Product Information Bulletin

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PlastiSpan Insulation Performance Properties

Product Information Bulletin

Plasti-Fab® EPS Insulation Performance Properties

What is Plasti-Fab® EPS insulation?
Plasti-Fab expanded polystyrene (EPS) insulation is an air-filled, closed cell, rigid foam plastic insulation. Plasti-Fab EPS insulation has never contained a blowing agent that is intended to provide enhanced thermal resistance such as CFC, HCFC or HFC. Plasti-Fab standard unfaced white EPS insulation is sold under the brand name ***PlastiSpan*** insulation and faced insulation with a film laminated to both faces is sold under the brand names ***DuroFoam***®, ***DuroSpan***® and ***ENERGREEN***® insulation.

What are the key advantages of Plasti-Fab EPS insulation?
The closed cell structure of Plasti-Fab EPS insulation provides ***constant thermal resistance***, is ***dimensionally stable*** and provides ***excellent mechanical properties***.

What are some typical PlastiSpan insulation applications?
PlastiSpan insulation is used in above-grade or below-grade building application including:

- Roofs - commercial and residential flat or sloped insulation.
- Above-grade walls - e.g. insulating sheathing
- Foundation wall insulation and drainage – interior or exterior below-grade wall application.
- Floor slab applications – above or below concrete slab
- Frost-protected shallow foundations.
- Plasti-Fab building systems – as a component in the ***Insulspan SIP System*** (a structural insulated panel) or the ***Advantage ICF System***® (an Insulating Concrete Form) for wall and roof systems.

What are the applicable product standards for Plasti-Fab EPS insulation?
The two primary EPS insulation standards in North America are:

1. CAN/ULC-S701.1 (Formerly CAN/ULC-S701), ***Standard for Thermal Insulation, Polystyrene, Boards*** for Canadian product applications.
2. ASTM C578, ***Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation***.

Material properties for products manufactured to these standards are provided in Tables 1 to 4.

Additional standards that use CAN/ULC-S701.1 and ASTM C578 material property requirements for EPS insulation as a component for specific building system applications are:

1. ASTM E2430, ***Standard Specification for Expanded Polystyrene ("EPS") Thermal Insulation Boards For Use in Exterior Insulation and Finish Systems ("EIFS")***. NOTE: Requirements for EPS insulation as a component in EIFS are provided in CAN/ULC-S701.1, Annex A.
2. CAN/ULC-S717.1, ***Standard for Flat Wall Insulating Concrete Form (ICF) Units***.
3. ASTM E2634, ***Standard Specification for Flat Wall Insulating Concrete Form (ICF) Systems.***

<u>**NOTE:**</u> Plasti-Fab EPS products are also used for a wide range of geotechnical engineering applications. <u>Material properties provided in ASTM C578 and CAN/ULC-S701.1 apply to thermal insulation applications.</u> However, Plasti-Fab has developed a separate series of PIBs[1] for geotechnical applications where Plasti-Fab EPS is required to support loads. For example, Plasti-Fab PIBs support use as EPS geofoam for structural lightweight fill material. ASTM D6817, ***Standard Specification for Rigid Cellular Polystyrene Geofoam*** is used to specify EPS geofoam material properties and types for this application.

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1. See Plasti-Fab PIB 1000 series for additional information on Plasti-Fab EPS product solutions for geotechnical applications.

