FOAMGLAS® INSULATION SYSTEM SPECIFICATION

FOAMGLAS®
Pittsburgh Corning

Application of FOAMGLAS® Insulation to Chilled Water Piping

I-C-82-07-01 1/2016a

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1. General Notes

1.1 This specification covers the supply and application of FOAMGLAS® insulation to chilled water piping systems operating between -4°C and 15°C (25°F and 59°F) for control of heat gain and surface condensation control. This specification is applicable for indoor or outdoor installations. This specification is valid as for pre-insulation and on-site installation. Additional requirements for the insulation system, such as fire protection and/or acoustic insulation, are not covered by this specification.

1.2 Any deviation from this specification (i.e. alternative accessory materials, design etc.) must be authorized by written approval.

1.3 The product data sheets referenced in the text are listed at the end of the specification. Product data sheets for Pittsburgh Corning products may be accessed on line at: http://www.foamglas.com/

1.4 SI and Metric unit conversions have been rounded to nearest United States customary unit equivalent.

1.5 This specification is subject to revision without notice. Contact Pittsburgh Corning for current revision data before using. This specification is offered as a guide for the purpose described herein and should be employed at the discretion of the user. No warranty of procedures, either expressed or implied, is intended.

2. Codes and Standards

2.1 AISI American Iron and Steel Institute

2.2 ASTM International Standards

2.2.1 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation

2.2.2 ASTM C1639 Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation

2.2.3 ASTM C1729 Standard Specification for Aluminum Jacketing for Insulation

2.2.4 ASTM C1767 Standard Specification for Stainless Steel Jacketing for Insulation

2.2.5 ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

2.2.6 ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

2.2.7 ASTM E 2231 Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

2.3 EN Standards

2.3.1 EN 13501-1, Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire test

2.3.2 EN 13823, Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item

2.3.3 EN 14305, Thermal insulation products for building equipment and industrial installations. Factory made cellular glass (CG) products. Specification

2.3.4 EN 15715: Thermal insulation products — Instructions for mounting and fixing for reaction to fire testing — Factory made products

2.3.5 EN ISO 1182, Reaction to fire tests for building products — Non-combustibility test (ISO 1182:2002)

2.3.6 EN ISO 1716, Reaction to fire tests for building products — Determination of the heat of combustion

2.3.7 EN ISO 9229, Thermal insulation — Vocabulary (ISO 9229:2007)

2.3.8 EN ISO 11925-2, Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame — Part 2: Single-flame source test (ISO 11925-2:2002)

2.4 International Organization for Standardization (ISO)

2.4.1 ISO 9001: Quality management systems — Requirements

2.4.2 ISO 9002: Quality systems. Modelled for quality assurance in production, installation, and servicing.

2.5 United States Coast Guard International Maritime Organization (USCG IMO)

2.5.1 Coast Guard Approval Number: 164.109/55/0

2.6 British Standards (BS)

2.6.1 BS 476-7 Method of test to determine the classification of the surface spread of flame of products

2.6.2 BS 4370-1-4 Method of test for rigid cellular materials

2.7 German Standards (DIN)

2.7.1 DIN 4102-1 Fire Behaviour of Building Materials and Building Components. Section 6.2 – Building Materials of Class B2

3. Preliminary Conditions

3.1 FOAMGLAS® pipe insulation and fabricated fittings should be transported and stored vertically. Packages should be handled with care and protected from the elements while in storage. FOAMGLAS® insulation should not be allowed to come into direct contact with the ground to prevent possible damage or contamination prior to application.

3.2 The surface to be insulated should be clean and free from all traces of grease, rust, dust and any foreign matter. The design engineer should decide whether a protective coating system is necessary, and to also determine if the system is compatible with the service temperature. If the engineer decides to specify an anti-corrosion product, the following rules should be observed:

3.2.1 The specifying engineer or owner shall at their option designate a protective coating system to be applied before the application of any insulation. The application of the product is not a requirement of this specification.

3.2.2 Any surface imperfection should be cleaned with a wire brush and then coated with a new layer of anti-corrosion paint or other suitable product. The surface should be moisture free before the insulation is applied and the product application should follow the anti-corrosion product manufacturer's guidelines.

3.2.3 When an adhesive is used, the compatibility between the anti-corrosion paint and the adhesive should be verified before applying the insulation.

3.3 The surface and the materials used should be dry before and during application, and should remain dry until start-up of the insulated system.

