

# LNG APPLICATIONS MANUAL



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The insulation LNG plants may foresee a multilayer design according to the specific characteristics and the working temperatures of the plants that need to be insulated.

In order to establish the correct scale of the insulation, always refer to the project specifications and to the specific “K-FLEX IN CLAD Piping Equipment Insulation Specification” attached to this document.



**L'ISOLANTE K-FLEX**

# INDICE

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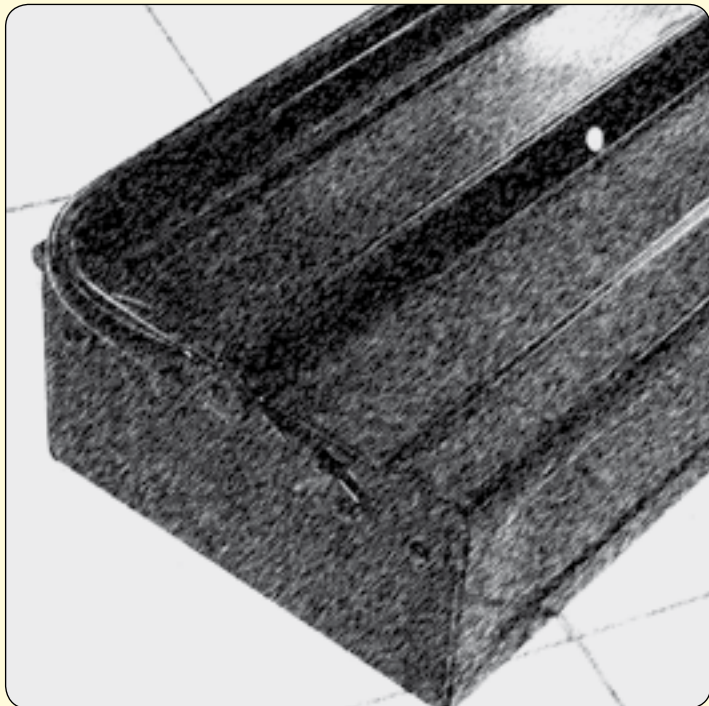
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## **GENERAL PRINCIPLES**

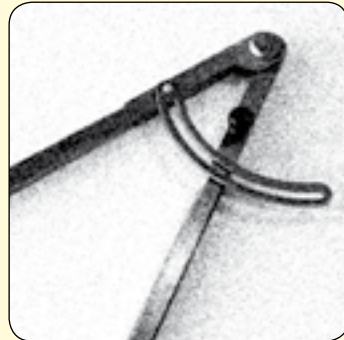
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- 1° LNG insulations are all multilayered**
- 2° The first layer is never glued**
- 3° The joints of the first layer always have an expansion joint**
- 4° The first layer is always covered with an aluminium/polyester vapour barrier**
- 5° The first layer does not adhere perfectly to the pipe: an excess of 2-5% is necessary to allow for thermal contraction of the insulation during use**
- 6° The following layers are installed in the same way as those for traditional applications for cold (glue and anticondensation tape on all joints and staggering of the joints between the various layers)**

## TOOLS NEEDED FOR THE JOB



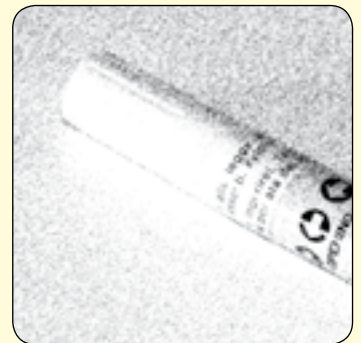
**COMPASS**



**BRUSHES**

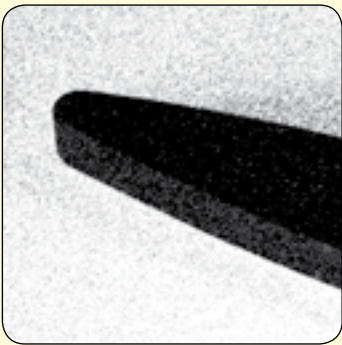


**SPATULA**



**MARKER PEN**

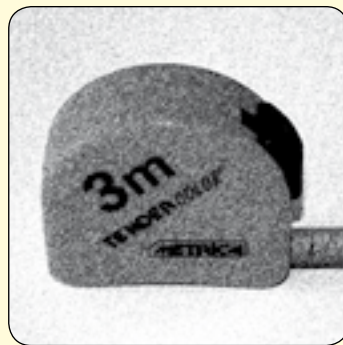
**KNIFE-SHAPENING STONE**



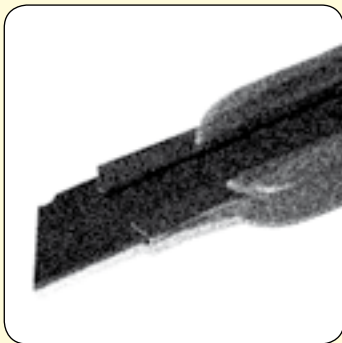
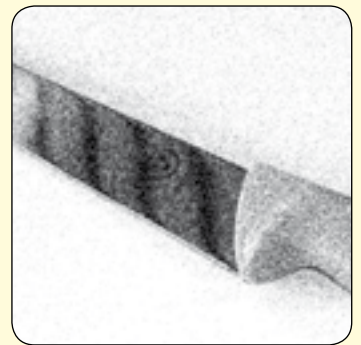
**SCISSORS**



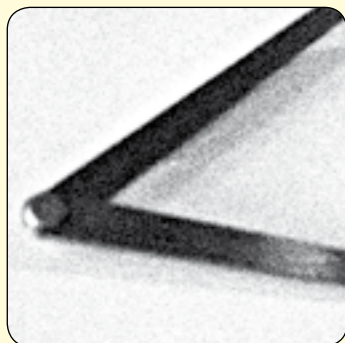
**RULER**



**KNIFE**



**SCALPEL**



**COMPASS TO MEASURE  
DIAMETERS**



**CHALK**



**SAND PAPER**

## ACCESSORIES

### TAPE, COVERING AND ADHESIVES

L'ISOLANTE K-FLEX advises using two types of tape: K-FLEX ST anticondensation tape and K-FLEX ALU AA 130 tape.



#### ANTICONDENSATION TAPE

##### Measurements

Thickness mm: 3  
Lengths m: 10, 15  
Widths mm: 50, 75, 100



#### ALU AA 130 Tape Self-adhesive joint covering tape in smooth aluminium

##### Measurements

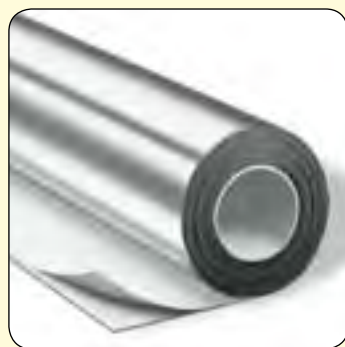
Thickness: 30  $\mu$   
Length m: 50  
Widths mm: 50, 75, 1000



#### K-FLEX IN CLAD TAPE

##### Measurements

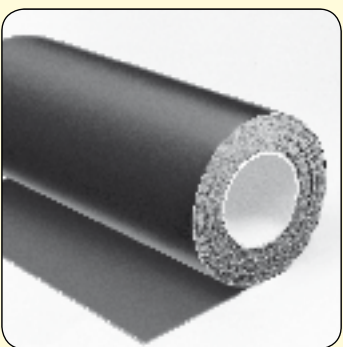
Thickness: 1 mm  
Length m: 25  
Widths mm: 50, 100



#### ALU 5 LAYER FOIL

##### Measurements

Thickness: 80  $\mu$   
Length m: 100  
Width mm: 1.000



#### K-FLEX IN CLAD COVERING

##### Measurements

Thickness mm: 1  
Length m: 10  
Width mm: 1.000



**INDICATED CONSUMPTION OF 1 LITRE OF ADHESIVE**

TUBES	glued to the heads	glued lengthways
thickness mm 9	every 1.350 m	every 150 m
thickness mm 13	every 500 m	every 100 m
thickness mm 19	every 300 m	every 80 m
thickness mm 25	every 220 m	every 60 m
thickness mm 32	every 180 m	every 40 m
thickness mm 40	every 139 m	every 27 m

L'ISOLANTE K-FLEX does not accept responsibility for consumptions that may differ to those indicated above

**K-FLEX ADHESIVES**

K-FLEX K 420 glue has been specifically designed for use with K-FLEX elastomeric foam insulation material. The securely bonded surfaces and joints are resistant to ageing and atmospheric agents and preserve the technical characteristics of the insulating material.

**K 420 ADHESIVE** in tins of: 0,26 - 1 - 2,6 litres



**MARINE SEALANT**

Marine sealant is suitable for making elastic constructive joints and has extremely good UV-resistance and ageing properties. Product is based on Silyl Modified Polymers.

Packaging: cartridges 290 ml



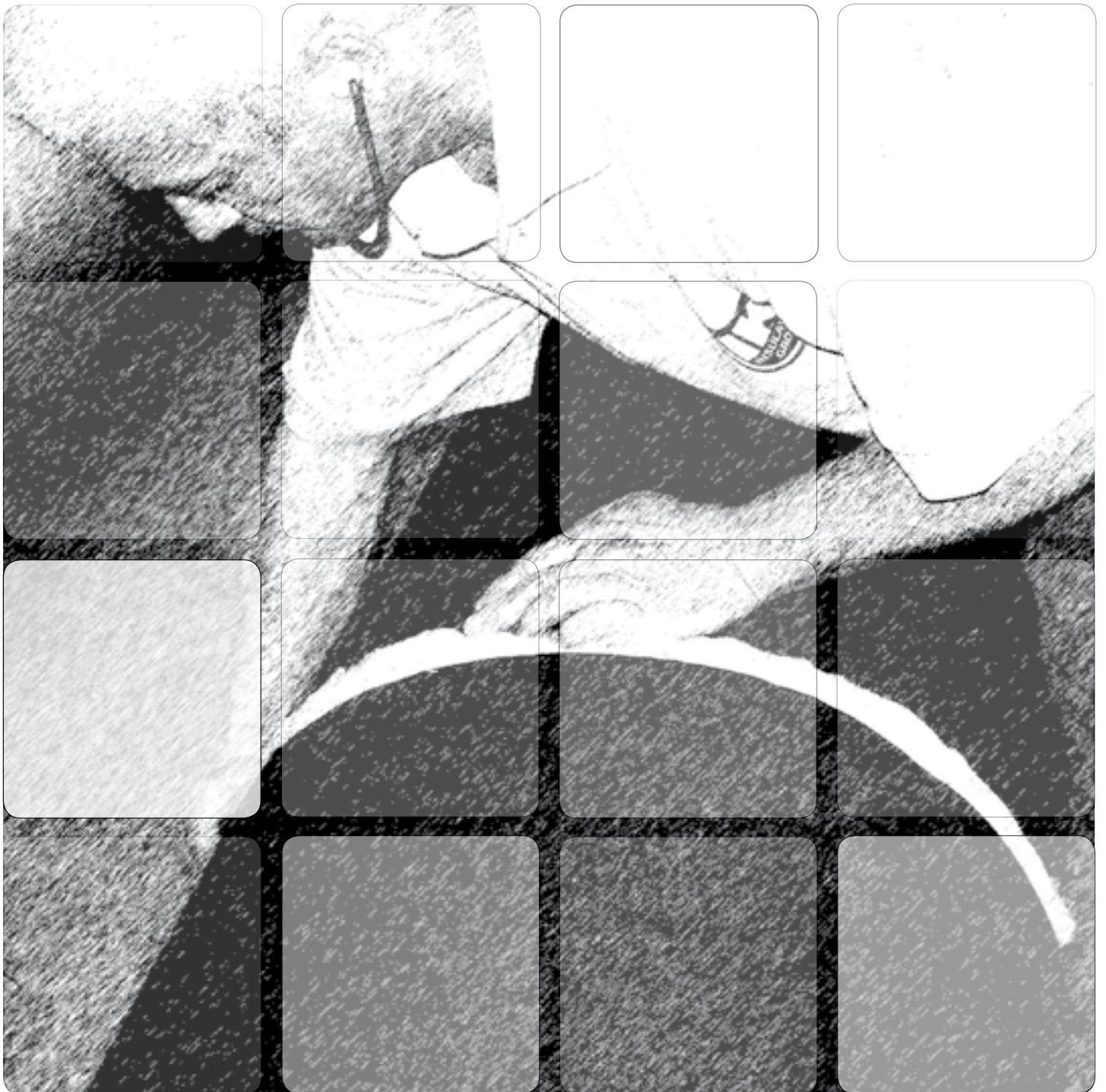
**SPECIAL K-FLEX THINNERS**

Before covering the surfaces to be insulated, it is advisable to clean them thoroughly with the special K-FLEX thinners.

