Platinum Powered Insulation

PLATINUM
GPS INSULATION

Graphite Polystyrene (GPS) Rigid Insulation

High Performance Thermal Innovation

INSULFOAM
EVERYTHING INSULATION

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Learning Objectives

After completing today's course, you will be able to:

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain **suitable applications** for GPS insulation.

Learning Objective #1

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
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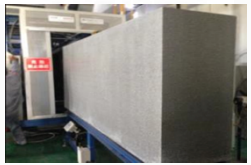
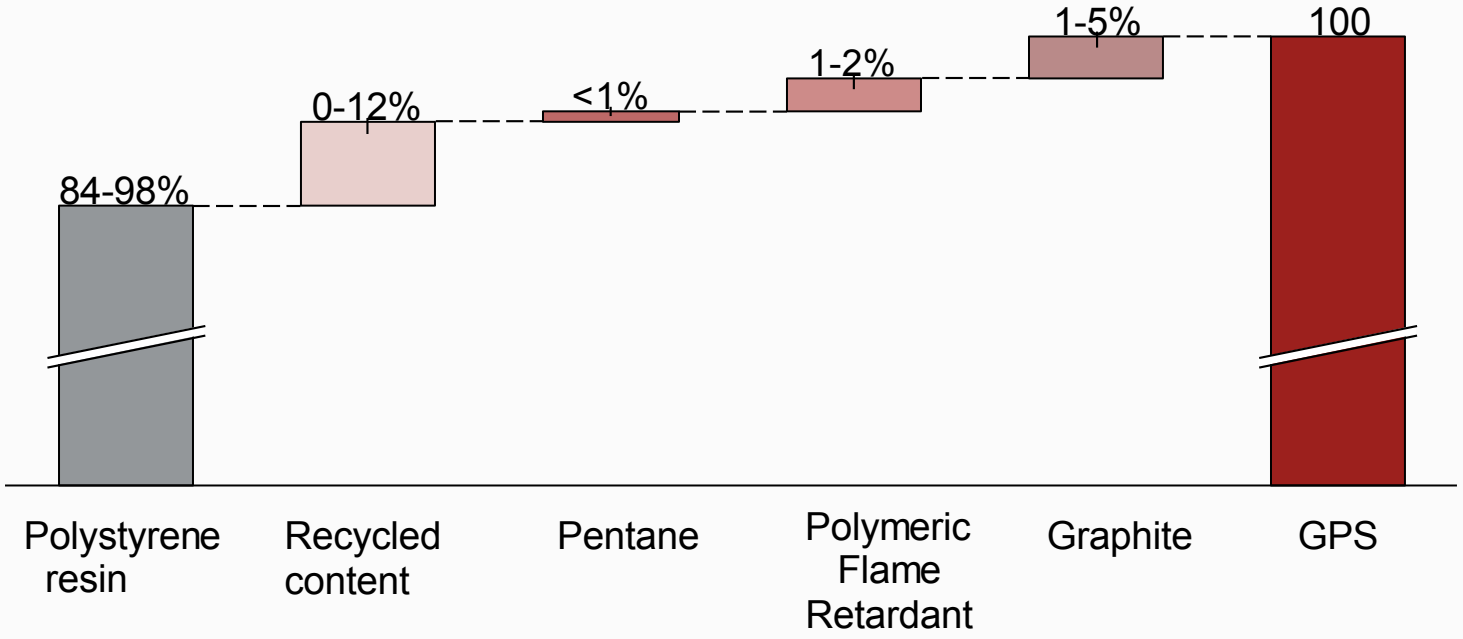
Manufacturing process



What's in the GPS Foam?

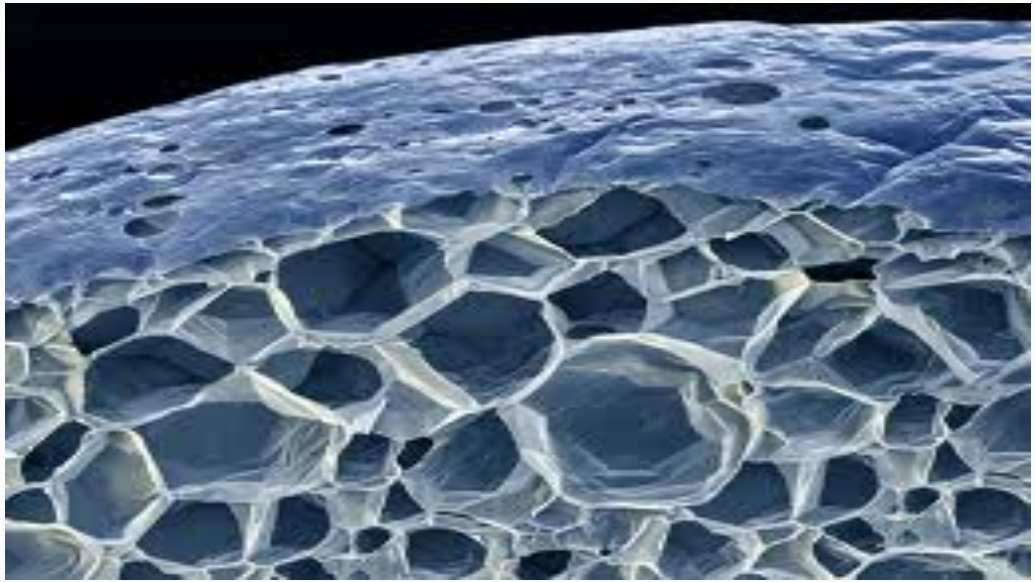


GPS

- GPS is a unique material used, in its final form, as ‘rigid thermal insulation’ in the construction industry.
- The material attributes a distinctive silver-gray color to high-purity graphite contained within the polymer matrix of the rigid foam.
- The graphite particles both reflect and absorb radiant energy, thereby increasing the materials insulation capacity, or R-value, while retaining all of the performance benefits inherently found in standard rigid foam.
- This is why GPS rigid thermal panels are up to 20% thinner than other rigid insulations.

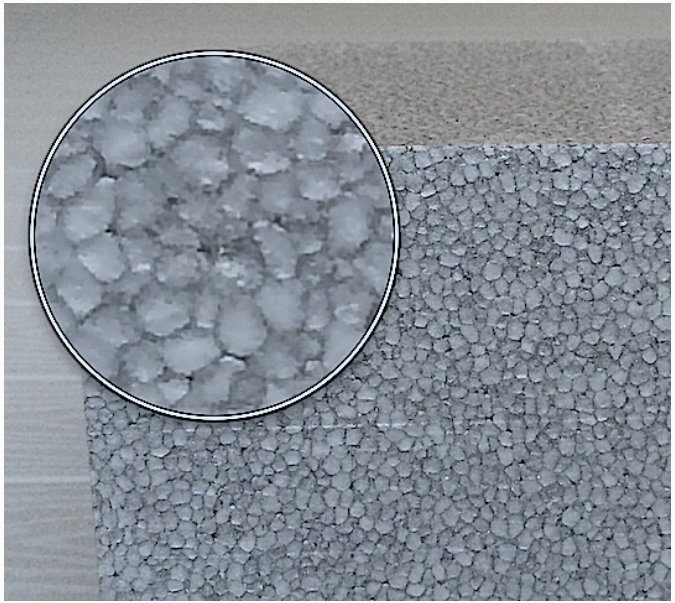
GPS

Close up of graphite contained within the polymer matrix



Graphite - How it Improves GPS

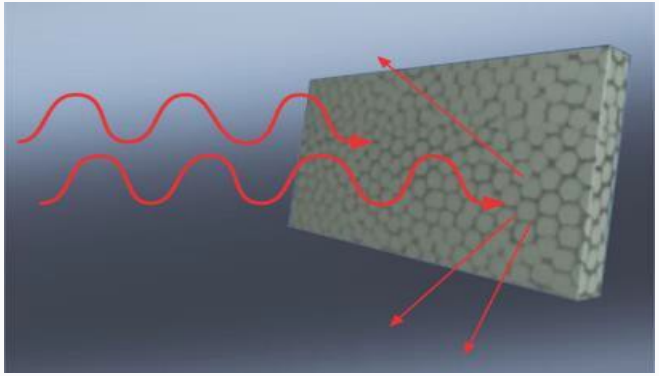
- Graphite is the most stable form of carbon – safe and chemically inert
- Thermal Performance
  - Reflects radiant heat energy
  - Reduces thermal conductivity
  - Increases R-value as much as 25%

