INSULATION JUST GOT EVEN COOLER

ArmaGel® XGC

Flexible aerogel insulation blankets for cryogenic and dual-temperature applications, including ArmaGel XGC (IMO)

Application Manual 2.0

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ArmaGel®

Dual-temperature

About ArmaGel XGC

The best performing insulation material for combined cryogenic and dual-temperature applications.

Flexible, improved work safety.
Cryogenic conditions down to -180°C (-292°F)*.

ArmaGel XGC is the reliable solution for cryogenic and dual-temperature applications.

Note
ArmaGel XGC is compliant with ASTM C1728 Type I Grade 1B and Type IV Grade 1A with minimum use temperature of -196°C (-321°F). For operating temperatures below -180°C (-292°F), special attention must be given to the system design and craftsmanship during installation to ensure that the material does not come in contact with liquid oxygen. For further information and support, please contact Technical Services.

Cryogenic

CONTENTS

Before you start

Personal protective equipment (PPE) and safety considerations: ArmaGel XGC will produce some amounts of dust particles - for your comfort some PPE measures are recommended.

Working with ArmaGel XGC

Figure 1:
Personal protective equipment

ArmaGel XGC will produce a small amount of dust and fibres during handling and cutting which must be managed in accordance with local regulations. See ArmaGel safety data sheet at www. armacell.com/ armagel.

For worker comfort we recommend the PPE shown above. Dust mask (disposable filtering half mask, class FFP2 acc. to EN 149, N95 American NIOSH Standard or equivalent).

Material Handling and storage

Figure 2:
Correct storage conditions

ArmaGel XGC rolls must always be laid / stacked sideways, never on end and always stored under cover, in dry conditions and not in direct sunlight. Care needs to be taken in order not to damage or break the integrated vapour barrier. All damaged vapour barrier shall be discarded or repaired.

Note
Masks should be properly fitted and worn in accordance with the manufacturer's instructions. Users are advised to be cleanly shaven.

Preparation

- Retractable craft type knife
- Electric / battery operated shears
- Heavy duty scissors
- Straight edge
- Scissors
- Tape card
- Set square
- Dividers and callipers
- Tape measure
- Marker pens
- Tensioning (Banding Tool)
- Seam Roller tool

Prefabrication and Preparation in the Workshop

Figure 3:
Prefabrication cutting in the workshop

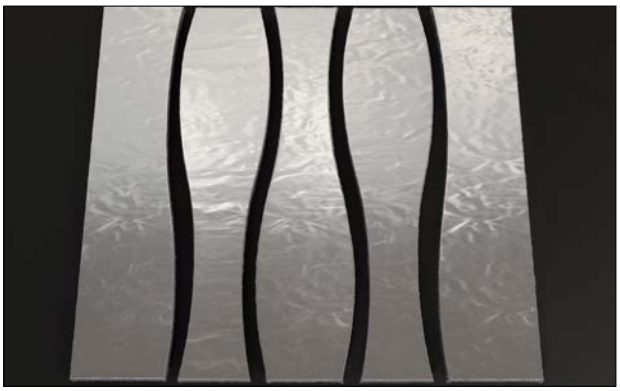

Figure 5:
Prefabricated parts ready to transport to jobsite

Prefabricated parts for straights and fittings can be prepared and palletised. Protect from adverse weather and damage.

Figure 4:
Recommended tools for application of ArmaGel XGC

Simple tools are required for measuring, marking and cutting.

Note
Within workshop locations, as part of good housekeeping, the use of an industrial type vacuum for cleaning aerogel dust is recommended.

Site requirements

Ensure that the jobsite conditions are optimal. Protect the insulation from adverse weather.

Weather and Equipment Conditions

Figure 6:
Ensure that piping is clean and dry

Enclosures / tenting may be required if rain or bad weather is expected during installation. Do not install ArmaGel XGC if weather conditions are unsuitable (e.g. rain, condensing fog, snowfall, ...)

Before any insulation material is applied, the pipe surfaces to be insulated shall be dry, free of dirt, dust, grease, frost, moisture and other imperfections

Application Details

Insulating Straight Pipe – Single Layer application

Figure 7:
Determining the circumference of the pipe

Figure 8:
Application of filament tape

Using a 150 mm wide strip of ArmaGel XGC, determine the actual outer circumference of the pipe / insulated pipe. This will provide the actual cutting size required to perform a complete wrap around the pipe. Note: Use the correct thickness of material for measuring as to be used to insulate the pipe. Always double check the actual measurement before mass fabrication of insulation parts.

Fixing and securement
Wrap the prepared section of material around the pipe making sure that it maintains a close fit. ArmaGel XGC insulation parts are secured with either 19-25 mm wide glass reinforced filament tape or 13-19 mm wide stainless-steel bands depending on the pipe size as indicated in Table 1. When filament tape is used, each filament tape fixing should be circumferentially bound (overlapped) around the insulation parts two times. Ensure that the surface of ArmaGel XGC is clean before applying the glass reinforced filament tape. The filament tape is to be applied at 75-250 mm centres depending on pipe size.

For vertical equipment/vessel or large diameter pipes (e.g.: 20“ and above), securement of intermediate ArmaGel XGC layers using stainless steel banding should be considered and decided by the Project Engineer in order to ensure safe securement of the insulation layer(s). The use of filament tape for securement of large vessel, vertical pipe or large diameter pipe should be carefully designed and applied to carry the weight and prevent slippage of insulation layer(s).

The use of stainless steel banding on the penultimate (second to last) layer shall always be applied on pipe sizes 10“ and above.

For sealing and taping of the ArmaGel XGC layer please consult the sealing and taping section on page 10.

Application Details

Insulating Straight Pipe - Multi-layer

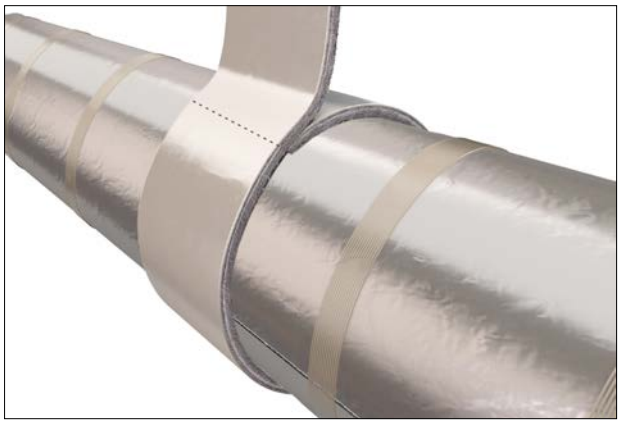

Figure 9:
Determining the circumference of insulation for multi-layering

For multi-layer applications, follow the same fabrication and installation process as with the 1st layer, ensuring that the circumference of the insulation on each subsequent layer is correctly measured each time with a new strip of material. See the straight piping section for details.

Ensure all the longitudinal and circumferential joints are butted tightly together with no gaps showing insulation surface below.

Stagger all seams and joints on all insulation layers at least 100 mm in all directions.

When an overlap is applied (typically with single layer only applications), it is recommended to position the overlap with downward facing watershed.

Installation of secondary vapour barriers

For multi-layer systems, both a primary and secondary vapour barrier sheet shall be applied where applicable as indicated in Fig 10, to provide protection against water vapour ingress.

The application of the primary vapour barrier is covered in Primary Vapour Section in this manual.

The secondary vapour barrier sheet (3-ply of aluminium and polyester (or similar) film to be a composite of minimum 12 µm polyester, 25 µm aluminium and 12 µm polyester film (i.e. total of minimum 50um) is applied and sealed over the thickness of insulation aligned with the second to last step of the staggered PUR/PIR connection on the cold shoe. For typical examples – see Figure 74 & 75.

Where no steps are present in the cold shoe, the secondary vapour barrier shall be sealed over the middle layer of ArmaGel XGC insulation (e.g. over layer 2 of a 5-layer system or over layer 3 of a 6-layer system etc.).

All secondary vapour barrier overlapping edges and at connections at the insulated pipe support surfaces shall be 100% fully sealed with vapour barrier tape (foil-faced butyl). Foil-faced butyl vapour barrier tape shall always be used to secure and seal the secondary vapour barrier sheet throughout and at the step of the insulated pipe support. The secondary vapour barrier sheet shall also be applied around all insulated piping parts and fittings including elbows, tees, valves and flanges, pipe protrusion etc to include a minimum 50 mm overlaps in all directions.

Care should be taken not to damage the secondary vapour barrier during the fitting and tightening of the bands and clips. A sacrificial 50 mm x 50 mm patch(s) of vapour barrier can be used and placed underneath and over the top of the clip / buckle to prevent damage.

Application Details

Table 1: Fixing and Securement of ArmaGel XGC

Pipe Size NB (inch)	Filament Tape 19-25 mm Wide (minimum)	Bands 13 mm wide (0.5 mm thick)	Bands 19 mm wide (0.5 mm thick)	Maximum spacing of Filament Tape/ bands (mm)
1	Yes	No	No	75
1½ to 3	Yes	No	No	100
4 to 8	Yes	No	No	150
10 to 20	Yes**	Yes*	Yes	200
above 20	Yes**	No*	Yes	250

Notes:

1. Insulation parts installed on piping, bends, tees and other pipe fittings, additional filament tape / bands applied as necessary for securement and better closure of longitudinal joints to avoid gaps showing pipe / insulation surface below.
2. For pipe sizes 1", 1½" & 2" filament tape can be spiral bound around the circumference of the insulation surface at maximum 75 mm centres.
3. Table 1, applicable for horizontal and vertical piping.
4. The appropriate width of steel banding shall always be applied on the penultimate insulation layer for pipe sizes ≥ 10" (DN 250 mm).
5. For vertical installations, additional metal banding shall be applied for systems with 7 or more layers, as shown in Figure 10.

