

# Neopor® Graphite Polystyrene (GPS)

Substitution Packet



## Why replace XPS with Neopor®?

- **Save Money**
  - Uses up to 30% fewer raw materials
  - Locally/Regionally Manufactured
- **Product Performance**
  - Stable long term R-Value.
  - Non-VOC Based R-Value
- **Locally Manufactured**
  - Reduced logistics
  - Possible LEED contribution.

 **BASF**  
We create chemistry



# SUBSTITUTION REQUEST

(During the Bidding/Negotiating Stage)

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_ Date: \_\_\_\_\_

A/E Project Number: \_\_\_\_\_

Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_

Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: Neopor® GPS

Manufacturer: BASF Corporation Address: 1609 Biddle Ave. Wyandotte, MI Phone: 800-543-1747

Trade Name: Neopor® GPS Model No.: \_\_\_\_\_

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

## A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_



# SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase)

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_  
 \_\_\_\_\_  
 From: \_\_\_\_\_  
 To: \_\_\_\_\_ Date: \_\_\_\_\_  
 \_\_\_\_\_  
 A/E Project Number: \_\_\_\_\_  
 Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
 Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
 Manufacturer: BASF Corp Address: 1609 Biddle Ave. Wyandotte, MI Phone: 800-543-1747  
 Trade Name: BASF Neopor GPS Model No.: \_\_\_\_\_  
 Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  1-4 years old  5-10 years old  More than 10 years old

Differences between proposed substitution and specified product: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: \_\_\_\_\_  
 \_\_\_\_\_

Similar Installation:  
 Project: \_\_\_\_\_ Architect: \_\_\_\_\_  
 Address: \_\_\_\_\_ Owner: \_\_\_\_\_  
 \_\_\_\_\_ Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work:  No  Yes; explain \_\_\_\_\_  
 \_\_\_\_\_

Savings to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_).

Proposed substitution changes Contract Time:  No  Yes [Add] [Deduct] \_\_\_\_\_ days.

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_

# SUBSTITUTION REQUEST

(After the Bidding/Negotiating Phase — Continued)

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The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
  - Same warranty will be furnished for proposed substitution as for specified product.
  - Same maintenance service and source of replacement parts, as applicable, is available.
  - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
  - Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
  - Proposed substitution does not affect dimensions and functional clearances.
  - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
  - Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
- 

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Telephone: \_\_\_\_\_

Attachments:

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## A/E's REVIEW AND RECOMMENDATION

- Approve Substitution - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Approve Substitution as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- Reject Substitution - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

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## OWNER'S REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
- Substitution rejected - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

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Additional Comments:     Contractor     Subcontractor     Supplier     Manufacturer     A/E

# Product Comparison

## Physical Properties



Neopor® GPS (Graphite Polystyrene) rigid foam is today's energy-efficient and cost-effective insulation solution for architects, builders and contractors. The table shows actual test data of Neopor® GPS F5300 Plus and ASTM C578 physical requirements for EPS and XPS.

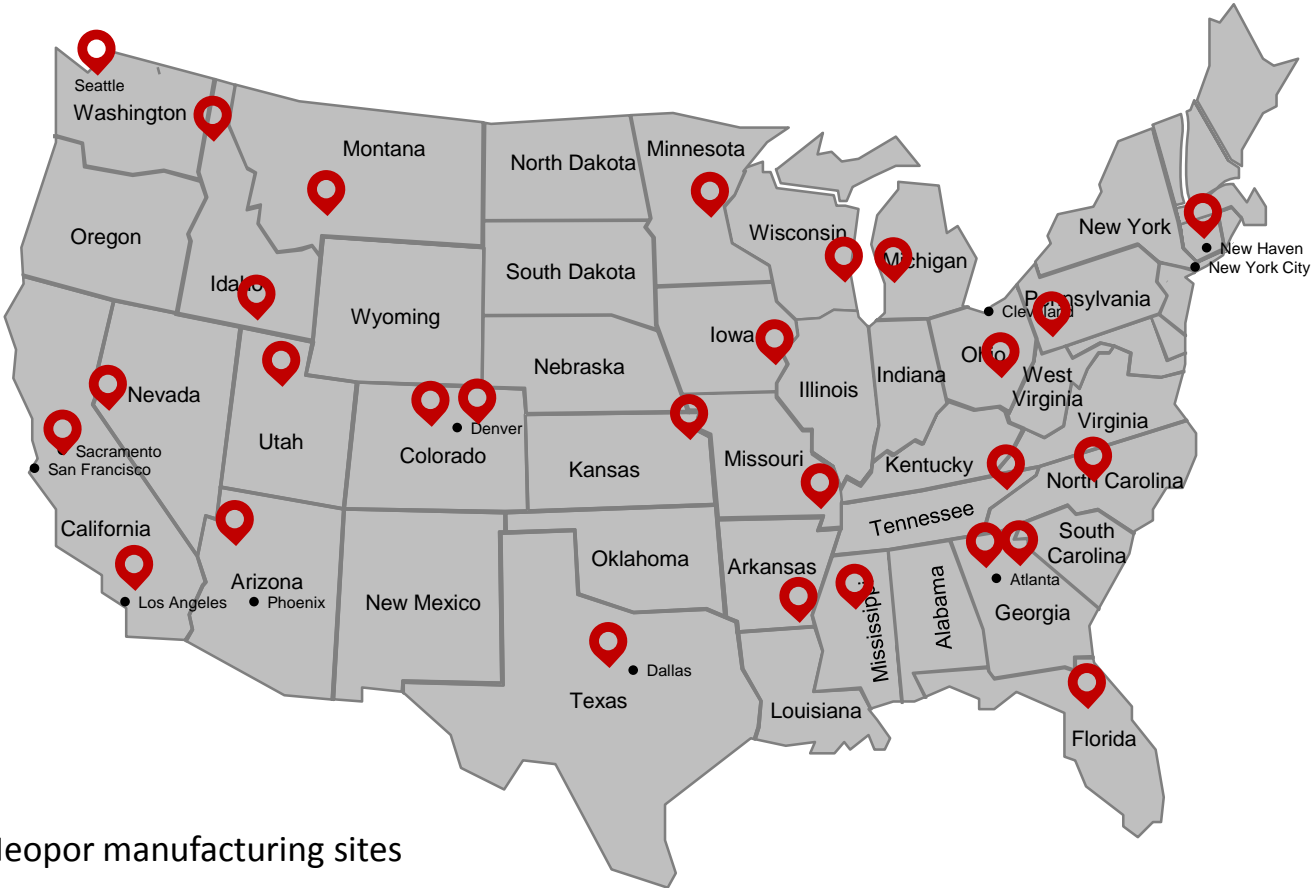
| Property                                   | Unit   | Neopor® GPS Plus vs EPS/XPS <sup>4)</sup> |                   |                   |                   |                   |                   |
|--|--|---|-------------------|-------------------|-------------------|-------------------|-------------------|
|  |  | GPS + 10 PSI                              | GPS + 15 PSI      | XPS               | GPS + 20 PSI      | XPS               | GPS + 25 PSI      |
| Polystyrene type <sup>1)</sup>             |  |   |                   |                   |                   |                   |                   |
| ASTM C578 Classification <sup>2)</sup>     |  | Type I                                    | Type II           | Type X            | Type II+          | Type IV           | Type IX           |
| Compressive Resistance                     | at yield of 10% deformation in psi (min)                                   | 10.0                                      | 15.0              | 15.0              | 20.0              | 25.0              | 25.0              |
| Thermal Resistance (R-value) <sup>3)</sup> | °F·ft <sup>2</sup> ·h/BTU<br>(°C·m <sup>2</sup> /W) 75 ±2°F<br>(23.9 ±1°C) | 5.0 <sup>4)</sup>                         | 5.0 <sup>4)</sup> | 5.0 <sup>4)</sup> | 5.0 <sup>4)</sup> | 5.0 <sup>4)</sup> | 5.0 <sup>4)</sup> |
| Water Vapor Permeance                      | Max perm (ng/Pa·s·m <sup>2</sup> )   | 4.0                                       | 3.1               | 1.5               | 3.1               | 1.5               | 2.5               |
| Water Absorption by Total Immersion        | volume % absorbed  | 1.1                                       | 1.1               | 0.3               | 1.1               | 0.3               | 1.1               |
| Flexural Strength                          | psi  | 25.0                                      | 32.0              | 40.0              | 40.0              | 50.0              | 50.0              |
| Density                                    | lbs./ ft <sup>3</sup>  | 0.90                                      | 1.35              | 1.30              | 1.45              | 1.45              | 1.80              |
| Surface Burning Characteristics E84        | Flame Spread<br>Smoke Developed  | 5<br>25                                   | 5<br>25           | 5-15<br>45-175    | 5<br>25           | 5-15<br>45-175    | 5<br>25           |

