OWENS CORNING® FOAMGLAS®

FOAMGLAS® INSULATION SYSTEMS FOR CHILLED WATER APPLICATIONS

CONSIDERATIONS FOR CHILLED WATER INSULATION SYSTEMS

Insulation Efficiency – From the Start

Water vapor intrusion is an important issue for a chilled water insulation system. During construction, relative humidity can reach near 100%. Many insulation system failures begin during construction since air-conditioning systems are typically turned on before the building is completely enclosed, thereby creating a vapor drive to the cold piping and equipment in ambient conditions that exceed the system design operating conditions.

FOAMGLAS® insulation is impermeable to water and water vapor.

Corrosion

The presence of moisture, oxygen, the optimal temperature range and an exposed metal surface are required for corrosion to occur. The presence of chemical contaminants can also contribute to corrosion.

Wet insulation can provide environment of water and oxygen for metal corrosion to occur. In commercial buildings, repairing corroded pipes often requires the removal of drywall, ceiling tiles and other items which block pipe access - greatly adding to the expense of remediation.

FOAMGLAS® insulation will not absorb water and contains no corrosive chemicals.

Quality and Design

Improperly designed systems can lead to dripping condensation, wet ceiling tiles and damage to anything below including furniture and electronics. The cost to remove and replace a failed system is often 3-5 times greater than the initial cost. Wet insulation can also contribute to mold growth, another costly problem when remediation is involved.

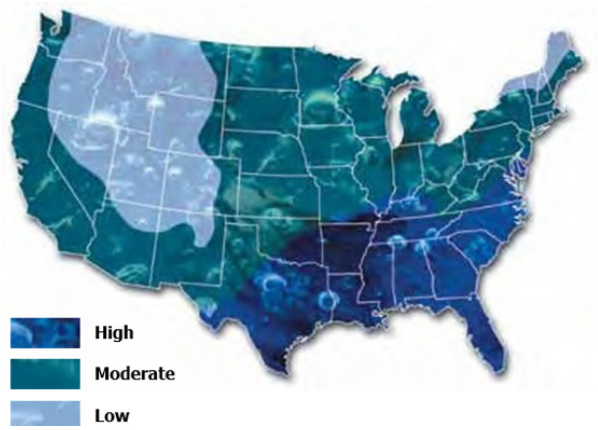
FOAMGLAS® insulation maintains its performance characteristics over time. This helps avoid increased cost of ownership through early renovations and repairs, downtime, and lost thermal efficiencies.

CONSIDERATIONS FOR CHILLED WATER INSULATION SYSTEMS

Moisture Intrusion

Chilled water systems can be located indoors, outdoors, underground, and above ground. They can be subjected to high or low humidity, and operate in conditioned or non-conditioned settings. But no matter where it's located, there is a potential for moisture penetration into the insulation system.

While systems in all areas of the country are subject to moisture damage, there are certain areas more prone to degradation. The figure below illustrates moisture intrusion potential across the United States:



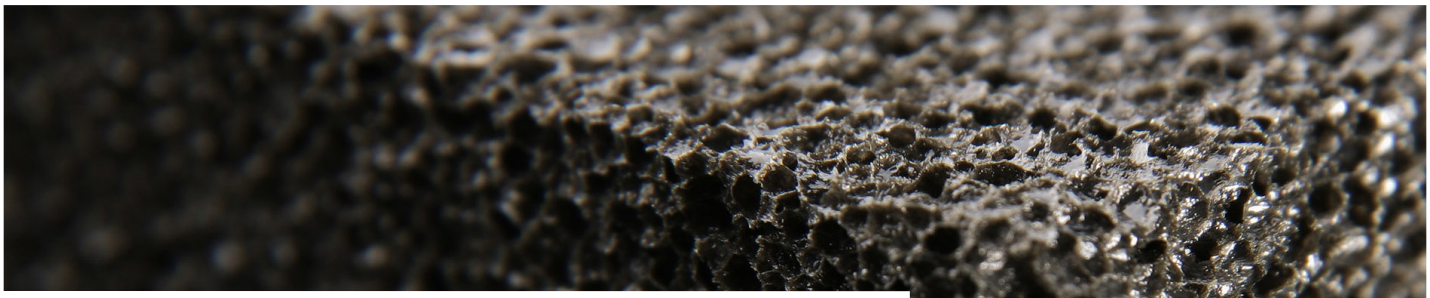
For general purposes only.