* *For external diameters (inc. insulation thickness) above 20" (DN 500 mm) 19 mm stainless steel bands may be considered.*

** *The use of filament tape for securement of ArmaGel insulation on large vessel, vertical pipe or large diameter pipe should be carefully designed and applied to carry its weight and prevent slippage of insulation layer(s). Special consideration to the use of filament tape should also be given where the insulation thickness exceeds 2" (DN 50 mm).*

Application Details

Taping joints and seams

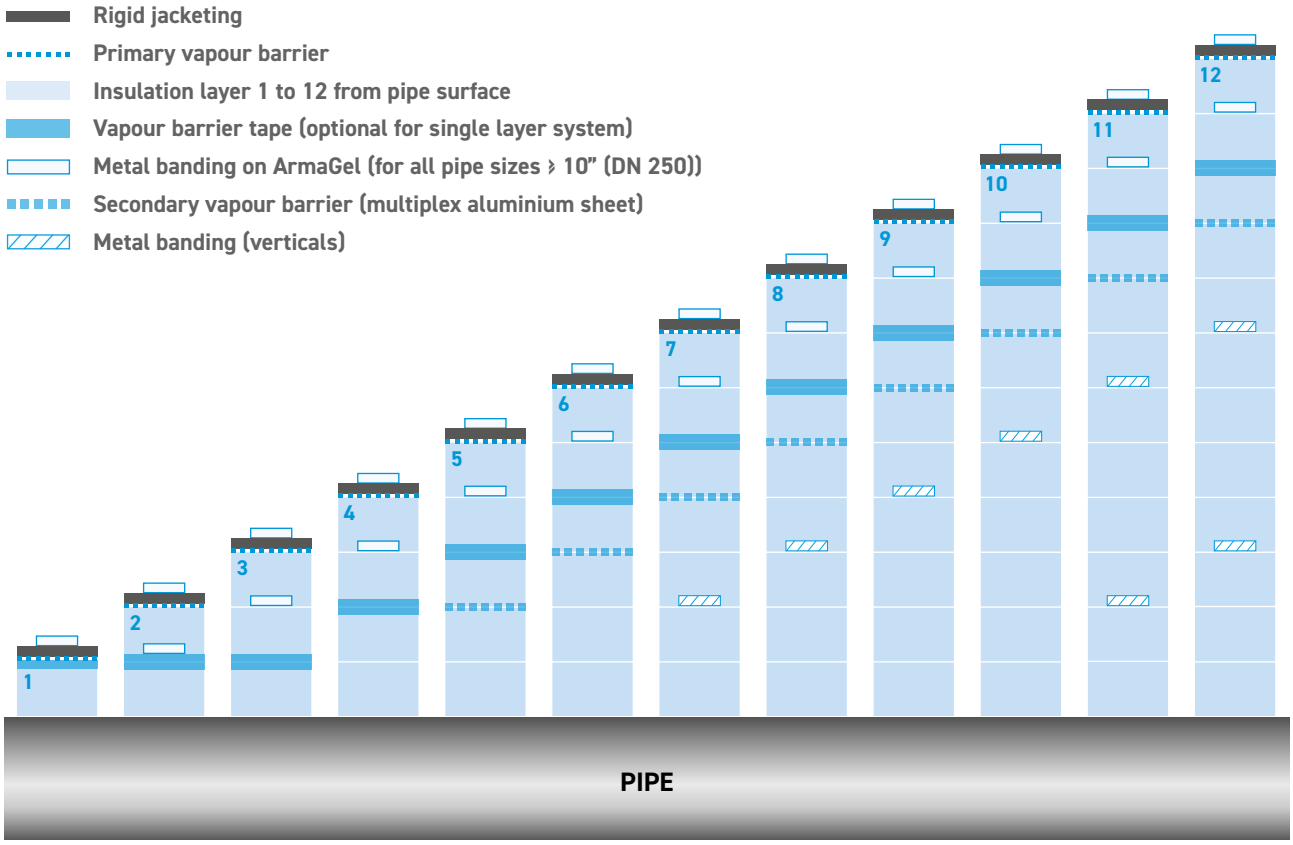

Figure 10:
Taping joints and seams

Notes:

1. Aerogel layers can either be 5 mm, 10 mm or 20 mm thickness.
2. Primary vapour barrier: An approved, self adhering (peel-and-stick) butyl-backed foil faced membrane.
3. Secondary vapour barrier: An approved 3-ply material of PET/AL/PET (PAP) to be applied over the insulation layer corresponding to the second to last step in the PIR/PUR support.
4. For temperatures below −50 °C with four layers or fewer, a secondary vapour barrier (multiplex aluminium sheet) may be added to improve protection against convective effects. This should be installed directly over the vapour-barrier-taped, sealed ArmaGel XGC layer.
5. Unless otherwise stipulated, all aerogel layers are to be fixed with filament tape or metal banding (depending on project specification).
6. Width of stainless steel banding to be applied as shown in Table 1.

Table 2: Recommended minimum pipe size for various ArmaGel XGC blanket 5 mm, 10 mm and 20 mm thickness on straight piping

Pipe Size: NB (inch) (mm)	ArmaGel XGC Insulation Blanket Thickness (mm)		
	5	10	20
½ & ¾ (21 & 28)	✓*	✗	✗
1 (35)	✓*	✓*	✗
1½ (48)	✓**	✓*	✗
2 (60)	✓**	✓**	✗
2½ (76)	✓**	✓**	✗
3 (89)	✓***	✓**	✗
4 (114)	✓***	✓**	✓*
6 & above (169 & above)	✓***	✓***	✓****

Notes:

1. * Recommended that insulation parts be cut and fabricated for ease of installation for a one-person installer in 375 mm or 500 mm width parts. (3 x 500 mm) or (4 x 375 mm) insulation part widths = 1500 mm in total, equivalent to the standard supplied width of ArmaGel XGC material.
2. ** Recommended that insulation parts be cut and fabricated for ease of installation for a one-person installer in 500 mm, 750 mm and 1500 mm width parts. (3 x 500 mm) or (2 x 750 mm) insulation part widths = 1500 mm in total, equivalent to the standard supplied width of ArmaGel XGC material.
3. *** Recommended that insulation parts be cut and fabricated for ease of installation for a one-person installer in 750 mm or 1500 mm width parts. (2 x 750 mm) insulation part widths = 1500 mm in total, equivalent to the standard supplied width of ArmaGel XGC material.
4. ✓ Indicates blanket thickness that can be used when bending round a given pipe size.
5. ✗ not recommended.
6. V-grooving of material is not required on any pipe size.
7. **** It is recommended to use bevel cuts (22.5 - 45° angle cuts) on 20 mm blankets for longitudinal joints in order to enhance the closure of the joints. For 20 mm XGC blanket on smaller pipe sizes 4" - 6" NPS bevel cuts can be implemented on one longitudinal connecting edge if required.

Application Details

Sealing and taping of joints and seams (for third to last (antepenultimate) layer only)

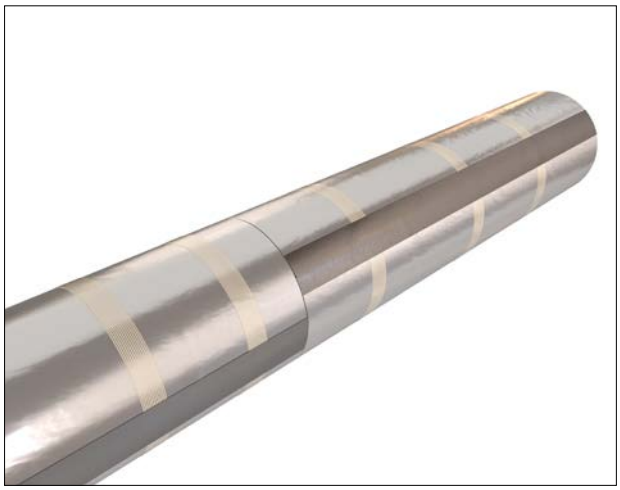

Figure 11:
Application of foil-faced butyl vapour barrier tape on a longitudinal joints

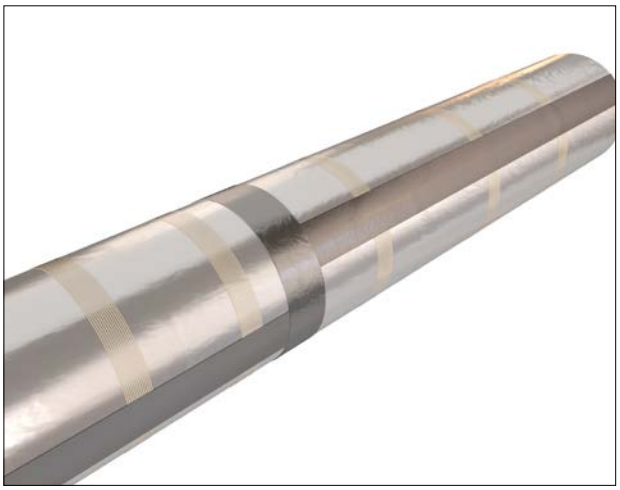

Figure 12:
Application of foil-faced butyl vapour barrier tape on circumferential joints

All joints and seams should be taped and sealed according to the insulation layer from pipe surface as above (Figure 11 & 12).

Clean the foil surface with a dry cloth before applying the foil-faced butyl vapour barrier tape to the seams and joints.

Apply minimum 75 mm wide foil-faced butyl vapour barrier tape over all longitudinal and circumferential seams and joints belonging only to the third to last (antepenultimate) insulation layer from the pipe surface, refer to Figure 10. The edges of the third to last (antepenultimate) XGC layer connected to the inner surface of the Pipe Support where applicable shall also be fully vapour sealed with the foil-faced butyl vapour barrier tape.