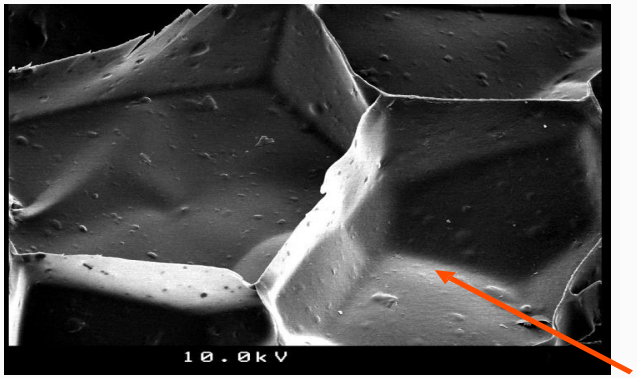


Foam chemistry basics

It's all about the Graphite

Most rigid insulations perform by reducing conduction and convection components of heat loss. The IR-Absorbers/Reflectors in GPS address energy loss through the third component of heat transfer, radiation, hence the R-Value is increased.





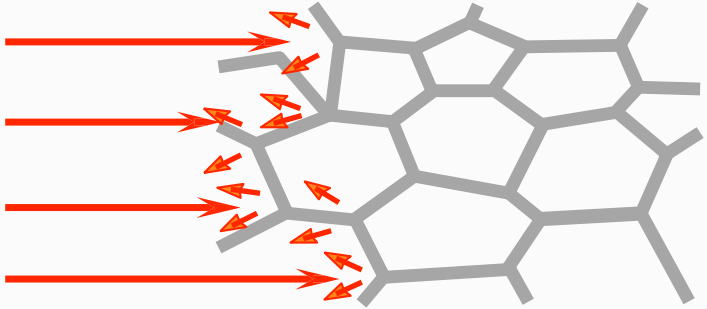
R-value = GPS Matrix + Cell gas + Radiation

Influence of foam density

High density

⇨ thick membranes

(≥1.6 lbs/ft³)

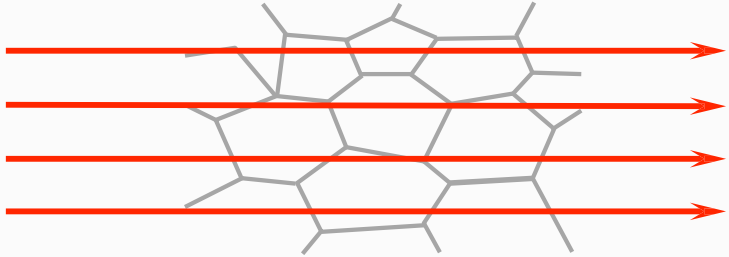


Foam

Low density

⇨ thin membranes

(< 0.95 lbs/ft³)

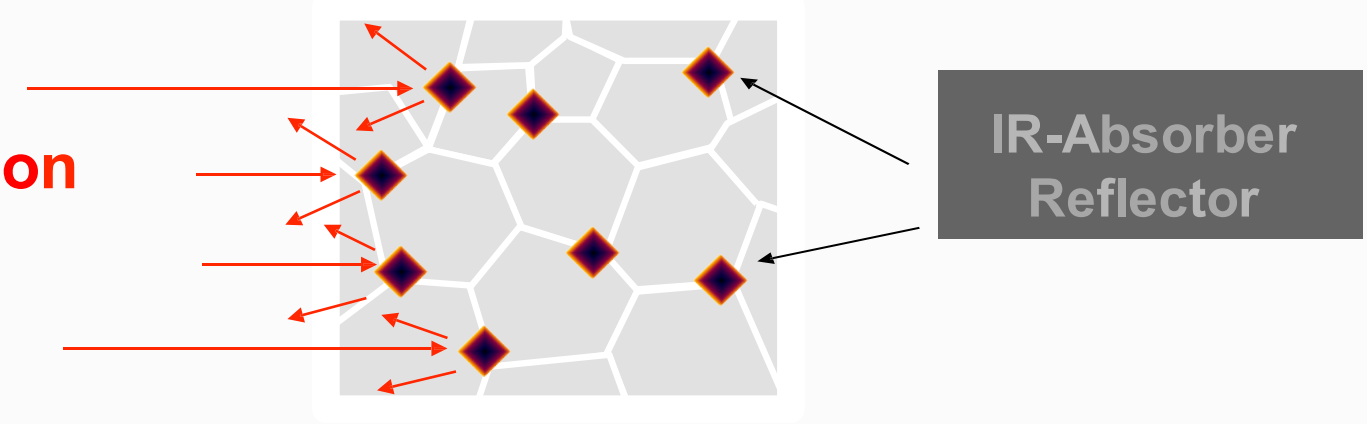


Foam

Reduction of Heat Conduction by IR-Radiation

Target:

Reduction of the Radiation in case of low foam densities.

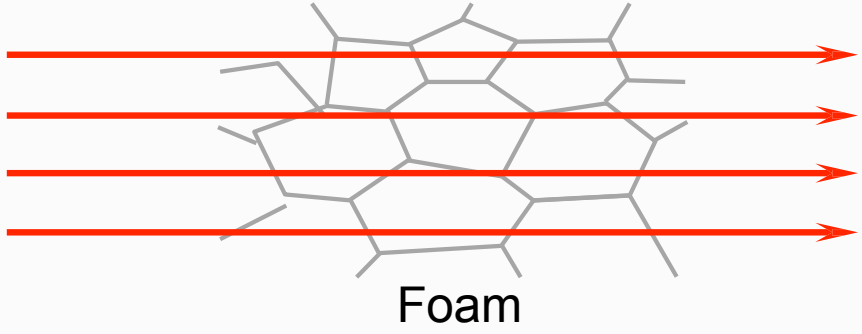


Solution:

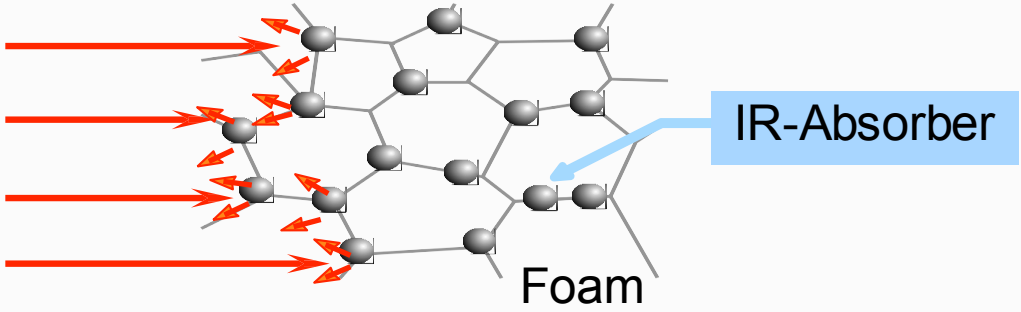
Incorporation of small quantities of highly effective Infrared-Absorbers/ Reflectors into the Polymer.

