

Polystyrene-based

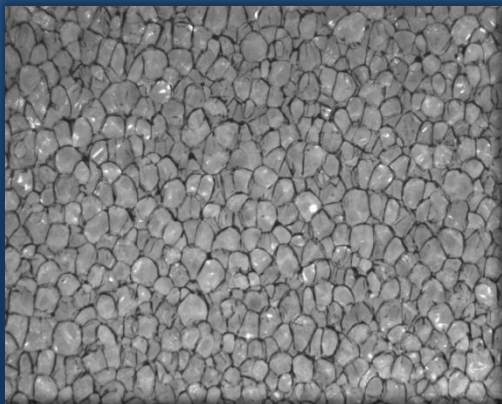
INSULATION BOARD PRODUCTS

SIMILAR BUT VERY DIFFERENT

- DIFFERENT CONSTRUCTION
- DIFFERENT PROPERTIES
- DIFFERENT PERFORMANCE
- DIFFERENT SUITABILITY FOR APPLICATIONS

XPS

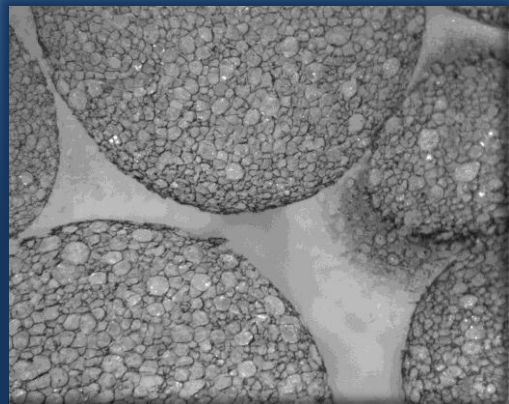
EXTRUDED POLYSTYRENE
FOAM INSULATION



XPS – Closed Cell
(25x)

EPS

Molded Bead
("beadboard")



EPS
(25x)

Extruded Polystyrene Foam Insulation (XPS) is a high-performance, closed-cell rigid insulation. XPS products are manufactured in proprietary processes that melt plastic resin and additives into a molten material that is extruded through a die where it expands and cools into a uniform closed-cell rigid foam insulation board with no voids or pathways for moisture to enter. This makes XPS insulation inherently moisture resistant.

