LEWCO

CRYO-SUPER MAT

LEWCO SUPER MAT

COLD SERVICE INSULATION

Installation Guide

Table of Contents

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Introduction/Scope

This installation guide pertains to CRYO Super Mat cold service insulation product application. CRYO Super Mat is a cold service, hydrophobic, PFTE-impregnated, needle-felted blanket insulation manufactured with an integral vapor barrier laminated to one face. The blanket is manufactured in several standard thicknesses.

CRYO Super Mat is essentially Super Mat with a laminated vapor barrier suitable for below ambient condensing atmospheres (operating more than 10% annually below the local atmospheric dew point) and for cryogenic insulation systems. The service temperature range is from ambient to -301°F (-185°C).

The recommended installation details and proper application of appropriate sealing materials is necessary to prevent migration of water vapor (in the atmosphere) into the insulation system. To achieve the design performance of cold service insulation systems, proper installation all components is critical, including:

- All specified layers,
- Butyl-backed joint sealing tape,
- Mastics,
- Butyl-backed sheet membrane,
- Outer metal jacket.

Priority Order of Documents

The recommendations in this guideline are not intended to take priority over, or in any way modify the requirements contained in a project insulation specification or the Owner Company's engineering standard.

The priority order of documents shall be:

1) Any Safety guidance associated with the installation of the insulation.
2) Project (insulation) specification, including safety rules and guidelines.
3) Company's corporate engineering standard for thermal insulation.
4) Vendor/Manufacturer's installation guidance.

Inconsistencies found among the documents should be brought to the attention of the Facility Owner for clarification with the understanding that the above order of priority should apply unless expressly communicated in writing by the Facility Owner or Purchaser.

Recommendations herein are for reference and are not intended to be a project or job specification, nor a contract document for insulation work. This document is intended as an installation guide only. Actual jobsite to jobsite field conditions encountered may vary and the requirements of the job specification may differ.

Installation details and recommendations herein are based on field and labor insulation applications trials with CRYO Super Mat.

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Responsibilities

The Facility Owner will provide:

- qualified installers with experience in installation of cold or cryogenic hydrophobic blanket insulation systems,
- proper quality assurance of the materials and installation.

It is the responsibility of the qualified Project Specifier to verify that the specified component materials of the insulation system are suitable for the intended application.

Trained installers. Proper installation is critical to the performance of the thermal insulation system. It is recommended that the installation of CRYO Super Mat be performed by installers who are trained and experienced in installation of below ambient thermal insulation systems for heavy industrial environments.

Quality assurance. Quality assurance is recommended throughout an insulation application process for the project. Facility Owners should utilize third party inspectors trained and certified by an independent body such as the National Insulation Association (in the USA) or other credentialed mechanical insulation certification association. The Inspector should have special training associated with cryogenic insulation systems.

Qualified third party quality assurance inspection is critical to ensure that not only is the insulation system installed in accordance with the project specification, but also that insulation is installed ONLY on surfaces which are deemed appropriate for insulation by the Facility Owner or their designated representative.

General

Methods and techniques for installing CRYO Super Mat are basically the same as for other hydrophobic, flexible, vapor retarder-laminated blanket insulation. A major difference is that the "**no dust"** property allows for effective and most efficient use of most mastics and adhesives to provide a true vapor-sealed system. The *No Dust* feature also saves time during cutting, and fabrication and eliminates costly ventilation systems for dust control.

Safety

CRYO Super Mat is composed of E-glass needled felt blanket, the fibers of which are coated with PTFE. There are no particulate-type materials included in CRYO Super Mat. The PTFE coating on the fibers helps reduce breakage of the glass fibers as compared to rigid insulation or fiber blankets which are not polymer-impregnated. As a result, handling and cutting CRYO Super Mat blanket produces no particulate dust, and the number of broken fibers resulting from cutting and handling is small.

Standard paper masks are suitable during the handling and installation of CRYO Super Mat.

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Storage and Handling

CRYO Super Mat does not require any special handling or storage.

The original packaging of CRYO Super Mat is cardboard boxes which, if wet will cause deterioration of the cardboard. However, the insulation itself is resistant to water. The boxes should be protected from the weather. If stored outdoors, boxed or un-boxed rolls should be stored on pallets and covered with plastic sheeting.

Rolls of CRYO Super Mat should be stored horizontally (on the sides, not the ends of the box or roll). The maximum recommended stacking height is three rolls.

Original packaging will identify the specific product by name and thickness.

CRYO Super Mat must not be fabricated nor installed on pipe and equipment during inclement weather that includes rain, fog or snow.

Roll Dimensions and Thicknesses

Roll widths currently available	
inches	meters
30* (2 rolls per box)	0.76 (2 rolls per box)
60	1.52
*NOTE: Smaller width rolls are available as a special order.	

Blanket Thickness Roll Area		
mm	**Square feet**	**Square meters**
8	625	~58
16	300	~27.9
20	250	~23.2
25*	225	~20.9
*NOTE: 25mm thick blanket is available as a special order.		

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Packaging

Boxes can contain one 6 ft. (1.5 m) wide roll, **or** two 3 ft.(0.76 m) wide rolls.

Shop or Onsite Cutting

Figure 1: *CRYO Super Mat roll on a stand*

Mount a CRYO Super Mat roll on a roller stand at the end of a cutting table. Pull the required length of the material on the cutting table. See Figure 1 above.

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Pre-cutting and nesting

Automated, pre-cutting is recommended to most efficiently achieve nested layers on multi-layer applications.

One-piece pre-cut fittings (such as lobster-back and inverse gore shapes) is encouraged in locales where it is sensible as a labor- and time-saving step which can favorably impact the total installed cost (TIC).

Cutting tool options

CRYO Super Mat is easy to install using common, readily available insulation tools. Most tools can be purchased at a local hardware store, insulation distributor, or over the internet.

CRYO Super Mat can be cut with a sharp knife, rotary cutter (with titanium blade), scissors, tin snips, hand shear, or by water jetting.

Cutting Tools

The recommended tools such as a ruler, measuring tape, box cutter knife, straight edge scissors spray adhesive, etc. are shown in Figure 2 below.

For the cryogenic system build up, additional tools required are trowel for mastic, caulking gun, roller, plastic card, etc.

