INSULATION ENGINEERED TO MAKE A DIFFERENCE.





An Objective Comparison of Rigid Polystyrene Insulations - EPS and XPS

Provider K 031 Course EPS 104, 1 LU HSW/SD

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Learning Objectives

- Define and understand the similarities and differences between how Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS) are manufactured
- Learn about the environmental features and benefits of polystyrene insulation including recyclability, LEED, thermal performance, energy efficiency, reducing global warming and mold resistance
- Understanding ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
- Review physical property data of both EPS and XPS: Compressive Strength, Long Term Moisture Retention and Sustainable R-Value

What is Expanded Polystyrene (EPS)?

- Expanded polystyrene (EPS) is a durable, rigid foam plastic material that is specified as an effective insulator. It is manufactured in large block form in a variety of strengths and cut to order based on the project specifications.
- EPS also possesses a tremendous strength to weight ratio and the cellular structure is well suited to resist compression under the most demanding dead/live load applications.
- The same fundamental chemistry has been used to manufacturer EPS since the 1950's
- There have been great advancements in manufacturing equipment and quality control in the last 20 years that make EPS much more predictable and attractive rigid insulation.

EPSMA – EPS Alliance Expanded Polystyrene Molders Association



www.epsindustry.org

- o Insulfoam
- o Cellofoam
- Atlas
- o Plasti-Fab
- \circ ACH
- Numerous local and regional companies

What is Extruded Polystyrene (XPS)? aka Styrofoam*

- Extruded polystyrene (XPS) foam insulation is durable, rigid foam plastic insulation that is manufactured in sheet form in a variety of strengths through an extrusion process and is typically available up to 3" thick in ½" increments
- XPS also possesses a tremendous strength to weight ratio and the cellular structure is well suited to resist compression under the most demanding dead/live load applications.
- Its excellent resistance to moisture, imperviousness to rot, mildew and corrosion, controlled compressive strength and ability to maintain insulating power make it a heavily specified product for the construction industry.
- $_{\odot}$ XPS is typically supplied as blue, pink, green or yellow colored boards in 2'x 8' or 4'x 8' panels

XPSA Extruded Polystyrene Manufacturers Association



www.XPSA.com







Key Raw Material





Both XPS & EPS are manufactured from a polystyrene resin...

- $_{\rm O}$ Modified and unmodified
- \circ Varying pentane contents
- Varying Sizes
- \circ Different blowing agents

EPS Manufacturing





XPS Manufacturing



Manufacturing Comparison

EPS

- Block-molded into large billets and then cut to job-specific sizes
- Virtually no limitations on product size
- Standard offering in 7 different compressive strengths
- 75+ different manufacturers

• **XPS**

- Continuously extruded through a die by thickness and then cut to length
- Limited thicknesses and panel sizes
- Standard offering in 3 different compressive strengths
- o 4 different manufacturers

Sustainability and Environmental Benefits

- Environmentally friendly; Conserves energy
- Contains no ozone depleting blowing agents; contains formaldehyde
- \circ 100% recyclable from jobsites
- May contain recycled content
- Reduces global warming
- Contributes towards LEED Certification credits



Recyclability

- EPS and XPS can be removed off jobsites and may be used in future manufacturing as long as it is not contaminated
- Can be introduced into the manufacturing of new product or returned to a styrene resin







Polystyrene Insulations Reduce Global Warming

Insulation can return up to 200 times the amount of energy required to produce it, and reduce emissions by up to 100 times the volume produced during the manufacturing process



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ENERGY & EMISSIONS EQUATION

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EXCEPTIONAL RETURN

ON NATURAL CAPITAL

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mode ware more promotional instances (1.50%) per-termination of the energy revealed and 3.50% of the antisateurs produced by the addition of DPS recalition.