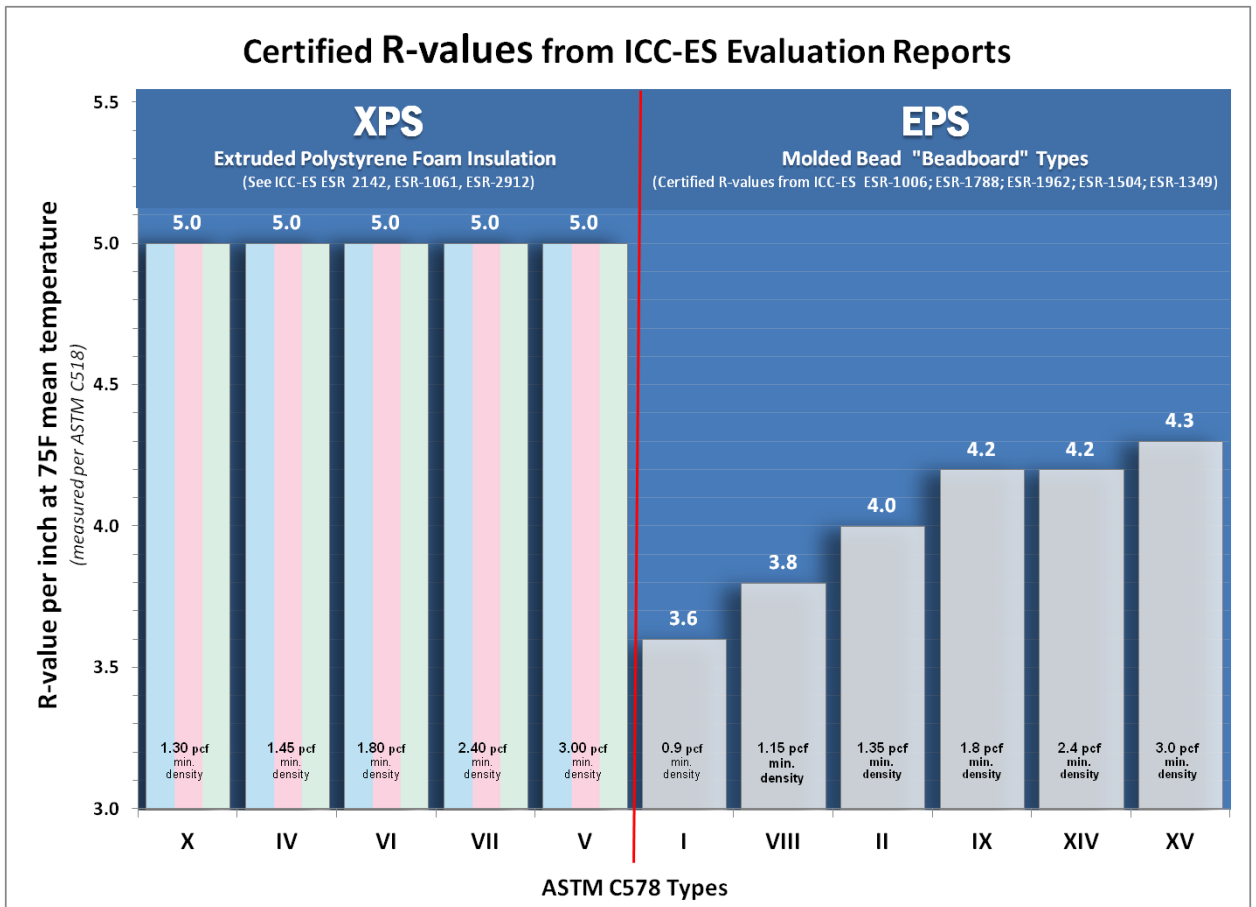
Molded bead expanded polystyrene (EPS) is made with small foam beads that are placed in a mold. These beads are exposed to steam while in the mold and this causes the beads to expand and stick together. This method of manufacture can result in interconnected voids between the beads which potentially can provide pathways for water to penetrate into the insulation. This makes molded bead EPS susceptible to absorbing available moisture. And degrading the insulating performance.

R-Value

R-Value is a measure of Thermal Resistance... Insulating Power. Higher R-Value means higher energy savings.

Foam insulation board is valuable in construction because it can provide extraordinary R-Value per inch of thickness along with other properties.

XPS R-Value Per Inch is 20 - 25% Higher



Specify R-values using the ASTM C578 Standard

R-values specified by ASTM C578 do not include air spaces. These values should not be confused with System R-values or Effective R-value that may include an air space. The conditions that support System R-values or Effective R-values are very restrictive and are generally not found in typical construction.