Reduction of Heat Conduction by IR-Radiation

Low density
⇨ thin membranes
(< 0.95 lbs/ft³)



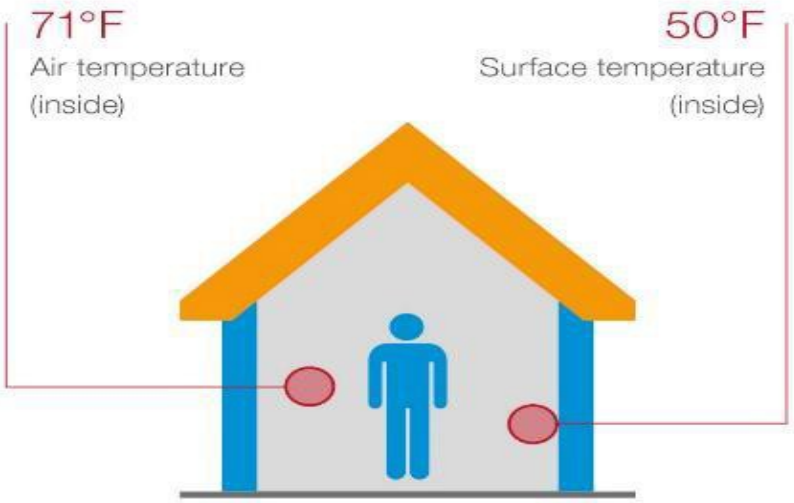
Incorporation of IR-Absorber
(< 0.95 lbs/ft³)



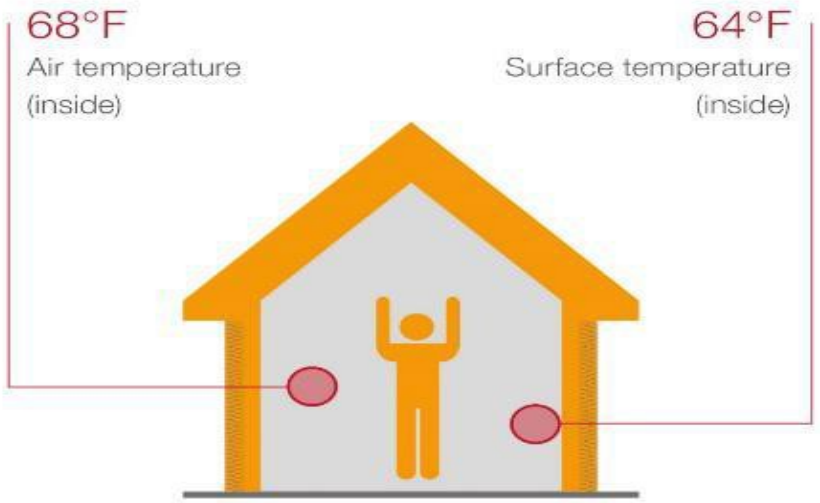
Thermal Insulation Matters!

Thermal comfort – a comparison:

Building **WITHOUT** thermal insulation



Building **WITH** thermal insulation



Source: Forschungsinstitut für Wärmeschutz e.V. München, FIW

Indoor air quality characteristics for GPS Foam

Allowable Emission Levels and Measurement

- Products are measured for chemical and particle emissions, as they are tested to simulate actual product use. Most building materials and furnishings are required to meet allowable emission levels within 7 to 14 days of installation.
- All products are tested in dynamic environmental chambers following guidance of:
  - ✓ ASTM Standards D-5116 and D-6670
  - ✓ US Environmental Protection Agency's (USEPA) testing protocol for furniture
  - ✓ State of Washington's protocol for interior furnishings and construction materials
  - ✓ California's Department of Public Health Services (CDPH) Standard Practice for Specification Section 01350
  - ✓ ISO 16000 environmental testing series
  - ✓ ANSI/ASHRAE Standard 62.1-2007
  - ✓ World Health Organization
  - ✓ LEED for New Construction (LEED-NC) and LEED for Commercial Interiors (LEED-CI)

Learning Objective #1 Summary

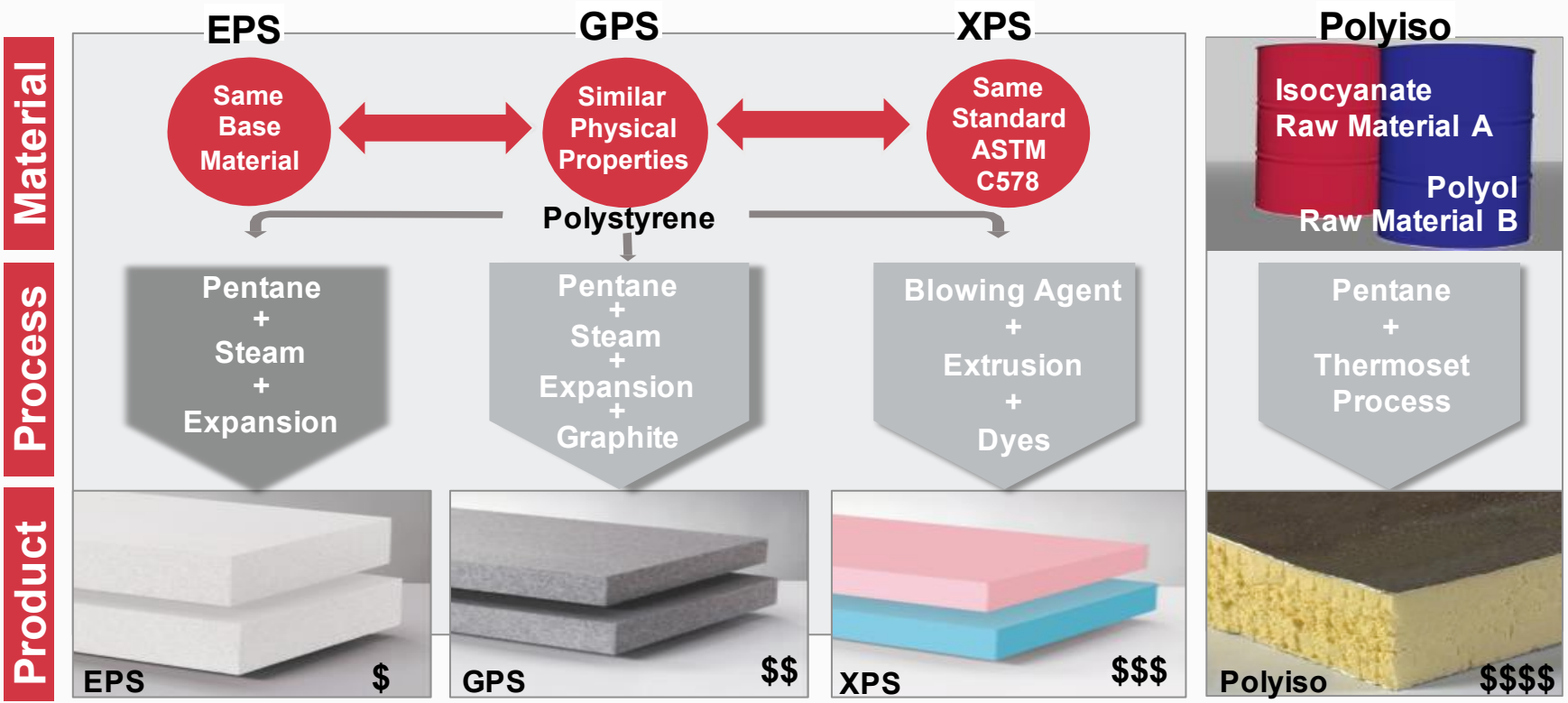
- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation and how that contributes to occupant comfort.
  - Primary raw material is Polystyrene.
  - High purity graphite embedded in polymer matrix.
  - Graphite acts as IR absorber and reflector.

This all contributes to more thermal resistance using fewer raw materials and a comfortable environment.

Learning Objective #2

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
- Explain **suitable applications** for GPS insulation and discuss inherent benefits.

