DOW® STYROFOAM™ Installation Guidelines

1.0 General

1.1 Scope:

This section pertains to installation guidelines for Dow® STYROFOAM™ for piping applications, elbows, fittings, valves, tanks, vapor barriers and jacketing for the following applications.

- 1.1.1 Chilled Piping Service (35F-70F)
- 1.1.2 Cold Piping Service (-100F to 35F)
- 1.1.3 Cryogenic Piping Service (-300F to -100F)

1.2 Standards that apply:

- 1.2.1 C- 518 Standard test method for steady – state thermal transmission properties by means of heat flow meter apparatus
- 1.2.2 D-1621 Standard test method for compressive properties of thermal rigid cellular plastics
- 1.2.3 est method for density of thermal rigid cellular plastics
- 1.2.4 E-96 Standard test method for water transmission of cellular plastics
- 1.2.5 C-272 Standard test method for water absorption of cellular plastics
- 1.2.6 D-696 Standard test method for coefficient of linear thermal expansion of plastics between -30C and +30C with a vitreous silica dilatometer
- 1.2.7 E-84 Standard test method for flame spread / smoke developed using tunnel burn test.
- 1.2.8 C-450 Standard practice for fabrication of thermal insulation fitting covers for nps and vessel lags
- 1.2.9 C-585 Standard practice for inner and outer diameters of thermal insulation for nominal pipe and tubing

1.3 Related Documents:

- 1.3.1 Specification 15088 – Pipe Painting
- 1.3.2 Polyguard / Dow XPS Data Sheet
- 1.3.3 Dow XPS MSDS Sheets

1.4 Definitions:

- 1.4.1 Rigid STYROFOAM™ PIB Insulation meets ASTM C-578 Standard Specification for Rigid Cellular Polystyrene Thermal Insulation and the standards and tests listed above.
- 1.4.2 Chilled Service Piping: Refers to below ambient piping in the 35F to 70F range
- 1.4.3 Cold Service Piping: Refers to below ambient piping in the -100F to 35F range
- 1.4.4 Cryogenic Piping: Refers to extremely cold piping in the -300F to -100F range
- 1.4.5 Nominal Insulation Thickness: Refers to the normal thickness that insulation fabricators will provide based on standard tables, pipe sizes and wall thicknesses
- 1.4.6 OD: Refers to the outer diameter of the insulation and/or finish covering
- 1.4.7 R-Value: 1 $h \cdot ft^2 \cdot °F/BTU$ Is the unit used for thermal resistance
- 1.4.8 K-Factor: BTU/ft2/F/hr./inch is the reciprocal or R-Value
- 1.4.9 SSL: Acronym for self-sealing lap. Often found on vapor barrier film and membranes.

1.5 Quality Assurance:

- 1.5.1 Dow® STYROFOAM™ PIB shall not be produced with, or contain, any of the United States EPA regulated CFC Compounds listed in the Montreal Protocol of the United Nations Environmental Program.
- 1.5.2 Installation guidelines and thickness recommendations must be followed by the skilled installer in a manner of good workmanship.

1.6 Delivery, Handling & Storage:

- 1.6.1 Protect insulation from physical damage and excessive moisture.
- 1.6.2 Store indoors and keep free from exposed UV, rain, hail, snow and wind.

1.6.3 Handle insulation sections carefully so corners are not broken off creating voids, inspect for lags or gaps in longitudinal and butt joints. Vapor barrier must be intact and free of holes or voids.

2.0 Products

2.1 Insulation:

2.1.1 Insulation Type is Extruded – Polystyrene Billet: ASTM C-578 with flame spread and smoke developed indexes of 5 & 165, respectively, up to 4" insulation thickness per ASTM E-84.

a. Rigid Close Cell Foam Insulation
b. Comply with ASTM C-578, Type III, density 1.6 lb/cu ft min compressive strength 20 psi (ASTM D1621)
c. Thermal resistance: K-Factor of .259 @ 75F Mean
d. Water absorption: 0.1 C-272
e. Surface Burning Characteristics: (ASTM E-84) up to 4"
   i) Flame Spread: 0
   ii) Smoke Developed: 165

2.1.2 Pipe sections, fittings, valves and vessels to be fabricated from bun stock by an authorized fabricator and must adhere to the appropriate standard listed in scope section 1.1

2.1.3 At 90 and 45 degree elbows, valves and fittings, pre-molded 2 piece system shall be installed that fits snug on the pipe or component. Mitered elbows and pvc filled elbows in particular are not recommended for chilled service piping and colder.

2.1.4 Vessel, heads, segments & bodies shall be fabricated to fit the curves and contours of the vessel being insulated.

2.1.4.1 Vessel head segments to be curved and cut to minimize or eliminate voids at the head section. Two part spray applied polyurethane foam shall be used to fill in voids.

2.1.4.2 Vessel segments shall be fabricated per ASTM C-450

2.2 Joint Sealant , Adhesive & Mastic, Vapor Retarder Tape

2.2.1 Joint Sealant for all joints of insulation shall be vapor barrier type, non-hardening, flexible with service temp range of -50F to 200F.

2.2.1.1 Childers, CP-70

2.2.1.2 Boss 368

2.2.2 Adhesive used to apply vapor retarder to insulation shall be one of the following:

2.2.2.1 Childers, 85-50

2.2.2.2 Childers, 85-60

2.2.3 Mastic

2.2.3.1 Childers, CP-35

2.2.4 Vapor Guard Tape:

2.2.4.1 Polyguard 1677 Tape

2.3 Vapor Barrier:

2.3.1 Vapor Barrier should have a maximum permeance of 0.015 or better after final application.

2.3.2 For Cold & Cryogenic service on outdoor piping, rubberized asphalt based vapor barriers are recommended since they are more puncture resistant and self-healing. Also for extreme Cryogenic piping, where triple layers of insulation is required, a rubberized asphalt vapor barrier is recommended for the primary and a film type vapor barrier is recommended for the secondary.

2.3.3 Vapor Barriers are applied to the outside surface of the insulation on pipe covering, valves, fittings and vessels. They are to minimize water and moisture migration from the external environment and keep away from the insulation and piping. Moisture causes a reduction in thermal performance of the insulation and can cause pipe corrosion if trapped between the pipe and insulation. Refer to the following products and links for installation information. Additional information in appendix section.

2.3.4 Acceptable Vapor Barriers
- 2.3.4.1 Polyguard Zero Perm
- 2.3.4.2 Dow Saran
- 2.3.4.3 Polyguard Insulrap 30

2.4 Protective Jacketing:

2.4.1 Cladding: Cladding should have a maximum permeance of 0.000 or better after final application.

2.4.2 Rubberized asphalt cladding products are recommended for exterior use. These products have the perm rating of a vapor barrier, yet are UV stable in exterior environments. Product must have a 10 yr warranty.