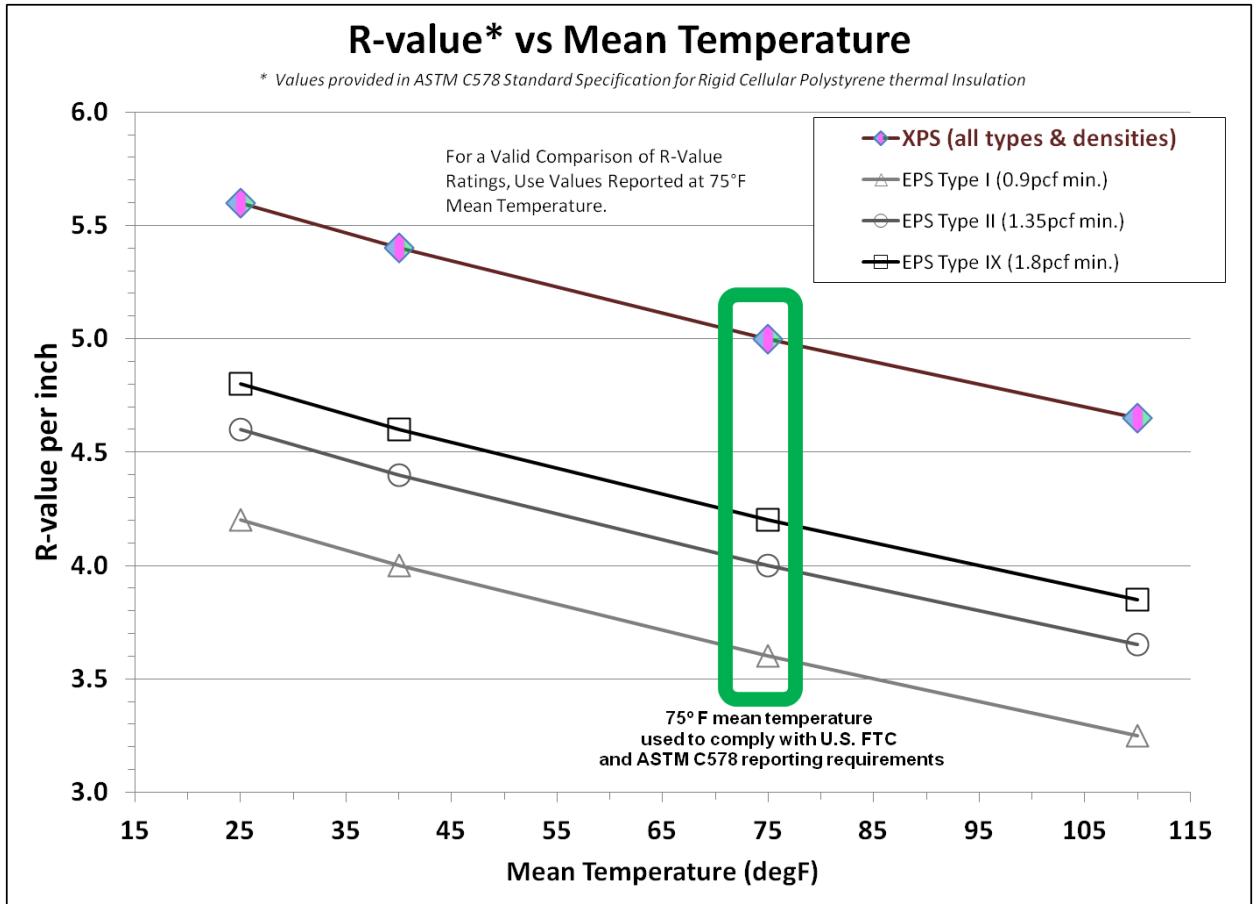
Compare R-values that are Certified by ICC-ES*

* ICC Evaluation Services (ICC-ES) – An independent no-profit company that provides technical evaluation service to the building and construction industry. The ICC-ES conducts technical evaluations of building products, components, methods and materials and issues Evaluation Service Reports (ESR) that provide evidence and confirmation that products and systems are code-compliant.