3.4 The application of FOAMGLAS® insulation on pipes or equipment shall be done at ambient temperature. In the event that the system is currently in operation or will be put in operation prior to complete installation of the insulation system, refer to Pittsburgh Corning Specification I-C-82-07-01IS Application of FOAMGLAS® Insulation To Chilled Water Pipes In Service.

3.5 The temperature limits of the accessory products should be respected during both storage and application.

3.6 Hydrostatic, radiographic and other tests should be completed before the insulation is applied in order to assure proper system performance.

4. Design Requirements

4.1 The heat transfers should be limited to acceptable values with respect to both economic and functional aspects. Design thickness criteria will limit heat gain roughly 25 W/m^2 (8 $Btu/hr•ft^2$). In some cases this may also limit condensation (recommended). The insulation thickness shall be determined through calculations based on particular and unique environmental and operating conditions.

The insulation thickness shall be calculated in accordance to ISO 12241, or ASTM C680, and based upon project requirements for heat loss, environmental conditions, etc.

4.2 Piping and equipment shall be insulated according to insulation class, operating temperature and insulation thickness defined in the specifications, piping and instrumentation diagram, line designation table, piping isometrics,

equipment drawings, general arrangement drawings, insulation thickness tables.

4.3 The entire system shall be fully insulated, including all piping components, instruments and tubing, drains to the extent specified.

All metal parts that protrude through the insulation shall be insulated, over a distance of 3 times the insulation thickness whenever possible.

4.4 The insulation at pipes and equipment shall end in such a distance to adjacent flanges, to allow removal of bolts without damage to the insulation.

4.5 The use of joint sealant is recommended on all systems that operate below ambient temperature for any length of time, and is required on systems that operate at or below 2.2°C (36 °F). In cases where the below ambient system is operating at a temperature higher than 2.2°C (36 °F), and the outdoor relative humidity is not routinely expected to exceed 50%, the use of a joint sealant is at the discretion of the design engineer.

5. Materials Used

5.1 Insulation material shall be FOAMGLAS® cellular glass insulation manufactured in accordance with ASTM C552, "Standard Specification for Cellular Glass Thermal Insulation" or EN14305, "Thermal insulation products for building equipment and industrial installations – factory made cellular glass (CG) products – Specification". Pittsburgh Corning's quality system for manufacturing, inspecting, and testing of FOAMGLAS® insulation is certified to meet the requirements of ISO 9001:2008. FOAMGLAS® pipe insulation shall be fabricated according to the requirements of ASTM C1639 "Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation".

5.2 An anti-abrasive coating is only to be applied on the FOAMGLAS® insulation in direct contact with pipe if the system is submitted to frequent and significant thermal movements, to strong vibrations, or in the support areas. The anti-abrasive coating should be applied onto the inner side of the FOAMGLAS® elements which will be in contact with the metal pipe or equipment. The anti-abrasive coating shall be:

5.2.1 Hydrocal® B-11 is a reactive gypsum product that is mixed with water to form an inorganic, non-combustible bore coating.

5.2.2 Any commercially available polyurethane varnish.[1]

5.2.3 Foster Products 30-16 WB Fire Resistive Anti-Abrasion Coating.[1]

5.3 The use of joint sealant and vapor stops are recommended on all systems that operate below ambient temperature and joint sealant is required on systems that operate at or below 2.2°C (36 °F). In cases where the below ambient system is operating at a temperature higher than 2.2°C (36 °F), and the outdoor relative humidity is not routinely expected to exceed 50%, the use of a joint sealant is at the discretion of the design engineer. Joint sealant and vapor stop sealant shall be one of the following:

5.3.1 PITTSEAL® CW sealant supplied by Pittsburgh Corning. A high performance, MS Polymer based sealant used for sealing joints in FOAMGLAS® insulation systems, on chilled water applications.

[1] Product manufacturer information available in Appendix C

5.3.2 PITTSEAL® 444N^{S} sealant or PITTSEAL® 444N sealant supplied by Pittsburgh Corning. PITTSEAL® 444N^{S} sealant and PITTSEAL® 444N sealant are specially formulated butyl sealant used for sealing joints in FOAMGLAS® insulation systems, and to seal protrusions and metal jacket laps.

5.4 Metal Bands shall be AISI type 304 (BSI 304 S16) stainless steel, 13 mm wide x 0.4 mm thick (0.5 in. x 0.016 in.), with matching seals or aluminum bands with matching seals, 13 x 0.5 mm (0.5 in. x 0.020 in.) for piping and equipment with O.D. up to 1219mm (48 in.), 19 x 0.5 mm (0.75 in. x 0.020 in.) for larger O.D.

