



FOAMGLAS®

LNG INSULATION SOLUTIONS

FOAMGLAS® CELLULAR GLASS INSULATION:

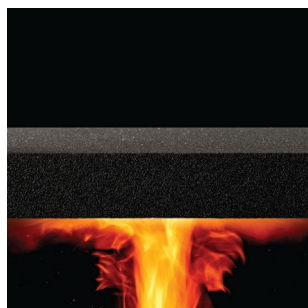
ENGINEERED FOR EXTREMES: FOAMGLAS® INSULATION FOR COLD AND CRYOGENIC DEMANDS

FOAMGLAS® insulation is engineered to meet the demanding requirements of cold and cryogenic insulation systems, where maintaining process temperatures and preventing condensation are critical. It is widely used in applications such as LNG and LPG piping, ammonia and ethylene systems, and low-temperature process lines.

With a proven track record dating back to 1942, FOAMGLAS® insulation has been relied upon for decades in demanding industrial environments. Its closed-cell structure is designed to prevent moisture ingress, even in the event of vapor barrier failure, helping to avoid ice formation. FOAMGLAS® insulation also expands and contracts at a rate similar to steel, reducing the risk of cracking or joint failure. Together, these properties, supported by more than 80 years of proven use, make FOAMGLAS® insulation a trusted solution for long-term performance in extreme cold.



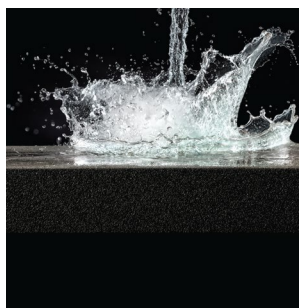
FOAMGLAS® INSULATION BENEFITS



Noncombustible¹

- Noncombustible and nontoxic
- No propagation of flames in event of fire
- Protects process pipework and vessels

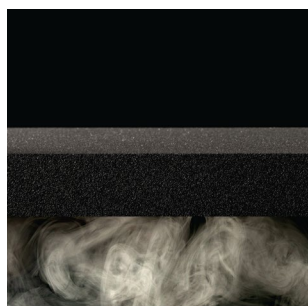
¹Achieves Euroclass A2



Nonabsorbent²

- 100% closed-cell material
- Will not absorb water or combustible fluids
- No warping or swelling

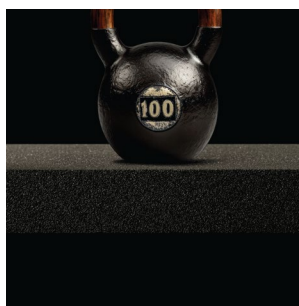
²Foamglas® technical newsletter, 2021



Vapor Impermeable³

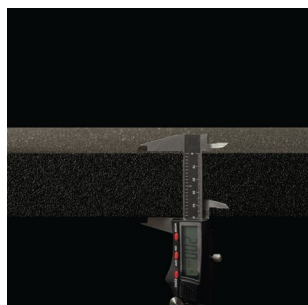
- Prevents the passage of water vapor
- Insulation will not accumulate moisture over time

³ASTMC240, C518/C177, E96



High Compressive Strength

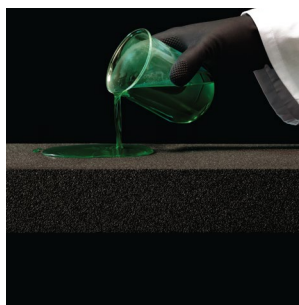
- Designed to withstand high loads



Dimensionally Stable⁴

- Similar thermal expansion and contraction to that of steel piping
- Does not shrink or degrade over time

⁴ASTMC240, C518/C177, E96



Chemical Resistance

- Will not react or corrode with most chemicals

PREFABRICATION: TAILOR-MADE SOLUTIONS

The high demand for custom-made insulation pieces for industrial applications drives the requirement for fabrication of these elements. These elements include pipe insulation, curved sidewall segments, specialty fabricated tank heads, and detailed pipe fittings such as elbows and tees.

Our specially fabricated segments are provided by the Owens Corning global team of channel partners and also by our factory's fabrication operations globally. In addition to the traditional fabrication methods, specialty coatings and membranes can be factory installed, improving the installation efficiency and lowering the labor costs on-site.

