INSULFOAM®
ROOF INSULATION SYSTEMS

PREDICTABLY **CONSISTENT** VALUE.

Roof Insulation Systems & Substitutions

Proven and tested insulation.
Most R-Value per dollar.

Insulation Need	Insulfoam Production	Savings
Recover applications requiring a separator board	R-Tech FF Fanfold Insulation	Up to $25 per square vs. other cover boards
Recover applications requiring a 1" separator board	1" R-Tech Insulation	Up to $10 per square vs. 1" Iso
High R-Value Insulation Systems	1.5" InsulFoam SP & InsulFoam I	Up to $40 per square vs. Iso
Tapered Insulation Systems	InsulFoam EPS tapered or hybrid tapered ISO systems using EPS fill	Up to 30% savings vs. Tapered Iso
Metal Roof Recover	InsulFoam FL (Flute Fill)	Up to 25% savings vs. Iso Flute Fill
High Traffic Areas	InsulFoam HD Composite (High-density Polyiso with EPS base)	Up to 25% savings vs. Other Composites
Inverted Roof Membrane Assemblies (IRMA)	InsulFoam High-Density Products	Up to 15% savings vs. XPS
Garden Roofs	InsulFoam EPS	Up to 40% savings vs. XPS

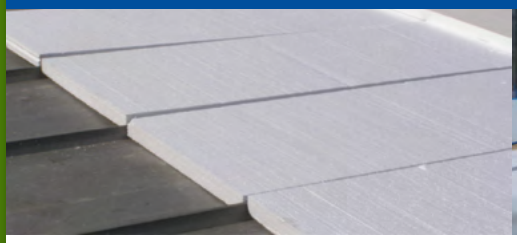
Why Insulfoam EPS?

With a broad range of insulation types available, it's easier than ever for contractors to construct an energy-efficient roof system. Insulfoam EPS (expanded polystyrene) rigid foam insulation has been used for decades by industry professionals looking to achieve high thermal properties for a cost-effective price. The benefit of lightweight EPS goes far beyond price, as it also helps to decrease material and labor expenses. Additionally, unlike other rigid insulations, EPS R-values remain stable, without drifting or fading over time. Backed with a 20-year thermal performance warranty, you can be confident that Insulfoam's EPS products are the best option for your project.

INSULATION ENGINEERED TO MAKE A DIFFERENCE.

INSULATION ENGINEERED TO MAKE A DIFFERENCE.

Proven Performance: The same Insulfoam EPS chemistry has been used since the mid-1950's, so the actual performance is well documented.



Insulfoam Roofing Insulation Products: New & Re-roofing Applica-

Products	Overview	Specifications
InsulFoam EPS: Flat & Tapered	High-performing, superior, closed-cell, lightweight EPS insulation is available flat or factory tapered to easily increase slope and economically meet drainage needs.	Density: 1.0 - 3.0 pcf Compressive Strengths: 10-60 psi Thicknesses: ½" - 40" (tapered starts at ⅛") Sizes: Custom per job, up to 24' panels
InsulFoam SP Insulation	EPS with factory-laminated glass facer. Approved for mechanically attached single-ply roof systems, without needing a slip-sheet on non-combustible decks.	Density: 1.25 pcf Compressive Strengths: 13-18 psi Thicknesses: 1½" - 7" Sizes: 4' x 4' or 4' x 8' panels
InsulFoam HD Composite Insulation	High-density Polyiso factory bonded to EPS approved for single-ply roof and re-roof applications.	EPS Density: 1.0 - 3.0 pcf Compressive Strengths: EPS 10-60 psi/ iso 100 psi Thicknesses: 1½" - 7" Sizes: 4' x 4' or 4' x 8' panels
InsulLam Nail Base	High-performance EPS insulation factory laminated to standard cover boards (OSB, plywood, gypsum and other cover board). Available vented as InsulVent.	Compressive Strengths: EPS 10-60 psi, cover boards vary by type Thicknesses: 1½" - 7" Sizes: 4' x 4' or 4' x 8' panels
1" R-Tech Recover Roof Insulation	Lightweight EPS insulation with factory-adhered advanced polymeric facers (white facer and metallic reflective face) for added durability. Maintains existing roof system's UL rating.	Compressive Strengths: 13-60 psi Thicknesses: ⅜" - 1" Sizes: 4' x 8' panels
InsulFoam FL (FLute-Fill) Metal Roof Insulation	Recover insulation for existing metal roof profiles. Available in taper, straight or custom-cut profiles.	Compressive Strengths: 10-60 psi Thicknesses: Available in virtually any job length/width Sizes: Custom cut to fit any metal roof system
R-Tech FF Fanfold Roof Underlayment	Lightweight EPS insulation with factory-adhered advanced polymeric facers (white facer and metallic reflective face) for added durability. Maintains existing roof system's UL rating.	Compressive Strengths: 10-60 psi Thicknesses: ⅜", ½", or ¾" Sizes: 200 sq. ft. fanfold bundles
InsulFoam HB (Holey Board)	For use in lightweight concrete insulating systems, factory-applied holes enable insulation to be fully encapsulated in concrete, and usually serves as a primary insulation in a roof system.	Compressive Strengths: 10-60 psi Thicknesses: ¾" - 20" Sizes: Typically available in 2' x 4' panels

PREDICTABLY **CONSISTENT** VALUE.

A Truly Green, High-Performance, & Economical Roof Insulation

Cost-Effective

- More R-Value per dollar than any other rigid insulation
- R-Value doesn't degrade over time
- Most cost-effective insulation - typically 25-50% less than other rigid insulations
- Easy to install - reduces labor costs by more than 50%
- Complimentary 20-year thermal performance warranty available

Engineered for Versatility

- Available in ½" - 40" product thicknesses
- Available in multiple densities, compressive strengths and panel sizes
- Suitable for use under all major BUR, Mod Bit roofing membranes: TPO, PVC, EPDM, & CSPE
- Code-recognized insulation (ICC-ES, UL, Factory Mutual) at an economical price
- Meets or exceeds ASTM C578 requirements

Easy to Install

- Lightweight panels
- Highly durable, yet resilient
- Simple to cut in the field with a saw or hot wire kit
- Custom, job-specific sizes with no additional lead time

Environmentally Sustainable

- 100% recyclable, may contain up to 25% recycled content
- High long-term thermal performance (stable R-Value) conserves energy and operational costs
- Contains no dyes, formaldehyde or ozone-depleting HCFC's
- ENERGY STAR®* qualified
- Can contribute toward LEED® credit requirements
- Does not support mold or mildew growth for improved indoor air quality (IAQ)
- Naturally water resistant - does not readily absorb moisture from the environment
- Regional manufacturing throughout North America reduces transportation costs to jobsites and environmental impact

INSULFOAM ROOF INSULATION SYSTEMS

PREDICTABLY **CONSISTENT** VALUE.

UL Class A Assemblies

- Insulfoam EPS insulations come with numerous code approvals and ratings, both national and regional
- The UL listings shown below are a sample of our approvals for common roof systems
- Check with your local Insulfoam rep for a complete listing of approvals and ratings applicable to your region
- UL Class A ratings automatically provide UL Class B and UL Class C ratings
- Coverboards, where needed, are available from Insulfoam as composite products (EPS factory-bonded to Gyp, OSB or Plywood) or can also be field applied

DECK	STEEL			CONCRETE			WOOD/COMBUSTIBLE		
Membrane	Fully Adhered	Mechanically Attached	Ballasted	Fully Adhered	Mechanically Attached	Ballasted	Fully Adhered	Mechanically Attached	Ballasted
InsulFoam® (Flat EPS roof insulation panels)	UL Class A with coverboard	UL Class A with slipsheet or coverboard	UL Class A	UL Class A with coverboard	UL Class A with slipsheet or coverboard	UL Class A	UL Class A with min. ¼" gyp coverboard	UL Class A with min. ¼" gyp coverboard	UL Class A
Tapered InsulFoam (Tapered EPS roof insulation - various densities & sizes)	UL Class A with coverboard	UL Class A with slipsheet or coverboard	UL Class A	UL Class A with coverboard	UL Class A with slipsheet or coverboard	UL Class A	UL Class A with min. ¼" gyp coverboard	UL Class A with min. ¼" gyp coverboard	UL Class A
InsulFoam HB (Flat EPS with 6 or 8 factory-applied holes, for lightweight concrete systems)	UL Class A with LWC systems			UL Class A with LWC systems			UL Class A with LWC systems		
R-Tech® FF (Flat EPS fanfold roof underlayment with polymeric white & metalized facers; 2 square bundles)	Not Applicable	Retains existing UL Classification		Not Applicable	Retains existing UL Classification		Not Applicable	Retains existing UL Classification	
R-Tech (Flat EPS roof underlayment with polymeric white & metalized facers; 4' x 8' panels)	Not Applicable	Retains existing UL Classification		Not Applicable	Retains existing UL Classification		Not Applicable	Retains existing UL Classification	
InsulFoam SP (Fire Rated System: Flat EPS with coated glass facer)	• Single-ply membrane with EPS-compatible adhesive • Peel & stick membranes (max. 60 mil)	UL Class A	UL Class A	• Single-ply membrane with EPS-compatible adhesive • Peel & stick membranes (max. 60 mil)	UL Class A	UL Class A	Not Applicable	Not Applicable	UL Class A
InsulFoam HD Composite (Flat EPS factory-bonded to ½"-thick 100 psi high-density polyiso)	UL Class A	UL Class A	UL Class A	UL Class A	UL Class A	UL Class A	UL Class A with min. 4½" thickness	UL Class A with min. 4½" thickness	UL Class A with min. 4½" thickness
InsulFoam FL (InsulFoam EPS custom-cut to fill metal roof flutes)	UL Class A with coverboard	• UL Class A with coverboard • No coverboard when combined with InsulRoof SP	UL Class A	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
InsulLam™ or **InsulVent™** (Flat EPS factory-bonded to Gyp, OSB, plywood)	UL Class A	UL Class A	UL Class A	UL Class A	UL Class A	UL Class A	UL Class A with min. ¼" gyp coverboard	UL Class A with min. ¼" gyp coverboard	UL Class A

INSULFOAM®
ROOF INSULATION SYSTEMS
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PREMIUM TAPERED INSULATION

Description

InsulFoam Taper is an engineered insulation consisting of a superior closed-cell, lightweight expanded polystyrene (EPS). InsulFoam Taper is cut from the same high-quality EPS as our flat InsulFoam EPS Roof products, and meets or exceeds the requirements of ASTM C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation. InsulFoam Taper offers a long-term, stable R-value and has excellent dimensional stability, compressive strength and water resistance properties.

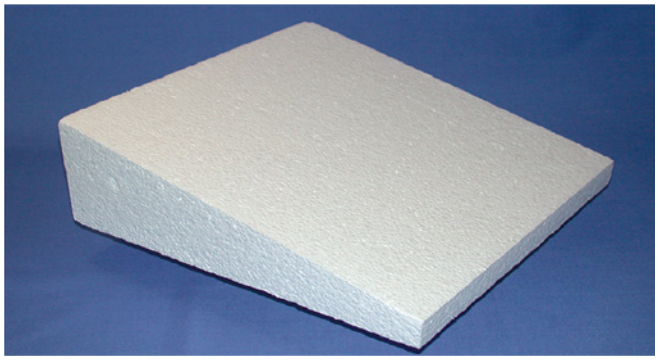
Uses

InsulFoam Taper is well-suited for single-ply roof applications that employ ballasted, mechanically fastened TPO, PVC, EPDM and CSPE with a slip sheet, as well as low-sloped built-up, modified bitumen and fully adhered single-ply roofs that incorporate cover boards. Consult local building codes and membrane manufacturers for system requirements.

Advantages

- Labor Savings. There are no complicated filler panel systems. InsulFoam Taper can be installed in a single layer for thicknesses up to 40", and is significantly more cost-effective than extruded polystyrene, perlite and isocyanurate tapered systems.
- Promotes Positive Drainage. InsulFoam Taper is the ideal insulation for both new construction and re-roofing projects in which positive slope is desired or ponded water is a concern.
- Environmentally Friendly. InsulFoam Taper does not contain any ozone-depleting blowing agents, may contain recycled material, and is 100% recyclable if ever removed or replaced.
- Stable R-value. The product's thermal properties will remain stable over its entire service life. There is no thermal drift, so the product is eligible for an Insulfoam 20-year thermal performance warranty.
- Proven Performance. EPS has been manufactured using the same chemistry since the mid-1950s, providing proven performance.
- Water Resistance. InsulFoam Taper does not readily absorb moisture from the environment.
- Code Approvals. Insulfoam insulations are recognized by the International Code Council Evaluation Service (ICC-ES), and have numerous Underwriters Laboratory and Factory Mutual Approvals. Please contact your local Insulfoam representative for details.

PREDICTABLY **CONSISTENT** VALUE.



Sizes

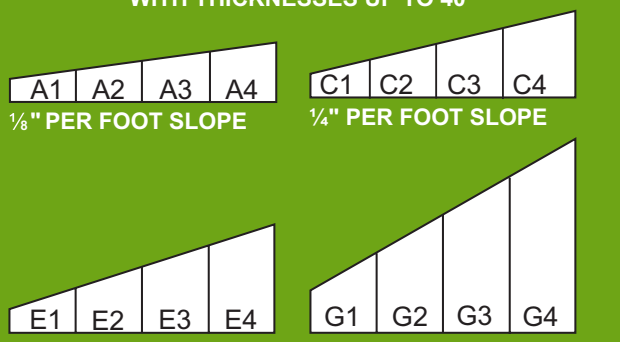
InsulFoam Taper is available in 4' x 4' and 4' x 8' panels with thickness from ½" to 40" in a single layer. There are no limitations to available slope per foot (minimum 1/16").

Typical Tested Physical Properties

For typical tested physical properties, please refer to the corresponding flat InsulFoam Data Sheet.

SAMPLE SLOPE CROSS SECTIONS
⅛" to 1" Per Foot Slopes

*** NO SEPARATE FILLER PANELS REQUIRED WITH THICKNESSES UP TO 40"**



SAMPLE HYBRID CROSS SECTIONS
½" to 1" Per Foot Slopes

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INSULFOAM ROOF INSULATION SYSTEMS
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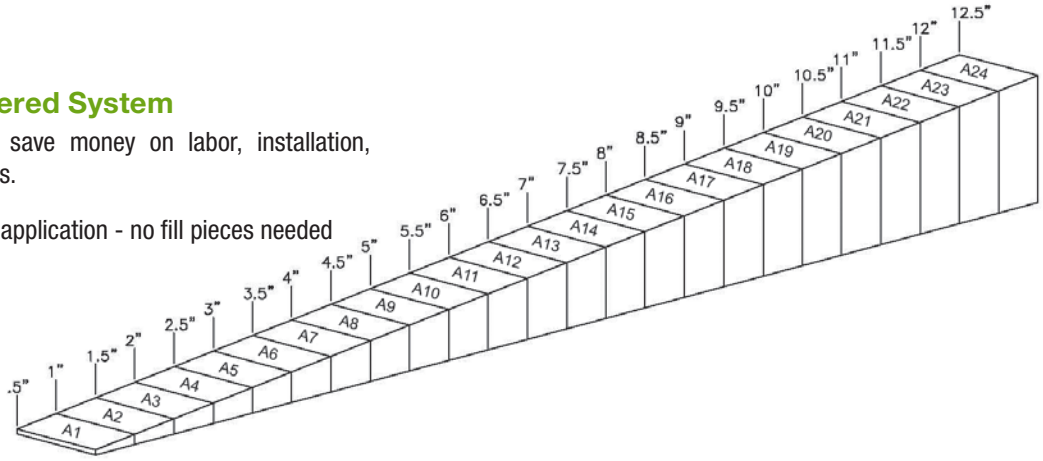
PREMIUM TAPERED INSULATION

InsulFoam EPS Tapered System

Use InsulFoam Taper and save money on labor, installation, adhesives and material costs.