5.5 Tape shall be a high tensile strength, fiber reinforced tape or equivalent.[1]

5.6 Reinforcing mesh fabric for mastic coating shall be synthetic fabric, 6.5 x 6 meshes, PC® Fabric 79 as supplied by Pittsburgh Corning or approved equal.

5.7 Metal jacket finish for mechanical protection and for outdoor applications shall be one of the following:

5.7.1 Use minimum 0.4mm (0.016 in.) aluminum jacket for insulation O.D.'s of 610mm (24 in.) or less. For larger O.D.'s use 0.6mm (0.024 in.) aluminum jacket. Aluminum jacketing shall conform to ASTM C1729 Standard Specification for aluminum jacketing for Insulation.

5.7.2 Use minimum 0.4 mm (0.016 in.) smooth steel (i.e. stainless galvanized, aluminized, galvalume, etc.) where the FOAMGLAS® insulation system is also being used for fire protection.

5.8 Insulation jacketing for indoor applications, shall be:

5.8.1 PITTWRAP® CF jacketing, a cellulose free fiberglass reinforced vapor retarder insulation jacketing used for protecting above ground indoor FOAMGLAS® insulation systems on chilled water and other moderate temperature service pipelines.

5.8.2 Any non-cellulose multi-ply laminated fiberglass-reinforced polypropylene, PVC, or vinyl faced/metalized film backed jacket. Jacket must not contain known mold or mildew nutrients, and exhibit no mold growth when tested according to ASTM C1338 “Determining Fungi Resistance of Insulation Materials and Facings”.

5.8.3 Proto PVC Jacketing available from Proto PVC Corporation, 10500 47th St., N. Clearwater, FL 33762-5017, (800) 875-7768, http://www.protocorporation.com/ or equal.

5.9 If required, mastic or protective finish shall be:

5.9.1 PITTCOTE® 404 Coating supplied by Pittsburgh Corning (for indoor or outdoor chilled water lines). PITTCOTE® 404 is a flexible, acrylic latex coating used with FOAMGLAS® insulation. PITTCOTE® 404 coating is used with PC® Fabric 79. PITTCOTE® 404 coating is typically used for an insulation finish over indoor fitting insulation when all-service-jacketing is used for the straight run insulation finish.

5.9.2 PITTCOTE® 300 finish supplied by Pittsburgh Corning (for outdoor chilled water lines only where the outer surface temperature of the pipe insulation may routinely fall below 0°C (32°F)). PITTCOTE® 300 finish is a vapor retarder asphalt coating especially formulated for use with FOAMGLAS® insulation. PITTCOTE® 300 finish is for outdoor use. It must be reinforced

[1] Product manufacturer information available in Appendix C

with a synthetic or glass fabric mesh, and must be covered with a metal jacket.

5.9.3 PITTWRAP® B100 jacketing, a 1.2 mm, (47 mil) thick Aluminum/butyl jacketing or equivalent (for outdoor chilled water lines only where the outer surface temperature of the pipe insulation may routinely fall below 0°C (32°F)). PITTWRAP® B100 jacketing must be covered with a metal jacket.

6. Application of Pipe Insulation

6.1 This portion of the application procedure is applicable for piping in all areas, including concealed spaces, mechanical rooms and inhabited areas.

6.2 Before application of the insulation the following procedures should be followed:

6.2.1 Mark location of insulation terminations (at flanges, valves, etc.) on the object.

6.2.2 The insulation of straight piping, bends, T-pieces, equipment heads will be fully fabricated following applicable standards before installation to fit the piping using the fewest number of pieces as possible, and defined by transport conditions.

6.3 The insulation application should include the following procedures:

6.3.1 The FOAMGLAS® insulation shall be applied in one layer when respective FOAMGLAS® insulation thicknesses are commercially available.

6.3.2 The insulation of straight piping, bends, T-pieces, equipment heads will be fully fabricated to fit the piping using the fewest number of pieces as possible, and defined by transport conditions.

6.3.3 The insulation shall be applied with all joints sealed with joint sealer. A continuous seal must be provided for the full length of all joints. Care should be taken to ensure that sealant in the longitudinal and circumferential joints meet in order to avoid sealant gaps. The application of sealant may be by extrusion (gun or cartridges) or bucket with a trowel or putty knife. Using a cartridge or applicator gun, the sealant is applied to the mating surfaces of each half pipe section then, using a trowel or putty knife the sealant is spread to achieve a seal that is the full depth of the insulation thickness. Joint sealer shall not be used to fill voids or cracks.