2.4.3 Acceptable Cladding Products: Exterior
- 2.4.3.1 Polyguard Alumaguard
- 2.4.3.2 Polyguard Alumaguard All Weather
- 2.4.3.3 Polyguard Alumaguard Cool Duct

2.4.4 Acceptable Cladding Products: Interior
- 2.4.4.1 Alumaguard Lite (White or Silver)

2.4.5 PVC Jacketing for Indoor Applications:
- 2.4.5.1 PVC jacket is not a vapor barrier; it is for some protection to the insulation and vapor barrier, aesthetics and color coding.
- 2.4.5.2 30 mil thick is recommended on pipe sections and fittings in standard applications. 40 mil thickness is recommended in spray or wash down areas.
- 2.4.5.3 Joints shall be solvent welded with manufacturer recommended product.
- 2.4.5.4 PVC jacketing for fittings, tees, elbows, valves etc. should be heavy duty fitting covers.
- 2.4.5.5 Pipe sections to be covered with pvc sectional pieces.

2.4.6 Acceptable PVC Manufacturers:
- 2.4.6.1 PIC Plastics
- 2.4.6.2 Proto
- 2.4.6.3 Ceel Co

2.4.7 Metal Jacketing for Outdoor Applications:
- 2.4.7.1 Metal jacketing is not a vapor barrier, it is designed to protect the insulation and vapor barrier from physical abuse from weather, mechanical wear or other damage. The jacketing shall be Aluminum Alloy 1100 meeting ASTM B209. Must have Polysurlyn moisture barrier on the back side.
- 2.4.7.2 Material recommendations:
  - 2.4.7.2.1 0.016 inch thick for pipe sections
  - 2.4.7.2.2 0.020, 0.024 or 0.032 should be considered in high abuse areas
  - 2.4.7.2.3 Stucco finish is recommended
  - 2.4.7.2.4 Banding should be stainless steel T304/T316 ½” x 0.020” with stainless steel wing seal.
- 2.4.7.3 Recommended Manufacturers:
  - 2.4.7.3.1 RPR Products
  - 2.4.7.3.2 Standard Metal
  - 2.4.7.3.3 Ideal Metal
  - 2.4.7.3.4 ITW Insulation

2.5 Pipe & Hanger Support Saddles:

2.5.1 Pipe support, load bearing insulation shall be fabricated in 180 degree sections from Dow® STYROFOAM™ up to 6” pipe diameter.

2.5.2 Load bearing shields shall be provided by the contractor.

2.5.3 Sliding saddles are recommended for use on any type of jacket system. They absorb all of the abuse from expansion and contraction. The jacket will remain in good condition much longer with a sliding saddle. Sliding saddles have enough give for expansion and contraction that they don't end up on the floor or falling from the roof. They are less expensive than roller hangers.

2.5.4 Recommended Saddles:

2.5.4.1 Polyguard AlumaGlide

2.6 Pipe Protection:

2.6.1 All piping on cold systems should have a coating to protect against corrosion. With a good vapor barrier and tightly closed cell XPS insulation, the chances of moisture intrusion are reduced significantly. Even with this reduced risk, pipe protection is still recommended. These systems will be in service for a long time, and there will be several opportunities for physical damage to the system. If moisture gets trapped between the pipe and insulation, corrosion will occur.

2.6.2 Protective Gel is recommended for pipe corrosion protection

2.6.2.1 Gel expands, contracts and moves with the entire piping system

2.6.2.2 Apply in 25 mil thickness as recommended by the manufacturer

2.6.3 Recommended Products

2.6.3.1 Polyguard RG-2400LT (Piping -100F to 250F)

2.6.3.2 Polyguard RG-CHW (Piping 33F to 160F)

2.6.3.3 Polyguard RG-2400ET (Hot lines up to 350F)

3.0 Execution

3.1 Preparation

3.1.1 Insulation should not be installed around welding, abrasion, or anything that would likely cause damage to the material. Install insulation after these jobs are complete.

3.1.2 Surface Preparation

3.1.2.1 Before insulation or anti corrosion gel (if applicable) is installed, all pipe surfaces should be free of dirt, oil, loose scale rust or other abnormal material.

3.2 Pipe Protection (If required by enduser)

3.2.1 After preparations steps above are complete, install pipe protective gel.

3.2.2 Check piping again for loose scale corrosion. If present wire brush (SP-2) existing corrosion

3.2.3 Brush or glove apply gel product to the piping at approx 25mil wft.

3.2.4 Use accutrowel to run over gel application for 20mil finish

3.2.5 Apply insulation immediately after gel step is complete. Can apply insulation within minutes of gel application. For best results apply insulation right behind gel application.

3.3 Insulation Installation (including vapor barrier)

3.3.1 Inspect insulation to make sure it is tightly butted and free of gaps and voids.

3.3.2 Inspect vapor barrier and other jacketing to make sure it is intact and free of damage.

3.3.3 Apply insulation to the piping with longitudinal joints at 3 and 9 o'clock positions. For chilled service, joint sealant is not always required. (This is based on the endusers preference). Staggered butt joints are not required for these applications either. For cold and cryogenic service applications, joint sealant is required on the longitudinal and butt joints. Also for these colder applications break the butt joints as well so that they do not line up. These upper and lower butt joints should be staggered between 6-18 inches. Expansion and contraction material recommended every 50 ft at 2" increments. Rubberized insulation products, Elastomeric Rubber type insulation is often used.

3.3.4 Use joint sealant listed above in section 2.2 for longitudinal and butt joints

3.3.5 Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.

3.3.6 Vapor barrier film or membrane should be applied on field for cold and cryogenic service work.

3.3.7 Insulation for chilled service piping can have factory applied vapor barrier when arriving on site.

3.3.7.1 For Insulation with factory applied jackets with vapor barriers, do not staple longitudinal tabs. Instead secure tabs additional adhesive or tape to strengthen SSL bond if needed.

3.3.8 All insulation shall be tightly butted and free of voids and gaps at all joints.

3.3.9 Vapor Stop Application

3.3.9.1 Apply vapor stops every 20 feet of straight runs, before and after every exposed valve or fitting and at terminations both around the pipe and over the butt joint of the insulation. Please see diagram 3 for further detail.

3.3.9.2 Apply either vapor guard tape or mastic – fab – mastic application.

3.3.10 Field Applied Vapor Barriers:

3.3.10.1.1 Field applied vapor barriers should be applied without staples or nails. Apply vapor barrier so that longitudinal joint is facing down ward (to fend water shed) at 4 o clock position.