R-Value

R-value Claims Can Be Misleading

Compare R-values At The Same Mean Temperature



R-value at different temperatures are not comparable

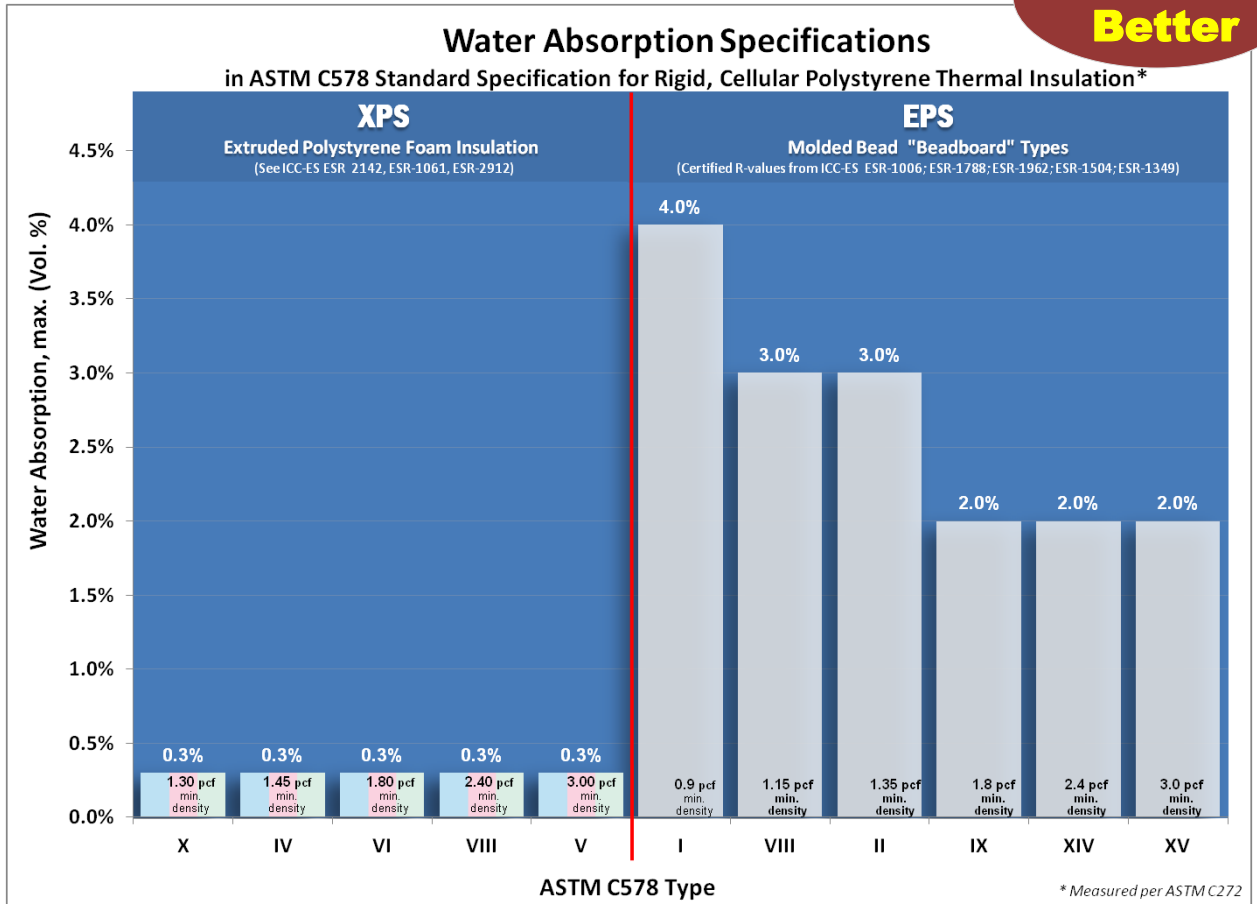
- The R-value of most insulations will go up as the mean temperature test conditions go down.
- The U.S. FTC requires the R-value of home insulation to be measured at 75F mean temperature. R-value claims should always be compared at the same Mean Temperature.
- The ASTM C578 thermal resistance requirements are based on R-values measured at 75F mean temperature.

Moisture Resistance

- Water is efficient in conducting and transferring heat.
- Moisture in insulation reduces insulating capability.

XPS Has Superior Moisture Resistance

Lower is Better



Insulation In Ground Contact Water Absorption Limited to 0.3% - ASHRAE

* ASHRAE 90.1-2010 section 5.8.1.7.3: Insulation materials in ground contact shall have a water absorption rate of **no greater than 0.3%** when tested in accordance with ASTM C272.

Only XPS Allowed in Horizontal Frost-Protected Foundation Applications – IRC

* XPS is recognized in the ICC IRC Section R403.3 as having 10% higher in-service R-value retention in applications where moisture is present such as the frost protected foundation application. Note: The IRC Section R403.3 **allows only XPS** in horizontal orientations designs in the frost protected foundation application.