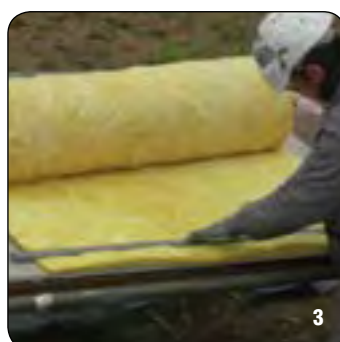
1 LITRE TINS



# INSTALLATION INSTRUCTIONS



## PREPARATION BEFORE STARTING TO INSULATE



### 1. CLEANING THE SURFACE TO INSULATE.

Thoroughly degrease the surface to be insulated with the producer's specified thinners

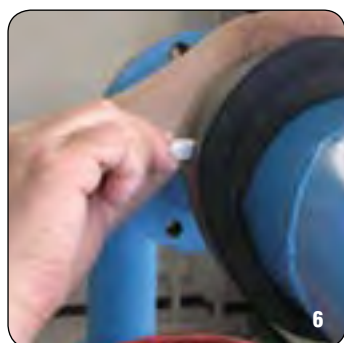
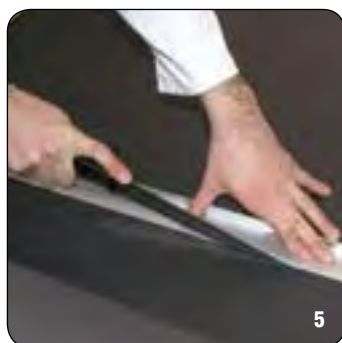
### 2) STAGGERED LAYERS.

The insulation must be carried out, making sure that the end joints of tubes (preformed up to a diameter of 168 mm) and of sheets (for diameters from 140-170 mm) are always staggered in order to ensure that the edges are never aligned. In this way, starting to insulate from the pipe supports (fig. 1) where the sections are already staggered, the next layers are applied with end joints that are not aligned.

### 3) COMPENSATION JOINTS.

Prepare a sufficient quantity of mineral fibre compensation joints according to the following indications:

- a) prepare several 30 mm thick mineral fibre strips;
- b) cut sections with the same width as the insulation's thickness eg. 50 mm thickness, (fig. 2).
- c) The mineral fibre strips should each be cut to a width of 50 mm. This material will be used for making the compensation joints, (figs. from 2 - 4).



### 4. MAKING THE RIGHT SIZE TUBES FROM SHEETS

The insulation of the pipes can be carried out using preformed tubes, cut out from sheets, or, when working on-site it is possible to use sheets for insulating pipes of large dimensions. Usually preformed insulating tubes are used for diameters from 140-170 mm whereas for greater diameters it is easier to use sheets cut to size, as indicated further on in the manual, in order to obtain the desired result, or one can even order the sheet section already prepared for installing.

- a) Cut a strip of K-FLEX ST elastomeric material of about 100 in width, fig. 5.
- b) With the strip, measure the circumference of the pipe to insulate and make a mark on the strip to indicate the correct circumference. Add to this measurement an excess of 3% (fig. 6). NB: Gently lay the strip onto the tube. Do not stretch, avoiding ending up with a section which is too short.
- c) Lay the K-FLEX insulation sheet onto a flat surface and use the previously cut strip to obtain the sheet sections needed to insulate the pipes, (figs. 7-8).

# MULTILAYER INSULATION, PIPES

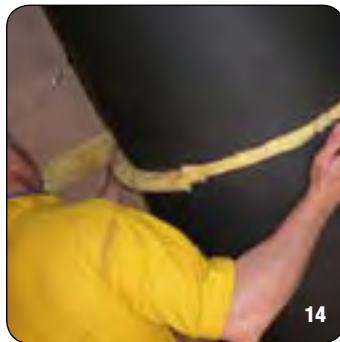
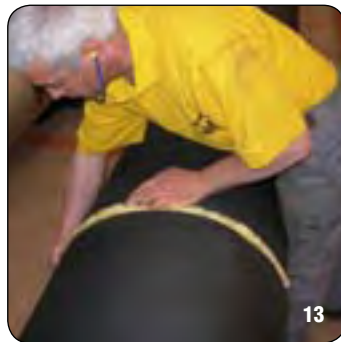
## FIRST LAYER



### 1. APPLYING THE FIRST LAYER

- a) apply the tube sections, previously cut out of a sheet, onto the pipes.
- b) Seal the insulation together with 50 mm ALU AA 130 self-adhesive tape, attaching strips every 30 cm perpendicularly to the cut, (fig. 9).
- c) To make sure that the ALU AA 130 tape is correctly placed, press together the longitudinal edges of the insulation so that they touch and securely fixdown the tape, (fig. 10).

- d) Once the tape is fixed perpendicularly, apply the tape along the complete length of the tube to be insulated, over the joint, (fig. 11).
- e) Rotate the longitudinal seal downwards, turning the insulation 180° to position the tube's sealed joint towards the ground.



### 2. INSTALLING THE COMPENSATION JOINTS

Between each insulated section, add a strip of previously prepared mineral fibres, see pag. 10.

- a) position the strip between the insulated tube sections, (fig. 12).

- b) It is advisable to install the elastomeric material so that they come into contact and then, using force, insert the mineral fibres strip between the end joints, (figs. 13-14).

## MULTILAYER INSULATION, PIPES

### FIRST LAYER



#### 3. VAPOUR BARRIER

a) From a roll of ALU 5 layer foil, cut out a sheet with a width equal to one and a half times the circumference of the insulated tube, (figs. 16-17).



b) Apply the sheet of ALU 5 layer foil onto the K-FLEX insulation, securely fixing it down to obtain a tight fitting cover, (figs. 18-19).

All the edges of the vapour barrier must be staggered.

## MULTILAYER INSULATION, PIPES

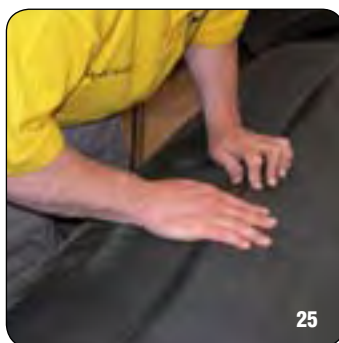
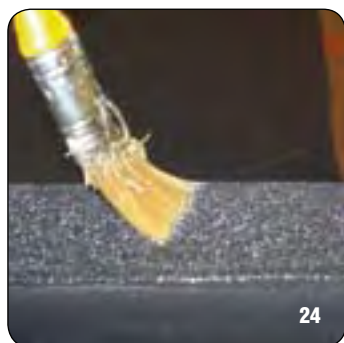
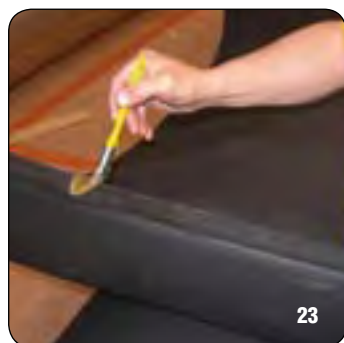
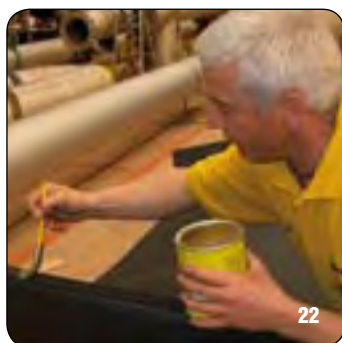
### FIRST LAYER



- c) It is important to stagger the edges of the insulation and the edges of the ALU 5 layer foil in order to avoid continuity with the underlying edge. Every sheet of ALU 5 layer foil should be positioned in such a way as to overlap the following one by at least 100 mm between one section and another.
- d) On both the longitudinal and end joints apply 50 mm ALU AA 130 self-adhesive tape to fix down the vapour barrier, (figs. 20-21).

# MULTILAYER INSULATION, PIPES

## MIDDLE LAYERS

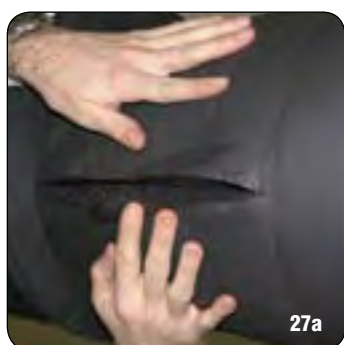
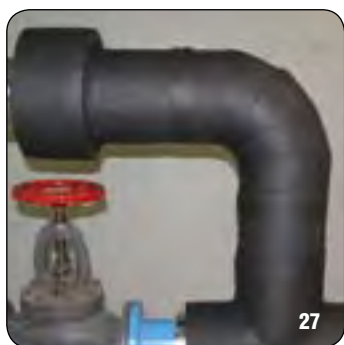
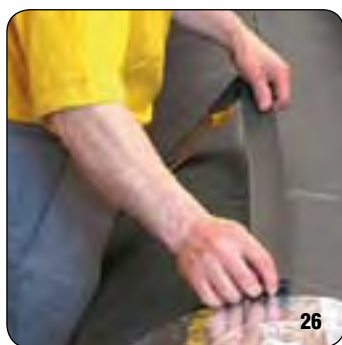


### INDICATIONS FOR CUTTING SHEETS TO SIZE

1. Repeat the procedure described above for carrying out the insulation of the following layers, without adding any excess during the preparation of the sheet sections.
2. Take care not to overlap the expansion joints of the following layers.

3. Use K-FLEX K-420 adhesive for sealing both the longitudinal and end joints of both the sheets and tubes, applying the glue with a brush on both the sides to be sealed. Wait until the glue dries before installing the insulation material, (figs. 22-24).

4. Install the insulation on the tube, taking care to avoid positioning the joints above those of the underlying layer. (first or second layer), (fig.25).

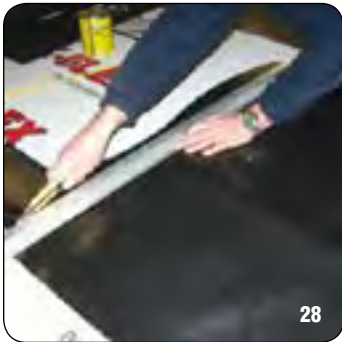


5. Apply, only on the second layer, 50 mm K-Flex anticondensation tape on all the longitudinal and (fig. 26) head joints which were previously glued together, (fig. 27).