3.3.10.1.2 Apply vapor barrier with one of recommended adhesives listed in section 2.2 Longitudinal overlap should be 2" for adequate adhesion. Apply SSL to firmly close longitudinal joints. Rubberized asphalt vapor barriers have a peel and stick overlap that is sufficient to seal membrane in installation temperatures above 50F. For below 50F installation temperatures, an activator is necessary.

3.3.10.1.3 Apply strip tape at butt joints to secure insulation sections and further hold vapor barrier in place.

3.3.10.1.4 Vapor barrier must be continuous on pipe sections and should be installed in a cigarette fashion.

3.3.11 Insulation Installation on Pipe Flanges:

3.3.11.1 Install preformed pipe insulation to outer diameter of pipe flange.

3.3.11.2 Make width of insulation section same as overall width of flange and bolts, and make thickness same as adjacent pipe insulation, not to exceed 1.5"

3.3.11.3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of styrene block insulation of same thickness as pipe insulation.

3.3.12 Insulation Installation on Pipe Fittings and Elbows:

Install preformed insulation sections of same material as straight segments of pipe insulation.
Joints should be consistent with pipe sections if sealant is required.
Spiral wrap vapor retarder tape with ½" overlap to secure elbow or fitting tightness and seal up joint.

3.3.13 Insulation Installation on Valve and Pipe Specialties

Install preformed section of polystyrene insulation to valve body.
Arrange insulation to permit access to packing and allow valve operation without disturbing insulation.
Install insulation to flanges as specified for flange insulation application.

3.4 Preparation For Double Layered Systems, Cold or Cryogenic systems with more than 2.5" of insulation.

3.4.1 Insulation should not be installed around welding, abrasion, or anything that would likely cause damage to the material. Install insulation after these jobs are complete.

3.4.2 Surface Preparation

3.4.2.1 Before insulation or anti corrosion gel (if applicable) is installed, all pipe surfaces should be free of dirt, oil, loose scale rust or other abnormal material.

3.5 Pipe Protection (If required by end-user)

3.5.1 After preparations steps above are complete, install pipe protective gel.

3.5.2 Check piping again for loose scale corrosion. If present wire brush (SP-2) existing corrosion

3.5.3 Brush or glove apply gel product to the piping at approx 25mil wft.

3.5.4 Use trowel to run over gel application for 20mil finish

3.5.5 Apply insulation immediately after gel step is complete. Can apply insulation within minutes of gel application. For best results apply insulation right behind gel application.

3.6 Insulation Installation (including jacket and vapor barrier)

3.6.1 Inspect insulation to make sure it is tightly butted and free of gaps and voids.

3.6.2 Inspect vapor barrier and other jacketing to make sure it is intact and free of damage.

3.6.3 Apply inner layer of insulation to the piping with longitudinal joints at 12 and 6 o'clock positions. Do not apply joint sealant to inner layer. For cold and cryogenic service applications, joint sealant is required on the longitudinal and butt joints. Break the butt joints as well so that they do not line up. These upper and lower butt joints should be staggered between 6-18 inches.

3.6.4 Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.

3.6.5 Stagger second layer so that butts and longitudinal joints do not line up. Orient second or outer layer of insulation between half sections in 3 and 9 o'clock positions on the pipe. Expansion and contraction material recommended every 50 ft at 2" increments. Rubberized insulation products, Elastomeric Rubber type insulation is often used.

3.6.6 Apply joint sealant to second (outer) layer only. Use joint sealant listed above in section 2.2

3.6.7 Vapor barrier film or membrane should be applied on field for cold and cryogenic service work.

3.6.8 All insulation shall be tightly butted and free of voids and gaps at all joints.

3.6.9 Vapor Stop Application:

3.6.9.1 Apply vapor stops every 20 feet of straight runs, before and after every exposed valve or fitting and at terminations both around the pipe and over the butt joint of the insulation. Please see diagram 3 for further detail.

3.6.9.2 Apply either vapor guard tape or mastic – fab – mastic application

3.6.10 Field Applied Vapor Barriers:

3.6.10.1 Field applied vapor barriers should be applied without staples or nails. Apply vapor barrier so that longitudinal joint is facing down ward (to fend water shed) at 4 o clock position.

3.6.10.2 Apply vapor barrier with one of recommended adhesives listed in section 2.2 Longitudinal overlap should be 2" for adequate adhesion.

3.6.10.3 Apply SSL to firmly close longitudinal joints. Rubberized asphalt vapor barriers have a peel and stick overlap that is sufficient to seal membrane in installation temperatures above 50F. For below 50F installation temperatures, an activator is necessary.

3.6.10.4 Apply strip tape at butt joints to secure insulation sections and further hold vapor barrier in place. Vapor barrier must be continuous on pipe sections and should be installed in a cigarette fashion.

3.6.11 Insulation Installation on Pipe Flanges:

3.6.11.1 Install preformed pipe insulation to outer diameter of pipe flange.

3.6.11.2 Make width of insulation section same as overall width of flange and bolts, and make thickness same as adjacent pipe insulation, not to exceed 1.5"

3.6.11.3 Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of styrene block insulation of same thickness as pipe insulation.

3.6.12 Insulation Installation on Pipe Fittings and Elbows:

3.6.12.1 Install preformed insulation sections of same material as straight segments of pipe insulation.

3.6.12.2 Joints should be consistent with pipe sections if sealant is required.

3.6.12.3 Spiral wrap vapor retarder tape with ½" overlap to secure elbow or fitting tightness and seal up joint.

3.6.13 Insulation Installation on Valve and Pipe Specialties:

3.6.13.1 Install preformed section of polystyrene insulation to valve body.

3.6.13.2 Arrange insulation to permit access to packing and allow valve operation without disturbing insulation.

3.6.13.3 Install insulation to flanges as specified for flange insulation application.

3.7 Tank & Vessel Insulation Installation:

3.7.1 Vessel Walls:

3.7.1.1 Walls of vessels to be insulated with double layered insulation, unless insulation thickness is less than 3" thick.

3.7.1.2 Double layered insulation systems should be staggered by 50% over lap so that no joints allow for full moisture penetration all the way through to the pipe.

3.7.1.3 Curved wall segments to be beveled to fit around the tank or vessel smoothly, segments should be the same size.

3.7.1.4 Vessels with diameters larger than 4 ft should have additional insulation to support tops and sidewalls.

3.7.1.5 Joint sealant from section 2.2 should be used to seal up joints
3.7.1.6 ½ banding required on 12" centers
3.7.1.7 Vapor barrier shall cover entire insulation section on walls before protective jacket is installed.