and delivery of Expanded Polystyrene (EPS) foam insulation yields an exponential benefit to the environment by providing substantial This Environmental Profile summarizes a life cycle analysis energy savings and critical reductions conducted by Franklin Associates for the EPS Molders Association – to quantify the energy savings and in greenhouse gas emissions, when EPS is used to insulate home North America. In fact, EPS house gas red provided by the use of EPS foam insulation in single-family residential construction, compared to the energy used and emissions insulation can return up to 200 times the amount of energy required to produce it, and reduce emissions by up to 100 times the volume produced during the manufacturing generated in the production, processing and transportation of process. The exce performance of EPS as an this material. As this life cycle analysis concludes, the savings are insulator for the built environ offers the construction industry the tools and technology needed to not only substantial but also rapid, providing a 100% payback in as little as three months after occupancy. These results present a powerful case for the significant achieve superior thermal performance while making a significant and restorative contribution to the reduction of global warming. contributions of EPS insulation in Architects, designers and ma making homes more efficient. specifiers can be more confident than comfortable and emin ever that they are providing an

PERFORMANCE MODEL The base model used to illustrate the properties and performance of EPS insulation was a specific single-family home constructed with wood-framed walls, fiberglass insulation, 3/2" OSB clad with wood siding on the exterior and finished with 3/2" gypsum drywall on the interior. The total insulated wal area of the representative home odeled was 1,791 sq. ft. The study evaluated the net energy and environmental effects of adding EPS insulation board to the exterior of the framed wall installed under the wood siding. The base wall in the U.S. was a 2x4 wood-framed wall with R-13 fiberglass insulation. The base wall in the Canadian house was a 2x6 wood framed wall with R-19 fiberglass insulation. Accordingly, separate results were calculated for the home a it would be constructed in the U.S. and Canada and occupied for 50 years

Energy and Environmental Benefits of Extruded Polystyrene Foam and Fiberglass Insulation Products in U.S. Residential and Commercial Buildings Merle F. McBride, Pk.D., P.E Owars Corning, Granville, OH, USA 43023

ABSTRACT

The use of extruded polystyrene foam and fiberglass insulation products in U.S. residential and commercial buildings has been analyzed to determine whether they have a net energy and environmental benefit. The fundamental questions are whether the energy consumed and emissions produced to manufacture these products are less than, equal to or exceed those benefits when installed in buildings. Several hundred locations across the U.S. were selected to determine the annual energy and emiss savings that are realized when extruded polystyrene foam and fiberglass insulation products are used in the envelopes of residential and commercial buildings. The energy savings were segregated by fiel type and the emissions are traced back to the site tions to manufacture the foam and fiberglass are evaluated source. The energy and emissions to manufacture the foam and fiberglass are evaluated the same way for consistency. The first year energy savings exceed the energy used to manufacture the insulation products. The emission savings also provide a net positive benefit. The absolute magnitudes of the emission benefits are directly proportional to the expected useful life of the buildings.

INTRODUCTION

The manufacturing of insulation products is an energy intensive process that results in the generation of direct environmental emissions as well as indirect environmental ions at electrical power plants. However, the use of those insulation products in residential and commercial buildings provides significant energy and environmental savings over an extended time period. The fundamental questions to answer are whether the energy consumed and emissions produced to manufacture the insulation products are less than, equal to or exceed those benefits when installed in buildings.

BACKGROUND

The benefits of insulation in residential and commercial buildings include lower energy consumptions, improved thermal comfort, reductions in the first costs of the heating and cooling equipment and reductions in CO2 emissions from the burning of fossil fuels across the United States. However, the manufacturing of insulation pr generates emissions that contribute to global warming. The issue of global warming has focused attention on the use, regulation and eventual elimination of selected materials that contribute to the greenhouse gases. Also, energy and emission reduction have received increased focus by the building community as the concept of environmentally responsible and sustainable construction or "green" has gained popularity.

Foamed thermal insulations, such as extruded polystyrene (XPS), have come under scrutiny relative to climate change. The blowing agents, which are used to produce the foam and contribute to its high insulating efficiency, have both global warming and