XPS Meets Building Code Requirements as a WRB – ICC-ES

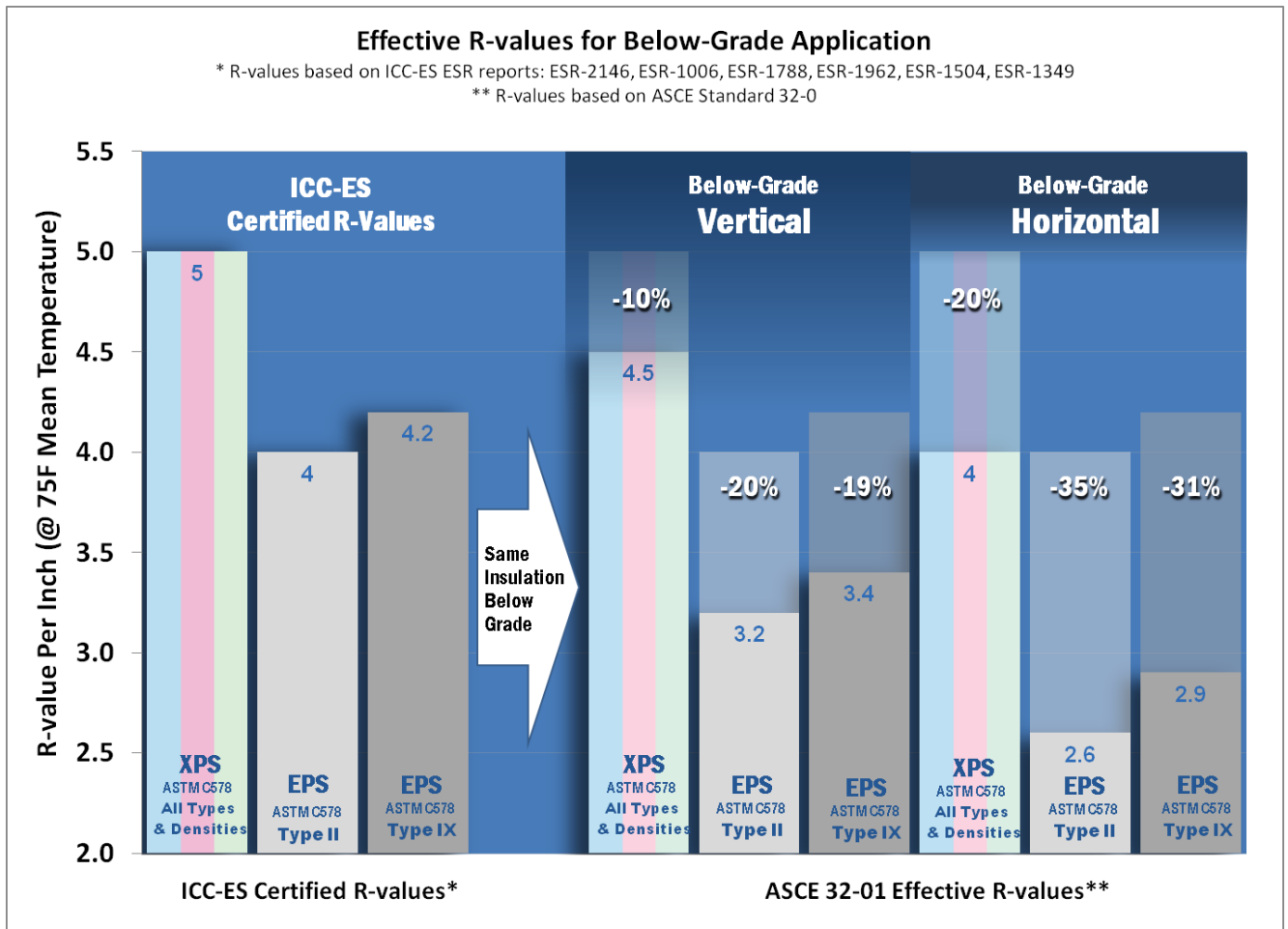
* XPS insulation meets building code requirements as a Weather-Resistive Barrier (WRB) when installed per ICC-ES requirements, whereas Molded Bead Polystyrene EPS (without film facers), installed on exterior above-grade walls **requires a separate code-approved Weather-Resistive Barrier (WRB) covering such as Housewrap**.

