEX USA does not publish more precise figures for the specific heat capacity.

R-Value - The National Commercial & Industrial Insulation Standards Manual defines R-Value as "*A measure of the ability to retard heat flow rather than to transmit heat.*" The higher the R-Value, the higher (better) the insulation value.

Determining the R-Value for flat insulation is easy. Simply divide the thickness of the insulation by its k-factor:

For **flat** insulation,

$$\text{R-value} = \frac{\text{Thickness (in)}}{\text{k-factor (BTU-in/hr-ft}^2\text{-°F)}}$$

Determining the R-value for tubular insulation is more complex since the outer surface area of the insulation is proportionately greater than the inner (in contact with the pipe) surface area. To compensate for this difference, an "equivalent thickness" calculation must first be done:

For **tubular** insulation,

$$\text{R-value} = \frac{\text{*Equivalent Thickness (in)}}{\text{k-factor (BTU-in/hr-ft}^2\text{-°F)}}$$

*Equivalent Thickness = $r_2 \times \ln(r_2/r_1)$

where:
- ln = Natural log function
- r_1 = inner radius of insulation (in) or pipe outer radius
- r_2 = outer radius of insulation (in)

Most insulation manufacturers publish R-values for their insulation products rounded to one decimal place on their product data sheets. R-values are also printed on packaging and on individual sheets or sticks of insulation.

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