6. For layers applied after the second one, it is not necessary to use (figs. 27 - 27b) anticondensation tape.

# MULTILAYER INSULATION, PIPES

## INSTALLING THE K-FLEX IN CLAD COVERING



### 1. PREPARATION OF IN-CLAD

From a roll of K-FLEX IN CLAD, cut a sheet with the same width as the circumference of the insulated tube, adding an excess of roughly 50 mm for the longitudinal overlap.

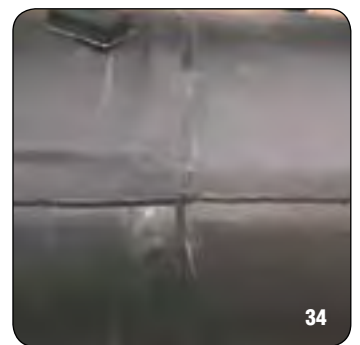
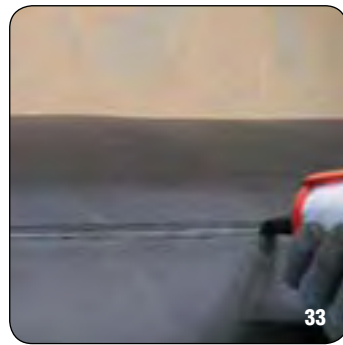
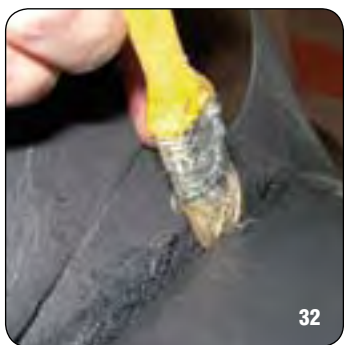
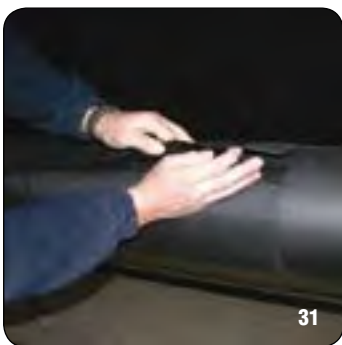
### 2. INSTALLATION

- Apply a layer of K-FLEX K-420 glue along the section of the tube to be covered with K-FLEX IN CLAD.
- Position the K-FLEX IN CLAD on the area where the glue has been applied and from that point wrap the K-FLEX IN CLAD sheet around the whole section.

c) Securely press down the K-FLEX IN CLAD covering along the whole circumference, in order to obtain a tightly fitting cover, fig. 29.

d) With a brush, apply K-FLEX K-420 adhesive on both ends in order to obtain a perfect seal against water between the covering and the insulation material, (figs. 30-32).

NB: Take care to stagger the edges of the insulation and the the edges of K-FLEX IN CLAD to avoid continuity with the underlying edge. Each sheet of K-FLEX IN CLAD should be positioned in such a way as to overlap the next sheet by at least 50 mm. Use K-FLEX K-420 on both the longitudinal and transverse overlaps.



### 3. SEALING WITH MARINE SEALANT

In order to obtain a covering with a secure water barrier, use marine sealant approved by L'ISOLANTE K-FLEX on all the joints:

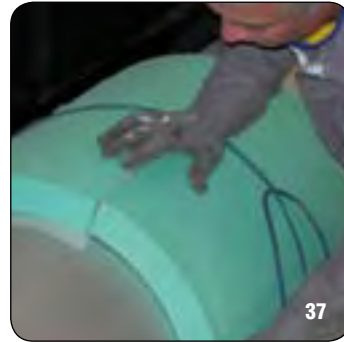
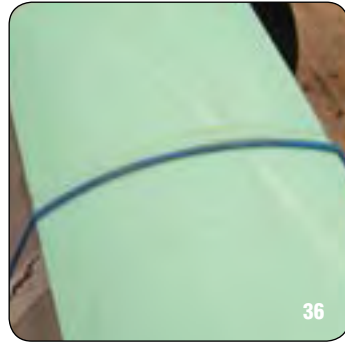
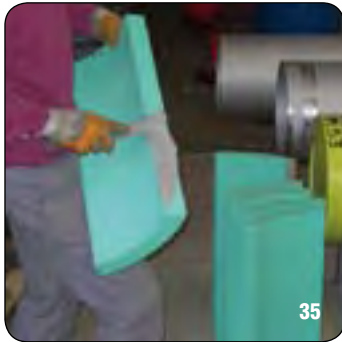
- Between all the longitudinal and transverse overlaps of the K-FLEX IN CLAD covering
- Between the pipe supports and the K-FLEX IN CLAD covering
- Between the overlaps of the valves, flanges, "T" connections and terminals
- On the sections of the elbow covered with K-FLEX IN CLAD
- On all the overlaps and K-FLEX IN CLAD joints.

Proceed as follows on all the joints indicated in figures 33 and 34:

- with the correct dispenser, spread a layer of marine sealant at least 10 mm wide, (figs. 33 - 34).
- check that there are no breaks in the seal
- carefully follow the instructions indicated on the tin of sealant and check the time required to obtain a secure and permanent seal.

# MULTILAYER INSULATION, PIPES

## PIPE SUPPORTS



### 4. PIPE SUPPORTS

For a correct installation of the PU pipe supports, proceed as follows:

- On a work surface, position all the shell sections needed for the pipe support
- Apply Foster putty on the edges of the PU "shell" sections, (fig. 35).
- On the tube, apply an elastic band as shown in figure 36, which will help to hold the shells onto the tube.
- Apply the support sections one at a time starting from the top and continuing in a clockwise direction, rotating then downwards, (fig. 37).
- Use the correct tools at the ends of the pipe support (10 cm from the right and left edges) to secure the support onto the tube, using sufficient

force in order to achieve a tight fit of the longitudinal shell sections. Position two aluminium sheets under the jack to avoid ruining the supports, (fig. 38).

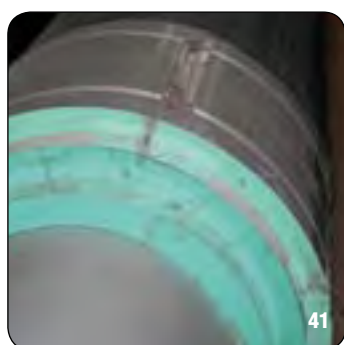
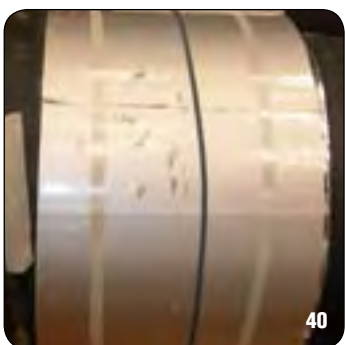
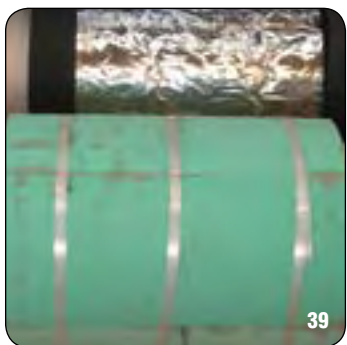
f) Wrap around the appropriate reinforced fiberglass tape three times in the following three positions, (fig. 39).

- On the side of the left jack towards the centre, at about 10 cm
- On the side of the right jack towards the centre, at about 10 cm
- At the centre of the pipe support

g) Remove both left and right jacks.

Proceed in the same way for the following layers taking care to:

- apply the vapour barrier on the first layer, leaving 100 mm of overlap on



each side, and apply 1,5 rotations of ALU 5 layer foil. Finally, seal the vapour barrier with reinforced fiberglass tape, (fig. 40).

h) For all the following layers (fig. 41) of the pipe support, the vapour barrier should be positioned only when the installer has attached the metal collars, (fig. 42); afterwards, proceed with the covering as follows:

- Measure the distance between the end of the metal collar and the pipe support, add 50 mm of excess for the overlap and cut out a strip of K-FLEX IN CLAD.

laps with K-FLEX K 420 adhesive.

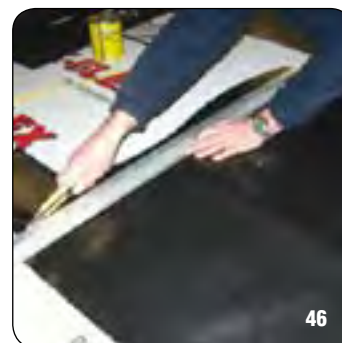
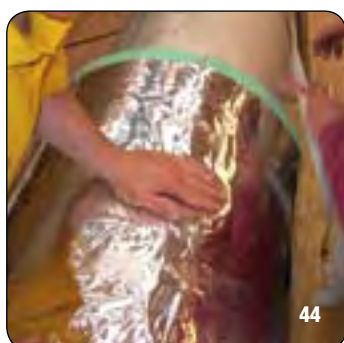
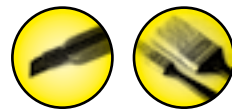
- Apply marine sealant to all the joints around the pipe support.
- to avoid water infiltrations, cover all the openings around the supporting collar with marine sealant, (fig. 42).

- Install this strip, taking care to glue the longitudinal and transverse over-



# MULTILAYER INSULATION, PIPES

## PIPE SUPPORTS



### CONNECTION BETWEEN THE PIPE SUPPORT AND THE TUBE SECTIONS

#### a) First layer

On the edges, apply mineral fibre strips as previously carried out for the elastomeric material, (fig. 43). Cover everything with the vapour barrier as shown in figure 44.

#### b) Following layers

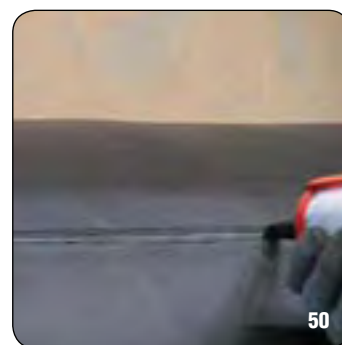
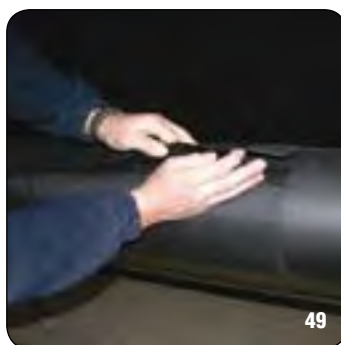
Glue the two ends of the supports to the elastomeric material using K-FLEX K-420 adhesive.

Only on the second layer, apply 50 mm K-FLEX anticondensation tape on all the glued joints, (fig. 45). In a three layer installation, on the third layer, it is not necessary to apply anticondensation tape.

### K-FLEX IN CLAD COVERING

The pipe supports should be covered externally with K-FLEX IN CLAD. Proceed as follows:

a) Cut a section of K-FLEX IN CLAD equal to the external circumference of the pipe support, plus 50 mm of longitudinal and transverse excess on all sides, (fig. 46).



b) Wrap the covering around the pipe support, (fig. 47).

c) Apply K-420 glue on both the longitudinal and transverse overlaps of the K-FLEX IN CLAD covering and also onto the areas below onto which the overlaps will be glued, (fig. 48).