Ensure no gaps are present in the insulation between all the longitudinal and circumference butt joint connections showing no pipe/insulation surface below.

Insulation parts are tight fitted up to pipe support inner surface of the staggered support with and additional 5-7 mm compression. To obtain this compression, the width of the insulation parts is measured and cut with an additional 5-7 mm – to obtain the compression fit of the insulation part.

When an overlap is applied (typically for single layer applications), it is recommended to position this pointing downward in order to create a watershed overlap.

Application Details

Sealing and taping of joints and seams (continued)

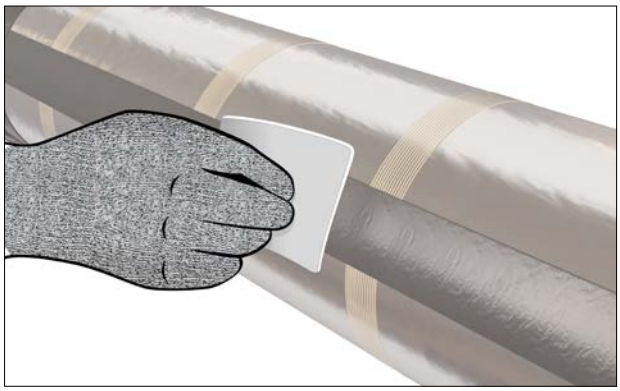

Figure 13:
Using a tape card

Apply firm even pressure using a tape card ensuring the foil-faced butyl vapour barrier tape and its edges are fully adhered to the outer surface of the foil covered ArmaGel XGC.

Note

To improve workability of the material after fabrication, ArmaGel XGC insulation parts can be pre-rolled around the pipe surface to release tension in the material. This technique will allow for the material to be installed easier around pipe surface/s during fixing.

V-grooving is not necessary on any pipe size when following the sizing guidance provided in table 2.

Note

For application of vapour barrier tape in high humidity environments (e.g: > 80%), spray adhesive may be pre-applied to all seams and joints of ArmaGel XGC to enhance the sealing of vapour barrier tape (foil-faced butyl).

Application Details

The butyl foil-faced vapour barrier acts as a primary vapour barrier and provides certain degree of both mechanical / puncture protection during the installation of the metal jacket.

Primary Vapour Barrier - Straights

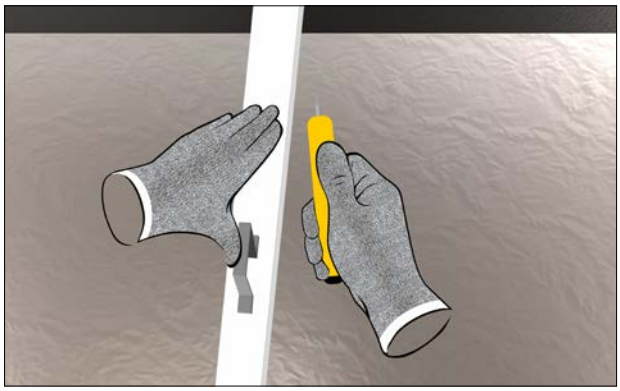

Figure 14:
Cutting foil-faced butyl vapour barrier

Figure 15:
50 mm overlap of foil-faced butyl vapour at joints

Primary vapour barrier – a 0.8-1.2 mm thick self adhering butyl foil-faced vapour barrier sheet shall be applied on the final layer of ArmaGel XGC before the installation of the cladding. Care needs to be taken not to damage / puncture the material during fabrication / application.

Refer to the manufacturers data sheet for recommending ambient temperature during fabrication and application.

For straight sections, roll out the material on a clean, dry and flat even surface (work bench).
Measure the outer surface circumference of the insulated part – allowing a minimum of 50 mm for the overlap in all directions.

Using a straight edge and a sharp retractable craft knife, cut the primary vapour barrier sheet to size.

Clean the outer foil surface of ArmaGel XGC with a clean, dry cloth to remove any dust before applying the primary vapour barrier sheet.
Remove the release liner from the back of the primary vapour barrier sheet and wrap it tightly around the insulated pipe. The overlap for longitudinal and circumferential joints shall be at minimum of 50 mm.

Figure 16:
Overlap at longitudinal and circumferential joints

Note
Wherever bitumen based primary vapour barriers are used in combination with mass load vinyl acoustic layers, care should be taken to ensure the compatibility between the two products.

Application Details

Primary Vapour Barrier - Straights (continued)

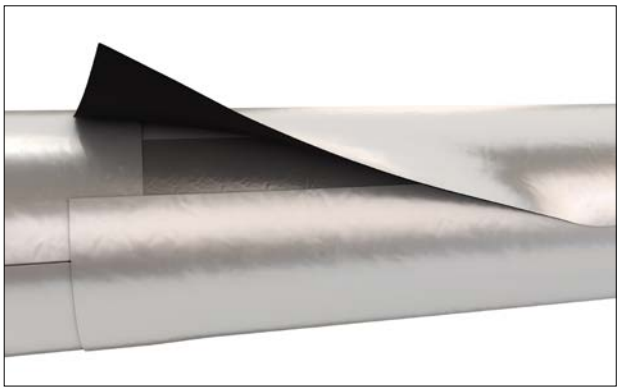

Figure 17:
Overlaps to be fixed down firmly and creases can be flattened down by using a tape card and small plastic seam roller

Creases and crinkles can be flattened down by using a tape card / seam roller during the application. This ensures that the voids in the creases are fully bonded down to the substrate underneath.

In high humidity environments (e.g., >80%), aerosol spray adhesive may be pre-applied to all overlaps of the primary vapour barrier to enhance the sealing. This is applicable to all insulated pipework and fittings.

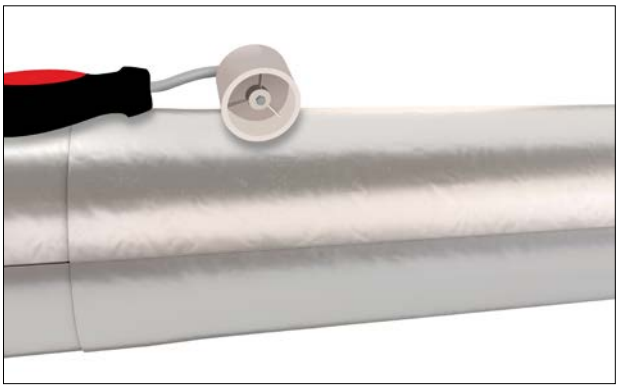

Figure 18:
Fixing seams with small plastic seam roller

The overlap is fixed with firm even pressure using a small plastic seam roller. Make sure the contacting area of the overlap is clean, dry and free from dust.

Longitudinal overlaps should be positioned to the side with the seams downward facing to provide a watershed.

IMPORTANT NOTE:

For the application of primary vapour barrier on vertical pipework and equipment, stainless steel metal bands (e.g. 19 mm x 0.5 mm) may be installed over the primary vapour barrier at maximum 300 mm on centres to improve the securement and prevent slippage, e.g. Vertical vessel and equipment. It is recommended that checks are taken to access the actual contact bond strength of the primary vapour barrier and the foiled insulation surface before the outer jacketing is applied.

Care should be taken not to damage the Primary vapour barrier during the fitting and tightening of the bands and clips. A sacrificial 50 mm x 50 mm patch(es) of vapour barrier can be used and placed underneath and over the top of the clip / buckle to prevent damage.

Note

For vertical piping the circumferential overlap seams should always face downwards.

Application Details

Vapour Stop Application

Figure 19:
Application of vapour stop at insulation termination

Complete the installation of primary vapour barrier. If required, the exposed edges of the ArmaGel can be taped over with foil-faced butyl vapour barrier tape for a smooth even surface finish prior to the vapour stop application. Apply the vapour stop coating with a brush, trowel or as manufacturers' recommendations. Tool to the outer surface of primary vapour barrier and pipe surface as shown.

The vapour stop shall extend at a minimum of 50 mm along the insulation and the pipe surface from the end termination of ArmaGel XGC.

Ensure that both surfaces have consistent film thickness coverage as per manufacturers recommendations.

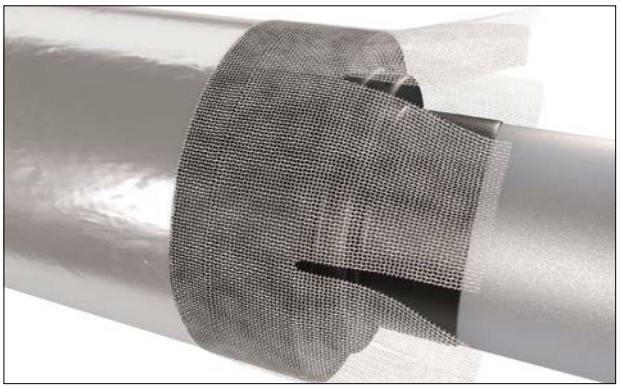

Figure 20:
Feathering of flexible reinforcing membrane (50 mm sections)

Determine the size of the flexible reinforcing membrane required to cover the coated area which provides a minimum of 100 mm overlap around the circumference of the insulation.

Embed the flexible reinforcing membrane into the insulation termination with a paintbrush and / or spatula.

The flexible reinforcing membrane is feathered into 50 mm wide sections depending on pipe size and embedded into the coating as shown.

Figure 21:
Application of vapour stop

Allow vapour stop coating to become touch dry before applying the next coat. Continue to apply additional coats until the vapour stop has reached a film thickness specified by the manufacturer.

Note
At insulation terminations next to flanged fittings, as well as all protruding pipe connections, a vapour stop coating is required in combination with an industry standard flexible reinforcing membrane. The vapour stop is applied in multiple coats to achieve a film thickness according to the manufacturer's recommendations.