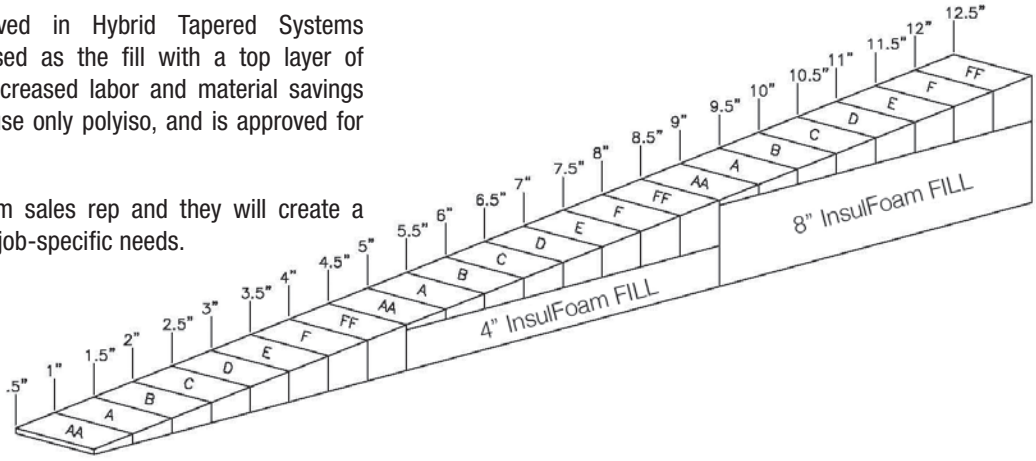
- 0.5-40" in a single layer application - no fill pieces needed
- No limitations on slope



Hybrid Tapered System

InsulFoam EPS is approved in Hybrid Tapered Systems where the InsulFoam is used as the fill with a top layer of polyiso. This system has increased labor and material savings compared to systems that use only polyiso, and is approved for fully adhered systems.

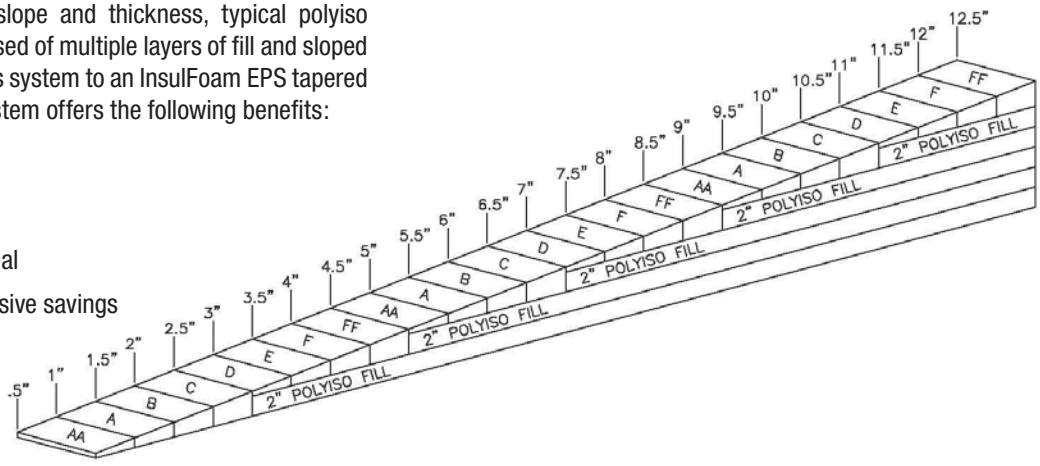
Contact your local Insulfoam sales rep and they will create a custom design to meet your job-specific needs.



Typical Polyiso Tapered System

Due to the limitations on slope and thickness, typical polyiso tapered systems are comprised of multiple layers of fill and sloped panels. When comparing this system to an InsulFoam EPS tapered system, the EPS tapered system offers the following benefits:

- Fewer installed panels
- Less complex system
- Less expensive fill material
- Labor, material and adhesive savings



INSULATION ENGINEERED TO MAKE A DIFFERENCE.

INSULFOAM®
ROOF INSULATION SYSTEMS
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FLAT AND TAPERED RIGID INSULATION

Description

Insufoam is an engineered insulation consisting of a superior closed-cell, lightweight and resilient expanded polystyrene (EPS). InsulFoam EPS meets or exceeds the requirements of ASTM C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation. InsulFoam EPS has a nominal density of 1 to 3 lb/ft^3. In addition, InsulFoam EPS offers a long-term, stable R-value and has excellent dimensional stability, compressive strength and water resistance properties.

Uses

InsulFoam EPS is a high-performance roof insulation used in numerous roofing applications.

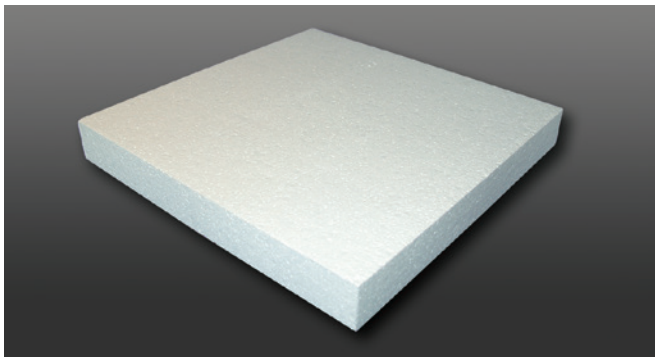
Roof Systems: InsulFoam EPS is well-suited for single-ply roof applications that employ mechanically fastened or ballasted TPO, PVC, and EPDM, as well as low-sloped built-up, modified bitumen and fully adhered single-ply roofs that incorporate cover boards or slip sheets. Please consult local building codes and membrane manufacturers for system requirements.

System Compatibility: InsulFoam EPS insulations are compatible with both light- and dark-colored single-ply membranes, can be applied directly to metal decks, are available in higher compressive stengths, and can be manufactured with fire-rated facers and coverboards. Please contact Insulfoam for more details.

Advantages

- Environmentally Friendly. It does not contain any ozone-depleting blowing agents, may contain recycled material, and is 100% recyclable if ever removed or replaced.
- Stable R-value. The product's thermal properties will remain stable over its entire service life. There is no thermal drift, so the product is eligible for an Insulfoam 20-year thermal performance warranty.
- Proven Performance. EPS has been manufactured using the same chemistry since the mid-1950s, providing proven performance.
- Water Resistance. InsulFoam EPS does not readily absorb moisture from the environment.
- Code Approvals. InsulFoam insulations are recognized by the International Code Council Evaluation Service (ICC-ES), and have numerous Underwriters Laboratory and Factory Mutual Approvals. Please contact your local Insulfoam representative for details.

PREDICTABLY **CONSISTENT** VALUE.



Sizes

InsulFoam EPS is available in 4' x 4' and 4' x 8' standard sizes with thickness from ¼" to 40", and is readily available in custom lengths and widths with little to no impact on lead time. It is also available in tapered panels, with thickness from 0 (⅛" actual) to 40", in any slope per foot.

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INSULFOAM® ROOF INSULATION SYSTEMS
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FLAT AND TAPERED RIGID INSULATION

Typical Physical Properties

Property	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV	Test Method
Density (nom. pcf)	1.00	1.25	1.50	2.00	2.50	3.00	ASTM C303
C-value (Conductance) - per inch BTU/(hr•ft²•°F)							ASTM C518
@ 25°F	0.230	0.220	0.210	0.200	0.198	0.196	or
@ 40°F	0.240	0.235	0.220	0.210	0.206	0.198	ASTM C177
@ 75°F	0.260	0.255	0.240	0.230	0.222	0.217	
R-value (Resistance) - per inch (hr•ft2•°F)/BTU							ASTM C518
@ 25°F	4.35	4.55	4.76	5.00	5.05	5.10	or
@ 40°F	4.17	4.25	4.55	4.76	4.85	5.05	ASTM C177
@ 75°F	3.85	3.92	4.17	4.35	4.50	4.60	
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 %)	2.0	2.0	2.0	2.0	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.

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TECHNICAL BULLETIN

TECHNICAL BULLETIN # 1023

SUBJECT: TENSILE AND SHEAR STRENGTH OF INSULFOAM EPS

DATE: DECEMBER 29, 2008 [Rev. November 1, 2012]

InsulFoam EPS is used in many applications where the Typical Physical Properties noted in ASTM C578 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulations" or in InsulFoam EPS data sheets do not supply values that may be required for engineered OEM applications. Many of these OEM uses of InsulFoam EPS rely on the shear and tensile capabilities of InsulFoam EPS in their final design.

Insulfoam has conducted numerous tests of our InsulFoam EPS products produced at each facility to determine accurate Tensile and Shear strength values for our end users. These tests have been conducted following ASTM C273 "Standard Test Method for Shear Properties of Sandwich Core Materials" and ASTM C297 "Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions". The following chart list the design values determined through this extensive testing:

InsulFoam EPS Tensile and Shear Properties				
	Tensile Strength, min. ASTM C297		Shear Strength, min. ASTM C273	
	psi	kPa	psi	kPa
InsulFoam I	20.0	138	12.0	83
InsulFoam VIII	25.0	175	15.5	107
InsulFoam II	30.0	208	18.0	124
InsulFoam IX	40.0	276	24.0	176

If you have more questions pertaining to Insulfoam EPS products, contact the Insulfoam Technical Center at 800-469-8870.

POLYSTYRENE FOAM INSULATION IN LONG-TERM BUILDING APPLICATIONS

Effective R-values

Executive Summary

The primary purpose of insulation is to isolate a building's interior environment from either warm or cold exterior conditions. In many building applications, polystyrene foam insulation is protected from moisture, and the R-values determined under dry laboratory conditions are appropriate. This document provides a methodology that uses short-term, laboratory-determined R-values with adjustment factors to account for the long-term conditions of buildings when a more detailed analysis is desired.

The focus is on the insulating or R-value performance of expanded polystyrene (EPS) and extruded polystyrene (XPS) foam products used in long-term building applications. A methodology is presented in which the laboratory-determined R-value is multiplied by three adjustment factors to determine the long-term effective R-value of installed insulation. After considering the impact of age, temperature, and moisture on both EPS and XPS, the following conclusions are drawn:

- The R-value for EPS was constant over time and the R-value for XPS decreased by approximately 14% over 50 years.
- The R-values for EPS and XPS increase when the mean temperature decreases below 75°F (24°C). At a mean temperature of 40°F (4°C), the R-values for EPS and XPS increase by approximately 10%.
- The R-values for both EPS and XPS decrease by approximately 10% due to the absorption of water in below-grade applications.

The magnitudes of the adjustments to the R-values were not extremely large, but the analysis demonstrated that the R-value performance of EPS was preserved better than that of XPS when all factors were considered. The prime contributor to this difference was the loss of R-value by XPS that occurred with age due to out-gassing of blowing agents.

Aging

The R-value of EPS is constant over time, and the R-value of XPS decreases over time.

Temperature

The R-value of EPS and XPS increases when the mean temperature decreases below 75°F (24°C).

Moisture

Similar R-value reductions occur for EPS and XPS in below grade applications.

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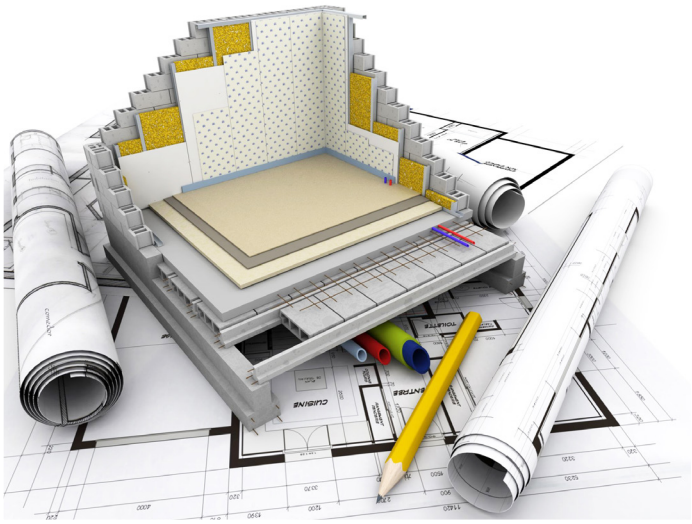
Introduction

The primary purpose of insulation is to isolate a building's interior environment from either warm or cold exterior conditions, i.e., to keep a building warm when it is cold outside or to keep a building cool when it is hot outside. R-value, or thermal resistance, is a measure of the ability of insulation to resist the flow of heat. The higher the R-value, the greater the resistance to heat flow. A higher R-value translates into lower heating and cooling costs and reduced pollution.

It is very important to understand the differences in the R-values of polystyrene foam insulations in various building applications over time, at various temperatures, and various moisture conditions. The U.S. Federal Trade Commission (FTC) has an "R-value Rule" regarding advertised R-values for insulation materials to consumers[1]. The R-value Rule requires that R-value testing is conducted on samples at a mean temperature of 75° F (24°C). This temperature is not intended to reflect the mean temperature of insulations in building applications but rather to provide a uniform basis that allows consumers to compare different insulations at standard laboratory conditions. Per the R-value Rule, R-values are most often measured using ASTM C518[2] or ASTM C177[3] test methods.

Unfortunately, the R-values derived from these ASTM standard laboratory scale tests do not provide a full representation of the performance of insulation in buildings because the tests do not account for the age of the insulation or its exposure to other temperatures and moisture after installation in a building.

Standard test methods are available for determining the impact of age[4-6] through methods that estimate the long-term R-values of foam plastics. The ULC and ASTM methods are most commonly used in North America to provide an estimate of the long-term thermal resistance (LTTR) of insulation at five years. The use of a five-year estimate of the R-value is an improvement over the use of a short-term R-value, but it is insufficient for predicting the R-value of extruded polystyrene foam over the life of a building, particularly since building professionals expect buildings to last at least 50 years[7].



> *"It is very important to understand the differences in the R-values of polystyrene foam insulations in various building applications over time, at various temperatures, and various moisture conditions.*

A methodology that uses short-term, laboratory-determined R-values along with adjustment factors to account for specific building conditions is warranted when a detailed analysis is needed. The R-value adjustment factor method discussed herein is analogous to the thermal conductivity adjustment method recognized in international standard ISO 10456[8].

Expanded polystyrene (EPS) and extruded polystyrene (XPS) used as insulation in buildings are considered. These products are recognized in the United States by U.S. product standard ASTM C578[9] and in Canada by CAN/ULC S701.1[10]. There are a wide range of EPS and XPS insulation types covered in the North America Standards, but this document focuses on EPS Types II, IX, and XPS Types X, IV per ASTM C578. These are the EPS and XPS types with 15 psi or 25 psi compressive strengths commonly used in building applications. Although not covered here, the methodology provided applies to other EPS and XPS types covered by ASTM C578 and CAN/ULC S701.1.

Performance Properties	ASTM C578 Material Type			
	EPS		XPS	
	II	IX	X	IV
Compressive Resistance[1], psi (kPa)	15 (104)	25 (173)	15 (104)	25 (173)
R-value[2], °F•ft²•h/BTU	4.0	4.2	5.0	5.0
RSI[3], °C•m²/W	0.70	0.74	0.88	0.88
Analogous CAN/ULC S701.1 Type[4]	2	3	2	4

[1] See ASTM C578 for details.
[2] Thermal resistance per 1.00 in (25.4mm). See ASTM C578 for details.
[3] Thermal resistance per 25.4 mm per ASTM C578. CAN/ULC S701.1 thermal resistance for XPS types 2, 3 and 4 are lower. See standard for complete details.
[4] The requirements of ASTM C578 and CAN/ULC are not identical, but they are very similar.

Table 1. EPS and XPS Types Commonly Used in Building Applications

Impact of Aging

The FTC's R-value Rule requires that the published R-value of insulation fully reflects the impact of aging on the insulation. The process of aging causes some insulation to lose its captive blowing agents over time. XPS uses gaseous blowing agents, which initially contribute to better R-values, but over time dissipate causing the R-value of XPS to decrease. In contrast, EPS contains only air, so its R-values do not decrease over time.

In Canada, XPS manufacturers are required to publish long-term thermal resistance (LTTR), which is an estimate of the product's R-value at five years of age. The LTTR requirement is distinct from the insulation's initial R-value or an R-value determined by a short-term conditioning method. Nonetheless, LTTR does not reflect the full extent of aging over the life of the insulation when used in buildings that are anticipated to have a minimum lifetime of 50 years. Figure 1 shows the R-value for EPS Types II, IX and XPS Types IV, X over time.