- 1) GPS is Graphite Polystyrene. XPS is Extruded Polystyrene
- 2) Neopor® GPS meets and exceeds ASTM C578-13, "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation"; published by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959
- 3) R means resistance to heat flow. The higher the R-value, the greater the insulating power. Ask your seller for the fact sheet on R-values.
- 4) The technical and physical metrics provided in this table are reference values for insulation products made of Neopor GPS. The values and properties may vary depending on how they are processed and produced. The R-value properties are at a nominal inch of thickness. Neopor GPS Plus R-value's are based on 1.06 in thickness.

# Product Availability US Manufacturing Sites



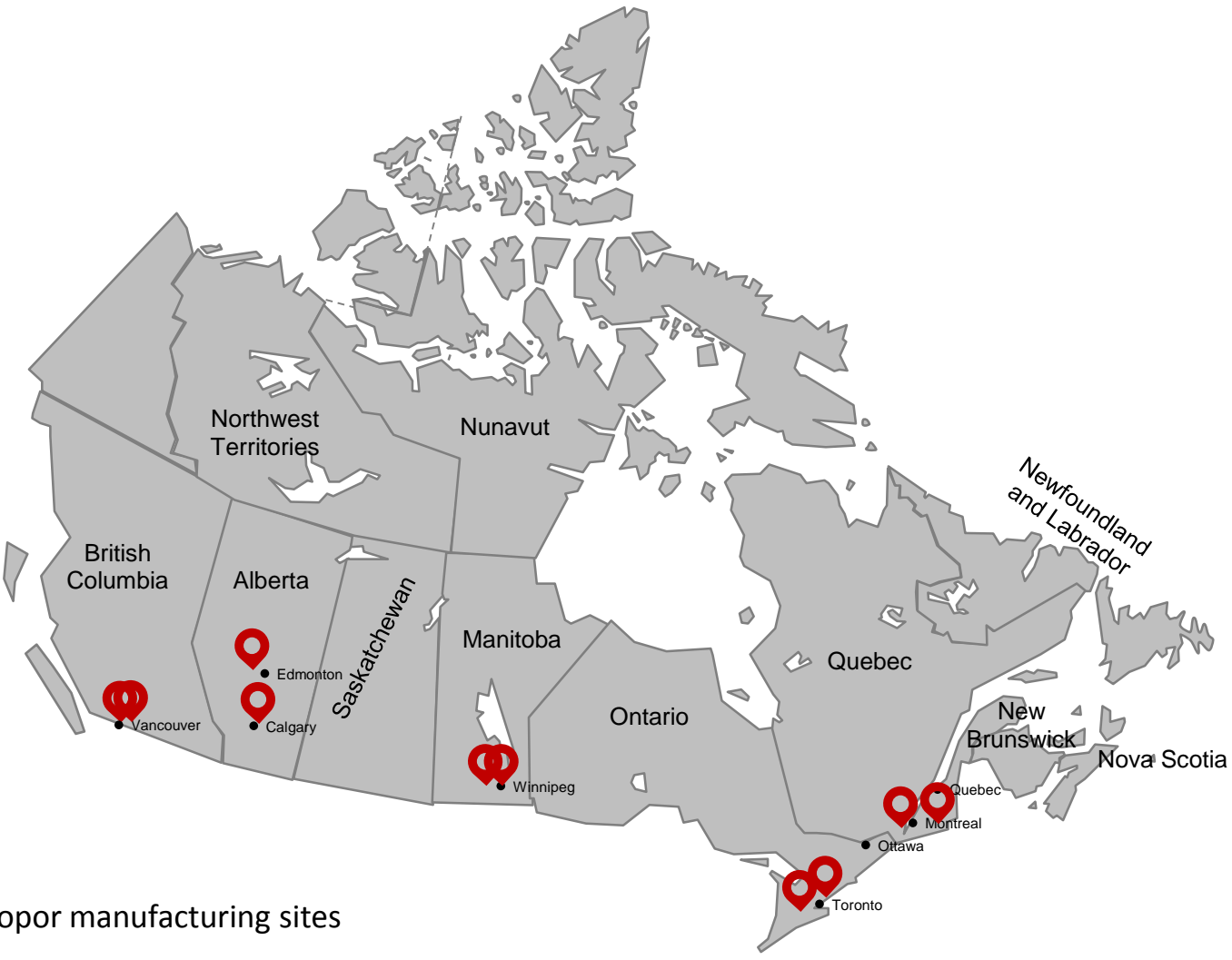
## Neopor® GPS is Globally Supported but Locally Manufactured



# Product Availability Canadian Manufacturing Sites



## Neopor® GPS is Globally Supported but Locally Manufactured





## Neopor® GPS is Third-Party Validated and Certified

### Neopor 3<sup>rd</sup> Party Evaluation Reports

ICC-ES [ESR-3463](#)

UL [ER5817-02](#)

### GREENGUARD Gold Certified for indoor air quality

Neopor GPS has achieved GREENGUARD Gold Certification by UL Environment for products with low chemical emissions. Certificate: [5253-40](#)

Products used to build indoor environments can have a significant impact on indoor air pollution levels. Those that have achieved GREENGUARD Certification are scientifically proven to meet some of the most rigorous, third-party chemical emissions standards—helping reduce indoor air pollution and the risk of chemical exposure while aiding in the creation of healthier indoor

### Neopor Plus GPS is proven to perform

Neopor Plus GPS meets ASTM C578 Type I, VIII, II, II (1.45 lbs/ft<sup>3</sup>), IX and CAN/ ULC S701 Type 1,2,3 requirements, complies with ASTM C1512, UL-723, UL S102.2 and is listed in NFRC 101 for use in fenestration products.

Neopor GPS is described in ICC-ES ESR 3463, listed with UL and UL Canada under UL ER 5817-02 and listed on the QAI Laboratories Material Directory. The product is fire and code approved by UL and ICC for ASTM E84, NFPA 286 and NFPA 285 for use in commercial cavity wall with a wide range of cladding approvals (i.e. multiple masonry veneer finishes over steel stud frame). The use of Neopor Plus GPS can earn points under the LEED® Energy Performance Process.



See complete UL Classification Marking on the product, product packaging or UL Certificate that accompanies the product.