Design vs. Real-World Performance

System design should maintain the outer surface temperature of the insulation above the dew point for the likely range in ambient air conditions.

Our team offers technical services for determining required insulation thickness to help prevent surface condensation. A variety of techniques provide insulation thicknesses of adequate accuracy for most applications.

However, any method will be only as good as the design and specification in ambient conditions. Designers are cautioned that calculating average ambient conditions for a particular location may provide quite reasonable insulation thickness values, but this is likely to result in a number of days during which sweating and dripping of condensate could occur.

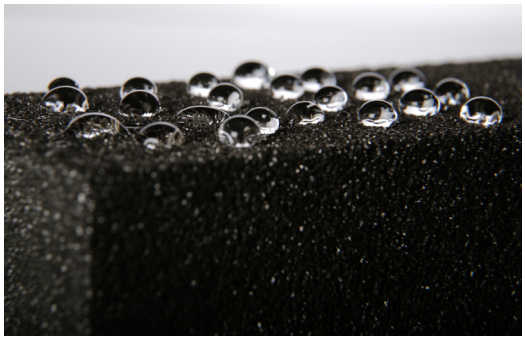


FOAMGLAS® INSULATION SYSTEMS FOR CHILLED WATER APPLICATIONS

FOAMGLAS® cellular glass insulation is a lightweight, rigid material composed of completely sealed cells. This closed-cell structure provides a unique combination of physical properties ideal for piping and equipment below or above ground, indoors or outdoors, at operating temperatures from -450°F to +900°F (-268°C to +482°C).

FOAMGLAS® Cellular Glass Insulation Properties

- Impermeable to water in both liquid and vapor forms
- Non-corrosive
- Non-combustible and fire-resistant
- Non-absorbent
- Resistant to most industrial reagents
- Dimensionally stable under a variety of temperature and humidity conditions
- Superior compressive strength
- Resistant to vermin infestation
- Does not support growth of bacteria or microorganisms



These diverse properties result in a unique combination of benefits and performance.

- Constant, long-term thermal performance helps lower energy demand
- Enhanced process control allows for consistent product quality
- Minimal maintenance or repair of insulation reduces life cycle costs
- Corrosion and fire resistance properties helps protect the insulated equipment
- Helps limit potential for auto-ignition from absorbed combustible liquids or fire from condensed, low-temperature gases
- Proven durability for underground and exterior applications

Environmental and Sustainability

- Owens Corning is a worldwide leader in building material systems, insulation and composite solutions, delivering a broad range of high quality products and services. Owens Corning is committed to driving sustainability by delivering solutions, transforming markets and enhancing lives. More information can be found at www.owenscorning.com.

THE IMPORTANCE OF COMPATIBLE ACCESSORIES

In addition to selecting the proper type of insulation, quality and compatible accessories are important factors that impact the system. Owens Corning® FOAMGLAS® Insulation System accessories are designed to complement the insulation for various types of applications and are key to a system's overall performance.

Sealants

Locally applied at the jobsite, sealants are utilized at joints, metal jacketing laps and around protrusions. Sealants help prevent water vapor entry on low- and intermediate-temperature and cyclic systems. Their function, however, is not to mask poor-fitting insulation. We offer compatible MS polymer-based sealants that are durable, have low temperature flexibility and excellent adhesion to glass surfaces.

Jacketing, Cladding and Mastics

Insulation is typically covered by protective jacketing and/or cladding to provide mechanical protection or act as a barrier to weather or vapor drive.

Jacketing provides mechanical protection on above- or below-ground installations and can act as a weather or vapor retarder. Jacketing can be made of metal, single-layer plastic or laminates incorporating various materials.

Cladding is a heavy-duty protective outer covering typically made of aluminum, steel, or stainless steel. The primary purpose of cladding is for mechanical protection. Cladding is commonly used for outdoor, above-ground systems. A limitation with using cladding is its inability to provide vapor retarder protection, especially on vertical runs.

Mastics are additional materials often used as a protective coating. These are sometimes used in combination with jacketing or cladding.