Closed Cell Rigid Insulations EPS, GPS, XPS and Polyiso



Manufacturing Versatility:
More Options on the Job Site

Standard Property	GPS	XPS & ISO
Width	Any, up to 48”	16”, 24”, 48” Only
Length	Any, up to 24’	8’, 9’
Thickness	1/4” up to 48” in any variation	¼”, ½”, ¾”, 1”, 1-½”, 2”, or 3”
Can be tapered and not affect physical properties	Yes	No

Rigid Insulation R-Value Comparison

Property	Units	EPS	GPS	XPS
Compressive Resistance ASTM D1621	Pounds/square inch (psi) at yield of 10% deformation	10	10	15
Thermal Resistance @75°F ASTM C518	Per inch of thickness in °F•ft²•h/BTU @75°F	3.85	5.0	5.0 **
Density	lbs/ft³	0.90	0.90	**1.30**
Relative material requirement to reach R-5		**+ 24% Thickness**	baseline	**+ 30% Density**

Nominal 1" (Actual 1.0625")

** = R-value decreases with time

GPS Rigid Insulation Overview

Property	Unit	GPS				
ASTM C578 Classification[1)]		Type I	Type VIII	Type II	Type II+	Type IX
Compressive Resistance	at yield of 10% deformation in psi (min)	10.0	14.0	15.0	20.0	25.0
Thermal Resistance (R-value)[2)]	°F·ft2·h/BTU (°C·m2/W) at 75°F	5.0	5.0	5.0	5.0	5.0
	°F·ft2·h/BTU (°C·m2/W) at 40°F	5.2	5.2	5.2	5.3	5.3
Water Vapor Permeance	Max perm (ng/Pa·s·m2)	4.0	3.1	3.1	3.1	2.5
Water Absorption by Total Immersion	Max volume % absorbed	1.1	1.1	1.1	1.1	1.1
Flexural Strength	psi (min)	25.0	32.0	39.0	40.0	50.0
Density	lbs./ ft^3 (min)	0.90	1.15	1.35	1.45	1.80
Flame Spread	Index	5				
Smoke Development	Index	25				

Nominal 1” (Actual 1.0625”)

GPS & Sustainability

Resource Efficient

- Expansion and molding processes use steam in relatively low-energy processes
- Pentane, the foaming agent is often captured and re-used for steam generation
- Water from manufacturing process is collected and re-used many times

Recyclable and Recycled Content

- 100% Recyclable – can be re-formed into another product
- Can contain post-industrial and post-consumer recycled content

Environmentally Friendly

- No land degradation due to quarrying for raw materials, no release of phenol during production
- Does not contribute to deforestation or the destruction of plant life
- Does not contain CFC, HCFC, HFC or formaldehyde or borate
- Inert, stable and does not produce methane gas or contaminating leachates

Carbon Footprint, Energy and Emissions

- Foaming agent, pentane, has Zero GWP
- Long-term stable R-value help to reduce energy consumption
- Energy payback of 1-2 years depending on climate zone
- EPS is manufactured locally, minimizing energy for transporting foam over long distances

Learning Objective #2 Summary

- Understand the **benefits** of GPS compared to other rigid insulation materials.
  - Thinner panels required.
  - Less dense panels required.

  As a result:

  - Fewer resources required to achieve same thermal results.
  - Fewer resources along with regional production generally means a cost savings as well as a positive environmental impact.

Learning Objective #3

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
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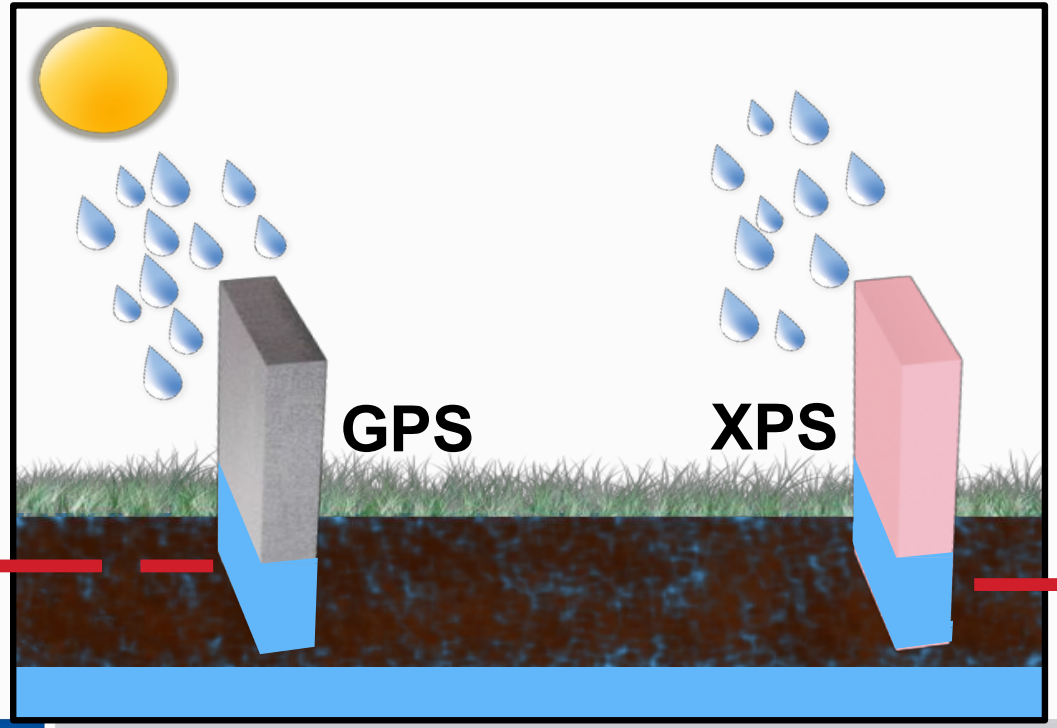
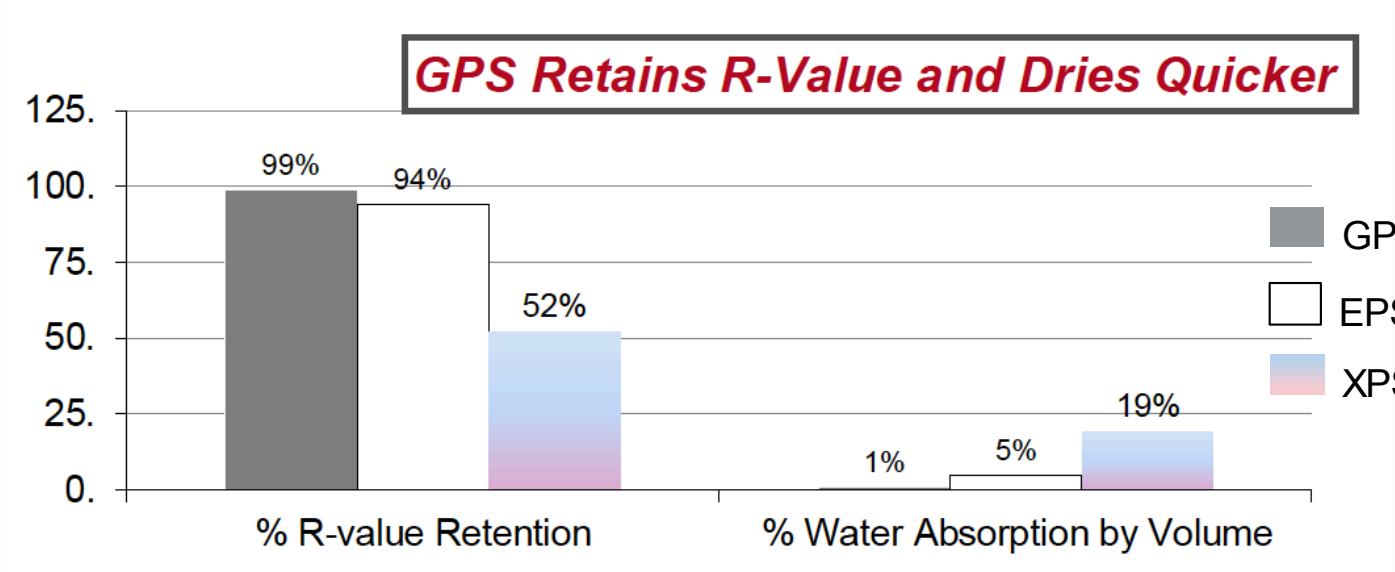
GPS Superior Below Grade Moisture Management Wetting-Drying Cycles