Figure 2: Recommended cutting and measuring tools.

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When cutting the blanket by hand, a cutting table with a mounted straight edge is the most efficient and effective means to achieve proper and accurate cuts.

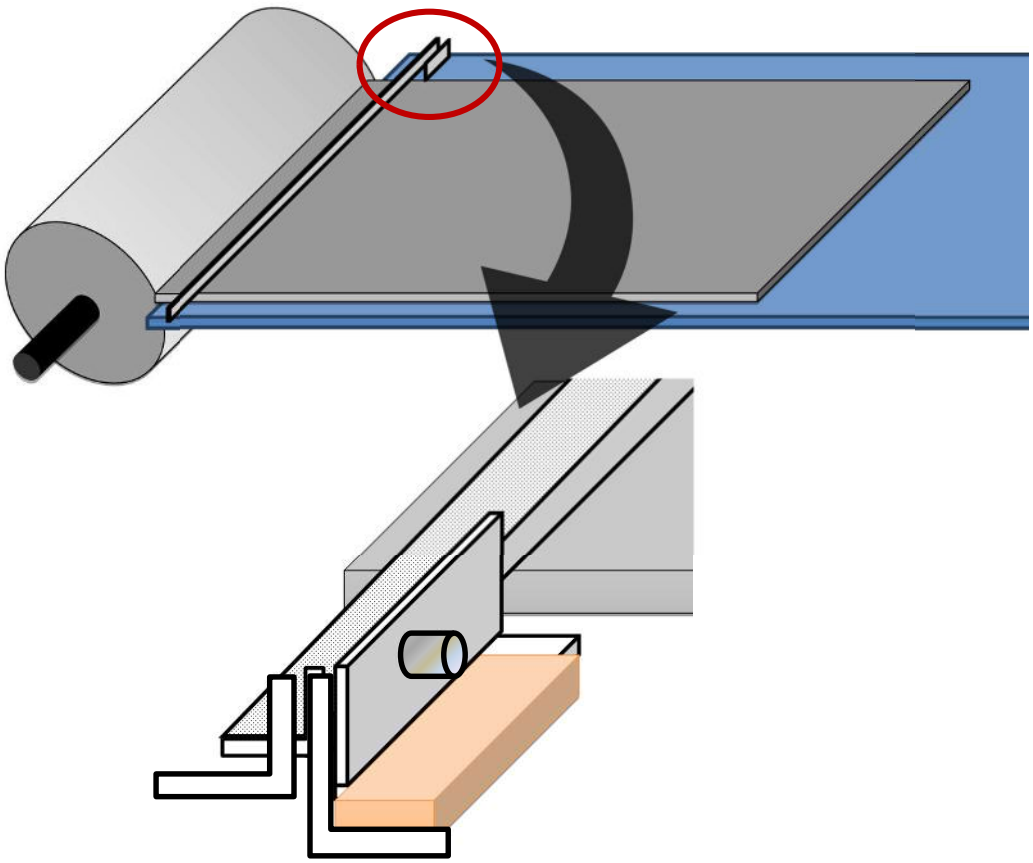
For widths 24”- 48” (610 mm – 1219 mm)

Mount a four-foot wide (1.2 m) shear at one end of several shop tables (4’ x 8’ x ¾” plywood top) aligned to accommodate long lengths pulled from a roll mounted on a 2” (50 mm) pipe supported at one end.

For widths up to 60” (1524 mm)

Cutting table width should be 7 ft. (2.1 m) wide.

A flat bar (pin-mounted on one end) can serve as a straight edge for cutting. A side edge alignment jig, such as a section of angle iron should be mounted on the first table exactly 90 degrees to the straight edge cutting aid to assure each cut is properly square. See Figure 3 below.



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Ancillary Vapor Barrier Materials

As covered in the **Responsibilities** section on Page 3 of this guide, recommendations and guidance herein are 4th in priority order. *The products in this section are intended as suitable (as noted for their temperature range) and do NOT take priority over Facility Owner or designated Project Engineering organization specifications or corporate engineering standards*.

The following products are some with which the technical team at Super Insulation, LLC have good experience. The products listed do not represent all that may be suitable or acceptable.

Definitions

- **PAP foil** – Polyester/aluminum/polyester foil is a composite seamless membrane adhered to CRYO Super Mat insulation blanket.
- **Secondary vapor barrier layer** – A layer of CRYO Super Mat which has all joints of the PAP foil sealed with the butyl foil-faced tape is defined as a fully sealed secondary vapor barrier.
- **Primary vapor barrier** – The butyl-backed sheet membrane which is applied to the outermost layer of insulation. This membrane, along with the vapor stops at termination, should provide a fully sealed insulation system.
- **Insulation layer build-up** – Non-sealed layers (without benefit of joints being sealed with butyl foil-faced tape) on a multi-layer system are considered as insulation layer buildup.

1) Primary Vapor Barrier Membrane

Primary vapor barrier of 1.2 mm thickness is available in rolls of foil-faced butyl sheet membrane. This type of primary vapor barrier is required on all outer surfaces of CRYO Super Mat prior to installation of metal jacketing.

Acceptable primary vapor barrier membrane products:

- Foster's Butylar NXT
- Polyguard's LNG Wrap JB
- Owens Corning's Pittwrap B100

2) Vapor barrier Joint Sealing Tape for Primary and Secondary Vapor Barriers

The foil-faced butyl tapes are intended to seal joints of secondary vapor barrier layers.

Where the geometry does not allow use of a sheet membrane as the primary vapor barrier, this type of tape is suitable.

Tapes are available in 2- and 4-inch (50 and 100 mm) widths. User shall verify compatibility of tape with the substrates.