PREFABRICATED FOAMGLAS® INSULATION MATERIALS PROVIDE A WIDE RANGE OF BENEFITS:

- Minimizes the amount of on-site cutting
- Fast installation with only two layers or less of FOAMGLAS® insulation required
- More precise fitting pieces
- Easy to remove for inspection
- Easy handling of large sections of insulation
- Virtually every size and shape is possible

Lost time as a result of field-applied coatings can be avoided utilizing factory prefabricated and precoated insulation pieces. We have a variety of finishes available for both hot and cold service.

Available Pre-Applied Coatings Owens Corning (EU)

- HTAA: High temperature anti-abrasive
- Bituminous cell filler for inner and outer layers
- PC® 700K: glass reinforced finish
- TEROSTAT PC® FRi
- PITTWRAP® B100



FOAMGLAS® CELLULAR GLASS INSULATION SYSTEMS

For Cryogenic and Cold Applications

A cryogenic insulation system should be designed and installed for the purpose of preventing condensation and ice on external surfaces and reducing heat flux into the process fluid. The temperature of the fluid in the pipeline must be maintained over long distances. Variations in temperature may reduce process yield and increase carbon emissions. FOAMGLAS® insulation, with its long-term stable insulating efficiency in cold and cryogenic service applications, will limit heat gain into the system.

FOAMGLAS® INSULATION SYSTEMS ARE AVAILABLE FOR:

- LNG piping and equipment
- Low-temperature piping and equipment
- Hydrocarbon fire resistance
- Cryogenic for LNG
- LNG pool fire suppression



FOAMGLAS® INSULATION'S BENEFITS FOR CRYOGENIC SERVICE

- Expands and contracts at a similar rate to steel, avoiding cracks and open joints
- Is 100% impermeable, mitigating moisture ingress when vapor retarders fail⁶
- Is non-combustible, providing passive fire protection where hydrocarbon products are present
- Has a high compressive strength capable of withstanding loads without damage or deformation
- Will not degrade in thermal performance over time

The FOAMGLAS® insulation system often requires only two layers in cryogenic applications. Other insulation systems may require three layers due to product performance or up to ten layers due to thickness availabilities.

In systems operating down to - 60°F (-51°C), FOAMGLAS® insulation can be applied in a single layer, thus avoiding the costly double layering required with alternative systems.

⁶ASTMC240, C518/C177, E96

FOAMGLAS® HIGH LOAD BEARING INSULATION

For Cryogenic and Cold Applications

When considering insulation materials, compressive strength is often overlooked as a distinguishing feature in the choice of insulation materials; however, compressive strength is needed to support loads in many applications such as tank bases, vessels, pipe supports, and hangers. Compressive failure of insulation materials can compromise system performance and lead to damage of mechanical systems and equipment.

FOAMGLAS® cellular glass insulation is available in grades to cover a wide range of compressive strength requirements.

- FOAMGLAS® ONE™ insulation is commonly used in piping and equipment applications, has an average declared compressive strength 90 lb/in² (620 kPa)
- FOAMGLAS® HLB (high-load bearing) insulation products, available in six standard grades, with an average declared compressive strengths ranging from 116 lb/in² (800 kPa) to 348 lb/in² (2400 kPa)

Cold and Cryogenic Tank Base Insulation

In low-temperature applications or cryogenic tank bases, weak or compressible insulation materials may result in unacceptable compression and decrease of thermal insulation performance. This can lead to ground heaving and foundations being brought to temperatures that could result in system failure. Ultimately, rupture in the steel bottom of a tank could occur with a subsequent loss of containment.

Applying FOAMGLAS® HLB insulation under a cryogenic tank can help to control heat gain and reduce risk of system failure. This is why it is often a preferred material for LPG, LNG, LOX, ammonia, ethylene, and liquid nitrogen tanks.



Pipe Supports and Hangers

FOAMGLAS® insulation can eliminate the need for special treatment at pipe supports or cradles and allows for insulation to be continuous without interruption. Its strength also means that cladding or other weather coats are better protected against failures caused by impact and point loading.

Proper design with a FOAMGLAS® insulation system helps to ensure that adequate compressive strength is available to support the system.