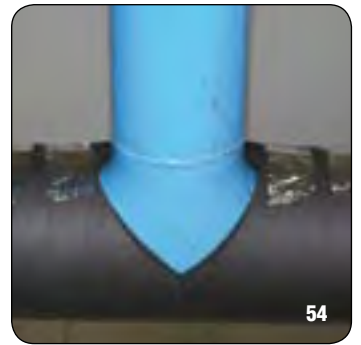
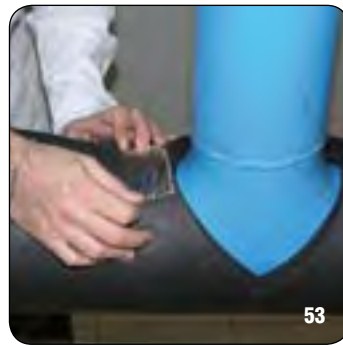
d) Join together the areas to be glued and apply enough force to ensure a perfect sealing, (fig. 49).

### COVERINGS

On both sides of all joints, apply a 10 mm layer of marine sealant, (fig. 50).

## MULTILAYER INSULATION, SPECIAL PARTS

### PREFORMED "T" CONNECTIONS, 1° LAYER



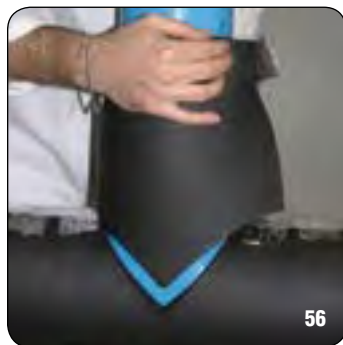
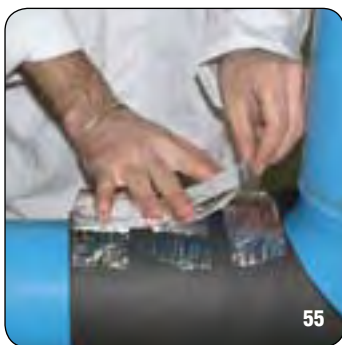
#### 5. "T" CONNECTIONS

##### FIRST LAYER WITH "T" CONNECTION IN SECTIONS READY FOR INSTALLING

The "T" connection is made of two pieces ready for installation as shown in figure 51. As previously indicated for straight sections, the installation should be carried out following the multilayer design. The first layer must never be glued; ALU AA 130 tape will be used to fix the "T" connection sections to the pipe. Proceed as follows.

a) On the tube, apply the single pre-cut "T" connection sections (fig. 51), fixing them together with 50 mm ALU AA 130 self-adhesive tape along all the joints (figs. 52, 53, 54). NB: first install the horizontal section (figs. 52 and above) followed by the vertical one (fig. 64 and following).

b) ALU AA 130 self-adhesive tape should be applied as shown in figures 55 to 58.

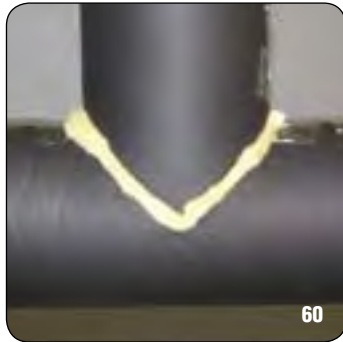


NB: The ALU AA 130 tape should be applied both longitudinally and transversely over the joints, as shown in figures 52 to 58.

NB: The prepared "T" connection sections needed for the installation are already supplied with a 3% excess. During the installation, this excess should be maintained. Therefore only seal down what is necessary.

## MULTILAYER INSULATION, SPECIAL PARTS

### PREFORMED "T" CONNECTIONS, 1° LAYER



d) With controlled pressure, insert the mineral fibre strips into the joints as shown in figure 59.

e) When this operation is complete, the "T" connection should now appear as shown in figure 60.

## MULTILAYER INSULATION, SPECIAL PARTS

### MAKING THE "T" CONNECTION SECTIONS ON-SITE FROM SHEETS



The "T" connection sections can be easily made directly on-site by cutting them out of a section of K-FLEX ST sheet. They should be made in two sections, a horizontal and vertical one, (fig. 51).

Proceed as follows.

#### a) Horizontal section

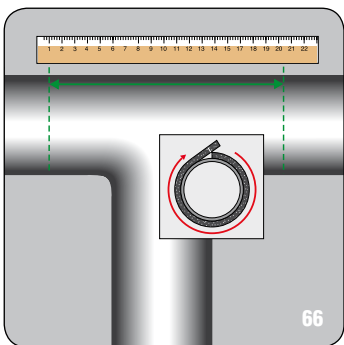
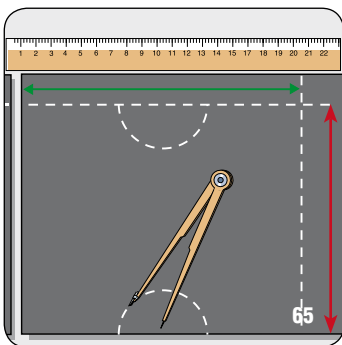
Prepare a strip of K-FLEX ST elastomeric material about 100 mm wide, with the same thickness as the insulation which will be used, in order to take the measurements of the circumference, fig. 61. Do not stretch the strip, avoiding creating a section that could be too short. Finally, add an excess of 3%.

- Transfer the measurements onto a K-FLEX ST sheet as indicated by the red arrow in figure 75 for preparing the length.

- Measure the diameter of the "T" connection, (fig. 62).

- Transfer the measurements of the diameter onto a ruler, (fig. 63).

- Divide the measurement by 2 (fig. 64) to obtain the radius needed to trace two semi-circles with a compass, (fig. 65).

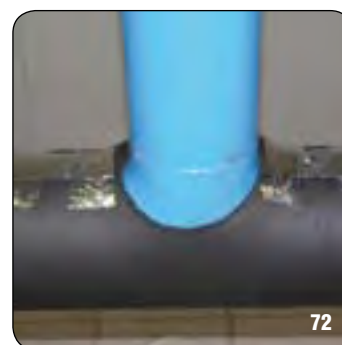
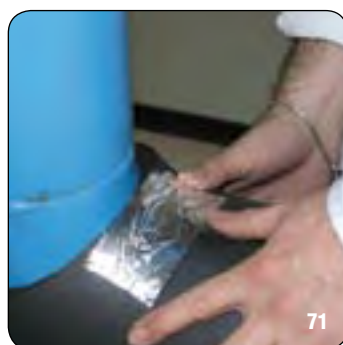


- The width of the sheet (green arrow in fig. 65) should be equal to 3 times that of the measured radius in figure 74. Whereas the length, as previously indicated, is the same as the circumference of the "T" connection section, as indicated in figure 66.

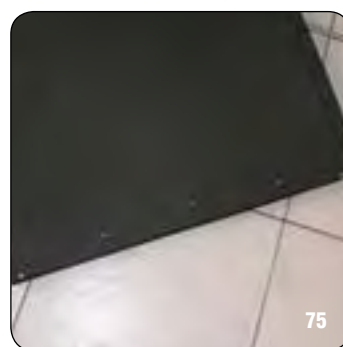
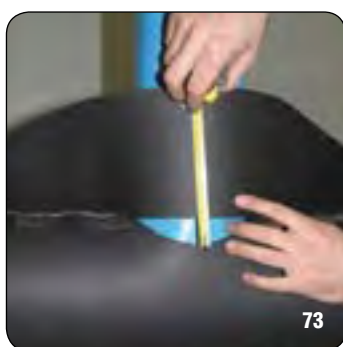
- Once the two semi-circles have been marked out with the point of a compass (fig. 67), start to cut them out along the lines with a sharp knife, (fig. 68).

## MULTILAYER INSULATION, SPECIAL PARTS

### MAKING THE "T" CONNECTION SECTIONS ON-SITE FROM SHEETS



- Apply the horizontal section of the "T" connection onto the pipe, (fig. 69).
- Fix the horizontal section together using ALU AA 130 tape as indicated in figures 70 to 72.



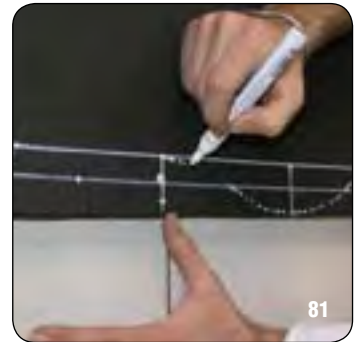
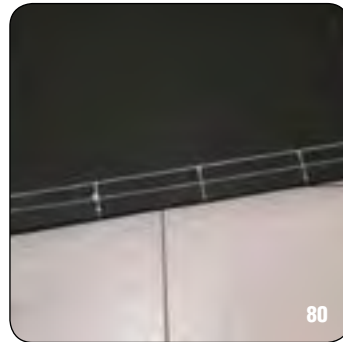
#### Preparing the vertical section

- To prepare the vertical section of the "T" connection, proceed as follows:
- Take the measurements of the coupling arm section by resting the cut sheet on it to use as a basis for measuring, (fig. 73).

- Divide a second K-FLEX ST sheet into four equal sections, using the same method as indicated in figure 61. Draw a line parallel to the edge. The distance from the edge must be equal to that of the difference in height measured in figure 85. This line is needed to obtain the intersecting point with the three previously drawn vertical lines to use as the center for the following circles, (figs. 86 - 93).

## MULTILAYER INSULATION, SPECIAL PARTS

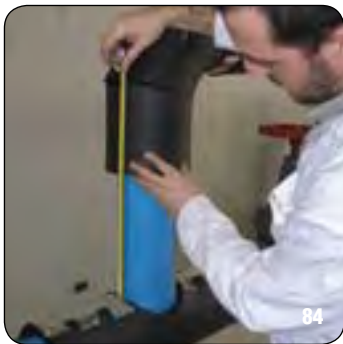
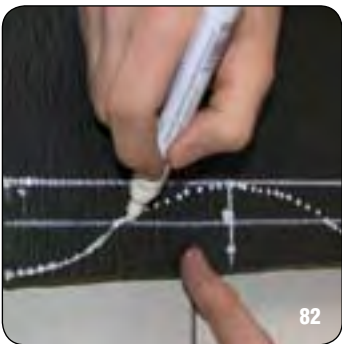
### MAKING THE "T" CONNECTION SECTIONS ON-SITE FROM SHEETS



- At this point, with the help of a metal ruler, trace 4 sections as indicated in figures 78 and 79.

- With a white felt pen, draw a median line which exactly divides in two the previously drawn section, (fig. 80).

- Finally draw the curves as indicated in figures 81 and 82.



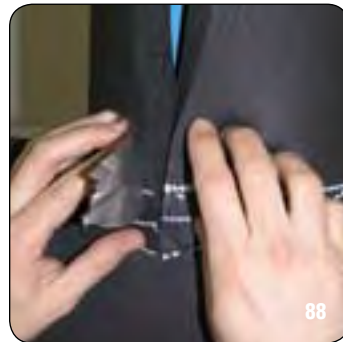
- cut out the final shape following the lines, (fig. 83).

- Measure the distance between the horizontal "T" connection section and the next already installed section, (fig. 84).

Transfer the measurements onto the sheet (fig. 85) and cut out the horizontal section of the "T" connection, which is now ready to be installed.

