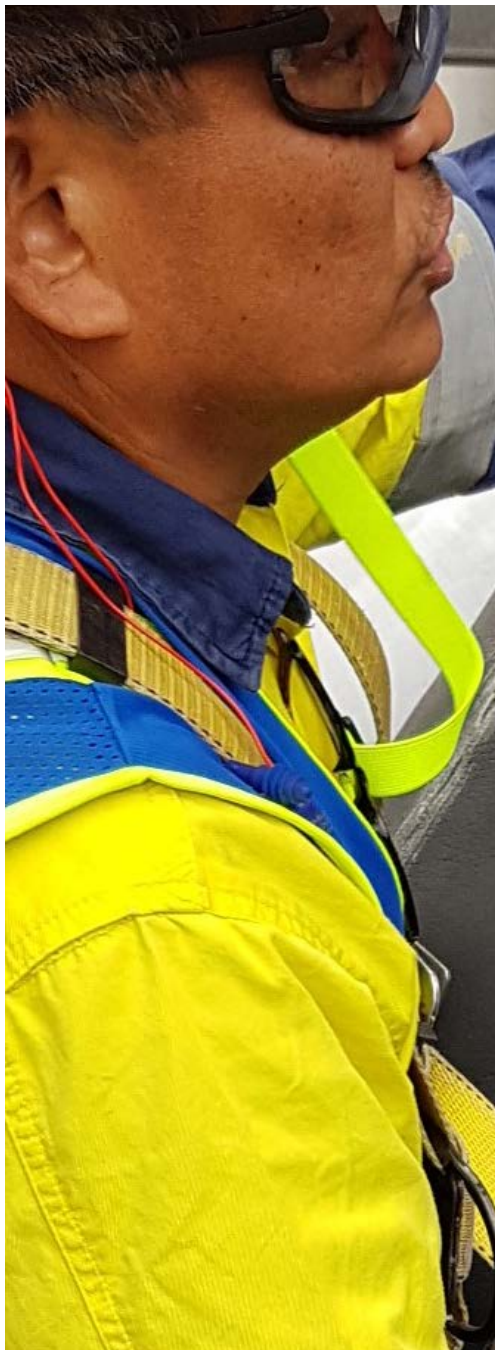


A THERMAL AND ACOUSTIC SOLUTION

ArmaFlex[®] Industrial

Industrial Application Guide for Sheet Material
Applications -50°C to 125°C (-58°F to 257°F)

www.armacell.com/energy



 **armacell**[®]
ArmaFlex[®]



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Scope

This guide describes the standard methods to apply ArmaFlex Industrial (FEF) thermal insulation to vessels and industrial process pipework with operating temperatures from -50°C to+ 125°C [-58°F to 257°F]. Additional guidance is given in the ArmaFlex Application Manual.

Products



- ArmaFlex Industrial insulation
- Arma-Chek D Tape
- ArmaFlex Adhesives
- ArmaFlex Cleaner
- Arma-Chek Mastic

Data sheets available at:
www.armacell.com/energy

Equipment / Tools



- Knives, examples:
 - 75 mm [3 in.] ceramic knife
 - 75, 150, 225 mm [3, 6, 9 in.] steel knives [not serrated] + sharpener
- Silver marker pen
- Square
- Ruler/ tape measure
- Glue brush/ Gluemaster dispenser
- Glue roller/ tray
- Mastic gun Dividers

Technical Support

Contact the Armacell Energy, Technical-Services team at www.armacell.com/energy or email technical.oilandgas@armacell.com for advice and guidance for non-standard applications and application support/training.

Application Conditions

Apply only when conditions are suitable. If conditions cannot be controlled, consult Armacell Energy for advice.



air temp.
5°C to 35°C
(41°F to 95°F)



surface temp.
5°C to 35°C
(41°F to 95°F)



humidity
< 80% RH.
3°C (5°F)
> dewpoint



shade



shelter
from rain

Adhesive Curing Conditions

Allow adequate time for drying/curing. Shelter from adverse weather until final protective jacket/cladding has been applied and adhesives/mastics are dry/cured. Do not seal tightly in polythene, or apply vapour barrier or Arma-Chek R jacket for 24 hours. If conditions cannot be maintained, contact Armacell Energy for advice.



Mastic Curing Conditions

For ArmaFlex termination sealing, the Arma-Chek mastic temperature should not drop below 5°C [41°F] until fully cured. If conditions cannot be maintained, contact Armacell Energy for advice.



Surface Preparation

Pipe/vessel surface must be clean, dry and free from rust, oil, contamination or damage. ArmaFlex Cleaner may be used on the pipe to assist in oil/grease removal, subject to client approval.

If any dust or surface blooming [light-brown deposit] is present on the ArmaFlex, it shall be removed prior to application of adhesive using a dry/damp cloth. The use of Cleaner on ArmaFlex is unnecessary, seek advice before using ArmaFlex Cleaner on ArmaFlex insulation.



Tubular or Sheet

Apply ArmaFlex preformed tubular sections [where available] or thin sheets, for small bore piping 3 in. NB.

Apply ArmaFlex sheet [or tube if available] for piping > 3 in. NB, ensuring that the natural curvature of the rolled sheet follows the curvature of the pipe.

Cut on flat part of tube, not on curved part.

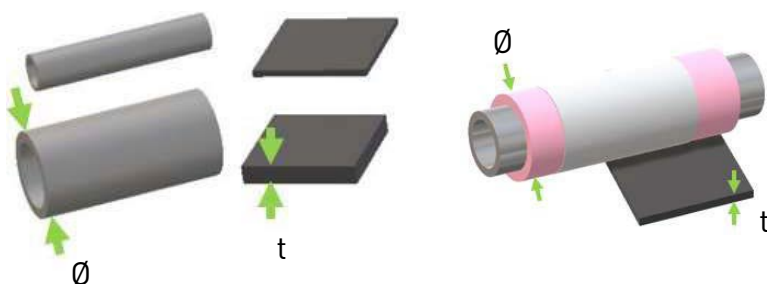


Maximum Sheet Thickness

Pipe diameter, \varnothing	ArmaFlex sheet thickness, t
60.3mm [2 in. NB]	13mm [0.5 in.]
88.9mm [3 in. NB]	19mm [0.7 in.]
114.3mm [4 in. NB]	25mm [1.0 in.]
168.3mm [6 in. NB]	32mm [1.3 in.]
273.0mm [10 in. NB]	40mm [1.6 in.]
323.9mm [12 in. NB]	50mm [2.0 in.]

Thin ArmaFlex sheet is easier to wrap around small diameter pipe than thick ArmaFlex sheet. To reduce stresses, do not exceed the maximum sheet thickness indicated for each pipe size. The maximum thickness will typically be the same for every layer. Where several thicknesses are used, the thinner layer shall normally be applied to the pipe surface.

If subsequent ArmaFlex layers are being installed [over ArmaFlex or another insulation product], then the pipe diameter used in the above table shall include the existing insulation layer thickness.



Measuring Circumference

Measure circumference with ArmaFlex strip [cut from the sheet which is to be applied]. not a tape measure, so that after jointing it may still be rotated easily. Do not stretch the ArmaFlex sheet to fit around the pipe. ArmaFlex shall never be installed under tension.



Adhesive Selection

Use the correct adhesive: ArmaFlex HT625 adhesive may be used with all ArmaFlex types, but ArmaFlex 520 adhesive may only be used with LT/ArmaFlex Industrial

ArmaFlex HT625 Adhesive



- ✓ LT/ArmaFlex Industrial
- ✓ HT/ArmaFlex Industrial
- ✓ HT/ArmaFlex Industrial IMO

ArmaFlex 520 Adhesive



- ✓ LT/ArmaFlex Industrial
- ✗ HT/ArmaFlex Industrial
- ✗ HT/ArmaFlex Industrial IMO

Applying Adhesive

ArmaFlex Adhesive shall be stirred well before use. To adhere ArmaFlex to itself or another surface, brush or roll a thin, even, film of ArmaFlex Adhesive to both contacting surfaces. Allow the adhesive to become tack-dry, then apply firm and even pressure to the ArmaFlex surface[s]. The term, tack-dry, means that adhesive is sufficiently dry that it will not stick to a finger nail when touched.



The time taken for the adhesive to become tack dry will depend on the ambient temperature and humidity and shall be rechecked at regular intervals during the working day.

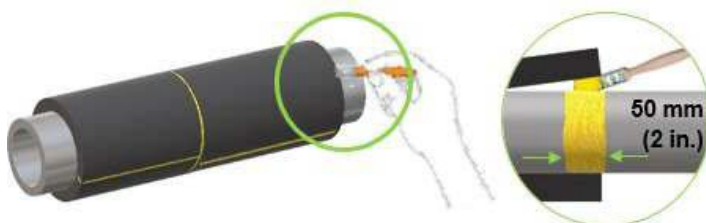
The 'open time' time during which a bond can be made is also limited by temperature and humidity. These time periods must be adapted as weather conditions change.



Applying Adhesive

MINIMUM ADHESIVE REQUIREMENTS BETWEEN PIPE AND INSULATION

When the insulation layer is not fixed to the pipe [or underlying insulation surface] using all-over adhesive coverage, a 50mm [2in.] strip of adhesive shall be applied to both the pipe and insulation using a small glue brush to "wet" seal the two surfaces. This shall be performed at one end of every section of insulation applied. This creates a fixed point so that a compressed joint can be achieved at the other end.

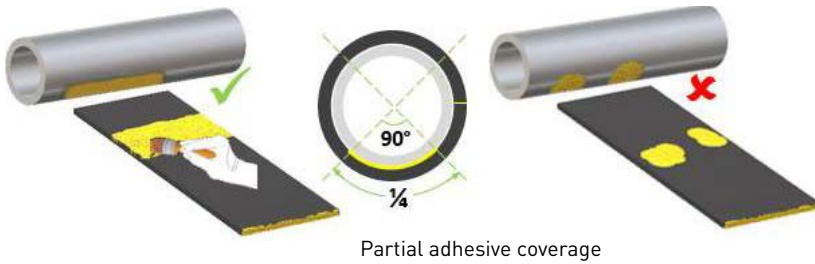


Apply adhesive between pipe and ArmaFlex to create 50mm (2in.) strip

Applying Adhesive

PARTIAL ADHESIVE COVERAGE

The term 'partial adhesive coverage' is defined as the application of 100% adhesive fixing for a specified limited contact area such as on the bottom quarter of a pipe for example as indicated below. Spot adhesion is not permitted.



Applying Adhesive

ALL-OVER ADHESIVE COVERAGE

The term 'all-over adhesive' coverage is defined as the application of 100% adhesive coverage over both contact surfaces where ArmaFlex is glued to the metal object or previous layer with its entire surface.




Note:

A 30mm [1.2 in.] strip without adhesive is required where joints will be installed under compression. Spot adhesion is not permitted.

