EPS Insulation Advancements
& Technology Innovations

TECHNICAL BULLETIN

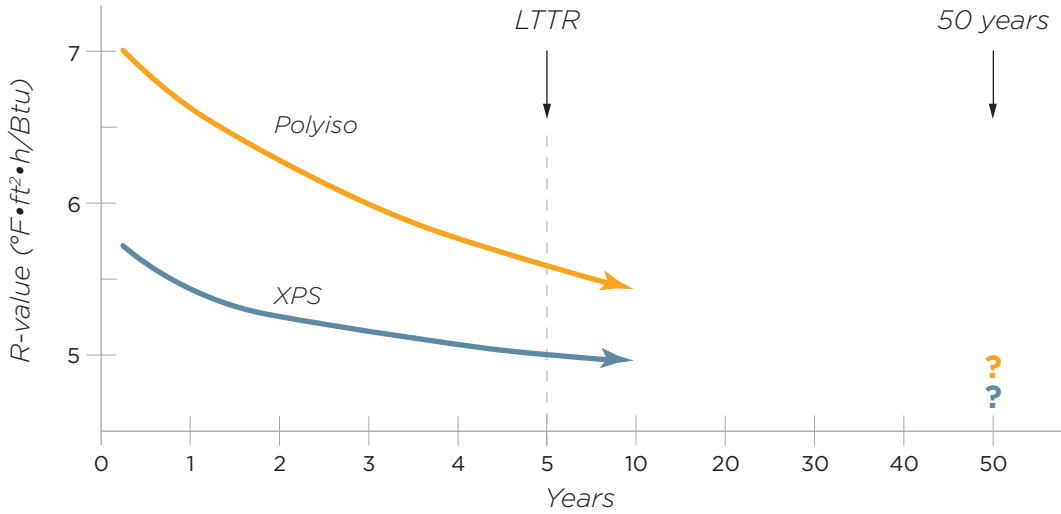
EPS Industry Alliance

XPS & Polyiso
Long-Term Thermal Resistance & R-Value Performance

Insulation is of paramount importance to reduce the energy consumption of buildings. In the summer, insulation reduces the heat flow from the hot exterior to the cool interior environment. In winter, insulation reduces the heat lost from the warm interior to the cold exterior. The resistance to heat flow through an insulation is called "thermal resistance". Thermal resistance is commonly referred to as R-value. A complete understanding of the R-value of insulation over its lifetime is critical to designing buildings that achieve reduced energy consumption. Most people understand that the higher the R-value, the greater the insulating power of an insulation. However, many people do not understand that the R-value of polyiso and XPS is lost over the lifetime of the product.

Long-term thermal resistance (LTTR) test methods have evolved considerably in the past decade. Two test methods are commonly used to report R-value for materials with trapped gases other than air. The test methods are ASTM C1303 and CAN/ULC-S770. Both test methods provide a method to estimate the long-term thermal resistance or long-term R-value of insulations. Each of the methods involves cutting thin sections approximately 3/8" (10 mm) from a sample of thicker insulation. Due to the thin size of the samples, diffusion of air in and trapped gases out is quicker than for the original thicker sample. The R-value loss of the thin sections can then be used to predict the R-value loss of the original thickness material.

Polyiso & XPS R-Values Over Time



50 YEAR R-VALUE

Most insulation users are interested in a true long-term thermal R-value for their insulations. A time period appropriate for building application is 50 years. In order to avoid confusion with the existing LTTR numbers commonly published, we recommend the use of a 50 year R-value be used for insulation specifications. 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.

Polyiso and XPS lose R-value over their lifetime. It is well understood that polyiso and XPS insulations trap gas in their cells other than air and polyiso and XPS will lose the gas over time. This is a natural process of materials coming to equilibrium with the environment. If this encapsulated gas assists with providing R-value then the R-value of the insulation will drop over time. The trapped gases in the cells of polyiso and XPS foam assist to provide an initial high R-value. During the life of these foams, air from the atmosphere diffuses in and the trapped gases diffuse out. The result is polyiso and XPS lose R-value over their lifetime. Unlike polyiso and XPS, the R-value of EPS is permanent.

The LTTR value commonly published from testing to ASTM C1303 or CAN/ULC-S770 is an estimate for the R-value of the insulation after five years. Many insulation manufacturers are promoting LTTR without providing a clear understanding that LTTR is an estimate for the R-value of the material after only five years. The concept of a five 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 five 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 five year numbers. Starting in year five and for the remaining life of the insulation, the R-values of polyiso and XPS are below LTTR published R-values.

EPS provides a permanent lifetime R-value. The five year and 50 year R-values for EPS are the same as the initial R-value since the gas trapped in the cells of EPS is atmospheric air. Unlike polyiso and XPS, EPS does not lose R-value over time. This is one reason the National Institute of Standards & Technology (NIST) chose EPS as the Standard Reference Material for Thermal Conductivity (SRM 1453), using a lot of samples certified in 1996 that still provide the same R-value today.

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