Table 1 – Typical *PlastiSpan* Insulation Types per CAN/ULC-S701.1

Material Property[2]	Units	Type 1	Type 2	Type 3[3]		
				25	40	60
Thermal Resistance[4] *Minimum per 25 mm (1-inch)* ASTM C518	$m^2 \cdot {}^oC/W$ ($ft^2 \cdot h \cdot {}^oF/Btu$)	0.65 (3.75)	0.70 (4.04)	0.74 (4.27)	0.75 (4.3)	0.75 (4.3)
Compressive Resistance *Minimum @ 10% Deformation* ASTM D1621	kPa (psi)	70 (10)	110 (16)	170 (25)	276 (40)	414 (60)
Flexural Strength *Minimum* ASTM C203	kPa (psi)	170 (25)	240 (35)	300 (44)	414 (60)	517 (75)
Water Vapour Permeance[5] *Maximum* ASTM E96	$ng/(Pa \cdot s \cdot m^2)$ (Perms)	300 (5.0)	200 (3.5)	130 (2.25)	130 (2.25)	130 (2.25)
Water Absorption[6] *Maximum* ASTM D2842	% By volume	6.0	4.0	2.0	2.0	2.0
Dimensional Stability *Maximum* ASTM D2126	% Linear Change	1.5				
Limiting Oxygen Index *Minimum* ASTM D2863	%	24				
Service Temperature *Maximum*	${}^oC$ (${}^oF$)	75 (165)				

Table 2 below provides ***additional*** materials properties not addressed by CAN/ULC-S701.1 for the typical ***PlastiSpan*** insulation types.

Table 2 - Additional Material Properties

Material Property	Units	Type 1	Type 2	Type 3		
				25	40	60
Shear Strength *Minimum* ASTM C273	kPa (psi)	83 (12)	125 (18)	165 (24)	210 (30)	260 (38)
Compressive Resistance *Minimum @ 1% Deformation* ASTM D1621	kPa (psi)	25 (3.6)	50 (7.3)	60 (8.7)	103 (15.0)	180 (26.1)
Poisson's Ratio	NA	0.1				

2. Material properties for Plasti-Fab EPS insulation per CAN/ULC-S701.1 are third party certified under a quality listing program with Intertek Testing Services NA and are evaluated for code compliance under Intertek Code Compliance Research Report CCRR-1072.
3. Compressive resistance properties for ***PlastiSpan 25***, ***PlastiSpan 40*** and ***PlastiSpan 60*** insulation exceed minimum requirement for CAN/ULC-S701.1, Type 3.
4. Thermal resistance is measured at a mean temperature of 75 °F (24 ºC).
5. Water vapour permeance values quoted are maximum values for 25-mm thick samples with natural skins intact. Lower values will result for thicker materials. Where water vapour permeance is a design issue, consult Plasti-Fab Sales representative for additional information.
6. The water absorption laboratory test method involves complete submersion under a head of water for 96 hours. The water absorption values above are applicable to specific end-use design requirements only to the extent that the end-use conditions are similar to test method requirements.

Table 3 - *PlastiSpan* Insulation Properties per ASTM C578

Material Property[7]	Units	Type XI	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV
Nominal Density	pcf	0.75	1.00	1.25	1.50	2.00	2.50	3.00
Compressive Resistance *Minimum @10% deformation* ASTM D1621	psi (kPa)	5.0 (35)	10 (69)	13 (90)	15 (104)	25 (173)	40 (276)	60 (414)
Thermal Resistance[8] *Minimum per inch (25.4 mm)* ASTM C518	ft^2·hr·°F/Btu (°C ·m^2/W)	3.2 (0.56)	3.9 (0.69)	3.9 (0.69)	4.2 (0.74)	4.4 (0.77)	4.4 (0.77)	4.5 (0.79)
Water Vapor Permeance[9] *Maximum* ASTM E96	Perm (ng/Pa·s·m^2)	5.0 (287)	5.0 (287)	3.5 (201)	3.5 (201)	2.5 (143)	2.5 (143)	2.5 (143)
Flexural Strength *Minimum* ASTM C203	psi (kPa)	10 (70)	25 (173)	30 (208)	35 (240)	50 (345)	60 (414)	75 (517)
Water Absorption[10] *Maximum* ASTM C272	% by volume	4.0	4.0	3.0	3.0	2.0	2.0	2.0
Dimensional Stability *Maximum* ASTM D2126	% linear change	2.0						
Limiting Oxygen Index *Minimum* ASTM D2863	volume %	24						
Service Temperature *Maximum*	°F (°C)	165 (75)						
Density *Minimum* ASTM C303	pcf (kg/m^3)	0.70 (12)	0.90 (15)	1.15 (18)	1.35 (22)	1.80 (29)	2.40 (38)	3.00 (48)

Table 4 below provides some ***additional*** material properties to those in ASTM C578 for the typical ***PlastiSpan*** insulation types.