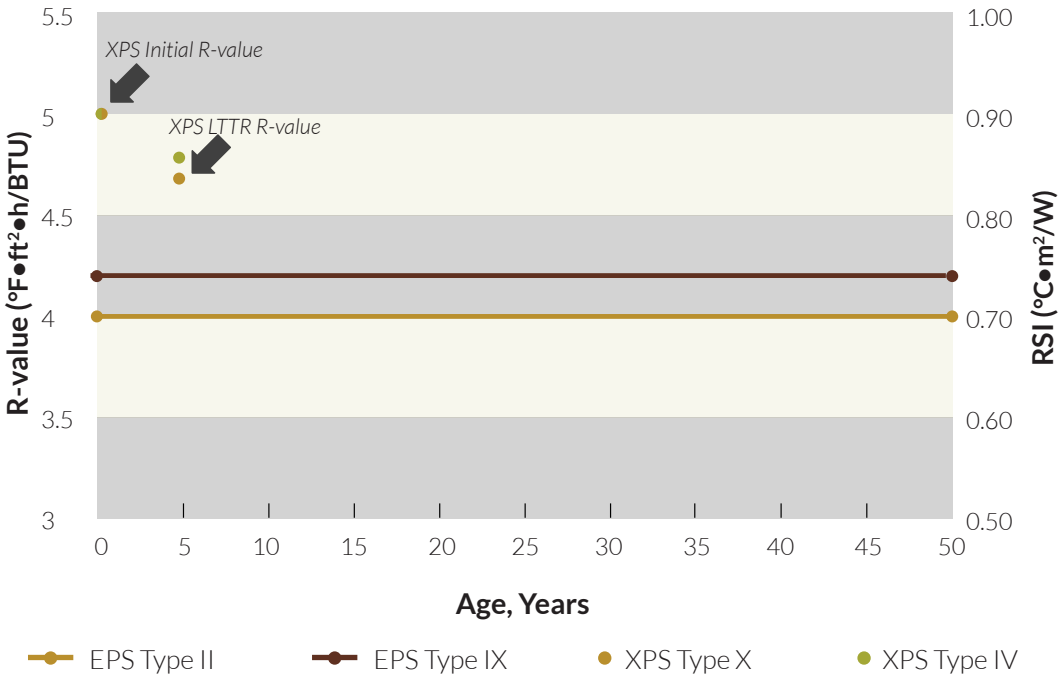


Figure 1. R-value Over Time for EPS and XPS

Temperature

Building insulation performance differs when tested at mean temperatures other than 75°F (24°C). This behavior is recognized in ASTM standards, by manufacturers, and by authoritative publications[2,3,9,11-13]. The mean temperature at which the thermal resistance of insulation is measured is a key factor to consider when used in buildings exposed to both cold and hot conditions, which is the prevailing case across North America.

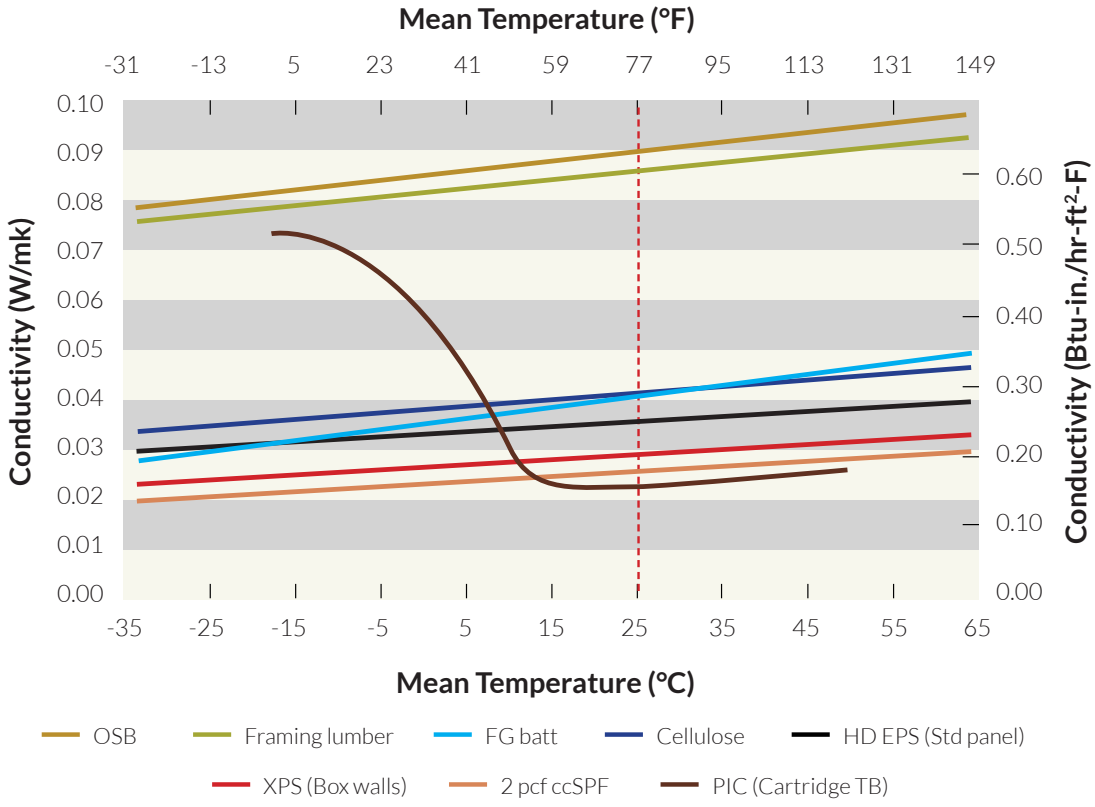


Figure 2. Thermal Conductivity of Building Materials as a Function of Mean Temperature[14]

Figure 2 shows that the thermal conductivity of many building materials decreases as the mean temperature decreases[14]. R-value correlates inversely with thermal conductivity. Thus a lower thermal conductivity at colder mean temperatures means that the R-value for the material increases as the temperature decreases. One insulation, polyisocyanurate insulation, does not exhibit this typical behavior. At mean temperatures below approximately 60°F (16°C), its thermal conductivity increases significantly, and thus the R-value decreases significantly.

It is important to adjust the R-value for the actual conditions when conducting a detailed analysis of the building at conditions with a mean temperature other than 75°F (24°C). This analysis may require further consideration of both winter and summer conditions. Alternatively, the lowest R-value based on summer and winter conditions of the building may be used as a conservative approach. Table 2 provides example calculations of mean temperatures based on different exterior climate conditions and an interior temperature of 72°F (22°C).

Climate Condition	"Inside" Temp.	"Outside" Temp.	Temp. Diff.	Mean Temp.
Very cold	72°F (22°C)	0°F (-18°C)	72°F (40°C)	36°F (2°C)
Cold	72°F (22°C)	36°F (2°C)	36°F (20°C)	54°F (12°C)
Hot	72°F (22°C)	108°F (42°C)	36°F (20°C)	90°F (32°C)
Solar heated	72°F (22°C)	144°F (62°C)	72°F (40°C)	108°F (42°C)

Table 2. Mean Temperatures as a Function of Climate Condition[15]

It is immediately apparent that the various climate conditions across North America do not correlate well with a mean temperature of 75°F (24°C). A mean temperature of less than 40°F (4°C) would be appropriate for winter conditions in very cold climates, and a mean temperature of 90°F (32°C) or higher would be appropriate for summer conditions in a hot climate.

With insulation generally installed between the exterior and interior of the building envelope, the mean temperature of the insulation depends largely upon the exterior temperature. As Figure 2 shows, insulation performance depends on the mean temperature, which is especially important for those products with a non-linear temperature dependence. The mean temperature applied should be based on climate conditions as well as the insulation location within the building envelope.

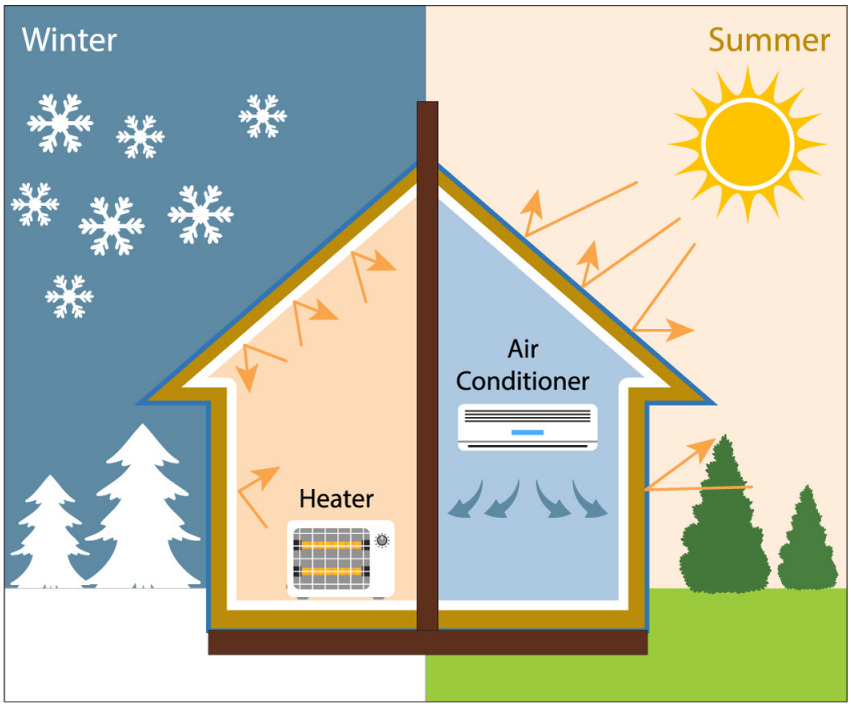


Figure 3. Winter & Summer Climate Conditions

Moisture

The R-value of insulation typically is determined under ideal, dry laboratory conditions. In many building applications, polystyrene foam insulation is protected from moisture, and the R-values determined under dry laboratory conditions are appropriate. Examples include insulation under roof membranes and wall insulation covered by a weather-resistive barrier. In these applications, no adjustment to the R-value is needed based on the insulation's exposure to moisture.

Polystyrene foam in below grade applications may be exposed to moisture, and in such cases an adjustment to the laboratory R-value based on these conditions is appropriate. Under these conditions, the reductions in the R-values of both EPS and XPS materials are well documented in international standard ISO 10456.

When the average moisture absorption is known, the adjustment of R-value due to this moisture can be calculated by Equation 1.

Equation 1 $$R\text{-value moisture adjustment factor} = 1/e^{(a \bullet Moisture\ \%\ by\ volume)}$$

where a = 4.0 for EPS and 2.5 for XPS and e is Euler's number, 2.71828.

Effective R-value

The discussion on aging, temperature, and moisture demonstrated that R-value is affected by each of these considerations. A methodology that includes all three considerations can be used to determine the effective R-value under specific building conditions.

Effective R-value Determination

The adjustment of the R-value from ideal laboratory conditions to the conditions in building applications is straightforward. The effective R-value determination discussed herein is analogous to the thermal conductivity adjustment method recognized in international standard ISO 10456.

The R-value determined in the laboratory (R_{LAB}) following the FTC R-value Rule is multiplied by three adjustment factors which determine the effective R-value ($R_{EFFECTIVE}$). There is an adjustment factor for aging (F_{AGE})where this value is a number equal to or less than one since the R-value decreases over time for some products due to the loss of captive blowing agents. There is an adjustment factor for temperature (F_{TEMP}) where this value may be less than or greater than one depending on the change in performance relative to the R-value determined at the mean temperature of 75°F (24°C). There is an adjustment factor for moisture (F_{H20}) where this value is a number less than or equal to one since moisture reduces the R-value.

Equation 2 $$R_{EFFECTIVE} = R_{LAB} \times F_{AGE} \times F_{TEMP} \times F_{H20}$$

where:

$R_{EFFECTIVE}$ = effective R-value under the specific conditions considered

Note: This equation is applicable to R-values (U.S. units) or RSI values (SI units).

R_{LAB} = R-value determined under standard laboratory conditions at 75°F (24°C) mean temperature per the FTC R-value Rule

F_{AGE} = adjustment factor for a product that is 50 years old

F_{TEMP} = adjustment factor for temperature

F_{H20} = adjustment factor for moisture based on application

Aging Adjustment Factor

The R-value of any insulation should account for the impact of R-value aging when used on buildings with a design life of 50 years. Aging is a process during which certain insulations with captive blowing agents lose those blowing agents over time. Since the blowing agents can contribute to the R-value of certain insulations, the R-value of these types of insulation decrease over time. Extruded polystyrene (XPS) contains a blowing agent that is lost over time, so its R-value must be adjusted.

R-value data is limited for XPS insulations in North America beyond five years. However, there are estimates of R-values at five years published in CAN/ULC S701.1. The ASTM C578 standard requires XPS producers to determine and report the LTTR following ASTM C1303 values, but this information is not readily available from XPS manufacturers in the US. However, several publications provide insight concerning the R-value of XPS after longer periods due to the loss of blowing agents[16-19] The R-values of insulations that contain only air do not decrease over time. As shown in Figure 1, the R-value of EPS products is constant over a 50 years.

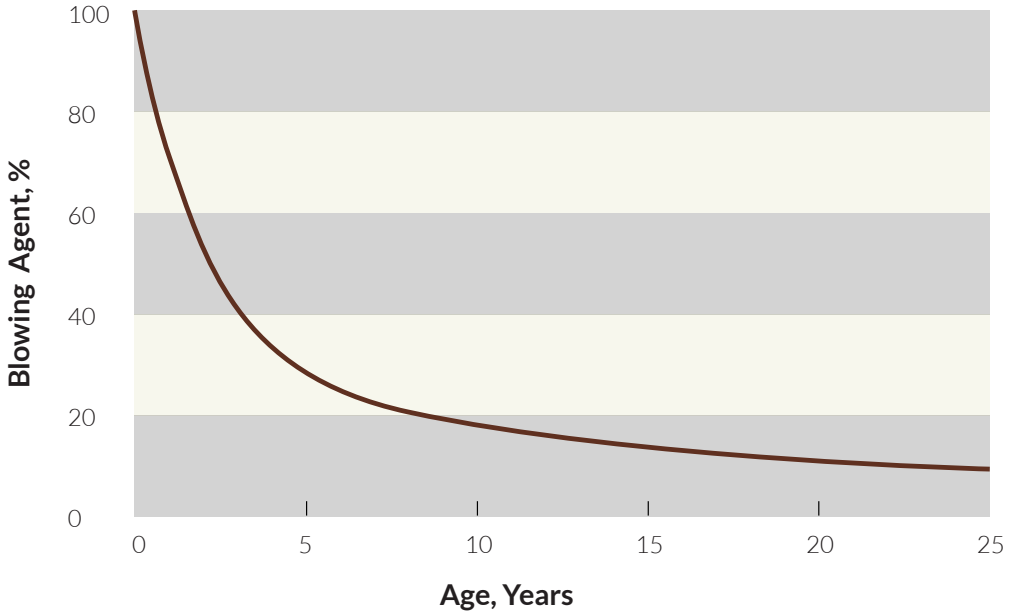


Figure 4. Blowing Agent Loss of XPS[18]

Figure 4 shows the decay of blowing agent HFC-134a in an XPS foam where after 25 years over 90% of the blowing agent has been lost. Since the blowing agent is lost over time, the R-value diminishes over time. Similar information on the loss of the blowing agent also has been published by other researchers.

As noted, there is limited data from the U.S. manufacturers of XPS, but some short-term data has been published[19]. There also has been recent aged R-value testing conducted on one U.S. manufactured XPS[20].

Figure 5 shows the estimated R-value over time for XPS produced in the U.S. based on recent testing[20] and available research[16-19] on the long term performance of XPS produced internationally. The R-value drops significantly over time below the claimed R-value of 5.0 and is in close agreement with the values provided in CAN/ULC S701.1 at 5 years.

Considering all the available data[16-20], the R-value used in this document to determine the long-term (50-year) aging adjustment factor for XPS is estimated to be 4.3. This value is an estimate and may need adjustment as more data becomes available.

