

EPS NO. 1013

SUBJECT: ENVIRONMENTAL CYCLING

DATE: APRIL 2008 (REVISED JANUARY 2019)

Expanded polystyrene has a proven track record of performance in below grade applications. Expanded polystyrene is a closed cell material with excellent resistance to moisture, freeze-thaw cycles, and the rigors of below grade use.

The successful performance of expanded polystyrene insulation used as below-grade insulation material has been demonstrated by a two-year exposure to a below-grade foundation application¹. Key performance issues highlighted during the project were:


- The expanded polystyrene insulation was directly exposed to high moisture content soil conditions; however, the moisture content after the two-year exposure period was found to be less than 0.5% by volume on average.
- The in-situ thermal performance of the expanded polystyrene insulation was monitored over the two-year exposure period and found to remain constant - i.e., there was no loss in thermal resistance value exhibited based upon field monitoring.
- Samples taken from the field exposure were subjected to laboratory testing to confirm thermal performance and durability. Test results indicated there was no change in material properties after the two-year field exposure.
- The research project included development of a durability test protocol to provide a means of assessing performance of all types of insulation subjected to extreme thermal gradient and environmental cycling. Testing confirmed that all types of expanded polystyrene insulation retained their specified material properties even after being subjected to freeze-thaw cycling.

The below-grade research¹ led to the development of ASTM C1512, “Standard Test Method for Characterizing the Effect of Exposure to Environmental Cycling on Thermal Performance of Insulation Products”. This standard provides a laboratory method to characterize the performance of insulations used in below grade applications.

The method exposes test specimens initially to moisture for 28 days to intentionally increase moisture content.

After this period, the samples are exposed to freeze-thaw cycles. The specimens divide two environments during the freeze-thaw cycling: 75°F 90%RH and an environment that cycles every 12 hours between 5°F and 60°F for 20 days. This exposure simulates the performance of building insulation in cold climates. The 75°F is similar to the interior of the building and the cycling between 5°F and 60°F is to simulate the changing exterior environment.

R-Shield® 100, 150, and 250 samples have been tested in accordance with ASTM C1512². The samples were tested for compressive strength and thermal resistance (R-value) before and after the environmental cycling. The moisture condition was also measured after the cycling.

AFTER ASTM C1512 Environmental Cycling			
	Compressive Strength, psi.	R-value, °F-ft ² -h/btu	Moisture Content, volume %
100	13.7	3.7	2.7
150	21.6	4.0	1.7
250	32.0	4.4	1.6

After testing, the compressive strength and R-value for the expanded polystyrene samples still meet the requirement of ASTM C578, “Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation”. In addition the moisture contents are below the values for moisture absorption presented in ASTM C578.

The ASTM C1512 test results clearly show that expanded polystyrene samples are not affected by the type of environmental conditions that is typical of building insulation.

¹Research program conducted by the National Research Council of Canada/Expanded Polystyrene Association of Canada and the Expanded Polystyrene Industry Alliance.

²Research conducted by the Expanded Polystyrene Industry Alliance.