**PROJECT ENGINEER RESPONSIBILITY:** This is a general specification guide, intended to be used by experienced construction professionals, in conjunction with good construction practice and professional judgment. This guide is to aid in the creation of a complete building specification that is to be fully reviewed and edited by the engineer. Sections of this guide should be included, edited, or omitted based on the requirements of a specific project. It is the responsibility of both the specifier and the purchaser to determine if a product or system is suitable for its intended use. Neither Owens Corning, nor any of its subsidiary or affiliated companies, assume any responsibility for the content of this specification guide relative to actual projects and specifically disclaim any and all liability for any errors or omissions in design, detail, structural capability, attachment details, shop drawings or other construction related details, whether based upon the information provided by Owens Corning or otherwise.

SECTION 07 21 00 - THERMAL INSULATION FOR LOW TEMPERATURE PIPING

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes: Provide FOAMULAR® Extruded Polystyrene (XPS) Pipe Fabrication Billets and accessories for low temperature piping systems:

Cold or chilled water from 32F (0C) to 60F (15.6C).

Refrigeration from -70F (-56.7C) to 31F (-0.6C).

Industrial piping with operating temperatures within insulation temperature limitations.

* + - 1. REFERENCES
				1. Materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or end use:

ASTM International (ASTM):

ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate.

ASTM C 272: Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Construction.

ASTM C 450: Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.

ASTM C 585: Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.

ASTM C 755: Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.

ASTM C 1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

ASTM D 1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastic.

ASTM D 2126: Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.

ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials.

National Commercial & Industrial Insulation Standards – MICA Sixth Edition.

PIPING – Section 4.2, Plate No. 1 through 9.

VESSELS, TANKS AND EQUIPMENT – Section 4.5, Plates No. 25 through 35.

REFRIGERATION AND EXTREME LOW TEMPERATURE INSULATION – Section 5.4, Plate No. 42 through 42.

Ammonia Refrigeration Piping Handbook – IIAR 2000.

* + - 1. DEFINITIONS
				1. Rigid Cellular Plastics: Extruded polystyrene (XPS).
			2. SYSTEM PERFORMANCE
				1. Extruded polystyrene pipe fabrication billets are intended for use in industrial applications only. Insulation material thickness furnished shall meet the design specifications required. Design considerations shall include the thermal, condensation control, personnel protection, as well as other factors, needed for the specific application.
				2. Fire performance of products fabricated using extruded polystyrene pipe fabrication billets may vary in the field depending on facings and adhesives used in the fabrication process. Consult fabricators if composite fire performance is required.
			3. SUBMITTALS
				1. Product Data: Submit data on product characteristics, compliance with standards listed in Par. 1.2, performance criteria, limitations, and installation instructions.
			4. QUALITY ASSURANCE
				1. Source Limitations: Obtain insulation through one source from a single manufacturer.
				2. Installers: Minimum 2 years experience installing low temperature piping insulation.
			5. DELIVERY, STORAGE, AND HANDLING
				1. Deliver materials in manufacturer’s original packaging.
				2. Store and protect products in accordance with manufacturer’s instructions. Store in a dry area and protect from water, direct sunlight, flame, and ignition sources. Do not install insulation that has been damaged or wet. Insulation shall be free of moisture in any form prior to installation.
1. PRODUCTS
	* + 1. MANUFACTURER
				1. FOAMULAR® XPS Pipe Fabrication Billets: Owens Corning Insulating Systems, LLC, Toledo, OH 43659; [www.owenscorning.com](http://www.owenscorning.com).
			2. FABRICATED PIPE INSULATION
				1. Pipe Insulation: Fabricated from FOAMULAR® XPS Pipe Fabrication Billets manufactured by Owens Corning by Owens Corning Certified Master Fabricators. Comply with Owens Corning FOAMULAR® XPS Pipe Fabrication Billet data sheet for specific properties required.
				2. Sections: FOAMULAR® XPS Pipe Fabrication Billets shall be manufactured in accordance with ASTM C450 and meet ASTM C 585 for sizes required in the particular system. It shall be of a type suitable for installation on piping systems as defined in Par. 1.1A.
				3. Fittings: Valves, valve stations, flanges, elbows, and tees shall be two pieces and pre-fabricated from Owens Corning FOAMULAR® XPS Pipe Fabrication Billets in accordance with ASTM C450 and meet ASTM C585 for sizes required in the particular system.
				4. Large Fittings: Large diameter valves and flanges may be oversized enough to assist installation. Cavities created by the oversize will be filled with tightly packed fiberglass blanket insulation or polyurethane spray foam in accordance with the MICA or IIRA manuals.
				5. Tanks and Vessels: Tanks and vessel head sections shall be preformed or flat cut to fit in single piece segments per ASTM C450.
			3. VAPOR RETARDER
				1. Comply with recommendations of ASTM C755 for information on selection and specification of vapor retarders and sealing tapes.
				2. Specific vapor retarders may be factory or field applied to the fabricated pipe insulation in accordance with manufacturer’s instructions. The same applies for tanks, vessels and equipment.
				3. The following materials are typical for use in the systems defined in Par. 1.1A. Comply with manufacturer's literature for proper selection and instructions on safe handling of materials including required operating temperatures:

Vapor Retarder Jackets:

Polyguard ZeroPermTM, Polyguard – www.polyguardproducts.com

Venture Wrap, Venture Tape – www.venturetape.com

Vapor Retarder Joint Sealer Tape:

Polyguard ZeroPermTM A, Polyguard – www.polyguardproducts.com

Venture Clad, Venture Tape – www.venturetape.com

Fittings:

Polyguard ZeroPermTM Tape, Polyguard – www.polyguardproducts.com.

* + - 1. PROTECTIVE JACKETING
				1. Indoor Applications of Jacketing:

PVC protective jacketing shall not be considered a vapor retarder.

Jacketing material shall be PVC. Jacketing materials shall be installed in accordance with project drawings and specifications, manufacturer’s instructions, and/or in conformance with the current edition of the MICA or IIRA manuals.

Joints of PVC jacket shall be solvent welded to prevent moisture and moisture vapor infiltration into the insulation system.

Mechanical or any other fastener capable of penetrating the underlying vapor retarder shall not be used to secure the PVC jacketing.

The following materials are typical for use in the systems defined in Par. 1.1A. Consult manufacturer's literature for proper selection and instructions on safe handling of materials including required operating temperatures:

PVC Jacketing: PIC Plastics, www.pic-plastics.com

* + - * 1. Outdoor Applications of Jacketing:

Aluminum protective jacketing shall not be considered a vapor retarder.

Jacketing material shall meet ASTM B 209 and be aluminum. Jacketing materials shall be installed in accordance with project drawings and specifications, manufacturer’s instructions, and/or in conformance with the current edition of the MICA or IIRA manuals.

Banding for holding jacketing in place shall be 1/2 inch wide stainless steel.

Mechanical or any other fastener capable of penetrating the underlying vapor retarder shall be used to secure the PVC jacketing.

The following materials are typical for use in the systems defined in Par. 1.1A above. Consult manufacturer's literature for proper selection and instructions on safe handling of materials including required operating temperatures:

Aluminum Jacketing: RPR Products, Inc, - www.rprhouston.com; Standard Metal Industries - www.standardmi.com.