On piping and equipment with operating temperatures below-ambient, highly reflective materials with low emissivity (such as unpainted metal jacketing) can decrease heat gains. When designing below-ambient insulation systems for maximum condensation protection, less reflective materials with a higher emissivity such as painted metal, solid polyvinyl chloride (PVC), all-service-jacketing (ASJ) or mastic should be selected for the outer surface of the insulation system.

PVC is one of the most common forms of non-metallic jacketing. This is usually seen on indoor, above-ground installations.

Laminate jacketing consists of non-cellulous, multiple laminated fiberglass reinforced polypropylene, PVC, or vinyl faced/metalized film backed jacket. Formats include: (1) ASJ with a low flame-spread-treated kraft paper, typically a glass fiber scrim and aluminum inner face, (2) vinyl/scrim/foil jacketing (VSF), (3) polypropylene, scrim and foil (PPSF), a combination with very low flame spread that can be more economical than VSF and (4) PVC/scrim/foil.

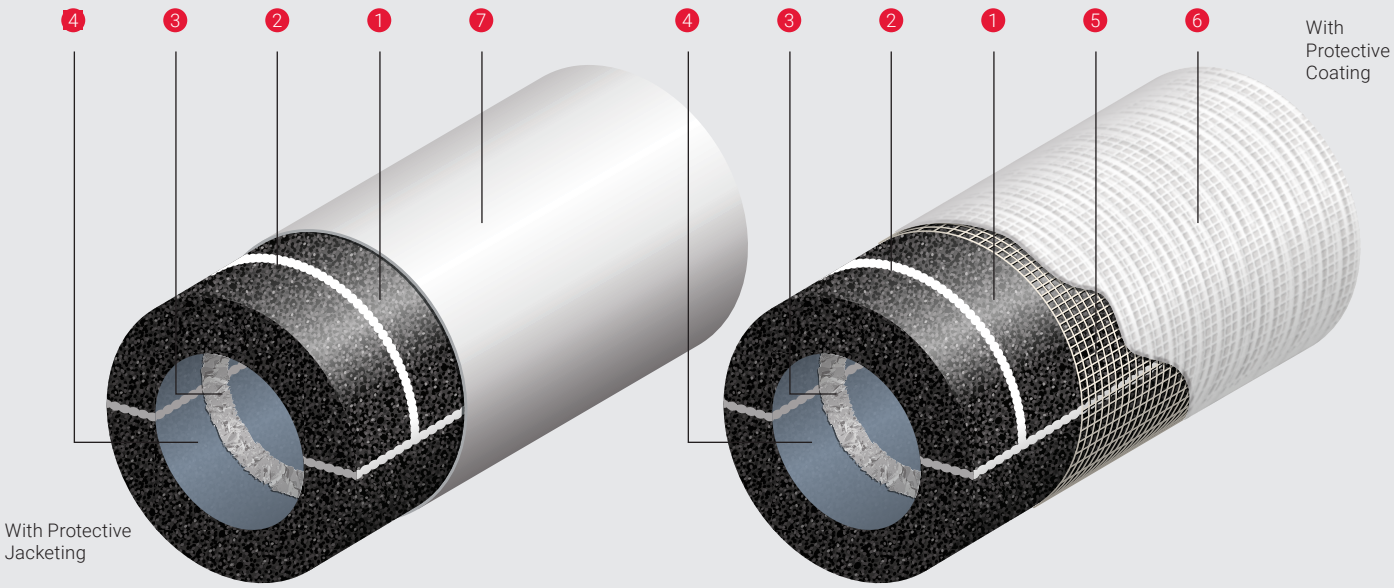
Because FOAMGLAS® insulation is impervious to water vapor with insulation joints fully-sealed, an additional vapor retarder—such as a laminate jacketing—is not required indoors. Laminate jacketing, however, is commonly applied to indoor FOAMGLAS® insulation systems for aesthetic purposes.

On underground systems, special bituminous-containing laminates are available. Their primary function is to provide a waterproof membrane and to help absorb the shock of soil and rock overburden when the insulated pipeline is direct buried.

Contact our team for specifications and recommendations for appropriate chilled water insulation system accessories.