6.3.4 NOTE: The use of joint sealant is recommended on all systems that operate below ambient temperature and is required on systems that operate at or below 2.2°C (36 °F). In cases where the below ambient system is operating at a temperature higher than 2.2°C (36 °F), and the outdoor relative humidity is not routinely expected to exceed 50%, the use of a joint sealant is at the discretion of the design engineer.

6.3.5 The insulation shall be secured with fiber reinforced tape applied on 300 mm (12 in.) centers, with a 50% overlap of the tape per wrap, or with metal bands. For pipe insulation on piping, below or equal to 76 mm (3 in.), use of bands is at the discretion of the design engineer.

6.3.6 Application of insulation with shop-applied jackets or coatings shall proceed as above, except tape securement of insulation is not required. All joints in the insulation shall be sealed as above with the appropriate sealant.

6.3.7 Fittings shall be insulated in a manner similar to that for piping.

6.4 Valve and flange insulation

6.4.1 Valves and flanges are to be insulated applying the same thickness and layering as the adjacent piping. Vapor stop mastic (if required) is applied to juncture in time to allow complete drying before fitting installation. It is recommended to insulate valves and flanges with prefabricated fitting covers custom made to fit.

6.5 Vapor stop

6.5.1 In situations where the chilled water system is operational before the insulation system is completely installed, vapor stops must be installed at the end of each open section. Refer to Pittsburgh Corning specification I-C-82-07-01IS for application recommendations for in-service systems. Additionally vapor stops must be used at either side of all penetration, insulation system interruptions, and at any FOAMGLAS® insulation to other insulation transition point.

6.5.2 Apply a one inch wide circumferential band of sealant to the inner bore of the FOAMGLAS® pipe insulation at each end of each half-section to form the vapor-stop. This will seal the inside of the pipe insulation to the pipe and provide a vapor stop.

6.5.3 Apply FOAMGLAS® pipe insulation at the vapor stop to piping with all joints sealed a full depth with specified joint sealant. All joints shall be tightly sealed with no voids as specified in 6.3 and shall be applied to conform to Pittsburgh Corning recommendations.

6.6 Miscellaneous

6.6.1 Vertical insulation should be supported in an appropriate manner; the self-supporting height of the insulation is determined by taking the mechanical resistance of FOAMGLAS® insulation into account, as well as the movement during contraction. For the purpose of dead load in a vertical support, the insulation will support its own weight on the face of the butt end of the insulation segment for a distance of 15 m (50 ft.). If insulation supports are used, angle iron or metal plates should be welded onto the vessel or piping to support the insulation. The width of the support should be chosen so as to support the insulation layer(s). To prevent a thermal break, an outer layer of insulation should be applied at the support with the mid-point of the insulation section covering the insulation support ring.

6.6.2 Should the ring be wider, a supplementary layer may have to be installed at the insulation support location. Should there be varying thicknesses of insulation on a vessel; a support should be placed at the point where the different thicknesses meet.

6.6.3 Supports, cradles, skirts and legs welded directly onto the equipment should be insulated with the same thickness of insulating material as the equipment itself in order to avoid thermal bridges. This insulation should extend over a distance equal to four times the insulation thickness and should never be less than 30 cm (12 in.). The cradle shall be designed to provide a sufficient bearing area to limit the compressive force on the insulation to 1.4 kg/cm2 (20 psi) maximum at any point.

6.6.4 Hollow spaces or voids between the substrate and insulation should be filled with pieces of FOAMGLAS® insulation and sealed with sealant.

7. Application of Insulation to Pipe Supports

7.1 Several factors govern the pipe span (spacing between supports) and size of the cradle (length, rolled width and thickness). The following are some general recommendations for the use of FOAMGLAS® insulation at pipe supports. Additional information on the use of FOAMGLAS® insulation at pipe supports is available in Pittsburgh Corning Specification I S-83-07-01 Guidelines for using FOAMGLAS® Insulation at Pipe Hangers and Supports. Contact Pittsburgh Corning for recommendations on specific situations or systems that are not covered here.

7.2 Coat the bore of the FOAMGLAS® pipe insulation to be used in the support area with a recommended bore coating (section 5.2).

7.3 Coat the outer surface of the FOAMGLAS® pipe insulation to be used in the support area with bore coating, or the recommended mastic finish (section 5.2 and 5.9).

7.4 Refer to Tables 1 & 2 (Appendix A) for proper support configuration. Note that the metal load-spreading plate needs to be thicker when used with point loading supports than with hangers. A pipe support manufacturer will be able to advise in more detail.

