

Revised R-values

NRCA has revised its longstanding design R-value recommendation for polyisocyanurate insulation

by Mark S. Graham

SINCE 1987, NRCA has recommended designers use an in-service R-value of 5.6 per inch thickness for polyurethane and polyisocyanurate roof insulation used in roof systems. With the January 2011 publication of *The NRCA Roofing Manual: Membrane Roof Systems—2011*, NRCA is updating its design R-value recommendation for polyisocyanurate roof insulation.

Background

Most roofing professionals recognize polyisocyanurate roof insulation loses some of its R-value over time. At the time polyisocyanurate insulation is manufactured, it has a relatively high R-value. As the insulation ages and is exposed to varying temperatures and field conditions, the gas producing the high R-value in the insulation's cells slowly diffuses and is replaced with air.

Considering an insulation's actual in-service R-value—instead of its as-manufactured R-value or long-term thermal resistance (LTTR) value—is important for designers because the in-service R-value more closely represents conditions in the built environment.

Since NRCA's 1987 R-value recommendation of 5.6 per inch thickness was announced, the insulation industry and ASTM International have developed a

number of conditioning (aging) procedures to more accurately report R-values.

The 1995 publication of ASTM C1303, "Standard Test Method for Estimating the Long-Term Change in the Thermal Resistance of Unfaced Rigid Closed-Cell Plastic Foams by Slicing and Scaling Under Controlled Laboratory Conditions," introduced the LTTR method of reporting R-values that most polyisocyanurate insulation manufacturers currently use. LTTR is a 15-year time-weighted average of tested values, and it closely approximates R-value after five years of aging in controlled laboratory conditions.

In 2005, NRCA participated in a limited testing program that showed a majority of polyisocyanurate insulation samples tested one to four years after being manufactured had actual R-values less than their LTTR values.

In 2009, NRCA conducted R-value testing at various temperatures. R-value typically is tested in controlled laboratory conditions where the temperature is 75 F. NRCA's testing of polyisocyanurate insulation at 25 F, 40 F, 75 F and 110 F showed actual R-values less than LTTR values.


Revised recommendations

Although the LTTR method of R-value determination and reporting may be

appropriate for laboratory analysis, research comparison and procurement purposes, NRCA does not consider LTTR use to be appropriate for roof system design purposes when actual in-service R-value can be an important aspect of roof system performance.

In *The NRCA Roofing Manual: Membrane Roof Systems—2011*, NRCA recommends designers using polyisocyanurate insulation determine thermal insulation requirements using an in-service R-value of 5.0 per inch thickness in heating conditions and 5.6 per inch thickness in cooling conditions. Designers should use the recommended in-service R-value for heating or cooling conditions based on the predominant conditions for building use and climate where the specific building being considered is located.

One way to evaluate whether the heating or cooling condition is predominant is by comparing the heating degree day (HDD) with cooling degree day (CDD) values for a specific climatic location. HDD and CDD values are provided in the *ASHRAE Fundamentals Handbook* and other authoritative references for thermal envelope design and evaluation.

NRCA also recommends designers specify polyisocyanurate insulation by its desired thickness—not its R-value—to avoid possible confusion during procurement. 

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To read other *Professional Roofing* articles about polyisocyanurate insulation's R-value and for links to the research referenced in this article and a table of NRCA's newly recommended design R-values, log on to www.professionalroofing.net.