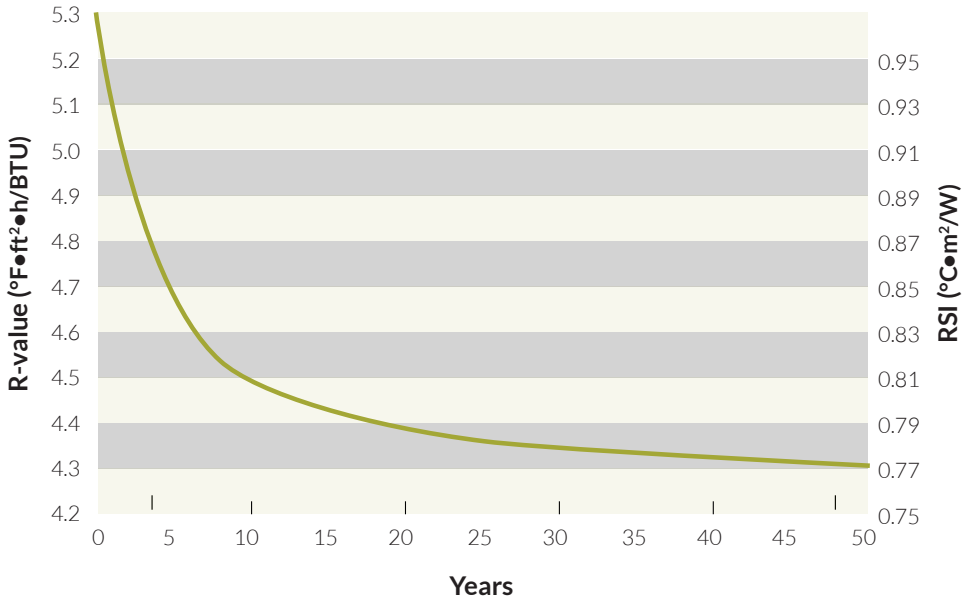


Figure 5. Estimated R-value over Time for a U.S. 1 inch Type X, IV XPS[16-20]

The R-values of insulations that contain blowing agents decrease over time. As shown in Figure 5, the R-value of XPS continually decreases over 50 years. The R-values of insulations that contain only air do not decrease over time. The R-value of EPS products is constant over 50 years.

Material	Initial R-value	5-year R-value[1]	50-year R-value[2]
XPS Type X	5.0	4.67	4.3
XPS Type IV	5.0	4.79	4.3
EPS Type II	4.0	4.0	4.0
EPS Type IX	4.2	4.2	4.2

[1]Estimated based on CAN/ULC-S701.1 Types since ASTM Types are similar to CAN/ULC-S701.1 Types
[2] Estimated based on available research[16-20]

Table 3. R-values over Time for XPS and EPS

The information contained in Table 3 allows for the determination of the aging adjustment factor for EPS and XPS.

Material	EPS	EPS	XPS	XPS
ASTM C578 Type	II	IX	X	IV
F_{AGE}	1.0	1.0	0.86	0.86

Table 4. F_{AGE} for EPS Type II, IX and XPS Types IV, X at 50 years

Temperature Adjustment Factor

The performance of polystyrene foam insulation is well documented in ASTM C578. The R-value of both EPS and XPS increases at mean temperatures colder than 75°F (24°C) and decreases at mean temperatures warmer than 75°F (24°C). Table 5 provides the recognized R-values at 75°F (24°C) for EPS and XPS in compliance with ASTM C578 as well as the R-values at 110°F (43°C), 40°F (4°C), and 25°F (-4°C) mean temperatures.

Temperature	ASTM C578 Material Type							
	EPS				XPS			
	II		IX		X		IV	
	R-value	RSI	R-value	RSI	R-value	RSI	R-value	RSI
110°F (43°C)	3.65	0.64	3.85	0.69	4.65	0.82	4.65	0.82
75°F (24°C)	4.0	0.70	4.2	0.74	5.0	0.88	5.0	0.88
40°F (4°C)	4.4	0.77	4.6	0.81	5.4	0.95	5.4	0.95
25°F (-4°C)	4.6	0.81	4.8	0.84	5.6	0.99	5.6	0.99

Table 5. ASTM C578/CAN S701.1 R-values at Various Mean Temperatures

Plotting the various R-values in ASTM C578 in Figure 6 shows that there is a linear relationship of R-value with a temperature that allows the prediction of R-value at other temperatures.

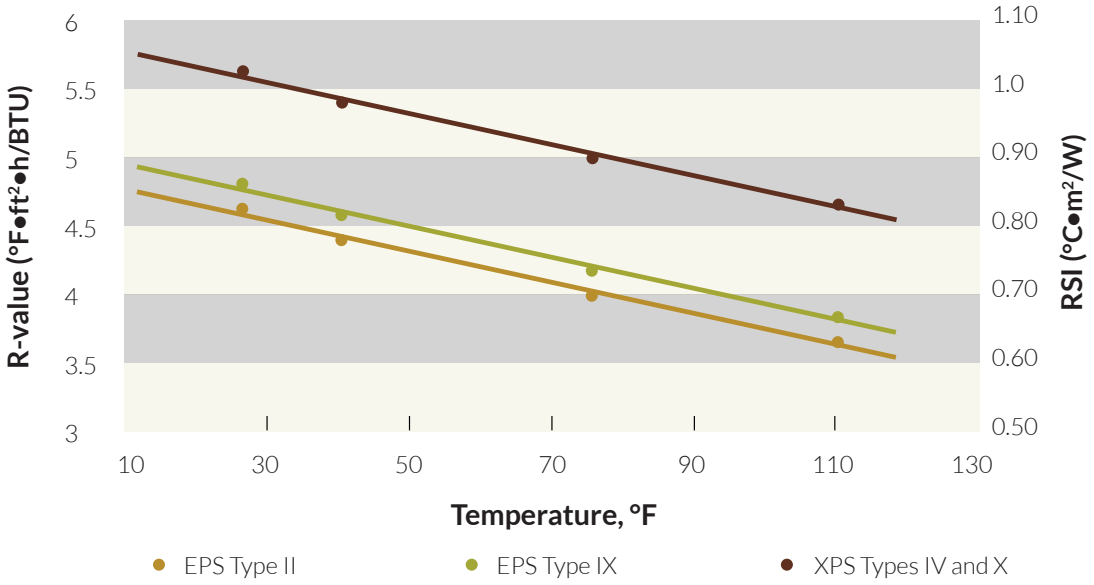


Figure 6. R-value vs. Mean Temperature for EPS Type II, IX and XPS Type IV, X

The best fit of the ASTM C578 data leads to equations that can be used to determine the temperature adjustment factor at temperatures other than 75°F (24°C):

For Type II EPS:

Equation 3 $F_{TEMP} = 1.214 - (0.0028 \times \text{Mean Temperature°F})$ or $F_{TEMP} = 1.125 - (0.0050 \times \text{Mean Temperature°C})$

For Type IX EPS:

Equation 4 $F_{TEMP} = 1.204 - (0.0026 \times \text{Mean Temperature°F})$ or $F_{TEMP} = 1.119 - (0.0048 \times \text{Mean Temperature°C})$

For Type X or IV XPS:

Equation 5 $F_{TEMP} = 1.172 - (0.0022 \times \text{Mean Temperature°F})$ or $F_{TEMP} = 1.100 - (0.0040 \times \text{Mean Temperature°C})$

Table 6 provides the temperature adjustment factor, F_{TEMP}, using Equations 3 through 5 for mean temperatures from 20°F (-7°C) to 110°F (43°C).

Temperature	ASTM C578 Material Type			
	EPS		XPS	
	II	IX	X	IV
20°F (-7°C)	1.16	1.15	1.13	1.13
30°F (-1°C)	1.13	1.12	1.11	1.11
40°F (4°C)	1.10	1.10	1.08	1.08
50°F (10°C)	1.08	1.07	1.06	1.06
60°F (16°C)	1.05	1.05	1.04	1.04
70°F (21°C)	1.02	1.02	1.02	1.02
80°F (27°C)	0.99	0.99	0.99	0.99
90°F (32°C)	0.96	0.97	0.97	0.97
100°F (38°C)	0.94	0.94	0.95	0.95
110°F (43°C)	0.91	0.91	0.93	0.93

Table 6. F_{TEMP} for EPS and XPS at Temperatures Between 20°F (-7°C) and 110°F (43°C)

Moisture Adjustment Factor

The R-value of insulation typically is determined under ideal, dry, laboratory conditions. In many building applications, insulations are protected from moisture. Examples include roof insulation under membranes and wall insulation behind weather-resistive barriers. In these applications, no R-value adjustment for moisture is needed. In below-grade and ground-contact applications, insulation may be exposed to moisture, and adjustments to the R-value based on these conditions are necessary.

The adjustment factor for moisture can be determined by knowing the moisture absorption of polystyrene foams over long periods, coupled with an understanding of the decrease in the R-value associated with the absorption of moisture.

Many building professionals often refer to ASTM C578 water absorption values published for polystyrene foam products. These values are the results of short-term quality control tests, and they should not be used as the values for the expected water absorption in building applications. As early as 1983, researchers from Dow Chemical concluded "that moisture gain in perimeter insulation cannot be predicted accurately by any single laboratory test"[21].

Numerous studies on the field performance of polystyrene foams have been conducted around the world. The findings of many of those studies are not directly applicable to products produced in North America, because the standards for the manufacture of polystyrene foam products in the U.S. and Canada are not aligned with international standards.

Five independent studies conducted in North America[22-26] provide field testing information on the water absorption of products produced in North America. Three of the studies include results on EPS, and four studies include results on XPS. Figure 8 shows the resulting data on EPS and XPS with a 1.35 pcf or greater density which relates to EPS Types II, IX, and XPS Types X, IV.

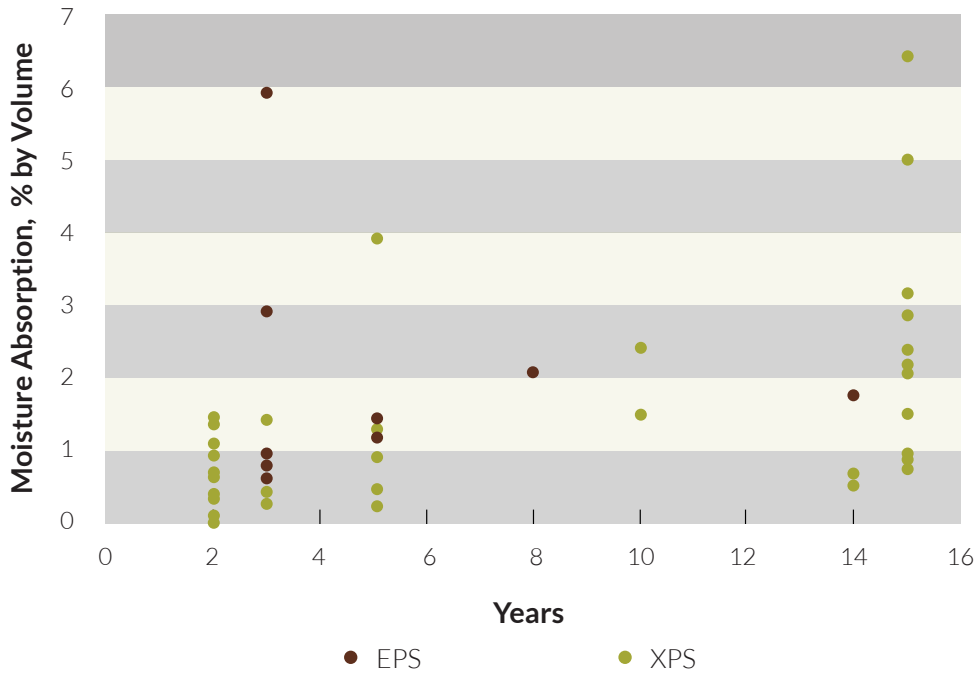


Figure 7. Below-Grade Water Absorption of EPS and XPS with Density Above 1.35 pcf Over the Long Term[23-27]

It is apparent that the water absorption of EPS products is relatively consistent over the 15 years of data that are available. The average water absorption of the EPS data collection is 2.2 % by volume with a range of 0.1 - 5.9% by volume. EPS products absorb some water during extremely wet conditions, but moisture is liberated during dry conditions.

The water absorption of XPS products appears to be relatively low within the first five years, but it increases significantly when considering the data at 15 years. The average water absorption of the XPS data collection is 2.6% by volume with a range of 0.0 to 6.3% by volume. The data demonstrates the initial water absorption of XPS is low, but over time water accumulates in the XPS.

It is notable that the average results in Figure 7 are lower than data published by The Dow Chemical Co.[27], where it appeared that the water absorption for XPS is higher in long-term highway applications as shown in Figure 8.

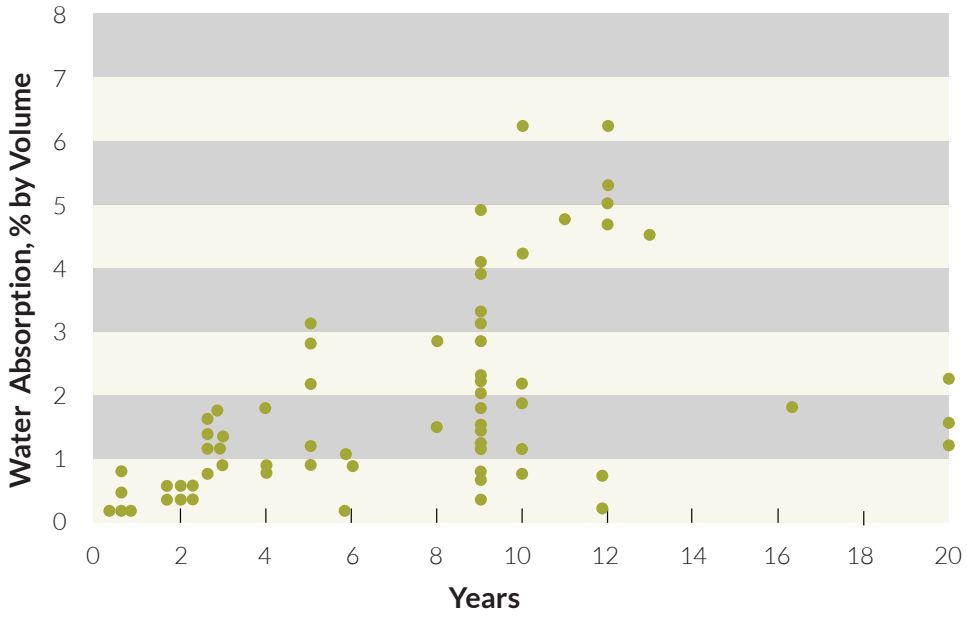


Figure 8. Water Absorption of XPS over time in North American Highway Installations[27]

Based on the analysis of the North American data, it is reasonable to approximate the long-term moisture absorption for both EPS and XPS in below-grade building applications at 3% by volume. It is reasonable to anticipate that water absorption is negligible in a properly installed wall or roof assembly. The combination of water absorption by volume along with equation 1 can be used to determine F_{H2O} in Table 7.

Equation 1 $$F_{H2O} = 1/e^{(a \bullet Moisture\ vol\%)}$$

where a = 4.0 for EPS and 2.5 for XPS and e is Euler's number, 2.71828.

Application	ASTM C578 Material Type	
	EPS	XPS
Below-grade applications	3% by volume	3% by volume
F_{H2O}	0.89	0.93
Above-grade wall applications	0% by volume	0% by volume
F_{H2O}	1.0	1.0
Roof applications	0% by volume	0% by volume
F_{H2O}	1.0	1.0

Table 7. Application Moisture Absorption and F_{H20} of EPS and XPS

Effective R-value Adjustment Examples

The adjustment factors for aging, temperature, and moisture can now be used to predict the effective R-value, $R_{EFFECTIVE}$, in various applications where R_{LAB} is determined from ASTM C578 values at 75°F (24°C).

Equation 2 $R_{EFFECTIVE} = R_{LAB} \times F_{AGE} \times F_{TEMP} \times F_{H20}$

Example 1

Effective R-value in long-term (50-year), above-grade wall applications for a summer condition with an outside temperature of 105°F (40°C) and an interior temperature of 75°F (24°C). The mean temperature will be (105°F +75°F)/2 = 90°F [(40°C +24°C)/2 = 32°C].

Equation Term	ASTM C578 Material Type					
	EPS				XPS	
	II		IX		X, IV	
	R-value	RSI	R-value	RSI	R-value	RSI
R_{LAB} *(Table 1)*	4.0	0.70	4.2	0.74	5.0	0.88
F_{AGE} *(Table 4)*	1.0	1.0	1.0	1.0	0.86	0.86
F_{TEMP} *(Table 6)*	0.96	0.96	0.97	0.97	0.97	0.97
F_{H2O} *(Table 7)*	1.0	1.0	1.0	1.0	1.0	1.0
R_{EFF}	**3.8**	**0.67**	**4.1**	**0.72**	**4.2**	**0.73**
% Change	*-4%*		*-3%*		*-16%*	

Table 8. $R_{EFFECTIVE}$ for Long-term, Above-grade Summer Wall Application of EPS and XPS

Example 2

Effective R-value in long-term (50-year), above-grade wall applications for a winter condition with an outside temperature of 5°F (-15°C) and an interior temperature of 75°F (24°C). The mean temperature will be (5°F +75°F)/2 = 40°F [(-15°C +24°C)/2 = 4.5°C].