Why GPS is Best in Class Insulation

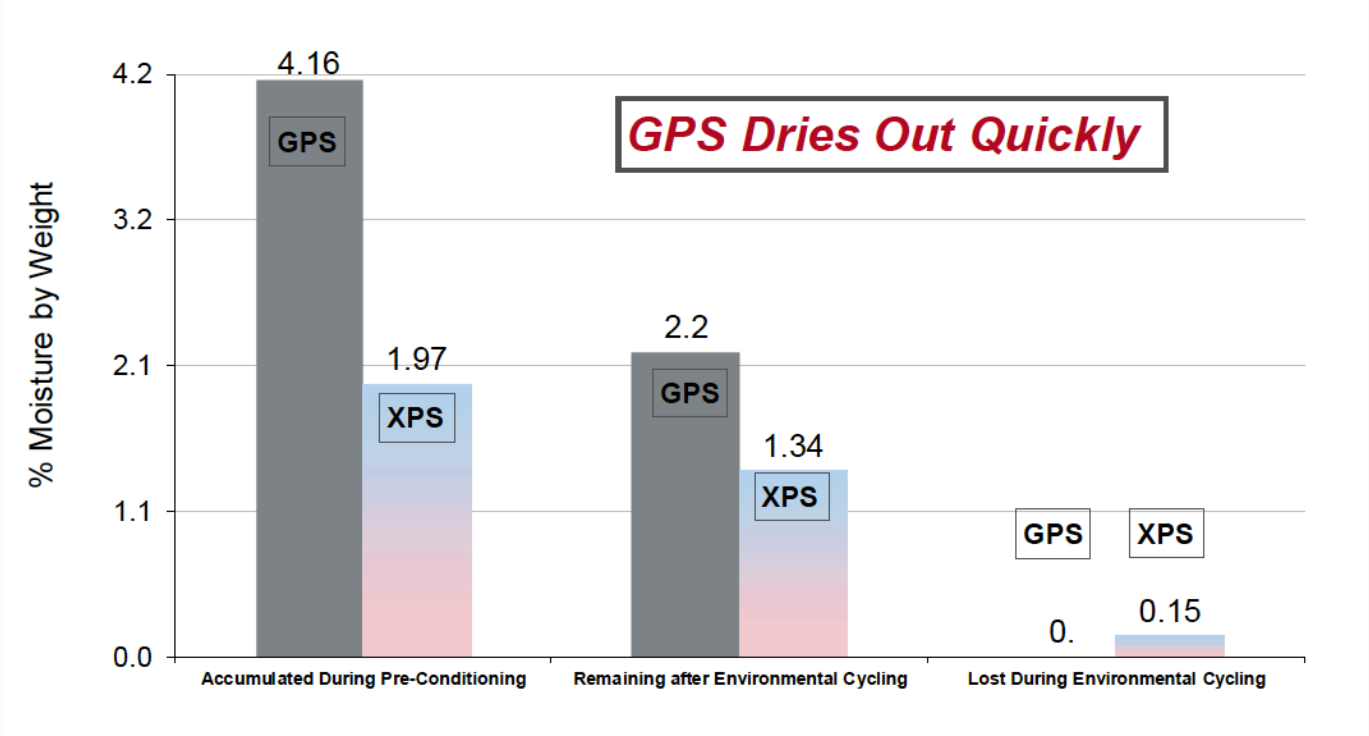


Below grade insulation experiences wetting/drying cycles

R-value loss for XPS insulation is directly related to the % of water absorption by volume

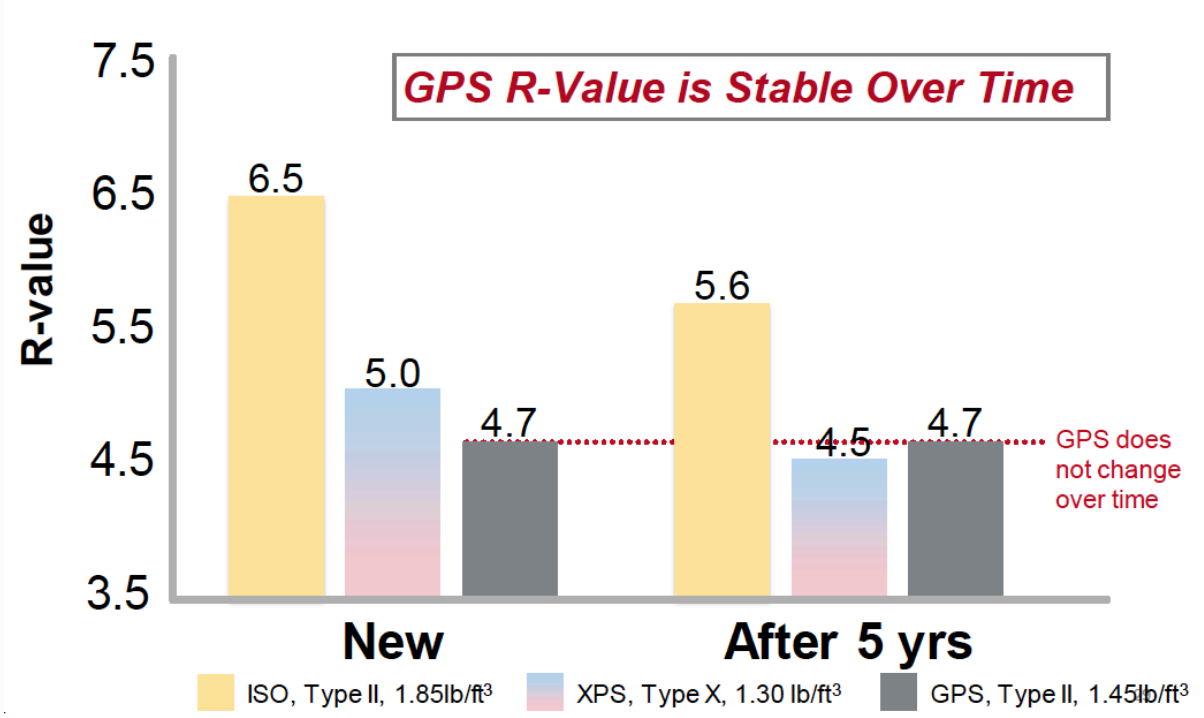
Source :BASF and 2013 Independent Test of Expanded Polystyrene referenced in March 2014 Series 105 Technical Bulletin – EPS Industry Alliance

Why GPS is Best in Class Insulation



Source: ASTM C1512 Intertek Testing Services NA Ltd. Expanded Polystyrene Industry Alliance Technical Bulletin 104, February 2014

Why GPS is Best in Class Insulation



Sources: XPS Warranty; ASTM C1289 Standard for Faced Rigid Cellular Polyisocyanurate; EPS Industry Association T echnical Bulletin Series 105

GPS - Superior Moisture Performance

Moisture Property	GPS	XPS	ISO
Absorbs Water	X	X	X
Changes Perm Rating with Facer	X	X	X
Retains Highest R-Value In Service Over Time	X		
Rapid Drying After It Gets Wet	X		
Most Common Below Grade Insulation in Europe	X		

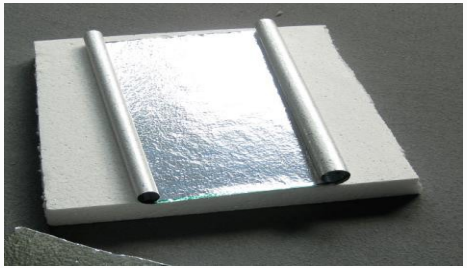
Permeability Factor

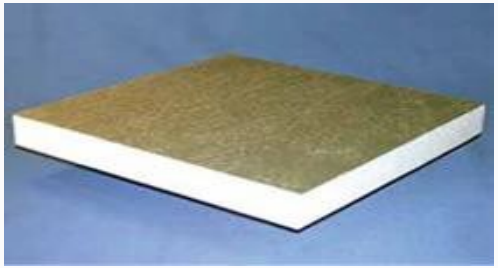
Perm Rating determined by:

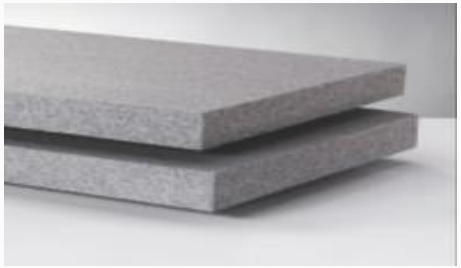
1. Thickness of Foam
2. Perm Rating of Facer