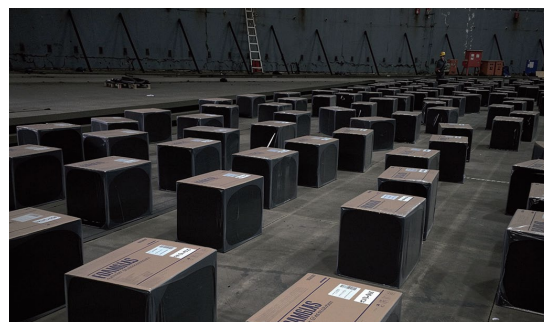
FOAMGLAS® CELLULAR GLASS INSULATION SYSTEMS

For Tank, Vessel, and Sphere Storage Applications

Storage tanks are used to hold a variety of organic liquids or gases including raw materials, intermediates, final products, or usable byproducts. Significant energy is gained and lost due to storage tanks not having proper insulation. FOAMGLAS® insulation's combination of properties makes it the ideal system for multiple types of storage applications in a wide range of temperatures.

FOAMGLAS® INSULATION SYSTEMS ARE AVAILABLE FOR:

- Low-temperature and cryogenic tank bases, walls, and roofs
- Below-ambient storage spheres, and vessels
- Prefabricated, numbered FOAMGLAS® head segments are engineered to match spherical tank geometry, enabling puzzle-like installation that reduces field cutting, labor, and installation time



FOAMGLAS® INSULATION'S BENEFITS FOR STORAGE APPLICATIONS

- Helps prevent the loss of energy by limiting the heat transfer
- Is 100% impermeable and, as such, helps avoid moisture ingress and helps to mitigate corrosion under insulation
- Is fire resistant, which is critical in the presence of hydrocarbon products
- Has a high compressive strength, providing support for tank bases across a wide range of temperatures
- Has an insulation value that does not deteriorate over time

In addition, Owens Corning offers multiple different FOAMGLAS® insulation systems consisting of different in-house PC® Accessory products to cover the requirements of different storage application systems.

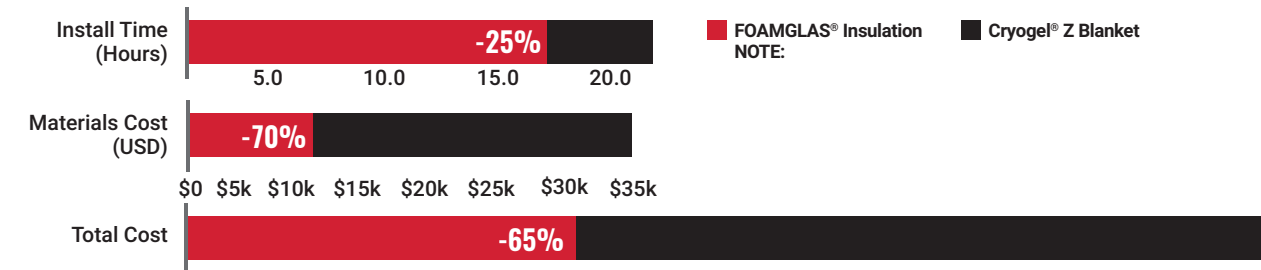
COMPARISON WITH ALTERNATIVE SYSTEMS

Save Up to 65% Compared to Aerogel Insulation Systems

According to the market installation study conducted by an independent third-party insulation contractor, commissioned by Owens Corning Insulating Systems, LLC, in August 2024, FOAMGLAS® insulation can save approximately 70% in material costs and 25% in labor costs compared to cold-service aerogel blankets. Overall, on a project basis, use of FOAMGLAS® insulation can save approximately 65% in materials and labor costs compared to the use of cold-service aerogel blanket insulation.

Based on the results of the study, the use of FOAMGLAS® insulation can save more than \$1,500 per linear foot. These savings, extrapolated over 1,000 feet of pipe, could lead to an overall savings of \$1.5 million.

INSTALLED COST COMPARISON



This is not a guarantee of savings or profit. Results based on insulating an 18-foot, 24-inch OD pipe, 90-degree elbow and tee according to LNG specifications summarized below. Extrapolated savings assume the same ratio of elbows and tees and build-up as sample pipe.

FOAMGLAS® insulation total installed cost is less than half the cost of an installed Cryogel® Z blanket system on a 24" pipe operating at the LNG process temperature of -256°F / -160°C.