Application Details

Piping Fitting – Segmented 1.5D Bend

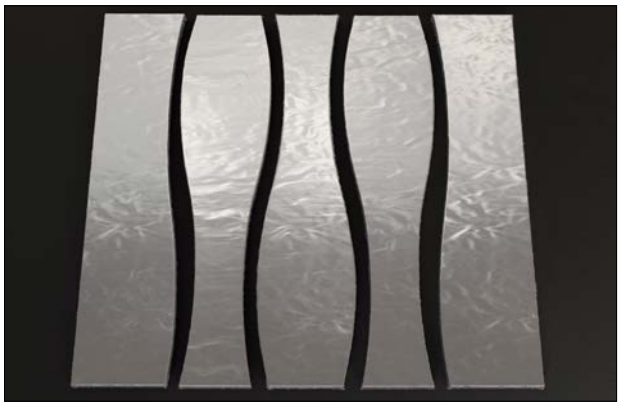

Figure 22:
Fabrication of segment (gore) insulation parts

Fabricate the appropriate segment (gore) pattern from metal sheet.

With a sharp knife cut the appropriate number of segments from the prefabricated metal sheet pattern to fit the bend.

Figure 23:
Application of starter segment (gore)

Apply the 1st segment (starter) up to the weld of the bend fitting.

Apply the filament tape to secure the segment in place. Ensure the seam is tightly butted with no gaps showing pipe/insulation surface below.

Figure 24:
Segment installation

Apply the centre segments around the bend fittings, and finish with final segment (finisher) as shown in the photo. Secure all segments in place with the filament tape. Ensure all seams and joints are tightly butted.

Clean the surface of the segments with a clean cloth before applying the vapour barrier tape (foil-faced butyl).

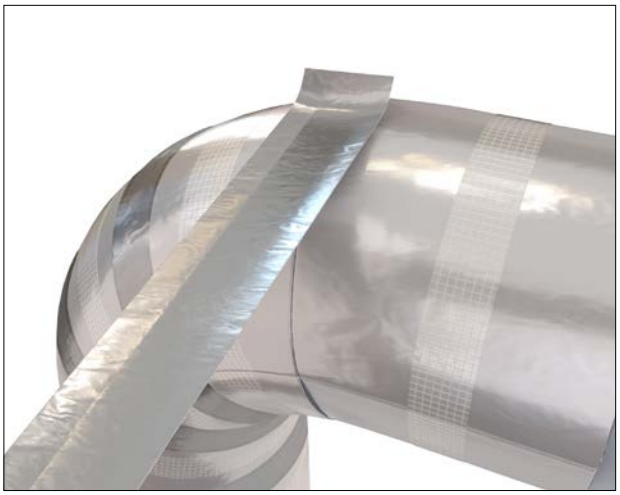

Figure 25:
Application of vapour barrier tape (foil-faced butyl)

Apply 50 or 75 mm wide vapour barrier tape (foil-faced butyl) to all the seams and joints on all the segments of the elbow belonging only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

Note
Final adjustments to the segments can be performed by twisting the segments carefully before applying vapour barrier tape (foil-faced butyl) to the seams and joints.

Application Details

Piping Fitting – Segmented 1.5D Bend (continued)

Figure 26:
Fully secured vapour barrier tape (foil-faced butyl)

Apply firm even pressure using a tape card, seam roller or with fingers, ensuring that the vapour barrier tape (foil-faced butyl) and its edges are fully secured to the surface of the foil covered ArmaGel XGC.

Table 3: 90° 1.5D - Welded Bends - Typical fabrication / installation methods ArmaGel XGC - thickness 5 mm, 10 mm & 20 mm

Pipe Size: NB (inch)	**Segments** (gores)	**Other** (90 Elbow / Tee end cap method)
1	**No**	**Yes**
1¼	**No**	**Yes**
1½	**No**	**Yes**
2	**Yes**	**No***
2½	**Yes**	**No***
3	**Yes**	**No**
4 & above	**Yes**	**No**

Notes:
* Elbow end capping at pipe size may be required where applicable within Project Specification / Project Engineer

Note
For multi-layering applications, fabricate the segment dimensions smaller or larger to provide the staggering of all seams and joints.

Application Details

Primary Vapour Barrier – Bend

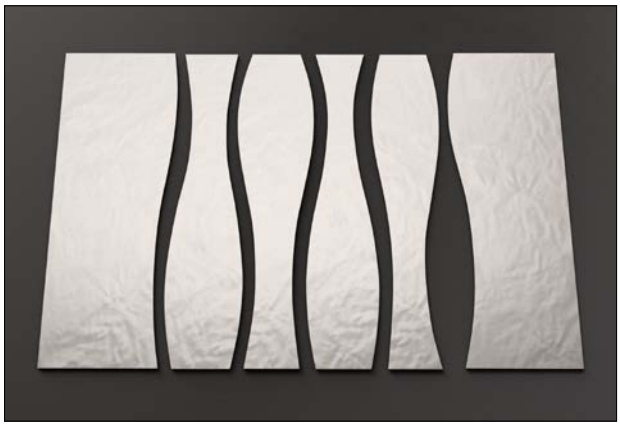

Figure 27:
Primary Vapour Barrier Segment (gore) parts

Fabricate the appropriate segment (gore) pattern from metal plate. The segments are fabricated to include for a (min) 50 mm longitudinal overlap and (min) 10 mm circumferential overlap.

Using a sharp cutting tool such as a blade or knife and metal template, cut the appropriate number of segments to complete the bend.

Figure 28:
Application of the first bend segment (starter part)

Start the installation of the primary vapour barrier by applying the starter segment part.

Fix and secure in the same way as the straight sections of material.

Figure 29:
Secure overlap with seam roller

Fix down the overlap (min. 50 mm) with firm pressure using a seam roller.

Figure 30:
Application of primary vapour barrier segments

Apply the remaining centre segment parts.

Each segment should overlap around the circumferential edges by a (min) of 10 mm.

Application Details

Primary Vapour Barrier – Bend (continued)

Figure 31:
Applying last segment (finishing) part of primary vapour barrier

To complete the fitting, apply the final finishing segment part.

Figure 32:
Securing overlaps down with seam roller

Using a seam roller, apply firm even pressure to all of the overlap seams and joints. Ensure all overlaps are fully secured down without any gaps or signs of lifting.

Creases and crinkles can be flattened down by using a tape card / seam roller during the application. This ensures that the voids in the creases are fully bonded down to the substrate underneath.

Application Details

Piping Fitting (Equal Tee) – 2 part construction

Figure 33:
Measure circumference of pipe

As with the instructions for insulating straight pipe, measure the outer circumference of the tee with a 150 mm wide strip of ArmaGel XGC.

Measure the un-insulated outer diameter of the pipe.

Figure 34:
Equal tee fabrication

Cut the insulation to the required size, circumference and length of the tee fitting. An allowance for an overlap can be provided if required (typically for single layer) applications.

Make the cut outs for the diameter of the bare pipe tee.

For repeated fabrication, a metal template can be produced.

Figure 35:
Securing insulation layer with filament tape

Apply the insulation tightly around the pipe and secure each side of the tee connection with filament tape.

Ensure the seams are tightly butted with no gaps showing pipe surface below.

Figure 36:
Securing equal tee with vapour barrier tape (foil-faced butyl)

Clean the outer surface of the material with a clean dry cloth and apply 75 mm wide vapour barrier tape (foil-faced butyl) along the linear seam belonging only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

Follow all procedures for the fixing and securing of the vapour barrier tape to the surface of the insulation.

Application Details

Piping Fitting (Equal Tee) – 2 part construction (continued)

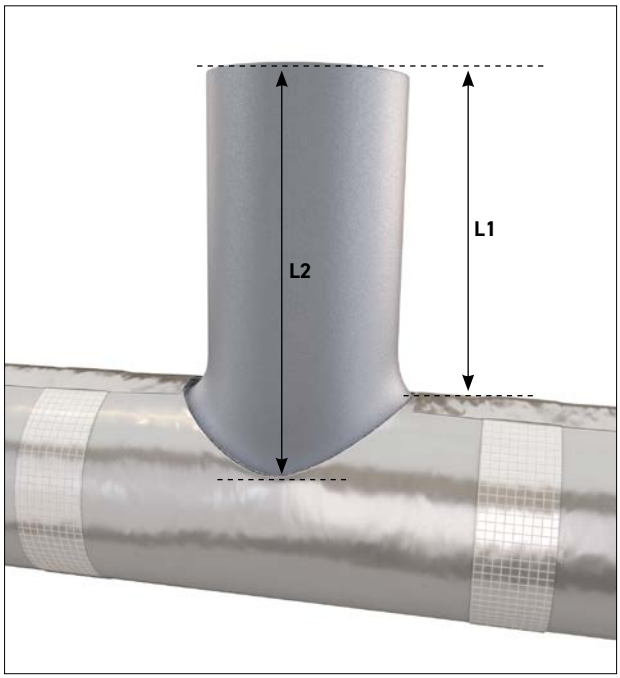

Figure 37:
Determining the height of tee piece

Use the lengths L1 & L2 to create the size and shape of the required tee piece. Metal templates can be fabricated when preparing multiple tee pieces.

Figure 38:
Tee piece fitting cover

Cut out the tee piece fitting cover and clean any dust from the foil surface with a clean cloth.

Figure 39:
Application of tee piece fitting cover

Fix and secure the tee fitting cover with filament tape. Ensure all the seams and joints are tightly butted with no gaps showing pipe surface below.