Equation Term	ASTM C578 Material Type					
	EPS				XPS	
	II		IX		X, IV	
	R-value	RSI	R-value	RSI	R-value	RSI
R_{LAB} *(Table 1)*	4.0	0.70	4.2	0.74	5.0	0.88
F_{AGE} *(Table 4)*	1.0	1.0	1.0	1.0	0.86	0.86
F_{TEMP} *(Table 6)*	1.10	1.10	1.10	1.10	1.08	1.08
F_{H2O} *(Table 7)*	1.0	1.0	1.0	1.0	1.0	1.0
R_{EFF}	**4.4**	**0.77**	**4.6**	**0.81**	**4.6**	**0.82**
% Change	*+10%*		*+10%*		*-7%*	

Table 9. $R_{EFFECTIVE}$ for Long-term, Above-grade Winter Wall Application of EPS and XPS

Example 3

Effective R-value in long-term (50-year), below-grade wall applications with a ground temperature of 50°F (10°C) and an interior temperature of 70°F (22°C). The mean temperature will be (50°F +70°F)/2 = 60°F [(10°C +22°C)/2 = 16°C].

Equation Term	ASTM C578 Material Type					
	EPS				XPS	
	II		IX		X, IV	
	R-value	RSI	R-value	RSI	R-value	RSI
R_{LAB} *(Table 1)*	4.0	0.70	4.2	0.74	5.0	0.88
F_{AGE} *(Table 4)*	1.0	1.0	1.0	1.0	0.86	0.86
F_{TEMP} *(Table 6)*	1.05	1.05	1.05	1.05	1.04	1.04
F_{H2O} *(Table 7)*	0.89	0.93	0.89	0.89	0.93	0.93
R_{EFF}	**3.7**	**0.65**	**3.9**	**0.69**	**4.1**	**0.73**
% Change	*-7%*		*-7%*		*-17%*	

Table 10. $R_{EFFECTIVE}$ for Long-term, Below-grade Wall Application of EPS and XPS

Summary

Building insulations are subjected to a wide range of temperatures and moisture conditions during their service life. It is important that R-values are maintained since the purpose of insulation is to isolate a building's interior environment from either warm or cold exterior conditions. Any deterioration of the R-value could lead to increased heating or cooling costs. After consideration of the impact of age, temperature, and moisture on both EPS and XPS, the following conclusions were apparent:

- The R-value for EPS is constant over time, but the R-value for XPS decreases by approximately 14% over 50 years.
- The R-value for EPS and XPS increases as the mean temperature decreases below 75°F (24°C). At a mean temperature of 40°F (4°C), the R-values for EPS and XPS increase by approximately 10%.
- The R-values for both EPS and XPS decrease by approximately 10% due to water absorption of 3% by volume in below-grade applications.

A methodology was provided to calculate the effective R-value for specific building applications when a detailed analysis is desired. An example of above-grade summer walls was shown with a reduction in R-value for EPS of 3-4% and a reduction in R-value for XPS of 16%. An example of above-grade winter walls was shown with an increase in R-value for EPS of 10% and a reduction in R-value for XPS of 7%. An example of below-grade walls was shown with a reduction in R-value for EPS of 7% and a reduction in R-value for XPS of 17%. The magnitudes of the adjustments to the R-values were not extremely large, but it was apparent that the R-value performance of EPS was better preserved than the R-value of XPS. The prime contributor to this difference was the loss of R-value as the XPS products aged.

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ICC EVALUATION SERVICE

ICC-ES Evaluation Report

ESR-1788

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DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 21 00—Thermal Insulation
Section: 07 22 00—Roof and Deck Insulation
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers

REPORT HOLDER:

INSULFOAM, A DIVISION OF CARLISLE CONSTRUCTION MATERIALS, LLC

ADDITIONAL LISTEE:

THERMAL BUILDING CONCEPTS, LLC

EVALUATION SUBJECT:

INSULFOAM EXPANDED POLYSTYRENE (EPS) AND R-TECH™ AND THERMAL 3HT INSULATION BOARDS

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

- 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)
- 2018, 2015, 2012 and 2009 *International Energy Conservation Code*® (IECC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

- Other Codes (see Section 8.0)

Properties evaluated:

- Physical properties
- Surface-burning characteristics
- Attic and crawl space installation
- Thermal resistance (*R*-values)
- Water-resistive barrier (R-TECH Board)

1.2 Evaluation to the following green code(s) and/or standards:

- 2019 California Green Building Standards Code (CALGreen), Title 24, Part 11
- 2015, 2012 and 2008 ICC 700 *National Green Building Standard*™ (ICC 700-2015, ICC 700-2012 and ICC 700-2008)

Attributes verified:

See Section 3.4.

2.0 USES

Insulfoam Expanded Polystyrene (EPS) and R-TECH™ insulation boards are EPS foam plastic boards used as nonstructural thermal insulation in wall cavities or ceiling assemblies, door cavities, roof and as exterior perimeter insulation around concrete slab edges, on foundation walls or under flat concrete slab on grade construction, except in areas where the probability of termite exposure is "very heavy" as defined in 2018, 2015 and 2009 IBC Section 2603.8 (2012 IBC Section 2603.9) and IRC Section R318.4. The insulation may be used on the outside faces of exterior walls of Type V-B (IBC) construction, or structures constructed in accordance with the IRC. The insulation boards may be used on walls in attics and crawl spaces with no covering applied to the attic or crawl space side of the foam plastic, when these boards are installed in accordance with Section 4.2. The R-TECH™ One-Coat Stucco Boards may be used as an alternative to the water-resistive barriers specified in the IBC or IRC, when installed as set forth in Section 4.3.

Thermal 3HT Insulation boards are identical to R-Tech Insulation boards and may be used and installed in the same manner as R-Tech Insulation boards.

3.0 DESCRIPTION

3.1 EPS Board:

Insulfoam EPS board is available with flat faces and square edges in various lengths and widths and in thicknesses up to 6 inches (152 mm). The foam plastic boards are Type I, II, VIII or IX boards complying with ASTM C578, and having densities and thermal resistance values as shown in Table 1. The foam plastic boards have a flame-spread index not exceeding 25 and a smoke-developed index not exceeding 450 when tested in accordance with ASTM E84 (UL 723).

3.2 EIFS Grade (IEG) EPS Board:

IEG board is available with flat faces and square edges in various lengths and widths and in thicknesses up to 4 inches (102 mm). The foam plastic board is a Type I board complying with ASTM C578. The board has a minimum density of 0.90 pcf (14.4 kg/m^3), and is used as a component of exterior insulation and finish systems (EIFS). The foam plastic board has a flame-spread index not exceeding 25 and a smoke-developed index not exceeding 450 when tested in accordance with ASTM E84 (UL 723). The foam plastic IEG board has more restrictive requirements than the EPS board for conditioning, product dimensions, marking and packaging.

3.3 R-TECH™ Board:

R-TECH™ board is available with flat faces and square edges in various lengths and widths, and in thicknesses up to 5 inches (127 mm). The foam plastic boards are Type I, II, VIII or IX boards complying with ASTM C578. The boards have densities and thermal resistance values as shown in Table 1. The foam plastic boards consist of an EPS core with the faces laminated with polyethylene and polypropylene films. The foam plastic boards are manufactured in a fanfold or standard configuration. An optional reflective metalized film facer is also available. The foam plastic boards have a flame-spread index not exceeding 25 and a smoke-developed index not exceeding 450 when tested in accordance with ASTM E84 (UL 723).

3.4 R-TECH™ One-Coat Stucco Board:

R-TECH™ One-Coat Stucco Boards are available with flat faces or with nominally $^1/_2$-inch-wide-by-$^1/_4$-inch-deep channels spaced a maximum of 12 inches (305 mm) on center on the back face of the board, with nominally 1.5-mil-thick plastic facers laminated to both sides of the board. The boards are produced in a 1-inch (25.4 mm) thickness and in the following configurations:

- Two or 4 feet wide by 8 feet long (610 or 1219 mm by 2438 mm) with either $^1/_2$-by-$^1/_2$-inch (12.7 by 12.7 mm) shiplap joints or tongue-and-groove joints on the long edges.
- Forty-nine inches wide by 8 to 10 feet long (1245 mm by 2438 to 3048 mm) with shiplap joints on the long edge.
- Four feet wide by 8 to 10 feet long (1219 mm by 2438 to 3048 mm) with square edges.

See Figure 2 for additional details on the board edges. The foam plastic boards are Type I boards, complying with ASTM C578, and have a nominal density of 1 pcf (16.0 kg/m^3). The foam plastic boards have a flame-spread index not exceeding 25 and a smoke-developed index not exceeding 450 when tested in accordance with ASTM E84 (UL 723).

The attributes of the R-TECH™ One-Coat Stucco Boards used as an alternative water-resistive barrier have been verified as conforming to the provisions of (i) CALGreen Section 5.407.1 and (ii) ICC 700-2015 Section 602.1.8, 11.602.1.8 and 12.6.602.1.8; (iii) ICC 700-2012 Section 602.1.8, 11.602.1.8 and 12.5.602.1.8; and (iv) ICC 700-2008 Section 602.9 for water-resistive barriers. Note that decisions on compliance for those areas rest with the user of this report. The user is advised of the project-specific provisions that may be contingent upon meeting specific conditions, and the verification of those conditions is outside the scope of this report. These codes or standards often provide supplemental information as guidance.

3.5 R-TECH™ Gable-Guard:

R-TECH™ Gable-Guard board is available with flat faces and square edges in 4-foot (1219 mm) widths and 8-foot (2438 mm), 10-foot (3048 mm) and 12-foot (3658 mm) lengths, and with a nominal thickness of $^1/_2$ inch. The foam plastic boards are Type I boards complying with ASTM C578. The boards have a nominal density of 1 pcf (16.0 kg/m^3) and a nominal 1.5-mil polymeric facer laminated to both sides of the board, and a thermal resistance value as shown in Table 1. The foam plastic boards have a flame-spread index not exceeding 25 and a smoke-developed index not exceeding 450 when tested in accordance with ASTM E84 (UL 723).

3.6 Poly-Guard 136 Tape:

Poly-Guard 136 tape must be used with the R-TECH™ One-Coat Stucco Board when the board is used as an alternative water-resistive barrier as described in Section 4.3. The tape consists of a polyethylene backing with a rubber-based adhesive, and has a nominal thickness of 9.0 mils and a width of 2 inches (51 mm). The tape is supplied in 36-yard (32 918 mm) rolls.

4.0 INSTALLATION

4.1 General:

Installation of Insulfoam EPS™ and R-TECH™ insulation boards must comply with this report and the manufacturer's published installation instructions. The manufacturer's published installation instructions must be available at the jobsite at all times during installation.

Except as described in Section 4.2, the interior of the building must be separated from the insulation boards with an approved thermal barrier as required by IBC Section 2603.4 or IRC Section R316.4. The use of the insulation boards in areas of "very heavy" termite infestation probability must comply with 2018, 2015 and 2009 IBC Section 2603.8 (2012 IBC Section 2608.9) or IRC Section R318.4 when boards are used in structures regulated by the IRC. A vapor retarder must be installed, in accordance with 2018 IBC Section 1404.3 (2015 And 2012 IBC Section 1405.3) or 2018, 2015 and 2012 IRC Section R702.7 (2009 IRC Section R601.3), as applicable. The insulation board may be applied to exterior faces of walls to a maximum thickness of 1$^1/_2$ inches (38 mm), except insulation board thicknesses greater than 1$^1/_2$ inches (38 mm) may be permitted if such installation is recognized in a current ICC-ES evaluation report on a wall covering. The attachment of finish materials over the insulation board must allow for a minimum 1-inch (25.4 mm) penetration of the fasteners into wood framing. Sheathing or a wall covering over the insulation must be structurally adequate to resist horizontal forces perpendicular to the wall. All walls must be braced in accordance with 2018 and 2015 IBC Section 2308.6 (2012 and 2009 IBC Section 2308.9.3) or IRC Section R602.10, as applicable.

Insulation boards must not be used as a nailing base for exterior siding materials. All nailing must be made through the insulation into the wall framing or structural sheathing as required by the siding manufacturer's instructions or the applicable code.

Use of insulation boards as roof insulation must be limited to installations recognized in a current ICC-ES evaluation report for the roof covering system.

4.2 Special Uses: Attics and Crawl Spaces:

Insulfoam EPS™, R-TECH™ and R-TECH™ Gable Guard insulation boards may be used in attics and crawl spaces without a covering being applied to the interior side of the foam plastic, provided all of the following conditions are met:

a. Entry to the attic or crawl space is only to service utilities, and no storage is permitted.

b. There are no interconnected attic or crawl space areas.

c. Air in the attic or crawl space is not circulated to other parts of the building.

d. Attic ventilation is provided when required by 2018 IBC Section 1202.2 (2015, 2012 and 2009 IBC Section 1203.2) or IRC Section R806, as applicable.

e. Under-floor (crawl space) ventilation is provided when required by 2018 IBC Section 1202.4 (2015 IBC Section 1203.4 (2012 and 2009 IBC Section 1203.3)) or IRC Section R408.1, as applicable.

f. Insulfoam EPS™ or R-TECH™ insulation boards are limited to maximum nominal density of 1 pcf (16.0 kg/m^3) and maximum thickness of 4 inches (102 mm), or maximum nominal density of 2 pcf (32.0 kg/m^3) and maximum thickness of 2 inches (51 mm); or maximum nominal density of 1.5 pcf (24.0 kg/m^3) and a maximum thickness of 2^2/$_3$ inches (67.8 mm).

g. Combustion air is provided in accordance with Section 701 of the *International Mechanical Code*.

h. Insulfoam EPS™, R-TECH™ One-Coat Stucco Board and R-TECH™ Gable-Guard (attics only) insulation boards are limited to those manufactured from Styropek USA, Inc. (F95) BF and (F95) BFL (ESR-1498), NOVA Chemicals Incorporated M77 (ESR-1798), and Flint Hills Resources, LP Grade 54 (ESR-1634) beads; and are labeled as indicated in Section 7.0 and Figure 1.

4.3 Water-resistive Barrier:

4.3.1 General: When installed in accordance with this section, the R-TECH™ One-Coat Stucco Boards may be used as an alternative to Type I felt complying with ASTM D226. The boards must be covered with exterior plaster complying with IBC Section 2512 or IRC Section R703.6, or with one of the cementitious exterior wall coatings noted in Section 4.4 of this report.

The 2- or 4-foot-wide (610 and 1219 mm) R-TECH™ boards with tongue-and-groove joints on the long edges must be oriented horizontally, with the tongues facing upward. The 2- or 4-foot-wide (610 and 1219 mm) boards with shiplap joints, and the 48- or 49-inch-wide (1219 mm and 1245 mm) boards with square edges, must be oriented vertically. Shiplap joints must occur over framing and must overlap a minimum of ^{1}/$_2$ inch (12.7 mm).

The R-TECH™ One-Coat Stucco Boards must be installed directly to framing and fastened to exterior framing spaced a maximum of 24 inches (610 mm) on center, except where further limited by the requirements for the wall covering. Fasteners used to attach the boards to framing must be minimum 6d ring-shank nails and ^{15}/$_{16}$-inch-diameter (23.8 mm) plastic washers, or equivalent, spaced at 12 inches (305 mm) on center, or 1-inch-wide-crown (25.4 mm), 1^3/$_4$-inch-long (45 mm), No. 16 gage staples spaced at 6 inches (152 mm) on center. Joints between boards, and corners created with the board, must be taped with Poly-Guard 136 polyethylene tape centered over the joint. R-TECH™ One-Coat Stucco Boards must be installed with a weep screed. See Figure 3 for installation details. R-TECH™ One-Coat Stucco Board used as a water-resistive barrier requires the use of self-adhering flashing, complying with the ICC-ES Acceptance Criteria for Flashing Materials (AC148), around penetrations as shown in Figure 4.

For exterior plaster complying with IBC Section 2512 or IRC Section R703.6, the length of the fasteners used to attach the lath must be proportionally increased based on the thickness of the R-TECH™ One-Coat Stucco Board. The increase in fastener length is to maintain penetration into framing that is equivalent to that of fasteners attaching the lath without insulation.

4.3.2 Penetrations: Flashing of flange-type window penetrations when R-TECH™ One-Coat Stucco Board is used as a water-resistive barrier must be accompanied by installation of flashing complying with AC148, completely covering the framing sill and extending a minimum of 6 inches (51 mm) up the sides of the opening and approximately 1^1/$_2$ inches (38 mm) beyond the face of the foam board at the front of the window opening. The flashing must be flush with the inside edge of the framing members on the inside of the wall. The flashing extending outside of the R-TECH™ One-Coat Stucco Board must be folded over the front face of the foam board. The flashing material must then be cut over the channels in the foam board and gently pushed down into the channels to allow for drainage. See Figure 4 for details.