Reduce Layering Complexity Vs. Polyisocyanurate (PIR) Systems

There are three major reasons for installing cryogenic insulation in multiple layers:

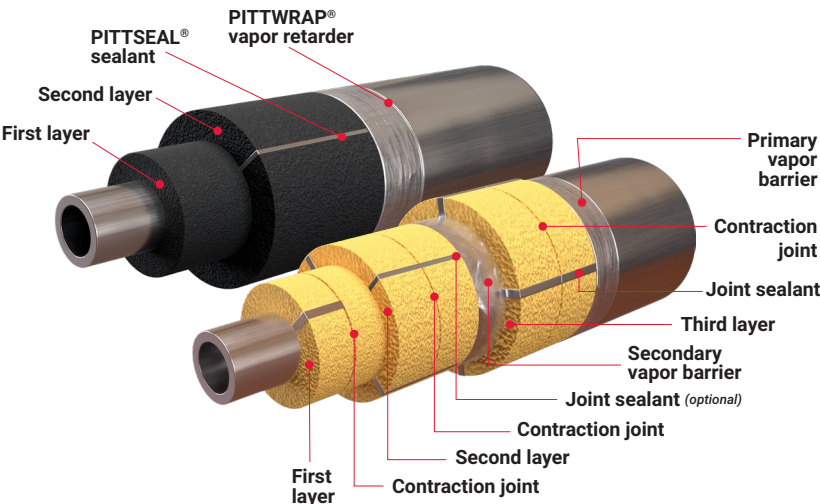
- Ensure appropriate service temperatures for accessories
- Protects the insulation from thermal shock/excessive stresses
- Eliminates thermal shorts in layers

A typical FOAMGLAS® insulation system for LNG applications can be installed in two layers without compromising system longevity. PIR plastic-foam systems may require two to three layers, depending on the total insulation system thickness. Installation of fewer layers can reduce both installation time and cost.



Grain LNG, UK, a two-layer, no-contraction joint, all-FOAMGLAS® insulation LNG piping insulation system.

FOAMGLAS® Insulation System



PIR Insulation System

PIR insulation systems typically require more complex installation than FOAMGLAS® insulation systems. Due to their higher thermal contraction characteristics, PIR systems generally require a greater number of contraction joints, multiple insulation layers, and a secondary vapor barrier. In contrast, FOAMGLAS® insulation is inherently vapor-tight and does not require a secondary vapor barrier. With fewer components and installation steps, FOAMGLAS® systems can help simplify installation, reduce labor requirements, and minimize potential points of failure over the life of the system.

PASSIVE FIRE PROTECTION

For Processing Piping and Equipment

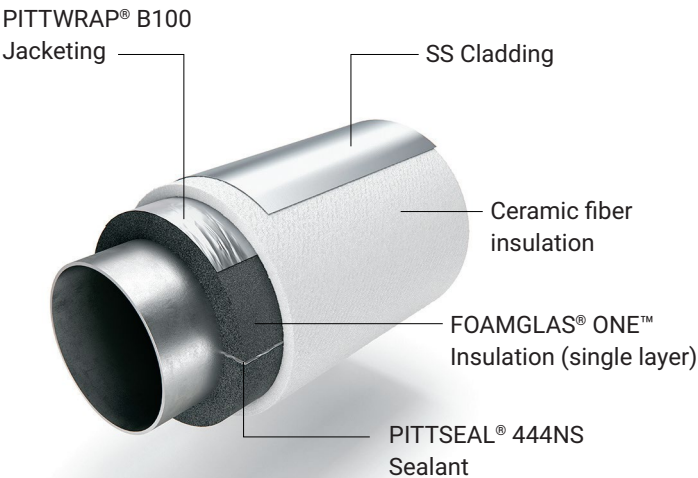
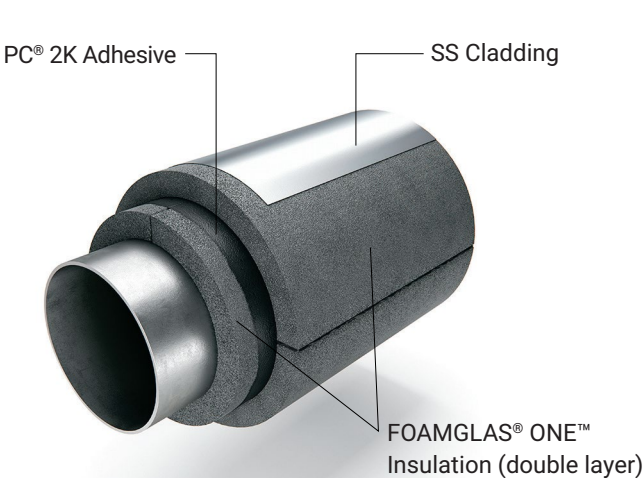
FOAMGLAS® insulation is considered one of the best insulating materials in hydrocarbon processing facilities based on its thermal and fire-resistant properties.