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Foil-faced butyl tape products suitable for sealing surfaces that will operate:

- At or above -40˚F (-40˚C):
  - 3M's Venture Tape – 1555CW for performance at or above 0˚F (-18˚C)
  - 3M's Venture Tape – 1517CW for performance down to -40ºF (-40˚C)
- Below -40˚F (-40˚C):
  - 3M's Venture Tape – 1580 Aluminum Foil Tape
  - Polyken's 360-17 Foil Mastic and repair Tape

3) Vapor Barrier Mastic for Complex Geometry

Hypalon rubber-based liquid-applied mastic is needed for irregular or complex geometry surfaces where vapor barrier sheet membrane is not suitable or practical. The vapor barrier mastic must be used with a reinforcing scrim.

a) For substrate temperatures down to -40˚F (-40˚C):

- Foster Products' Monolar 60-38/39
- Foster Products' Monolar 60-95/96

b) For substrate temperature down to -320˚F (-196˚C):

- Foster Products' 90-66
- Foster Products' Cryolar 1K 90-61

Do not use a water-based vapor barrier mastic product, as it will not retain water vapor resistant properties at below dewpoint temperatures.

4) Reinforcing Membrane for Vapor Barrier Mastic and Vapor Stop Mastic.

The reinforcing membrane for vapor barrier mastic and vapor stop mastic must be synthetic (polyester based) or glass scrim cloth as recommended by mastic manufacturers.

- Foster's Mast A Fab 42-24
- Childers' Chil Glass # 10

5) Adhesive Spray for temporary securement

Suitable non chlorinated flexible waterproof adhesive for temporary or permanent bonding of CRYO Super Mat to metallic surfaces or to itself are listed below. They are rapid tacking and halogen free.

- Foster Products' – Fos-Stick 85-45
- 3M's Insulation Adhesive 78 Spray grade
- Nashua's Low VOC Premium grade spray adhesive 357 SA.

8) Glass Reinforced Filament Tape for securement of blanket sections

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One-half inch (12 mm) wide glass-reinforced filament tape with a self-adhering polypropylene backing suitable for securing layers of CRYO Super Mat insulation blanket are:

- 3M's Scotch 893
- 3M's Scotch 862

Preparation For Installation

Do not install insulation until all specified testing and/or coating of piping and equipment to be insulated is completed and released for insulation by authorized parties.

Assure surfaces to be insulated are clean, dry and free of dirt, scale, oil and grease.

Do not apply insulation to surfaces that are wet or frosted.

Provision of Pre-insulated Pipe Supports

1) Pre-insulated pipe supports:
   - Are most often provided by a third party which manufactures the support as per the project specification,
   - Are the first item to be installed on piping and equipment prior to installation of any insulation,
   - Are most often installed by a qualified contractor that is not the installer of the specified insulation system,
   - Can be fabricated using high density polyurethane or a specialized proprietary design utilizing CRYO Super Mat insulation.

2) A pre-insulated pipe support which utilizes CRYO Super Mat is expected to include:
   - The number of layers of the specified insulation system,
   - Stepped layering construction at terminations to accommodate staggered joints,
   - A primary vapor barrier extending at least the distance of the widest stepped layer with peel-off backing still adhered,
   - A metallic outer jacket in accordance with the project specification which extends past the structural support base at least 4 inches (100 mm).

3) See also Section for guidance on mating and sealing the main pipe insulation with the pre-insulated pipe support.

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Insulation System Buildup

General requirements

- All joints between sections of insulation blanket should be tightly butted.
- On multi-layer systems, assure that the joints are staggered between adjacent layers.
- Vapor stops are mandatory at all insulation terminations.
- Strictly avoid puncturing the primary and secondary vapor barriers. If screws are to be utilized to secure any components of the metal jacketing, install a sacrificial layer of standard Super Mat or CRYO Super Mat of a thickness to accommodate the screw length.

A) CRYO Super Mat with integral PAP foil

1) Precut the required length of CRYO Super Mat and install over pipe or equipment, assuring all butt joints are tightly fitted. The CRYO Super Mat insulation may be held in place by use of fiber-reinforced tape, stainless steel banding or halogen free adhesive.
2) For a single layer application, the longitudinal joint may be a lap joint with the lap facing downward to form a watershed. Seal all joints with foil-faced butyl tape.
3) For multi-layer applications, assure all longitudinal and circumferential joints are staggered relative to the preceding layer by a minimum of 100 mm.
4) Where necessary, trim CRYO Super Mat fibers at the longitudinal edge of the blanket to assure the joint sealing tape makes full contact onto clean vapor barrier surfaces on both edges of the joint.
5) Provide pipe fittings with the same number of insulation layers and the same insulation thickness as the corresponding pipe insulation. Stagger all joints and secure all segments with glass reinforced tape.
6) Secure insulation with stainless steel bands on large diameter (greater than 30 inch) vertical and horizontal piping and equipment to prevent insulation sagging.
7) Where stainless steel banding is used, a small section of butyl tape is needed as a protective pad:
    - under the banding seals on all secondary vapor barriers, and
    - on top of banding seals on the outer layer of insulation which will receive the primary vapor barrier.
8) Use of stainless steel banding on the primary vapor barrier is prohibited.

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B) Secondary vapor barrier

1) Install a secondary vapor barrier layer below the top layer of a multi-layer system. Seal all joints of secondary vapor barrier with foil faced butyl sealing tape. Press the tape firmly with a roller or stiff tape card to achieve a smooth and fully adhered seal. (Figure 4).

Figure 4: Butyl-backed aluminum tape applied over secondary vapor barrier.

2) A secondary vapor barrier (sealing the PAP foil with butyl tape) is not necessary for pipe and equipment operating warmer than -40˚F (-40˚C).

   On one- or two-layer systems, install foil-faced butyl sealing tape to seal all joints prior to installing the primary vapor barrier consisting of butyl-backed sheet membrane.

3) If stainless steel banding is used (e.g., on vertical surfaces), apply a piece of butyl tape under and over band seals to protect the secondary and the primary vapor barriers.

C) Primary vapor barrier

1) The outermost layer of the specified thickness of insulation must receive a primary vapor barrier to fully encapsulate the entire underlying insulation system.

   The primary vapor barrier applied to the outside of the outermost layer on a two-dimensional shape is most often a butyl-backed sheet membrane because it is much more labor-efficient, and yields the least risk of pinholes or other imperfections.