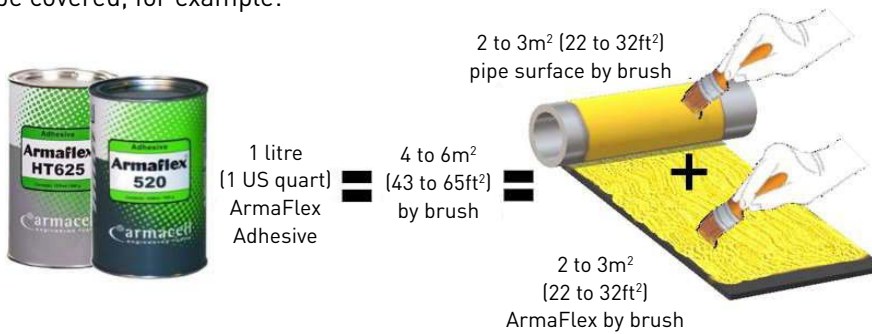


Adhesive Coverage

1 litre [1 US quart] of ArmaFlex Adhesive 520 or HT625 will cover between 3 and 8m² [32 to 86 ft²] of each bonded surface, depending on the type of surface and application method.

Adhesive coverage m ² / litre [ft ² / quart]	
Brush/glue-master 	Roller/spreader 
6-8 [65-86]	4-6 [43-65]

The total quantity of adhesive required must allow for both surfaces to be covered, for example:



ArmaFlex Adhesive Waiting Times

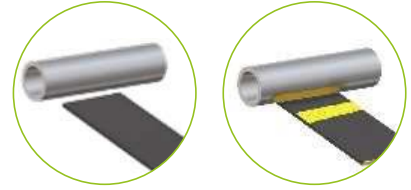
ArmaFlex Adhesive Waiting Times before next ArmaFlex layer, Arma-Chek R, Acoustic Barrier or Arma-Chek Mastic is applied

ArmaFlex Adhesive Waiting Time (During Installation of Single & Multi-layering Materials & Cladding)				
ArmaFlex / ArmaSound RD 240		Arma-Chek R / Acoustic Barrier / Other Impermeable Materials & Rigid Claddings		Arma-Chek Mastic
Adhesive Method:	NEW Wait Time: (Between Layers)	Adhesive Method:	NEW Wait Time: (Between Layers)	NEW Wait Time: (Between Layers)
Seams & Wet Seal Joints (All Layers) Standard Installation	1 Hour	Overlaps Only	3 Hours	4 Hours
Seams & Wet Seal Joints Including (Partial ¼ - ⅓) Adhesive Fixing	12 Hours or 1 Hour Using D-Tape Method	Overlaps Including (Partial ¼ - ⅓) Adhesive Fixing	24 Hours	4 Hours
Seams & Wet Seal joints Including (All Over Adhesive) Fixing	12 Hours or 1 Hour Using D-Tape Method	Overlaps Including (All Over Adhesive) Fixing	24 Hours	4 Hours

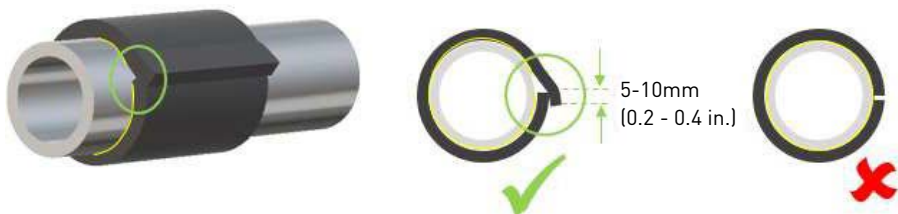
Adhering Longitudinal Seams

ARMAFLEX SHEET WITHOUT ALL-OVER ADHESIVE COVERAGE

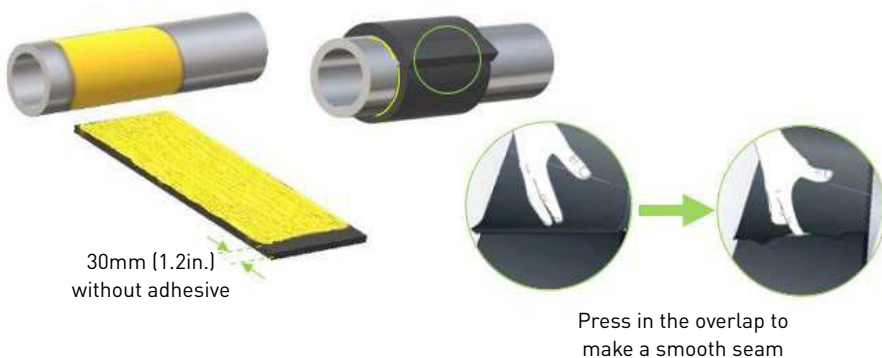
When the insulation layer is **not** fixed to the pipe [or underlying insulation surface] using all-over adhesive coverage, then apply the adhesive to the joint surfaces and allow to become tack dry before joining the seam.



When the ArmaFlex sheet is fully adhered to the pipe, then extra material must be installed to create compression in the longitudinal seam joint. Cut the ArmaFlex sheet to a length 5-10 mm [0.2 - 0.4 in.] longer than the circumference, so that an overlap is created.



Adhere the ArmaFlex to the pipe but leave a border of 30 mm [1.2 in.] without adhesive so that the overlap will not stick to the seam edge underneath. Press in the overlapped edge to create a compressed longitudinal seam joint.

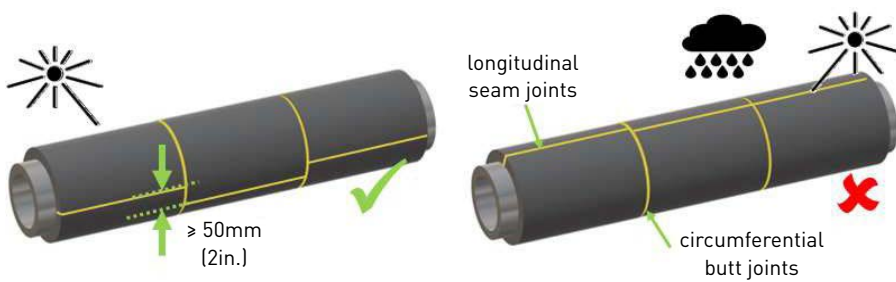


Finish the seam joint by pulling apart the seam slightly and applying adhesive into the joint using a small glue brush, without waiting for the adhesive to become tacky.



Staggering Joints

All longitudinal seams shall be staggered by a minimum 50mm [2 in.] and positioned to the side to shed water and avoid direct sunlight.



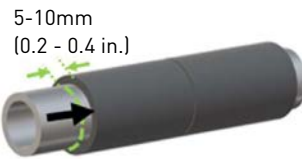
Adhering Circumferential Joints

ARMAFLEX SHEET WITH MINIMUM ADHESIVE COVERAGE

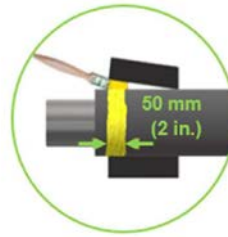
Apply the ArmaFlex sheet and adhere the longitudinal joint. Mark the end of the underlying surface and then push the jointed tube towards the previously applied section by 5 to 10 mm [0.2 - 0.4 in.]. Secure the inner surface of the ArmaFlex section to the surface of the previous system layer with a 50mm [2 in.] strip of ArmaFlex Adhesive, applied by inserting a glue brush between the layers. Allow to cure so that will not slip. Check that 5 to 10 mm [0.2 - 0.4 in.] still exists between the new section and the mark on the underlying surface.



Apply sheet then
mark position of end

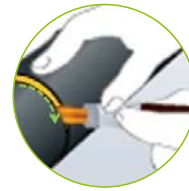


Push ArmaFlex to
achieve 5-10mm (0.2 -
0.4in.) of compression

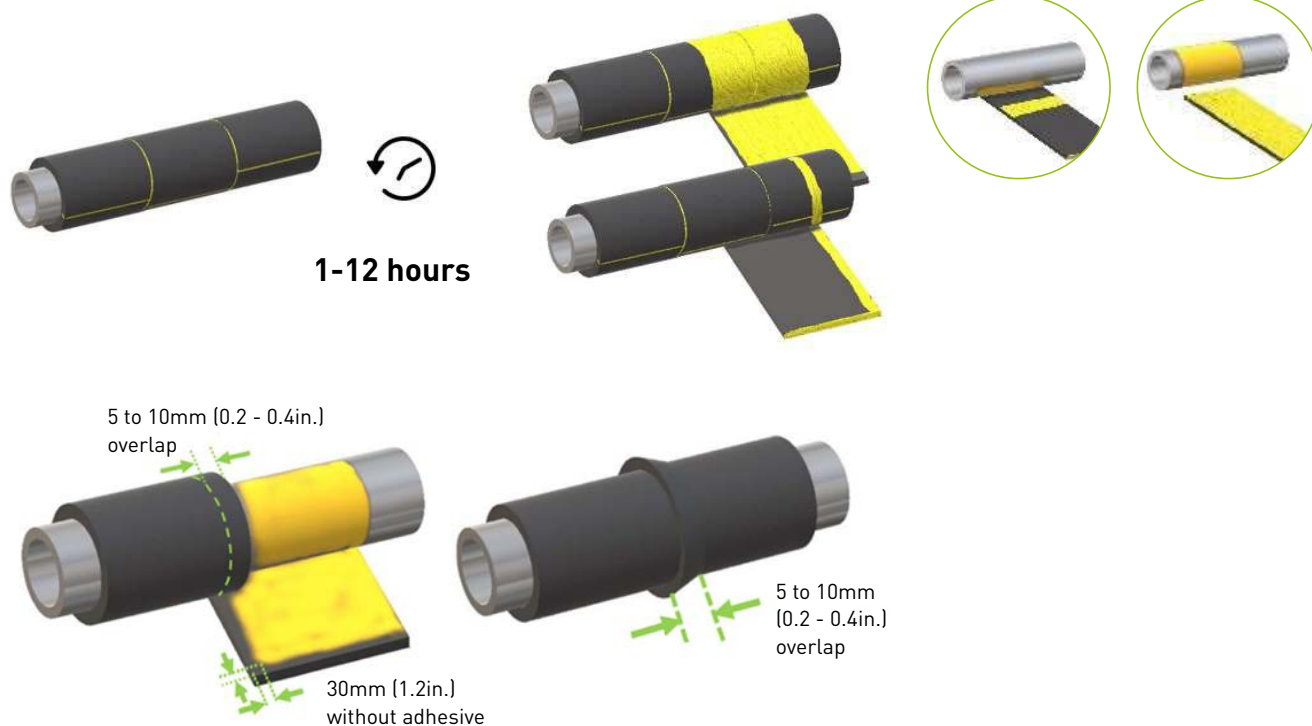


Apply adhesive between layers
to create 50mm (2in.) strip

Apply adhesive into the circumferential joint using a small glue brush to “wet” seal the two sections of ArmaFlex. There is no need to let the adhesive become tack dry, but apply pressure to ensure that the joint is closed.



