CRCA Roofing Industry Breakfast
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New LTTR-values for polyiso.

presented by

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R-value history

Polyurethane and polyisocyanurate insulation

- 1960-70s: ASTM C518
  - R = 7.2 per inch
- 1980-90s: RIC/TIMA 281-1 and PIMA 101
  - R = 6.6 per inch
- 1996: ASTM C1303 (LTTR)
- 2003: LTTR labeling (PIMA Quality Mark^{cm})
  - LTTR = 6.0 per inch
- 2013: PIMA Quality Mark^{cm} update

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NRCA

New minimum LTTR values

PIMA Quality Mark[cm] program (minimum values)

Revised LTTR values		
Thickness (inches)	**New LTTR values per inch thickness**	**New LTTR values per thickness**
1	5.6	5.6
2	5.7	11.4
3	5.8	17.4
4	5.9	23.6

"Tech today," *Professional Roofing,* August 2013

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NRCA

Comparing existing vs. new LTTR values

Thickness	LTTR (2004 – 2013)	New LTTR (2014 –)
1 inch	6.0	5.6
1.5 inches	9.0	8.6
2 inches	12.1	11.4
3 inches	18.5	17.4
4 inches	25.0	23.6

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NRCA

NRCA recommends designers specify polyisocyanurate insulation by thickness – not R-value or LTTR.

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NRCA

INDUSTRY ISSUE UPDATE

NRCA Member Benefit

Polyiso's R-value

NRCA recommends polyisocyanurate insulation be specified by its desired thickness

Jan. 1, 2014

This month, U.S. polyisocyanurate insulation manufacturers will begin reporting long-term thermal resistance (LTTR) values based on updated and revised test methods. As a result, LTTR values will be less than values previously used.

Theory of foam aging

The R-value of closed-cell, polyisocyanurate insulation is affected by the amount of gas in the foam's cells. Because the R-value of most blowing agents (gases) is greater than that of air, polyisocyanurate insulation's R-value is greatest when there is more blowing agent and less air in the foam's cells.

During polyisocyanurate insulation's service life, air diffuses into the foam's cells and the blowing agent diffuses out or partially dissolves into the cell's polymer matrix. Each of these processes occurs at rates dependent upon temperature, pressure and the foam's polymer type, gas type and cell structure. Generally, the inward diffusion of air occurs at a much faster rate than the outward diffusion of the captive blowing agent. Diffusion rates also are affected by the foam's thickness and type of facer sheets.

Because of this phenomenon, the R-value of polyisocyanurate insulation is not constant. Its R-value is highest soon after manufacturing and decreases at a relatively significant rate during the earliest portion of its service life. As polyisocyanurate insulation ages further, its R-value decreases at a slower rate until the gas concentration in the foam's cells equals the gas concentration in air, at which point its R-value no longer changes with time.

R-value testing

The R-value of most insulation products used in the roofing industry is tested using ASTM C518, "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," originally published in 1963.

When urethane foam and later polyisocyanurate insulation boards were introduced to the U.S. roofing industry, their R-values typically were reported using ASTM C518 testing conducted immediately after manufacturing and before the cell gas had diffused from the foam's cells and been replaced with air. As a result, R-values of 7.2 or higher per inch thickness were reported.

Beginning in the 1980s, the Roof Insulation Committee of the Thermal Insulation Manufacturers Association's (RIC/TIMA's) conditioning procedure (RIC/TIMA 281-1) and later the Polyisocyanurate Insulation Manufacturers Association's (PIMA's) conditioning procedure (PIMA 101) called for preconditioning foam samples at room conditions (75 F) for 180 days before R-value testing. This preconditioning was an early attempt at addressing polyisocyanurate insulation's R-value loss over time. Using RIC/TIMA 281-1 or PIMA 101 conditioning, R-values of about 6.6 per inch thickness were reported.

In 1987, based on extensive testing of in-service R-values, NRCA and the Midwest Roofing Contractors Association issued a joint technical bulletin regarding the in-service R-values of polyisocyanurate and polyurethane insulation. The bulletin recommended using an in-service R-value of 5.6 per inch of foam thickness. This in-service R-value was intended to account for polyisocyanurate insulation's R-value losses over time and provides a more realistic design R-value for polyisocyanurate insulation during a roof system's entire design life.

LTTR

During the early 1990s, Oak Ridge National Laboratory (ORNL), Oak Ridge, Tenn., in cooperation with NRCA, PIMA and The Society of the Plastics Industry, conducted research that led to the development of a new methodology for assessing aged R-values for closed-cell plastic foam insulation. This methodology involves thin slicing and accelerated aging of polyisocyanurate insulation specimens and testing their R-values using ACTM C518—a process called LTTR.

In 1995, ASTM International published an LTTR test method, 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," based upon this new methodology.

In 1998, the Standards Council of Canada and Underwriters Laboratories of Canada published CAN/ULC-S770, "Standard Test Method for Determination of Long Term Thermal Resistance of Closed-Cell Thermal Insulation Foams." CAN/ULC-S770 is based on ORNL's research and ASTM C1303 and provides R-value data based on a 15-year time-weighted average, corresponding to a product's R-value five years after manufacturing.

Beginning in 2003, U.S. polyisocyanurate insulation manufacturers began reporting LTTR values using a third-party certification program, referred to as PIMA's QualityMark™ program. This program used the 2003 edition of CAN/ULC-S770 for LTTR

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