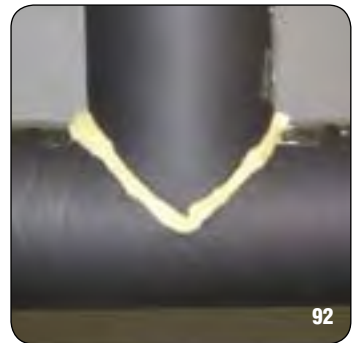
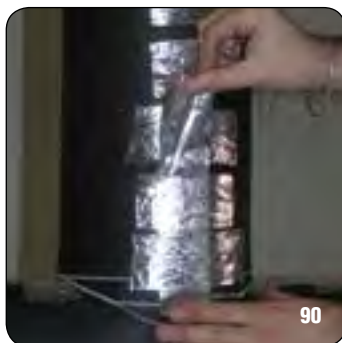
## MULTILAYER INSULATION, SPECIAL PARTS

### MAKING THE "T" CONNECTION SECTIONS ON-SITE FROM SHEETS



- Install the section onto the pipe, fixing it together with 50 mm ALU AA 130 self-adhesive tape, as indicated in figures 86 to 90.

NB: The ALU AA 130 tape should be applied both transversely (figure 103), and longitudinally to the cut as shown in figure 90.



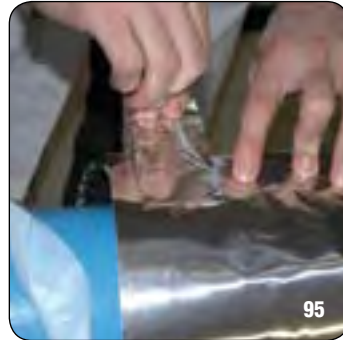
- Apply, in the intersection between one sheet and another, a 30 mm thick strip of mineral wool; with the same thickness as the insulation which will be used.

- Proceed to cut a few strips of mineral fibre as indicated in figure 105 and previously on page 20, and insert them between the intersections as seen in figures 91 and 92.

NB: Bearing in mind the function of these strips (to compensate for the contraction of the elastomeric sheet), it is advisable to install the elastomeric material so that they come into contact, and then, using force, open them apart to allow enough space for the wool.

## MULTILAYER INSULATION, SPECIAL PARTS

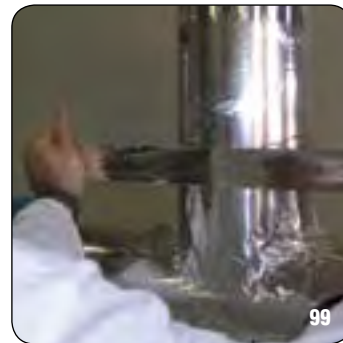
### APPLYING THE VAPOUR BARRIER ON THE "T" CONNECTION



#### PREFABRICATED VAPOUR BARRIER

- On the first insulated layer, apply the prefabricated, ALU 5 layer foil sections of the "T" connection, (fig. 93).
- Apply the vapour barrier securely, in order to obtain a tight fitting cover which compensates for the 3% of excess previously added to the insulation, (figs. 91 - 97).
- Cover each overlap with 50 mm ALU AA 130 self-adhesive tape, (figs. 95 - 96 - 98 - 99).

The final result will result in a perfect vapour barrier, (fig. 100).



#### MAKING THE VAPOUR BARRIER ON-SITE

Prepare the sections which will be applied to the insulation by cutting them out of a sheet of ALU 5 layer foil, following the instructions indicated in the previous pages for making the "T" connection with K-FLEX insulation. Apply each sheet of 5 layer aluminium foil onto the insulation, fixing them down securely in order to obtain a tightly fitting cover and to compensate for the 3% of excess previously added to the insulation. Take care to stagger the edges of the insulation and the edges of the ALU 5 layer foil sheet to avoid continuity with the underlying edge.

Every sheet of ALU 5 layer foil should be positioned in such a way as to overlap the following sheet by at least 100 mm. On both the longitudinal and transverse overlaps, 50 mm ALU AA 130 self-adhesive tape should be used.



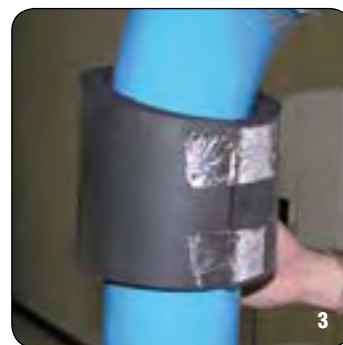
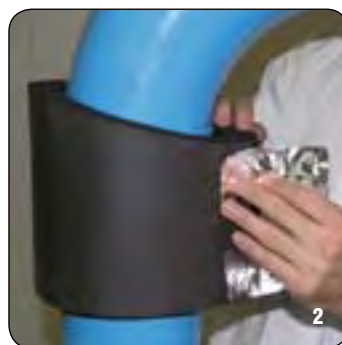
## MULTILAYER INSULATION, SPECIAL PARTS

### PREFORMED ELBOWS: FIRST LAYER

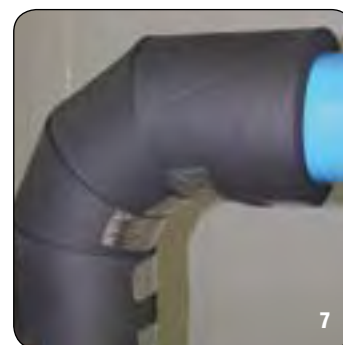
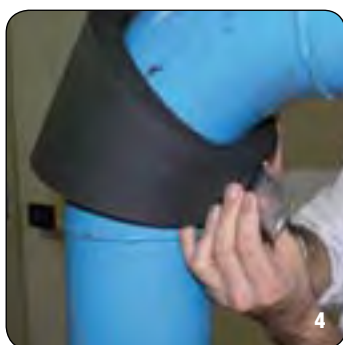


#### A) FIRST LAYER: ELBOW IN SECTIONS

- The first layer of the elbows must be constructed using pre-cut sections, ready to be installed, (fig. 1).



- On the pipe, apply the single pre-cut elbow sections previously cut out of a sheet of K-FLEX ST, closing them together with 50 mm ALU AA 130 self-adhesive tape along all the joints, (figs. 2 - 3).



- Repeat the operation and proceed to apply all the elbow sections.  
NB: The elbow sections which have a straight side, the ones at the start and at the end, can be used in a specular way, (fig. 1).

- Continue to apply ALU AA 130 self-adhesive tape to close all the sections, as shown in figures 4- 5- 6- 7.

## MULTILAYER INSULATION, SPECIAL PARTS

### PREFORMED ELBOWS: FIRST LAYER



#### B) COMPENSATION JOINTS

- Insert a mineral fibre strip (see previous pages for indications on how to make mineral wool strips) between each section of the elbow.

NB: When this operation is complete, the elbow should resemble the photo in figs. 9 (detail) and 10 (complete elbow).



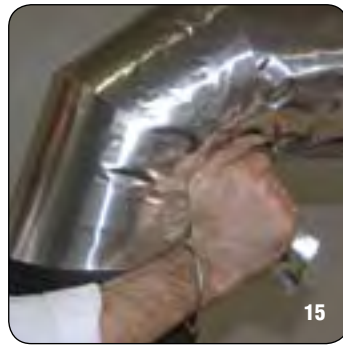
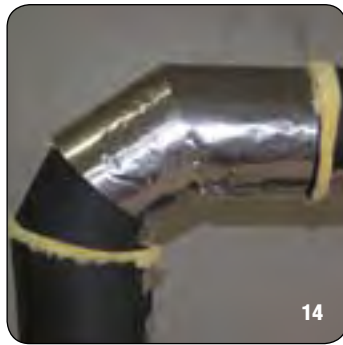
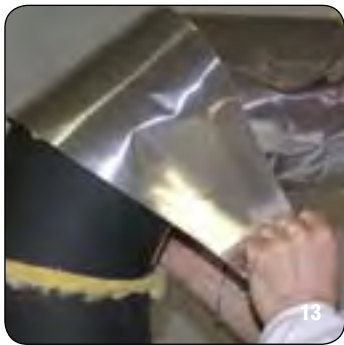
#### C) VAPOUR BARRIER

- On the insulated first layer, apply the prefabricated elbow sections in ALU 5 layer foil (fig. 11), taking care to overlap each segment over the previous one by at least 50 mm.

- Attach them securely, in order to obtain a tight fitting cover and close each section with ALU AA 130 self-adhesive tape, (fig. 12).

## MULTILAYER INSULATION, SPECIAL PARTS

### PREFORMED ELBOWS: FIRST LAYER



- Repeat the previously indicated operations for all the elbow sections, (figs. 20 and 21). Cover each overlap with 50 mm ALU AA 130 self-adhesive tape, (fig. 16).

## MULTILAYER INSULATION, SPECIAL PARTS

### ELBOWS AND "T" CONNECTIONS: FOLLOWING LAYERS

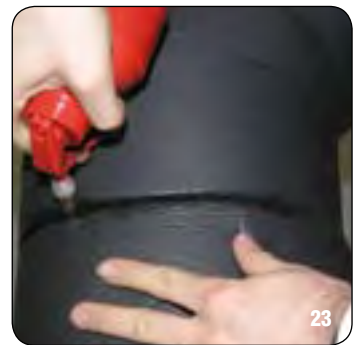
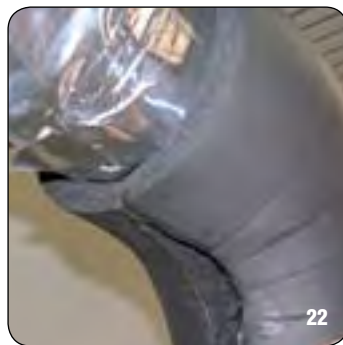
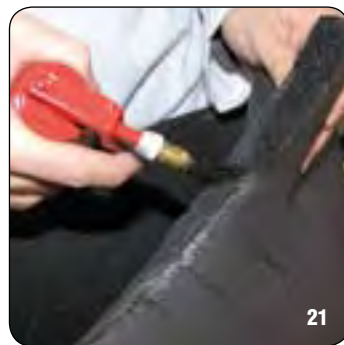


#### ELBOWS

With preformed elbows:

a) Cut the preformed elbow along the lower spine, (figs. 18 - 19).

b) Apply K-FLEX K 420 glue on the cut edges and wait until the glue is almost dry, (fig. 21).



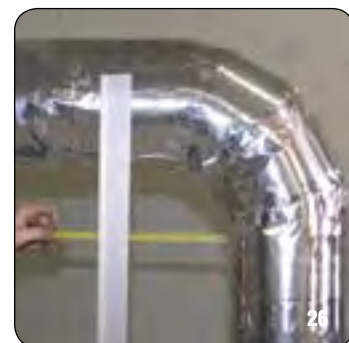
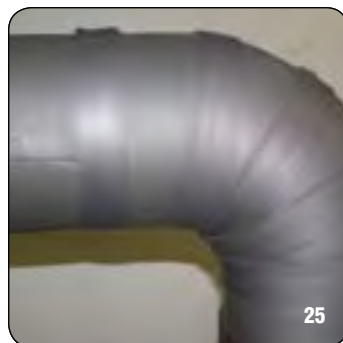
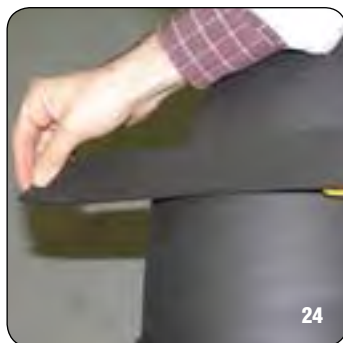
c) Mount the elbow onto the tube, (fig. 20).

d) Starting from the two extremities, glue the joints together. Make sure that both sides are well glued, also internally, (fig. 22).

e) Apply K-Flex K-420 glue on both the lateral edges and wait until the glue is almost dry, (fig. 23).