2) For complex geometry three-dimensional shapes, a primary vapor barrier can be achieved with a glass scrim-reinforced liquid-applied vapor barrier mastic. This mastic system is expected to provide the same vapor barrier properties as the sheet membrane vapor barrier and should be installed as follows:

   a) Apply the first coat of mastic according to manufacturer's instructions.

   b) While the mastic is still tacky, lay the reinforcement scrim onto the wet mastic surface to lightly embed into the mastic. Assure the scrim is smooth, without puckers or creases,

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and in full contact with the mastic. Assure a minimum of 2 inches (50 mm) overlap of scrim sections. For larger diameter, a greater dimension may be necessary to achieve a satisfactory overlap.

c) Apply the second layer of mastic to fully cover the scrim with a thickness that does not allow the shape or texture of the scrim to be discerned through the second coat of mastic. Allow all mastic applications to fully cure according to manufacturer's instructions before permanently covering with either a layer of insulation or with the primary vapor barrier membrane.

3) Precut the primary vapor barrier sheet membrane to the required cut length and any include special cutouts for protrusions where needed. (Figure 5). Provide a 3 inch (75 mm) overlap at all joints.

Figure 5: Installing primary vapor barrier.

4) Install the vapor barrier membrane smoothly, without voids, gaps, or pinholes. Smooth out the vapor barrier with a roller or stiff tape card, making sure that all overlapping joints are firmly bonded to achieve surfaces as smooth as possible. See Figure 6.

5) Use butyl-based aluminum tape or a strip of primary vapor barrier membrane to seal intersecting joints at tees, elbows, flanges and valves.

6) For irregular shapes of complex geometry such as pumps, small diameter fittings, and vessel heads, scrim-reinforced vapor barrier mastic may be used.

7) Apply the vapor barrier mastic in accordance with Paragraph C 2) above.

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Figure 6: Use of roller to smooth out wrinkles.

D) Vapor Stops

1) Vapor stops are required at all insulation terminations, such as at uninsulated protrusions, both sides of flanged connections, valves, dummy legs and pipe supports.
2) The vapor stop consists of three layers applied in the following order:
   a) Vapor stop mastic – First coat applied according to manufacturer's instructions to the specified thickness or the first-coat thickness indicated on the product datasheet.
   b) Scrim reinforcement -- Applied to the still tacky first coat of vapor barrier mastic with joints overlapped a minimum of 2 inches (50 mm). For larger diameter, a greater overlap dimension may be needed to accommodate assurance of a satisfactory overlap. Smooth scrim to remove all wrinkles, puckers, or gaps. Assure scrim is in complete contact with the first layer.
   c) Vapor barrier mastic – Second coat applied according to manufacturer's instructions to achieve the required total wet film thickness.

E) Vapor stop construction

1) Begin the first layer of the vapor stop mastic on the uninsulated steel surface 3 inches (75 mm) away from the edge of the terminated insulation. Apply the first vapor stop mastic layer according to manufacturer instructions to coat all steps of the insulation. Assure full coverage at inside corners and outer corners of each step. Extend the mastic at least 3 inches (75 mm) onto the outermost layer.

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2) While the first layer of vapor stop mastic is still tacky, install the scrim reinforcement as described in Paragraph D2 b) above. (See Figure 8).

3) It is permissible to achieve a stepped termination with steps consisting of multiply layers.

4) Apply the second layer of vapor stop mastic to fully encapsulate the scrim reinforcement, achieving a thickness that does not reveal the texture of the scrim prior to cure of the of the mastic. (Figure 9).

5) Allow vapor stops to cure per manufacturer's recommendations before proceeding with insulation work (Figure 10).

Figure 7: First coat of vapor stop mastic.
Masking tape (yellow) was used to achieve clean termination of the mastic layers.

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Figure 8: Imbedding reinforcing membrane into the first coat of mastic.
Masking tape (yellow) was used to achieve clean termination of the mastic layers.

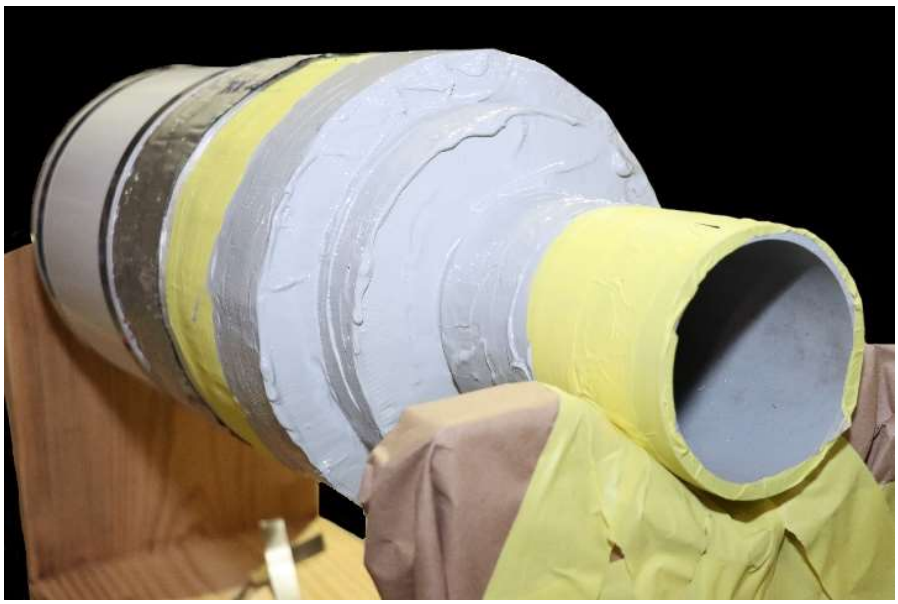

Figure 9: Second coat of mastic. Yellow tape providing for clean edge termination of mastic.

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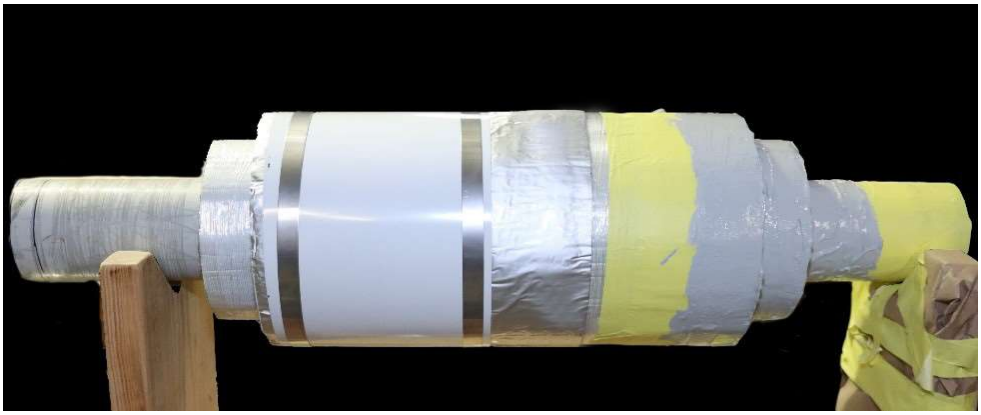

Figure 10: Completed vapor stop.