7.5 See Figures 1 through 7 (Appendix B) for typical support designs.

8. Insulation Finish

8.1 Indoor Field-Applied jacketing. Apply 8.1.1 and 8.1.2 or apply 8.1.3.

8.1.1 If prefabricated fitting covers are not used, apply mastic and fabric finish to fittings according to manufacturer's recommendations over the completed insulation installation.

8.1.2 Apply jacketing see section 5.8 in accordance with manufacturer's instructions ensuring a minimum 51 mm (2 in.) lap at all joints, both circumferential and longitudinal. Laps shall be either adhesive faced (self-seal) or sealed by field application of appropriate adhesive. Staples shall not be used.

8.1.3 Apply metal jacketing according to manufacturer's recommendations ensuring a minimum 51 mm (2 in.) lap at all joints, both circumferential and longitudinal. Seal laps in metal jacket with PITTSEAL® 444N^{S} sealant or PITTSEAL® 444N sealant if the system is subject to wash down or where required by the owner.

8.2 Finish on Outdoor Systems.

8.2.1 On outdoor applications where the surface temperature of the pipe may reasonably be expect to reach or fall below 0°C (32°F), protective coatings, membranes, or finishes will be installed. This material will fill the surface cells of the FOAMGLAS® insulation to improve mechanical resistance of the system, improve freeze-thaw protection of the system, and to serve as an additional barrier to vapor and liquids.

8.2.2 If prefabricated fitting covers are not used, apply mastic and fabric finish to fittings according to manufacturer's recommendations over the completed insulation installation.

8.2.3 Metal jacketing shall be applied with all laps positioned to shed water. All laps shall be a minimum of 51 mm (2 in.). Aluminum jacketing shall be secure

using bands and seals of similar materials. Band spacing shall be per jacketing manufacturer's recommendations. Butyl rubber or uncured EPDM based membrane/Metal jacket.

9. Inspection

9.1 The general contractor, insulation contractor and owner shall provide sufficient inspection during the insulation and finish application. Continuous inspection of the application is not to be considered a requirement of Pittsburgh Corning.

9.2 Inspect all insulation and accessory materials to be certain they are applied in conformance with the specification recommendations. Joints should be tight, sealing and flashing should be thorough and water-tight, and finishes should be uniform and free of defects.

10. Quality Assurance

10.1 The insulation manufacturer's quality system including its implementation, shall meet the requirements of ISO 9001:2008.

11. Certificates

11.1 The manufacturer will furnish evidence of compliance with the quality system requirements of ISO 9001:2008.

12. Product Data Sheets

12.1 Product data sheets for Pittsburgh Corning products may be accessed on line at: http://www.foamglas.com/. The following are Pittsburgh Corning products referenced in this specification:

12.1.1	FOAMGLAS® ONE™ Insulation	FI-003
12.1.2	Hydrocal® B-11	FI-169
12.1.3	PC® Fabric 79	FI-159
12.1.4	PITTCOTE® 300 finish	FI-120
12.1.5	PITTCOTE® 404 coating	FI-138
12.1.6	PITTSEAL® 444N^{s} sealant	FI-164s
12.1.7	PITTSEAL® 444N sealant	FI-164
12.1.8	PITTSEAL® CW sealant	FI-269
12.1.9	PITTWRAP® B100 jacketing	FI-281
12.1.10	PITTWRAP® CF jacketing	FI-288

13. Appendix A: Pipe Support Schedules

TABLE 1

CRADLE SUPPORT SCHEDULE CONFIGURATION

Nominal Pipe Diameter *mm (in.)*	Insulation Thickness *mm (in.)*	Cradle Thickness for Clevis Hangers *Gauge/mm (in.)*	Cradle Thickness for Point Load and Roller Applications *mm (in.)*	*Cradle Length mm (in.)*	*Span m (ft.)*
21 to 33 (½ To 1)	38 to 76 (1 ½ to 3)	14 GA / 1.89 (0.0747)	12 GA / 2.65 (0.1046)	254 (10)	2.13 (7)
48 to 60 (1½ to 2)	38 to 89 1½ to 3½	14 GA / 1.89 (0.0747)	12 GA / 2.65 (0.1046)	254 (10)	3.04 (10)
73 to 89 (2½ To 3)	38 to 102 (1 ½ To 4)	12 GA / 2.65 (0.1046)	10 GA / 3.41 (0.1344)	254 (10)	3.65 (12)
102 to 114 (3 ½ & 4)	39 to 114 (1 ½ To 4 ½)	12 GA /2.65 (0.1046)	10 GA / 3.41 (0.1344)	254 (10)	4.27 (14)
141 & 168 (5 & 6)	39 to 114 (1 ½ To 4 ½)	10 GA / 3.41 (0.1344)	3/16 / 4.74 (0.187)	254 (10)	5.18 (17)
219 to 324 (8 To 12)	39 to 140 (1 ½ To 5 ½)	10 GA/ 3.41 (0.1344)	See Table 4	305 (12)	6.1 (20)
356 to 508 (14 To 20)	39 to 152 (1½ To 6)	3/16 in. / 4.74 (0.187)	See Table 4	607 (24)	6.1 (20)
559 to 619 (22 To 24)	39 to 165 (1 ½ To 6 ½)	3/16 in. / 4.74 (0.187)	See Table 4	762 (30)	6.1 (20)