Application Details

Piping Fitting (Equal Tee) – 2 part construction (continued)

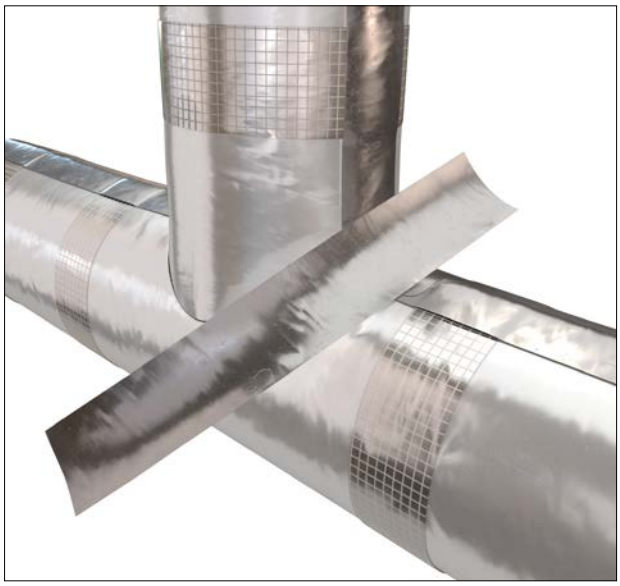

Figure 40:
Application of vapour barrier tape (foil-faced butyl)

Using a clean cloth, clean and remove any dust from the surfaces where the vapour barrier tape (foil-faced butyl) is to be installed.

Seal all the seams and joints with the vapour barrier tape (foil-faced butyl) belonging only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

Figure 41:
Securing vapour barrier tape (foil-faced butyl)

With firm pressure using a tape card, seam roller or fingers, smoothen the vapour barrier tape (foil-faced butyl). following the contours of the tee connection, making sure the vapour barrier tape is fully secured down to the foiled covered surface.

Note: For multi-layering, stagger all seams and joints from layer below.

Application Details

Primary Vapour Barrier – Equal Tee

Figure 42:
Measuring equal tee

For the main body part of tee, cut the primary vapour barrier to the required sizing - circumference and length of the body tee part as shown. Allowance for a (min) 50 mm overlap to be added.

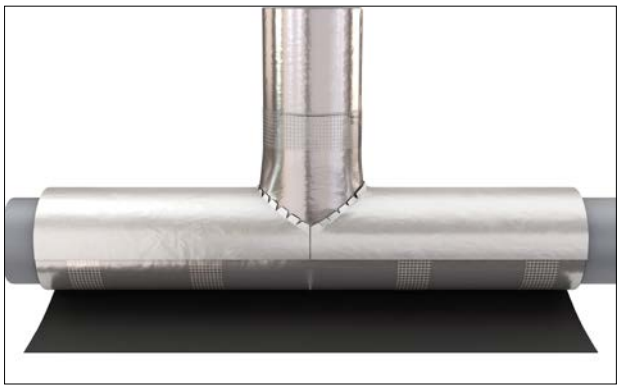

Figure 44:
Application of primary vapour barrier on equal tee including (min) 20 mm long "feathering" onto the adjacent Tee connection

Position the primary vapour barrier in the correct position ready for fixing down to the insulation surface.

Peel back the release paper of the primary vapour barrier and fix it to the insulation surface.

Continue the application of the primary vapour barrier in the same way as with the straight sections.

Creases and crinkles can be flattened down by using a tape card / seam roller during the application. This ensures that the voids in the creases are fully bonded down to the substrate underneath.

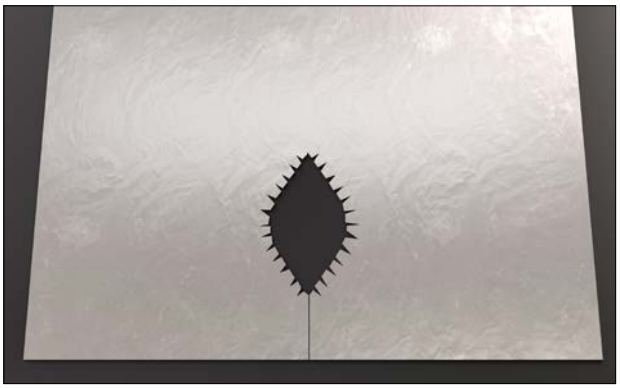

Figure 43:
Template of primary vapour barrier for equal tee

Depending on the positioning of the Tee, the longitudinal overlap shall be considered when fabricating the body tee section.

Make the cut outs for the diameter of the insulated pipe tee.

A metal template can be produced for multiple fittings.

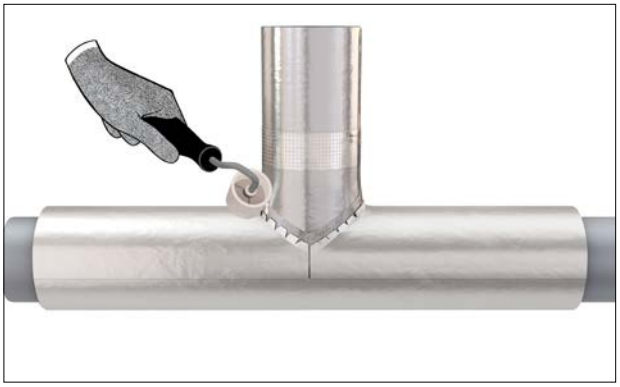

Figure 45:
Securing joints and "feathering" connections with seam roller

Using the seam roller, apply even pressure to all of the overlap seams and joints. Ensure all overlaps are fully secured down without any gaps or signs of lifting.

Application Details

Primary Vapour Barrier – Equal Tee (continued)

Figure 46:
Determining the height of Tee piece

Cut the primary vapour barrier to the appropriate size and shape.

Use the lengths L1 & L2 to create the size and shape of the required tee piece. Metal templates can be fabricated when preparing multiple tee piece parts.

Figure 47:
Application of primary vapour barrier on Tee

Apply the primary vapour barrier similar to the method as for straight pipe.

Figure 48:
Securing overlap joints with seam roller

Using a roller, apply even pressure to all of the overlapping seams and joints. Ensure all overlaps are fully secured down without any gaps or signs of lifting.

Creases and crinkles can be flattened down by using a tape card / seam roller during the application.

This ensures that the voids in the creases are fully bonded down to the substrate underneath.

Application Details

Protrusions

Figure 49:
Insulating a protrusion

Insulate the protrusion as per the insulation specification or to a minimum length of 4 times the insulation thickness of connecting pipe or equipment. Vapour seal all seams and joints with vapour barrier tape (foil-faced butyl).

The vapour sealing of all seams and joints is only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

Figure 50:
Application of vapour stop

Complete the installation of primary vapour barrier. Apply the vapour stop coating to the protrusion and the connecting insulated pipe surface which extends at a minimum of 50 mm either side of the protrusion.

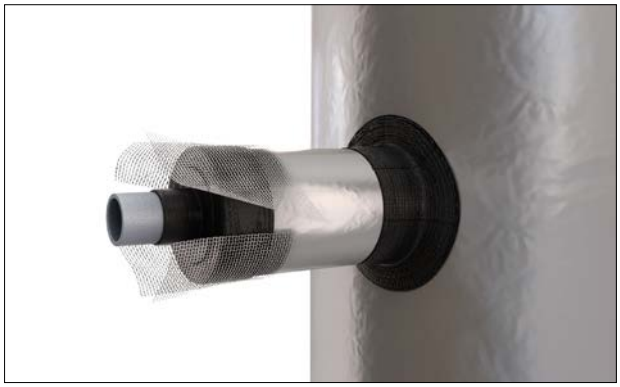

Figure 51:
Application of flexible reinforcing membrane

Cut the flexible reinforcing membrane to the applicable size and feather to enable the membrane to cover the protrusion and the termination insulation end.

The reinforcing membrane should have a minimum circumferential overlap of 100 mm and extend onto the pipe surface by a minimum of 50 mm.

Figure 52:
Embed the flexible reinforcing membrane into the vapour stop

Embed the flexible reinforcing membrane into the vapour stop coating with a brush, then apply a reinforcing membrane strip over the feathered section connecting to the pipe surface.

Note

It is recommended to insulate the protrusion following project insulation specification where applicable.

Application Details

Protrusions (continued)

Figure 53:
Application of vapour stop

Allow the vapour stop coating to become touch dry before applying additional coats. Continue to apply additional coats until the vapour stop has reached a film thickness specified by the manufacturer.

Application Details

Valve Body

Figure 54:
Packing pipe void

For the preparation for insulating a valve body, allow the vapour stop at insulation terminations to become completely dry.

Pack out the bare pipe voids between the insulation connection and the valve flange ends plus the valve body cavity with strips of loose fill ArmaGel XGC.

Secure the loose fill strips with filament tape.

Figure 55:
Insulating valve body

Determine the required length of the valve body insulation cover. The length of the insulation cover should extend at least 100 mm either side of the pipe end terminations or in accordance with the project specifications.

Figure 56:
Valve body cut out

Determine the size of cut-out required for any valve spindle or connections protruding from the valve body.

Remove the required cut out from the valve body insulation cover. Clean any dust from foil surface with a clean, dry cloth.

Figure 57:
Securing valve body cover with filament tape

Wrap ArmaGel XGC around the valve body and secure with filament tape.

Ensure all seams and joints are tightly butted with no gaps.

Application Details

Valve Body (continued)

Figure 58:
Application of vapour barrier tape (foil-faced butyl)

Clean the ArmaGel XGC foiled surface and vapour seal all seams and joints with the vapour barrier tape (foil-faced butyl) belonging only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

For multiple layers, apply as the 1st layer, with all seams and joints staggered away from layer below on all layers.