E) Metal Jacketing

1) Install metal jacketing over all insulated surfaces to protect the primary vapor barrier from mechanical abuse and atmospheric elements.
2) Utilize white coated, stainless steel or galvanized steel metal jacketing.
3) If possible, avoid screws and rivets, and instead use ¾ inch (18 mm) wide stainless-steel bands on 12 inch (300 mm) centers.

   If screws or rivets are needed to secure metal jacketing, install a sacrificial layer of CRYO Super Mat or standard unfaced Super Mat beneath the metal jacketing to protect the primary vapor barrier from puncturing.
4) Install metal jacketing with a minimum of 2 inch (50 mm) overlap. Position the overlap to shed rainwater.
5) Seal all protrusions through metal jacketing with silicone caulking compound.
6) Figure 11 depicts an example of a completed cold service insulation system.

Figure 11: A completed insulation system.

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Recommended Installation Technique

A) Straight Run Pipe -- Single Layer Application

1) The longitudinal joint may be either an overlap or butt joint depending on pipe diameter. Pipe diameter can impact the insulation's tendency to fish mouth between reinforced tape securement.

   When a butt joint does not permit not full closure of the longitudinal joint, an overlap joint is recommended. Orient longitudinal overlap to shed water.

2) Determine the cut length of CRYO Super Mat by wrapping a small width strip of the thickness of CRYO Super Mat being installed around the circumference of the surface being insulated. (See Figure 12)

3) For 4 inch NPS diameter and smaller, a single-layer application of 8 mm thick CRYO Super Mat can be best applied with a longitudinal overlap joint. To achieve a total thickness of greater than 8 mm, multiple layers of 8 mm thick blanket may be used.

   Secure CRYO Super Mat using glass reinforced filament tape. Overlap the tape a minimum of 50% and install on 8 – 12 inches (200 – 300 mm) centers. (See Figure 13)

4) In single layer application, for 6 NPS and greater, 16 mm thick or greater thickness can be installed with a tightly fitted overlapping or butt joint and secured with glass reinforced tape. (See Figure 14)

5) Where necessary, trim CRYO Super Mat fibers at the longitudinal edge of the blanket to achieve a clean closure of joints and to assure the PAP foil to make direct contact with the mating PAP foil.

6) On secondary vapor barrier layers, apply foil-faced butyl tape over the longitudinal and circumferential joints, assuring a complete seal without puckering or gaps.

Figure 12: Cut length determination using a piece of CRYO Super Mat.

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Figure 13: Single layer with overlapping longitudinal joint. Circumferential tape overlapping 50%.

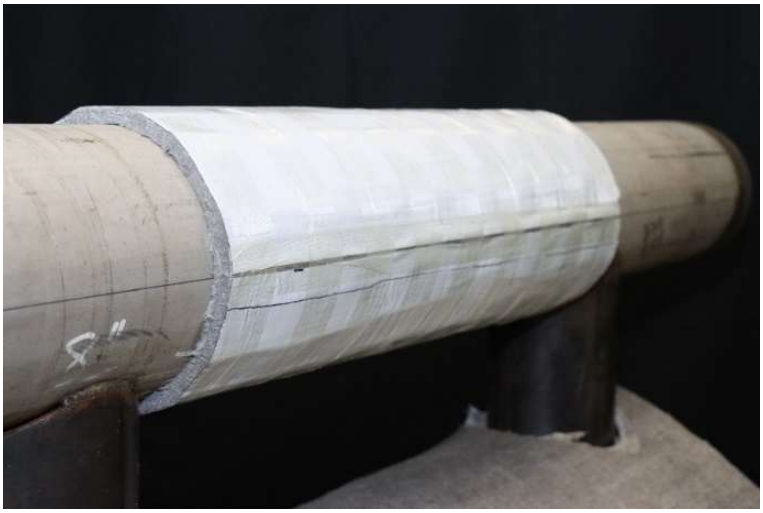

Figure 14: Single layer with butt joint and secured with tape.

B) Straight Run Pipe -- Multi-Layer Application

1) For multi-layer applications, utilize the same cut length measurement procedure as for the single layer application by using a new strip of the thickness to be installed for each layer.

2) All multi-layer insulation can be installed using butt joint construction, making sure that all joints are tightly fitted. Overlap joints may be acceptable where the need to mate with insulated pipe supports is not necessary.

3) Install multi-layer insulation making sure that all circumferential and longitudinal joints are staggered between layers by a minimum of 4 inches (100 mm). (Figure 15)

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4) Secure each layer of multi-layer insulation using filament tape, adhesive or stainless-steel banding with seals padded with butyl tape to assure no puncturing of a vapor barrier layer.

5) For large diameter pipe and equipment, a bungee cord may be necessary to secure insulation firmly until glass reinforcing filament tape or stainless-steel banding can be installed.

Figure 15: Second layer with offsetting joints.

C) Pipe Fittings – Elbows

1) Pre-cut gored elbow shapes of CRYO Super Mat blanket using pattern shapes that are used for fabricating metal elbow shapes. Achieve tightly fitted butt joints by use of a correctly sized pattern. (Figure 16 and Figure 17).

2) Install the first insulation segment starting at the weld of pipe to elbow. Secure each subsequent segment tightly fitted against the previous segment using filament tape.

