

D. Physical Properties

Technical Bulletin D-1

Thermal Properties of VERSATEX

Heat Transfer Rates (R & U Values)

The two most common units used to evaluate the thermal properties of a material are U-value and R-value. The U-value is defined as the amount of conductive heat energy (BTU's) transferred through a one square foot area for each one (1) degree temperature difference between the indoor and outdoor air. Units are BTU/hr/ft²/degree F. The lower the number the better the insulator.

The R-value is just a different way of evaluating the thermal properties of a material. The R-value is the reciprocal of the U-value. R measures the ability of a given material (barrier) to resist the transfer of heat through a one square foot area for each one (1) degree temperature difference. Units are Hr/ft²/degree F/BTU. Both units are per inch of thickness. The higher the number the better the insulator.

Material	U-Value	R-Value
White Pine	0.78 1.3	
Rigid PVC	1.02 - 1.45	0.69 - 0.98
Cellular PVC	0.48	2.1
Aluminum	1642	.00061

Density, moisture content, etc. can have an effect on the U and R values shown above.

As illustrated in the table above, cellular PVC is a better insulator than white pine or rigid PVC (i.e. vinyl siding). Also, the lower the density of the material the better the insulator. A lower density means more trapped air pockets within the core of the PVC board or sheet, which in themselves, are good insulators.

Thermal Expansion and Contraction

VERSATEX is a cellular PVC (thermoplastic) product that will expand when heated and contract or shrink when cooled. The amount of movement is dependent on the coefficient of thermal expansion/contraction of the material. The coefficient of linear thermal expansion (CLTE) of any material is the change in the material's length and to a much lesser degree the width or thickness per unit change in temperature. Thermal coefficient values for cellular PVC and other building products are as follows:

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Material	Coefficient of Thermal Expansion/Contraction
Rigid PVC	4.5×10^{-5} in/in/F
Cellular PVC	3.2×10^{-5} in/in/F
Polystyrene	4.16×10^{-5} in/in/F
Polyurethane	11.0×10^{-4} in/in/F (Density Dependent)
Aluminum	11.7 to 13.7×10^{-5} in/in/F
Concrete	0.4 to 0.7×10^{-5} in/in/F
Steel	0.8×10^{-5} in/in/F
Glass	0.4×10^{-5} in/in/F

It is important to take into consideration the environmental conditions when fabricating and installing VERSATEX. When installing VERSATEX, it is recommended that a space be placed between runs of the product to accommodate thermal expansion and contraction. If the product is not fastened in accordance with our nailing schedule, the recommended gap setting may have to be doubled. To obtain a finished appearance the joints may be filled with a good quality polyurethane or polymer sealant (see Bonding & Filling Applications Technical Bulletin B-4).

For lengths up to 20' allow for 1/4" expansion and contraction.

For lengths up to 12' allow for 1/4" expansion and contraction.

Heat Deflection/Distortion Value

VERSATEX should not be used in areas where a service temperature of 150°F may be reached. 150°F is equal to or greater than the heat distortion or heat deflection temperature (HDT) of most if not all cellular PVC. The HDT is a measure of a polymer's resistance to distortion under a given load at elevated temperatures or the temperature where the material starts to deform. Conventional rigid polyvinyl chloride has a HDT of approximately 160°F, while for most PVC cellular trims this value ranges from 145°F to 150°F. The common ASTM test to determine the heat deflection temperature of PVC or other plastic product is ASTM D 648. ASTM defines deflection temperature as the temperature at which a test bar, loaded to the specified bending stress, deflects by 0.010 inch (0.25 mm). The results obtained from this test are a useful measure of relative service temperatures for a polymer when used in load-bearing parts. However, the distortion/deflection temperature test is a short-term test and should not be used alone for product design. Other factors such as the time of exposure to elevated temperature, the rate of temperature increase, and the part geometry all affect the performance of a particular PVC cellular product. If the service temperature is reached, the PVC trim may soften or distort resulting in a permanent change to the product dimensions. Using paints with a light reflectance value of 55 units or greater will prevent the PVC foam board or sheet from reaching its heat distortion value.