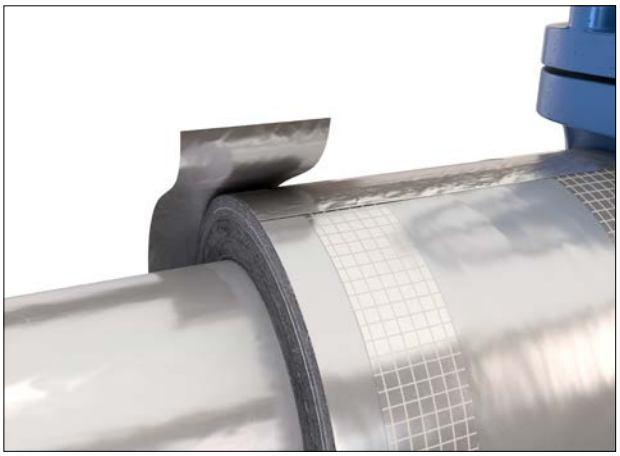

Figure 59:
Application of vapour barrier tape (foil-faced butyl) at termination

Vapour seal the termination ends of the valve body with strips of vapour barrier tape to the outer surfaces of the terminations and the connecting insulated piping surfaces.

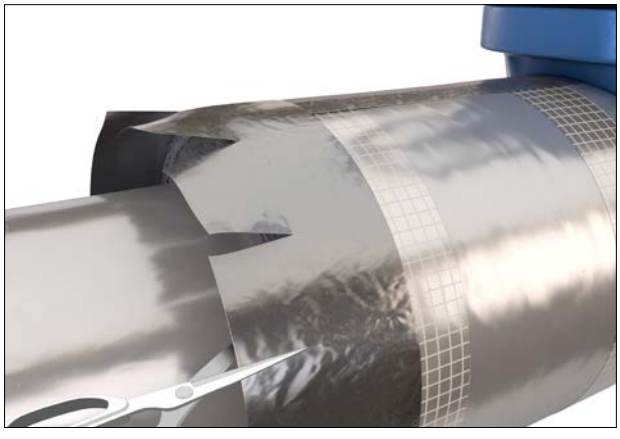

Figure 60:
Cutting and feathering the vapour barrier tape

The vapour barrier tape (foil-faced butyl) is cut and feathered as required and secured down to the surface of the insulated pipe connections.

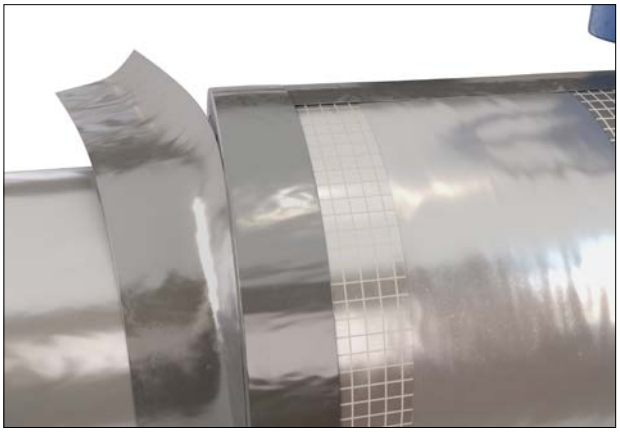

Figure 61:
Application of vapour barrier tape at termination

Apply a strip of vapour barrier tape (foil-faced butyl) over the feathered connections at the adjacent insulation pipe surface. Additional strips of vapour barrier tape (foil-faced butyl) can be used to seal the connections when needed.

Application Details

Valve Body (continued)

Figure 62:
Completely sealed termination

Complete the sealing of termination end using vapour barrier tape (foil-faced butyl).

Application Details

Valve Spindle

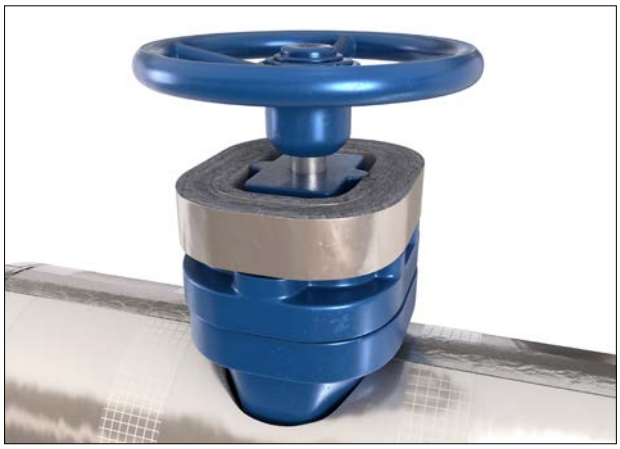

Figure 63:
Pack out spindle cavity

With thin strips of ArmaGel XGC, pack out the spindle cavity to the required height as recommended by valve manufacturers or project specification. The thickness of the packing should equal the depth of the flanged spindle fitting.

Build up the insulation thickness to be same level with the flanged spindle fitting connection.

Determine the circumference of the flanged spindle fitting with a strip of ArmaGel XGC.

Figure 64:
Fabricating the insulation for valve connection

Cut out the applicable insulation material to suit the shape required for the connection – Similar to a tee connection.

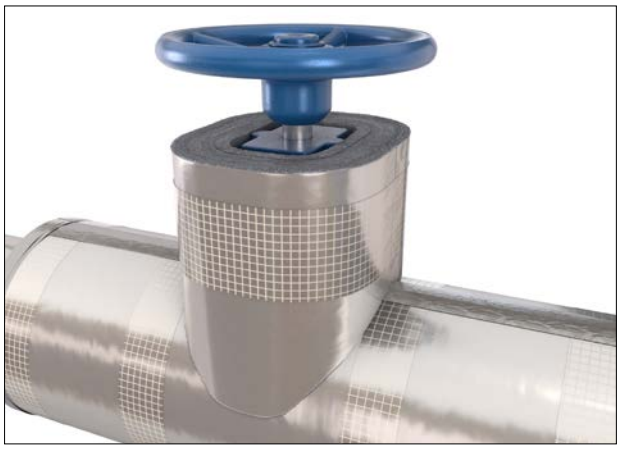

Figure 65:
Secure fitting cover with filament tape

Wrap the fitting cover around the spindle and secure with filament tape. Clean the foiled surface of ArmaGel XGC with a clean dry cloth. Seal all seams and joints with the foil-faced butyl vapour barrier tape belonging only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

Figure 66:
Insulate the top of valve spindle

Insulate the exposed layers of insulation at the top of the insulation cover with a bespoke disc of ArmaGel XGC to complete the installation. Do not insulate over any maintenance or moving parts contained within the spindle mechanism.

Application Details

Valve Spindle (continued)

Figure 67:
Application of vapour barrier tape (foil-faced butyl) on all joints and seams

Using a clean, dry cloth, clean and remove any dust from the foiled surface of ArmaGel XGC.

Seal all seams and joints with vapour barrier tape (foil-faced butyl) belonging only to the third to last (antepenultimate) insulation layer from the pipe surface as indicated in Figure 10.

Note
Ensure there is no gap between the insulation joints and seams before sealing with vapour barrier tape (foil-faced butyl).

Application Details

Vapour Stop of Valve

Figure 68:
Clean, dry, dust, damage free surface

Apply primary vapour barrier over the final layer of ArmaGel XGC. Ensure the surface of primary vapour barrier is clean and dry before applying the vapour stop. Remove all dust from the surface with a clean and dry cloth. Check there is no damage or holes etc on surfaces.

Figure 69:
Application of vapour stop

Apply the vapour stop onto the outer surfaces of the terminations and the surfaces of the connecting insulated piping.

Figure 70:
Application of flexible reinforcing membrane

Pre-fabricate the flexible reinforcing membrane. Follow the procedures as indicated in the section for "Vapour Stop at Pipe Application".

Allow vapour stop coating to touch dry before applying additional coats. Continue to apply additional coats until the vapour stop has reached a film thickness specified by the manufacturer.

Figure 71:
Application of vapour stop at valve spindle

Apply the vapour stop onto the termination end of the spindle insulation cover.

Application Details

Vapour Stop of Valve (continued)

Figure 72:
Application of the flexible reinforcing membrane at spindle insulation termination

Apply and embed the flexible reinforcing membrane into the vapour stop.

Figure 73:
Application of vapour stop at spindle insulation termination

Smooth out the vapour stop to an even film thickness using the appropriate tools.

Allow the vapour stop coating to touch dry before applying additional coats. Continue to apply additional coats until the vapour stop has reached a film thickness specified by the manufacturer.

Application Details

Typical positions of secondary vapour barrier and vapour barrier tape sealing - rigid pipe supports