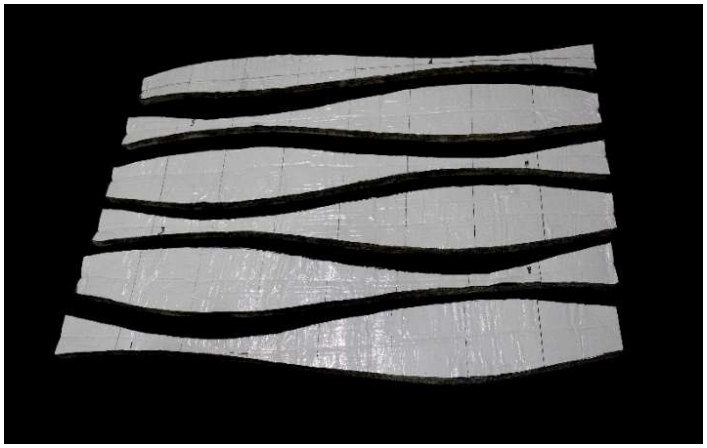

Figure 16: Precut gored elbow pieces.

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Figure 17: Gored elbow with CRYO Super Mat.

3) Stagger joints of subsequent layers of elbow gores (along with staggering the pipe-to-elbow circumferential joint), once again making sure that all joints are tightly fitted. Secure each segment tightly using glass reinforced filament tape. (Figures 18 and 19)

Figure 18: Staggered second layer of elbow gores.

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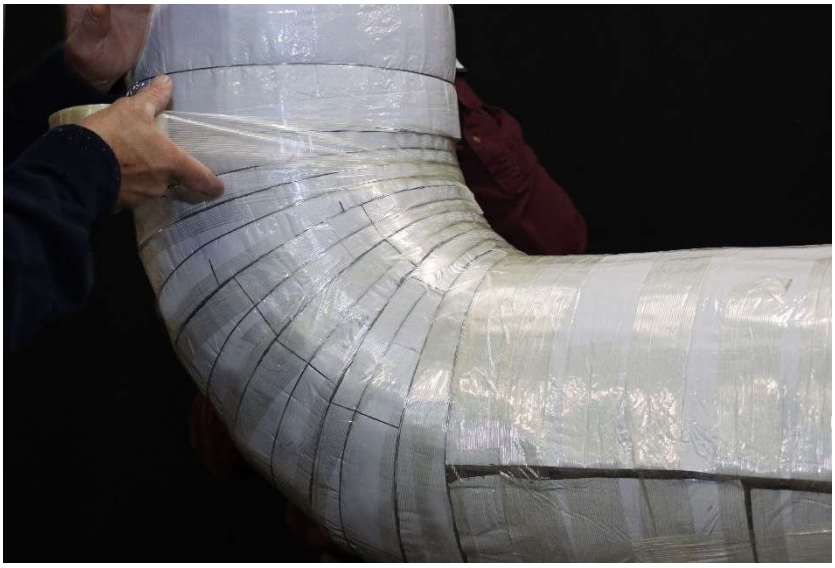

Figure 19: Outer layer gored joints secured with filament tape.

4) Seal all joints of the secondary vapor barrier layer(s) by use of foil faced butyl tape. (Figure 20)
5) Install the outermost layer of CRYO Super Mat.

Figure 20: Butyl tape to form secondary vapor barrier.

6) Install primary vapor barrier membrane to seal the outer layer of insulation. (Figure 21)

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Figure 21: Primary vapor barrier membrane sealing outermost layer.

D) Pipe Fittings – Tees, Dummy supports, Protrusions and Penetrations

1) Insulation at all piping branches must be of stagger joint construction. To avoid through-thickness joints this requires alternate installation of the main pipe layers with the layers applied to the branch.
2) Extend insulation onto uninsulated branch pipe, dummy legs and protrusions a minimum of three times the insulation thickness on the main piping.
3) The installation technique to achieve staggered joints at the branch are as follows:
    a) After the first layer of insulation is installed on the main pipe, cut out the first layer for the branch pipe using a template sized to fit that layer. (Figure 22)
    b) Trim the cut edge of the top of the branch piece to achieve an angle that allows PAP foil contact with the PAP foil of the main pipe insulation. Assure there is no gap at this juncture. (Figure 23). Secure insulation with glass-reinforced filament tape.
    c) Install subsequent layer to the main pipe, overlapping onto the branch layer, and securing with filament tape. Continue alternating installation of layers between the main pipe and branch.
4) Seal the joints of any secondary vapor barrier layer using butyl-based aluminum tape. (Figure 24)
5) Install an insulation disk at the termination of the branch insulation to create step construction at the bottom termination. (Figure 24)
6) Install the primary vapor barrier membrane as final step to achieve a complete sealed system on the main pipe and the branch. (Figure 25 and 26)
7) Vapor stops are required at the insulation termination of protrusions, making sure that the vapor stop is continuous onto the bare pipe of the branch. (Figures 27 and 28)

6859 Renoir Avenue
Baton Rouge, Louisiana
USA 70806
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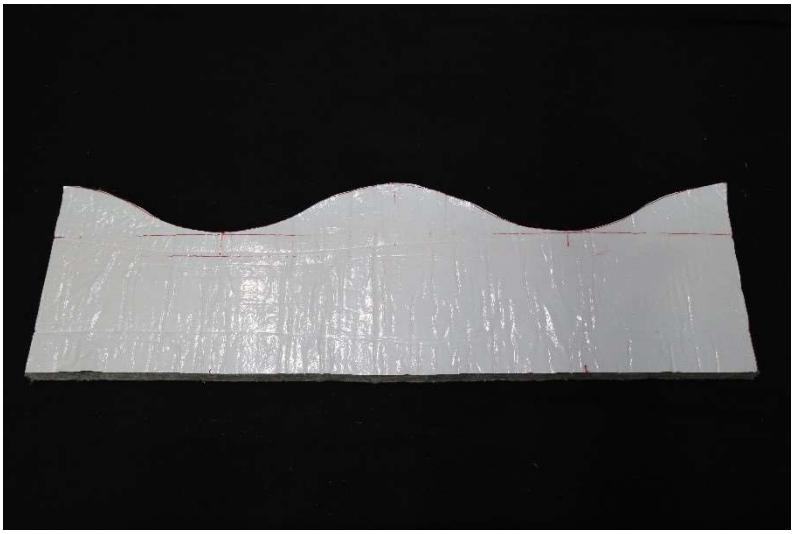

Figure 22: Cut out for the branch pipe insulation (dummy leg).

