

Roofing No. 3017

Subject: Comparing Polyiso and Molded Polystyrene from the past to today.

Date: August 2016 (Revised January 2019)

Insulation is a key component of the exterior building envelopes of commercial buildings. The performance of roof insulation is particularly important in large commercial buildings where the roof area is a large percentage of the overall building envelope. Roof systems and the roof insulation contained in them are often replaced as part of regular roof maintenance programs. Roofing replacement projects provide an ideal opportunity to investigate the performance of the insulation many years after the initial installation.

A school building located in Minnesota was undergoing a roofing system replacement in 2016 and it provided a perfect opportunity to evaluate the performance of the existing roof insulations. The school was originally built in 1999 and consisted of a combination of polyiso and molded polystyrene roof insulation. Samples of both products were removed from the roof and evaluated for R-value at various temperatures (See figures on page 3).

Testing was conducted following ASTM C518 at mean temperatures of 75°F, 40°F, and 25°F.

R-value per inch ¹ for 17 year old roof insulation			
Product	Temperature ²		
	75°F	40°F	25°F
Polyiso	5.0	5.6	5.7
Molded Polystyrene (Type VIII)	3.8	4.1	4.2

¹ R-value units are °F-ft²/h/Btu
² Mean Temperature

It is clear that the 17 year old polyiso R-value of R-5.0 at 75°F is well below the published R-value for polyiso of R-5.6. This is not surprising since polyiso insulation loses blowing agents and R-value with age. At colder temperatures, the R-value of the polyiso improved slightly.

The R-value for the 17 year old molded polystyrene at 75°F meets the published R-value of 3.8 for a Type VIII molded polystyrene product. This is not surprising since the R-value of molded polystyrene does not change with time. At colder temperatures, the R-value of the molded polystyrene increased.

In addition to testing old insulation samples, samples of the new polyiso roof insulation installed on the roof and molded polystyrene from a local manufacturer were sourced for testing. Samples of both products were evaluated for R-value at various temperatures.

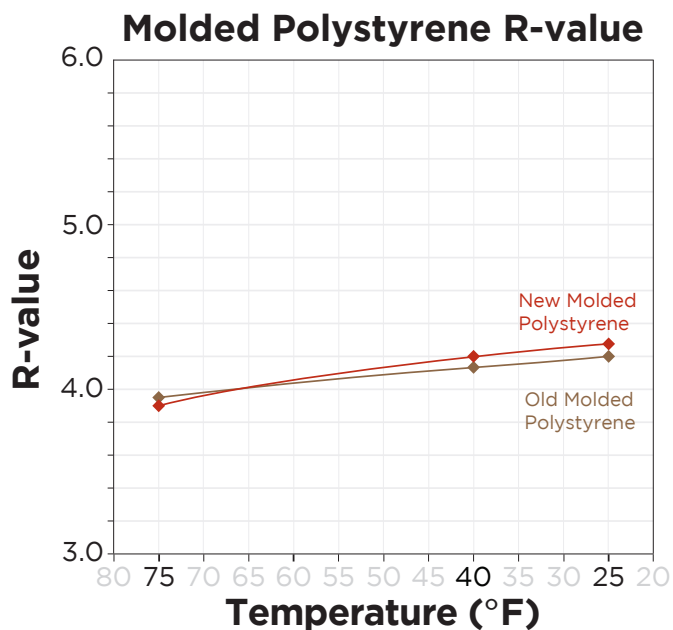
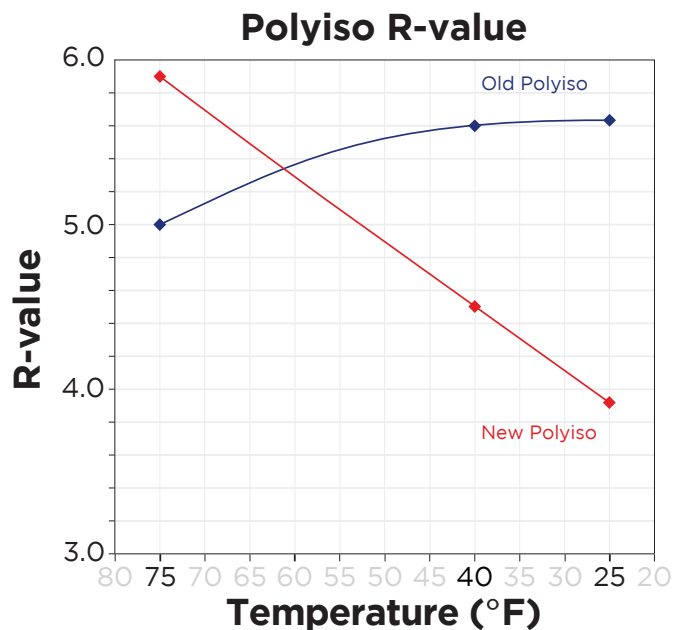
R-value per inch ¹ for “new” roof insulation			
Product	Temperature ²		
	75°F	40°F	25°F
Polyiso	5.8	4.5	3.9
Molded Polystyrene (Type VIII)	3.9	4.2	4.3