3.7.2 Vessel Heads:
3.7.2.1 Vessel heads should have joints consistent with the longitudinal sections and walls.
3.7.2.2 For systems that require more than 4 inches, vessel heads should also be double layered and joints should be staggered.
3.7.2.3 Joint sealant from section 2.2 shall be used on all joints.
3.7.2.4 Vapor barrier to cover tank head is important on cold or cryogenic systems.
3.7.2.5 Dish type vessel head is preferred.

3.8 Indoor Jacketing Installation:

3.8.1 PVC jacket to be installed directly over the insulation and vapor barrier.
3.8.1.1 Longitudinal PVC slip to overlap 2-3 inches past the insulation longitudinal joint
3.8.1.2 PVC butt lap slip overlap should be 2-3 inches in to the following section, telescope format.
3.8.1.3 PVC over lap and bond to be at approximately 4 o'clock.
3.8.1.4 PVC lap to be solvent welded with sealant recommended by manufacturer.
3.8.1.5 Valves, fittings, tees, elbows and other specialty items to be pre molded or fabricated by a skilled contractor or fabricator.
3.8.1.6 See manufacturer's guidelines on PVC installation.

3.8.2 If Indoor cladding is desired Alumaguard Lite white is a good choice.
3.8.2.1 Alumaguard lite can be applied in place of a vapor barrier and pvc jacket.
3.8.2.2 Spiral wrap elbows and fittings in similar fashion as listed in above vapor barrier guideline.
3.8.2.3 Overlap longitudinal joints by 2 inches, secure with peel and stick overlap.
3.8.2.4 Connect insulation sections with Alumaguard lite tape at the butt joints.
3.8.2.5 In some cases for mild temperatures in the chilled service category, this jacket can come factory applied.

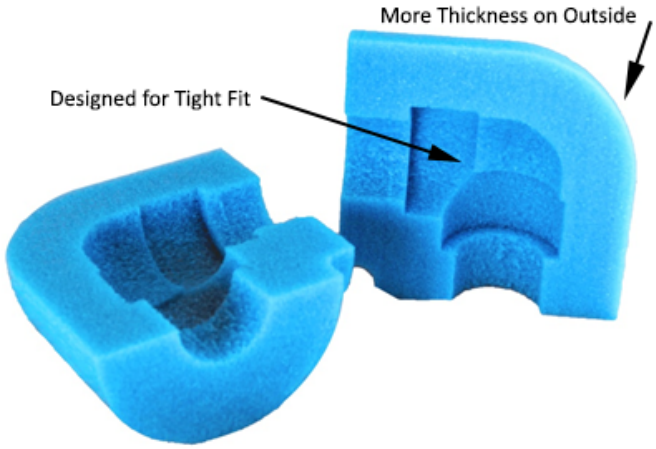
3.9 Outdoor Jacketing Installation:

3.9.1 Metal jacket to be installed directly over the insulation and vapor barrier.
3.9.1.1 Longitudinal metal slip to overlap 2-3 inches past the insulation longitudinal joint.
3.9.1.2 PVC over lap and bond to be at approximately 4 o'clock.
3.9.1.3 PVC lap to be solvent welded with sealant recommended by manufacturer.
3.9.1.4 Valves, fittings, tees, elbows and other specialty items to be pre formed up to 12". Where preformed is not available, metal gores fabrication by a skilled contractor or fabricator shall be used.
3.9.1.5 Stainless steel strapping bands shall be used to secure metal jacket on pipe sectionals circumferences on 12" centers. No screws or sharp objects to risk puncture of vapor barrier.
3.9.1.6 See manufacturer's guidelines on metal installation and banding pattern.

3.9.2 If outdoor cladding is desired Alumaguard or Alumaguard All Weather is a good choice.
3.9.2.1 Alumaguard can be applied in place of a vapor barrier and metal jacket.
3.9.2.2 Spiral wrap elbows and fittings in similar fashion as listed in above vapor barrier guideline.
3.9.2.3 Overlap longitudinal joints by 2 inches, secure with peel and stick overlap
3.9.2.4 In some cases for mild temperatures in the chilled service category, this jacket can come factory applied.
3.9.2.5 Stainless steel banding must be used every 18" on center of the insulation section.

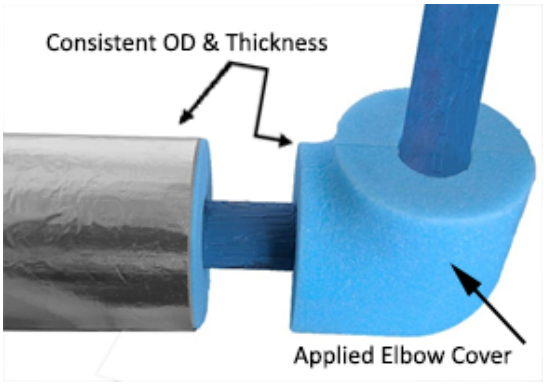
4.0 Insulation Diagrams & Thickness Tables

Elbows: Pre molded elbows are highly recommended on a system that is chilled or colder in temperature. As shown in figure 2 the wall thickness on the end of the elbow, there is plenty of insulation thickness. Mitered elbows don't provide this level of insulation on either end.



Advantages:

- Longer service life
- Easy to install
- Tight fit, no voids
- Compatible with metal or PVC covers
- Only 2 seems
- Less moisture intrusion possibility

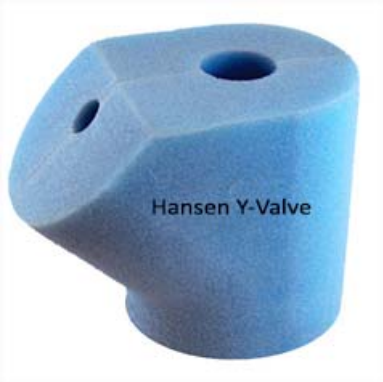


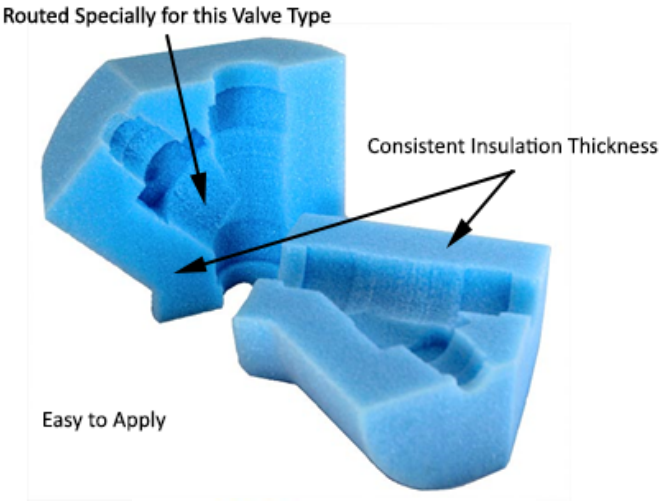
Installation (Quick Facts):