Cradle/ shield material ASTM A 1011 Galvanized Carbon Steel. Table is based on spans for ASTM A53 Grade A Carbon Steel pipe, maximum allowable stress in tension 12,000 psi. Use this table in conjunction with Section 5.6. For conditions not covered in this table or Table 2, contact a pipe support manufacturer such as National Pipe Hanger Corporation, 200 Campus Drive Mount Holly, NJ 08060 USA +1 609 261 5353 Fax: +1 609 261 3249 http://www.nationalpipehanger.com

TABLE 2

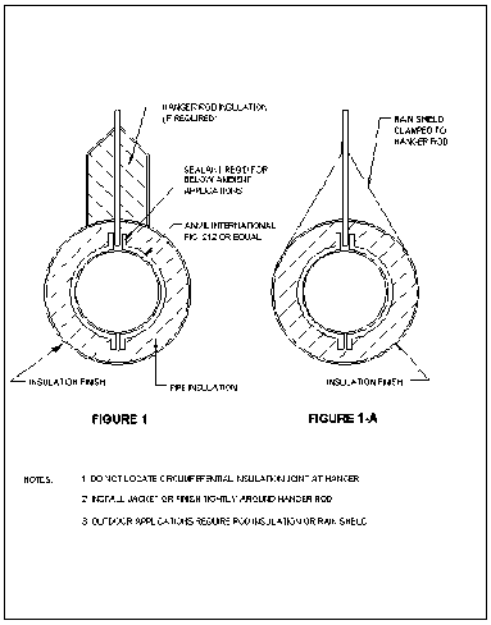
CRADLE SUPPORT SCHEDULE FOR POINT LOAD CONFIGURATION FOR 219mm (8 in.) to 618 mm (24 in.) NPS DIAMETER LINES

NOMINAL PIPE DIA. *mm, (in.)*	INSULATION THICKNESS *mm, (in.)*	CRADLE THICKNESS *mm, (in.)*	CRADLE LENGTH *mm, (in.)*	SPAN *m, (ft.)*
219 to 324, (8 To 12)	39 to 140, (1½ To 5½)	3/16 in. : 4.74, (0.187)	457, (18)	6.1, (20)
345 to 508, (14 To 20)	39 to 152, (1½ To 6)	3/16 in. : 4.74, (0.187)	607, (24)	6.1, (20)
559 to 618, (22 To 24)	39 to 165, (1½ To 6½)	3/16 in. : 4.74, (0.187)	607, (24)	6.1, (20)

