EPS NO. 1002

SUBJECT: R-VALUE AND LONG TERM R-VALUE – BACKGROUND

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The blowing agents used in extruded polystyrene, polyisocyanurate, and polyurethane foams provide for an initial high R-value. During the life of the foam, air from the atmosphere diffuses into the cells of the foam and reduces the R-value. In addition, the blowing agents themselves diffuse out of the foam, further reducing the R-value.

Two test methods have been developed to help provide information and standardize the reporting of R-value for materials with blowing agents other than air. The following test methods have been developed:

ASTM C1303 Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation.

CAN/ULC-S770 Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Insulating Foams.

Both test methods provide a similar method to predict the Long Term Thermal Resistance (LTTR) or long term R-value of insulations.

Diffusion theory for gases establishes that the diffusion of gases in foam is mathematically dependent upon the thickness. Each of the methods involves cutting thin sections approximately 10 mm (3/8") from a sample of thicker insulation such as 100 mm (4"). Due to the relative size of the thin samples, diffusion of air into the foam and blowing agents out of the foam is quicker than for the original thick sample. The measurement of thermal resistance for the thin samples along with mathematical relations allows for the prediction of the LTTR or long term R-value. However, in each method long term is defined only as 5 years.

ASTM C1303 excerpt: "The values produced by the Prescriptive Method correspond to the thermal resistance at an age of five years"

CAN/ULC-S770 excerpt: "This procedure defines the long-term thermal resistance (LTTR) of a foam product as the value measured after 5-year storage..."

As noted above, the LTTR value commonly published from testing to ASTM C1303 or CAN/ULC-S770 is a prediction for the R-value of the insulation after 5 years.

Many insulation manufacturers are promoting LTTR without providing a clear understanding that LTTR is a prediction for the R-value of the material after only 5 years. The concept of a 5 year R-value being equal to the "time-weighted 15 year average" is also often used by Polyiso and XPS manufacturers. This approach assumes that the higher R-value established in years 1-4 is weighted by the inevitably lower R-value of the insulation in years 6-15.

Neither the 5 year R-value, nor the time-weighted 15 year average approach is appropriate for use in building design. This is due to the fact that the R-values of Polyiso and XPS continue to decline below the LTTR published 5 year numbers. Starting in year 5 and for the remaining life of the insulation, the R-values of Polyiso and XPS are below LTTR published R-values.

Most insulation users are interested in a true long-term thermal R-value for their insulations. A 50 year R-value is a more suitable long-term R-value for use in building design. The 50 year R-value can easily be determined using the existing protocol described in ASTM C1303 or CAN/ULC-S770.

Specify a 50 year R-value for a reliable long-term R-value for building design.

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