* + - 1. ADHESIVES, JOINT SEALANTS AND MASTICS
				1. Review all manufacturers’ information to insure compatibility with polystyrene prior to use.
				2. The following materials are typical for use in the systems defined in this Section. Consult manufacturer's literature for proper selection and instructions on safe handling of materials including required operating temperatures:
				3. Mastic: Vapor retarder CHIL-PERM WB CP-35, Childers Products Company – www.fosterproducts.com; weather barrier AK-CRYL CP-9, Childers Products Company – www.fosterproducts.com; VI-CRYL CP-10/11, Childers Products Company – www.fosterproducts.com
				4. Vapor Retarder Joint Sealer: CHIL-JOINT CP-70, Childers Products Company – www.fosterproducts.com; Daxcel 161D, Dacar Industries – www.dacar.com.
				5. Facing Adhesive: CP 56, Childers Products Company – www.fosterproducts.com; 85-50, Childers Products Company – www.fosterproducts.com; 85-60, Childers Products Company – www.fosterproducts.com
1. EXECUTION
	* + 1. INSTALLATION
				1. Installation: Comply with manufacturer’s recommendations and current edition of the MICA and IIRA manuals. Refer also to the illustrations at the end of the section.

If indicated or required by engineer, install a pipe coating system to minimize the likelihood of pipe corrosion (CUI).

Insulation shall be tightly butted and free of gaps and voids at all joints.

Pre-fabricated insulation fittings for elbows, tees, and valves, shall be the same thickness at fittings as pipe sections.

Each layer of insulation shall be secured to the pipe with 3/4 inch wide fiber reinforced tape. If factory applied facings are used, fiber reinforced tape in not required on the outer layer.

Vapor barrier performance is extremely important; the vapor retarder shall be continuous.

Vapor stops shall be used on either side of valves frequently removed for servicing, valve stations left exposed, or odd fittings, elbows, tees, and similar items where the chance of moisture infiltration is high.

Before outer jacketing can be installed on a portion of the piping, the vapor retarder system on that portion shall be complete.

Tape, fasteners, and bands shall be neatly aligned and properly installed.

Contraction/expansion joints shall be installed per the MICA or IIRA Manual or approved alternate design. Comply with engineer’s requirements for spacing of contraction/expansion joints for each system.

Allow mastics to dry before installing PVC or Metal Jacketing.

Seal around protrusions, such as valve stems with a full bead of silicone sealant.

XPS Insulation shall be protected from prolonged exposure to UV light and weather after installation.

* + - * 1. Outdoor Installation, General: Comply with manufacturer’s installation instructions, including but not limited to the following.

Outdoor jacketing shall overlap a minimum of 2 inches at both butt and longitudinal joints.

Outdoor jacketing shall be positioned with the overlap facing downward at either the 3 or 9 o’clock position.

Bands shall be on a maximum 9 inches on center spacing.

End joints shall be secured with bands and seals directly over the joint.

Outdoor sections of jacketing and banding shall be properly installed..

* + - * 1. Single Layer Systems (Systems with insulation thickness 2-1/2 inches and less): Comply with manufacturer’s installation instructions, including but not limited to the following.

Stagger insulation half sections so that butt joints are staggered between top and bottom half sections by 6 to 18 inches on insulation layers that do not have a vapor retarder factory applied to them. Orient longitudinal joints between half sections in the 3 and 9 o'clock position on the pipe.

Seal all joints full depth with joint sealant and spread to uniform thickness so that joints appear tight and uniform.

Install an 18 inch length half round pipe section on bottom of all pipe hanger saddles with a full half round pipe section on the top to maintain a staggered joint through the pipe hanger saddle.

Insulation and vapor retarder shall be secured with fiber reinforced tape. Use a 1/4 circumferential overlap on 12 inch centers when installing insulation with factory applied facing.

Fiber tape shall be applied to the exterior of the insulation/vapor retarder system.

Vapor retarder should be oriented such that the longitudinal lap joint overlaps facing downward at either the 3 or 9 o’clock position. Lap joint shall be sealed using SSL tape as a temporary bond.

On factory applied vapor retarder system, lap joint shall be sealed with SSL tape.

Butt joints shall be covered with vapor retarder tape using the same 3 or 9 o’clock orientation as the longitudinal seam on the vapor barrier.

For factory applied facing systems, apply the vapor retarder tape around the butt joint overlap per the manufacturer’s installation directions in the appropriate orientation as noted above.