Earth Technologies Forum

4-27-04

Polystyrene Insulations Reduce Global Warming

Energy Savings Provided by	Ener	Millions Btu's					
Adding Exterior R-4 EPS Ins	EPS	Production	8.90				
the second	EPS	Transporta					
Single Family Home - U.S.	Tota	9.03					
Energy Savings (Millions Btu's)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S. Average	
Annual Energy Savings	11.37	9.58	7.84	5.58	5.00	6.58	
Payback Period in Years	0.79	0.94	1.15	1.62	1.81	1.32	
Savings Over 50 Years	568	479	392	279	250	329	
Return on Investment (ROI%)	6,290	5,305	4,341	3,090	2,769	3,64	
Global Warming Potential (GWP) Reductions Provided by Adding Exterior R-4 EPS Insulation Single Family Home - U.S.							
Provided by Adding Exterio			EPS	Production Transporta	tion	7.9	
Provided by Adding Exterio			EPS	Production Transporta	tion	7-95 24 815	
Provided by Adding Exterio Single Family Home - U.S.	r R-4 EPS	Insulatio	EPS Tota	Production Transporta I GWP Inve	tion sted	7.99 24 819 U.S. Average	
Provided by Adding Exterio Single Family Home - U.S. GWP Reductions Compared to Base Wall	7 R-4 EPS	Zone 2 3,354	Zone 3	Production Transporta I GWP Inve Zone 4	tion sted Zone 5	7.99 24 819 U.S. Average 98	
Provided by Adding Exterio Single Family Home - U.S. GWP Reductions Compared to Base Wall Annual Reductions	Zone 1	Zone 2 3,354	Zone 3	Production Transporta I GWP Inve Zone 4 831	tion sted Zone 5 777	Ds. CO2 Equiv 7.95 24 815 U.S. Average 983 0.8 49,095	

- The use of foam insulation on a building significantly increases the R-Value of walls to save energy
- Lower residential energy use translates into fewer emissions and reduced GWP

USGBC and LEED

Materials and Resources (MR Credits)

- MR Credit 2.1 and 2.2 Construction Waste Management:
 - Divert 20% or 75% from Disposal, 2 points possible
- MR Credit 3.1 & 3.2 Materials Reuse: 5% or 10%, 2 points possible
- MR Credit 4.1 & 4.2 Recycled Content: 10% or 20%, 2 points possible
- MR Credit 5.1 & 5.2 Regional Materials, 2 points possible

Sustainable Sites (SS Credits)

• SS Credit 7.2 – Heat Island Effect Roof, 1 point possible

Energy and Atmosphere (EA Credits)

- EA Credit 1 Optimize Energy Performance, 10 points possible
- EA Credit 5 Measurement & Verification, 1 point possible





EPS Products

Product Features:

- Standard 10 60 psi compressive strength at 10% strain
- Long-term R-value of 3.85 to 4.6 per inch
- Any thickness from 3/8" to 48"
- Available in panels, blocks & custom shapes
- Tapered Panels available 0-40", any slope
- T&G, bevel or straight-cut edges
- Specialty & Architectural shapes

Product Benefits:

- 100% recyclable
- Job specific sizes and performance requirements
- Minimal waste and material handling
- Moisture resistant
- Most R-value per dollar
- No thermal drift





EPS Products: Skinned & Composites

Factory-laminated Facers:

- Polymeric facers printed, white and silver
- Reflective films low emissivity
- Fiber glass reinforced facers

Composites:

- Wood fiber & perlite
- OSB & Plywood
- Gypsum & DensDeck®
- High-Density and Standard Iso

Benefits:

- $_{\circ}$ Improved handling & durability
- Fanfold capabilities
- Eliminate compatibility concerns
- Improved moisture absorption
- Enhanced performance and code approvals

 $\mathsf{DensDeck} \ensuremath{\mathbb{R}}$ is a registered trademark of Georgia Pacific