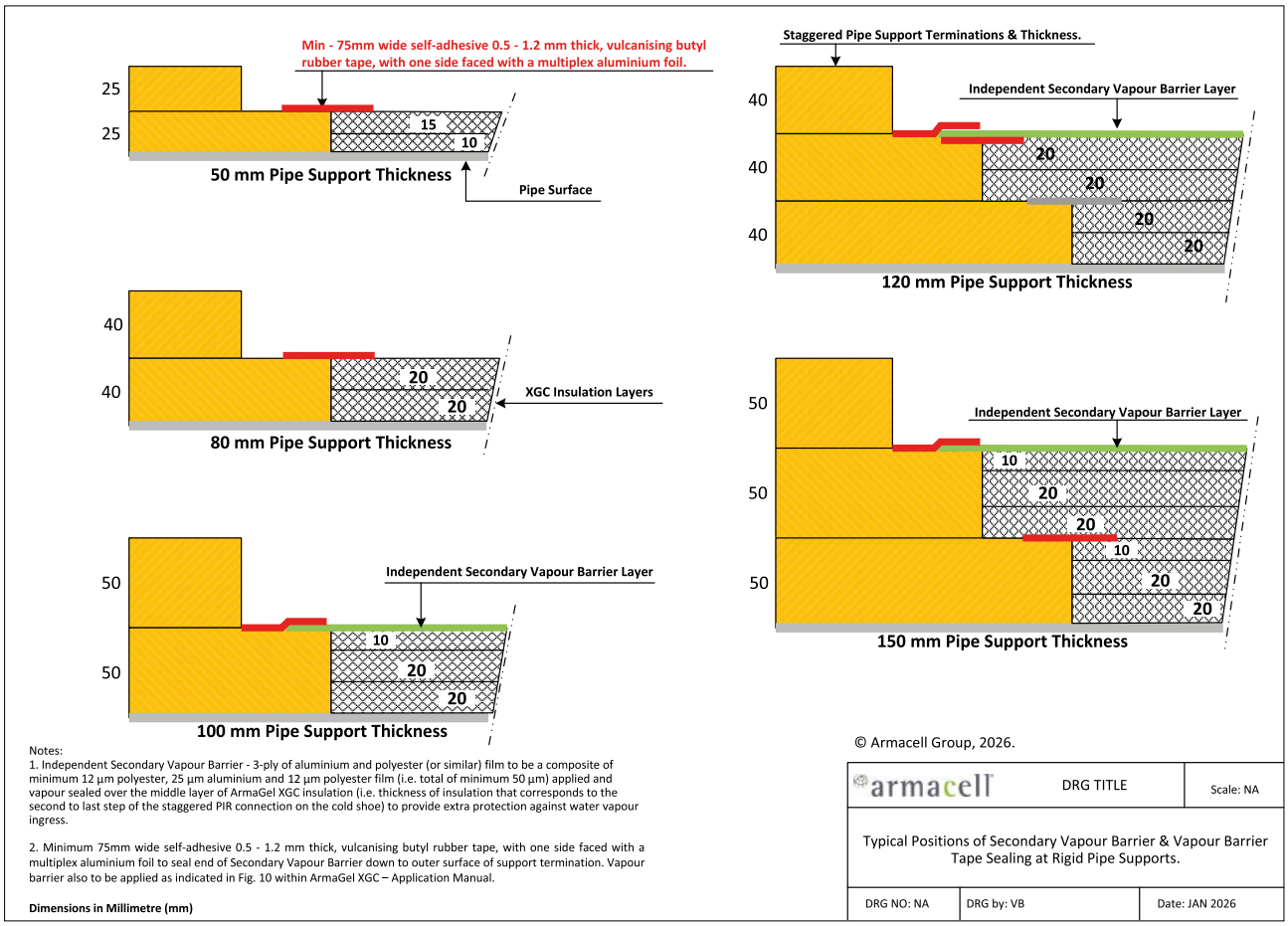

Figure 74:
Typical positions of secondary vapour barrier and vapour barrier tape sealing - rigid pipe supports.

Application Details

Pipe Support Termination Connections

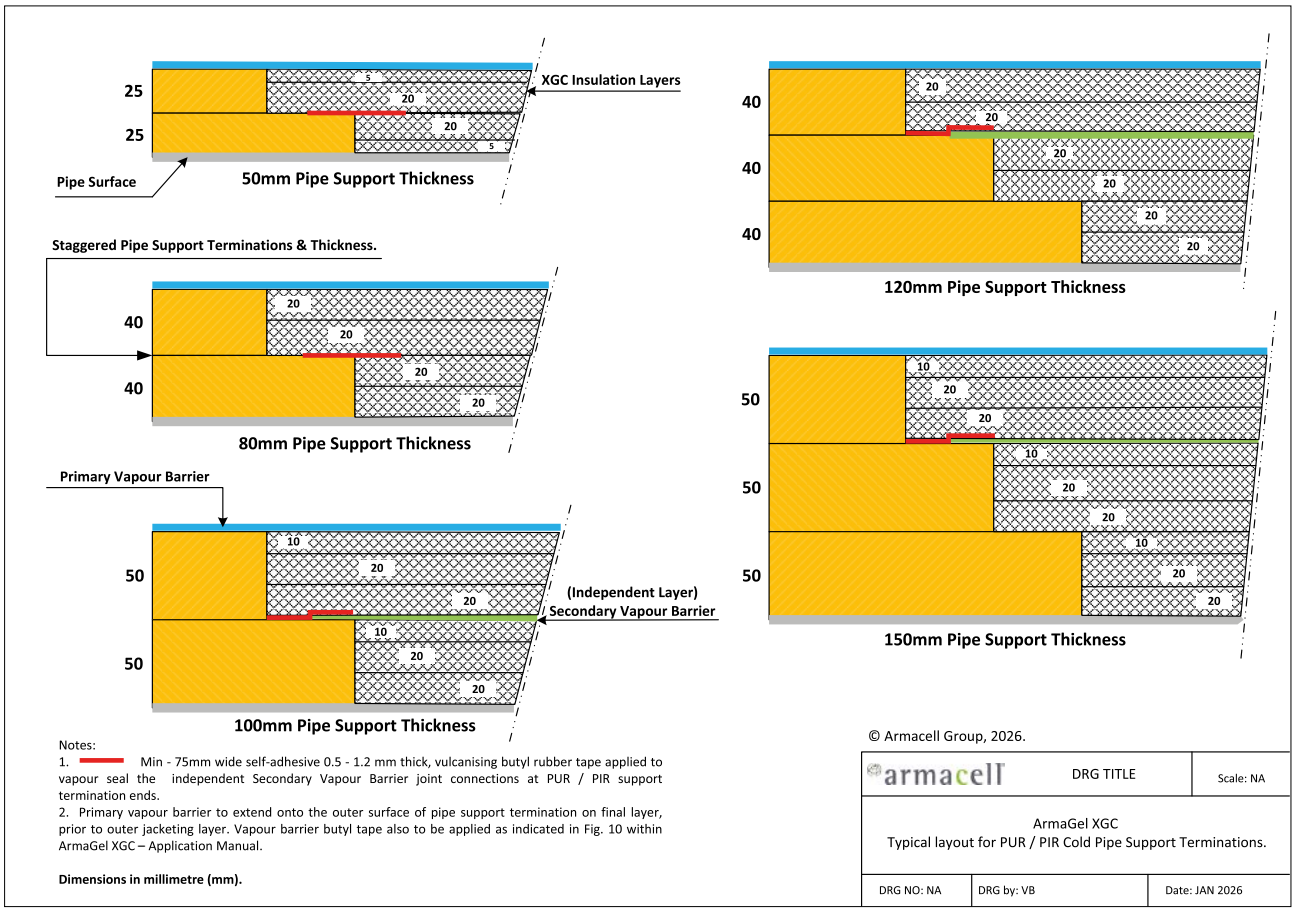

Figure 75:
Pipe Support Termination Connections.

Application Details

Insulation Build-up Of Rigid Pipe Supports

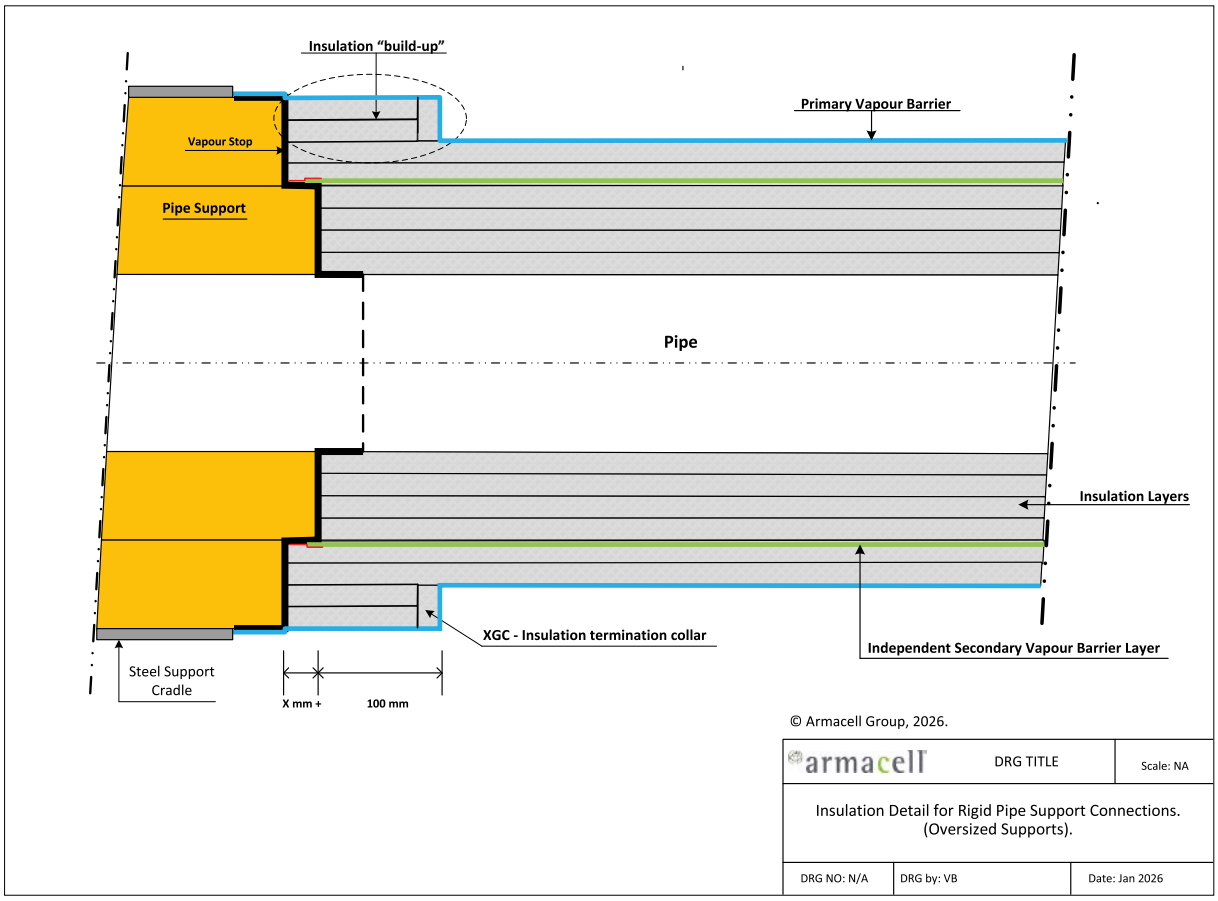

Figure 76:
Details of the insulation build up at pipe support where thickness of pipe support is less than total insulation thickness applied

Ensure that the vapour stop on the pipe support is clean, fully cured and dry. Excess dust shall be removed from the surface of the foiled insulation and pipe support termination using clean dry cloth.

