



## New polyisocyanurate R-values

### NRCA updates its polyisocyanurate insulation recommendations

January 2016

**N**NRCA's Jan. 1, 2014, Industry Issue Update, "Polyiso's R-value," provided an overview of the theory of foam aging; the R-value test method and the long-term thermal resistance (LTTR) methodology; and NRCA's R-value recommendations associated with the use of polyisocyanurate insulation used in roof systems.

This month, NRCA has revised and updated its recommendations applicable to polyisocyanurate insulation. The following supersedes the previous Industry Issue Update and provides an explanation regarding the changes to NRCA's design in-service R-value recommendations.

#### NRCA's testing

Dec. 31, 2002, marked a federally mandated deadline for ceasing production of HCFC-141b, the blowing agent that had been used in polyisocyanurate insulation since the early 1990s. Individual polyisocyanurate insulation manufacturers reportedly made the conversion to a third-generation hydrocarbon-based (pentane) blowing agent between August 1998 and the first quarter of 2003. Currently, this same general class of blowing agent reportedly still is in use for manufacturing polyisocyanurate insulation.

At the same time, beginning Jan. 1, 2003, U.S. polyisocyanurate insulation manufacturers began using LTTR as the exclusive method for reporting the thermal performance of permeable-faced polyisocyanurate insulation such as that used in roof systems.

Since the introduction of the current generation of polyisocyanurate blowing agents and implementation of the LTTR method, NRCA has conducted three R-value test programs applicable to polyisocyanurate insulation. NRCA also is aware of two additional test programs conducted by others that have shown results similar to NRCA's results.

During 2005, NRCA and the Canadian Roofing Contractors Association participated in a limited research project where the R-values of stored, uninstalled polyisocyanurate insulation were tested and compared with the manufacturers' published LTTR values. Seventeen of the 20 samples tested exhibited R-values less than their established LTTR values. This finding was significant because all the samples tested were less than 5 years old—the aging period

the LTTR method is intended to replicate. Four of the samples tested with R-values less than the established LTTR values were less than 1 year old at the time of testing.

During 2009, NRCA conducted limited R-value testing of uninstalled polyisocyanurate insulation samples ranging in ages from 4 to 13 months. Test results showed R-values less than the products' established LTTR values. In addition to testing at a 75 F mean reference temperature, which is typical for R-value labeling, NRCA's 2009 test program also included testing specimens at 25 F, 40 F and 110 F mean temperatures. This additional testing revealed R-values lower than those at 75 F.

This finding is significant because with the previous CFC-11 and HCFC-141b polyisocyanurate blowing agents, R-values at relatively low temperatures typically were recognized to be noticeably higher than those tested at the 75 F temperature used for product labeling. As a result, the current generation of polyisocyanurate blowing agents appears to result in lower R-values at colder temperatures than previous generations of blowing agents.

During 2013, Building Science Corp., Westford, Mass., published a report about its R-value testing of polyisocyanurate insulation and the results replicated NRCA's 2009 testing results. Similarly, in 2014, independent testing conducted by RDH Building Engineering Ltd., Vancouver, British Columbia, replicated the results of NRCA's 2009 testing.

During late 2014, NRCA conducted additional limited R-value testing of polyisocyanurate insulation and found R-values lower than the current LTTR values. The results also are somewhat lower than the results at 25 F, 40 F, 75 F and 110 F mean test temperatures from NRCA's 2009 testing.

#### Updated recommendations

Although the LTTR method for determining and reporting the thermal performance of permeable-faced polyisocyanurate insulation may be appropriate for laboratory analysis, research comparison, energy code compliance and procurement purposes, NRCA does not consider LTTR use to be appropriate for roof system design purposes when actual in-service R-values can be important aspects of roof system and whole building performance.

NRCA conducted testing of polyisocyanurate insulation and found R-values lower than current LTTR values

| Polyisocyanurate         |   |                                  |
|--------------------------|---|----------------------------------|
| Board thickness (inches) | QualityMark <sup>cm</sup> minimum LTTR values | NRCA-recommended design R-values |
| 1.0                      | 5.6   | 5.0                              |
| 1.1                      | 6.2   | 5.5                              |
| 1.2                      | 6.7   | 6.0                              |
| 1.3                      | 7.3   | 6.5                              |
| 1.4                      | 7.9   | 7.0                              |
| 1.5                      | 8.5   | 7.5                              |
| 1.6                      | 9.1   | 8.0                              |
| 1.7                      | 9.6   | 8.5                              |
| 1.8                      | 10.2  | 9.0                              |
| 1.9                      | 10.8  | 9.5                              |
| 2.0                      | 11.4  | 10.0                             |
| 2.1                      | 12.0  | 10.5                             |
| 2.2                      | 12.6  | 11.0                             |
| 2.3                      | 13.2  | 11.5                             |
| 2.4                      | 13.8  | 12.0                             |
| 2.5                      | 14.4  | 12.5                             |
| 2.6                      | 15.0  | 13.0                             |
| 2.7                      | 15.6  | 13.5                             |
| 2.8                      | 16.2  | 14.0                             |
| 2.9                      | 16.8  | 14.5                             |
| 3.0                      | 17.4  | 15.0                             |
| 3.1                      | 18.0  | 15.5                             |
| 3.2                      | 18.6  | 16.0                             |
| 3.3                      | 19.2  | 16.5                             |
| 3.4                      | 19.9  | 17.0                             |
| 3.5                      | 20.5  | 17.5                             |
| 3.6                      | 21.1  | 18.0                             |
| 3.7                      | 21.7  | 18.5                             |
| 3.8                      | 22.3  | 19.0                             |
| 3.9                      | 23.0  | 19.5                             |
| 4.0                      | 23.6  | 20.0                             |

A comparison of minimum LTTR values based on the Polyisocyanurate Insulation Manufacturers Association's QualityMark<sup>cm</sup> program and NRCA's recommended design in-service R-values

With this month's publication of the January 2016 interim update to The NRCA Roofing Manual, NRCA has revised and updated its R-value recommendations for polyisocyanurate insulation used in roof systems. In *The NRCA Roofing Manual: Membrane Roof Systems—2011 and The NRCA Roofing Manual: Membrane Roof Systems—2015*, NRCA had recommended designers use in-service R-values of 5.0 per inch thickness in predominant heating-climate conditions and 5.6 per inch thickness in predominant cooling-climate conditions. With the publication of this interim update, NRCA has revised its design in-service R-value recommendation to 5.0 per inch thickness in all climate conditions.

The table compares minimum LTTR values based on the Polyisocyanurate Insulation Manufacturers Association's QualityMark<sup>cm</sup> certification program and NRCA's recommended design in-service R-values for commonly available thicknesses of polyisocyanurate insulation board.

In addition to NRCA's design in-service R-value recommendations for polyisocyanurate insulation, NRCA recommends designers specify polyisocyanurate insulation by its desired thickness and not LTTR or R-value to avoid possible confusion.

### Getting the interim update

NRCA members who access The NRCA Roofing Manual using the NRCA app on their tablets and smartphones will receive push notifications providing them with an updated version of *The NRCA Roofing Manual: Membrane Roof Systems—2015*, which incorporates the January 2016 interim update.

NRCA members and those who have downloaded PDFs of the manual can access updated PDFs at [shop.nrca.net](http://shop.nrca.net).

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