Adhering Circumferential Joints



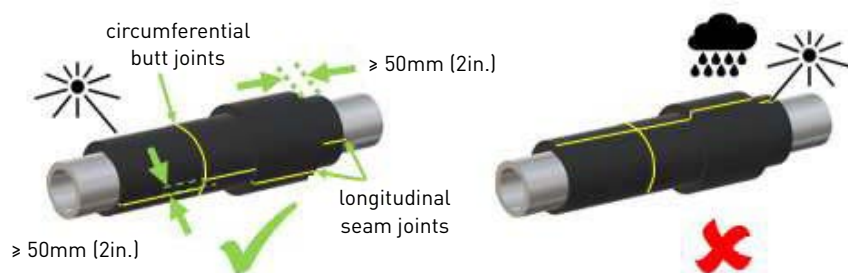
Press in the overlapped edge to create a tight-butted joint. This joint will be compressed. Apply adhesive into the joint using a small glue brush to “wet” seal the two sections of ArmaFlex. There is no need to let the adhesive become tack dry, but apply pressure to ensure that the joint is closed.



Staggering Joints

MULTI LAYER

All seams and joints shall be staggered by a minimum 50mm [2 in.] and staggered relative to the underlying layer and each other. Longitudinal seam joints shall be positioned to the side to shed water and to avoid direct sunlight.



Standard Application Method

<p>Horizontal Piping $\varnothing \leq 20''$ NB (508mm) - Adhered seam/joints - Adhered strip under one edge</p>	 <p>50mm (2in.) adhered strip adhered edges</p>
<p>Horizontal Piping 22'' NB (559mm) $\leq \varnothing \leq 36''$ NB (914mm): $\frac{1}{4}$ adhesive coverage 38'' NB (965mm) $\leq \varnothing \leq 72''$ NB (1829mm): $\frac{1}{3}$ adhesive coverage - Adhered seam/joints - Adhered strip under one edge</p>	 <p>$\frac{1}{4}$ adhesive coverage $\frac{1}{3}$ adhesive coverage 50mm (2in.) adhered strip</p>
<p>Horizontal Piping $\varnothing > 72''$ NB (1829mm) - All-over adhesive covering - Adhered seam/joints</p>	
<p>Vertical Piping All sizes up to 72'' NB (1829mm): $\frac{1}{4}$ vertical fixing down center of pipe. Above 72'' NB (1829mm): all over adhesive covering. Vertical/Horizontal Vessels/Equipment, all \varnothing: all-over adhesive covering.</p>	

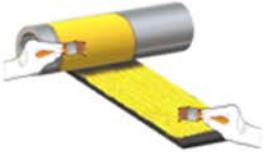

\varnothing represents nominal (NB in inch) or outer (mm) uninsulated diameter unless applied over existing non-Armacell insulation layers

All layers to be applied using same method as first layer

Wait 12 hours from application of previous layer of ArmaFlex before applying next layer of ArmaFlex, or 1 hour when using ArmaFlex D tape

Premium Application Method

FOR CORROSION UNDER INSULATION (CUI) MINIMISATION

<p>Horizontal Piping, all \varnothing - All-over adhesive covering - Adhered seam/joints</p>	
<p>Vertical Piping, Vertical/Horizontal Vessels/Equipment, all \varnothing - All-over adhesive covering - Adhered seam/joints - Support rings are not normally required</p>	

\varnothing represents nominal (NB in inch) or outer (mm) uninsulated diameter unless applied over existing non-Armacell insulation layers

All layers to be applied using same method as first layer

Wait 12 hours from application of previous layer of ArmaFlex before applying next layer of ArmaFlex, or 1 hour when using ArmaFlex D tape

Multi-Layer Wait-Time

Wait between 1 & 12 hours depending on type of adhesive fixing. For horizontal pipe up to 20" NB, 1 hour wait time is only required before multiple ArmaFlex layers are applied using Standard Application Method.. For other sizes where partial / all over adhesive fixing is required, the wait time is 12 hours, before applying the next layer of ArmaFlex (unless using the "D-Tape Time Reduction Method").

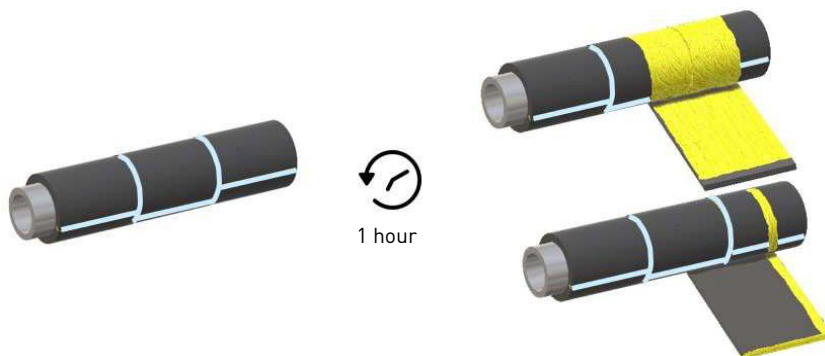
The wait time can be reduced to 1 hour when applying ArmaFlex by using the "D-Tape Time Reduction Method".



Multi-Layer Wait-Time Reduction

D-TAPE WAIT TIME REDUCTION METHOD

The wait time before applying the next layer of ArmaFlex can be reduced to 1 hour if the joints of the previous layer are covered with Arma-Chek D Tape as illustrated below. The D Tape may be applied without delay. D Tape is a specially developed breathable tape: do not use alternative self-adhesive tapes.



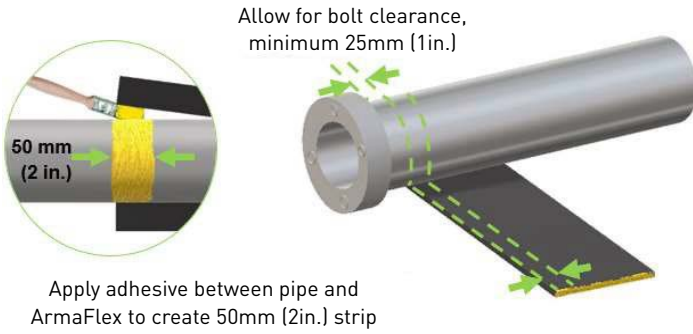
D-Tape Wait-Time Reduction Method

Apply adhesive to the ArmaFlex only, either side of the seam/joint. Keep adhesive at least 10 mm (0.4 in.) away from seam/joint. While the adhesive is still wet, apply the Arma-Chek D Tape.



Terminations

Where the insulation terminates at valves, flanges, etc it must be sealed. Insert glue brush to adhere and seal the inner surface to the pipe surface, with a 50 mm [2 in.] strip of ArmaFlex Adhesive (adhesive is applied to both the pipe and ArmaFlex surfaces). Ensure clearance allowed for bolt removal (typically 25 mm [1 in.]).



Trace Heating

TRACE TEMPERATURES

Before applying ArmaFlex to trace heating ensure that the temperatures of the trace heating cable at start up or during operation will not be able to exceed the limit temperatures specified for the ArmaFlex insulation, adhesive and Arma-Chek Mastic. It may be necessary to use additional heat-resistant materials and metal end caps if the temperature limits cannot be respected. Verify compatibility of adhesives and mastic with trace heating cable.

Consult Armacell Energy for advice.



Trace Heating

ARMAFLEX TUBING

When applying ArmaFlex tubing over trace heating for piping sizes up to 3 in. NB, the ArmaFlex tubing inner diameter shall be increased to next larger diameter to accommodate the sizing of the cable. If required to reduce the inner bore of the insulation, use a strip cut from ArmaFlex tube to measure the width of the linear cut which will need to be made in the tube to remove excess material to ensure that the tube fits closely to the pipe without causing excess stress on the longitudinal seam.

Note: For fabrication / installation methods for pipe fittings using ArmaFlex Tube material – refer to the Local Armacell ArmaFlex Application Manual.

Cut excess strip from
ArmaFlex tubing



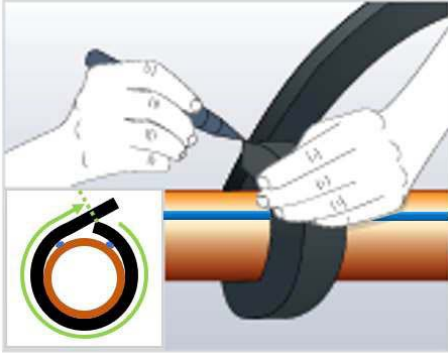
The ArmaFlex tube shall not be stretched excessively. The tube shall not be hollowed out/cut away unless next layer(s) are applied.



Trace Heating

ARMAFLEX SHEET

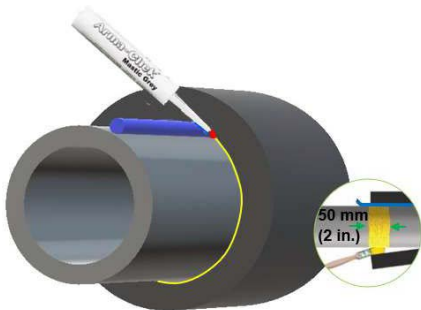
When applying ArmaFlex sheet over trace heating, take the circumference measurement over the installed trace-heating cables.



Trace Heating

CIRCUMFERENTIAL JOINTS

Install each ArmaFlex section with compression in circumferential joints, in the same way as for other applications. One circumferential end of the ArmaFlex section will be adhered to the pipe, as usual. This may result in a small gap around the trace heating which must be filled with a thick bead of Arma-Chek Mastic to ensure a watertight seal.



Fill void either side of trace cable with Arma-Chek Mastic (Mastic shown in red for clarity).

Trace Heating

TERMINATIONS

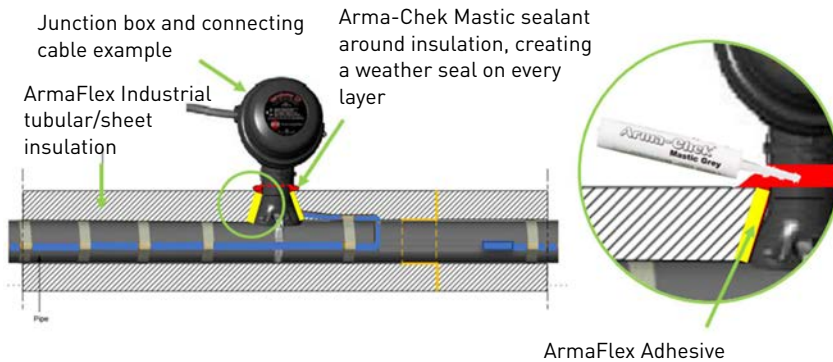
At terminations over trace heating, adhere the ArmaFlex to the pipe by applying adhesive between the pipe and ArmaFlex, and apply a triangular bead of Arma-Chek Mastic to seal the ArmaFlex to the pipe. The bead shall be a minimum of 10 mm x 10 mm [0.4 x 0.4 in.].