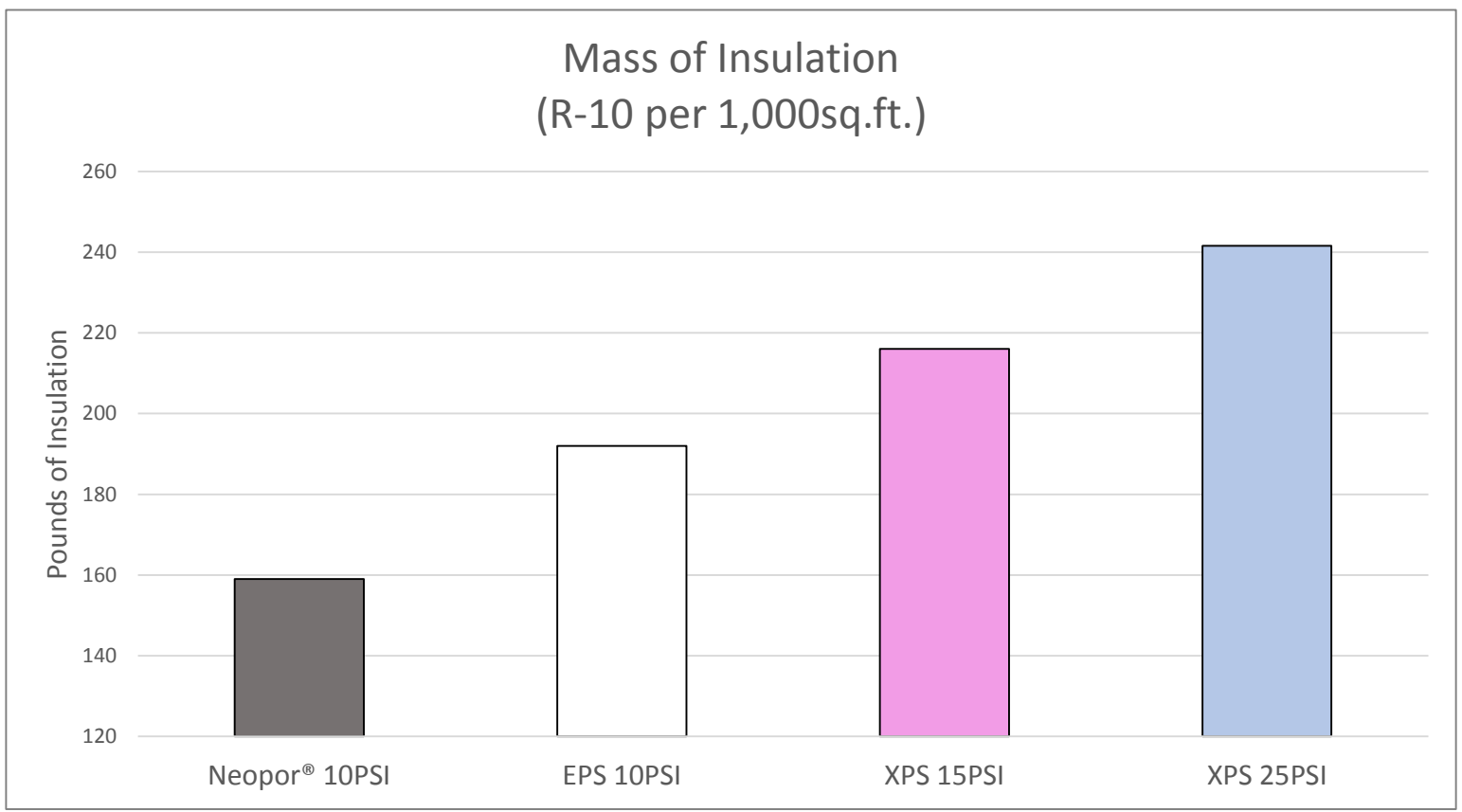
# Product Comparison Raw Material Usage



Neopor® GPS (Graphite Polystyrene) rigid foam delivers more insulating power will utilizing less raw material compared to other materials. Utilizing fewer raw materials makes Neopor better for the environment as well as more cost effective.

The table below illustrates the mass of insulation required to insulate 1,000 square feet with R-10 insulation.

Results in achieving R-10 insulation:  
**Neopor® uses ~26% fewer raw materials compared to XPS.**  
**Neopor® uses ~ 21% fewer raw materials compared to EPS.**



Source: ASTM C578

- 072100 Specification
- Global Warming Potential Data
- Moisture Management Data
- Packaging and Transportation
- Environmental Product Declaration (EPD)
- BASF Contact and further resources

**SECTION 07 2100**  
**NEOPOR PLUS GRAPHITE POLYSTYRENE (GPS) THERMAL INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, and exterior wall behind \_\_\_\_\_ wall finish.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 2723 - Cavity Wall Unit Masonry: Masonry walls enclosing insulation.
- B. Section 06 1000 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.
- C. Section 07 2400 - Exterior Insulation and Finish Systems: Board insulation on exterior side of walls, finished with weatherproof coating.

**1.03 REFERENCE STANDARDS**

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2012.
- E. ASTM E119 –Standard Test Methods for Fire Tests of Building Construction and Materials.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

Visit [www.neopor-insulation.com/contact](http://www.neopor-insulation.com/contact) to locate the nearest manufacturing facility to your project.

- A. United States:
  - 1. ACH Foam
  - 2. Atlas EPS
  - 3. Big Sky
  - 4. Carpenter
  - 5. Cellofoam
  - 6. Drew Foam
  - 7. FMI-EPS LLC
  - 8. Insulfoam, LLC
  - 9. Opco
  - 10. Perma R Products
  - 11. Plymouth Foam
  - 12. Polar Industries
  - 13. Progressive Foam Technologies
  - 14. Star R Foam
  - 15. Styrotech

16. Versatech
- B. Canada:
  1. AMC Foam Insulation
  2. Beaver Plastics
  3. Concept JRC, Inc. (Polyform)
  4. Form Solutions
  5. Groupe Isofoam
  6. Le Groupe Legerlite
  7. PlastiFab

## 2.02 APPLICATIONS

- A. Insulation Under Concrete Slabs: Graphite polystyrene board.
- B. Insulation at Perimeter of Foundation: Graphite polystyrene board.
- C. Insulation Inside Masonry Cavity Walls: Graphite polystyrene board.
- D. Insulation Inside Prefabricated Wall Panels: Graphite polystyrene board.
- E. Insulation Over Metal Stud Framed Walls, Continuous: Graphite polystyrene board.

## 2.03 FOAM BOARD INSULATION MATERIALS

- A. Graphite Polystyrene (GPS) Board for Above and Below Grade Insulation.

ASTM C578, Type I; with the following characteristics:

  1. Flame Spread Index: 5 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 25 or less, when tested in accordance with ASTM E84.
  3. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
  4. Board Edges: \_\_\_\_\_.
  5. Water Absorption: 1.1 percent by volume, maximum.
  6. Compressive Resistance: 10 psi at yield of 10% deformation.
  7. Thermal Resistance: R-value of 5 per 1-1/16 inch (27 mm) at 75 degrees F (24 degrees C) mean temperature.
  8. Manufacturers:
    - a. BASF Corporation; BASF Neopor Plus GPS: [www.neopor-insulation.com](http://www.neopor-insulation.com).
    - b. Visit [www.neopor-insulation.com/contact](http://www.neopor-insulation.com/contact) to locate the nearest manufacturing facility to your project.
- B. Graphite Polystyrene (GPS) Board for Above and Below Grade Insulation.

ASTM C578, Type VIII; with the following characteristics:

  1. Flame Spread Index: 5 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 25 or less, when tested in accordance with ASTM E84.
  3. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
  4. Board Edges: \_\_\_\_\_.
  5. Water Absorption: 1.1 percent by volume, maximum.
  6. Compressive Resistance: 14 psi at yield of 10% deformation.
  7. Thermal Resistance: R-value of 5 per 1-1/16 inch (27 mm) at 75 degrees F (24 degrees C) mean temperature.
  8. Manufacturers:
    - a. BASF Corporation; BASF Neopor Plus GPS: [www.neopor-insulation.com](http://www.neopor-insulation.com).
    - b. Visit [www.neopor-insulation.com/contact](http://www.neopor-insulation.com/contact) to locate the nearest manufacturing facility to your project.

- C. Graphite Polystyrene (GPS) Board for Above and Below Grade Insulation.  
ASTM C578, Type II; with the following characteristics:
1. Flame Spread Index: 5 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 25 or less, when tested in accordance with ASTM E84.
  3. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
  4. Board Edges: \_\_\_\_\_.
  5. Water Absorption: 1.1 percent by volume, maximum.
  6. Compressive Resistance: 20 psi at yield of 10% deformation.
  7. Thermal Resistance: R-value of 5 per 1-1/16 inch (27 mm) at 75 degrees F (24 degrees C) mean temperature.
  8. Manufacturers:
    - a. BASF Corporation; BASF Neopor Plus GPS: [www.neopor-basf.com](http://www.neopor-basf.com).
    - b. Visit [www.neopor-insulation.com/contact](http://www.neopor-insulation.com/contact) to locate the nearest manufacturing facility to your project.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

#### **3.02 INSTALLATION**

- A. General
  1. Install GPS board insulation in a [Single] [Double] layer to achieve required R-value(s) as indicated in drawings. Cut and fit tightly around projections and penetrations.
  2. Secure insulation to substrate with [Mechanical fasteners] [Or] [Spot adhesive applied to back of board] using quantity and pattern recommended by manufacturer.
  3. Insulation Board Joints: Stagger GPS insulation board joints in one direction for each course. Butt edges and ends tightly to adjacent GPS boards.