Table 4 – Additional Material Properties

Material Property	Units	Type XI	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV
Shear Strength *Minimum* ASTM C273	kPa (psi)	35 (5.0)	85 (12.0)	104 (15.0)	125 (18.0)	165 (24.0)	210 (30.0)	260 (38)
Compressive Resistance *Minimum @ 1% Deformation* ASTM D1621	kPa (psi)	15 (2.2)	25 (3.6)	40 (5.8)	50 (7.3)	60 (8.7)	103 (15)	180 (26.1)
Poisson's Ratio	NA	0.1						

7. Material properties for Plasti-Fab EPS insulation per ASTM C578 are third party certified and labelled under a quality listing program administered by Intertek Testing Services NA and are evaluated for code compliance under Intertek Code Compliance Research Report CCRR-1072.
8. Thermal resistance is measured at a mean temperature of 75 °F (24 °C).
9. Water vapor permeance values quoted are maximum values for 1.0 inch (25.4-mm) thick samples with natural skins intact. Lower values will result for thicker materials. Where water vapor permeance is a design issue, consult Plasti-Fab Sales representative for additional information.
10. ASTM Test Method C272 water absorption requires 24 hours submersion of specimen under water. The water absorption values above are applicable to specific end-use design requirements only to the extent that the end-use conditions are similar to requirements stated in the test method.

What performance characteristics need to be considered for insulation applications?
The test methods used to determine material properties in the above tables provide a means of comparing different types of cellular plastic thermal insulation. They are intended for use in specifications, product evaluations and quality control. However, the material properties in product standards alone may not provide complete answers with regard to required product performance in end-use insulation applications. This product information bulletin provides additional guidance in using material properties specified to assess suitability for end-use applications.

Based upon the insulation application requirements, performance characteristics that may be considered include:

- Service Temperature
- Thermal resistance
- Compressive resistance
- Flexural strength
- Moisture resistance
- Water vapour permeance
- Freeze-thaw performance
- Drainage capabilities
- Resistance to vermin attacks
- Protection from ultraviolet light
- Chemical resistance

This bulletin provides a brief discussion on each of the above properties. Plasti-Fab has also developed a Product Information Bulletin (PIB) series to assist designers and specification writers in selecting the appropriate insulation type for specific end-use applications. Visit the Technical Library on the Plasti-Fab website at https://www.plastifab.com/technical-library/pib-plastifab.html for a complete listing of PIBs.

Service Temperature
Products manufactured to meet the requirements of CAN/ULC-S701.1 and ASTM C578 are intended for use in building construction and other applications where the service temperature exposures are in the range from -54 °C (-65°F) to +75 °C (165 °F).

Thermal Resistance/Thickness Relationship
The major mechanism of heat transfer in foam plastic insulation is by conduction. Heat transfer by conduction occurs through both the gas and solid portions of the foam. However, since gases occupy approximately 90 to 98 percent by volume of cellular plastics, conduction through the gas portion of the foam is by far the most significant.[11] The thermal resistance of EPS insulation is closely related to the density of the finished product. Within the normal range of insulation densities, as the density increases, the thermal resistance values also increase.

EPS insulation thermal resistance in product standards is stated as RSI (SI units) or R-value (inch-pound units). The RSI/R-value of insulation is a relative measure of the ability of the material to resist heat flow, with a higher RSI/R-value indicating a greater resistance to heat flow. Table 1 provides minimum RSI per 25 mm (R-value per inch) of thickness per CAN/ULC-S701.1. Table 2 provides minimum R-value per inch (RSI per 25.4 mm) of thickness per ASTM C578.