Vapor Retarder Characteristics		
Class	Perm Rating	Description
I	< 0.1 perm	Impermeable
II	0.1 – 1.0 perm	Semi-Impermeable
III	> 1.0 perm*	Semi-Permeable

*Above 10 perm material is considered Permeable and no longer a Vapor Retarder



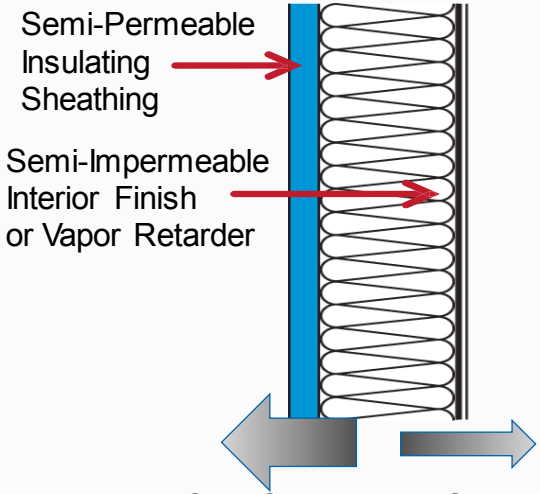




Permeance Drives Wall Design

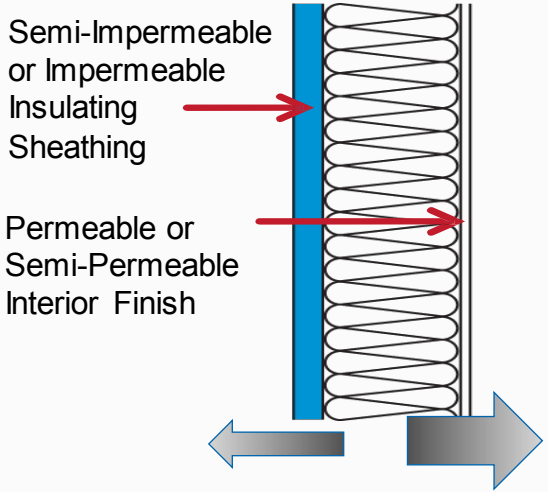
Moisture Vapor in Above Grade Walls:

1. Dry to outside



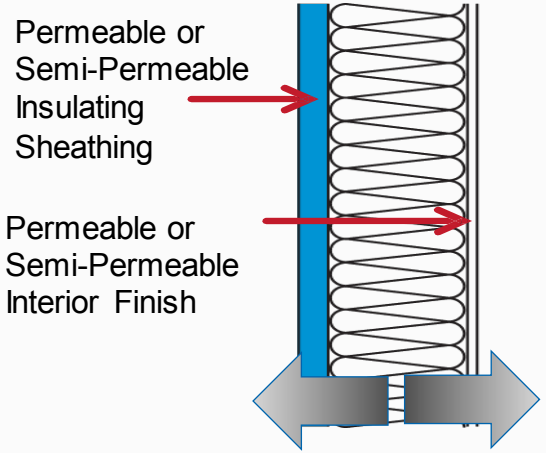
Cold Climate Wall Section
(Drying Primarily to the Exterior)

2. Dry to inside



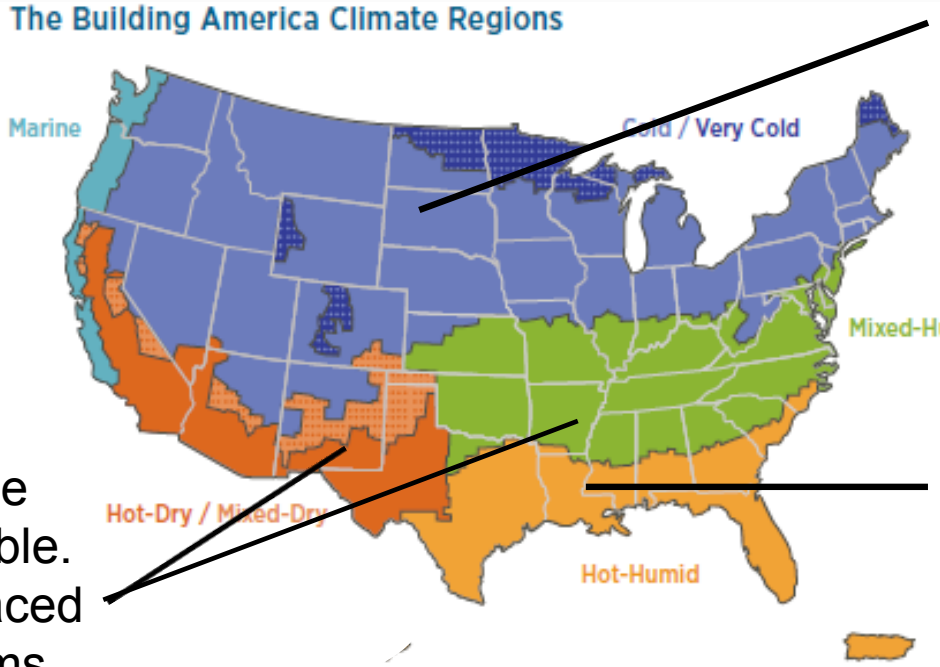
Hot-Humid Wall Section
(Drying Primarily to the Interior)

3. Dry in both directions



Mixed-Humid Wall Section
(Drying to both the Exterior and the Interior – "Flow through approach")

Climate Specific: GPS Exterior Insulation



Vapor permeable or semi-permeable insulating sheathing. Plain GPS or Faced with >1 perm films.

Vapor Permeable or semi-permeable. Plain GPS or Faced with >1 perm films

Vapor impermeable insulating sheathing on the exterior. GPS with <1 perm films.

Learning Objective #3 Summary

- Discuss how the **moisture management** properties of GPS contribute toward the drying strategy of the wall.
  - GPS is breathable allowing it to dry quickly.
  - Due to breathability, GPS retains R-Value overtime better than XPS.
  - Depending on zones, permeability is addressed with facer options available from the manufacturer.

GPS is suited for all climate zones

Learning Objective #4

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
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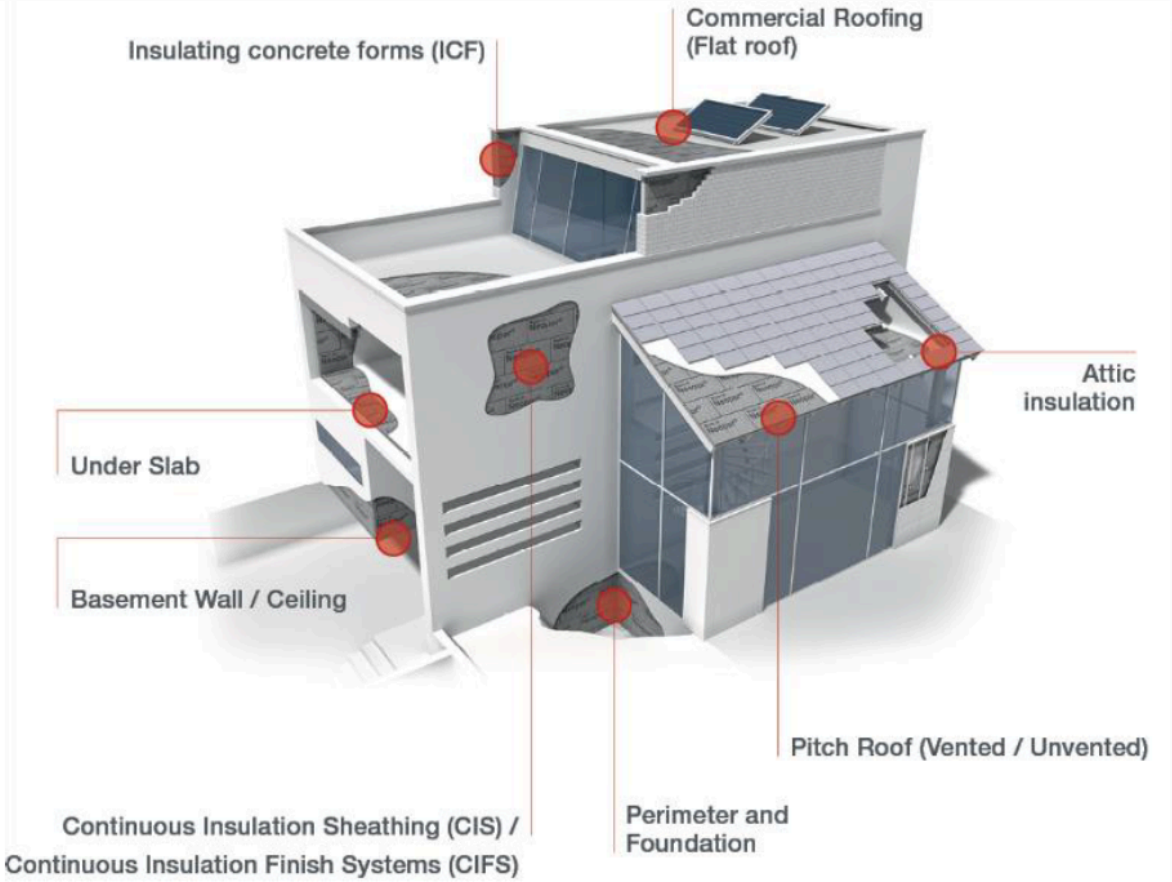