- Line up right & left side of elbow
- Apply snug fit to elbow
- Apply joint sealant if required
- Apply filament tape to both ends
- Apply vapor barrier tape in spiral fashion
- Apply metal or PVC cover

Valves & Fittings:

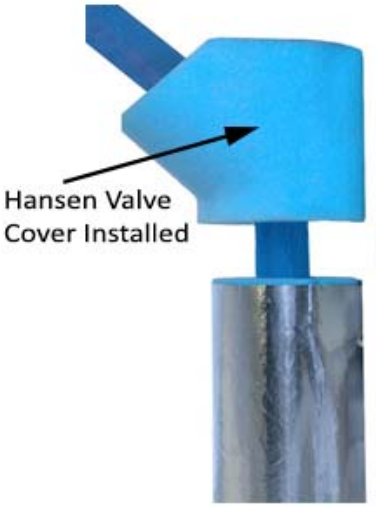
Pre-Molded valves and fittings are a good choice on a cold or cryogenic system. Most common Dan Foss or Hansen valves can have XPS foam covers manufactured that will fit them perfectly.





Advantages:

- Compatible with metal or PVC covers
- Available custom fit for most valves
- Easy to install
- Re-useable
- Tight fit, no voids
- Only 2 seems



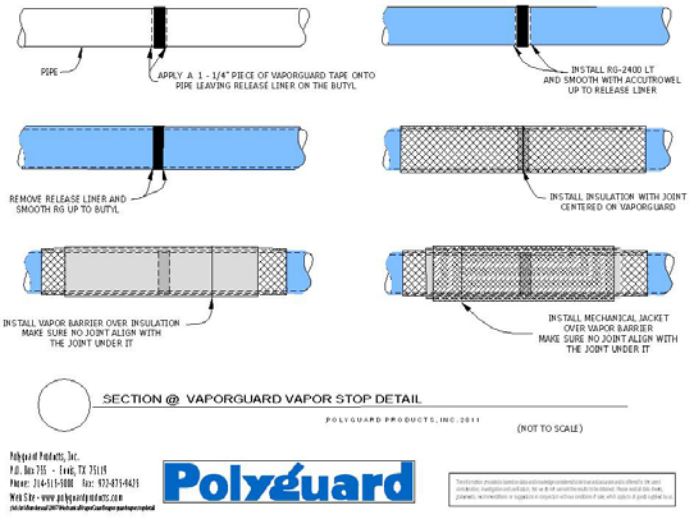
Installation (Quick Facts):

- Line up right & left side of valve
- Apply snug fit to valve
- Apply joint sealant if required
- Apply filament tape to both ends
- Apply vapor barrier tape in spiral fashion
- Apply metal or PVC cover

Vapor Stops: Vapor stops are a valuable design criteria on below ambient piping. If moisture is present in the insulation system, a good vapor stop will limit the moisture travel to a much smaller area. Vapor stops shall be applied every 30 feet on long runs or before and after every valve and fitting. As the diagram shows, apply 1677 butyl tape around diameter of the pipe. Also apply tape to insulation butt joints to cover the entire insulation surface.

Apply Vapor Stops:

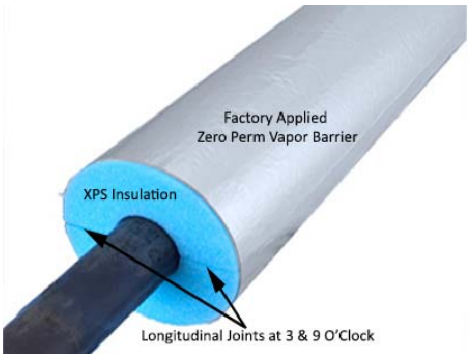
- Every 20-30 Ft
- Before & After Valves and Fittings
- At Terminations



Single layer insulation system (Chilled Water) On Chilled Water application and sometimes on the high temperature side of cold service (25F to 35F) it is common to install a single layer of insulation with a factory applied vapor barrier.

Pre – Applied Vapor Barriers

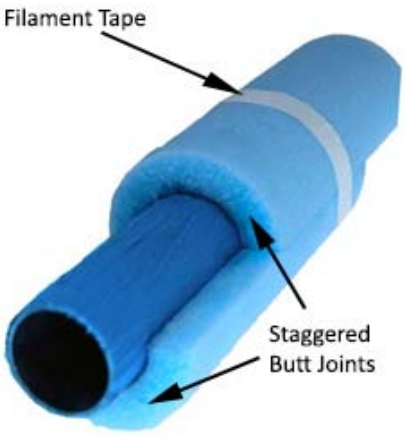
- Arrives already installed to insulation
- Great for single layer, mild applications
- Labor savings for contractor
- Peel & Stick SSL is very common
- Rubberized barriers can also be pre applied

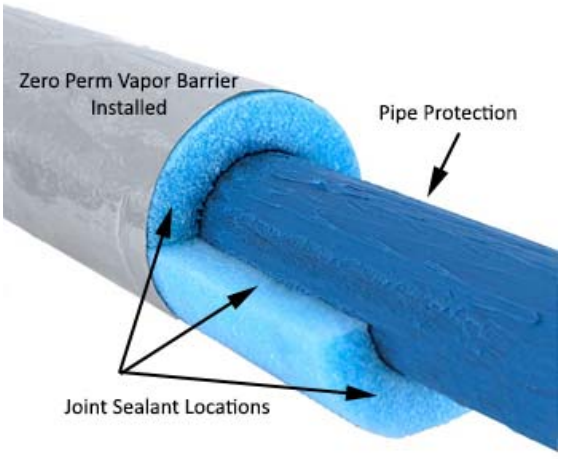


Chilled Service Installation (Quick Facts)

- Single layer of insulation
- Pre applied vapor barrier
- Longitudinal joints at 3 & 9 o'clock
- Overlap vapor barrier SSL 2"
- Vapor barrier bond joint at 4 o'clock
- Joint sealant applied if required by owner
- Pipe protection applied if required by owner

Single layer insulation systems (Cold Service) In the medium temperature side of the cold system temperature range, single layers are common On Chilled Water application and sometimes on the high temperature side of cold service (0ºF to 25ºF) it is common to install a single layer of insulation but with broken butt joints and joint sealant. The moisture drive is becoming very intense so more precautions are necessary.