Trace Heating

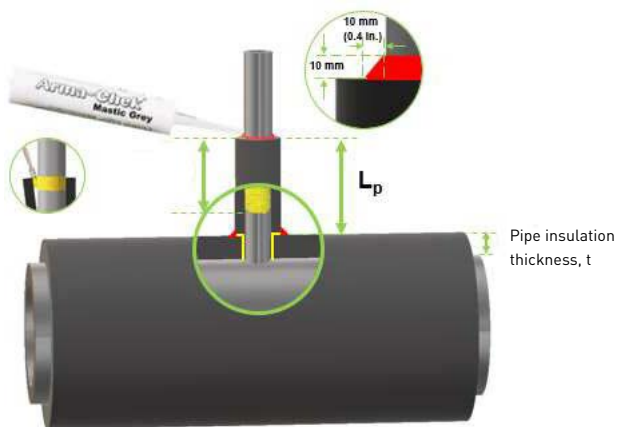
JUNCTION BOXES

When installing around junction boxes, the cut out in the ArmaFlex needs to be 5-10 mm [0.2-0.4 in.] smaller than the diameter of the junction box stem to create compression. Apply a finishing seal bead of Arma-Chek Mastic [minimum 10 mm [0.4 in] wide and 3 mm [0.1 in.] thick].





Penetrations and Protrusions

Small penetrations such as for vents, drains or instrument connections shall be insulated or as indicated by the Project Specification/Project Engineer. Apply extension to penetration insulation to reduce heat transfer. Apply adhesive to secure joints, and 50 mm [2 in.] strips of adhesive between pipes and ArmaFlex to seal. It is common to insulate for a distance of 3x the insulation thickness along the penetration for hot systems and 4x the insulation thickness along the penetration for cold systems.



Length of insulation on penetration, L_p :

-  Cold (< ambient temperature) $L_p \geq 4t$,
(recommended entire length)
-  Hot (> ambient temperature) $L_p \geq 3t$

Fabrication of Fittings with ArmaFlex Sheet

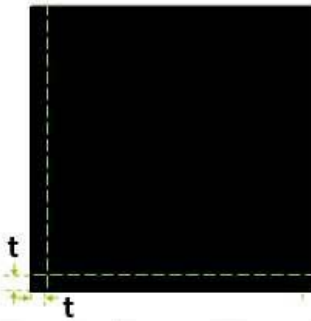
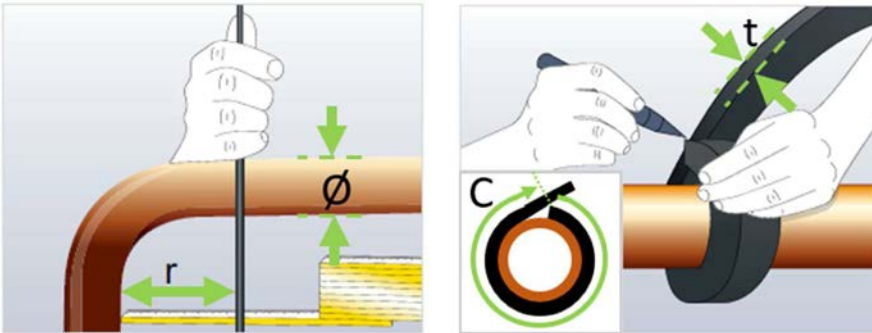
Install fittings before straight sections. Fabrication of common fittings from ArmaFlex sheet is detailed below.

Fabrication Example - Elbow

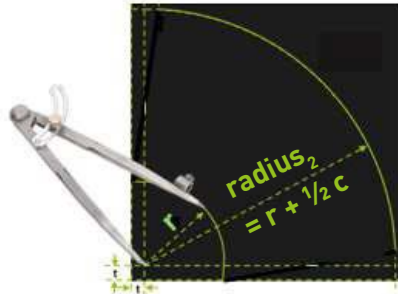
2 PIECE BEND

A 2-piece bend/long radius elbow can be manufactured using 4 measurements:

- 1) Insulation thickness, **t**
- 2) Elbow inside radius, **r**, weld to weld
- 3) Circumference around outside of insulation, **C**
- 4) Pipe diameter, **Ø**

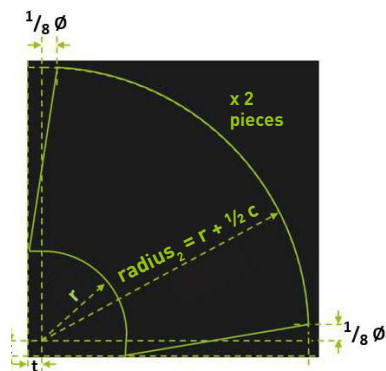


Draw two lines at distance **t** from two edges of a square sheet of ArmaFlex

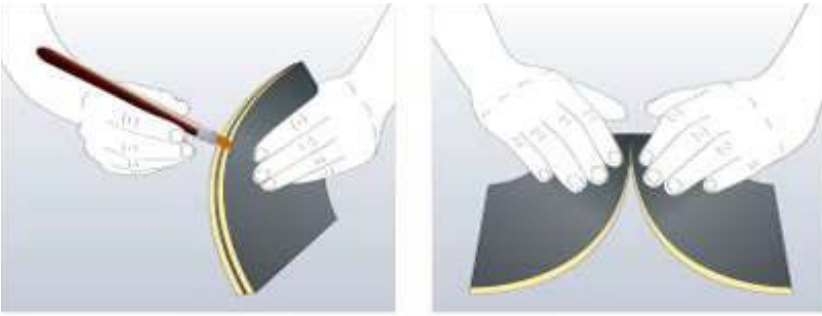


Draw two curves of radius₁ = **r** and radius₂ = **(r + 1/2C)**

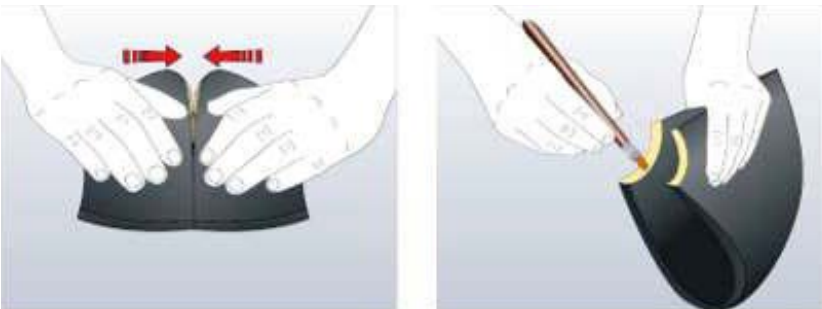
Draw two lines from where the smaller radius curve crosses the edge of the ArmaFlex to a point on the larger radius curve, at distance $[t + \frac{1}{8}\text{Ø}]$ from the edge of the ArmaFlex.



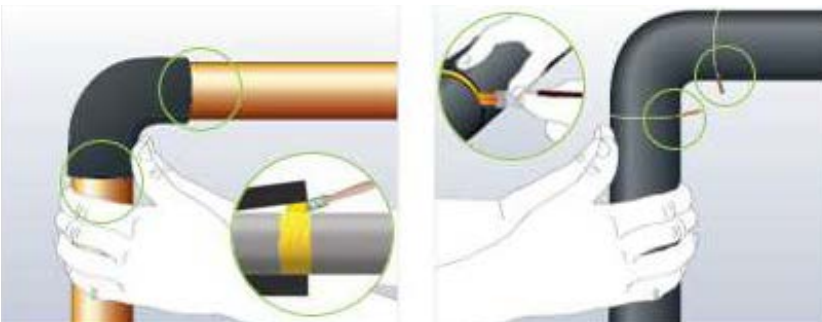
Cut out two identical pieces.



Apply adhesive to the outer edges and stick together.




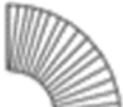


Apply adhesive to the inner curved edges.



Wrap around elbow and stick edges together. Apply adhesive between the pipe and ArmaFlex. After applying straight sections, apply adhesives in circumferential joints.

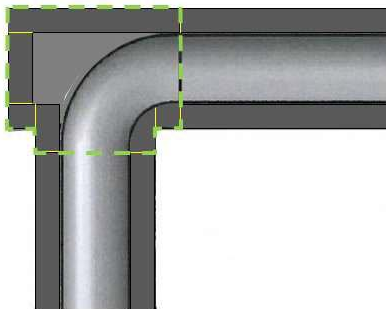
The two-piece elbow fabrication method may be split into multiple pieces for ease of application.

Pipe diameter, OD (Nominal pipe size, Ø)	Configuration
88.9 < OD < 323.9 mm (3 < Ø < 12 in. NB)	2 pieces 
323.9 < OD < 559 mm (12 < Ø < 22 in. NB)	2 pieces, split 2 ways 
559 < OD < 914 mm (22 < Ø < 36 in. NB)	2 pieces, split split 4 ways 
OD ≥ 914 mm (Ø ≥ 36 in. NB)	segments 



Note:

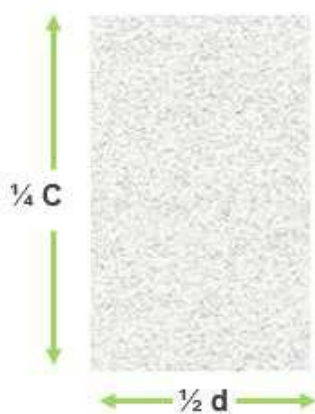
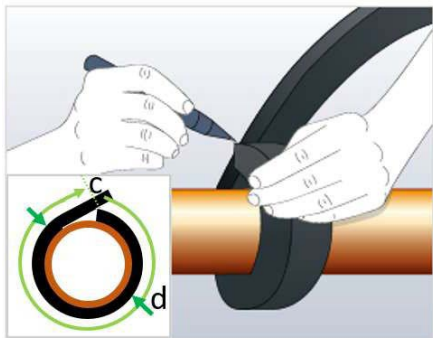
For large insulation thickness (typically 75mm (3 in.) and pipe diameters 88.9 mm (3 in. NB) it is recommended that the ArmaFlex system is installed as an end-capped T piece.



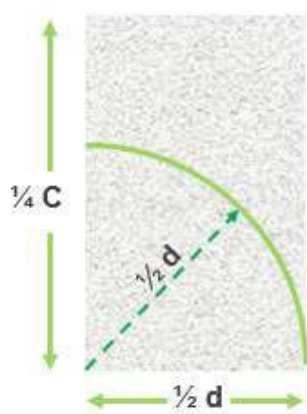
Fabrication Example - Equal Tee Piece

Measure the external circumference, **C**, and diameter, **d**, over the ArmaFlex insulation.