Insulating concrete forms (ICF)
Commercial Roofing
(Flat roof)
Attic
insulation
Under Slab
Basement Wall / Ceiling
Pitch Roof (Vented / Unvented)
Continuous Insulation Sheathing (CIS) /
Continuous Insulation Finish Systems (CIFS)
Perimeter and
Foundation

Insulation Requirements by Component

Insulation and Fenestration Requirements by Climate Zone

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

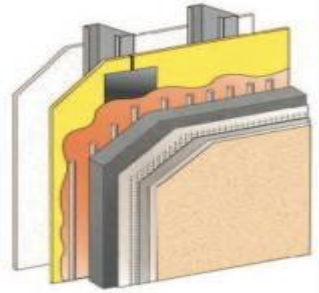
GPS Application Versatility

MOST COMMON RIGID FOAM BY APPLICATION	GPS	XPS	ISO
Exterior Continuous Insulation	X	X	X
Roof Insulation	X	X	X
Under Slab Insulation	X	X	X
Below Grade Walls Insulation	X	X	X
Insulated Garage/Entry Doors	X	X	X
Structural Insulated Panels	X	X	
EIFS	X	X	
Insulating Concrete Forms	X		
Integrated Insulated Vinyl Siding	X		
Radiant flooring OEM products	X		
Geofoam used to stabilize soil	X		
One Coat Stucco (T&G)	X		