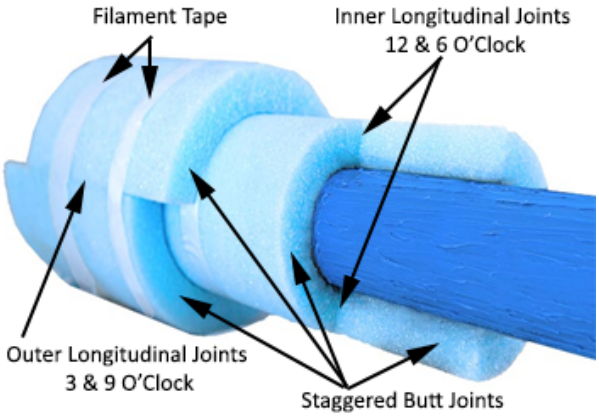


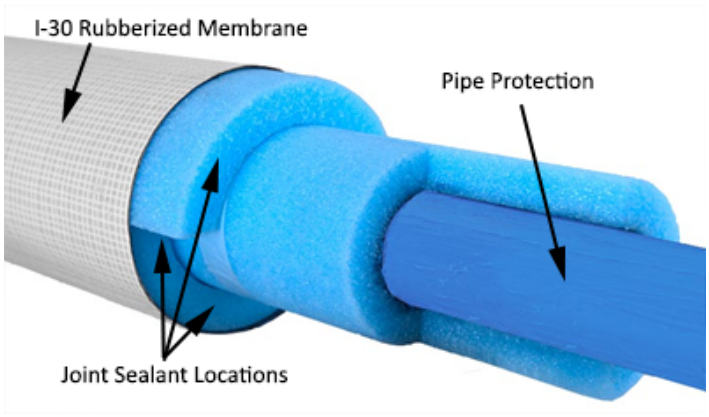


Cold Service Installation Single Layer (Quick Facts)

- Single layer of insulation
- Field applied vapor barrier
- Longitudinal joints at 3 & 9 o'clock
- Overlap vapor barrier lap 2"
- Vapor barrier bond joint at 4 o'clock
- Joint sealant applied on butt & longitudinal joints
- Pipe protection (gel coat) is highly recommended

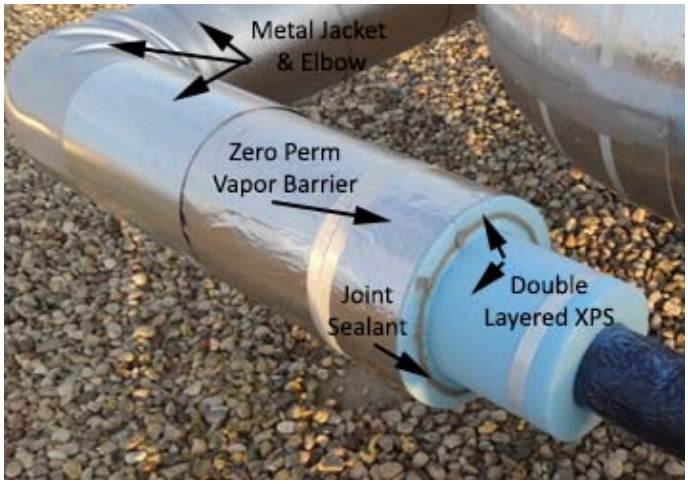
Double Layer Insulation Systems (Very Cold & Cryogenic). In the medium temperature side of the cold system temperature range, single layers are common On Chilled Water application and sometimes on the high temperature side of cold service (0ºF to 25ºF) it is common to install a single layer of insulation but with broken butt joints and joint sealant. The moisture drive is becoming very intense so more precautions are necessary.





Cold / Cryogenic Service Installation (Quick Facts)

- Field applied vapor barrier
- Over lap vapor barrier lap by 2"
- Double layered insulation
- Inner longitudinal joints at 12 & 6 O'Clock
- Outer longitudinal joints at 3 & 9 O'Clock
- Joint sealant applied to butt & longitudinal joints on outer layer only
- Pipe gel coat is highly recommended



Pipe Protection: It is highly recommended on cold systems to install cathodic protection to piping under insulation. No matter how good the insulation and jacketing is, over time moisture will get caught inbetween the pipe and insulation.

In the illustration above (left) moisture got caught inbetween the pipe and insulation. The epoxy paint was not able to stop corrosion from occuring. As pipes expand and contract, gel is better suited to flow with the pipe and not chip or flake off and allow corrosion to occur.

Pipe Protection Installation (Quick Facts):

- Remove loose scale rust (SP-2)
- Clean pipe of oil, weld flux or dirt
- Apply 30 mils of RG by hand or brush
- Use Accutrowel to achieve 25 mil wft
- Install insulation immediately following

RG products work by forming a mineralized layer over the metal surface and blocking moisture and oxygen from connecting with the annode and cathode in the metal. This mineralized layer also provides a buffer to the outer surface and alters the ph level to a more basic ph of around 10 – 10.7PH.

RG can also be directly applied to valve groups. Valve groups should then be covered with insulation or weather cover jacketing.

Advantages:

- Alters Surface PH level of metal piping
- Blocks moisture and oxygen from pipe surface
- Expands and contracts with piping system
- Doesn't flake or peel off
- No sand blasting requred
- Less stringent surface prep conditions
- Easy to apply

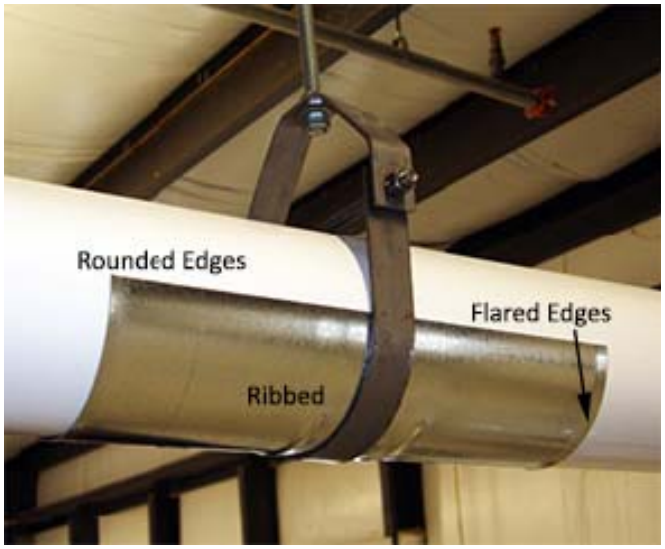
Tanks & Vessels: Insulating tanks and vessels is similar to piping where single and double layering patterns of insulation should be followed. Joints should be overlapped by 6" on centers. Joint sealant to be applied to the outer layer. Use filament tape or metal banding to hold insulation tightly in place.