14. Appendix B: Technical Drawings

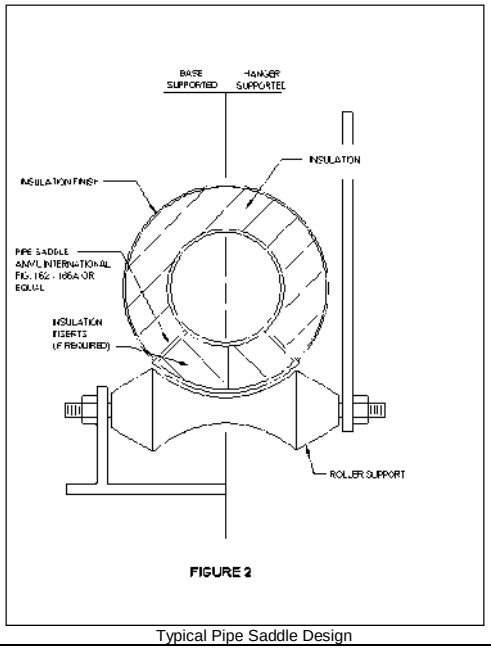
14.1 Appendix B1: Support Details

FIGURE 1



Typical Pipe Hanger Design

FIGURE 2



Typical Pipe Saddle Design

FIGURE 3

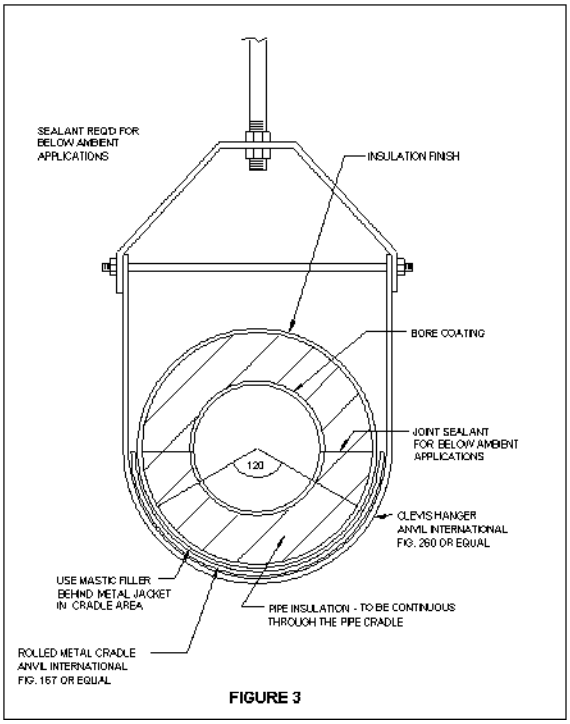
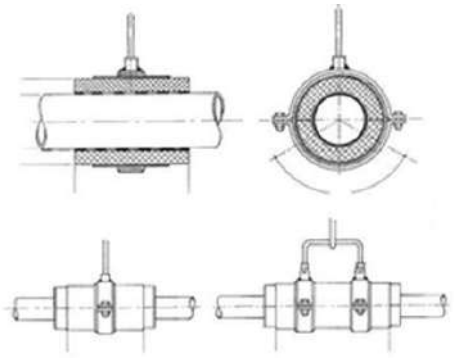


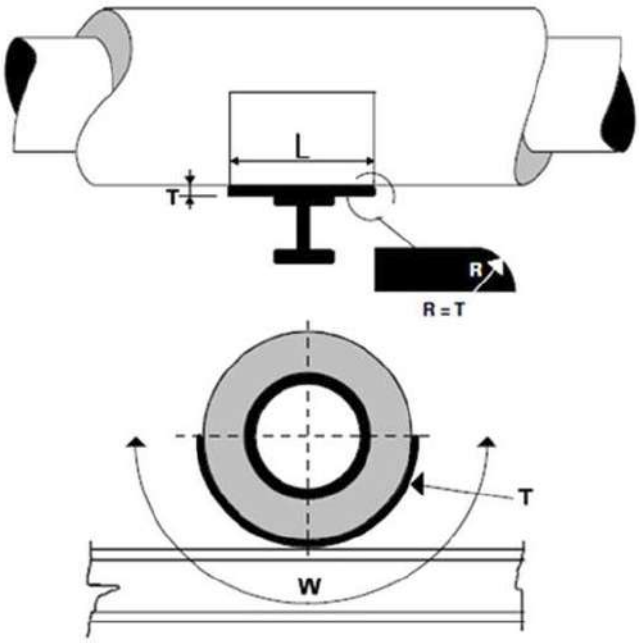
FIGURE 4



Typical Clevis Hanger Designs

14.2 Appendix B2: Support Details Continued

FIGURE 5



Typical Sliding Support Design

FIGURE 6

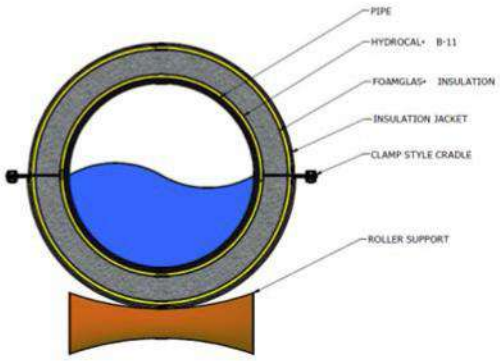
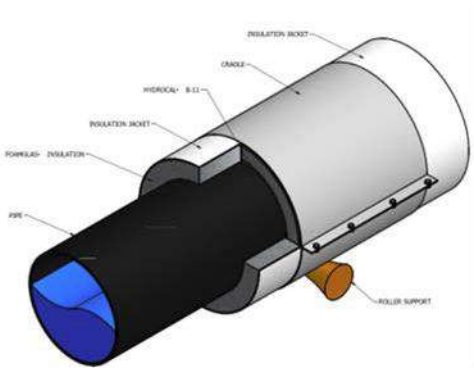