EPS Physical Properties

	Typical Physical Properties						
Property	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV	Test Method
Nominal Density (pcf)	1.0	1.25	1.5	2.0	2.50	3.0	ASTM C303
C-Value (Conductance) BTU/(hr•ft²•°F) @ 25° F (per inch) @ 40° F @ 75° F	.230 .240 .260	.220 .235 .255	.210 .220 .240	.200 .210 .230	0.198 0.206 0.222	0.196 0.198 0.217	ASTM C518 or ASTM C177
R-Value (Thermal Resistance) (hr•ft²•°F)/BTU @ 25° F (per inch) @ 40° F @ 75° F	4.35 4.17 3.85	4.55 4.25 3.92	4.76 4.55 4.17	5.00 4.76 4.35	5.05 4.85 4.50	5.10 5.05 4.60	ASTM C518 or ASTM C177
Compressive Strength (psi, 10% deformation)	10 - 14	13 - 18	15 - 21	25 - 33	40	60	ASTM D1621
Flexural Strength (min. psi)	25	30	35	50	60	75	ASTM C203
Dimensional Stability (maximum %)	2%	2%	2%	2%	2.0	2.0	ASTM D2126
Water Vapor Permeance (max. perm., 1 inch)	5.0	3.5	3.5	2.0	2.5	2.5	ASTM E96
Water Absorption (max. % vol.)	4.0	3.0	3.0	2.0	2.0	2.0	ASTM C272
Capillarity	none	none	none	none	none	none	-
Flame Spread	< 20	< 20	< 20	< 20	< 20	< 20	ASTM E84
Smoke Developed	150 - 300	150 - 300	150 - 300	150 - 300	150-300	150-300	ASTM E84

*Properties are based on data provided by resin manufacturers, independent test agencies and Insulfoam.

EPS Construction Applications

- Below Grade Insulation
- Below/Between Slab Insulation
- Radiant Heat Floors
- Roof & Wall Insulation
- Plaza Deck
- Block-outs & Concrete Forming
- EIFs & Cavity Wall
- Landscape and Structural Void Fill
- Siding Underlayment
- Pre-cast Wall Panels













XPS Products

Product Features:

- Standard 25, 40 & 60 psi compressive strength at 10% strain
- 100 psi available as a special order
- R-value of 5 per inch
- Thicknesses from 1/2" to 3" in 1/2" increments
- \circ Standard panels of 2'x 8' or 4'x 8'; other special order sizes available
- T&G or straight-cut edges

Product Benefits:

- Typically contains recycled content
- 100% recyclable
- Several standard compressive strengths
- Moisture resistant
- Durable & Lightweight







XPS Physical Properties



XPS Construction Applications

- Below Grade Insulation
- Below/Between Slab Insulation
- Radiant Heat Floors
- Roof & Wall Insulation
- Plaza Deck
- Block-outs & Concrete Forming
- EIFs & Cavity Wall
- $_{\odot}$ $\,$ Landscape and Structural Void Fill $\,$
- Siding Underlayment
- Pre-cast Wall Panels



Product Comparisons

EPS

- Wide variety of compressive strengths available
- \circ 1/8" 48" thickness available
- Boards can be custom fabricated to any length
- Made to order; short lead times; job-lot quantities
- Tapered



- 3 standard compressive strengths available
- $_{\odot}$ Limited thickness available 3" max
- $_{\odot}$ Limited to standard lengths 8' and 9'
- Standard sizes; special orders require lengthy lead times; full pallets only; larger minimum orders
- No tapered

EPS and XPS Codes and Compliances

- o **FM**
- o UL
- o ASTM
- ICC-ES
- o IBC
- o Miami Dade
- State of Florida, FBC
- Various State Approvals













ASTM C578



Designation: C 578

Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation¹

This standard is issued under the fixed designation C 578; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

- The industry's consensus standard for Expanded and Extruded polystyrene
- Establishes the minimum physical properties requirements

