



PREFERRED FOAM PRODUCTS, INC.

"Specialists in Urethane Foam"

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INSULATION EXPRESSIONS

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Architects, contractors and builders use various "factors" to express the insulation value of a material or a composite structure: U, C and R. Material suppliers often speak of products having a particular K factor.

The purpose of this document is to explain what these factors mean, how they differ from each other, and how they relate to each other.

K Factor

K Factor is a *rate* at which heat flows through a material. Values for insulation are normally based on one-inch thickness of *one* homogeneous material, and are expressed in BTU/ft²/°F/hr./inch.

The lower the K Factor, the better the insulation value of the material. Some examples are:

Vermiculite:	K = .50 - .60
Fiberglass:	K = .22 - .30
Urethane Rigid Foam:	K = .11 - .16

These values are shown as a range because the K Factor does change with age. For example, urethane foam exhibits a K of .11 or .12 when new. In two to six months, the K increases to .15 or .16, then remains stable.

C Factor

C Factor is also a *rate* of heat through a material, but could be for any given thickness, not just at 1 inch. C Factor at 1 inch would be equal to the K Factor. C Factor of the same material at three inches thickness is 1/3 of the K Factor; at two inches, it is 1/2 the K Factor.

U Factor

U Factor is the *overall* coefficient of heat transfer (conductivity) for all the elements of construction, as well as the environmental factors. An example would be the U Factor of a composite structure such as gypsum wallboard, fiberglass core and exterior wood sheathing. The U Factor should not be used with a single material, only with combinations.

A U Factor is determined by adding the C Factors of the various individual materials making up a composite structure. $U = C_1 + C_2 + C_3$, etc. If the materials are not in close contact, the C Factor of an air space must be included in the

calculation. Units are expressed as BTU/ft²/°F/hr. The smaller the U Factor, the better the insulation value of the composite structure.

R Factor

R Factor is a measure of the resistance to heat flow. R can be determined for a single material at a specific thickness. As the thickness of the insulation increases, the resistance to heat flow increases.

R can be determined in two ways:

1. R = one divided by the C Factor of the material.

$$R = \frac{1}{C}$$

2. R = the thickness divided by the K Factor.

$$R = \frac{\text{thickness in inches}}{K}$$

Example:

With rigid urethane foam at 3-inch thickness

$$R = \frac{3}{.15} = 20$$

At two inches

$$R = \frac{2}{.15} = 13$$

The higher the R, the better the insulation.

Approximate R values are presented for common insulation materials:

Insulation	Thickness		
	1"	2"	3"
Rigid Urethane Foam	7	13	20
Fiberglass	4	8	12
Vermiculite	2	3.6	5.5

From this table, it can be seen that rigid urethane foam is 60% better than fiberglass and 350% better than Vermiculite when all are the same thickness. Fiberglass is 100% better than Vermiculite at the same thickness.

K Factors or C Factors can be obtained from material suppliers, lumber yards, and Engineering handbooks.

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