FOAMGLAS® insulation can assist in protecting the steel substrate from the heat of a fire by reducing the heat input and extending the time it takes for the temperature of the protected media to reach critical temperatures. It will not burn, promote flame spread, or produce toxic smoke, maintaining the integrity of escape routes to the temporary refuge.

Multiple FOAMGLAS® insulation passive fire protection systems are currently available to aid in limiting heat flux and protecting the structural integrity of installations during jet fires and hydrocarbon pool fires.



EXAMPLES OF POSSIBLE CONFIGURATIONS



BELOW-AMBIENT ADHERED SYSTEMS	
TEST METHOD	WHERE TO SPECIFY?
UL 1709	• Below ambient • Tanks/vessels • Structural steel • Piping/equipment • Oil and gas processing • Petrochemical

BELOW-AMBIENT ADHERED SYSTEMS	
TEST METHOD	WHERE TO SPECIFY?
Jet fire	• Below ambient • Ambient • Piping/equipment • Tanks/vessels • Structural steel • Oil and gas processing

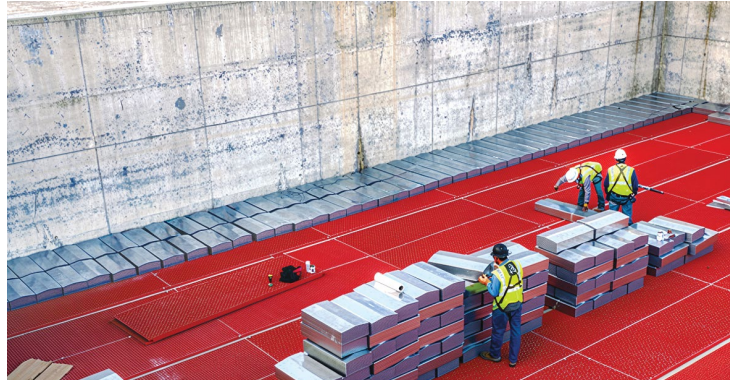
POOL FIRE PROTECTION

For Cryogenic Spill Basins

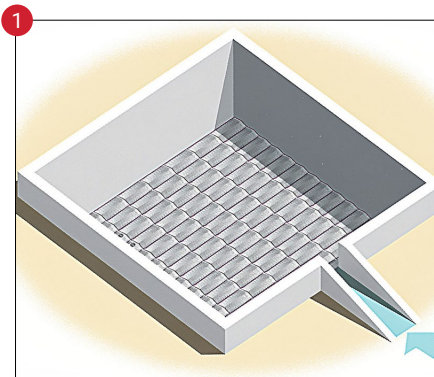
Industrial fire safety. Production demands require oil and gas facilities to run continuously. Many companies communicate successful safety records both internally and externally.

FOAMGLAS® PFS™ Generation 2

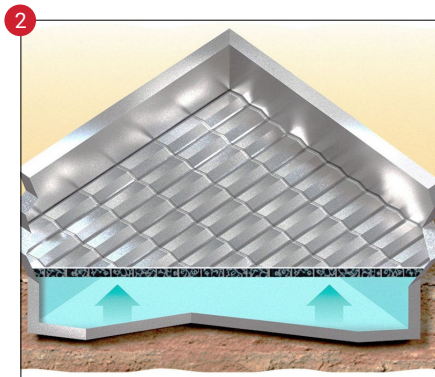
The FOAMGLAS® PFS™ Generation 2 pool fire suppression system complements safety programs by delivering a reliable, low-maintenance passive solution for the reduction of thermal radiation and flame height in contained liquid natural gas (LNG) fires. The FOAMGLAS® PFS™ system is easy to install and can provide immediate mitigation of the thermal flux, rate of combustion and overall size of an LNG pool fire.