ASTM C 578

														_
Classification	Type XI	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV	Type XII	Type X	Type XIII	Type IV	Type VI	Type VII	Type V
								-						
Compressive resistance at	5.0	10.0	13.0	15.0	25.0	40.0	60.0	15.0	15.0	20.0	25.0	40.0	60.0	100.0
yield or 10 % deformation, whichever occurs first (with skins intact), min, psi (kPa)	(35)	(69)	(90)	(104)	(173)	(276)	(414)	(104)	(104)	(138)	(173)	(276)	(414)	(690)
Thermal resistance of 1.00-in.	3.1	3.6	3.8	4.0	4.2	4.2	4.3	4.6	5.0	3.9	5.0	5.0	5.0	5.0
(25.4-mm) thickness, min, F·ft ͡͡͡ h/Btu (K·m͡͡ ₩)	(0.55)	(0.63)	(0.67)	(0.70)	(0.74)	(0.74)	(0.76)	(0.81)	(0.88)	(0.68)	(0.88)	(0.88)	(0.88)	(0.88)
Mean temperature: 75 6 2°F (24 6 1°C)							I							
Flexural strength, min, psi (kPa)	10.0 (70)	25.0 (173)	30.0 (208)	35.0 (240)	50.0 (345)	60.0 (414)	75.0 (517)	40.0 (276)	40.0 (276)	45.0 (310)	50.0 (345)	60.0 (414)	75.0 (517)	100.0 (690)
Water vapor permeance of	5.0	5.0	3.5	3.5	2.5	2.5	2.5	1.5	1.5	1.5	1.5	1.1	1.1	1.1
1.00-in. (25.4-mm) thickness (See Note 5.), max, perm (ng/Pa·s·m͡ f	(287)	(287)	(201)	(201)	(143)	(143)	(143)	(86)	(86)	(86)	(86)	(63)	(63)	(63)
Water absorption by total immersion, max, volume %	4.0	4.0	3.0	3.0	2.0	2.0	2.0	0.3	0.3	1.0	0.3	0.3	0.3	0.3
Dimensional stability (change in dimensions), max,%	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Oxygen index, min, volume %	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Density, min, lb/ft (kg/m)	0.70	0.90	1.15	1.35	1.80	2.40	2.85	1.20	1.30	1.60	1.55	1.80	2.20	3.00
	(12)	(15)	(18)	(22)	(29)	(38)	(46)	(19)	(21)	(26)	(25)	(29)	(35)	(48)

EPS options

Compressive Strengths

EPS

- 7 standard types available
- 5 psi 60 psi
 - 5 psi for packaging or compressible inclusions
- Any thickness or sheet size available in all strengths
- Recommend right density based on actual project loading conditions

XPS

- 3 standard types available
- o 15 psi 100 psi
 - 15 and 100 psi products are special order only
- Typical recommendation of 15 psi for residential & wall applications only
- \circ 25 100 psi for commercial applications



Plaza Parking Deck

ASTM D6817 Specification for Rigid Cellular Polystyrene Geofoam Improves Design Predictability

- \circ 1st published in 2002
- Establishes additional physical properties to aid Engineers in designing projects where Polystyrene will act as a structural void fill material & will bear the weight of concrete slabs, soil overburden, pavement and heavy truck traffic
- 1% deformation values published for EPS and XPS
 Considered as the conservative Elastic Limit Stress (σ)
- Material will NOT exhibit post construction creep or plastic deformation as long the combined dead/live loads do not exceed the 1% strain values identified in ASTM D6817

The Strength That Really Counts Design within the Elastic Range

Type I EPS can bear a minimum of 518 psf @ 1% strain (σ) $_{\circ}$ 10 psi @ 10% strain

Concrete weighs 150 pcf

Divide elastic limit stress (1% strain value) of foam type

- \circ by weight of overburden material
- 518 psf / 150 pcf = 3.45 feet







6" of Type I EPS

XPS Manufacturers Say: 25 psi Minimum Under Slab

- Type IV XPS can bear a minimum of 1,569 psf @ 1% strain
 - $_{\circ}$ 25 psi @ 10% strain
- Type IX EPS can also bear a minimum of 1,569 psf @ 1% strain
 25 psi @ 10% strain
- 1569 psf / 150 pcf = 10.45 feet

10.45 feet (125") of concrete

1% strain of 6" =0.06" Less than 1/16" compression



6" of Type IV XPS or Type IX EPS

The Right Choice for your Project?

- Concrete weighs 150 pcf
 6" slab weighs 75 psf
- Soil weighs 120 pcf
 2' of soil weighs 240 psf



- Most concrete parking garages and structural roof decks are designed to withstand 100-200 psf total dead/live loads
- Pedestrian foot traffic loads are typically 50-75 psf
- Heavy semi-truck traffic loads are typically 100-200 psf

Actual Project: Cost of Over Specifying

100 psi XPS specified as tiered void filler sandwiched between a structural deck and 6" thick concrete slab with pedestrian traffic San Diego, CA: 10,000 cubic feet