Specifier Note: Retain, edit or delete articles below to suit project and specifier practice

4. Sheathing and Underlayment Installation: On exterior side of stud framing, install GPS insulation board [Vertically] [Horizontally]. Fasten vertically 12" (300 mm) maximum on centers using fasteners recommended by manufacturer. On interior side of stud framing, install minimum 1/2" (12.7 mm) thick gypsum wallboard over GPS board.
5. Concrete and Masonry Walls: Install GPS insulation board over furring channels attached to concrete and unit masonry substrates. Fasten vertically 12" (300 mm) maximum on centers using fasteners recommended by manufacturer.
6. Cavity Walls: Install GPS insulation board on exterior surface of interior width of cavity wall, fitting board between wall ties and other projections and penetrations.
7. Perimeter Foundation: Install GPS insulation board on exterior surface of perimeter foundation walls. Secure board with spot adhesive applied to back of board using quantity and pattern recommended by manufacturer.
8. Slab-On-Grade: Install GPS insulation board under slab-on-grade and over properly prepared subgrade of compacted fill and vapor retarder. Place GPS board with sides and ends butted.

Specifier Note: Specify the final actions required to clean installed equipment or other completed work to properly function or perform. Coordinate article below with Division 1 Execution Requirements (Cleaning) Section.

### **3.03 PACKAGING AND TRANSPORTATION**

- A. Material handling, and the flow of materials from manufacturing site to job site is a significant part of the construction process. Precautionary measures taken in packaging, storage, transportation and installation of insulation products made of Neopor can help minimize the potential for damage to the products.
- B. Precautions taken when storing insulation products on the jobsite can help minimize the potential for damage. Keep product tarped or covered to protect from weather. Do not use clear plastic covering film. If possible, store in-doors. Care should be taken to keep exposed foam protected from reflective sunlight or prolonged solar exposure.
- C. Precautions taken during the construction process can help minimize the potential for damage. Care should be taken to keep exposed foam protected from reflected sunlight or prolonged solar exposure. If deformation of the insulation product occurs due to excessive heat transferred from reflected and concentrated sunlight, remove the reflective surface or shield the insulation product.
- D. A secondary method to protect the foam from direct sunlight and heat is to install sunscreen or tarp on the outside of the scaffolding, much the same that is used on building construction that protects the public when it is necessary for them to pass by construction site underneath the scaffolding. This is only needed until the finish coat of the foam is applied.

**END OF SECTION**

# Product Comparison Global Warming Potential



## Neopor® GPS Demonstrates Low Global Warming Potential (GWP)

Insulation is key to reducing carbon emissions and global warming potential from buildings by saving energy consumption. On the other hand, all insulation materials take energy to manufacture and transport something the industry refers to as embodied energy.

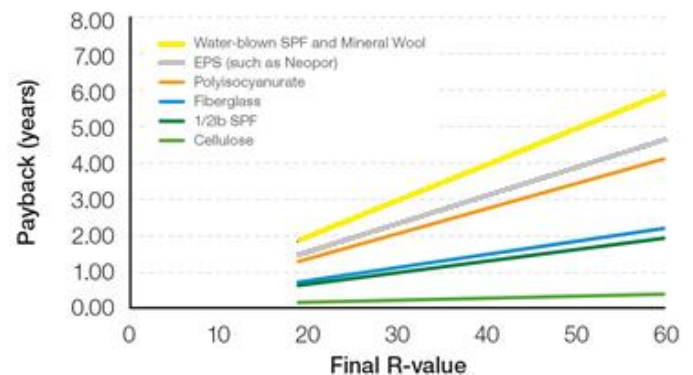
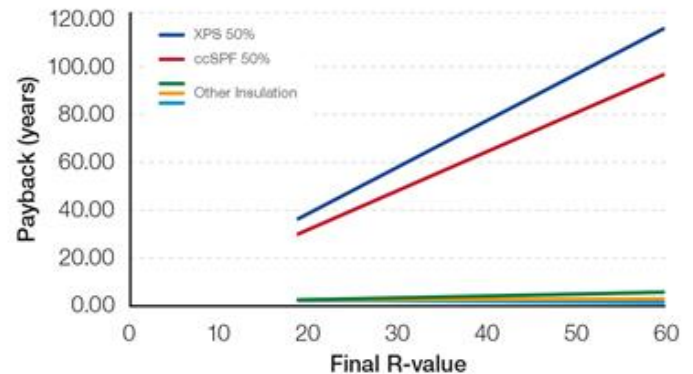
The amount of embodied energy depends to a great extent on the blowing agent in insulation material. Designers, architects and builders aiming to minimize the global warming impacts of their buildings should choose non-HFC (hydrofluorocarbon) foam insulation.

Two common foam insulation materials are produced with HFC blowing agents: Extruded polystyrene (XPS) and standard closed-cell spray polyurethane foam (ccSPF). Neopor Plus GPS is a non-HFC foam insulation and complies with the latest requirements published as part of the Significant New Alternatives Policy (SNAP, 2015) by the Environmental Protection Agency (EPA).

### Payback (years) of insulation materials

The graphs below show the payback period (years) of different insulation materials based on their R-value.

Payback refers to how many years of energy savings will be required to neutralize the global warming potential of the insulation. Neopor Plus GPS, listed under EPS, with an R-value of 40 will be fully covered after 3 years. In comparison to XPS that will need almost 80 years for the same R-value.





# Neopor® GPS Moisture Management Under Extreme Environmental Conditions

Thermal Performance and Drying Potential

Neopor — the construction grade, graphite-enhanced polystyrene (GPS) insulation from BASF — is well known for its specially embedded graphite particles that reflect heat radiation like a mirror to reduce heat loss. More and more architects, contractors and builders have come to depend on Neopor GPS for greater energy and cost efficiencies.

The innovative rigid foam insulation is also known for its high performance in the critically important area of moisture management. Its exceptional breathability and permeability help reduce the risk of mold, rot and structural damage associated with moisture condensation and long-term water retention.

In order to confirm these essential properties of Neopor GPS under environmental extremes, BASF commissioned Intertek Testing Services NA Ltd., a respected independent test laboratory. Intertek conducted extensive tests using ASTM C1512, which is a standard test method for characterizing the effects of extreme temperature variations and exposure to moisture on the thermal performance of insulation products. Testing was conducted from October 21, 2014, through June 26, 2015, on Types I, VIII, II and IX Neopor.

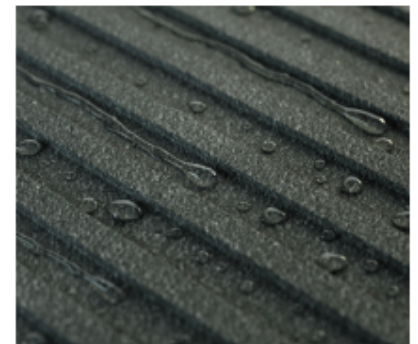
## Preconditioning

In the first stage of the ASTM C1512 test, the Neopor GPS samples were subjected to conditioning in the ASTM C1512 chamber for 28 days to artificially increase moisture content due to vapor diffusion associated with a constant thermal gradient. The specimens were set up to divide two environments. The warm side was set at  $75 \pm 3^\circ\text{F}$  and  $90 \pm 5\%$  relative humidity, and the cold side was set at a constant  $5 \pm 5^\circ\text{F}$  with uncontrolled ambient humidity. The intention of the extreme temperature and humidity gradient between the warm and cold side is to artificially accumulate moisture within the test specimens from vapor diffusion.