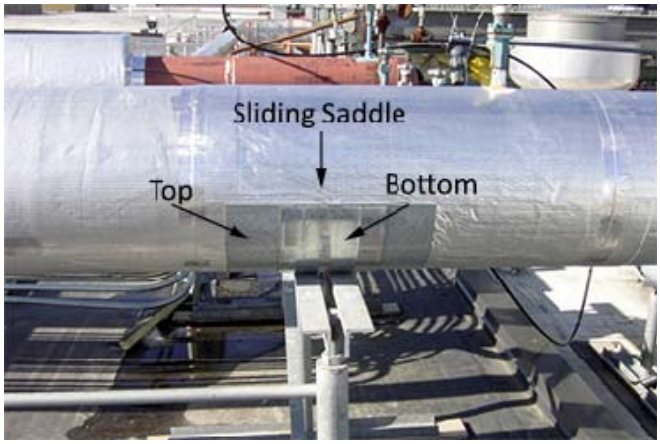
Head Installation: Heads to be fabricated and form fitted. To be applied in sections. RG will help adhere insulation to tank heads and bottoms.

Indoor tanks to be finished with PVC or Alumaguard Lite. Out door tanks and vessels to be finished with Metal or Alumaguard jacketing.

Hangers: Subpar hangers are often a cause of problems on cold systems. Hanger supports and insulation that support the piping need to be specified and installed correctly. It is very common for moisture to enter the system at the hangers. Hangers can tear the jacket and vapor barrier if not applied correctly. Sliding saddles are a very good idea on ammonia systems. Piping systems expand and contract a lot and in most cases the abuse is taken by the jacket. In a sliding saddle the abuse is taken by the top side of the saddle which is designed to take the abuse.

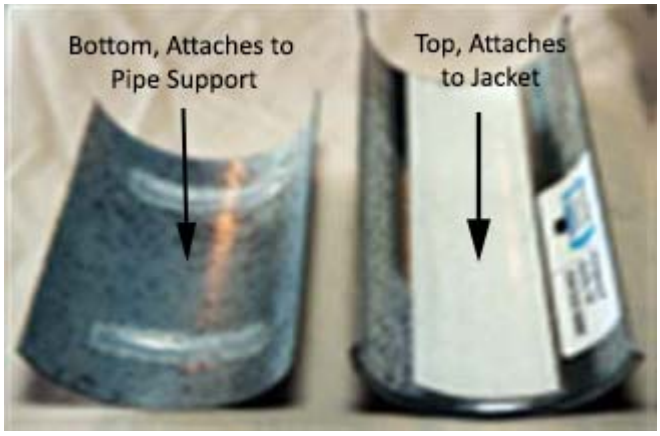
If a traditional style saddle is used, rounded edges and flared out ends are a good idea so that they can't puncture the jacket or vapor barrier. The supporting insulation should either be XPS up to 10" pipe diameter or heavy density PIR for larger pipe diameter sizes.





Sliding Saddle Advantages:

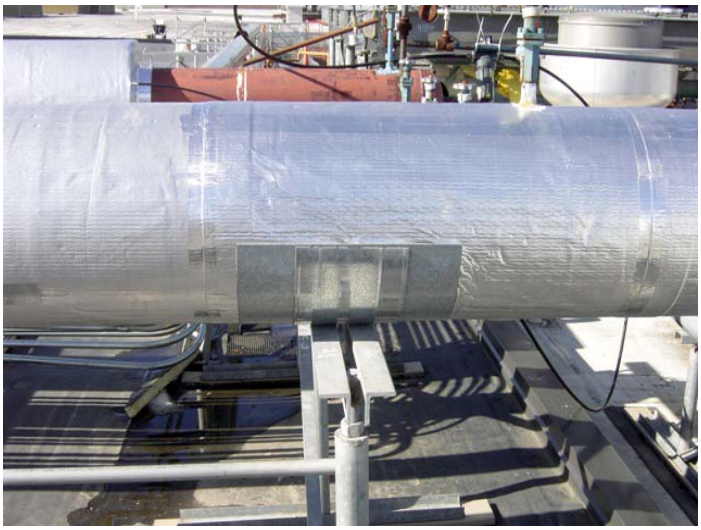
- Designed to take pipe expansion and contraction
- Sliding system takes the abuse
- Top part of saddle is adheres to pipe jacket
- Sharp edges are rounded and flared to reduce risk of jacket puncture
- Teflon coated to ensure good slide mechanism
- Wide variety of sizes available



Jacketing: Outdoor:
Traditionally 0.16 stucco clear coat aluminum with polysurlene backing is installed on insulation for outdoor rooftop ammonia refrigeration. It is durable, long lasting and aesthetic.

- Pre Molded Elbow Covers
- Stainless Steel Banding at least every 12”
- Longitudinal Joints at 4 O'Clock
- Butt Joints to be Telescoped
- Metal is not a vapor retarder

Alumaguard also acceptable for exterior outer jacketing. Alumaguard can save cost and is self-healing and is both a protective jacket and vapor barrier.



Indoor: 20-30 mil PVC jacketing is usually installed over insulation as a final jacket for indoor applications. PVC is available in several colors and thicknesses. 20 mil is primarily used, but of extreme cold or heavily abusive areas 30 mil is a good choice.

- Pre Molded Elbow Covers
- Heat Bonded Adhesives to be used at joints
- Butt Joints to be Telescoped
- PVC is not a vapor retarder

Alumaguard Lite is also acceptable for indoor insulation jacketing. It has a perm rating of 0.000 and is an economical way to provide a jacketing and vapor retarder system. Available in white or silver.

Thickness Tables: **All Tables Calculated using 3EPlus v4.1 Table lists the greater thickness required to prevent condensation or limit heat gain to a maximum 8 BTU/hr/Sq.Ft.**

Cold Room

Diameter	-100	-80	-60	-40	-20	-10	0	10	20	30	40
½	3.5	3	3	2.5	2	2	1.5	1.5	1		
¾	4	3.5	3	2.5	2.5	2	2	1.5	1	1	1
1	4	4	3.5	3	2.5	2	1.5	1.5	1	1	1
1 ½	4.5	4	3.5	3	2.5	2	2	1.5	1	1	1
2	5	4.5	4	3.5	2.5	2.5	2	1.5	1	1	1
2.5	5	4.5	3.5	3	2.5	2	2	1.5	1	1	1
3	5	5	4	3.5	3	2.5	2	1.5	1.5	1.5	1
4	5.5	5	4.5	4	3	2.5	2.5	2	1.5	1.5	1
5	6	5	4.5	4	3	3	2.5	2	1.5	1.5	1
6	6	5.5	5	4	3.5	3	2.5	2	1.5	1.5	1
8	6.5	6	5	4.5	3.5	3	2.5	2	1.5	1.5	1
10	7	6	5.5	4.5	3.5	3	2.5	2	1.5	1.5	1.5
12	7	6.5	5.5	4.5	3.5	3	2.5	2	1.5	1.5	1
14	7.5	6.5	6	5	4	3.5	3	2	1.5	1.5	1.5
16	7.5	6.5	6	5	4	3.5	3	2	1.5	1.5	1.5
18	7.5	7	6	5	4	3.5	3	2	1.5	1.5	1.5
20	8	7	6	5	4	3.5	3	2.5	1.5	1.5	1.5
24	8	7	6	5	4	3.5	3	2.5	1.5	1.5	1.5
30	8.5	7.5	6.5	5.5	4.5	3.5	3	2.5	1.5	1.5	1.5
36	8.5	7.5	6.5	5.5	4.5	3.5	3	2.5	1.5	1.5	1.5
48	9	8	7	5.5	4.5	4	3	2.5	1.5	1.5	1.5
Design Criteria: Ambient Temp: 40F, Relative Humidity 90%. Dew Point 37.3F Wind Speed: 0 MPH, Jacket: (PVC) 0.9 Emissivity											