<u>EPS</u>

- 518 psf or 3.6 psi @ 1% or 10 psi @ 10% strain
- Cost per cubic foot : \$3.00

<u>XPS</u>

- 5,846 psf or 40.6 psi @ 1%
 or 100 psi at 10% strain
- Cost per cubic foot: \$25

Total loads: 175 psf (75: slab + 100: live) Total savings to use EPS: \$220,000

Water Absorption Test ASTM C272

24-hour Full Submersion Test

<u>XPS</u>	<u>EPS</u>
0.3%	2 - 4%

Long-Term Moisture Retention

bulletin 15-Year In-Situ Research Shows

EPS Outperforms XPS in R-Value Retention

Studies show that as much as 25% of energy loss from a structure can be attributed to a lack of insulation on below-grade foundations, crawl spaces and under stabs. Insulation R-value is directly correlated to maximum energy efficiency in a building envelope: higher R-values translate into increased savings. In below grade applications, form insulation is exposed to moisture and could lose r-value over time if this moliture is absorbed.

As shown in an independent, third-party test program expanded polystyrene (EPS) maintains its R-value even after long-term exposure in cold, wet climates. A competing insulation material, extruded polystyrene (XPS) was shown to have lost R-value over time. The results of this test program demonstrate that BPS insulation is a perfect choice to reduce energy loss.

IN-SITU TEST RESULTS

EPS Below Grade Series 103

Novmber 2008

In August 2008, Independent testing¹ evaluated the field performance of EPS and XPS inculation in a side-by-side. below grade application following a continuous 15-year installation period. EPS Type I and XPS Type X text samples were excented from the exterior of a commercial building in St. Paul, MN at a depth of approximately 6 feet below grade.

Speciment were tested for thermal resistance using ASTM C318 "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the

Heat Flow Apparatus" immediately after excevation . Moisture content was determined by measuring the sample weight at the time of removal and again after being oven pried.



Encavation Sile Minneapols, MN Climate Zone 1



Conceptible (1995, Matthew Association 2008)



In-Situ R-Value Retention & Water Absorption



The results demonstrate that EPS Type I outperforms XPS Type X in both R-value retention and decreased water absorption. Further, whereas the in-service R-value of the XPS insulation is reduced by half, expanded polystyrene still delivers 94% of its specified_Rvalue of 3.6 per inch after 15 years . These long term performance advantages make EPS insulation a preferred choice when compared to the competition.

EPS Below Grade Series 103

Page Two

This testing further confirms that water absorption results determined using ASTM C272 cannot be correlated to the in-service performance of foam insulation. The main reason

for the lack of correlation is that the laboratory test procedures call for partial or full submersion conditions which are not encountered in field applications. In fact, laboratory test methods were not developed for predicting actual performance, but were intended for use in specifications as a means of comparing relative physical properties of different cellular plastics and for product evaluations and quality control.

To find out how EPS can meet your future project needs contact the closest EPS Molders Association member manufacturer. For a list of participating companies visit www.epsmolders.org or call (800) 607-3772.



Copyright 0575 Molders Association 2008

Compare Moisture Retention After 15 years in service

	15					
	and the second sec	sults xtraction	days @	after 30 72° F & R.H.	ASTM C578 Values	
	EPS	XPS	EPS	XPS	EPS	XPS
R-Value/inch	3.4	2.6	3.7	2.8	3.6	5.0
Moisture Content (Volume %)	4.8	18.9	0.7	15.7	4.0	0.1

Unlike other Type I EPS, when exposed to dry conditions for four weeks, the XPS did not approach values expected per ASTM 578 *Standard Specification for Rigid Polystyrene Thermal Insulation*

Water Absorption Percentage



Water Absorption Percentage



Published R-Values

EPS

 $_{\odot}3.85$ - 4.6 per inch @ 75° F

R–Value increases as
 temperature decreases

- $_{\odot}40^{\circ}$ and 25° F values available
 - Higher per inch
 - Base on local climate

XPS

 $_{\odot}5$ per inch @ 75° F

R–Value increases as
 temperature decreases

- $_{\odot}40^{\circ}$ and 25° F values available
 - Higher per inch
 - Base on local climate



Life Sciences: U of A, Fairbanks, Alaska

Thermal Drift Reduces Long Term R-Value

- Thermal Drift is defined as loss of insulating power over time as trapped low conductivity blowing agent used to manufacture XPS escapes out of the foam and is replaced with air.
- R-Value of XPS starts higher and then irreversibly decreases over time.
- EPS does not experience thermal drift because there is no blowing agent trapped in between the cells (just air).