Long-Term Thermal Resistance (LTTR) properties of foam plastic insulation
Some cellular foam plastic insulations depend upon blowing agents such as HFCs or HCFCs inside their cellular structure to increase the RSI/R-value. However, since the foam plastic insulation is not enclosed within a gas impermeable barrier, the blowing agent in the cellular structure diffuses out over time and is replaced by air, which has a lower thermal resistance value. This phenomenon is known as thermal aging. To address this characteristic, designers must be provided design RSI/R-value based upon long-term thermal resistance (LTTR) testing.

The foam plastic insulation industry has developed test methods for ***predicting*** the LLTR of foam plastic insulation. CAN/ULC-S770[12] is the National Standard of Canada recognized as the test method for

11. Sirdeshpande, Gourish and Khanpara, J. C., ***Heat Transfer Through Elastomeric Foams - A Review***, Volume 66, Rubber and Chemistry Technology.
12. CAN/ULC-S770, ***Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams***, Underwriters Laboratories of Canada.

predicting the LTTR of closed-cell foam plastic insulation that meet the following criteria (see PIB 241 for additional information):

> *All cellular plastic insulations manufactured with the intent to retain a blowing agent, other than air, for a period longer than 180 d, shall be tested for long-term thermal resistance (LTTR) in accordance with CAN/ULC-S770,* ***Standard Method of Test for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams****.*

Minimum LTTR values and product labeling requirements are included in National Standards of Canada for all foam plastic insulation that meet the above criteria.

Similarly, ASTM C1303[13] has been developed for use in ASTM foam plastic insulation specifications; however, ASTM C1303 has not yet been widely adopted and **ASTM specifications do not include minimum LTTR values** (**see PIB 314 for additional information**). Both test methods provide a means for ***predicting*** LTTR for foam plastic insulation with a captive blowing agent based upon an accelerated laboratory test.

LTTR properties of EPS insulation

The closed cellular structure of EPS insulation contains only stabilized air; ***therefore, the RSI/R-value of EPS insulation does not decrease with age. Reported RSI/R-values are determined by direct testing using ASTM C518[14] or ASTM C177.***[15] In other words, ***published RSI/R-values are design values*** and do not require any adjustments for aging over the life of the structure.

Compressive resistance of EPS insulation

Compressive resistance is determined using ASTM Test Methods C165[16] or D1621.[17] The value included in material standards and specifications for cellular plastics, including ***PlastiSpan*** insulation, is the compressive stress at 10% strain (deformation from original thickness). This value is not a failure strength, but rather is intended for product evaluations and quality control, as well as for comparing relative compressibility of different cellular plastics. The compressive resistance of EPS insulation is closely related to product density.

The compressive resistance at 10% deformation should not be used for design purposes when a cellular plastic is to be subjected to short or long term compressive loads. If compressive loads are anticipated, either short or long term, the compressive resistance at 1% deformation provided in Tables 2 and 4 should be used for design purposes for the insulation types identified in these tables.

Flexural strength of EPS insulation

Flexural strength provides a relative measure of resistance to bending. It is measured using ASTM C203, Procedure B[18] and may be important when considering the handling characteristics of the product, as well as the ability to resist point loads. The values given in material standards are not intended for design purposes as they are breaking strengths.

Moisture resistance characteristics per laboratory test methods

EPS insulation is a closed cell foam plastic insulations and as such resists the absorption of moisture into the cellular structure. Foam plastic insulation standards specify maximum water absorption (% by volume) obtained from laboratory test method.