FIGURE 7



Typical Roller Support Design

14.3 Appendix B3: Pipe Fitting Details

FIGURE 8

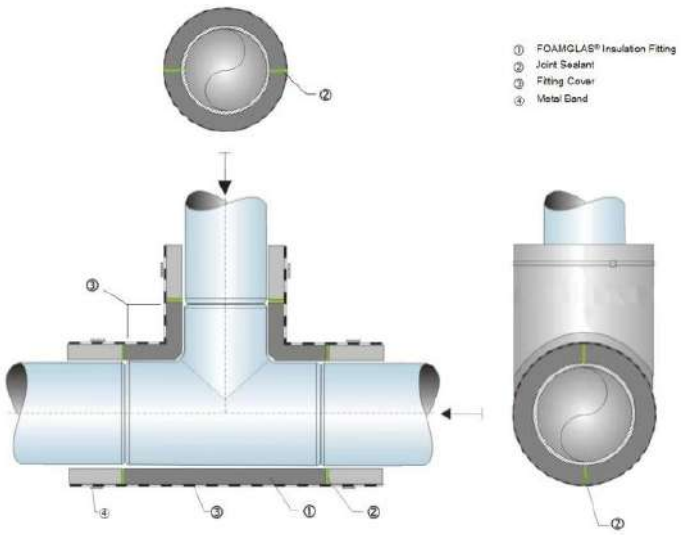


FIGURE 9

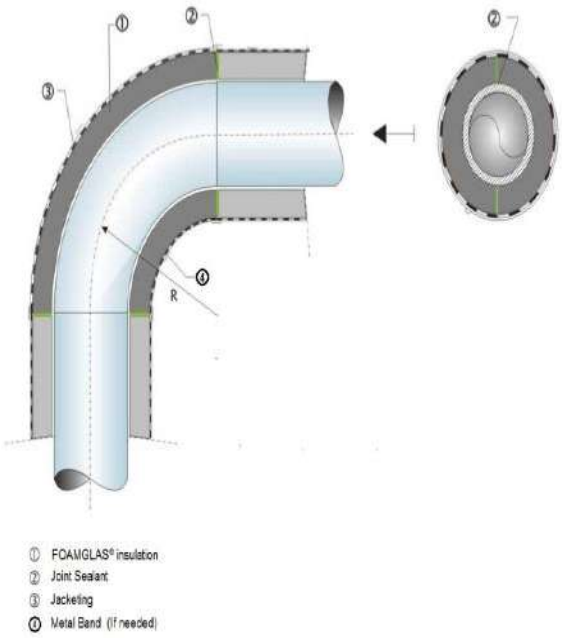


FIGURE 10

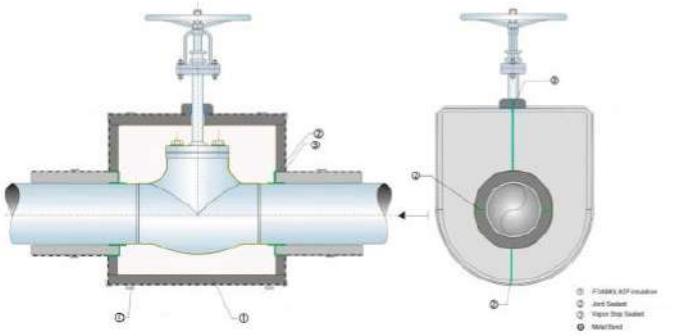
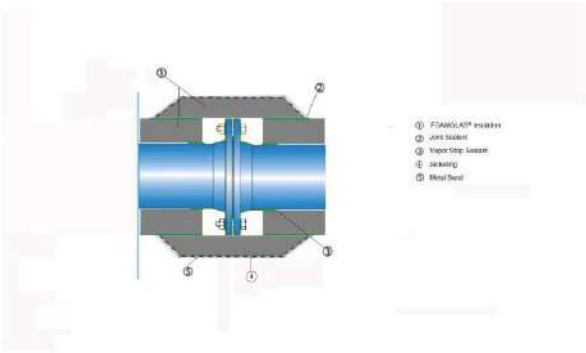


FIGURE 11



15. Appendix C: Other Product Manufacturers

Foster® Products H.B. Fuller Construction Products Inc. 1105 Frontenac St. Aurora, IL 60504 +1 (800)552-6225 http://www.fosterproducts.com/default.aspx?PageID=main or approved equal.

3 M Scotch No. 880 tape or equivalent

16. Additional Information

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