## MULTILAYER INSULATION, SPECIAL PARTS

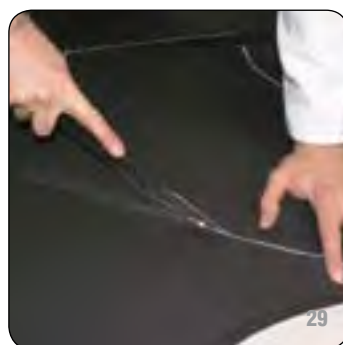
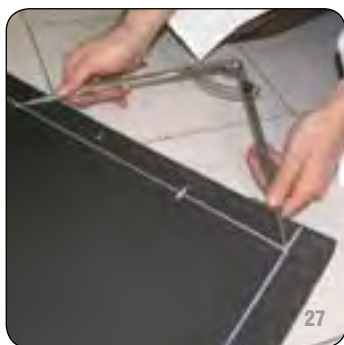
### ELBOWS AND "T" CONNECTIONS: FOLLOWING LAYERS



f) Next, apply 50 mm K-FLEX anticondensation tape over all the glued joints, (figs. 24 - 25).

#### Preparing the elbows on-site from sheets

- First of all, measure the internal radius of the curve using a ruler with another ruler lying perpendicular to it, as shown in figure 26.



- Using a compass, mark out the outline of the internal radius on the K-FLEX sheet, using the corner of the square marked out on the insulating material as the axis, (fig. 27).

- measure the exact circumference of the pipe using a strip of K-FLEX ST sheet of the correct thickness and divide the circumference by two, and mark the middle of the strip accordingly.

- Add the outer radius to the measurement of the inner radius and, using the same axis, mark out a semicircle onto the sheet with the compass, (fig. 28).

- Cut the sheet accurately along the arc of the circle, (fig. 29).

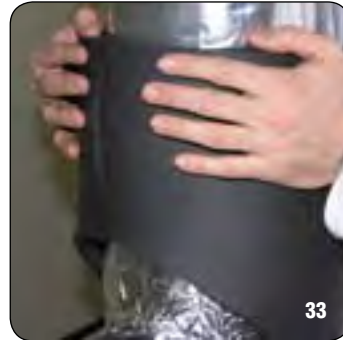
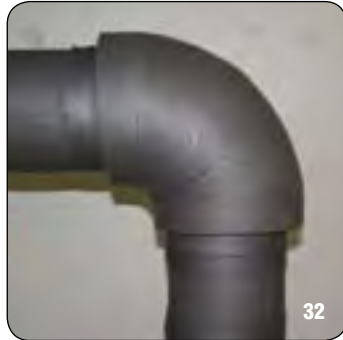
- Place the section obtained on the reverse side of another sheet and use it as a template to cut out a second, mirror image section, (fig. 30).

- Allow the glue to dry and stick the edges together, starting from the two extremities.

- Finally, install the elbow and follow the same procedures already indicated for preformed elbows, (figs. 23 - 24 - 25).

## MULTILAYER INSULATION, SPECIAL PARTS

### ELBOWS AND "T" CONNECTIONS: FOLLOWING LAYERS



#### INSTALLATION OF THE 3<sup>rd</sup> ELBOW LAYER

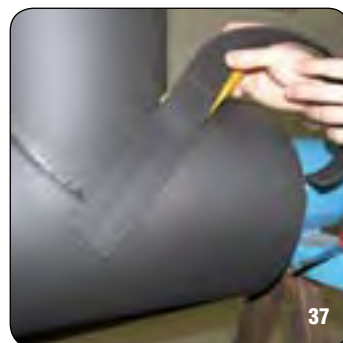
Proceed to install the third layer of the elbow as previously indicated for the second layer (both for preformed elbows and elbows cut out of sheets on -site).

NB: In the third layer do not use K-FLEX ST anticondensation tape. It is only necessary to:

- Install the elbow
- Glue the joints with K-FLEX K-420 adhesive, (figs. 31 - 32).

#### INSTALLATION OF THE SECOND "T" CONNECTION LAYER

- The installation of the second "T" connection layer must be carried out with the same procedure as previously indicated on pages 19 and 25, both for preformed "T" connections and for those made directly on-site from sheets.



- However, there are certain aspects to take into consideration:  
1. K-FLEX K-420 glue, which was not used on the first layer, must be used on all the joints of the "T" connection.

- Apply ST anticondensation tape over all the joints as indicated in figures 37 and 38.

At this point the "T" connection is ready to be covered with K-FLEX IN CLAD, or in the case of the three layer design, the third elastomeric layer can now be installed.

The procedure to follow for the third elastomeric layer is exactly the same as that indicated for the second layer except that ST anticondensation tape should not be applied.

## MULTILAYER INSULATION, SPECIAL PARTS

### ELBOWS AND “T” CONNECTIONS: FOLLOWING LAYERS

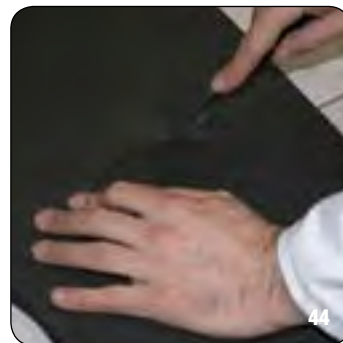


#### APPLICATION OF THE THIRD “T” CONNECTION LAYER

- As previously indicated, the application of the third layer differs from that of the previous one in as much as it is not necessary to apply ST anti-condensation tape on the joints. The photos from 39 to 41 show the “T” connection insulated with 3 layers.

## MULTILAYER INSULATION, SPECIAL PARTS

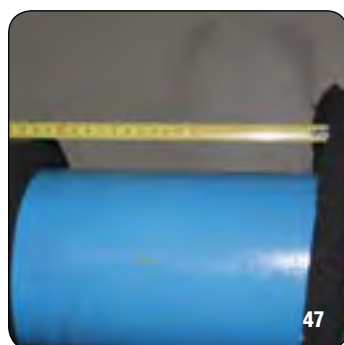
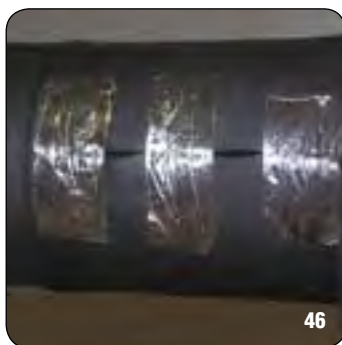
### FLANGES



#### INSTALLATION OF THE FIRST LAYER OF THE FLANGE COVER

- Measure the pipes' circumference. Use the measurements of the two diameters to calculate the respective inner and outer radii, (fig. 42).
  - After calculating the two radii, mark out the inner and outer circumferences of the rings on two separate squares of K-FLEX ST sheet.
  - Attaching a sharp blade to the tip of the compass allows the first incision to be made so that a knife can then be used to cut out the ring. However, a knife alone can give acceptable results, (fig. 43).
- Cut the rings out and make an opening on one side to attach them around the pipes, (fig. 44).

Use Alu AA 130 tape to secure the ring onto the flange, (fig. 45). Complete the insulation of the tubes on the left and right sides of the flange as indicated in the above figures, (figs 46 - 47).



- Repeat the same operation for the other side of the flange, (fig. 48).
- Apply a strip of mineral fibres between the rubber ring and the pipe as shown in figures 48 - 49.

- Measure the distance between the two rings, including the thickness of the insulating material, (fig. 49).



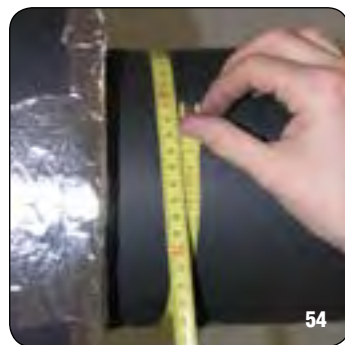
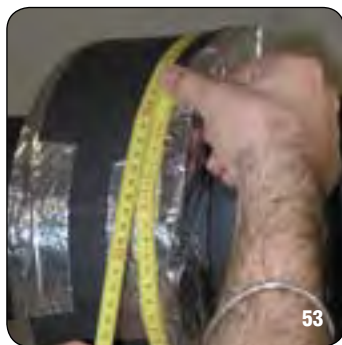
## MULTILAYER INSULATION, SPECIAL PARTS

### FLANGES



- Use a strip of K-FLEX ST sheet of the same thickness to measure the circumference of the insulating rings, (figs. 50 - 51).  
- Transfer the measurements onto a K-FLEX sheet to obtain the outline of the sleeve that will complete the flange's insulation.

- Mount it around the rings and tape together the edges, (fig. 51).  
- Fix it securely with Alu AA 130 tape as indicated in figure 52.

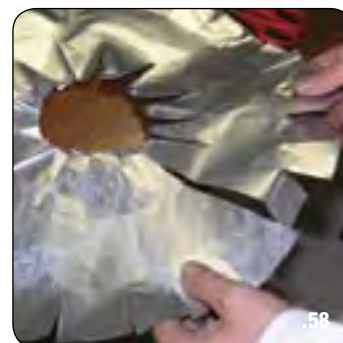
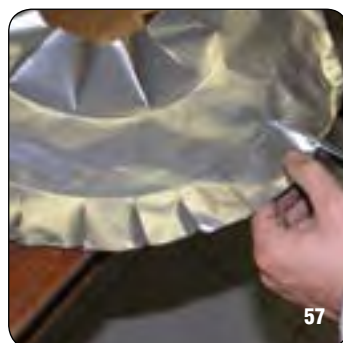
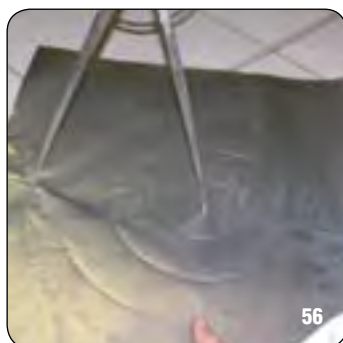
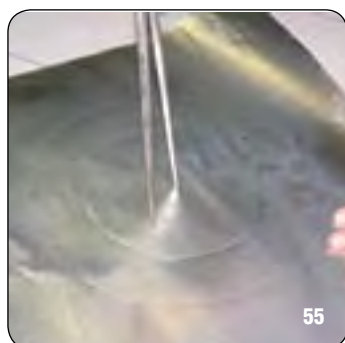


#### INSTALLING THE VAPOUR BARRIER

Measure the circumference of the insulated flange and the tube section, (figs. 53-54).

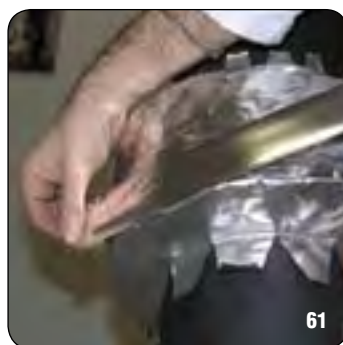
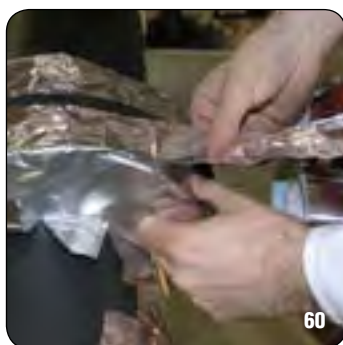
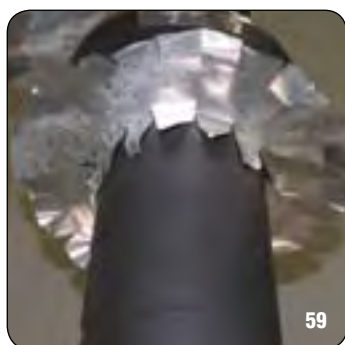
## MULTILAYER INSULATION, SPECIAL PARTS

### FLANGES



- Transfer the measurements onto a sheet of ALU 5 layer foil using a compass as shown in figure 55.
- With the compass, add 5 cm for the overlap and draw the circle, (fig. 56).