XPS Holds R-Value Better in Below-Grade Applications

Retention of Certified R-values After Long Term Exposure in Below-Grade Applications

(ASCE 32-01 values as a % of ICC-ES Certified R-value)

	Vertical orientation <u>Below-grade</u>	Horizontal orientation <u>Below-grade</u>
XPS	90%	80-81%



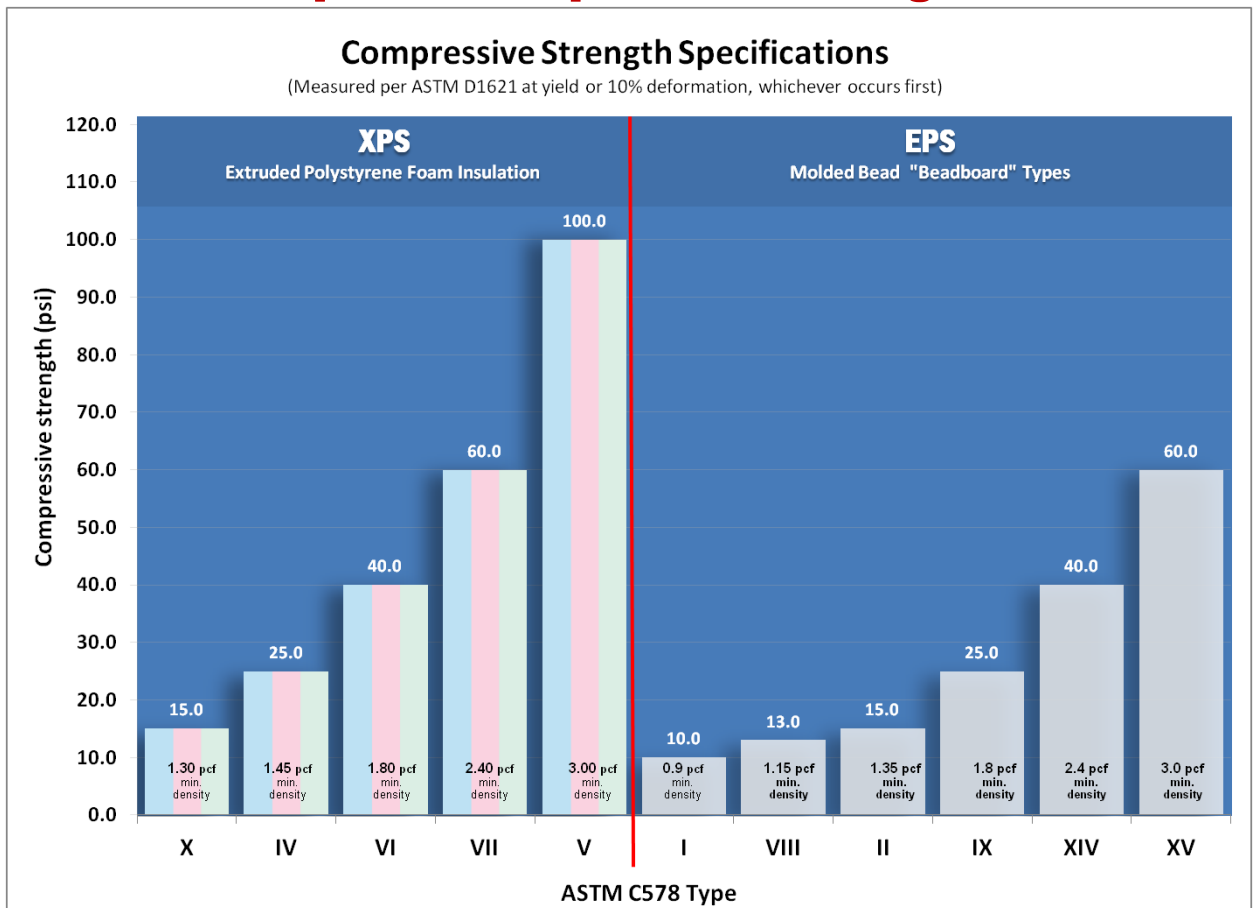
ASCE Standard 32-01 Effective In-service R-values based on Field Performance Studies of Below-grade Insulation