Figure 23: Dummy leg or tee insulation piece secured using glass reinforced tape. Note the full, continuous contact of the branch PAP foil onto the main pipe PAP foil.

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Figure 24: Photo depiction of butyl tape to achieve a secondary vapor barrier layer and an installation of an insulation disk to achieve a stepped construction.

Figure 25: Primary vapor barrier over tee.

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Figure 26: Main piping primary vapor barrier (Note cutouts in main pipe).

Figure 27: Primary vapor barrier joint sealed with either butyl-based aluminum tape or a strip of vapor barrier membrane.

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Figure 28: Example of continuous mastic type vapor stop over termination of tee.

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E) Fittings – End Cap

1) Stagger all layers of pipe insulation as shown in Figure 29. The extension dimension of each layer must be equal to the thickness of each layer.
2) Fabricate end cap disks and install to achieve a tight fit all around the outside diameter of each disk. (Figures 30 and 31)

Figure 29: Pipe insulation termination at the pipe end cap.

Figure 30: Sample of end cap disk cut from CRYO Super Mat.

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3) Install successive end caps with tight-fitting edges. (Figures 31, 32 and 33)
4) Install the final outermost disk with PAP foil facing outside. (Figure 34)

Figure 31: End cap of an inner disk.

Figure 32: Successive end cap installation.

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Figure 33: Successive layer of end cap installation.

Figure 34: Final end cap layer.

5) Install butyl-based aluminum tape to achieve a secondary vapor barrier layer using cut tabs and press them over the end disk. (Figures 35 and 36)

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Figure 35: Butyl based aluminum tape over secondary vapor barrier.

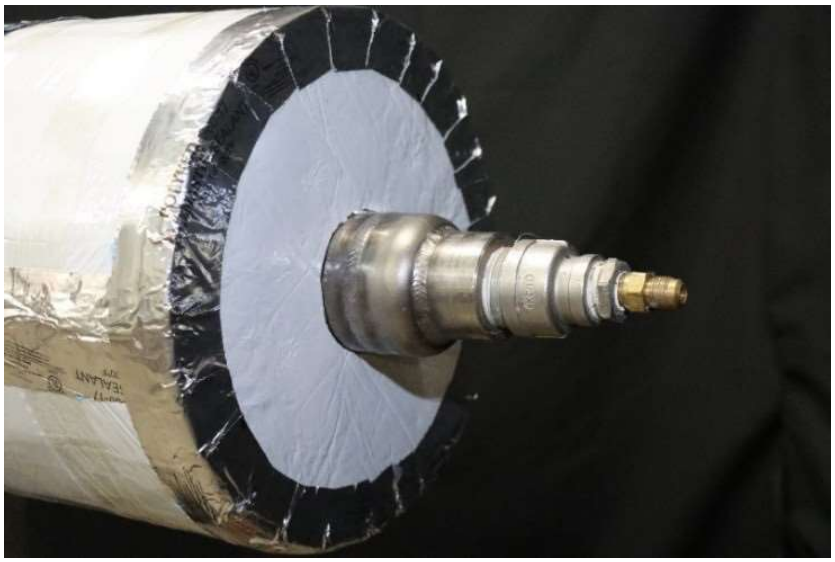

Figure 36: Sealing of secondary vapor barrier with cut tabs.

6) Cut and install a continuous ring of primary vapor barrier membrane to seal cut tabs in butyl tape. (Figure 37)
7) Install a complete vapor stop starting from piping nipple to overlap the primary vapor barrier and to provide the final seal of the insulation system. (Figure 38)
8) Figure 39 is an example of a completed insulation system.

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Figure 37: Use of primary vapor barrier membrane to seal tabs of butyl-based aluminum tape.

Figure 38: Vapor stop applied to the pipe nipple to overlap the primary vapor barrier.

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Figure 39: An example of finished insulation.

F) Fittings – Flanged valve

1) Terminate CRYO Super Mat application on the main piping, leaving bolt removal space and stair-stepping layers leading to valve flanges. (Figure 40).
2) Install a full vapor stop to seal terminations on both sides of the valve flanges as shown in Section D which describes construction of vapor stops. (Figure 41).
3) Insert fill (scrap) pieces of CRYO Super Mat into the void spaces around the valve body and over the stepped insulation terminations on each side of the outboard flanges. Build up scrap insulation thickness to align with OD of flanges. The buildup is required to support the valve body insulation and minimize air gap. Secure the scrap insulation pieces with stainless steel wires or glass-reinforced filament tape.

Figure 40: Insulation termination distance from flange to allow bolt removal space.

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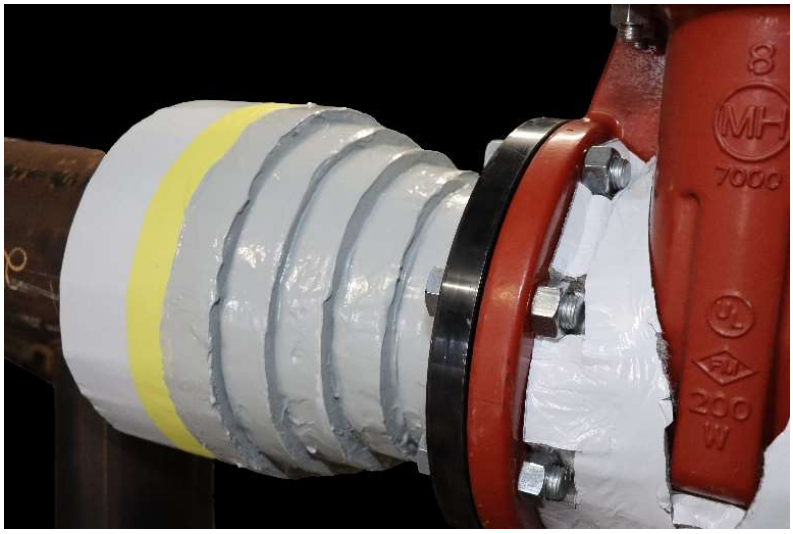

Figure 41: Fully cured vapor stop at the termination of pipe insulation.

4) Install insulation on the valve body and flanges to achieve the thickness specified for the main piping.