- Make perpendicular internal and external cuts with a pair of scissors, (fig. 57).
- Make a cut as indicated in figure 58 and apply the vapour barrier onto the flange as shown in figure 59.



- Repeat the same operation for the other side of the flange.
- Seal everything using Alu AA 130 tape, (fig. 60).

- Finish the vapour barrier with Alu AA 130 tape as indicated in figure 61.

## MULTILAYER INSULATION, SPECIAL PARTS

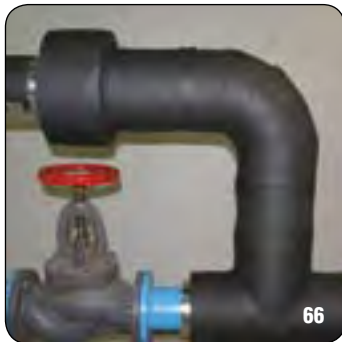
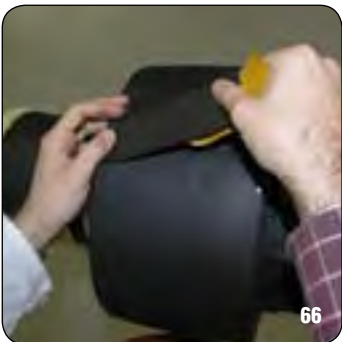
### FLANGES



#### SECOND FLANGE LAYER

- Repeat the operations previously carried out for the first layer to create the second layer of the flange cover, (fig. 62).
- Use K-FLEX K-420 glue to seal together the second layer of the flange cover, (figs. 63 - 64).

- Apply K-Flex ST anticondensation tape over all the joints, (figs. 65 - 66).



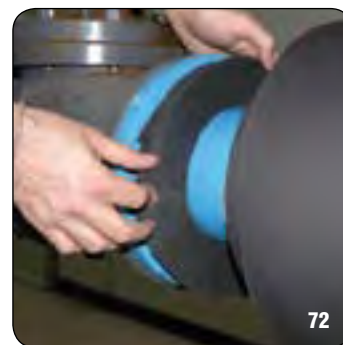
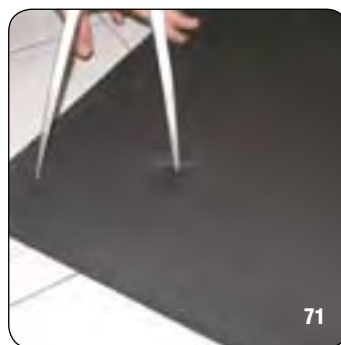
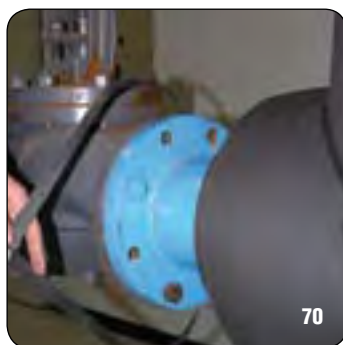
- Once the ST anticondensation tape has been applied, the insulation of the flange should appear as in figure 66.

#### INSULATION OF THE 3° FLANGE LAYER

To apply the third insulation layer on the flange, follow the same procedure indicated for the application of the second layer. However in this case it is not necessary to apply K-FLEX ST anticondensation tape. To seal the flange cover, as indicated for the second layer, use K-FLEX K-420 glue.

## MULTILAYER INSULATION, SPECIAL PARTS

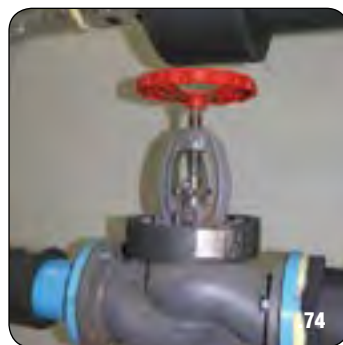
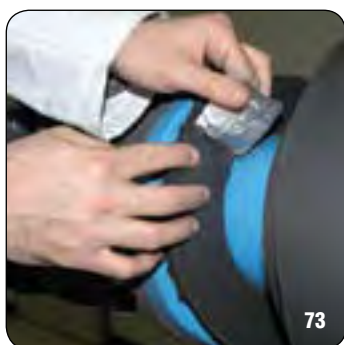
### INSULATION OF THE VALVE



#### INSULATION OF THE VALVES

- Measure the diameter of the pipes and the flanges. Use these measurements to calculate the relevant radii, (fig. 70).
- After calculating the radii, mark out the respective inner and outer circumferences on two separate squares of K-FLEX ST sheet of the same thickness, (fig. 71).

- Carefully cut out the rings.
- Make an opening so that they can be fitted over the pipes.
- Place a ring on the outside of the valve, (fig. 72).



- Fix the ring onto the valve with AA 130 tape as shown in figure 73
- Apply a strip of mineral fibre between the ring and the flange, (fig. 74).
- Apply a strip of K-FLEX ST sheet around the top part of the flange as indicated in figure 74 and fix it with ALU AA 130 tape.

- Next, calculate the shape of the disc for the top of the flange.
- Measure the circumference of the supporting flange and the form of the face plate around which the disc must fit. Mark out the measurements on a section of K-FLEX ST sheet and cut the disc out, (figs. 75 - 76 - 77).

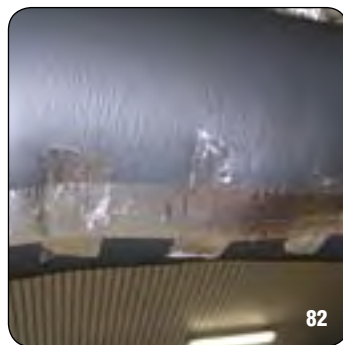
## MULTILAYER INSULATION, SPECIAL PARTS

### INSULATION OF THE VALVE



- Make an opening so that the disc can be fitted over the face plate, (fig. 77).
- Position the disc over the face plate.

- Draw the outline of the sleeve section measurements onto a sheet of K-FLEX ST sheet and draw a line down the middle.
- Measure the diameter of the stopcock housing.
- Divide the diameter by two to obtain the radius. Place the compass at the end of the sleeve's center line and draw a semicircle at each end, (fig. 80).



- If there are any imperfections along the cut edges, smooth them out so that they precisely bond together.
- Fix the valve's cover with Alu AA 130 tape, (fig.82).

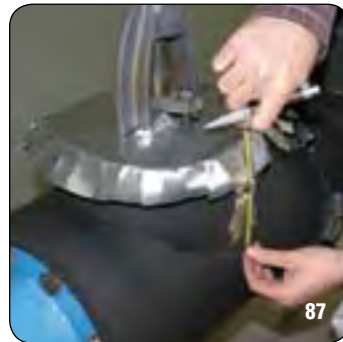
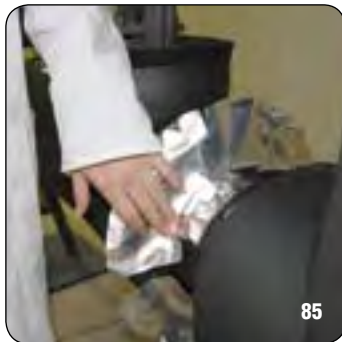
#### APPLYING THE VAPOUR BARRIER ONTO THE VALVE COVER FIRST LAYER

The insulation of the valve on the first layer should be completed with the vapour barrier made from ALU 5 layer foil. As already indicated in the previous sections for making the vapour barrier, proceed as follows:

- measure the internal and external diameters of the sides of the valve, (fig. 83).
- transfer these measurements onto a sheet of ALU 5 layer foil (see figures 55 to 58 on page 34) and cut out the covers in aluminium as shown in figure 84.

## MULTILAYER INSULATION, SPECIAL PARTS

### INSULATION OF THE VALVE



- Position the previously prepared rings onto the left and right side and also onto the cover of the valve, (figs. 85 - 86).

- take the measurement as indicated in figure 87 in order to prepare the second section of the vapour barrier.  
- transfer the measurements onto a sheet of ALU 5 layer foil and cut out the shape using a pair of scissors.

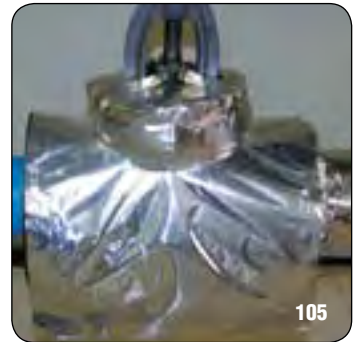
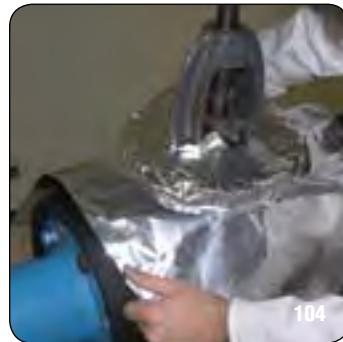
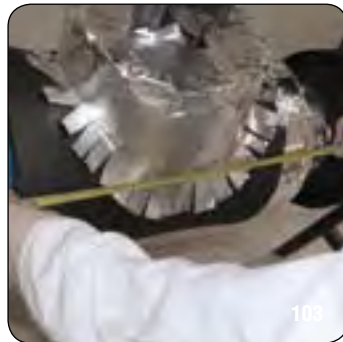
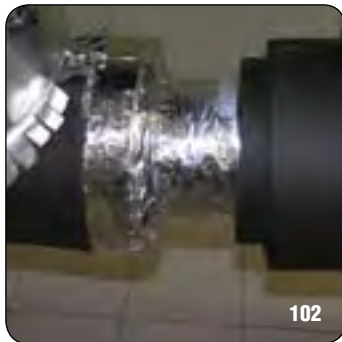


- Once this section of the vapour barrier has been cut out, it should have the same shape as shown in figure 99.  
- Finally proceed to install this section onto the valve as shown in figure 100.

- Fix this section of the vapour barrier onto the valve with ALU AA 130 tape, (figs. 100 - 101).

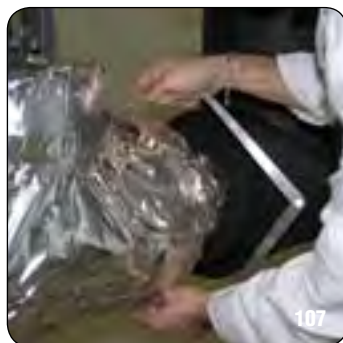
## MULTILAYER INSULATION, SPECIAL PARTS

### INSULATION OF THE VALVE



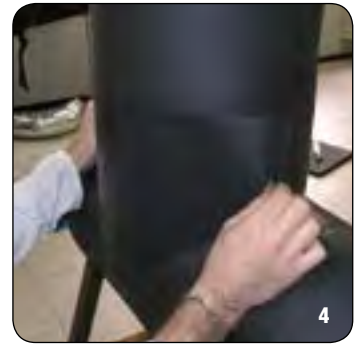
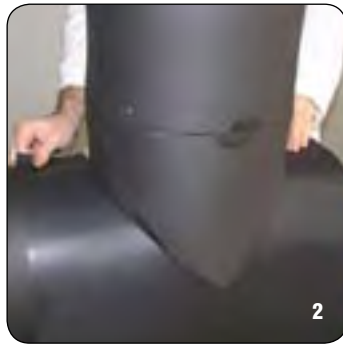
- Proceed to insulate the right and left tube sections of the valve with the vapour barrier (already insulated with the first layer of K-FLEX ST).
- Measure the valve section which still needs to be covered with the vapour barrier, (fig. 103).

