National Roofing Contractors Association   **Midwest Roofing Contractors Association**

TECHNICAL EXAMINATION AND EXPLANATION
REGARDING POLYISOCYANURATE AND POLYURETHANE
ROOF INSULATION BOARDS
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Technical evidence clearly indicates that a decay in the thermal performance of polyurethane (PUR) and polyisocyanurate (PIR) thermal insulations occurs as the fluorocarbon gas in the foam cells is replaced with air which has a higher thermal conductivity. It has been shown that the initial R-value of these materials can decrease as follows:[1]

Conditioning at 75°F . . . . for 180 days . . . . average decrease 28%
Conditioning at 75°F . . . . for 360 days . . . . average decrease 33%
Conditioning at 140°F . . . . for 90 days . . . . average decrease 32%
Conditioning at 140°F . . . . for 180 days . . . . average decrease 37%

This data indicates that the R-values continue to decline from those reported (after conditioning in accordance with the current manufacturers' recommended aging practices). Several factors have been identified in the technical literature that determine the initial and stablized (aged) R-values of these foam insulations. They include, among others, cell properties and dimensions, blowing agents, aging temperature, thickness, and facing materials.[2]

Although it has been established scientifically that PUR and PIR thermal insulations continue to decay in R-value in service, the question arises as to what will be the final stabilized R-value needed for design purposes? Unfortunately, there is no way to know or predict what the ultimate R-value will be over its life because of changing technology, usage and thickness effects, technical limitations of in situ testing and limitations with the testing of field samples as pointed out by Michelsen.[3] Further, there is no standard test protocol available to the industry to predict accurately the effects of long-term, in-service aging on the degradation of the R-values. The current artificial conditioning practices of either 75°F for 180 days (RIC/TIMA 281-1) or the more recently proposed 140°F for 90 days[4] are useful for determining initial R-values and quality of the materials. However, published data shows that they are not indicative of the (in-service) stabilized R-value needed for design purposes. In addressing this question of aged R-values, an expert working group of the Canadian General Standards Board Thermal Insulation Committee concluded that in the absence of specific data on specific products, the PUR and PIR thermal insulations protected with truly impermeable membranes should be assumed to be equivalent in a five year, aged R-value to the unsurfaced product, i.e., and R-value of 5.8 per inch thickness.[5]

In summary, the ultimate stablized R-value of individual products are unknown and will depend on multifarious factors. Further, technical evidence indicates that the reduction in the PUR and PIR thermal performance over its lifespan will continue from the R-value established from either the six month conditioning at 75°F or the 90 days at the 140°F temperature.

In the absence of specific data and information on specific products regarding the stablized (in-service) R-value of PUR and PIR thermal insulation, and pending receipt of any additional testing or studies, NRCA/MRCA have concluded that an R-value of 5.6 per inch thickness is a reasonable value to be used when calculating thermal performance over the anticipated life of the roof.

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