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13. ASTM C1303, ***Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation***, ASTM International.
14. ASTM C518, ***Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus***, ASTM International.
15. ASTM C177, ***Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus***, ASTM International.
16. ASTM C165, ***Test Method for Measuring Compressive Properties of Thermal Insulations***, ASTM International.
17. ASTM D1621, ***Test Method for Compressive Properties of Rigid Cellular Plastics***, ASTM International.
18. ASTM C203, ***Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation***, ASTM International.

Maximum water absorption specified in CAN/ULC-S701.1 is determined using ASTM D2842[19] which states the following under section 2, "***Significance and Use***":

> *The purpose of this test is to provide a means for comparing relative water absorption tendencies between different cellular plastics. It is intended for use in specifications, product evaluations, and quality control.* ***It is applicable to specific end-use design requirements only to the extent that the end-use conditions are similar to the immersion period (normally 96 h) and 5.1 cm. (2 in.) head requirements of the test method.*** (Bold print added for clarity.)
>
> Note: The above not taken from ASTM D2842 is also included as a note in CAN/ULC-S701.1.

Maximum water absorption values specified in ASTM C578 are determined using ASTM C272[20]. ASTM C578, Appendix Clause X1.4 contains a similar note that states maximum water absorption values in the specification may have significance when the end-use requirements are similar to the 24 hour submersion requirements of the test method.

Moisture resistance of EPS insulation in actual applications

There are now a number of published reports demonstrating that moisture resistance of EPS insulation in actual applications exposed over extended periods of time is much better than indicated by water absorption laboratory test methods. Below are a few examples:

1. The results of an NRC/CPIA study of EPS insulation installed below grade for 2 years confirmed water absorption less than 0.7% by volume (see PIB 209 for additional information).
2. A Finnish study[21] comparing results from laboratory water absorption test methods to values from field applications found actual that actual water absorption in below grade applications was less than half that predicted by Laboratory test values.
3. Published report from Norway[22] for EPS lightweight fill material samples retrieved from applications after up 30 years in service in a drained position found moisture contents less than 1% by volume.
4. Plasti-Fab Product Information Bulletin No. 268 provides test results for ASTM C578, Type I EPS insulation and Type X extruded polystyrene (XPS) insulation installed side-by-side on a below-grade foundation application. The bulletin highlights test results from an independent, third-party test laboratory[23] for each insulation type removed after 15 years of service from the exterior of a commercial building in St. Paul, MN at a depth of approximately 6 feet below grade.

Equilibrium moisture content (EMC)

Equilibrium moisture content (EMC) is the moisture content of a material at which the material is neither gaining nor losing moisture when exposed to a specific relative humidity and temperature. Although it is a dynamic equilibrium, after the moisture content of EPS insulation has attained its equilibrium value under given conditions, EMC changes that take place as conditions change would not exceed 0.15% of the mass of the material. This EPS insulation material property is another reason why actual moisture absorption measured from field applications differs greatly from results obtained in laboratory tests that expose test specimens to conditions that are not experienced in actual intended product applications.

Drying Potential of EPS insulation

Moisture intrusion into insulation used in below grade applications is sometimes unavoidable. For this reason, it is important to evaluate the *drying potential* of an insulation material when exposed to long term environmental conditions as well as their ability to resist moisture intrusion.

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19. ASTM D2842, ***Test Method for Water Absorption of Rigid Cellular Plastics***, ASTM International.
20. ASTM C272, ***Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions***, ASTM International.
21. Oajnen, Tuomo and Kokko, Erkki, ***Moisture Performance Analysis of EPS Frost Insulation***, ASTM STP 1320, Insulation Materials – Testing and Applications, 3rd Volume, April 1997.
22. Norwegian Public Roads Administration, ***Long-Term Performance and Durability of EPS as a Lightweight Fill***, Nordic Road Transport Research Report 1-2000
23. Stork Twin Cities Testing Corporation, St. Paul, MN – IAS Accreditation TL-217.