Flashing of pipe penetrations must be accomplished by sealing around the pipe with flashing complying with AC148. Flashing of other penetrating items must be in accordance with the wall covering manufacturer's published installation instructions.

4.4 Cementitious Exterior Wall Coatings:

R-TECH™ One-Coat Stucco Board and R-TECH™ Gable-Gard may be used with cementitious exterior wall coatings when installed in accordance with this section (Section 4.4).

When used with a cementitious exterior wall coating recognized in an ICC-ES evaluation report, the R-TECH™ One-Coat Stucco Boards are an alternative to 1-inch-thick (25.4 mm), 1.5 pcf density (24.0 kg/m^3), EPS foam plastic insulation specified in the ICC-ES evaluation report on the coating. When installed in accordance with Section 4.3 of this report, the R-TECH™ One-Coat Stucco Boards may be used as an alternative to Type I felt complying with ASTM D226. R-TECH™ One-Coat Stucco Boards used in conjunction with stucco systems where the R-TECH™ One-Coat Stucco Board is not the water-resistive barrier, are not required to be taped.

When used with ICC-ES recognized cementitious exterior wall coatings, the R-TECH™ Gable-Guard installed on attic wall framing is an alternative to 1-inch-thick (25.4 mm), 1.5 pcf density (24.0 kg/m^3), EPS foam plastic insulation specified in the ICC-ES evaluation report on the coating. The R-TECH™ Gable-Guard must be installed, with a water-resistive barrier, directly to open framing with blocked insulation board joints, or must be installed over solid sheathing. Conditions in the evaluation report for the foam plastic insulation as part of the coating system, such as orientation, tongue-and-groove edges, square edges and taping, must be observed. Acceptable coating manufacturers and their respective evaluation reports for the code edition(s) referenced in the individual evaluation report, are as follows:

- Parex USA, Inc. ESR-2564
- StarRcoat, LLC ESR-2099
- EZ-Wall Concentrate, Inc. ESR-2477
- Omega Products International, Inc. ESR-1194
- Superwall Manufacturing, Inc. ESR-2214
- UltraKote Products, LLC. ESR-1471

5.0 CONDITIONS OF USE

The Insulfoam EPS boards described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Installation must comply with this report, the manufacturer's published installation instructions and the applicable code. In the event of a conflict between the manufacturer's published installation instructions and this report, this report must govern.

5.2 The insulation board must be covered with an approved exterior wall covering, including a water-resistive barrier complying with 2018 IBC Section 1402.4 (2015, 2012 and 2009 IBC Section 1404.2) or IRC Section R703.2, as applicable.

5.3 The exterior wall covering spanning between wall framing members must provide the necessary structural resistance to wind and seismic forces.

5.4 Insulation boards must not be used as a nailing base for exterior siding materials. All nailing must be made through the insulation into the wall framing or structural sheathing as required by the siding manufacturer's instructions or the applicable code.

5.5 Except as noted in Section 4.2 of this report, the insulation boards must be separated from the interior of the building with a thermal barrier complying with IBC Section 2603.4 or IRC Section R316.4, as applicable.

5.6 A vapor retarder must be installed where required by IBC Section 1405.3 or 2015 and 2012 IRC 702.7 (2009 IRC Section R601.3), as applicable.

5.7 Use of the foam plastic insulation in areas where the probability of termite infestation is "very heavy" must be in accordance with 2018, 2015 and 2009 IBC Section 2603.8 (2012 IBC Section 2603.9) or IRC Section R318.4.

5.8 For buildings in which the R-Tech One-Coat Stucco Board is used as a water-resistive barrier, all plans must be accompanied by drawings, consistent with the illustrations in this report, that include the following:

a. Installation at all openings, corners and insulation board terminations.

b. Location, configuration and method of sealing of joints between boards and at corners.

c. Typical cross section, showing all components of the wall.

d. Typical wall pipe and window penetrations.

5.9 Insulfoam insulation boards are produced at the locations listed in Table 2 of this report, under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Manufacturer's published installation instructions and descriptive literature.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated June 2015 (editorially revised October 2017), including data in accordance with Appendix B.

6.3 Data in accordance with the ICC-ES Acceptance Criteria for Water-resistive Barriers (AC38), dated August 2016 (Editorially revised April 2018).

6.4 Data in accordance with the ICC-ES Acceptance Criteria for Foam Plastic Sheathing Panels Used as Weather-resistive Barriers (AC71), dated February 2003 (editorially revised January 2018).

6.5 Data in accordance with Section 3.1.7 of the ICC-ES Acceptance Criteria for Cementitious Exterior Wall Coatings (AC11), dated January 2013 (editorially revised May 2018).

6.6 Report containing results of testing performed in accordance with ASTM C578.

6.7 Report containing results of testing performed in accordance with UL 1715.

7.0 IDENTIFICATION

7.1 The insulation board packaging must bear a label with Insulfoam or Thermal Building Concepts, LLC; the manufacturing facility location; the date of manufacture; the evaluation report number (ESR-1788); the density; the flame-spread index (75 or less); and the smoke-developed index (450 or less).

In addition, insulation boards used for installations in attics and crawl spaces, as described in Section 4.2, must be identified as being produced from Styropek, NOVA or Flint Hills Resources LP beads.

The Poly-Guard 136 polyethylene tape is identified with the product name.

7.2 The report holder's contact information is the following:

INSULFOAM, A DIVISION OF CARLISLE CONSTRUCTION MATERIALS, LLC
19727 57th AVENUE EAST
PUYALLUP, WASHINGTON 98375
(253) 271-3056
www.insulfoam.com

7.3 The Additional Listee's contact information is the following:

THERMAL BUILDING CONCEPTS, LLC
1366 ELON DRIVE
WAUKON, IOWA 52172

8.0 OTHER CODES

In addition to the codes reference in Section 1.0, the products in the report were evaluated for compliance with the requirements of the following codes:

- 2006 *International Building Code*® (2006 IBC)
- 2006 *International Residential Code*® (2006 IRC)
- 2006 *International Energy Conservation Code*® (2006 IECC)

The products comply with the above-mentioned codes as described in Sections 2.0 through 7.0 of this report, except as noted below:

- **Uses:** See Section 2.0 except use of the insulation boards in areas of "very heavy" termite infestation is in accordance with 2006 IRC Section R320.5.
- **Design and Installation:** See Section 4.1 except the interior of the building must be separated from the insulation boards with a thermal barrier complying with Section R314.4 of the 2006 IRC and a vapor barrier must be installed in accordance with Section R318.1 and N1102.5 of the 2006 IRC and Section 402.5 of the 2006 IECC.
- **Special Uses—Attics and crawl spaces:** See Section 4.2 except combustion air is provided in accordance with Section 701 and 703 of the 2006 IMC.
- **Conditions of Use:** See Section 5.0.

TABLE 1—DENSITIES AND *R*-VALUES FOR BOARDS

EPS TYPE	NOMINAL DENSITY (pcf)	MINIMUM DENSITY (pcf)	*R*-VALUE PER INCH OF THICKNESS AT 75°F (ft^2-hr-°F/Btu)
I	1	0.9	3.6
VIII	1.25	1.15	3.8
II	1.5	1.35	4.0
IX	2	1.8	4.2

For **SI:** 1 inch = 25.4 mm, 1 pcf = 16.02 kg/m^3, 1°F·ft^2·hr/Btu = 0.176 m^2·K/W, 1°F = 1.8°C+32.

TABLE 2—MANUFACTURING LOCATIONS

LOCATIONS OF INSULFOAM MANUFACTURING	LOCATION NUMBERS FOR PRODUCT IDENTIFICATION
Insulfoam 628 Western Drive Anchorage, Alaska 99501	I-62
Insulfoam 3401 West Cocopah Street Phoenix, Arizona 85009	I-65
Insulfoam 5635 Schaefer Avenue Chino, California 91710	I-64
Insulfoam 1155 Business Park Dr., Bldg. A Dixon, California 95620	I-63
Insulfoam 12601 East 33rd Avenue—Unit 110 Aurora, Colorado 80011	I-42
Insulfoam 1057 Sunburst Lane Mead, Nebraska 68041	I-41
Insulfoam 4500 South Frontage Road Lakeland, Florida 33815	I-46
Insulfoam 501 S. Emerald Road Tooele, Utah 84074	I-43
Insulfoam 19727 57th Avenue East Puyallup, Washington 98375	I-61