   Overlap the valve body insulation onto the main pipe insulation to achieve an overlap dimension that is equal to the thickness of the main pipe.

   Because flanges are a larger diameter than the pipe and larger than most valve bodies, providing the specified pipe insulation thickness to the flanges will result in a step down to the main pipe insulation as seen in Figure 42.

5) Install butyl-based aluminum tape to seal all insulation joints on any secondary vapor barrier layer. (Figure 42 and 43)

Figure 42: Installing butyl-based aluminum tape over secondary vapor barrier.

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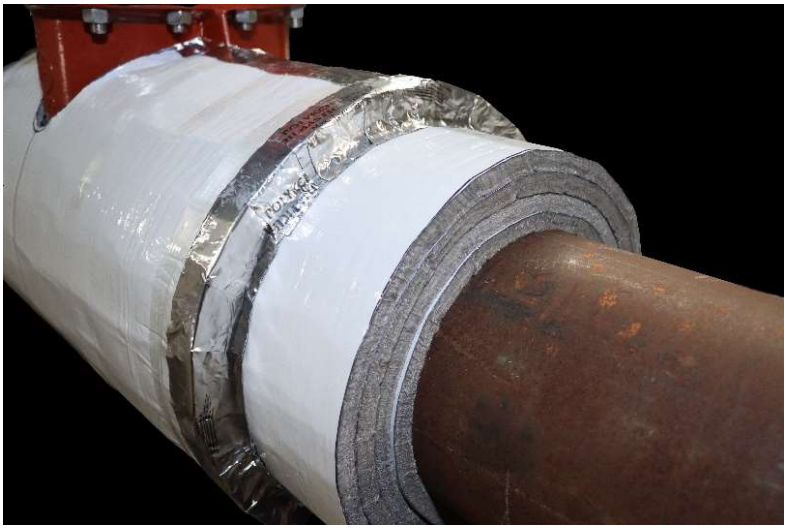

Figure 43: Secondary vapor barrier tape at the termination of valve body insulation.

6) Insert scrap pieces of CRYO Super Mat to fill the void below the flange of the bonnet, filling up to the OD of the bonnet flange. Secure the insulation pieces with glass-reinforced filament tape.

7) Insulate valve bonnet using specified number of layers, achieving stepped top terminations to allow for insertion of each successive disk layer. Secure with glass-reinforced filament tape or stainless steel banding. Insulate the bonnet to a height that allows sufficient room for maintenance of the packing gland. (Figure 44)

8) Insert the successive disks, making sure that each disk fits evenly and tightly, without any gaps. (Figure 45)

Figure 44: Flange insulation on valve bonnet.

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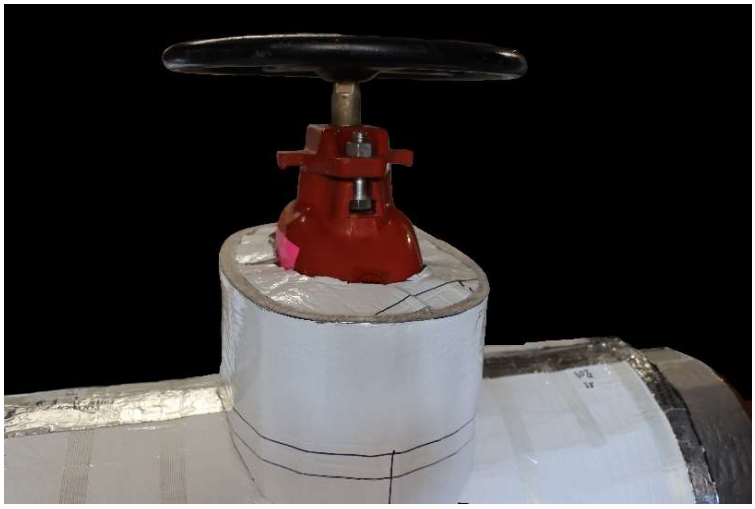

Figure 45: Disk insulation covering “fill” insulation which fills the void around valve bonnet.

9) Install butyl-based aluminum tape to seal all joints of the secondary vapor barrier layer. (Figure 46)
10) Install and secure the final layer of insulation over the secondary vapor barrier layer. (Figure 47)
11) Install and seal primary vapor barrier over all outer surfaces of valve insulation. (Figures 48, 49 and 50)

Figure 46: Butyl-based aluminum tape over secondary vapor barrier.

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Figure 47: Final layer of CRYO Super Mat insulation.

Figure 48: Installing and sealing of primary vapor barrier.

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Figure 49: Sealed primary vapor barrier.

Figure 50: Sealed primary vapor barrier over valve body.

12) Install liquid-applied scrim-reinforced vapor stop mastic at the termination of the valve bonnet, terminating the vapor stop immediately below the packing gland. (Figure 51).

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Figure 51: Vapor stop terminating below packing gland.

G) Pre-Insulated Pipe Supports

1) Information regarding responsibility for delivery, placement, and preparation for pipe insertion is covered in **Provision of Pre-insulated Pipe Supports** on Page 11.
2) Pre-insulated, load bearing cold service and cryogenic pipe supports are recommended. Insulation thickness and insulation layering inside of pipe supports must match the main piping insulation thickness and layering.
3) For a multi-layer application, the pre-insulated pipe support construction requires stepped layering.
4) After pre-insulated pipe supports are installed and secured, a scrim-reinforced liquid-applied mastic vapor stop is required on both ends of the pipe support. (See vapor stop construction detail in Section D of this installation guide.)
5) After vapor stop installation to seal the ends of the pipe supports, install pipe insulation to mate with the stepped edges of the pipe support insulation. Install each layer of the main piping insulation to achieve a tightly jointed mating of the pipe support insulation and the insulation being installed on the piping.
    a. Apply butyl foil-faced tape to seal joints on any secondary vapor barrier layer to form a continuous seal between the pipe support and the main pipe insulation.
    b. Install the primary vapor barrier onto the main pipe outer layer, overlapping the pipe support vapor barrier.
6) When installing the metal jacketing to the pipe insulation leading to the pipe support, provide an overlap onto the pipe support metal shield or jacket. Apply a stainless steel band to secure the metal jacketing overlap.

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