INDOOR CHILLED WATER PIPE SYSTEMS

For use with Reinforcing Fabric and Protective Coating or Protective Jacketing



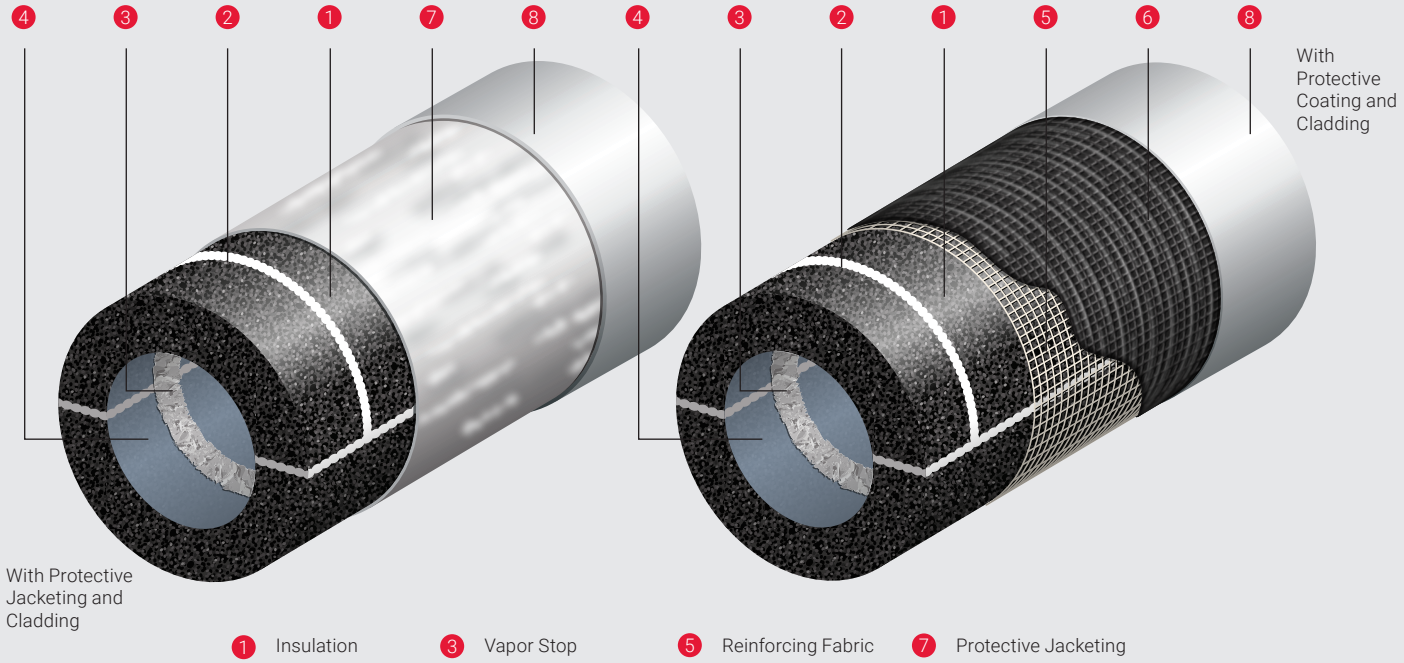
1 Insulation
2 Joint Sealant
3 Vapor Stop
4 Bore Coating
5 Reinforcing Fabric
6 Protective Coating
7 Protective Jacketing

ITEM	PRODUCT NAME	PRODUCT DESCRIPTION	SERVICE TEMPERATURE[1]	SUPPLEMENTAL INFORMATION
1 **Insulation**	FOAMGLAS® Insulation	A lightweight, rigid cellular glass insulation	-268°C to 482°C (-450°F to 900°F)	
2 **Joint Sealant**	PITTSEAL® CW Sealant	MS polymer	-59°C to 104°C (-75°F to 220°F)	VOC compliant For joints, protrusions and laps
3 **Vapor Stop**	PITTSEAL® CW Sealant	MS polymer	-59°C to 104°C (-75°F to 220°F)	VOC compliant
4 **Bore Coating**	PITTCOTE® 16 LTAA	A water-based product	-182°C to 120°C (-296°F to 248°F)	
5 **Reinforcing Fabric**	PC® Fabric 79	Open mesh synthetic fabric	No limit listed	
6 **Protective Coating**	PITTCOTE® 404 Coating	Weather barrier mastic/coating	-34°C to 82°C (-30°F to 180°F)	
7 **Protective Jacketing**	PITTSEAL® CF Jacketing	Cellulose free fiberglass reinforced vapor retarding jacket	-40°C to 104°C (-40°F to 220°F)	Often supplied pre-jacketed for ease of installation
Other	Metal Cladding Foil Wrap Filament Tape			

[1] Service temperature limits are derived from laboratory evaluation of the product. Variations in substrates, loading conditions, or other external factors may further limit service temperature. Always consult Owens Corning® FOAMGLAS® insulation guide specification for suitability for use recommendations for a specific application.