¹ R-value units are °F-ft²/h/Btu
² Mean Temperature

It is clear that the R-value of “new” polyiso of 5.8 at 75°F meets the the published R-value for polyiso of R-5.6. This is not surprising since the polyiso insulation is new and has not yet lost its blowing agents and R-value which will occur with age. At colder temperatures, the R-value of the polyiso decreased dramatically. This loss of R-value for polyiso is a known phenomenon and has been documented extensively^{1,2}.

A plot of the R-value for the 17 year old polyiso and new polyiso demonstrates the dramatic change in polyiso insulation in recent years. "New" polyiso loses significant R-value at cold temperatures.

In comparison, the R-value for 17 year old molded polystyrene and new molded polystyrene are similar. This demonstrates that molded polystyrene can be trusted to have stable R-value performance.



It is very important to understand that the latest generation of polyiso insulations and molded polystyrene have very similar R-values when used at cold temperatures. This has dramatic implications when selecting your insulation product and its thickness for use in cold weather and cold storage applications.

References:

1. Building Science Corporation Information Sheet 502, "Understanding the Temperature Dependence of R-values for Polyisocyanurate Roof Insulation", September 2013.
2. Professional Roofing, "Testing R-values, Polyisocyanurate's R-values are found to be less than their LTTR values", March 2015.



Figure 1. 17 year old Minnesota school



Figure 2. Roof replacement in progress



Figure 3. Existing roof being removed

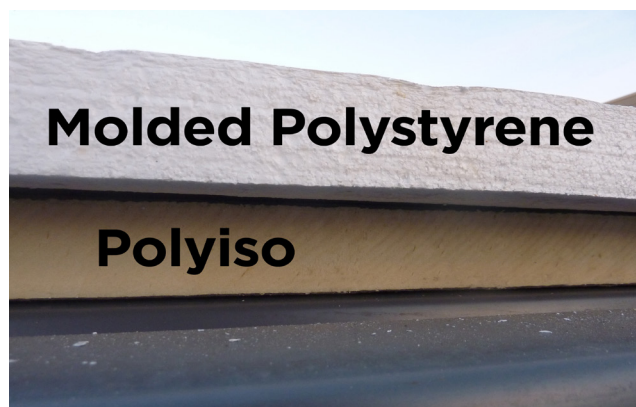


Figure 4. Existing roof components



Figure 5. 17 year old polyiso sample

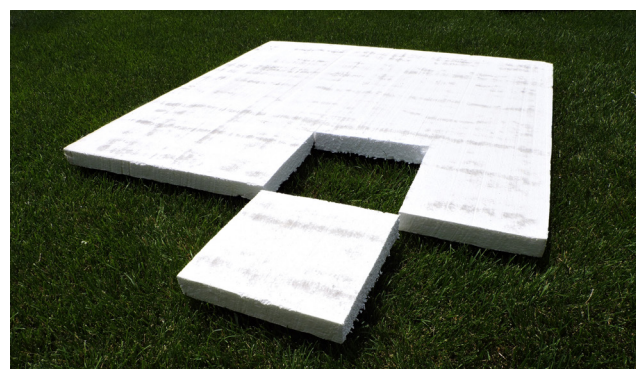


Figure 6. 17 year old Molded polystyrene sample



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