## Key Net Takeaways

After undergoing severe third-party environmental testing, the study concluded that Neopor GPS:

- Holds its R-value over time
- Does not retain moisture
- Maintains its physical properties







### Cycling Stage

After 28 days, the samples were removed and weighed, and then were returned to the ASTM C1512 chamber to undergo another 20 days of testing comprised of 12-hour cycles. In this stage, the upper chamber was still set at  $75 \pm 3^\circ\text{F}$  and  $90 \pm 5\%$  relative humidity. But, the lower chamber was cycled every 12 hours from  $5 \pm 5^\circ\text{F}$  uncontrolled humidity to  $59 \pm 5^\circ\text{F}$  uncontrolled humidity for 40 cycles. This rigorous testing was designed to determine the moisture management properties of the insulation under common field exposure conditions.

At the end of the conditioning cycles all of the Neopor® GPS samples were weighed again, dried and then differential moisture content was measured. The cycling stage is where the drying potential of the insulation under common field exposure conditions is measured.

The samples were subjected to ASTM D1621 (Compressive Strength) and ASTM C518 (Thermal Transmission Properties) testing to measure the effects of the extreme environmental exposure on the material's physical properties.

The next stage of the ASTM C1512 test subjects specimens to exposure conditions on the cold side of the test chamber cycling between  $5^\circ\text{F}$  ( $-15^\circ\text{C}$ ) and  $59^\circ\text{F}$  ( $15^\circ\text{C}$ ) at ambient relative humidity at 12-hour intervals for 20 days to simulate extreme field exposure conditions. The warm side of the test specimen stays at a constant  $75^\circ\text{F}$  ( $24^\circ\text{C}$ ) and 90% relative humidity for the 20-day period. The cycling stage is where the drying potential of the insulation under common field exposure conditions is measured.

### Results

As the following chart clearly shows, Neopor GPS held its R-value, didn't retain moisture and maintained its physical properties after undergoing severe environmental testing.

| Neopor GPS | Compression<br>ASTM D1621 | Moisture Content<br>After Cycling (%) | % of R-value<br>retained |
|------------|---------------------------|---------------------------------------|--------------------------|
| Type I     | 12                        | 0.03                                  | 99.7                     |
| Type VIII  | 16                        | 0.02                                  | 100                      |
| Type II    | 18                        | 0.04                                  | 100                      |
| Type IX    | 24                        | 0.04                                  | 100                      |

### Conclusions

The series of tests conducted by Intertek was designed to see how Neopor GPS insulation responded to extreme environmental conditions in terms of thermal performance, moisture management and compressive strength. After eight months of rigorous testing, Neopor GPS proved itself in a number of key areas:

- Most importantly, Neopor GPS held its R-value after undergoing 48 days of extreme environmental testing that involved both a constant thermal gradient and cycling between large temperature and humidity variations.
- ASTM C1512 testing showed that Neopor GPS doesn't retain moisture, drying quickly after cycling from low to high humidity.
- Neopor GPS holds its physical properties after exposure to extreme environmental cycling, further confirming and quantifying what building professionals have observed in the field.

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Neopor® is a trademark of BASF SE.

## Recommendations on Handling, Storage and Installation of Building Insulation Products made from Neopor®

- Material Handling:** Material handling, and the flow of materials from manufacturing site to job site is a significant part of the construction process. Precautionary measures taken in packaging, storage, transportation and installation of insulation products made of Neopor can help minimize the potential for damage to the products.
- Jobsite Storage:** Precautions taken when storing insulation products on the jobsite can help minimize the potential for damage. Keep product tarped or covered to protect from weather. Do not use clear plastic covering film. If possible, store in-doors. Care should be taken to keep exposed foam protected from reflective sunlight or prolonged solar exposure.
- Installation:** Precautions taken during the construction process can help minimize the potential for damage. Care should be taken to keep exposed foam protected from reflected sunlight or prolonged solar exposure. If deformation of the insulation product occurs due to excessive heat transferred from reflected and concentrated sunlight, remove the reflective surface or shield the insulation product.

A secondary method to protect the foam from direct sunlight and heat is to install sunscreen or tarp on the outside of the scaffolding, much the same that is used on building construction that protects the public when it is necessary for them to pass by construction site underneath the scaffolding. This is only needed until the finish coat of the foam is applied.

Find products using Neopor® as powerful insulation on our 'Where to Buy' page at [www.neopor.basf.us](http://www.neopor.basf.us) or write to us at [neopor-us@basf.com](mailto:neopor-us@basf.com)

# ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

|                          |   |
|--------------------------|---|
| Owner of the Declaration | EUMEPS European Manufacturers of Expanded Polystyrene |
| Programme holder         | Institut Bauen und Umwelt e.V. (IBU)                  |
| Publisher                | Institut Bauen und Umwelt e.V. (IBU)                  |
| Declaration number       | EPD-EUM-20160273-IBG1-EN                              |
| ECO EPD Ref. No.         | ECO-00000510  |
| Issue date               | 20/04/2017  |
| Valid to                 | 19/04/2022  |

Expanded Polystyrene (EPS) Foam Insulation  
(with infra red absorbers, density 15 kg/m<sup>3</sup>)  
EUMEPS

[www.ibu-epd.com](http://www.ibu-epd.com) / <https://epd-online.com>



## 1. General Information

EUMEPS – Expanded Polystyrene (EPS) Foam Insulation

**Programme holder**

IBU - Institut Bauen und Umwelt e.V.  
Panoramastr. 1  
10178 Berlin  
Germany

**Declaration number**

EPD-EUM-20160273-IBG1-EN

**This Declaration is based on the Product Category Rules:**

Insulating materials made of foam plastics, 07.2014  
(PCR tested and approved by the SVR)

**Issue date**

20/04/2017

**Valid to**

19/04/2022



Prof. Dr.-Ing. Horst J. Bossenmayer  
(President of Institut Bauen und Umwelt e.V.)



Dr. Burkhard Lehmann  
(Managing Director IBU)

Expanded Polystyrene (EPS) Foam Insulation  
(with infra red absorbers, density 15 kg/m<sup>3</sup>)

**Owner of the Declaration**

EUMEPS – European Association of EPS  
Weertersteenweg 158  
B-3680 Maaseik  
Belgium

**Declared product / Declared unit**

Expanded polystyrene foam (EPS) produced by EUMEPS members. The EPD applies to 1 m<sup>2</sup> and 1 m<sup>3</sup> with R-value 1 (in EPD Annex) with average density of 15 kg/m<sup>3</sup> (with infra red absorber).

**Scope:**

The companies contributing to the data collection produce one third of the expanded polystyrene foam boards sold by the members of the EUMEPS association in Europe. The data have been provided by 19 factories out of 18 companies for the year 2015.

The applicability of the document is restricted to EPS boards produced by manufacturing plants of EPS converters who are members of their national EPS association, which themselves are members of EUMEPS.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

**Verification**

The CEN Norm /EN 15804/ serves as the core PCR

Independent verification of the declaration according to /ISO 14025/

internally  externally



Prof. Dr. Birgit Grathl  
(Independent verifier appointed by SVR)

## 2. Product

### 2.1 Product description / Product definition

This EPD describes Expanded Polystyrene foam (EPS). The closed cell structure is filled with air (98% air; only 2% polystyrene) and results in a light weight, tough, strong and rigid thermoplastic insulation foam.

The products are mainly used for thermal and acoustical insulation of buildings. The foam is available in various dimensions and shapes. Boards can be supplied with different edge treatments such as butt edge, ship lap, tongue and groove. Density range is from about 13 to 17 kg/m<sup>3</sup> corresponding to a compressive strength value of about 60 kPa.

This EPD is applicable to homogeneous EPS products without material combinations or facings. Most important properties are the thermal conductivity and compressive strength.

The applicability of the document is restricted to EPS boards produced by manufacturing plants of EPS converters who are members of their national EPS association, which themselves are members of EUMEPS. The data have been provided by a representative mix of 19 converters from amongst the EUMEPS membership from all parts of Europe, based upon production during 2015.