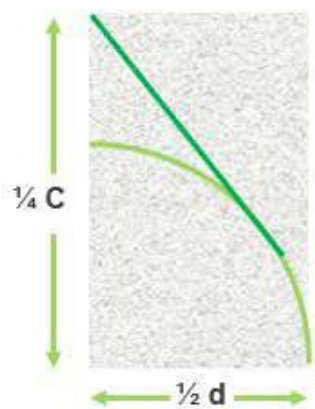
Use these measurements to create a template for marking out how to cut the ArmaFlex.



Cut a rectangular template, height = $\frac{1}{4} C$, length = $\frac{1}{2} d$



Draw an arc, radius = $\frac{1}{2} d$

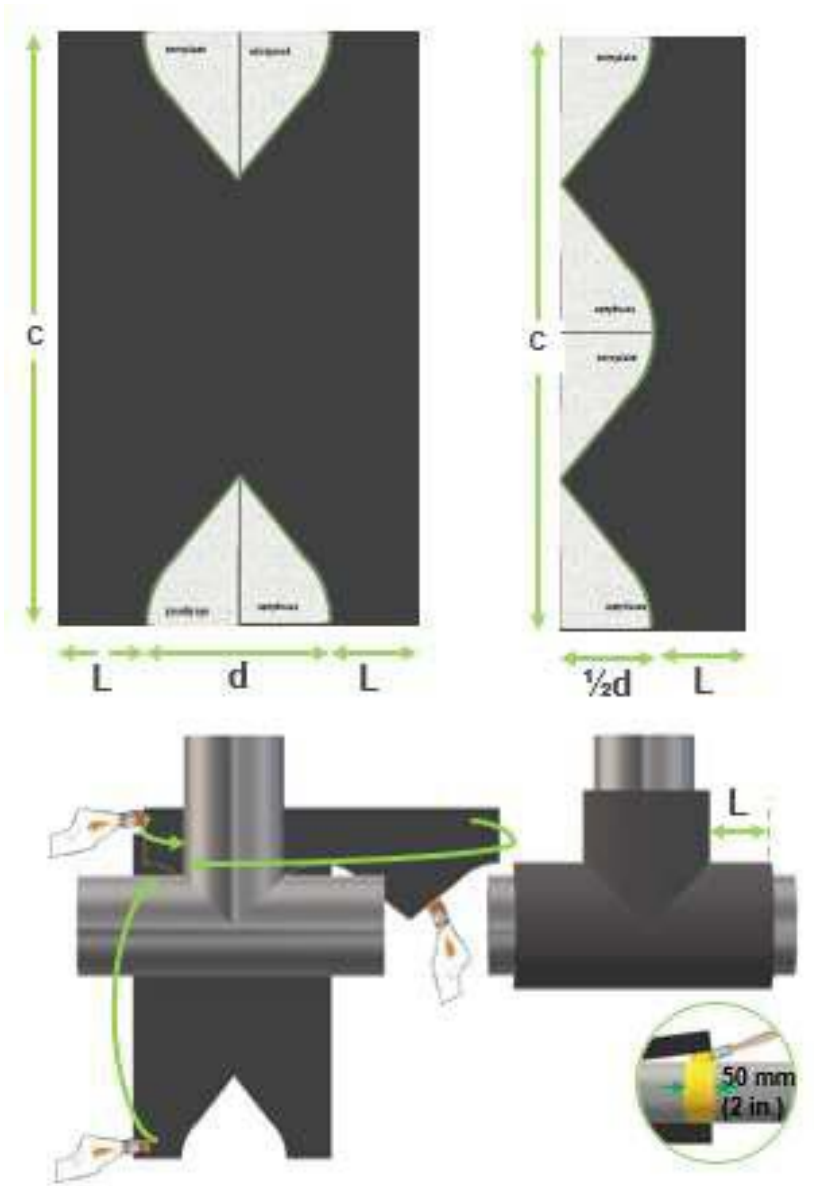


Draw a tangent line from the arc to the corner of the template



Cut out template

Use template to mark out two sheets of ArmaFlex as shown below.



L = desired leg lengths of T piece [typically 50mm [2 in.]].

Cut out ArmaFlex pieces and wrap around T piece, applying adhesive to secure joints and 50 mm [2 in.] strips of adhesive between pipes and ArmaFlex to seal.

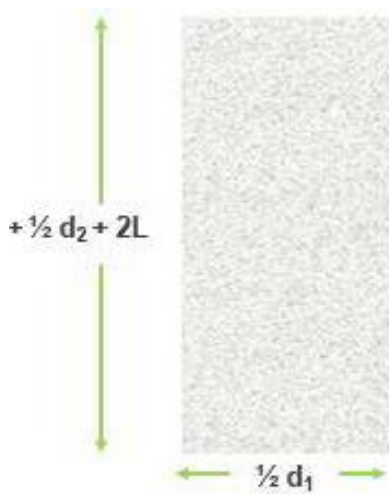
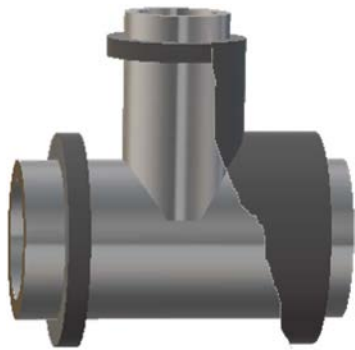
Fabrication Example - Unequal Tee Piece

Measure the external circumferences, **C**, and **C2**, and diameters **d**, and **d2**, over the ArmaFlex insulation.

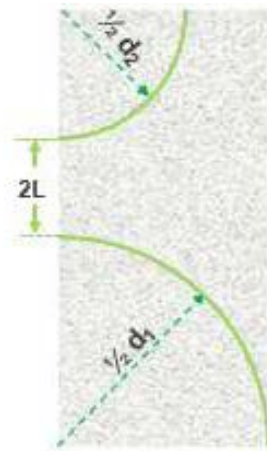
Use these measurements to create a template for marking out how to cut the ArmaFlex.

Leg length **L** = 50mm [2 in.] or longer.

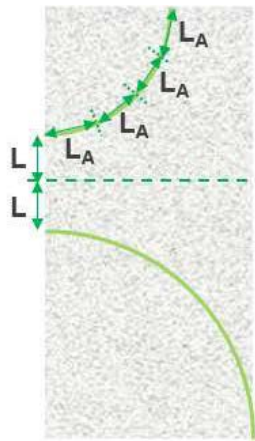
Start by preparing a piece of ArmaFlex to wrap around the smaller branch.



Use a rectangular template,
height = $[\frac{1}{2} d_1 + \frac{1}{2} d_2 + 2L]$
length = $\frac{1}{2} d_1$



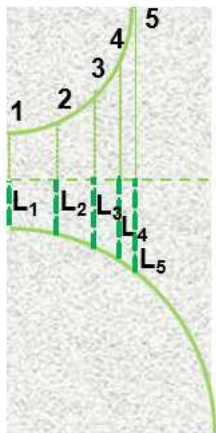
Draw two arcs from the
corners, radius = $\frac{1}{2} d_1$ and $\frac{1}{2} d_2$



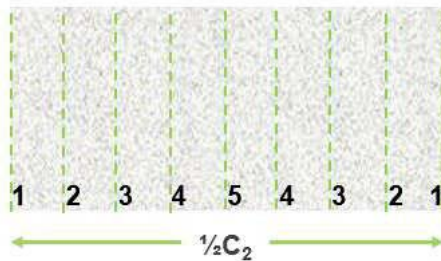
Divide the gap between the arcs into 2 equal parts, length = L and draw a horizontal line. Divide the smaller arc into 4 parts of equal arc length, L_A



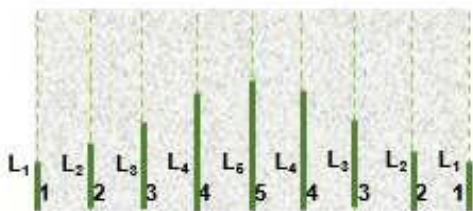
Starting from the divisions and ends of the smaller arc, draw horizontal lines to join the larger and smaller arcs. Label 1 to 5



Measure the distance between the larger arc and the horizontal dividing line



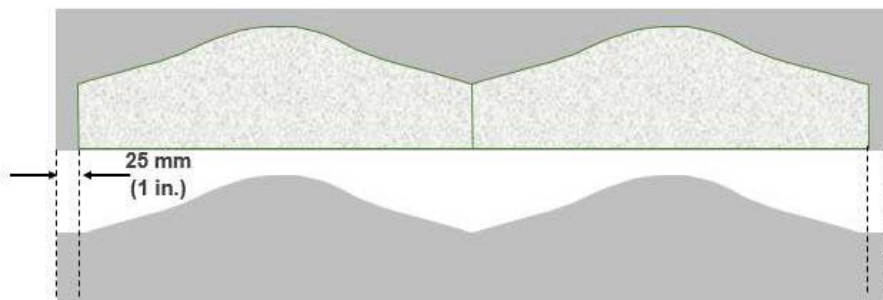
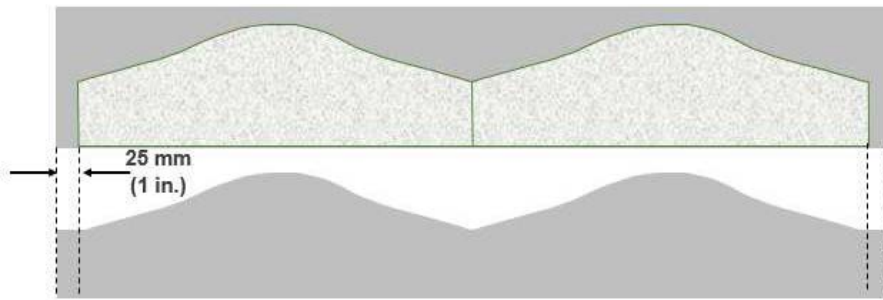
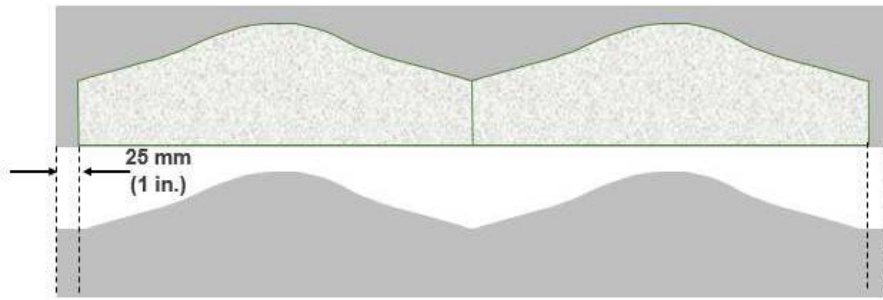
Cut a new template, length $\frac{1}{2} C^2$ and divide into 8 parts. Label as shown