Warranted R-Values

EPS

100% of published value Ο

in the United States.

installation

B. Insulation must be installed in typical building

that were in effect at the time of such

the time of any warranty claim.

in strict accordance with all applicable Dow

15 YEAR THERMAL LIMITED WARRANTY STYROFOAM[™] BRAND EXTRUDED POLYSTYRENE FOAM INSULATION THERMAL LIMITED WARRANTY D. This warranty shall be void if, in Dow's sole judgment, there is damage to the insulation The Dow Chemical Company hereby warrants to resulting from improper handling and installation the owner of the building/structure upon which the maintenance, intentional or unintentional misuse, insulation was installed that, for a period of fifteer negligence, impact of falling objects, vandalism, (15) years, commencing with the date of manufacture printed on the unit label or insulation, earthquake, lightning, hurricane, flood, fire, hailstorm, high wind, tornado, excessive UV that the insulation's actual thermal resistance will not vary by more than ten (10) percent from the exposure, cascading roof/floor water, ponding water, immersion in water, non-diffusion oper minimum R-value identified in ASTM C578 or assemblies, or failure or distortion in the walls or insulation with a thickness of 1/2" to 3/4". If the foundation of the building/structure, including insulation is determined by sampling and tests settling of the building or movement of framing (conducted as provided below) to not meet warrant value, Dow will deliver to the owner of the building membere on which the insulation was initially installed a Insulation must be stored prior to installation in quantity of substantial equivalent product to replace accordance with Dow's recommendations. the non-performing insulation or, in the alternative, These instructions are available by calling at Dow's sole discretion, refund to the owner the 1-866-583-BLUE (2583) original purchase price of the non-performing Dow does not warrant the compatibility of any insulation. In no event shall Dow be liable for any other products, whether manufactured by Dow other costs or damages, including labor costs. or not, including (but not limited to) any roofing Total Dow expense for the life of this warranty will membranes or coatings. be limited to the original purchase price of the Building and/or construction practices unrelated insulation to building materials could greatly affect moisture and the potential for mold formation. CONDITIONS/EXCLUSIONS No material supplier including Dow can give The following conditions/exclusions apply to this assurance that mold will not develop in any Warranty: specific system or product. A. Dow's obligations under this warranty are INSULATION SAMPLING/TESTING applicable only to insulation with a thickness of 1/2" to 3/4" manufactured by Dow after All sampling shall be conducted in accordance with November 1, 2010 and purchased and installed

sampling procedures prescribed by Dow, and samples of the insulation shall only be taken in the presence of an authorized Dow representative. Testing of insulation samples shall be in accordance with ASTM C518, or the then closest Dow-approved and construction assemblies (including roofing) effective equivalent thereof. Insulation samples shall specifications, recommendations and guidelines be conditioned to equilibrium prior to testing. All sampling and testing costs (including but not limited to costs of insulation covering removal and C. The building must be owned by the claimant at replacement) shall be at the owner's sole expense

Typical, 90% of published Ο value

<u>XPS</u>

- 10% decrease in writing Ο
- R- 5 per inch published
 - Thermal Drift Occurs \cap

= •R- 4.5 per inch warranted

EPS is viable alternative to XPS

Stable, long term R-Value that won't drift

 Compressive strengths to match with loading requirements of job

 Low long-term moisture retention with no detrimental structural effect on physical properties



Learning Objectives

- Define and understand the similarities and differences between how Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS) are manufactured
- Learn about the environmental features and benefits of polystyrene insulation including recyclability, LEED, thermal performance, energy efficiency, reducing global warming and mold resistance
- Understanding ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
- Review physical property data of both EPS and XPS: Compressive Strength, Long Term Moisture Retention and Sustainable R-Value

INSULATION ENGINEERED TO MAKE A DIFFERENCE.





Thank You for Your Time! Questions?