The drying potential of thermal insulation is critical to ensuring thermal resistance (RSI/R-value) is maintained even after exposure to severe long-term exposure conditions since changes in moisture content will impact their thermal performance. Plasti-Fab Product Information Bulletin No. 297 provides information on drying potential for EPS insulation after exposure to the environmental cycling described in ASTM C1512.[24]

Water Vapour Permeance of EPS insulation
The ability of a material to resist water vapour movement through it depends upon its water vapour permeability. Water vapour permeability characteristics of rigid cellular plastic insulation are determined using ASTM Test Method E96. Maximum water vapour permeability values can be varied with thickness. Values for various types of ***PlastiSpan*** insulation given in the material property tables in this PIB are for minimum product thickness as noted.

Water vapour transmission through a material is the passage of water through the material in the vapour phase. Capillary movement of moisture is eliminated in closed cellular plastic insulation such as ***PlastiSpan*** insulation; therefore, redistribution of moisture occurs through vaporization and condensation mechanisms as a result of the prevailing thermal gradient. Most moisture gain in field applications is restricted to either the surface cells or as water vapour in the interstitial spaces, rather than absorbed moisture.

The following points should be noted regarding water vapour permeability in relation to EPS insulation performance in the building system:

1. Water vapour pressure rises significantly as temperature rises.
2. A significant vapour drive (i.e. temperature/pressure differential) is required in order to induce a significant water vapour movement for the typical range of water vapour permeability values provided by EPS insulation.
3. Water vapour movement that could be expected at moderate temperature differentials encountered in below-grade applications would be minimal - e.g. vapour pressure differential for 72 °F (22 °C) inside and 41 °F (5 °C) outside = 0.52" Hg (1772 Pa).
4. A University of Minnesota Underground Space Centre 1986 study of existing research related to foam plastic used in below grade applications offered the following comment on water vapour pressure differentials encountered in below-grade applications:

    Building/ground vapour pressure differentials should seldom exceed 0.30" Hg (1015 Pa vapour pressure) outwards and 0.50" Hg (1690 Pa vapour pressure) inwards. Laboratory test results at this level of vapour differential did not result in a significant absorption of moisture.

Water vapour permeance of EPS insulation with laminated facers
Maximum vapour permeance value for EPS insulation typically varies per unit of thickness. The vapour permeance value for ***DuroFoam***, ***DuroSpan*** and ***ENERGREEN*** insulation is significantly lower as a result of the laminated films. Where water vapour permeance is a design issue, contact Plasti-Fab technical services for additional information.

Resistance to freeze-thaw action
One laboratory test method that has been used in the past by some foam plastic insulation manufacturers as a freeze-thaw durability test procedure is a modified version of ASTM C666, ***Test Method for Resistance of Concrete to Rapid Freezing and Thawing***. This procedure has been used to subject insulation samples to up to 600 cycles of full-thickness freezing in air and thawing by complete submersion in water. The test procedure does not correlate to conditions encountered with typical applications for an insulation material. The question becomes how many cycles of an inappropriate test procedure are required to **create** a "failure" of the product, rather than how an insulation product will perform in an application.

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24. C1512-2010 (Reapproved 2015), ***Standard Test Method for Characterizing the Effect of Exposure to Environmental Cycling on Thermal Performance of Insulation Products***, ASTM International.

In reviewing performance of foam plastics in below-grade applications, the University of Minnesota Underground Space Centre concluded that:

1. Freeze-thaw testing involving hundreds of full-thickness freeze-thaw cycles of a fully or partially submerged insulation is poorly related to the expected performance of insulation for below-grade applications over a reasonable economic life for a building.
2. The impact of freeze-thaw cycling in a drained, below-grade building foundation application should not be large since the annual number of freeze-thaw cycles is small below grade, and little of the insulation thickness will experience sub-freezing temperatures.