In Door

Diameter	-300	-200	-150	-100	-80	-60	-40	-20	-10	0	10	20	30	40
½	3	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1	1
¾	3.5	3	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1
1	4	3.5	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1
1 ½	4	3.5	3	2.5	2.5	2.5	2	2	2	2	1.5	1.5	1.5	1
2	4.5	4	3.5	3	3	2.5	2.5	2	2	2	1.5	1.5	1.5	1
2.5	4	3.5	3.5	3	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1.5
3	5	4	4	3.5	3	3	2.5	2.5	2	2	2	1.5	1.5	1.5
4	5	4.5	4	3.5	3	3	2.5	2.5	2.5	2	2	2	1.5	1.5
5	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2	2	2	1.5	1.5
6	5.5	4.5	4.5	3.5	3.5	3.5	3	2.5	2.5	2.5	2	2	1.5	1.5
8	5.5	5	4.5	4	3.5	3.5	3	2.5	2.5	2.5	2	2	1.5	1.5
10	6	5	4.5	4	4	3.5	3	2.5	2.5	2.5	2	2	1.5	1.5
12	6	5.5	5	4	4	3.5	3	3	2.5	2.5	2	2	1.5	1.5
14	6.5	5.5	5	4.5	4	3.5	3.5	3	2.5	2.5	2.5	2	2	1.5
16	6.5	5.5	5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5
18	6.5	6	5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5
20	7	6	5.5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5
24	7	6	5.5	4.5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
30	7	6	5.5	4.5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
36	7.5	6.5	5.5	5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
48	7.5	6.5	6	5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
Design Criteria: Ambient Temp: 90F, Relative Humidity 80%. Dew Point 83F Wind Speed: 0 mph, Jacket: (PVC) 0.9 Emissivity														

Out Door Moderate Conditions

Diameter	-300	-200	-150	-100	-80	-60	-40	-20	-10	0	10	20	30	40
½	3	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1.5	1
¾	3.5	3	3	2.5	2.5	2.5	2	2	2	2	1.5	1.5	1.5	1.5
1	4	3.5	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1
1 ½	4	3.5	3	2.5	2.5	2.5	2	2	2	2	1.5	1.5	1.5	1.5
2	4.5	4	3.5	3	3	2.5	2.5	2	2	2	2	1.5	1.5	1.5
2.5	4.5	3.5	3.5	3	2.5	2.5	2.5	2	2	1.5	1.5	1.5	1.5	1.5
3	5	4	4	3.5	3	3	2.5	2.5	2	2	2	2	1.5	1.5
4	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2	2	2	1.5	1.5
5	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2.5	2	2	1.5	1.5
6	5.5	5	4.5	3.5	3.5	3.5	3	2.5	2.5	2.5	2	2	2	1.5
8	5.5	5	4.5	4	3.5	3.5	3	2.5	2.5	2.5	2	2	2	1.5
10	6	5.5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5	1.5
12	6	5.5	5	4	4	3.5	3	3	2.5	2.5	2	2	2	1.5
14	6.5	5.5	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2	2	1.5
16	6.5	5.5	5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5
18	6.5	6	5.5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5
20	7	6	5.5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	1.5
24	7	6	5.5	4.5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
30	7	6	5.5	5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
36	7.5	6.5	5.5	5	4.5	4	3.5	3	3	2.5	2.5	2	2	1.5
48	7.5	6.5	6	5	4.5	4	3.5	3	3	3	2.5	2	2	1.5

Design Criteria: Ambient Temp: 90F, Relative Humidity 80%. Dew Point 83F Wind Speed: 7.5mph, Jacket: (In Service Aluminum) 0.1 Emissivity

Out Door Severe Conditions

Diameter	-300	-200	-150	-100	-80	-60	-40	-20	-10	0	10	20	30	40
½	3.5	3	2.5	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5	1.5
¾	3.5	3	3	2.5	2.5	2.5	2.5	2	2	2	2	1.5	1.5	1.5
1	4	3.5	3	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5
1 ½	4	3.5	3.5	3	2.5	2.5	2	2	2	2	2	2	1.5	1.5
2	4.5	4	3.5	3	3	3	2.5	2.5	2	2	2	2	1.5	1.5
2.5	5	4	3.5	3	3	2.5	2.5	2	2	2	1.5	1.5	1.5	1.5
3	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2.5	2	2	2	1.5
4	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2.5	2	2	2	1.5
5	5.5	4.5	4.5	4	3.5	3.5	3	3	2.5	2.5	2.5	2	2	1.5
6	6	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2.5	2	2	2
8	6.5	5.5	5	4	4	3.5	3	3	2.5	2.5	2.5	2	2	2
10	7	6	5.5	4.5	4	4	3.5	3	3	2.5	2.5	2	2	2
12	7.5	6.5	5.5	5	4.5	4	3.5	3	3	3	2.5	2.5	2	2
14	7.5	6.5	6	5	4.5	4.5	4	3.5	3	3	2.5	2.5	2	2
16	8	7	6	5.5	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2
18	8.5	7	6.5	5.5	5	4.5	4	3.5	3.5	3	3	2.5	2.5	2
20	8.5	7.5	6.5	5.5	5.5	5	4.5	4	3.5	3.5	3	3	2.5	2
24	9	8	7	6	5.5	5	4.5	4	4	3.5	3	3	2.5	2.5
30	9.5	8.5	7.5	6.5	6	5.5	5	4.5	4	3.5	3.5	3	3	2.5
36	10	9	8	7	6.5	5.5	5	4.5	4	4	3.5	3	3	2.5
48	11	9.5	8.5	7.5	6.5	6	5.5	5	4.5	4	4	3.5	3	2.5

Design Criteria: Ambient Temp: 100F, Relative Humidity 90%. Dew Point 96.6F Wind Speed: 7.5mph, Jacket: (In Service Aluminum) 0.1 Emissivity