Above Grade Walls and Roofs

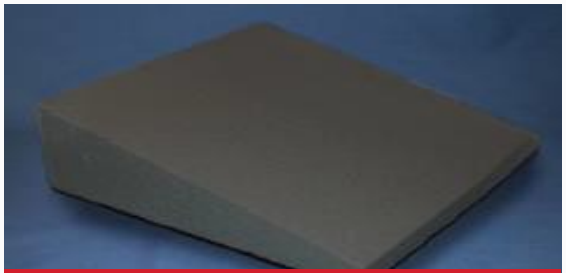
Faced/Unfaced GPS Sheathing

Exterior Siding



EIFS Systems

Freezer Panels



Roof Insulation

SIPs

Below Grade Walls and Foundation

Radiant Floor Panels

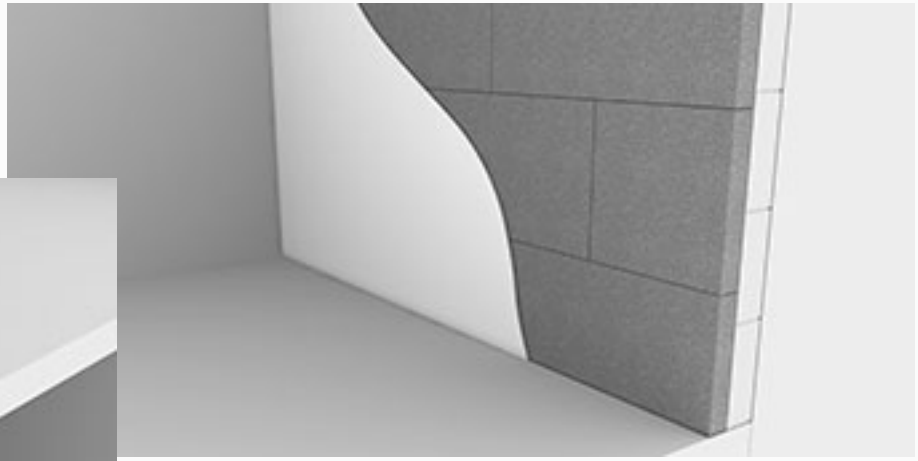
Exterior Basement Wall

Under Slab

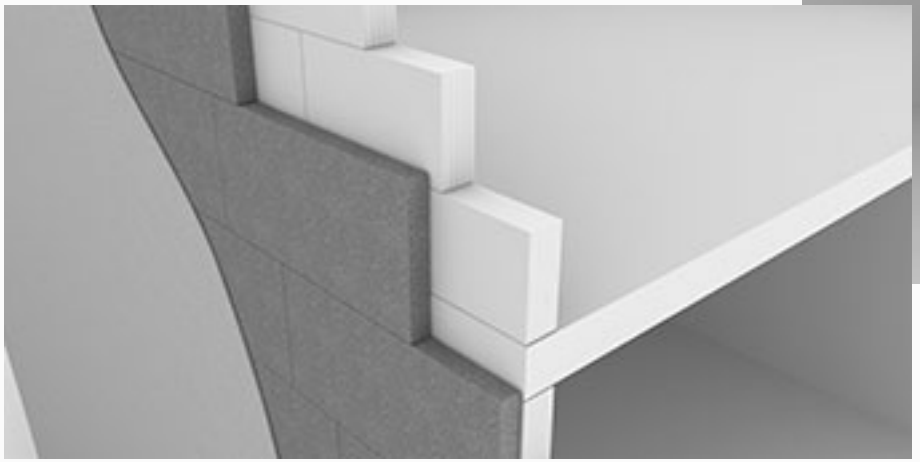
Interior Basement Wall

Wall Sheathing

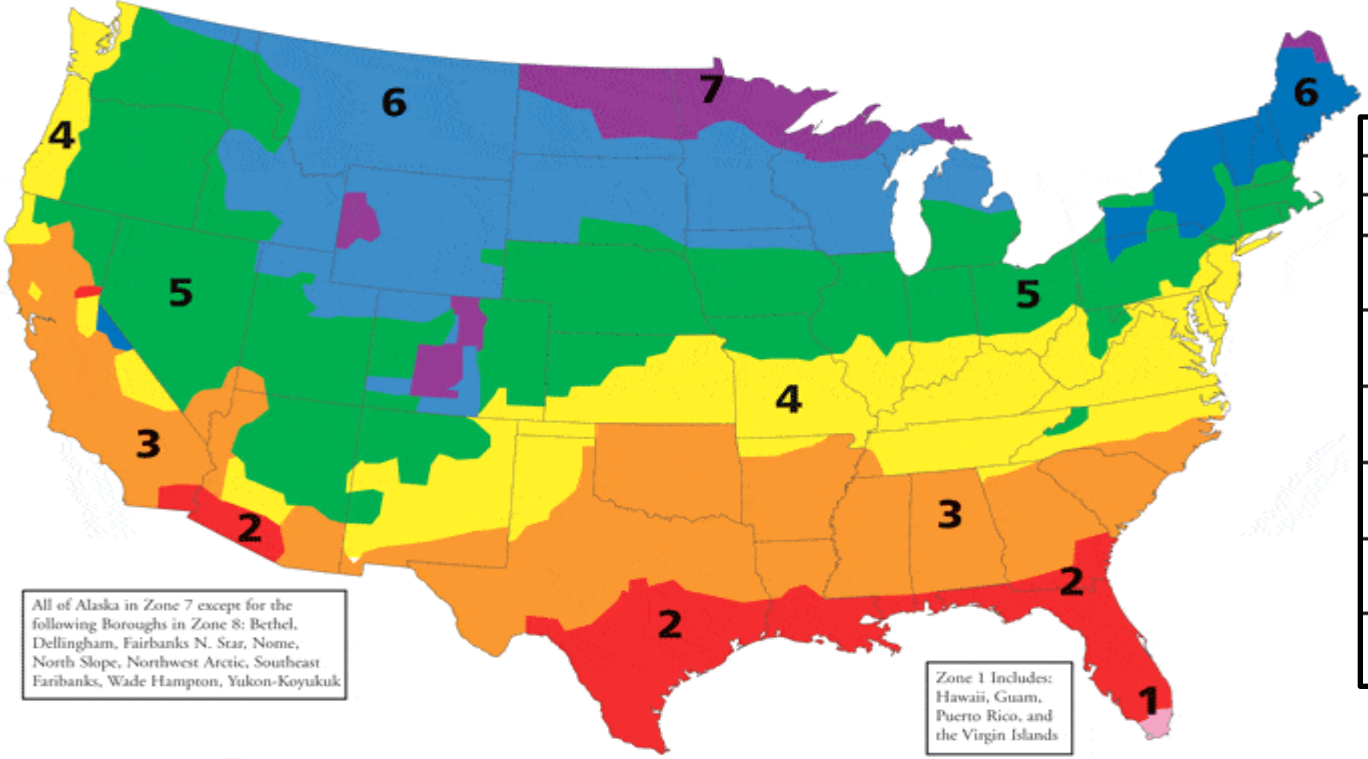
Interior (Basement) Wall Sheathing



Exterior Sheathing



2015 IECC Requirements



Zone	Wood-Framed[1] Wall
1	R-13
2	R-13
3	R-13+5ci or R-20
4 except Marine	R-13+5ci or R-20
5 and 4 Marine	R-13+5ci or R-20
6	R-13+10ci R-20+5ci
7	R-13+10ci R-20+5ci
8	R-13+10ci R-20+5ci

Insulation and Fenestration Requirements by Climate Zone

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

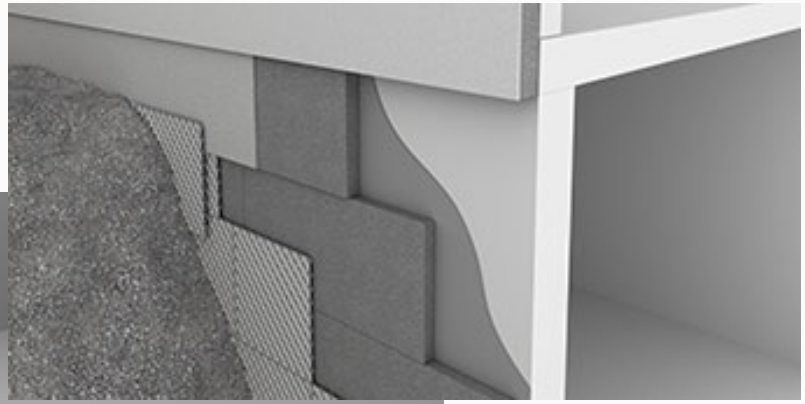
g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

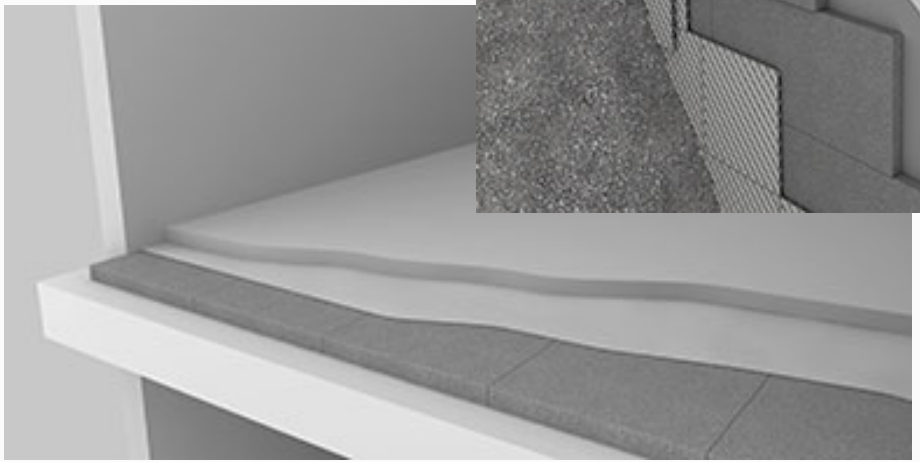
i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Below Grade (Slide needs new chart)

Foundation Perimeter



Under Slab



Zone	Below Grade Wall
1	0
2	0
3	R-5/13
4 except Marine	R-10/13
5 and 4 Marine	R-15/19
6	R-15/19
7	R-15/19

Recreate as GPS

Learning Objective #4 Summary

- Explain **suitable applications** for GPS insulation and discuss inherent benefits.
  - High R-Value at a low density (but can be made at higher densities for compressive strength).
  - Superior drying capability
  - GPS is produced regionally/locally.

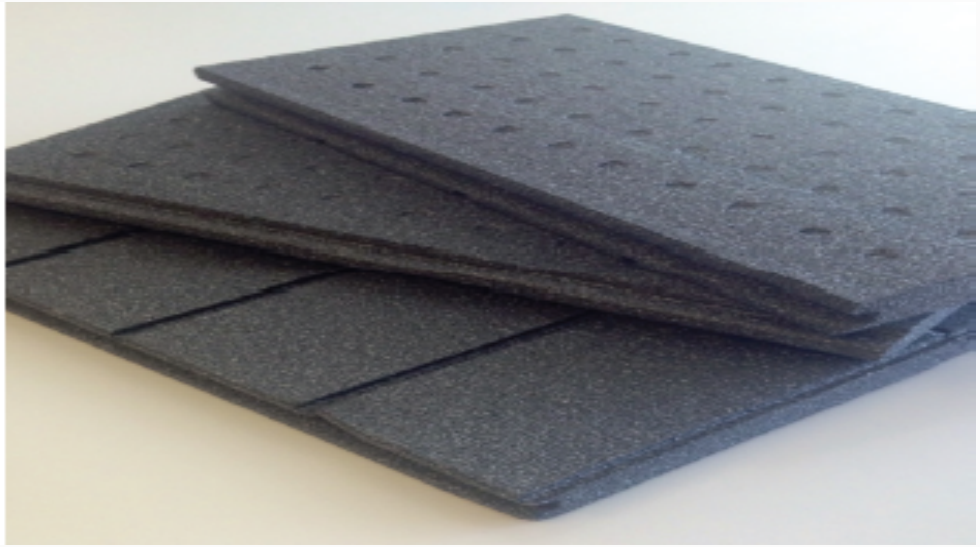
Overall Summary

- Explain the **basic chemistry** of Graphite enhanced Polystyrene (GPS) rigid insulation for achieving maximum occupant comfort.
- Understand the **benefits** of GPS compared to other rigid insulation materials.
- Discuss how the **moisture management** properties of GPS can keep a building interior comfortable and dry.
- Explain **suitable applications** for GPS insulation and discuss inherent benefits.

Why do Insulation Experts specify GPS Insulation?

Versatility in manufacturing, sourcing, and installation	*On a $/R basis, GPS is a cost effective rigid insulation*
Fast drying insulation	*R-value not compromised by cyclic water exposure*
Certified for Indoor air quality standards, low Global Warming Potential	*Supports sustainable building practices*
Long-term stable R-value	*Energy savings will not decline over time*
Adaptable	*Available as a monolithic board in nearly any thickness up to 48" wide and 24' long*

T&G



- No Changes- Nom.1.50 pcf
- Increase in R-Value of 0.3 per inch
- Challenge will be $$$ as grind currently limited on availability.

This officially concludes the AIA/CES course

Graphite Polystyrene (GPS) Rigid Insulation

Thank You – Questions?