For the placing on the market of the product in the EU/EFTA (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. The product needs a Declaration of Performance taking into consideration /EN 13163:2012+A1:2015 Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification/ and the CE-marking.



These products are additionally approved for use in specific applications under mandatory or voluntary agreement or certification schemes at the national level. These products are controlled and certified by Notified Bodies.

A large number of the manufacturing plants are certified according to /ISO 9001/ and/or /ISO 14001/.

## 2.2 Application

The performance properties of EPS thermal insulation foams make them suitable for use in many applications. The range of products described in this document is used in applications such as wall insulation, pitched roof insulation, ETICS, cavity wall insulation, ceiling insulation, insulation for building equipment and industrial installations.

## 2.3 Technical Data

Performance data of the product in accordance with the Declaration of Performance with respect to its Essential Characteristics according to EN 13163:2012+A1:2015.

Additional data:

### Constructional data

| Name  | Value | Unit              |
|---|-------|-------------------|
| Thermal conductivity acc. to /EN 12667/                     | 0.032 | W/(mK)            |
| Density   | 13-17 | kg/m <sup>3</sup> |
| Compressive stress or compressive strength acc. to /EN 826/ | 60    | kPa               |
| Bending strength acc. to /EN 12089/                         | 115   | kPa               |
| Water vapour transmission $\mu$ acc. to /EN 12086/          | 20-40 |                   |

## 2.4 Delivery status

Polystyrene is normally transported by lorry. The product dimensions can vary depending on, for example, the product, the manufacturer, the application and the applicable quality label. Dimensional data: length: max. 8000 mm, width: max. 1300 mm, thickness: max. 1000 mm.

## 2.5 Base materials / Ancillary materials

EPS foams are made of polystyrene (90% by weight), blown with pentane up to 5% by weight, which is released partly during or shortly after production. The consideration of pentane emissions is explained in chapter 3.

The polymeric flame retardant (Butadiene styrene brominated copolymer, CAS-nr. 1195978-93-8) is present at ca. 1.3% by weight to provide fire performance. This grey material contains 4% graphite per weight. In addition to the basic materials, the manufacturers use secondary (recycled) material. No other additives are used in relevant amounts. Polystyrene and pentane are produced from oil and gas, therefore linked to the availability of these raw materials.

## 2.6 Manufacture

The conversion process of EPS beads to foamed insulation consists of the following manufacturing

stages: pre-foaming, conditioning and finally block moulding. During the pre-foaming and moulding stages heating by steam causes the foaming of the beads due to the pentane blowing agent. The final shape is achieved by hot wire cutting of the block to give the desired board dimensions. Finally, the board edges are trimmed by cutting or grinding to obtain the desired edge detail. Typically cut offs are 100% recycled in line.

## 2.7 Environment and health during manufacturing

No further health protection measures, beyond the regulated measures for manufacturing companies, are necessary during any of the conversion steps for EPS.

EPS insulation is already in use for more than 50 years. No negative effects are known to people, animals or the environment.

No ozone depleting substances as regulated by the EU, such as CFC or HCFCs, are used as blowing agents for the production of EPS.

## 2.8 Product processing/Installation

There are no special instructions regarding personal precautions and environmental protection during product handling and installation. Product specific handling recommendations can be found in product and application literature, brochures and data sheets provided by the suppliers.

## 2.9 Packaging

The products are packed loose, bundled by tape or packed on 4 or 6 sides with PE-film. The polyethylene based packaging film is recyclable and recycled in those countries having a suitable return system. A few manufacturers use cardboard in addition.

## 2.10 Condition of use

Water pick up by capillarity does not occur with well manufactured EPS foams, due to the closed cell structure. The thermal insulation performance of EPS is practically unaffected by exposure to water or water vapour.

Properly installed EPS boards (see: Installation) are durable with respect to their insulation, structural and dimensional properties. They are water resistant, resistant against microorganisms and against most chemical substances. EPS, however, should not be brought into contact with organic solvents.

The application of insulation material has a positive impact on energy efficiency of buildings. Quantification is only possible in context with the construction system of the building.

Dependent on the specific material and the frame conditions of installation, residual pentane may diffuse. Quantified measurements and release profiles cannot be declared.

## 2.11 Environment and health during use

EPS insulation products in most applications are neither in direct contact with the environment nor with indoor air. When naked EPS products were tested for VOC emissions, the emissions proved to be below the most stringent regulatory limit values in countries with such regulation (see chapter 7.1).

## 2.12 Reference service life

If applied correctly the lifetime of EPS insulation is equal to the building life time, usually without requiring any maintenance. Durability studies on applied EPS show no loss of technical properties after 35 years. Additional tests with products under artificial aging show that "no deficiencies are to be expected from EPS fills placed in the ground over a normal life cycle of 100 years." /Langzeitverhalten 2004/, /Long-term performance 2001/.

## 2.13 Extraordinary effects

### Fire

EPS products usually achieve the fire classification Euroclass E according to /EN 13501-1/. In their end use application, constructions with EPS can achieve a classification of B-s1,d0 according to /EN13501-1/. Ignition of the foam can only be observed after longer flame exposures. If the contact with the external heat source stops, the flame extinguishes and neither further burning nor smouldering can be observed. Tests according to /EN 45545-2/, the test to evaluate the toxicity of produced combustion gasses for railway components show for EPS insulation products CIT (Conventional Toxicity Index) values up to only 0.04. This means that EPS insulation products do not have a high contribution to the toxicity of smoke produced in case of fire. /PlasticsEurope 2015/.

### Water

EPS rigid foam is chemically neutral and not water soluble. No water soluble substances are released, which could lead to pollution of ground water, rivers or seas.

Because of the closed cell structure EPS insulation can be used even under moist conditions. In the case of unintended water ingress, e.g. through leakage, there is normally no need for replacement of EPS insulation. The insulation value of EPS remains almost unchanged in moist conditions.

### Mechanical destruction

Not relevant for EPS products that have superior mechanical properties.

## 2.14 Re-use phase

Construction techniques should be employed to maximise the separation of EPS boards at the end of life of a building in order to maximise the potential for re-use. Another option for re-use is to leave the EPS boards in place when the existing construction is thermally upgraded.

## 2.15 Disposal

EPS manufacturers advise that their products should be treated according to the EU waste strategy. The first option is recycling. Take back schemes are already in place in many countries. Recycling of EPS in many cases is technically and economically feasible, e.g. as aggregate in light weight concrete /Waste Study 2011/.

At the end of its life cycle as the second option an EPS product can be ultimately incinerated with energy recovery. Due to the high calorific value of polystyrene, energy embedded in EPS boards can be recovered in municipal waste incinerators equipped with energy recovery units for steam and electricity generation and for district heating.

In this EPD two EoL scenarios are considered: 100% thermal treatment (EoL1) and 100% material recycling (EoL2) are taken into consideration, also to allow easily the calculation of several mixed scenarios. For example to calculate the global warming potential (GWP) for a 70/30 scenario, following calculation rule for module 3 is applied:

$$GWPC_{3\text{ calc}} = 70\% * GWP_{C3H} + 30\% GWP_{C3Z}$$

The same calculation rule is valid for modules C3, C4 and D.

The material is assigned to the waste category: 17 08 04 insulation materials other than those mentioned in 17 08 01 (insulation materials containing asbestos) and 17 08 03 (other insulation materials consisting of or containing dangerous substances) /AVV/.

## 2.16 Further information

Additional information can be found at [www.eumeps.org](http://www.eumeps.org) or at the homepages of the respective manufacturer.

## 3. LCA: Calculation rules

### 3.1 Declared Unit

The declared unit is 1 m<sup>2</sup> expanded polystyrene rigid foam. In addition, the results for the functional unit of a volume per square metre that leads to an R-value of 1 are considered. The conversion factors are listed in the table below.

#### Declared unit

| Name                      | Value | Unit              |
|---------------------------|-------|-------------------|
| Gross density             | 15    | kg/m <sup>3</sup> |
| Conversion factor to 1 kg | 0.066 | -                 |
| Declared unit             | 1     | m <sup>2</sup>    |

The primary data is weighted over the annual amount of saleable EPS by mass per producer.