The American Society of Civil Engineers (ASCE) has established Effective R-values for rigid polystyrene foam insulations used in below-grade applications. (J. Crandell, Below-Ground Performance of Rigid Polystyrene Foam Insulation: review of Effective Thermal resistivity Values Used in ASCE Standard 32-01 - Design and Construction of Frost Protected Shallow Foundations", J. Cold. Reg. Engrg. June 2010)

Compressive Strength

- **Critical for load-bearing applications:**
 - Under Slabs
 - Plaza Decks
 - Garden Roofs
 - Roads
- **Related to durability and resistance to physical damage**

XPS Has Superior Compressive Strength



Extruded polystyrene foam insulation products provide a higher compressive strength per unit density and therefore represent a greener more effective use of resources.

Molded Bead EPS Requires higher density to meet compressive strength requirements:

25% Higher Density to Meet 25 psi *

20% Higher Density to Meet 40 psi and 60 psi *

*ASTM C578 Standard

Best Practices for Selecting Thermal Insulation

1. Check application exposure conditions
2. Refer to the industry standard and material specifications
3. Select the material type that has specifications needed to satisfy the application needs

ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

Insulation Type per ASTM C578	ASTM C578	Extruded Polystyrene Foam Insulation (XPS)					Expanded Polystyrene Foam Insulation (EPS)					
		X	IV	VI	VII	V	I	VIII	II	IX	XIV	XV
Density (pcf), min.	ASTM D1622	1.30	1.45	1.80	2.20	3.00	0.90	1.15	1.35	1.80	2.40	3.00
Thermal resistance of 1.00 inch thickness, min. (F ft ² h/Btu) at 75F mean temperature	ASTM C518	5.0	5.0	5.0	5.0	5.0	3.6	3.8	4.0	4.2	4.2	4.3
Compressive resistance, min. at 10% or yield (psi)	ASTM D1621	15.0	25.0	40.0	60.0	100.0	10.0	13.0	15.0	25.0	40.0	60.0
Water Absorption, max. (% by volume)	ASTM C272	0.3	0.3	0.3	0.3	0.3	4.0	3.0	3.0	2.0	2.0	2.0
Flexural strength, min. (psi)	ASTM C203	40.0	50.0	60.0	75.0	100.0	25.0	30.0	35.0	50.0	60.0	75.0
Water vapor permeance, max. (perm)	ASTM E96	1.5	1.5	1.1	1.1	1.1	5.0	3.5	3.5	2.5	2.5	2.5
Oxygen index, min.	ASTM D2863	24	24	24	24	24	24.0	24.0	24.0	24.0	24.0	24.0

Insulation thickness to Meet 2012 IECC Prescriptive Continuous Insulation Requirements

	Extruded Polystyrene Foam Insulation (XPS)			Expanded Polystyrene Foam Insulation (EPS)								
	ASTM C578 All Types			ASTM C578 Type I			ASTM C578 Type II			ASTM C578 Type IX		
ICC-ES Certified R-value at 75F mean temperature	R-5.0/inch			R-3.6/inch			R-4.0/inch			R-4.2/inch		
Thicknesses to Meet 2012 IECC Prescriptive Continuous Insulation Requirements	Wall	Basement	Slab	Wall	Basement	Slab	Wall	Basement	Slab	Wall	Basement	Slab
IECC Climate Zone 3 :	1"	1"	n.a.	1.4"	1.4"	n.a.	1.3"	1.3"	n.a.	1.2"	1.2"	n.a.
IECC Climate Zone 4 :	1"	2"	2"	1.4"	2.8"	2.8"	1.3"	2.5"	2.5"	1.2"	2.3"	2.3"
IECC Climate Zone 5 :	1"	3"	2"	1.4"	4.2"	2.8"	1.3"	3.8"	2.5"	1.2"	3.6"	2.3"
IECC Climate Zone 6 :	2"	3"	2"	2.8"	4.2"	2.8"	2.5"	3.8"	2.5"	2.3"	3.6"	2.3"