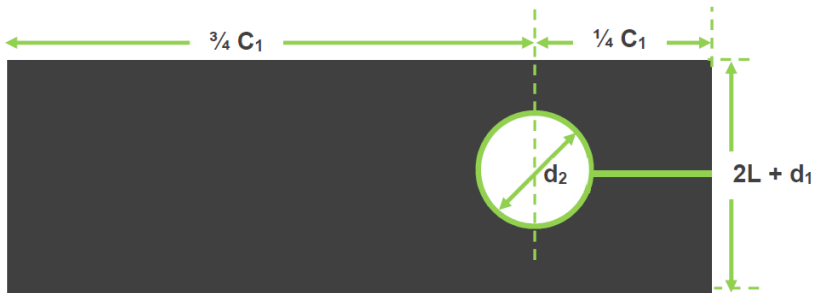
Transfer the measurements L_1 to L_5 onto the template at the positions 1 to 5



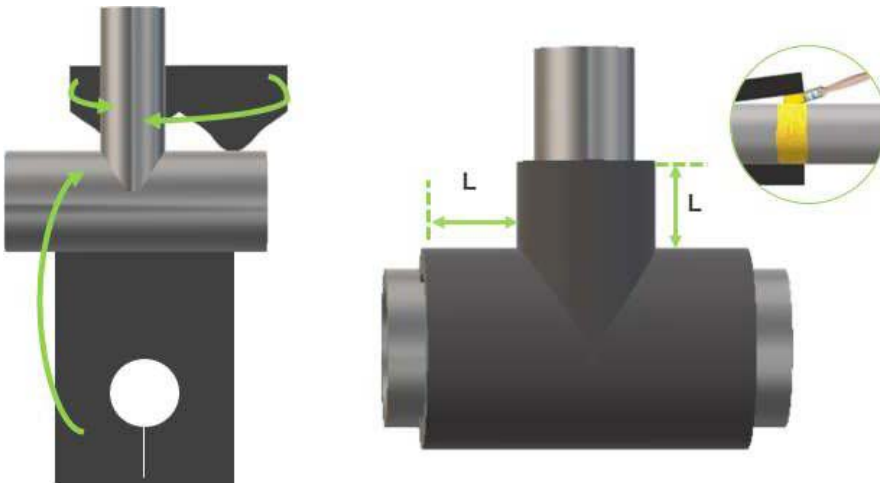
Join the tops of the lines together to form a curve. Cut out bottom part of template



Use template to mark out and cut out the ArmaFlex for the small branch of the T piece.



Cut a sheet of ArmaFlex for the body, length C_1 and width $[2L + d_1]$. Cut out a disc of diameter d_2 , centred distance $\frac{1}{4} C_1$ from one short end, equidistant between the long sides. Cut a straight line from the disc to the nearest short edge.



Wrap cut pieces of ArmaFlex around T piece, applying adhesive to secure joints and apply 50 mm [2 in.] strips of adhesive between pipes and ArmaFlex to seal.

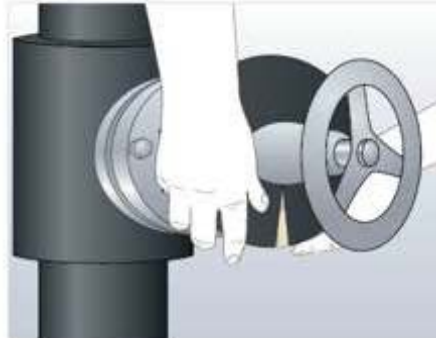
Fabrication Example - Valve

USE OFT PIECE TO INSULATE VALVE

A valve may be insulated using component pieces made in a similar way to those for a T pieces.



Wrap valve body



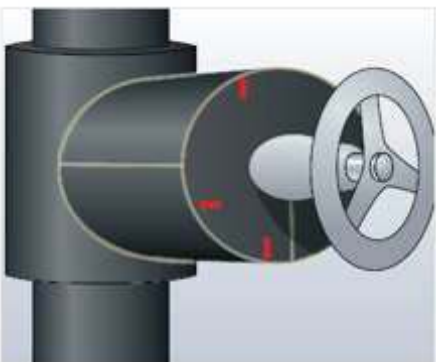
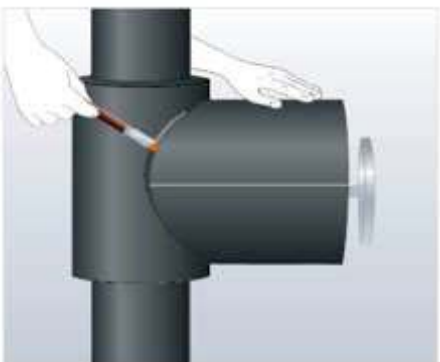
Cut and apply cap around stem



Cut T branch to fit over actuator/stem



Fit T branch over actuator/stem



Glue all joints

Fabrication Example - Reducer

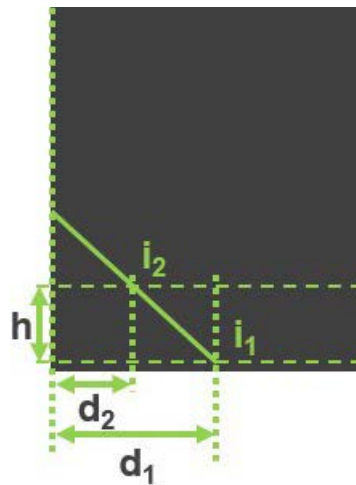
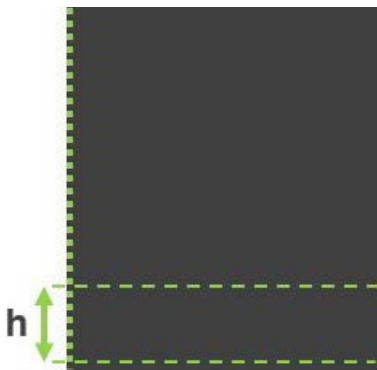
REDUCTION IN PIPE DIAMETER

Measure the height, **h**, of the reducer.

Measure the diameter of the insulation around the larger pipe, **d1**.

Measure the diameter of the insulation around the smaller pipe, **d2**.

Cut a strip of ArmaFlex of length **C** which fits around the larger pipe without being stretched.

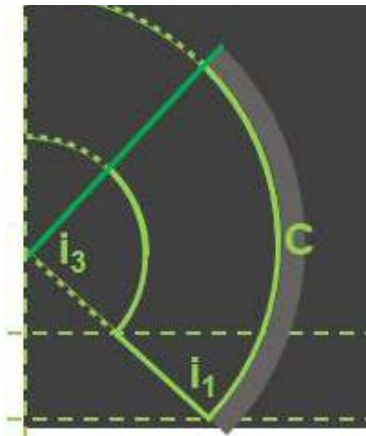


Draw a vertical line on the left of the piece, and two perpendicular, horizontal lines separated by the cone height, **h**

Mark two vertical lines at distance **d1** and **d2** from the left vertical line and draw a diagonal line from the left side to the bottom horizontal line, joining the intersections



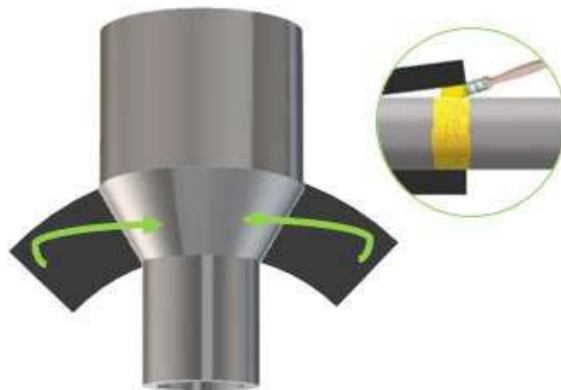
Draw two arcs, centred at i_3 with radius i_1 and i_2



Lay the ArmaFlex strip, C, along the longest arc, starting at i_1 and draw a line from where it ends to i_3



Cut out ArmaFlex reducer piece



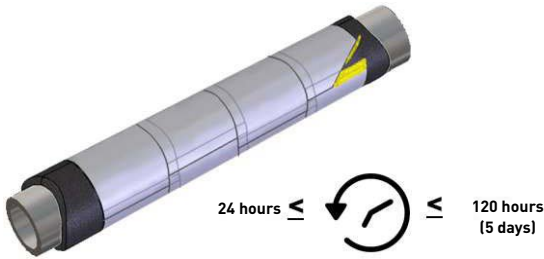
Wrap the ArmaFlex reducer piece around the reducer, applying adhesive to secure

Apply adhesive to secure joints and 50 mm [2 in.] strips of adhesive between pipes and ArmaFlex to seal.

Flexible Jacketing

Application of Arma-Chek flexible, non-metallic jacketing is described in the Arma-Chek R [Flexible Non-Metallic Covering] Application Guide.

Allow at least 24 hours adhesive curing time before applying any sealed jacket over ArmaFlex. It is recommended that the Arma-Chek R is applied within 5 days of completion of application of the previous layers of insulation.



Pipe Supports

Metal-clamp and shoes pipe supports may be insulated as described below. Guidance for cryogenic HDPU insulated supports is available from Energy Technical Services.

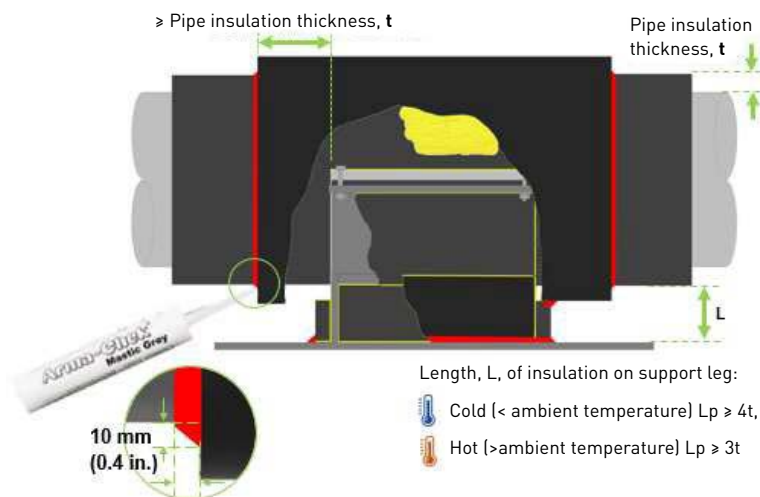
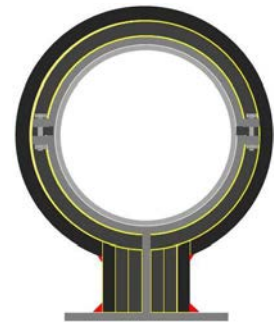
Best results are achieved by fully adhering ArmaFlex to the supports. In all cases the first layer of ArmaFlex shall be tight butted to the support and secured and sealed by at least a 50mm [2 in.] strip of adhesive and Arma-Chek Mastic.