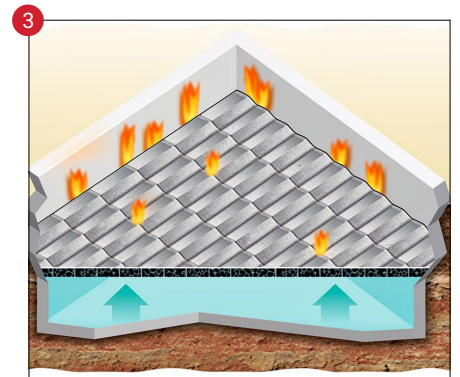
HOW IT WORKS



The FOAMGLAS® PFS™ system is a passive system that remains in place to assist in providing immediate and automatic control of LNG pool fires without deployment delays.



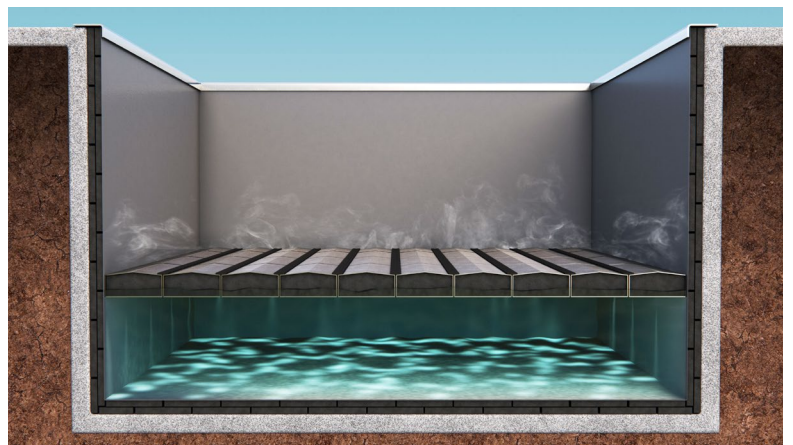
Because the FOAMGLAS® PFS™ system is highly buoyant, the pool fire suppressant modules rise immediately to the surface of the LNG to provide an insulating cap that can aid in reducing vaporization.



In the event of ignition, the FOAMGLAS® PFS™ system modules quickly limit thermal radiation and flame length.