Elbows and fittings shall be wrapped with vapor retarder tape or covered with a mastic type vapor retarder product. Vapor retarder tape shall be wrapped in a spiral configuration. If using mastic type vapor retarder at fittings and elbows, form mastic so that fitting covers can be applied true and tight.

Polyurethane foam filled fittings are not acceptable.

* + - * 1. Double Layer Systems (Systems with insulation thickness of greater than 2-1/2 inches): Comply with manufacturer’s installation instructions, including but not limited to the following.

Stagger all longitudinal and butt joints between the inner and outer layers. Install the inner and outer layer longitudinal joints perpendicular to each other with the inner layer joints in the 12 and 6 o’clock positions and the outer layer joints in the 3 and 9 o’clock positions. All butt joints between the inner and outer layers shall be staggered between 6 and 18 inches.

Inner layer shall not be installed with sealants. The inner and outer layer shall remain independent of each other so as to allow movement between the layers.

Insulation shall be secured with fiber-reinforced tape on both inner and outer layers except as noted above for factory applied facings.

Install nested half and full pipe half-round sections in bottom of saddle or use a full thickness single layer pipe section with shiplap ends cut to the depth of the inner layer thickness so the outer layer will overlap.

Bottom insulation sections in hanger saddles may require higher compressive strength material such as FOAMULAR 400 or 600 Insulation. Comply with engineer’s requirements for proper load calculations and saddle spacing to determine proper material usage.

Saddles shall wrap the insulation in an arc of no less than 120 degrees with the maximum wrap depending upon the load.

All fittings shall be cut to full thickness with fabricated shiplap butt ends. The depth of the shiplap shall be cut to the match the thickness of the inner layer.

Insulation and vapor retarder shall be secured with fiber-reinforced tape. Use a 1/4 circumferential overlap on 12 inch centers when installing insulation with factory applied facing.

Fiber tape shall be applied to the exterior of the insulation/vapor retarder system.

Vapor retarder should be oriented such that the longitudinal lap joint overlaps facing downward at either the 3 or 9 o’clock position. Lap joint shall be sealed using SSL tape or liquid adhesive.

On factory applied vapor retarder system, lap joint shall be sealed with SSL tape.

Butt joints shall be covered with vapor retarder tape using the same 3 or 9 o’clock orientation as the longitudinal seam on the vapor barrier.

For factory applied facing systems, apply the vapor retarder tape around the butt joint overlap per the manufacturer’s installation directions in the appropriate orientation as noted above.

Elbows and fittings shall be wrapped with vapor retarder tape or covered with a mastic type vapor retarder product. Vapor retarder tape shall be wrapped in a spiral configuration. If using mastic type vapor retarder at fittings and elbows, form mastic so that fitting covers can be applied true and tight.

Polyurethane foam filled fittings are not acceptable.

* + - * 1. Tank and Vessel Equipment Insulation: Comply with manufacturer’s installation instructions, including but not limited to the following.

Vessel Head:

Head segments shall be preformed to fit the contour of the head and eliminate voids.

Flat head sections shall be installed with the same number of layers and thickness as the vessel walls.

The vapor retarder on the head sections shall be continuous and of the same material as the vessel walls of the tank.

Vessel Walls:

Curved segments shall be fabricated to fit the contour of the surface and in equal width pieces to go around the vessel.

Every effort shall be made to eliminate through joints.

Vertical vessels greater than 4 feet in diameter shall have a insulation support ring welded or bolted around the bottom of the tank to prevent insulation movement.

In double layer systems, stagger both horizontal and vertical joints between the inner and outer layers.

Where the head meets the side wall in a in a double layer application the inner layer and outer layer shall be offset by a minimum distance equal to the thickness of the insulation.

Secure insulation with minimum 1/2 inch steel bands on 12 inch centers.

On vertical vessels, install vapor retarder and beginning at the bottom of the vessel working upward to create a shingle effect to naturally shed water.

Install vapor retarder with a minimum of 2 inch overlap at all vertical and horizontal joints.

END OF SECTION

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