Voids in supports shall be filled with ArmaFlex to provide a continuous surface over which to apply the full specified thickness of ArmaFlex.

Any clamps or bolts shall be insulated over with the full specified thickness of ArmaFlex: it will be necessary to apply additional layers of ArmaFlex to build up a continuous surface.

Apply insulation extensions to the support legs to reduce heat transfer. This insulation shall be the same thickness as specified for the piping.

Arma-Chek Mastic shall be used to weather seal terminations / metal connections.



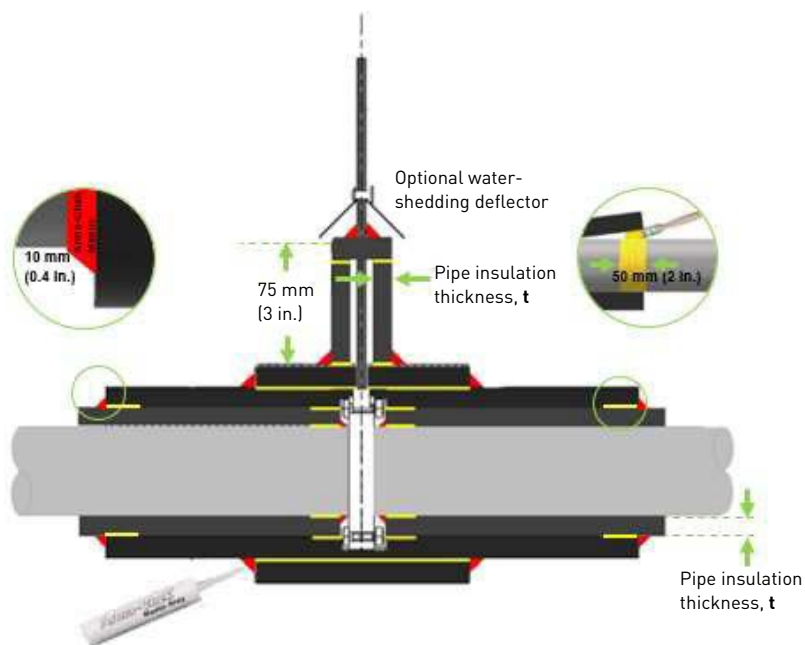
Pipe Hangers

The ArmaFlex pipe insulation shall be tight butted to the support hanger and secured and sealed by at least a 50mm (2 in.) strip of adhesive and if required with Arma-Chek Mastic.

The hanger and any clamps or bolts shall be insulated over with the full specified thickness of ArmaFlex: it will be necessary to apply additional layers of ArmaFlex to build up a continuous surface.

It is considered good practice to reduce the possibility of rain water / moisture entering the pipe hanger. To reduce this possibility, fabricate and apply a minimum 75 mm (3 in.) insulation extension section of ArmaFlex sheet or Tube material as indicated below. The insulation thickness shall be the same thickness as the connecting insulated pipe.

Arma-Chek Mastic shall be used to weather-seal terminations.

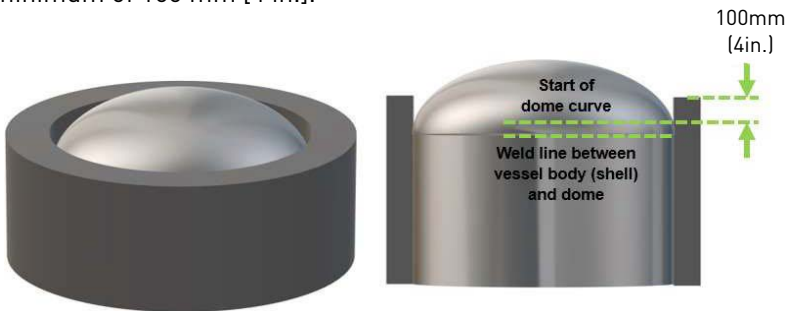


Vessels, General Guidance

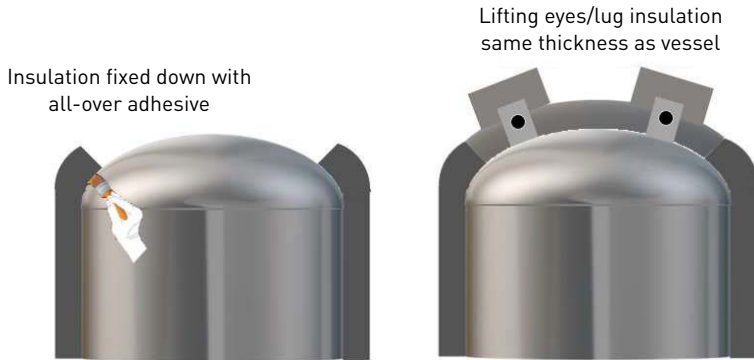
The size and quantity of insulation sheet panels needed to insulate the body (shell) section of the vessel shall be planned in advance. The body section of the vessel shall be insulated first, followed by the dome-end sections.

All-over adhesive coverage shall be used to fix and secure the ArmaFlex to the vessel surface on all insulation layers, with all joints/seams staggered and wet sealed with ArmaFlex adhesive. 5 - 10 mm (0.2 - 0.4 in.) compression shall be achieved in all joints/ seams and care shall be taken to avoid stretching the ArmaFlex.

The ArmaFlex panels shall extend over the curved vessel dome end by a minimum of 100 mm [4 in.].

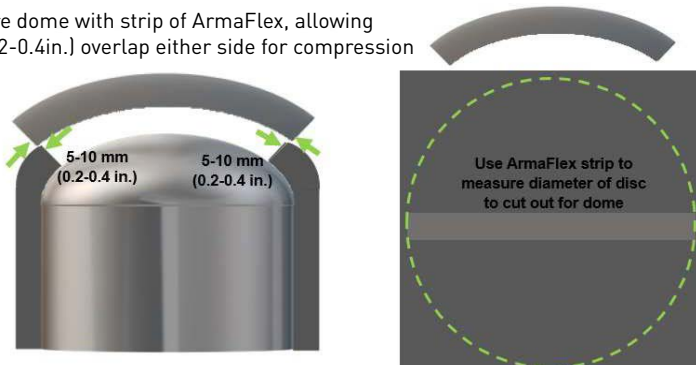


Any lifting eyes/lugs shall be insulated with the same insulation thickness as the body of the vessel and be fully weather sealed to reduce water / moisture ingress.

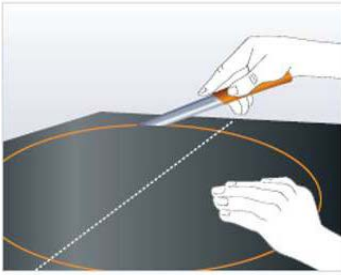


To cover the dome end, a disc or segments of ArmaFlex sheet will be required: measure the diameter required using a strip of ArmaFlex over the dome and allow 5 - 10 mm [0.2 - 0.4 in.] compression on either side.

Measure dome with strip of ArmaFlex, allowing 5-10mm (0.2-0.4in.) overlap either side for compression



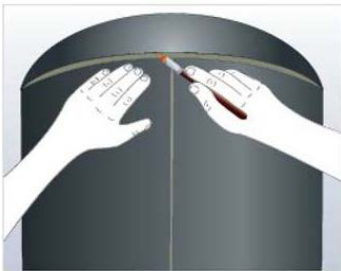
Apply all-over adhesive to the ArmaFlex and vessel dome and apply the ArmaFlex disc.



Cut out disc for dome



Apply all-over adhesive



Apply additional wet seal along edge



Press edges of seam together

For larger vessel domes the disc must be constructed from separate pieces, always ensuring that seams/joints are staggered and allow 5 - 10 mm [0.2 - 0.4 in.] compression on either side.



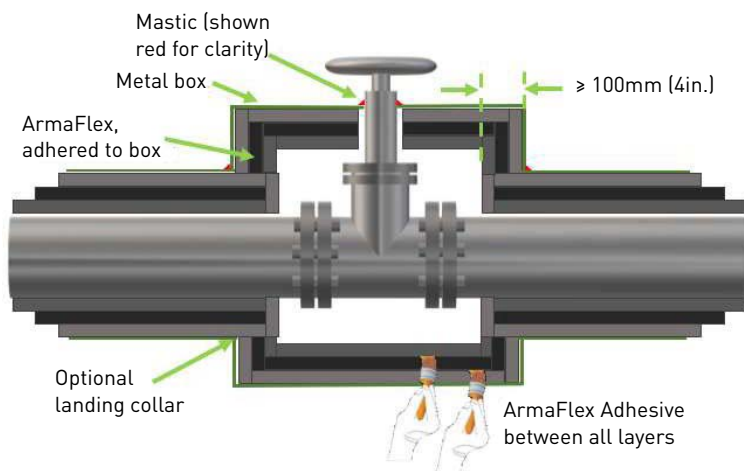
Removable Metal Box Enclosures

VALVES/FLANGES WITH PIPEWORK OPERATING TEMPERATURES -50°C to +125°C [-58°F to +257°F]

A pre-fabricated metal box may be lined with ArmaFlex Insulation, adhered to the inner face of the box using all-over coverage with ArmaFlex adhesive.

Layering requirements shall be as for the pipework insulation and all joints shall be staggered and adhered with ArmaFlex adhesive. The total insulation thickness shall be sufficient to meet the same thermal requirements as the pipe insulation. A water-shed angle on the top of the box is recommended.

If there is a cavity/void created in the box it may be fully insulated or filled with loose pieces of ArmaFlex insulation.

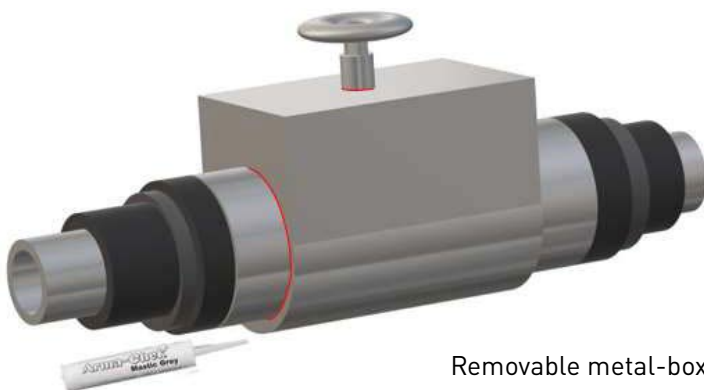


For installation, cut outs will be required over the existing pipe insulation, extending at least 100mm [4 in.] past the pipe insulation terminations. These and other cut outs/penetrations shall be fully sealed with appropriate mastic. Allowance shall be made for flange bolt removal, if required.

The use of metal landing collars or sleeves shall be considered to prevent the box cutting into the pipe outer covering/jacket. Sleeves shall be secured with metal bands and vapour sealed with Arma-Chek Mastic / local approved metal jacketing extruded sealant.