Cryogenic Liquid Spill Protection

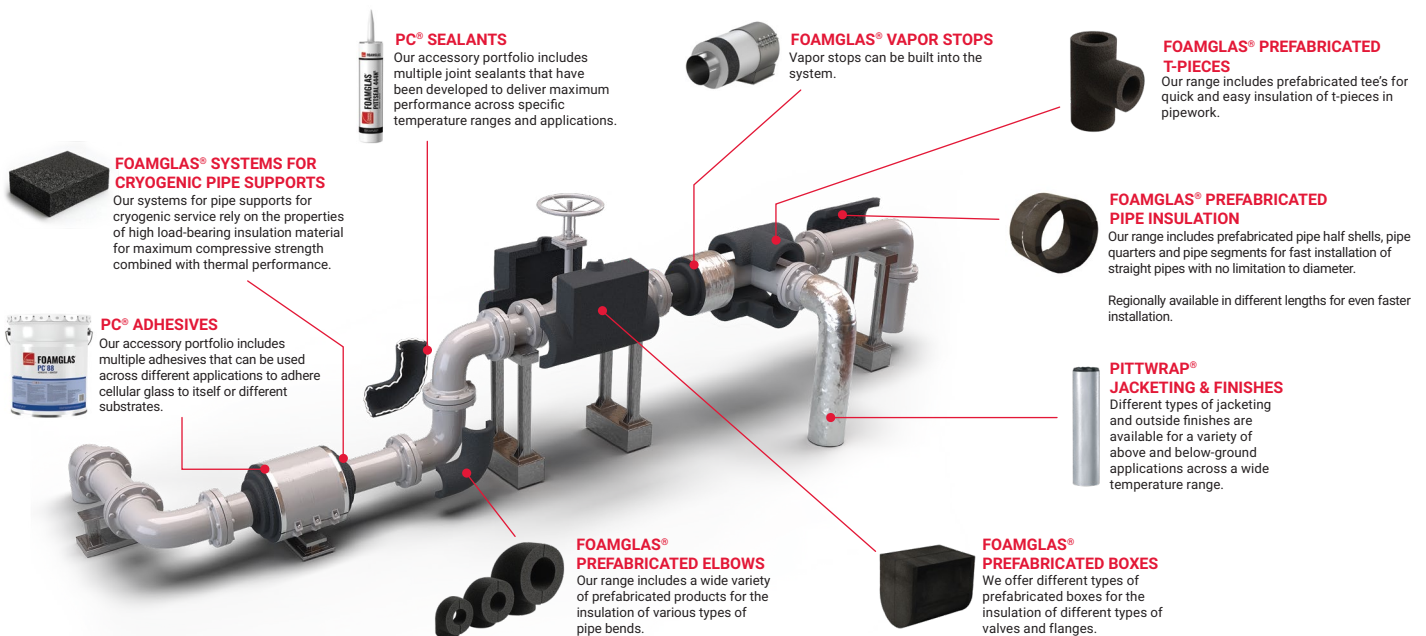
In the event of a cryogenic liquid spill, the FOAMGLAS® Cryo Spill™ System can help reduce the rate of vaporization and provide thermal shock protection to concrete and steel. The Cryo Spill™ System is a passive response solution designed to help protect containment pits from damage during LNG spill containment or other cryogenic liquid spills. Its cellular glass insulation is a critical component of this protective cryogenic insulation system, shielding structural materials from thermal shock while limiting heat transfer into the liquid.



INSULATION PORTFOLIO

FOAMGLAS® systems are supported by a complete material portfolio designed to work together as a fully compatible insulation solution. All accessories, including sealants, adhesives, coatings, fabrics, and jacketing—are specifically engineered and tested for use with FOAMGLAS® insulation to ensure reliable, long-term performance. These systems undergo rigorous third-party material and system performance testing to verify fire performance, environmental durability, corrosion resistance, and service across cold, cryogenic, and hot applications. By providing application-tested, compatible components from a single manufacturer, Owens Corning helps simplify specification, installation, and warranty management while reducing risk in the field.

A TOTAL SYSTEMS PROVIDER FOR HIGH-QUALITY AND LONG-LASTING INSULATION SYSTEMS



Examples of Applications Tested Systems

Service temperatures from -61°F (-52°C) to -292°F (-180°C) (LNG and liquid gases)

A double-layer system of prefabricated shells (PSH), segments (PSG), and shapes is generally sufficient for this temperature range.

The insulation layers shall be designed/manufactured so that the interface temperature of the two layers is not lower than -60°F (-51°C). System shall be applied with staggered joints.

Outer-layer joints shall be sealed with a PITTSEAL® 444NS sealant appropriate for this application.

Service temperatures below -292°F (-180°C) (LIN and LOX)

A multi-layer system of prefabricated shells (PSH), segments (PSG), and shapes is generally recommended for this temperature range.

Many designers and national regulations impose liquid oxygen compatibility requirements to all applications at temperatures below -292°F (-180°C).

Our comprehensive portfolio of in-house accessories allows us to deliver fully application-tested systems utilizing components from a single, trusted manufacturer. This integrated approach provides clear benefits to end users and operators, ensuring compatibility, as well as simplifying support and warranty management.

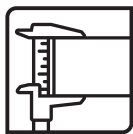
ENGINEERING & SPECIFICATION SUPPORT SERVICES

Our Global Technical Services & Training team can help to optimize your process performance by supporting you during design, installation, and maintenance 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 that help improve installation quality, cost effectiveness, and speed of installation. Training is offered both on-site and off-site at one of our three global training locations, providing flexible learning opportunities to meet the needs of our customers and partners.



Energy Analysis and Insulation Thickness Calculations

To simplify your insulation specification process, Owens Corning offers energy calculations via our exclusive Global Energy Analysis Report (GEAR) software. Developed with customer-specific data subjected to computer analysis and other calculations, GEAR assists 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.owenscorning.com



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