The performance of EPS insulation in a below-grade application was further demonstrated as part of a joint NRC/CPIA research project. In this project, EPS insulation was installed as exterior foundation insulation for a period of two years. The in situ thermal performance of the insulation was continuously monitored over the period and found to be constant. In addition, the mechanical properties of samples of the material tested after removal from the application were unchanged.[25,26]

A second part of the NRC/CPIA research project included development of a laboratory durability test protocol that subjected test material to extreme thermal gradient and environmental cycling, including freeze-thaw cycling.[27] Laboratory testing performed by NRC on samples from the same manufacturing lot of material subjected to the 30-month field exposure confirmed that all types of EPS insulation retained their specified material properties even after being subjected to the laboratory durability test protocol. The test protocol was subsequently developed into an ASTM standard test method to provide a means of assessing durability performance of all types of insulation.

EPS insulation drainage properties in below-grade applications

When used as below-grade foundation insulation, the surface of EPS insulation will act as a capillary-breaking layer. The surface of the insulation resists movement of water into the insulation and provides a drainage plane. If adequate provision for drainage is provided at the base of the wall, water will drain to the base of the wall. Plasti-Fab ***GeoDrain***® foundation insulation board[28] is a proprietary product designed specifically as a drainage product.

Effect of sunlight (ultraviolet light) on EPS insulation

Ultraviolet light (sunlight) will cause surface degradation on all types of cellular plastic insulation, including EPS insulation. If the product is to be stored outside for extended periods of time (more than 3 or 4 days in a bright summer sun), it should be covered with a tarpaulin or opaque light-coloured polyethylene film.

Insulation subject to attack by insects, parasites or animal and plant life

EPS insulation does not provide any nutritive food value and will not attract insects, parasites or animal and plant life. However, care should be taken to minimize possible exposure to carpenter ants and termites as these wood-boring insects are known to use any insulation material, with the exception of foam glass, as a nesting or tunneling medium. Plasti-Fab PIB 243 provides additional recommendations measures to control pest infestations.

Chemical Resistance

Plasti-Fab Technical Bulletin 115-01 provides information regarding EPS insulation chemical resistance.

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25. Swinton, Bomberg, Kumaran and Maref, **In situ Performance of Expanded Molded Polystyrene in the Exterior Basement Insulation System (EIBS)**, Journal of Thermal Envelope & Building Science, Vol. 23, October 1999.
26. Swinton, Bomberg, Kumaran, Normandin and Maref, **Performance of Thermal Insulation on the Exterior of Basement Walls**, NRC Construction Technology Update No. 36.
27. Normandin, N., Bomberg, M. T. and Swinton, M.C., ***Development of a Draft Test Protocol for Evaluating Durability Under Environmental Cycling of Insulation Products for Exterior Basement Applications***, NRC Report No. 3132.2, December 1999.
28. See Plasti-Fab Product Information Bulletin 210 for additional information regarding ***GeoDrain*** foundation insulation board.

Industry Acceptance

Since 1951, EPS insulation has been one of the most widely used thermal insulations in the world and is a key component in a number of energy-efficient building systems. Its versatility and high RSI/R-value per dollar make EPS insulation the preferred product of architects, specifiers and application contractors.

Buy with confidence

The industry provides a voluntary, third-party quality assurance program to help participating manufacturers control product quality and monitor compliance. All Plasti-Fab EPS insulation products are manufactured in facilities under a third party certification program maintained with Intertek Testing Services NA. Consumers, architects, specifiers, building owners, home builders, roofers and insulation contractors can benefit from this nation-wide program by specifying the purchase of labeled products.

CCMC Evaluation Listings

Canadian Construction Materials Centre (CCMC) evaluation listings 12424-L, 12425-L and 12426-L address ***PlastiSpan***, ***DuroFoam*** and ***ENERGREEN*** insulation material property requirements per CAN/ULC-S701.1, types 1, 2 and 3 as well as compliance with the National Building Code of Canada. See Plasti-Fab Product Information Bulletins 267, 295 and 296 for more information on these code evaluation listings.