OUTDOOR CHILLED WATER PIPE SYSTEMS

For use with Reinforcing Fabric and Protective Coating or Protective Jacketing



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5 **Reinforcing Fabric**	PC® Fabric 79	Open mesh synthetic fabric	No limit listed	
6 **Protective Coating**	PITTCOTE® 300E Coating	Vapor barrier mastic/coating	-40°C to 93°C (-40°F to 200°F)	Must be protected from UV exposure with metal or other jacketing.
7 **Protective Jacketing Options[2]**	PITTWRAP® B100	Self-sealing aluminum butyl laminate for above-ground systems	-50°C to 140°C (-58°F to 284°F)	
	PITTWRAP® IW50 AL	Self-sealing modified bituminous membrane for above ground systems	-20°C to 75°C (-4°F to 167°F)	Ideal for asphalt roller coated applications
	PITTWRAP® IW30	Self-sealing modified bituminous membrane for above ground systems	-32°C to 38°C (-25°F to 100°F)	
Other	Metal Cladding Filament Tape Metal Bands			

[1]Service temperature limits are derived from laboratory evaluation of the product. Variations in substrates, loading conditions, or other external factors may further limit service temperature. Always consult Owens Corning® FOAMGLAS® insulation guide specification for suitability for use recommendations for a specific application.

[2]Contact us for below-ground options.

VALUE-ADDED SERVICES

Our Global Technical Services & Training team can help to optimize your process performance by supporting you during design, installation, maintenance and follow-up with a periodic assessment of the performance of your insulation systems. Our objective is to give you, accurate and effective technical advice, application guidance and personalized support.

Training and Education
We offer a wide variety of education and training opportunities for all those involved in specifying, procuring or installing FOAMGLAS® insulation systems. We teach proven methods which may help improve installed quality, cost effectiveness, and speed of installation. In addition to our three global training centers in the United States, Europe and China, job-site training and start-up support is available.

Energy and Thermal Imaging Surveys
Assists in the planning for building renovations and identifies deteriorating insulation systems. It helps to determine payback periods for reinsulated systems. This will evaluate the performance of existing thermal insulation on piping and equipment. They are conducted on-site and can help result in energy savings and condensation/ice control.