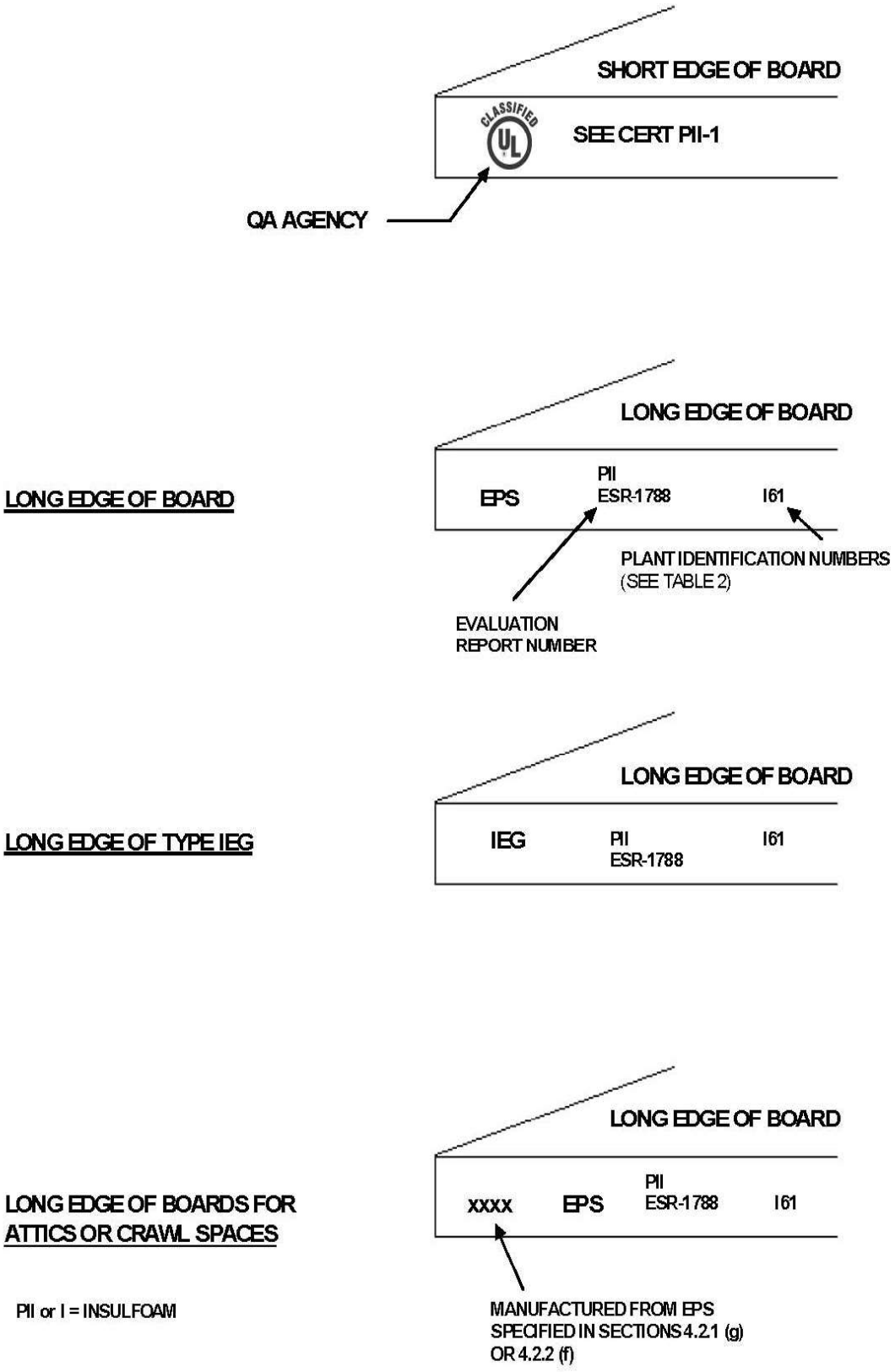


FIGURE 1—MARKINGS

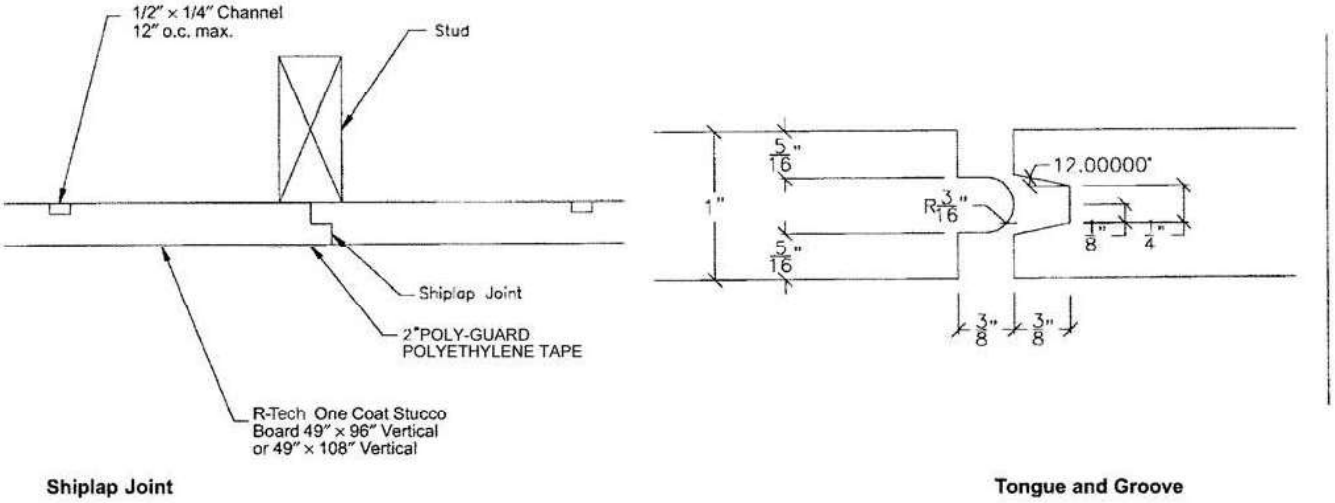


FIGURE 2—R-TECH EDGE DETAILS

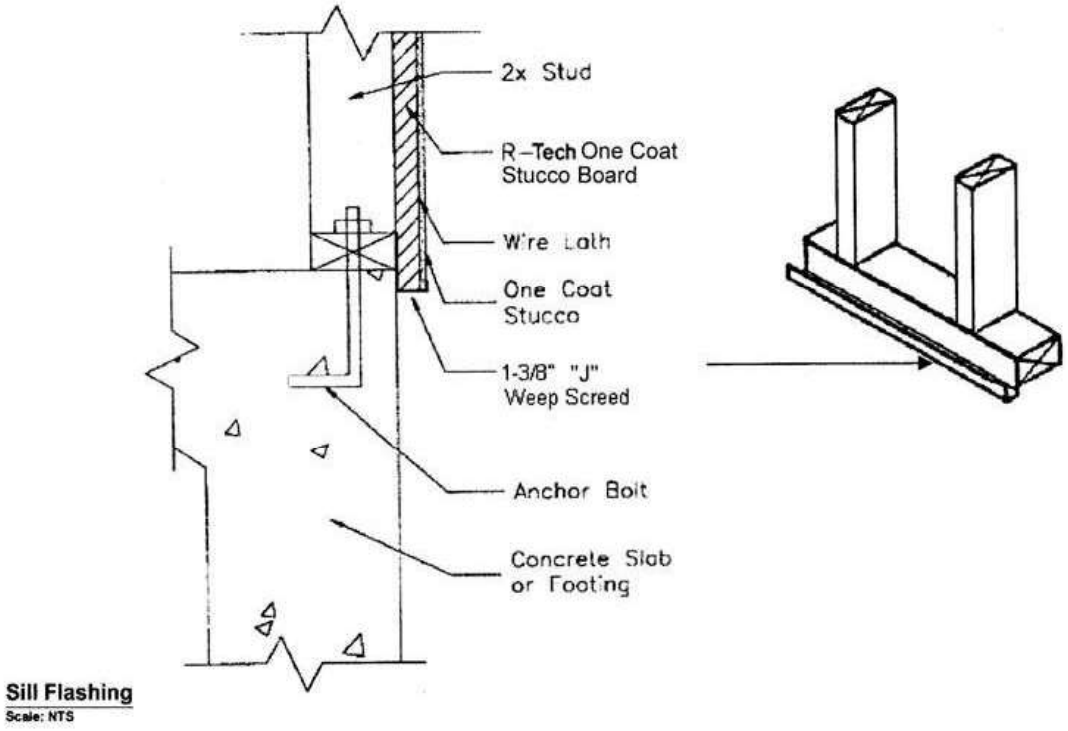
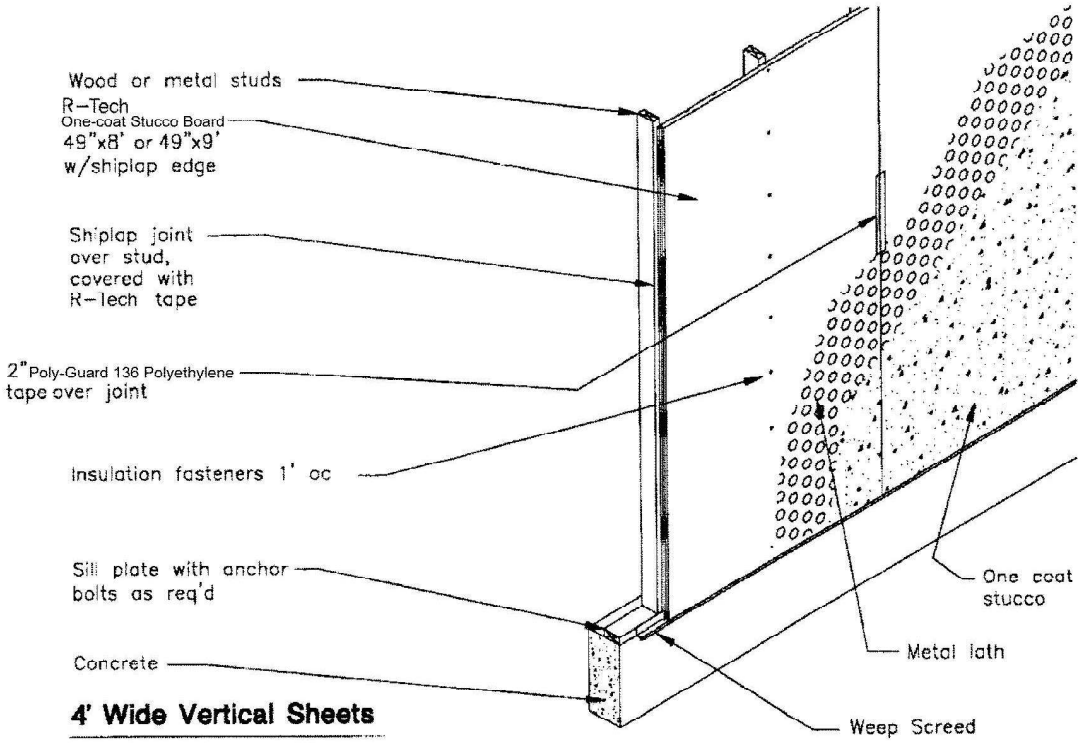


FIGURE 3—INSTALLATION DETAILS FOR R-TECH ONE-COAT STUCCO BOARD INSULATION USED AS A WEATHER-RESISTIVE BARRIER



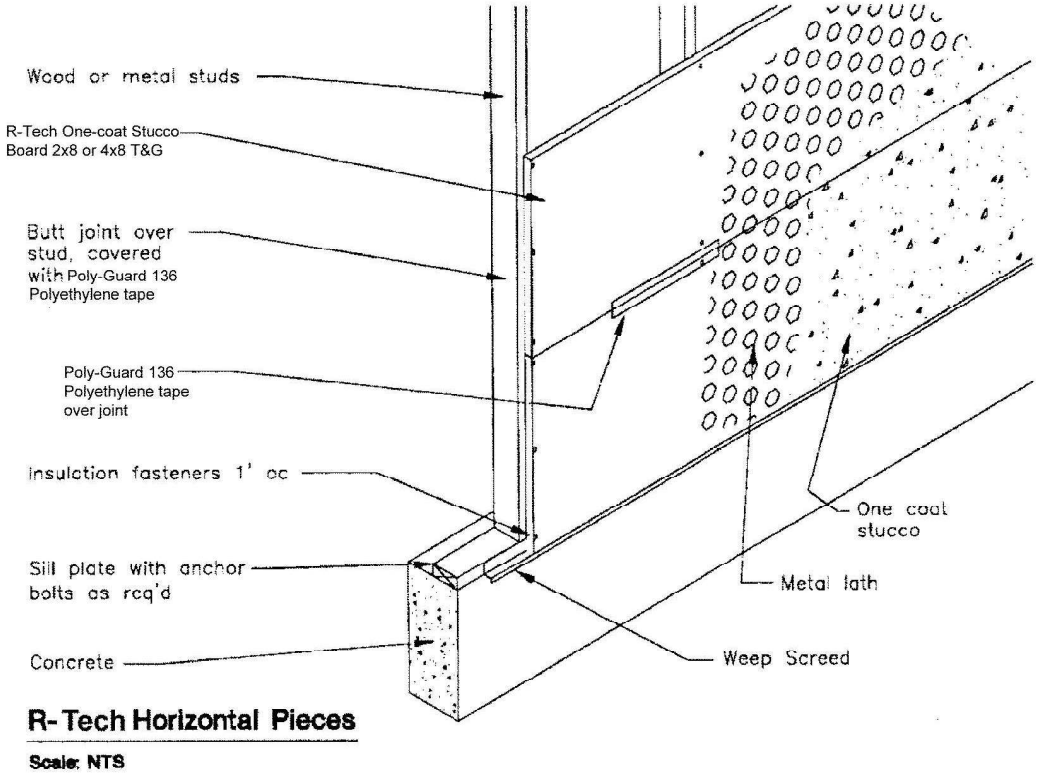


FIGURE 3—INSTALLATION DETAILS FOR R-TECH ONE-COAT STUCCO BOARD INSULATION USED AS A WEATHER-RESISTIVE BARRIER (Continued)

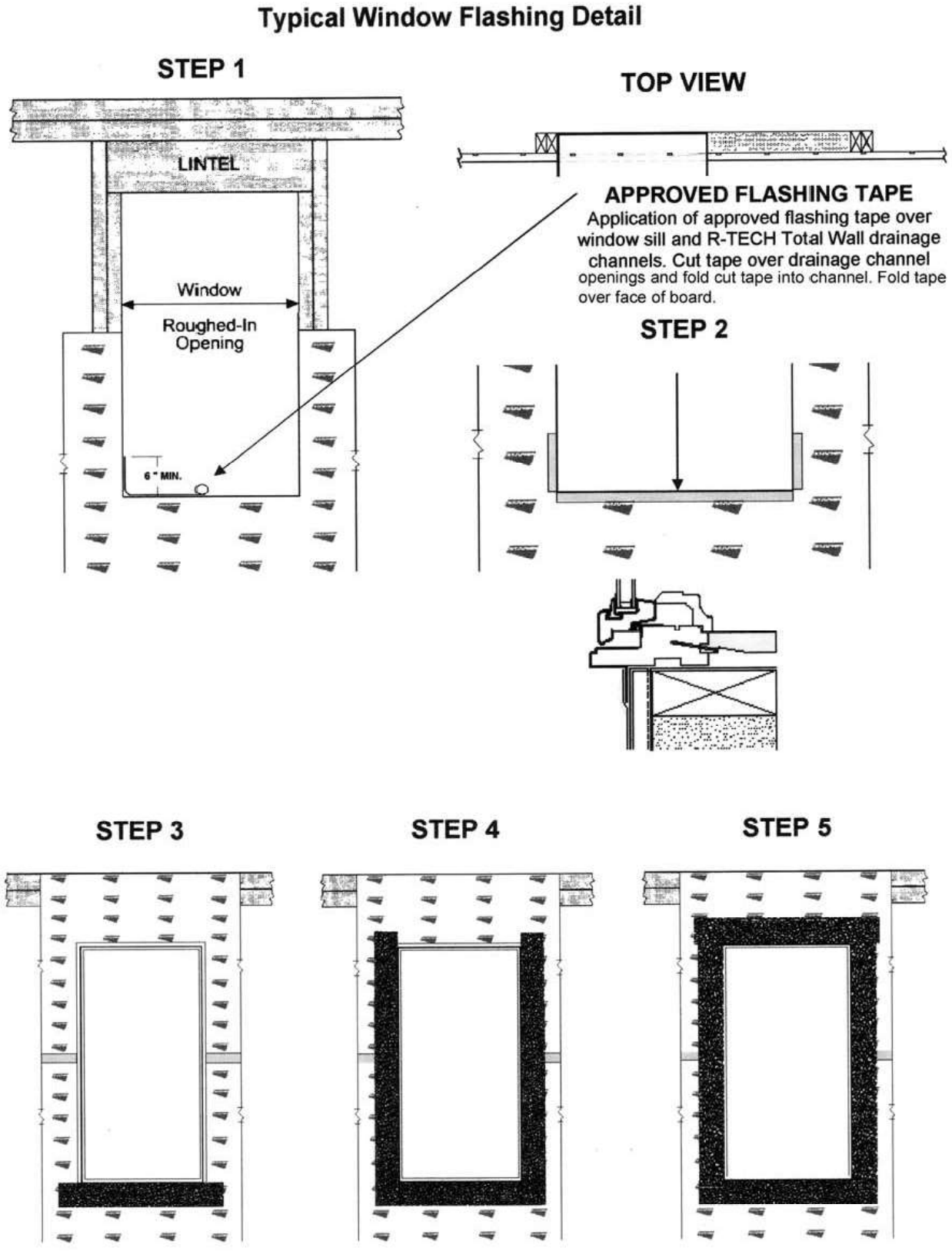


FIGURE 4—INSTALLATION DETAILS FOR R-TECH ONE-COAT STUCCO BOARD INSULATION USED AS A WEATHER-RESISTIVE BARRIER

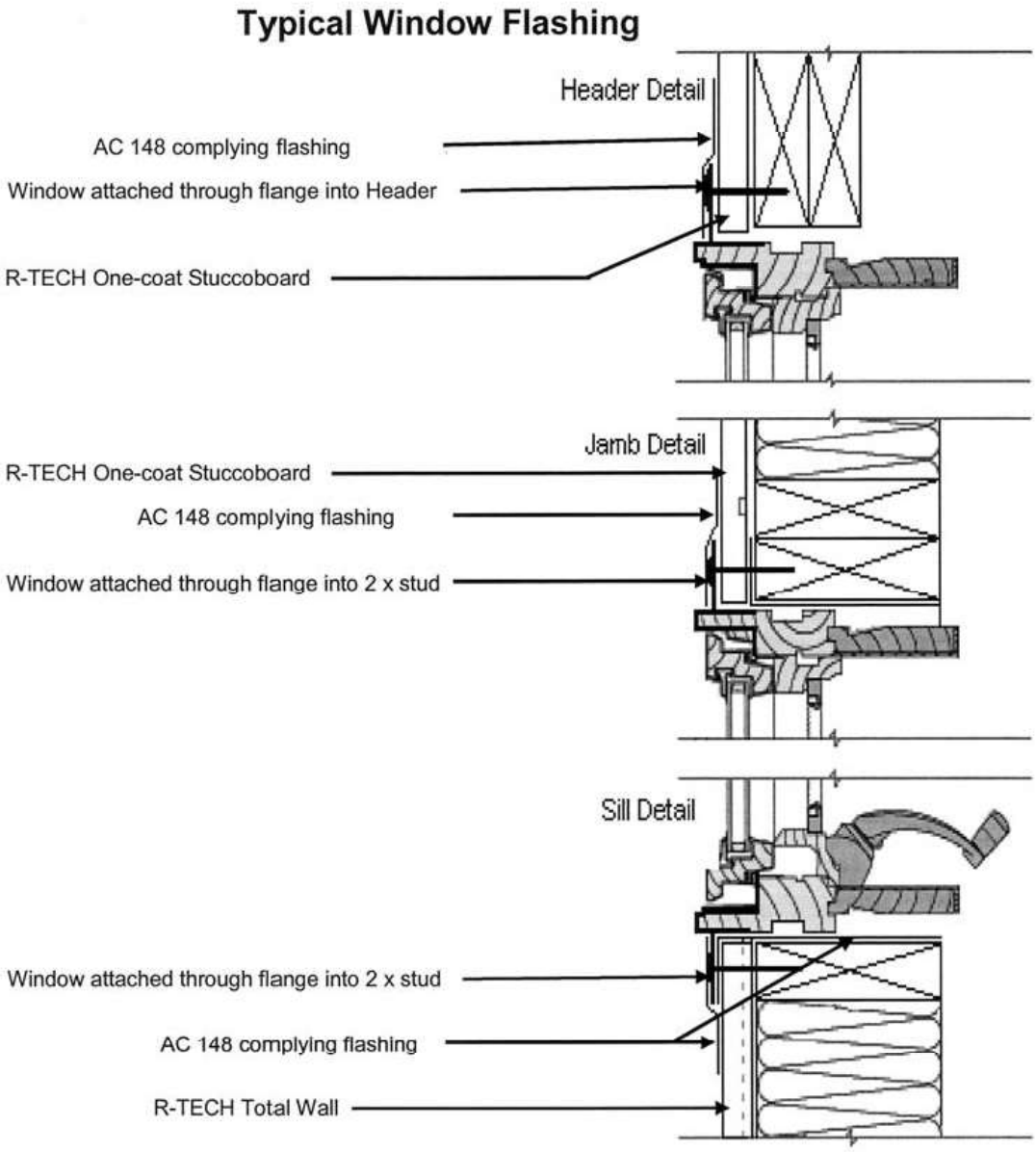


FIGURE 4—INSTALLATION DETAILS FOR R-TECH ONE-COAT STUCCO BOARD INSULATION USED AS A WEATHER-RESISTIVE BARRIER (Continued)

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 21 00—Thermal Insulation
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REPORT HOLDER:

INSULFOAM, A DIVISION OF CARLISLE CONSTRUCTION MATERIALS, LLC

EVALUATION SUBJECT:

INSULFOAM EXPANDED POLYSTYRENE (EPS) AND R-TECH™ AND THERMAL 3 HT INSULATION BOARDS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Insulfoam Expanded Polystyrene (EPS) and R-TECH™ and Thermal 3HT Insulation Boards, recognized in ICC-ES evaluation report ESR-1788, have also been evaluated for compliance with the code*(s)* noted below.

Applicable code edition*(s)*:

- 2019 *California Building Code*® (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) and Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2019 *California Residential Code*® (CRC)
- 2019 *California Energy Code*® (CEC)

2.0 CONCLUSIONS

2.1 CBC:

The Insulfoam Expanded Polystyrene (EPS) and R-TECH™ and Thermal 3HT Insulation Boards, described in Sections 2.0 through 7.0 of the evaluation report ESR-1788, comply with the CBC, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report.

The products have not been evaluated under CBC Chapter 7A for use in the exterior design and construction of new buildings located in a Fire Hazard Severity Zone within State Responsibility Areas or any Wildland–Urban Interface Fire Area.

2.1.1 OSHPD:

The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement

2.1.2 DSA:

The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

2.2 CRC:

The Insulfoam Expanded Polystyrene (EPS) and R-TECH™ and Thermal 3HT Insulation Boards, described in Sections 2.0 through 7.0 of the evaluation report ESR-1788, comply with the CRC, provided the design and installation are in accordance with the 2018 *International Residential Code*® (IRC) provisions noted in the evaluation report.

The products have not been evaluated under CRC Section R337 for use in the exterior design and construction of new buildings located in a Fire Hazard Severity Zone within State Responsibility Areas or any Wildland–Urban Interface Fire Area.

2.3 CEC:

The Insulfoam Expanded Polystyrene (EPS) and R-TECH™ and Thermal 3HT Insulation Boards, described in Sections 2.0 through 7.0 of the evaluation report ESR-1788, comply with the CEC, provided the design and installation are in accordance with the 2018 *International Building Code*® (IBC) provisions noted in the evaluation report.

2.3.1 Conditions of Use:

In accordance with Section 110.8 of the 2019 California Energy Code (CEC), verification of certification by the Department of Consumer Affairs, Bureau of Household Goods and Services, must be provided to the code official, demonstrating that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, "Standards for Insulating Materials." The certification must be verified with the DCA Bureau of Household Goods and Services using the following link to the bureau's Directory of Certified Insulation Materials: https://bhgs.dca.ca.gov/consumers/ti_directory.pdf

The products recognized in this supplement have not been evaluated for compliance with the *International Wildland–Urban Interface Code*®.