ArmaGel XGC shall be tightly butted to the surface of the pipe support or insulation transition.

For the build-up of insulation thickness at exposed inner surface of pipe support, continuous strips of XGC insulation are applied around the circumference of the final layer of insulation. The number of strips and thickness of insulation should equal the outer diameter of the pipe support. Note: To improve the integrity of the exposed build-up strip edges, a termination collar can be fabricated to cover the exposed termination.

Application Details

End Caps

Figure 77:
Application of end disc

Cut out an end disc equal to the outer diameter of the pipe end cap. The total thickness build-up of the disc shall be the same as the thickness of connecting insulation.

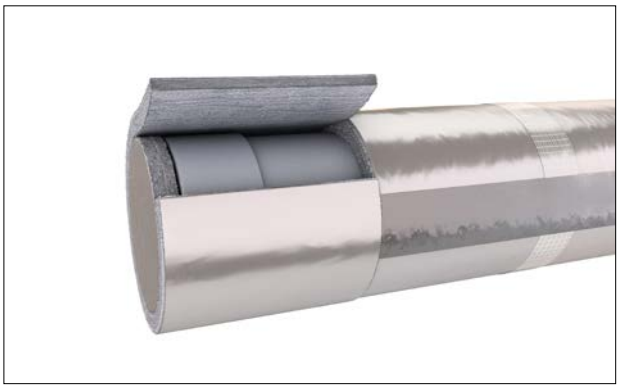

Figure 78:
Insulating an end cap

Cut a piece of insulation to fit the length and circumference of the pipe and end cap.

The application of primary and secondary vapour barrier and vapour stop shall follow the principle of installation of ArmaGel XGC.

Figure 79:
Securing end cap with filament tape and vapour barrier tape (foil-faced butyl)

Wrap the insulation around the pipe and secure with filament tape.

Ensure all seams are tightly butted with no gaps. Seal all seams and joints including the end cap end with the vapour barrier tape (foil-faced butyl).

Hot Insulation with Line Temperature from Ambient to 250 °C

For **hot insulation** with line temperature from ambient to +250 °C, glass reinforced filament tapes, stainless steel wire with diameter of 1 mm, or stainless steel bands with 13-19 mm wide x 0.5 mm thick can be used to secure the insulation layer(s).

Glass reinforced filament tapes shall not be used for the securement of insulation layer(s) with interface temperature above 70 °C unless otherwise specified by Project Insulation Specification or Project Engineer.

The seams and joints of insulation do not require sealing with the vapour barrier tape unless otherwise specified by the projects insulation specification or project engineer.

No additional primary and secondary vapour barriers are required for the construction of the insulation systems.

No vapour stop is required for the construction of the insulation systems.

Note
Ambient temperature refers to the maximum summer high temperature at the facility location/site of the project.

Dual-temperature Insulation with Line Temperature from -40 °C to 250 °C

For **dual-temperature insulation** with line temperature operating in cyclic mode from -40 °C to +250 °C, glass reinforced filament tapes, or stainless-steel bands with 13-19 mm wide x 0.5 mm thick can be used to secure the insulation layer(s).

Glass reinforced filament tapes shall not be used for the securement of insulation layer(s) with interface temperature above 70 °C unless otherwise specified by Project Insulation Specification or Project Engineer.

Only seams and joints of the last layer of ArmaGel XGC shall be sealed with vapour barrier tape unless otherwise specified by the Projects Insulation Specification or Project Engineer.

The primary vapour barrier sheets shall be applied over the last layer of ArmaGel XGC prior to the installation of the outer jacketing (metal / UVGRP cladding) unless otherwise specified by the project insulation specification or Project Engineer.

Refer to Project Insulation Specification or Project Engineer for the needs and the construction details of vapour stop.

Note
Ambient temperature refers to the maximum summer high temperature at the facility location/site of the project.

Jacketing and Finishing

Jacketing and Finishing

Allow the vapour stop coating to fully dry before applying the outer jacketing.

In all industrial applications, ArmaGel XGC must be protected with an adequate outer jacketing. ArmaGel XGC is compatible with all forms of jacketing such as metal cladding, polymeric covering (such as Arma-Chek R), GRP and multiple laminate cladding system.

The outer cladding should always be applied according to manufacturer's instructions and in accordance with the site/project insulation specification.

Screws and rivets shall be avoided wherever possible unless absolutely necessary.

A sacrificial layer using closed-cell foam materials (e.g. ArmaFlex), additional layer of ArmaGel or standoffs shall be applied if screws or rivets are necessary to be used to secure the metal cladding in order not to puncture the primary vapour barrier. The thickness of sacrificial layer or standoff shall be higher than the length of the rivet/screw used.

Care shall be taken not to damage the insulation system during installation of metal / GRP type outer cladding.

Insulation and Accessory Materials List

Material Component & Suggested Products	Material Description	Areas of Use
Insulation • ArmaGel XGC 5 mm sheet • ArmaGel XGC 10 mm sheet • ArmaGel XGC 20 mm sheet	• Dual temperature aerogel insulation blanket, 5 mm thickness • Dual temperature aerogel insulation blanket, 10 mm thickness • Dual temperature aerogel insulation blanket, 20 mm thickness	Used as insulation material for cryogenic and/or dual-temperature (cyclic) conditions up to +250 °C.
Primary Vapour Barrier - foil-faced butyl sheet • Polyguard / Insulrap 50 • Sam Hwa – BUSEAL Polyguard / Insulrap 50 • Sam Hwa BUSEAL WRAP 12 • Foster C.I. Wrap 50 • STI 5000 • Temati Tembutil-IF • Foster Butylar NXT • TIC Bwrap PB201 • or approved equivalent	A self-adhesive 0.8 – 1.2 mm thick, vulcanizing butyl rubber sheeting wrap, with one side faced with a multiplex aluminium foil.	Used as primary vapour barrier. Applied on the outer surface of last layer of ArmaGel XGC insulation, prior to the application of the outer jacketing.
Secondary Vapour Barrier – multiplex aluminium sheet • Temati – vapour stop foil • TIC – mylar foil • or approved equivalent	A 3-ply of aluminium and polyester (or similar) film to be a composite of minimum 12 µm polyester, 25 µm aluminium and 12 µm polyester film (i.e. total of minimum 50 µm)	Is applied and sealed over the thickness of insulation aligned with the second to last step of the staggered PUR/PIR connection on the cold shoe. For typical examples – see Fig. 74 & 75.
Vapour Barrier Tape (foil-faced butyl) • Polyken 360-17 • Venture Mastik tape 1580 • TIC Bwrap tape • Temati Tembutil-IF • or approved equivalent	A self-adhesive 0.5 - 1.2 mm thick, vulcanizing butyl rubber tape, with one side faced with a multiplex aluminium foil.	For the sealing of all seams and joints of ArmaGel XGC insulation only on the third to last layer (antepenultimate) below the final outer layer from pipe surface, secondary vapour barrier (including connection at pipe support and insulation).

Insulation and Accessory Materials List (continued)

Material Component & Suggested Products	Material Description	Areas of Use
Vapour Stop Coating • **Foster 60-38/39*** • **Foster 60-95/96*** • **Foster 90-66**** • **Foster 90-61**** • **Sam Hwa - SHC 107-61**** • **TIC 4055*** • **TIC 6051**** • **STI 9066**** • **STI 9061**** • **or approved equivalent**	Elastomer based vapour stop sealant - to be used with the flexible reinforcing membrane.	Used as vapour stop sealant for insulation terminations next to flanged fittings, cap ends, protrusions, valve and flange and etc. *For service temperature down to -40 °C. ** For service temperature down to -196 °C.
Spray Adhesive • **Glukon spray adhesive** • **or approved equivalent**	General purpose aerosol adhesive.	For the use in high humidity environments typically 80% & above. A aerosol spray adhesive may be pre-applied to all seams and joints of ArmaGel XGC prior to the application of the vapour barrier tape and the overlap of primary / secondary vapour barriers to improve the sealing performance.
Flexible Reinforcement Membrane • **Mast –A– Fab 42-22.** • **Chil-Glas** • **Scrimtex (N 10)** • **or approved equivalent**	Glass cloth fabric composed of assembled inorganic fibreglass yarn or woven glass scrim reinforced chlorosulfonated polyethylene (CSPE) membrane or similar polymeric compound materials or	Used as reinforcing membrane for the construction of vapour stop.
Filament Tape • **Scotch 893** • **or approved equivalent**	Glass fibre-reinforced synthetic tape 19 & 25 mm wide.	Used to secure ArmaGel XGC insulation layers around piping parts. Refer to table 1.
Tensioning Metal Bands	13-19 mm wide Type 304 Stainless Steel (SS), according to ASTM A167.	Fixing and securing of ArmaGel XGC insulation material on piping parts. Refer to table 1.

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ABOUT ARMACELL

As the inventor of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal and mechanical insulation solutions that create sustainable value for its customers. Armacell's products significantly contribute to driving energy efficiency worldwide. With more than 3,100 employees and 26 production plants in 20 countries, Armacell operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for acoustic and lightweight applications, recycled PET products, next-generation aerogel technology and passive fire protection systems.

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