Declaration type according to PCR part A:

2b) Declaration of an average product as an average from several manufacturers' plants.

### 3.2 System boundary

Type of the EPD: cradle to gate - with options.

The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials and is declared in module A1-A3. Transport of the product is declared in module A4, and disposal of the packaging materials in module A5. Gained energy from packaging incineration is declared in module D, beyond the system boundary.

The use stage is not taken into account in the LCA calculations. The positive impact on environment due to energy saving depends on the application system in the building. This needs to be considered on next level by the evaluation of buildings. The end-of-life scenarios include the transport to end-of-life stage (C2)

**EoL-scenario 1: 100% incineration:** The effort and emissions of an incineration process is declared in module C4. Resulting energy is declared in module D

**EoL-scenario 2: 100% Material recycling:** The effort of material treatment is considered in C3. Resulting benefits on avoided primary material is declared in module D.

### 3.3 Estimates and assumptions

The applied European average polystyrene data set "Expandable Polystyrene (EPS)" - provided by /PlasticsEurope/ in 2015 - already include blowing agent and flame retardant as a defined recipe. Due to the limited variation of ingredients within the EPS production, this generic data set fulfills the requirement of an LCA in an adequate way.

### 3.4 Cut-off criteria

All data from the production data acquisition are considered, i.e. all raw materials and their transport, water, thermal and electrical energy, packaging materials and production waste. Machines, facilities and infrastructure required during manufacture are not taken into account.

### 3.5 Background data

Background data is taken from the GaBi software /GaBi ts/, see [www.gabi-software.com/databases](http://www.gabi-software.com/databases).

### 3.6 Data quality

For life cycle modelling of the considered products, the GaBi ts Software System for Life Cycle Engineering and GaBi ts database is used.

The annual quantities for 2015 have been provided by the manufacturers and used as primary data.

### 3.7 Period under review

As a good basis EUMEPS foreground data already exists from the generation of environmental product declarations in 2011. For the current EPD update only former detected parameters with significant influence are collected this time. Important processes are basically the consumption of thermal energy and electricity. For the included ingredients only small variations are possible. Waste and water consumption is of marginal importance in regard to the considered environmental categories.

Moreover the collection of 2015 production volumes is essential to allow the calculation of a new weighted average.

The data collected by the manufacturers is based on yearly production amounts. The production data refers to the yearly consumption in 2015.

### 3.8 Allocation

The production process does not deliver any co-products. The applied software model does not contain any allocation.

Nevertheless the overall EPS production of all participating EUMEPS members comprises further products with differing densities beside the product considered in this study. Data for raw material input, thermal and electrical energy as well as auxiliary material are allocated by mass.

### 3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account. The used background database has to be mentioned.

## 4. LCA: Scenarios and additional technical information

The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment if modules are not declared (MND). The values refer to the declared unit of 1 m<sup>2</sup>.

### Transport to the building site (A4)

| Name  | Value | Unit              |
|---|-------|-------------------|
| Transport distance                          | 200   | km                |
| Capacity utilisation (including empty runs) | 70    | %                 |
| Gross density of products transported       | 15    | kg/m <sup>3</sup> |
| Capacity utilisation volume factor          | 25    | -                 |

### Installation in the building (A5)

The amount of installation waste varies and is not declared in this EPD. For the calculation of the environmental impact of EPS including a certain amount of installation waste the values for the production stage (A1-A3) and end of life (C3, C4 and D) have to be multiplied with the amount of waste (e.g. 2% installation waste, factor 1.02).

### End of life (C1-C4)

The transport distance to disposal respective recycling is 50 km

For the End of Life stage two different scenarios are considered. One scenario with 100% incineration (sc. 1; module C4 and D, R1<0.6)) and one scenario with 100% material recycling (sc. 2; module C3 and D) are calculated.

The incineration of EPS results in benefits, beyond the system boundary, for thermal energy and electricity under European conditions. The material recycling scenario generates benefits due to avoiding of primary EPS production.

| Name   | Value | Unit |
|--|-------|------|
| Collected separately Scenario 2                  | 15    | kg   |
| Collected as mixed construction waste Scenario 1 | 15    | kg   |
| Recycling Scenario 2                             | 15    | kg   |
| Energy recovery Scenario 1                       | 15    | kg   |

### Reuse, recovery and/or recycling potentials (D), relevant scenario information

Scenario 1: Module D includes the benefits of the incineration process C4 (incineration of EPS). A waste incineration plant with R1-value < 0.6 is assumed.

Scenario 2: For the calculation of benefit by recycling the data set "Expandable polystyrene" /PlasticsEurope/ is used, same as on input side.

## 5. LCA: Results

The following tables display the environmental relevant results according to /EN 15804/ for 1 m<sup>2</sup> EPS board. The two EoL Scenarios are represented in modules C3, C4 and D. Scenario 1 reflects the thermal treatment of EPS with energy recovery. Scenario 2 shows the environmental results in case of material recycling considering avoided primary EPS material.

### DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

| PRODUCT STAGE       |           |               | CONSTRUCTION PROCESS STAGE          |          | USE STAGE |             |        |             |               |                        |                       |                            | END OF LIFE STAGE |                  |          |  | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES |
|---------------------|-----------|---------------|-------------------------------------|----------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|----------------------------|-------------------|------------------|----------|--|---|
| Raw material supply | Transport | Manufacturing | Transport from the gate to the site | Assembly | Use       | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-construction demolition | Transport         | Waste processing | Disposal | Re-use- Recovery- Recycling- potential |   |
| A1                  | A2        | A3            | A4                                  | A5       | B1        | B2          | B3     | B4          | B5            | B6                     | B7                    | C1                         | C2                | C3               | C4       | D                                      |   |
| X                   | X         | X             | X                                   | X        | MND       | MND         | MND    | MND         | MND           | MND                    | MND                   | MND                        | X                 | X                | X        | X                                      |   |

### RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m<sup>2</sup> EPS foam (with infra red absorbers, 15 kg/m<sup>2</sup>)

| Parameter | Unit                                     | A1-A3   | A4       | A5       | C2       | C3/1    | C3/2    | C4/1     | C4/2    | D/1       | D/2      |
|-----------|--|---------|----------|----------|----------|---------|---------|----------|---------|-----------|----------|
| GWP       | [kg CO <sub>2</sub> -Eq]                 | 47.13   | 0.88     | 0.70     | 0.15     | 0.00    | 10.88   | 50.57    | 0.00    | -35.99    | -35.88   |
| OOP       | [kg CFC11-Eq]                            | 3.01E-9 | 4.06E-12 | 1.51E-12 | 5.86E-13 | 0.00E+0 | 1.68E-9 | 9.68E-11 | 0.00E+0 | -6.42E-10 | -2.88E-9 |
| AP        | [kg SO <sub>2</sub> -Eq]                 | 1.18E-1 | 2.32E-3  | 4.89E-5  | 4.44E-4  | 0.00E+0 | 1.13E-2 | 2.89E-3  | 0.00E+0 | -1.23E-1  | -9.75E-2 |
| EP        | [kg (PO <sub>4</sub> ) <sup>3</sup> -Eq] | 1.09E-2 | 5.44E-4  | 1.04E-5  | 9.51E-5  | 0.00E+0 | 1.31E-3 | 6.07E-4  | 0.00E+0 | -5.78E-3  | -8.66E-3 |
| POCP      | [kg ethene-Eq]                           | 1.96E-1 | -6.84E-4 | 4.94E-6  | -1.48E-4 | 0.00E+0 | 1.71E-3 | 3.62E-4  | 0.00E+0 | -7.86E-3  | -1.82E-2 |
| ADPE      | [kg Sb-Eq]                               | 2.32E-5 | 5.88E-8  | 3.88E-9  | 4.62E-9  | 0.00E+0 | 1.15E-6 | 2.45E-7  | 0.00E+0 | -3.32E-6  | -1.95E-5 |
| ADPF      | [MJ]                                     | 1320.00 | 12.15    | 0.08     | 2.15     | 0.00    | 163.88  | 4.80     | 0.00    | -363.51   | -1153.80 |