ICC-ES Evaluation Report

ICC-ES ESR-1587 addresses ***PlastiSpan*** insulation material property requirements per ASTM C578, Types I, VIII, II and IX as well as compliance with the requirements of the International Building Code (IBC) and the International Residential Code (IRC). See Plasti-Fab Product Information Bulletin 269 for more information on this code evaluation report.

Intertek Code Compliance Research Reports

CCCR-1072 addresses ***PlastiSpan***, ***DuroFoam***, ***DuroSpan*** and ***ENERGREEN*** insulation material property requirements per ASTM C578 and CAN/ULC-S701.1 as well as compliance with the requirements of the IBC and IRC for United States applications and National Building Code of Canada (NBCC) for Canadian applications. See Plasti-Fab Product Information Bulletin 346 for more information on this code evaluation report.

GREENGUARD Gold Certification Listings

As part of its commitment to quality and ongoing sustainability initiatives, Plasti-Fab maintains ***GREENGUARD Gold Certification*** for its expanded polystyrene (EPS) insulation products. The certification includes ***PlastiSpan***®, ***DuroSpan***®, ***DuroFoam***®, ***EnerSpan***® and ***ENERGREEN***® insulation, as well as the ***Advantage ICF System***®.

GREENGUARD certification was developed with UL Environment, an independent global safety science organization using their process and procedures in accordance with established environment and safety standards (see https://spot.ulprospector.com/en/na/BuiltEnvironment for listings). See Plasti-Fab Product Information Bulletin 266 for more information on this product certification.

Research and Development

Bringing an insulation material to the market is one thing, but Plasti-Fab has been providing sustained support and developing new innovative EPS product solutions as a market leader over a number of decades. Plasti-Fab has provided customers with innovative expanded polystyrene (EPS) product solutions for over fifty years. Below is a brief introduction to two additional products that Plasti-Fab has introduced to the construction market recently.

1. ***EnerSpan***® insulation is rigid, closed cell insulation with a silver-gray color that meets or exceeds requirements for expanded polystyrene (EPS) insulation manufactured to CAN/ULC-S701.1 and ASTM C578. ***DuroSpan GPS*** insulation is the same insulation with a laminated film applied to both faces. ***EnerSpan*** insulation is manufactured using ***Neopor***® ***F5300 Plus***, a graphite-enhanced expandable polystyrene (GPS) resin provided by ***BASF*** that reduces radiation heat transfer and results in an enhanced thermal resistance compared to white EPS insulation.

See Plasti-Fab Product Information Bulletins 302 and 304 for ***EnerSpan*** insulation material property data and Product Information Bulletins 348 and 349 for ***EnerSpan EFS*** insulation material property data. See Plasti-Fab Product Information Bulletin 354 for ***DuroSpan GPS*** insulation material property data.

Intertek Code Compliance Research Report CCCR-1033 addresses ***EnerSpan*** and ***DuroSpan GPS*** insulation compliance with the requirements of the IBC and IRC for United States applications and NBCC for Canadian applications. See Plasti-Fab Product Information Bulletin 312 for more information on this code evaluation report.

2. ***Radon Guard*** insulation is a patent-pending sub-slab depressurization panel. The interconnected channels on the underside of the panel direct soil gas movement between the ground and the air barrier system to a vent pipe in slab on ground applications as required by National Building Code of Canada 2010, Section 9.13.4. The vent pipe is required to connect to a radon gas mitigation system as per applicable code.

   See Plasti-Fab Product Information Bulletins 294, 300 and 358 for more information on this product.

   CCMC Evaluation Report 13698-R confirms that ***Radon Guard*** Insulation is a code compliant replacement for a 100 mm thick layer of clean granular fill material as required by code.

Recognized as experts in the design and manufacture of EPS products for a wide variety of applications, we provide our customers with professional assistance to select the right EPS product solution for their application.