This supplement expires concurrently with the evaluation report, reissued May 2020.

For a complete listing of roofing codes go to www.Insulfoam.com.
Click on *Roofing Applications* and select *Technical Information.*

Single Ply Systems

Single Ply- Mechanically Attached

***Class A**
***Deck:** **Combustible or Non-Combustible**
***System:** **Single Ply- Mechanically Attached**
Barrier Board: 1/2" (min.) gypsum board or 1/4" (min.) DensDeck.
Insulation: InsulFoam EPS, Tapered InsulFoam, R-Tech; any thickness, any density.
Membrane: Any UL-Classified EPDM, TPO, PVC, CPE, CSPE, CR, NBP, EIP, EP, PIB or TPA.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Mechanically Attached**
Insulation: InsulFoam EPS, Tapered InsulFoam, R-Tech, InsulLam, InsulVent; any thickness, any density. InsulFoam/wood fiber or InsulFoam/perlite; factory-laminated or field-applied.
Membrane: Any UL-Classified EPDM, TPO, PVC, CPE, CSPE, CR, NBP, EIP, EP, PIB or TPA.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Mechanically Attached**
Insulation: InsulFoam SP; any thickness, any density, mechanically attached.
Membrane: Any UL-Classified PVC, TPO, CSPE or reinforced Carlisle Sure Seal; max. 60 mil.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Mechanically Attached**
Insulation: InsulFoam EPS, Tapered InsulFoam, R-Tech; any thickness, any density.
Slip Sheet: SecurePly
Membrane: Any UL-Classified EPDM, TPO, PVC, CPE, CSPE, CR, NBP, EIP, EP, PIB or TPA.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Mechanically Attached**
Insulation: InsulFoam HD Composite, any thickness, any density.
Membrane: Any UL-Classified EPDM, CPE, CSPE, PVC, NBP, TPA, EIP, or TPO.
Surfacing: See membrane listing.
Note: Classification (A, B or C) will be the same as the classification for the membrane when applied directly over polyisocynaurate insulation. The maximum incline can not exceed 1/2:12

Single Ply- Ballasted Systems

***Class A**
***Deck:** **Combustible or Non-Combustible**
***System:** **Single Ply-Ballasted**
Insulation: InsulFoam EPS, Tapered InsulFoam, InsulFoam HD Composite, R-Tech, InsulLam, InsulVent, InsulFoam SP; any thickness, any density.
Membrane: Any UL-Classified membrane system.
Surfacing: River bottom stone – 1000 lb/sq. min.

Single Ply- Adhered Systems

***Class A**
***Deck:** **Combustible or Non-Combustible**
***System:** **Single Ply- Adhered**
Barrier Board: 1/2" (min.) gypsum board or 1/4" (min.) DensDeck.
Insulation: InsulFoam EPS, Tapered InsulFoam, R-Tech; any thickness, any density.
Membrane: Any UL-Classified EPDM, TPO, PVC, CPE, CSPE, CR, NBP, EIP, EP, PIB or TPA.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Adhered**
Insulation: InsulFoam EPS, Tapered InsulFoam, R-Tech, InsulLam, InsulVent; any thickness, any density.
InsulFoam/wood fiber or InsulFoam/perlite; factory-laminated or field-applied.
Membrane: Any UL-Classified EPDM, TPO, PVC, CPE, CSPE, CR, NBP, EIP, EP, PIB or TPA.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Adhered**
Insulation: InsulFoam SP; any thickness, any density, mechanically attached.
Membrane: GAF Material Corp. EverGuard Freedom TPO or Genflex Roofing System's GenFlex Peel & Stick TPO, max. 60 mil, self-adhered.
Surfacing: See membrane listing.

***Class A**
***Deck:** **Non-Combustible**
***System:** **Single Ply- Mechanically Attached**
Insulation: InsulFoam HD Composite, any thickness, any density.
Membrane: Any UL-Classified EPDM, CPE, CSPE, PVC, NBP, TPA, EIP, or TPO.
Surfacing: See membrane listing.
Note: Classification (A, B or C) will be the same as the classification for the membrane when applied directly over polyisocynaurate insulation. The maximum incline can not exceed 1/2:12

UNDERWRITERS LABORATORIES ROOF SYSTEM APPROVALS

Bituminous Systems

Self-Adhered Modified Bitumen

***Class A**
Deck: **Combustible or Non-Combustible**
System: **Self-Adhered Modified Bitumen**
Barrier Board: 1/4" (min.) G-P Gypsum DensDeck® or 1/2" (min.) gypsum board with 6" offset to plywood joints.
Insulation: InsulFoam EPS, Tapered InsulFoam, InsulFoam SP, InsulFoam HD Composite; any thickness, any density.
Membrane:
1. Polyglass Elastoflex SA V FR Base self-adhered/Polyglass Elastoflex SA V FR.
2. Polyglass Elastoflex SA V FR Base self-adhered/Polyglass Elastoflex VG FR.
3. Soprema EPS Flam Stick self-adhered Sopralene Flam 180 FR+ Granular/ Sopralene Flam 250 FR+ Granular.
4. Soprema EPS Flam Stick FR self-adhered/ Sopralene Flam 180 FR+ Granular/ Sopralene Flam 250 FR+ Granular.

Surfacing: See membrane listing.

***Class A**
Deck: **Non-Combustible**
System: **Self-Adhered Modified Bitumen**
Insulation: InsulFoam EPS, Tapered InsulFoam, InsulFoam SP, InsulFoam HD Composite, InsulLam, InsulVent; any thickness, any density. InsulFoam/wood fiber or InsulFoam perlite; factory-laminated or field-applied.
Membrane:
1. Polyglass Elastoflex SA V FR Base self-adhered/Polyglass Elastoflex SA V FR.
2. Polyglass Elastoflex SA V FR Base self-adhered/Polyglass Elastoflex VG FR.
3. Ridglass Roofgard HD self-adhered Roofgard Blasé-Ply G/Ridglass Roofgard FR G.
4. Soprema EPS Flam Stick self-adhered Sopralene Flam 180 FR+ Granular/ Sopralene Flam 250 FR+ Granular.
5. Soprema EPS Flam Stick FR self-adhered/ Sopralene Flam 180 FR+ Granular/ Sopralene Flam 250 FR+ Granular.

Surfacing: See membrane listing.

Modified Bitumen

***Class A**
Deck: **Non-Combustible**
System: **Modified Bitumen**
Insulation: InsulFoam EPS, Tapered InsulFoam, R-Tech, InsulLam, InsulVent; any thickness, any density.
InsulFoam/wood fiber or InsulFoam/perlite; factory-laminated or field-applied.
Membrane: Any UL-Classified Modified Bitumen.
Surfacing: See membrane listing.

BUR Membrane

***Class A**
Deck: **Combustible or Non-Combustible**
System: **BUR Membrane**
Insulation: InsulFoam EPS, Tapered InsulFoam. R-Tech, InsulLam, InsulVent; any thickness, any density.
InsulFoam/wood fiber or InsulFoam/perlite; factory-laminated or field-applied.
Membrane: 3-5 plies UL-Classified
A. Type 15 (organic)
B. G1 or G2 (fiberglass)
Surfacing:
A. 400 lbs. roofing gravel/square
B. 400 lbs. crushed stone/square
C. 300 lbs. crushed slag/square
D. Type G3 mineral surfaced cap sheet

Maintenance and Repair

***Class A, B or C**
Deck: **Combustible or Non-Combustible**
Existing
Roof System: Class A, B or C built-up smooth surface, cap sheet or gravel surfaced, gravel may be removed.
Insulation: InsulFoam EPS, R-Tech or R-Tech Fanfold; any thickness, any density.
Membrane: Any UL-Classified EPDM, TPO, PVC, CPE, CSPE, CR, NBP, EIP, EP, PIB or TPA.
Surfacing: River bottom stone (3/4"-1 1/2" dia.) at a min. 900 lbs./square.

***Class A, B or C**
Deck: **Combustible or Non-Combustible**
Existing
Roof System: Class A, B or C built-up smooth surface, cap sheet or gravel surfaced (gravel maintained) to retain the existing Classification.
Insulation: InsulFoam SP; any thickness, any density, mechanically attached.
Membrane: Any UL-Classified TPO, PVC or CSPE max. 60 mil., mechanically attached.
Surfacing: See membrane listing.

***Class A, B or C**
Deck: **Non-Combustible**
Existing
Roof System: Class A, B or C built-up smooth surface, cap sheet or gravel surfaced, gravel may be removed.
Insulation: InsulFoam EPS, R-Tech or R-Tech Fanfold; max. 1" thickness, any density.
Membrane: Mechanically attach one of the following:
A. Conklin “Hi-Crown” (CSPE)
B. Burke “358” (CSPE)
C. Stevens Hypalon
D. Seaman Fibertite (EIP)
E. Duro-Last (PVC)
Surfacing: See membrane listing.

***Class A, B or C**
Deck: **Non-Combustible**
Existing
Roof System: Class A, B or C built-up smooth surface, cap sheet or gravel surfaced(gravel maintained) to retain existing classification.
Insulation: InsulFoam EPS, R-Tech or R-Tech Fanfold; max. 1" thickness, any density.
Membrane: Mechanically attach one of the following:
Any UL-Classified EPDM, TPO, PVC, CSPE, EIP, TPA or CPA.
Surfacing: See membrane listing.

***Class A, B or C**
Deck: **Non-Combustible**
Existing
Roof System: Class A, B, or C
Insulation: InsulFoam HD Composite, any thickness, any density.
Membrane: Any UL-Classified EPDM, CPE, CSPE, PVC, NBP, TPA, EIP, or TPO.
Surfacing: See membrane listing.
Note: Classification (A, B or C) will be the same as the classification for the membrane when applied directly over polyisocynaurate insulation. The maximum incline can not exceed 1/2:12

*Contact Insulfoam Representative or consult UL Roofing Materials Guide for more specific listing information.

UL Roof Constructions

InsulFoam EPS Roof Insulations also qualify for the following UL Roof Constructions, as specified in the UL Roofing Materials Guide.
Const. No. 219
Const. No. 237
Const. No. 374
Const. No. 412
Const. No. 419
Const. No. 421
Const. No. 458
Const. No. 631
Const. No. 666
Const. No. 667
Const. No. 669

UNDERWRITERS LABORATORIES HOURLY P-DESIGNS

P225

- Steel Deck
- 5/8" Gypsum WallBoard
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P230

- Steel Deck
- 5/8" Gypsum WallBoard
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P231

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P235

- IRMA-EPS above
- Class A, B, C Roof Cover

P238

- Steel Deck
- Min. 1" Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P246

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P250

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P251

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P253

- Cement Fiber Deck
- InsulFoam EPS
- Class A, B, C Roof Cover

P254

- Steel Deck
- 5/8" Gypsum Wall Board
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P255

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, with or without holes, max. 3"
- Class A, B, C Roof Cover

P259

- Steel Deck
- 5/8" Gypsum Wall Board
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P261

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P262

- Cement Fiber Deck
- InsulFoam EPS
- Class A, B, C Roof Cover

P264

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P269

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P302

- Steel Deck
- 5/8" Gypsum Wall Board
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P404

- IRMA-EPS above
- Class A, B, C Roof Cover

P410

- Steel Deck
- Insulating Concrete with InsulFoam Holy Board, max. 8"
- Class A, B, C Roof Cover

P411

- Steel Deck
- Insulating Concrete with InsulFoam Holy Board, max. 8"
- Class A, B, C Roof Cover

P501

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P503

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P508

- Steel Deck
- 5/8" Gypsum Wall Board
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P509

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P510

- Steel Deck
- 5/8" Gypsum Wall Board
- 1"-thick Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P511

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P513

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P514

- Steel Deck
- 5/8" Gypsum Wall Board
- 1" Mineral Fiber Board
- InsulFoam EPS
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P515

- Steel Roof Truss
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS
- Class A, B, C Roof Cover

Note: Two layers 5/8" gypsum wall board to underside of truss.

P519

- Steel Deck
- 5/8" Gypsum Wall Board
- 1" Mineral Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P520

- Steel Deck
- Insulating Concrete with InsulFoam Holey Board, max. 8"
- Class A, B, C Roof Cover

P521

- Steel Truss System
- Steel Deck
- 1/2" Gypsum Wall board
- InsulFoam EPS, min. 1"-thick, no max. thickness
- Class A, B, C Roof Cover

Note: One layer 5/8" gypsum wall board to underside of truss.

P525

- Steel Truss System
- Steel Deck
- 1/2" Gypsum Wall Board
- InsulFoam EPS, min. 1"-thick, no max. thickness
- Class A, B, C Roof Cover

Note: One layer 5/8" gypsum wall board to underside of truss.

P527

- Steel Truss System
- Steel Deck
- 1/2" Gypsum Wall Board
- Insulfoam EPS, min. 1"-thick, no max. thickness
- Class A, B, C Roof Cover

Note: One layer 5/8" gypsum wall board to underside of truss.

P529

- Steel Truss System
- Steel Deck
- 1/2" Gypsum Wall Board
- InsulFoam EPS, min. 1"-thick, no max. thickness
- Class A, B, C Roof Cover

Note: One layer 5/8" gypsum wall board to underside of truss.

P701

- Steel Roof Deck
- Spray-applied under-deck fireproofing
- 5/8" Gypsum Wall Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P708

- Precast Concrete Units
- Spray-applied under-deck fireproofing
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P710

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P713

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P717

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P719

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1" min., no max. thickness
- Class A, B, C Roof Cover

P725

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P731

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P732

- Spray applied under-deck fire proofing
- Steel Deck
- 5/8" Gypsum Board
- Carlisle Fast 100 adhesive
- Insulfoam EPS-min 1.0" thick, no max overall thickeness, max density 2.5pcf
- Class A, B, C Roof Cover

P734

- Spray applied under-deck fire proofing
- Steel Deck
- Sheathing Material-Carlisle Waterproofing
- 5/8" Gypsum Board
- Carlisle Fast 100 adhesive
- Insulfoam EPS-min 1.0" thick, max density 2.5pcf
- Class A, B, C Roof Cover

P735

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P739

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P741

- Spray applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Board
- Insulfoam EPS-min 1.0" thick, no max overall thickness, max density 2.5pcf
- Class A, B, C Roof Cover

P743

- Spray applied under-deck fireproofing
- Steel Deck
- Vapor retarder
- 5/8" Gypsum Board
- Insulfoam EPS- 1-8" thick, max density 2.5pcf
- Class A, B, C Roof Cover

P801

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P803

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, 1-8"-thick
- Class A, B, C Roof Cover

P810

- Spray-applied under-deck fireproofing
- Precast Concrete Units
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P814

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, no max. thickness
- Class A, B, C Roof Cover

P815

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, no max. thickness
- Class A, B, C Roof Cover

UNDERWRITERS LABORATORIES HOURLY P-DESIGNS

P825

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS, no max. thickness
- Class A, B, C Roof Cover

P828

- Spray-applied under-deck fireproofing
- Steel Deck
- 5/8" Gypsum Wall Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P840

- Spray applied under-deck fireproofing
- Steel Deck
- 5/8” Gypsum Board
- Insulfoam EPS-min 1.0” thick, max density 2.5pcf
- Class A, B, C Roof Cover

P902

- Spray-applied under-deck fireproofing
- Insulating Concrete, 1-8"
- InsulFoam Holey Board, max. thickness 8"
- Class A, B, C Roof Cover

P904

- Precast Concrete Units
- 1-3/4" Mineral & Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P905

- Precast Concrete Units
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P909

- Precast Concrete Units
- 1-3/4" Mineral & Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P910

- Precast Concrete Units
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P912

- Precast Concrete Units
- 1-3/4" Mineral & Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P913

- Precast Concrete Units
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P915

- Precast Concrete Units
- 1-3/4" Mineral & Fiber Board
- InsulFoam EPS
- Class A, B, C Roof Cover

P916

- Precast Concrete Units
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P919

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P920

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P921

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P922

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness 8"
- Class A, B, C Roof Cover

P923

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P925

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P928

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P929

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P930

- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

P936

- Spray-applied under-deck fireproofing
- Steel Deck
- Insulating Concrete
- InsulFoam Holey Board, max. thickness varies
- Class A, B, C Roof Cover

Note: Many systems may allow a vapor retarder. Final determination on acceptability for use must be determined per Underwriters Laboratories Fire Resistance Directory, Volume 1.