Caption: GWP = Global warming potential; OOP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

### RESULTS OF THE LCA - RESOURCE USE: 1 m<sup>2</sup> EPS foam (with infra red absorbers, 15 kg/m<sup>2</sup>)

| Parameter | Unit              | A1-A3   | A4      | A5      | C2      | C3/1    | C3/2    | C4/1    | C4/2    | D/1      | D/2      |
|-----------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|
| PERE      | [MJ]              | 27.92   | 0.69    | 0.49    | 0.01    | 0.00    | 11.60   | 0.74    | 0.00    | -48.63   | -15.76   |
| PERM      | [MJ]              | 0.48    | 0.00    | -0.48   | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    | 0.00     | 0.00     |
| PERT      | [MJ]              | 28.40   | 0.69    | 0.01    | 0.01    | 0.00    | 11.60   | 0.74    | 0.00    | -48.63   | -15.76   |
| PENRE     | [MJ]              | 741.00  | 12.20   | 8.92    | 2.17    | 0.00    | 179.52  | 605.74  | 0.00    | -382.41  | -1177.80 |
| PENRM     | [MJ]              | 608.82  | 0.00    | -8.82   | 0.00    | 0.00    | -600.00 | -600.00 | 0.00    | 0.00     | 0.00     |
| PENRT     | [MJ]              | 1349.80 | 12.20   | 0.10    | 2.17    | 0.00    | -420.48 | 5.74    | 0.00    | -382.41  | -1177.80 |
| SM        | [kg]              | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    | 0.00     | 15.00    |
| R\$F      | [MJ]              | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0  | 0.00E+0  |
| NRSF      | [MJ]              | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0  | 0.00E+0  |
| FW        | [m <sup>3</sup> ] | 2.59E-1 | 1.73E-3 | 1.52E-3 | 1.10E-5 | 0.00E+0 | 2.03E-2 | 9.60E-2 | 0.00E+0 | -1.30E-1 | -1.80E-1 |

Caption: PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; R\$F = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

### RESULTS OF THE LCA - OUTPUT FLOWS AND WASTE CATEGORIES:

1 m<sup>2</sup> EPS foam (with infra red absorbers, 15 kg/m<sup>2</sup>)

| Parameter | Unit | A1-A3   | A4      | A5       | C2       | C3/1    | C3/2    | C4/1    | C4/2    | D/1      | D/2      |
|-----------|------|---------|---------|----------|----------|---------|---------|---------|---------|----------|----------|
| HWD       | [kg] | 1.43E-2 | 9.22E-7 | 6.73E-10 | 8.05E-10 | 0.00E+0 | 4.79E-8 | 4.59E-9 | 0.00E+0 | -1.66E-7 | -1.40E-2 |
| NHWD      | [kg] | 6.39E-1 | 1.02E-3 | 8.52E-4  | 1.09E-5  | 0.00E+0 | 4.25E-2 | 5.01E-2 | 0.00E+0 | -1.13E-1 | -5.73E-1 |
| RWD       | [kg] | 1.18E-2 | 1.74E-5 | 5.84E-6  | 2.51E-6  | 0.00E+0 | 6.23E-3 | 3.74E-4 | 0.00E+0 | -7.47E-3 | -9.53E-3 |
| CRU       | [kg] | 0.00    | 0.00    | 0.00     | 0.00     | 0.00    | 0.00    | 0.00    | 0.00    | 0.00     | 0.00     |
| MFR       | [kg] | 0.00    | 0.00    | 0.00     | 0.00     | 0.00    | 15.00   | 0.00    | 0.00    | 0.00     | 0.00     |
| MER       | [kg] | 0.00    | 0.00    | 0.00     | 0.00     | 0.00    | 0.00    | 0.00    | 0.00    | 0.00     | 0.00     |
| EEE       | [MJ] | 0.00    | 0.00    | 1.28     | 0.00     | 0.00    | 0.00    | 79.40   | 0.00    | 0.00     | 0.00     |
| EET       | [MJ] | 0.00    | 0.00    | 2.90     | IND      | 0.00    | 0.00    | 181.02  | 0.00    | 0.00     | 0.00     |

Caption: HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

In addition an EPD annex contains the LCA results for 1 m<sup>2</sup> with a specific R-value 1, because the provided function by an insulation material is the thermal resistance provided.

## 6. LCA: Interpretation



All impact categories, with the exception of POCP, are dominated by the influence of the basic material polystyrene and its production. The polystyrene employed in the production process already contains a large part of the environmental burdens.

The foaming process for the declared product also contributes significantly to the environmental impacts. The emission of pentane during that process contributes to the Photochemical Ozone Creation Potential (POCP).

The effort (input of additional energy and material) for the end-of-life scenarios (C3 and C4) and the resulting potential benefits of electricity and steam in scenario 1 (module D/1), due to the combustion, is separated. This results in negative values in module D/1. The recycling effort in scenario 2 causes benefits as well in module D/2 by avoiding production of primary EPS material.

Transports have a low influence on all impact categories compared to the contributions from the other areas.

## 7. Requisite evidence

### 7.1. VOC emission to indoor air

EPS products can be used for indoor applications, however they typically are not directly exposed to the indoor air, but covered by some kind of covering layer such as gypsum board.

The emissions of EPS have been measured for samples based upon 12 different kinds of EPS raw material. The measurements according to /CEN TS 16516/ and /ISO 16000 3-8-9-11/ were performed by Eurofins Product Testing A/S, Denmark in April 2016. The tested products all comply with the requirements of DIBt (October 2008) and /AgBB/ (May 2010) for use in applications directly exposed to indoor air.

### VOC Emissions

| Name                            | Value | Unit              |
|---------------------------------|-------|-------------------|
| Overview of Results TVOC (28 d) | 25    | µg/m <sup>3</sup> |
| TVOC (C6 - C16) TVOC (3 d)      | 72    | µg/m <sup>3</sup> |
| R (dimensionless) average       | 0.084 | -                 |
| Carcinogenic Substances (28 d)  | <1    | µg/m <sup>3</sup> |

All tested products live up to the current regulations in place around Europe and has emissions which are below AgBB limit values and would be rated A+ in the French VOC regulation.

### 7.2 Leaching performance

Leaching behaviour is not relevant for EPS products

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**Publisher**

Institut Bauen und Umwelt e.V.  
Panoramastr. 1  
10178 Berlin  
Germany

Tel +49 (0)30 3087748- 0  
Fax +49 (0)30 3087748- 29  
Mail [info@lbu-epd.com](mailto:info@lbu-epd.com)  
Web [www.lbu-epd.com](http://www.lbu-epd.com)



**Programme holder**

Institut Bauen und Umwelt e.V.  
Panoramastr 1  
10178 Berlin  
Germany

Tel +49 (0)30 - 3087748- 0  
Fax +49 (0)30 - 3087748 - 29  
Mail [info@lbu-epd.com](mailto:info@lbu-epd.com)  
Web [www.lbu-epd.com](http://www.lbu-epd.com)



thinkstep

**Author of the Life Cycle Assessment**

thinkstep AG  
Hauptstraße 111 - 113  
70771 Leinfelden-Echterdingen  
Germany

Tel +49 771341817-0  
Fax +49 77134181725  
Mail [info@thinkstep.com](mailto:info@thinkstep.com)  
Web [www.thinkstep.com](http://www.thinkstep.com)



**Owner of the Declaration**

EUMEPS-European Association of EPS  
Weertersteenweg 158  
B-3680 MAASEIK  
Belgium

Tel +32 89 75 61 31  
Fax -  
Mail [info@eumeps.org](mailto:info@eumeps.org)  
Web [www.eumeps.org](http://www.eumeps.org)



**For specification assistance, please contact:**

Justin DeMarco, CSI CDT

(248) 595-9920

[Justin.DeMarco@BASF.com](mailto:Justin.DeMarco@BASF.com)

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