The application of ArmaFlex shall follow the general guidance given in the Application Guidelines.

If a valve stem penetrates the box, it shall be resealed with appropriate mastic each time the valve is operated and if required a deflective rain shield can be fabricated and installed.



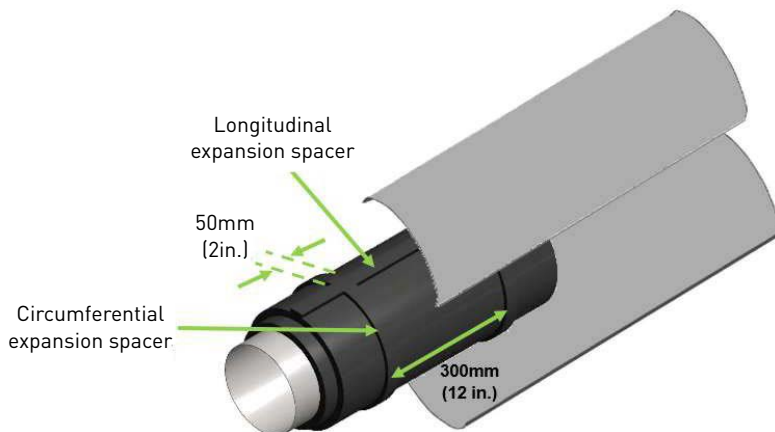
Removable metal-box enclosure,
weather sealed with appropriate sealant.

Rigid Cladding/Jacketing

EXPANSION SPACERS

Application of rigid cladding/jacketing will require the use of expansion spacers when the process operating temperature (or interface temperature between ArmaFlex and other insulation materials) is above 40°C (104°F).

Note: Some ArmaSound acoustic systems incorporate spacers, in which case additional thermal expansion spacers are not required.

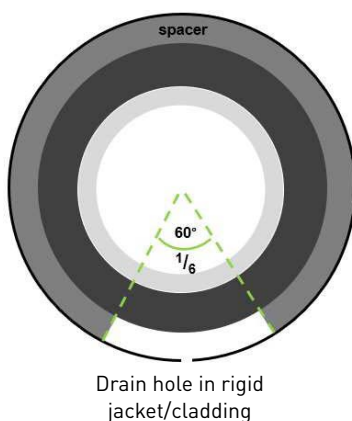


Expansion spacers shall be fabricated from various thicknesses of ArmaFlex Industrial (FEF) sheet and/ or ArmaFlex self-adhesive insulation tape of 3 mm thickness ($\frac{1}{8}$ in.) The width of the expansion spacers shall be 50 mm (2 in.) and the spacers shall be applied at 300 mm (12 in.) centres throughout the entire length of the insulated piping system, including all attached piping fittings.

Expansion spacers shall be fixed and secured with ArmaFlex Adhesive HT625/520 directly around the circumference of the outer surface of the underlying insulation layer. In addition, for horizontal pipes, a 50 mm (2 in.) wide longitudinal expansion spacer strip shall also be applied at the twelve o'clock position, in between the circumferential expansion spacers.

PRECAUTIONS WHEN USING METAL BANDING: If metal banding is applied, locate directly over the ArmaFlex spacers and not over the void area.

PRECAUTIONS WHEN USING DRAIN HOLES: If drain holes are required, locate the ArmaFlex spacers around the upper $\frac{5}{6}$ of the circumference to allow for drainage.



Expansion Spaces Thickness

Use ArmaFlex strips to achieve the required thickness.

Pipe Size NB [Inch]	Pipe OD [mm]	Operating Temperature				
		Expansion spacer thickness [mm]				
		40 to 60°C	61 to 80°C	81 to 100°C	101 to 120°C	>120°C
½	21.3	3	3	6	6	6
¾	26.9	3	3	6	6	6
1	33.7	6	6	6	6	6
1½	48.3	3	6	6	6	10
2	60.3	3	6	6	6	10
3	88.9	3	6	6	10	10
4	114.3	3	6	6	10	10
6	168.3	6	6	10	10	13
8	219.1	6	6	10	13	13
10	273	6	6	10	13	13
12	323.9	6	6	10	13	13
14	355.6	6	10	10	13	13
16	406.4	6	10	10	13	13
18	457	6	10	10	13	13
20	508	6	10	10	13	13
24	610	6	10	13	13	13
> 24" or Flat Surface	> 610 or Flat Surface	6	10	13	13	13

Note: Expansion spacer material - ArmaFlex Industrial [FEF]

Expansion Spaces Thickness

Use ArmaFlex strips to achieve the required thickness.

Pipe Size NB [Inch]	Pipe OD [mm]	Operating Temperature				
		Expansion spacer thickness [in.]				
		40 to 60°C	61 to 80°C	81 to 100°C	101 to 120°C	>120°C
1/2	21.3	1/8	1/8	1/4	1/4	1/4
3/4	26.9	1/8	1/8	1/4	1/4	1/4
1	33.7	1/4	1/4	1/4	1/4	1/4
1 1/2	48.3	1/8	1/4	1/4	1/4	4/10
2	60.3	1/8	1/4	1/4	1/4	4/10
3	88.9	1/8	1/4	1/4	4/10	4/10
4	114.3	1/8	1/4	1/4	4/10	4/10
6	168.3	1/4	1/4	4/10	4/10	1/2
8	219.1	1/4	1/4	4/10	1/2	1/2
10	273	1/4	1/4	4/10	1/2	1/2
12	323.9	1/4	1/4	4/10	1/2	1/2
14	355.6	1/4	4/10	4/10	1/2	1/2
16	406.4	1/4	4/10	4/10	1/2	1/2
18	457	1/4	4/10	4/10	1/2	1/2
20	508	1/4	4/10	4/10	1/2	1/2
24	610	1/4	4/10	1/2	1/2	1/2
> 24" or Flat Surface	> 610 or Flat Surface	1/4	4/10	1/2	1/2	1/2

Note: Expansion spacer material - ArmaFlex Industrial [FEF]

Application of ArmaFlex over other Materials

ArmaFlex insulation will sometimes be applied over insulation materials other than ArmaFlex or ArmaSound. If an ArmaSound system is to be applied over other insulation materials, a layer of ArmaFlex shall be applied first.

Compatibility with non-Armacell products shall always be assessed by the project partners, and trial applications are recommended due to variation between generic products. The maximum operating temperature of the pipe or vessel shall not exceed +250°C [482°F]. Contact Armacell Energy for specific advice on the design of combined insulation systems.

PRECAUTIONS: Ensure that underlying surfaces are clean and that there are no gaps or cracks which might allow heat transfer. Ensure that sufficient time has been allowed for all mastics or coatings to cure completely, and for solvents to evaporate. Underlying insulation, vapour barrier or jacketing shall be secured adequately.

If a vapour barrier or jacket is applied it shall be verified that it is capable of supporting the weight of the ArmaFlex. If the vapour barrier or jacketing does not provide adequate bond strength, consideration shall be given to the use of secured spiral wound insulation binding wire around the vapour barrier or jacketing surface, at 200mm [8 in.] centres, or to using metal banding.

SURFACE PREPARATION BEFORE APPLYING ARMAFLEX

Underlying surface	Surface preparation		
	Untreated surface	Surface sealed with reinforced liquid coating	Surface covered with foil-faced laminate
Rigid preformed PIR/PUR [Polyisocyanurate/ Polyurethane]	Acceptable Seal with ArmaFlex adhesive for density 80 kg/ m ³	Acceptable	Acceptable ¹
Cellular Glass	Fill cells and seal with ArmaFlex adhesive	Acceptable	Acceptable ¹
Mineral Wool with density 80kg/m ³	Acceptable	Not Acceptable	Acceptable ¹
Ceramic Fibre with density 80kg/m ³	Acceptable	Not Acceptable	Acceptable ¹
Nanocomposite Insulation	Unknown	Not Acceptable	Acceptable ¹

Note: Acceptable provided that foil is fully & securely adhered to underlying surface

Inspection Checklist

Continuous or frequent supervision of all application activities is recommended and as a minimum the following inspections shall be carried during every working period.

Inspection Activity - Piping:	Completed ✓
Temperature and relative humidity monitored and recorded during installation. Precautions taken if weather conditions unsuitable for application	
All insulation layers to be clean, dry and fit for purpose. All pipes/surfaces to be insulated clean, dry and inspected/released for insulation application	
All circumferential butt joints tightly fitted and secured with no gaps. Adhered/vapour sealed with applicable ArmaFlex Adhesive	
All circumferential butt joints installed under compression	
All longitudinal seam joints tightly fitted and secured with no gaps. Adhered/vapour sealed with applicable ArmaFlex Adhesive	
All longitudinal seam joints 'staggered' and positioned to shed water	
If all-over adhesive coverage fixing used, all longitudinal seam joints to be installed under compression	
Insulation fixed to pipe surface, or underlying surface as per insulation specification. All applications either all-over adhesive coverage fixing premium application or standard application: Horizontal pipes 20" - at insulation ends. Horizontal pipes 22" to 36" NB - bottom quarter partial adhesive coverage fixing. Horizontal pipes 38" to 72" NB - bottom third partial adhesive coverage fixing. Horizontal pipes , above 72" NB - 100% all over adhesive coverage fixing. Vertical pipe sizes upto 72" NB - quarter partial vertical adhesive coverage fixing down center of pipe. Vertical pipes above 72" NB - 100% all-over adhesive coverage fixing	
Vapour seal applied to first insulation layer using ArmaFlex Adhesive/Arma-Chek Mastic sealant or other applicable mastic sealant at all welded/clamped piping supports	
Insulation layers tight-butted to pipe supports and vapour sealed. Thickness and type of insulation identical to connecting pipe	
All connecting metal parts appropriately insulated and fully weather sealed against water ingress	
Over-sized ArmaFlex insulation Tube material installed to accommodate thickness of trace heating cable without stretching the ArmaFlex, and fully weather sealed with Arma-Chek Mastic sealant against water ingress	
Insulation layers observed to be damage free	
Subsequent layers applied using same application method as first layer	

All data and technical information are based on results achieved under the specific conditions defined according to the testing standards referenced. Despite taking every precaution to ensure that said data and technical information are up to date, Armacell does not make any representation or warranty, express or implied, as to the accuracy, content or completeness of said data and technical information. Armacell also does not assume any liability towards any person resulting from the use of said data or technical information. Armacell reserves the right to revoke, modify or amend this document at any moment. It is the customer's responsibility to verify if the product is suitable for the intended application. The responsibility for professional and correct installation and compliance with relevant building regulations lies with the customer. This document does not constitute nor is part of a legal offer to sell or to contract.

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00144 | ArmaFlex Industrial | ArmaFlex | InstManual | 012023 | Global | EN MASTER

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 solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With more than 3,300 employees and 27 production plants in 19 countries, the company 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.

For more information, please visit:
www.armacell.com/energy