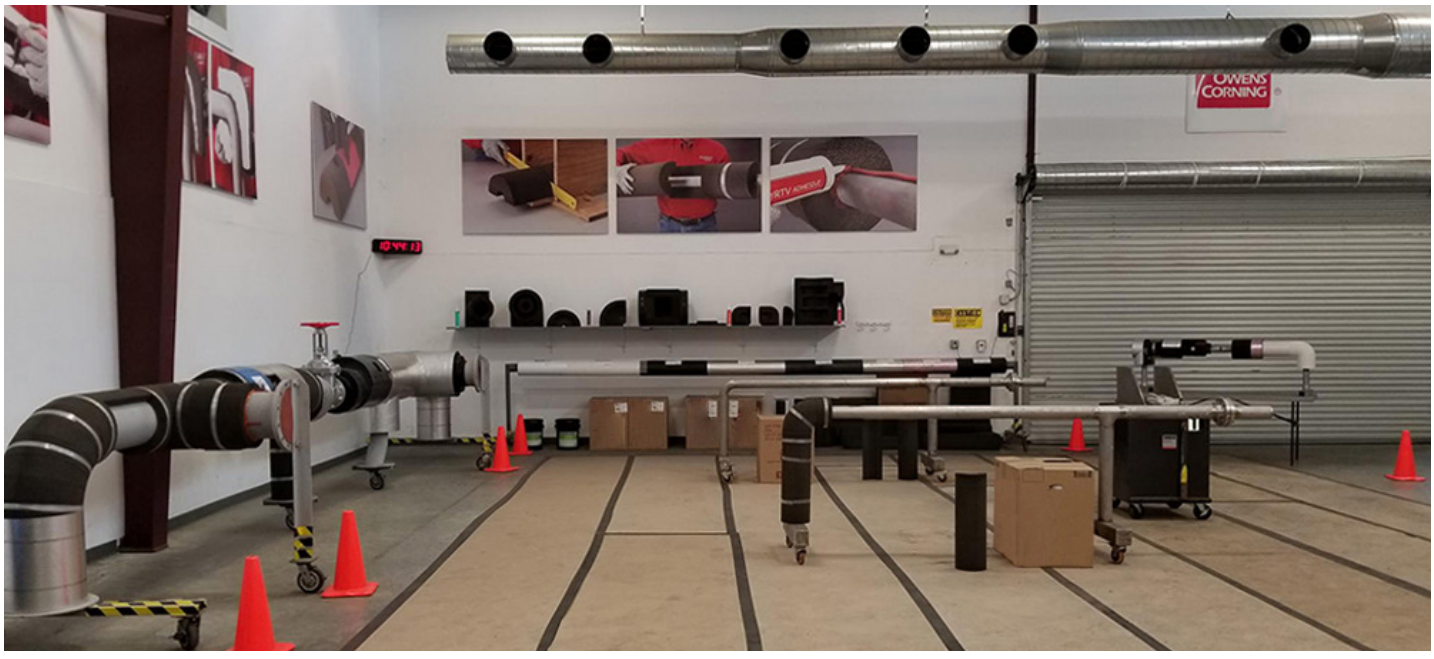
Energy Analysis & Insulation Thickness Calculations
To simplify your insulation specification process, Owens Corning offers an Energy/ Economic Analysis Service and our exclusive Energy Analysis Report (EAR). Developed with customer-specific data subjected to computer analysis and other calculations, EARs assist systems designers in specifying the proper insulation thicknesses for:

- Condensation control
- Process control
- Outlet temperature
- Thickness recommendations due to different type of jacketing

Special Testing Services
We bring together a team of scientists, engineers and industry experts to help resolve critical technical issues for your project, specializing in measuring the behavior of insulation systems in real world applications. We conduct most testing with our own resources, but we also work closely with other organizations for testing services not available in our own laboratories.

Installation Guide Specifications
We maintain FOAMGLAS® Insulation Installation Guide Specifications for a wide variety of commercial and industrial insulation systems, to assist engineers, contractors and facility owners with all aspects of the design, installation and maintenance of their insulation systems. Our experienced Technical Services Engineers will provide you with personalized support and documentation to enable you to achieve your objectives using high-quality, reliable FOAMGLAS® insulation systems.

For more information or to contact our Global Technical Services and Training team, visit www.foamglas.com.



TRAINING CENTER IN FRESNO, TX

TESTING METHODS

When analyzing test results for insulation performance, it is important to use the appropriate test methods for determining performance in a chilled water system:

ASTM E96
(Standard Test Methods for Water Vapor Transmission of Materials)

There is both a "wet cup" and a "dry cup" method to perform this test, which measures water vapor permeability. The "dry cup" method measures materials at 0% relative humidity (RH) on one side and 50% on the other side. The "wet cup" method measures materials at 100% RH on one side and 50% RH on the other side. The "wet cup" method of testing is more indicative of chilled water piping applications in humid climates.

When analyzing test results for insulation performance, it is important to use the appropriate test methods for determining performance in a chilled water system. Chilled water insulation should be selected based on ASTM E96 "water method" test values.

ASTM E84
(Standard Test Method for Surface Burning Characteristics of Building Materials)

This test observes the comparative surface burning characteristics of building materials—versus red oak and inorganic reinforced cement board. "Flame spread index" is a comparative, numerical measure relating to the progress of a flame zone. "Surface flame spread index" is the advancement of flame away from an ignition source across a specimen's surface. "Smoke developed index" is a comparative classification based on smoke observation.

FOAMGLAS® insulation is inorganic and contains no blowing agents with high global warming potential or flame retardants. The insulation is non-combustible, therefore there is no smoke or flame propagation with FOAMGLAS® insulation. FOAMGLAS® insulation has a "flame spread index" rating of 0 and a "smoke development index" rating of 0 when tested according to ASTM E84.

For a listing of UL Through-Penetration Fire-Stop Approved Systems, please visit www.UL.com

NOTES

NOTES

FOAMGLAS®

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