- From a sheet of ALU 5 layer foil, cut out this section of the vapour barrier and position it onto the valve, (figs. 104 - 105).
- Fix everything together with ALU AA 130 tape, (fig. 106).



## MULTILAYER INSULATION, SPECIAL PARTS

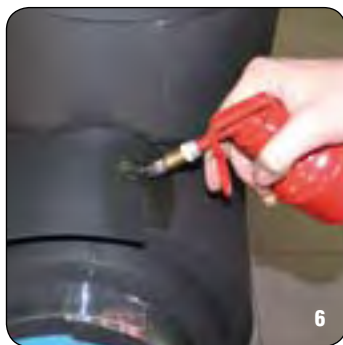
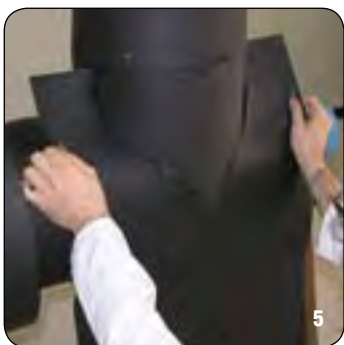
### FIXING THE K-FLEX IN CLAD COVERING ONTO THE "T" CONNECTION



#### FIXING THE K-FLEX IN CLAD COVERING ONTO THE "T" CONNECTION

- a) Thoroughly degrease each section of the prefabricated K-FLEX IN CLAD "T" connection with the correct thinners.
- b) The "T" connections are made in three pieces which should be directly applied onto the elastomeric sections. First install the main section of the "T" connection followed by the coupling sections.

- c) Apply K-FLEX K 420 glue, as shown in figures 20 onwards, both to the elastomeric material and the K-FLEX IN CLAD covering.



- d) Once the K-FLEX IN CLAD covering is positioned onto the insulation, carefully seal all the overlaps with K-FLEX K 420 glue, (fig. 6).

- e) Finally, press the overlaps down with force to make sure that both surfaces firmly adhere together, (fig. 8).



## MULTILAYER INSULATION, SPECIAL PARTS

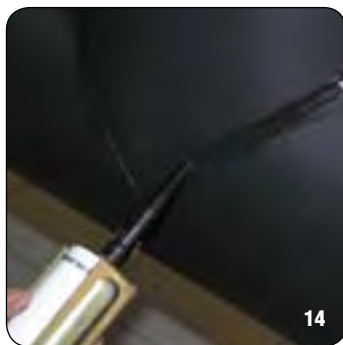
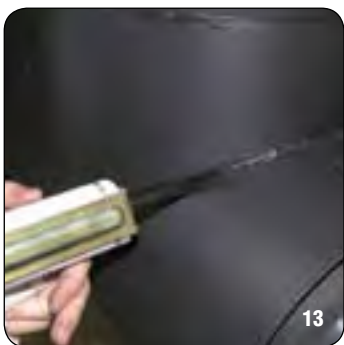
### FIXING THE K-FLEX IN CLAD COVERING ONTO THE "T" CONNECTION



f) Proceed to apply the K-FLEX IN CLAD covering onto the coupling, repeating the same procedure as before, (figs. 9 and 10).

g) Finally, spread glue over all the joints, (fig. 11).

e) The "T" connection is now ready to be sealed with marine sealant, (fig. 12).



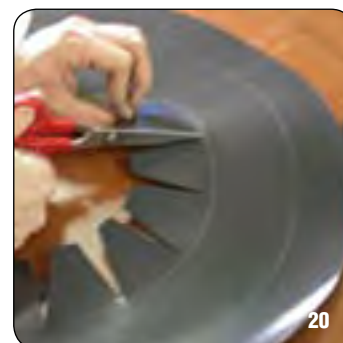
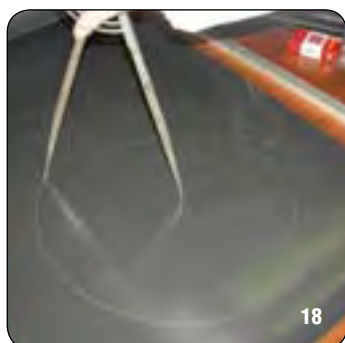
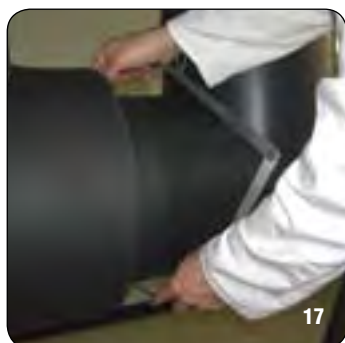
#### APPLYING MARINE SEALANT:

a) Apply a 10 mm layer of marine sealant on both sides of all the joints  
b) Proceed carefully as indicated in figures 13 - 14.

c) Marine sealant should be applied to all joints as can be seen in figure 16.

## MULTILAYER INSULATION, SPECIAL PARTS

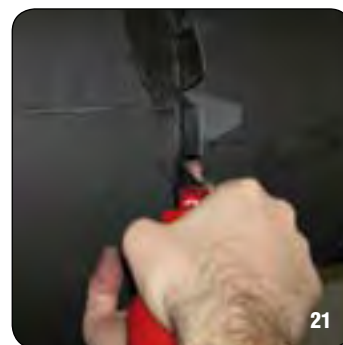
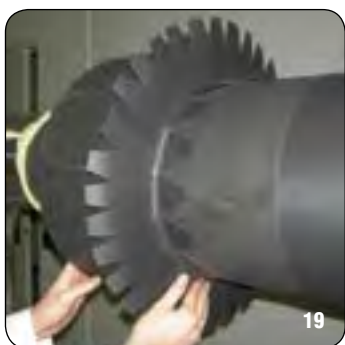
### FIXING THE K-FLEX IN CLAD COVERING ON THE FLANGE



#### APPLYING THE K-FLEX IN CLAD COVERING ONTO THE FLANGE

a) measure the internal and external diameters of the flange, (fig. 17).  
 b) using a compass, mark out the internal and external measurements onto a sheet of K-FLEX IN CLAD. Add an excess of 5 cm to the external diameter and trace a third circle, (fig. 18).

c) using a sharp knife, cut around the furthest circle to obtain the disc.

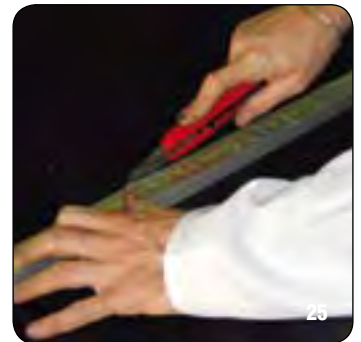
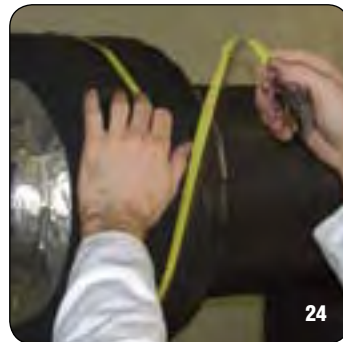
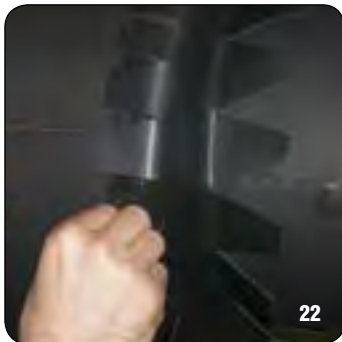


d) Make external and internal fringes on the disk as indicated in figures 19 and 20  
 e) The disk is now ready to be mounted onto the flange, (fig. 18).  
 f) Repeat the same operation to cover the other side of the flange.  
 g) Make an opening cut on the disk and slot it onto the flange, (fig.19).

h) Use K-FLEX K-420 glue to fix the disk onto the flange, (figs. 20 - 21).

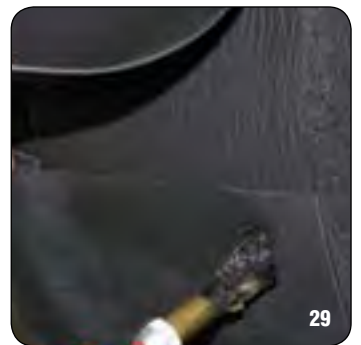
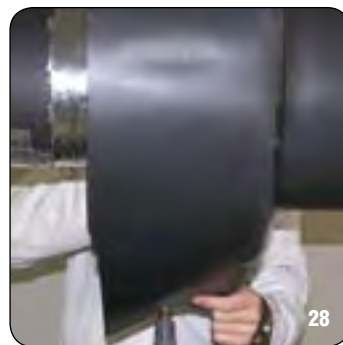
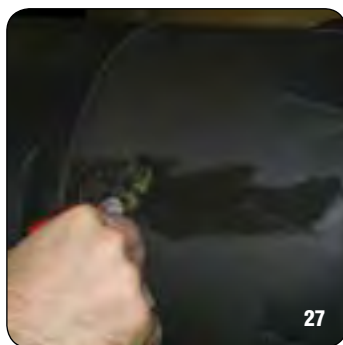
## MULTILAYER INSULATION, SPECIAL PARTS

### FIXING THE K-FLEX IN CLAD COVERING ON THE FLANGE



i) tightly close the fringes of the disc, which have already been glued with K-FLEX K-420, in order to obtain a perfect grip.  
j) When installed, the disk should appear as in figure 23.

k) Proceed by measuring the central section of the flange, (fig. 24).  
l) Transfer the measurements onto a sheet of K-FLEX IN CLAD and cut out the required section, (fig. 25).

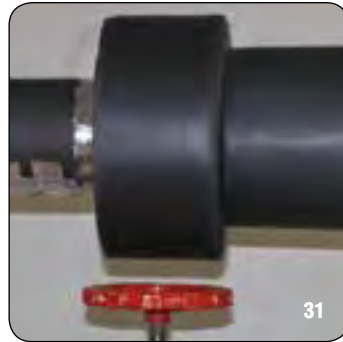


m) spread K-FLEX K-420 glue on the elastomeric material and wait until it is almost dry.

n) Place the previously prepared strip of K-FLEX IN CLAD onto the flange.  
o) To correctly attach the K-FLEX IN CLAD sheet, use K-FLEX K-420 glue and allow it to almost dry before sealing down both edges .

## MULTILAYER INSULATION, SPECIAL PARTS

### FIXING THE K-FLEX IN CLAD COVERING ON THE FLANGE

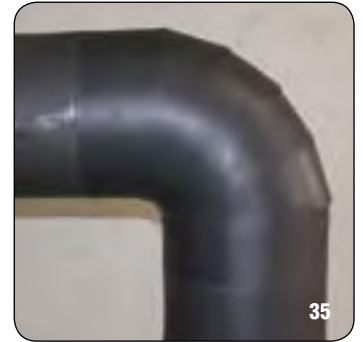
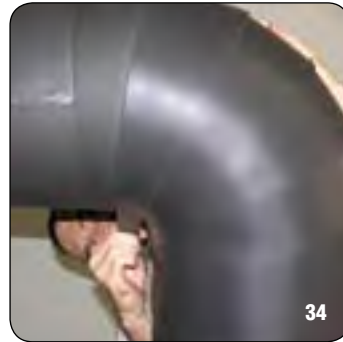
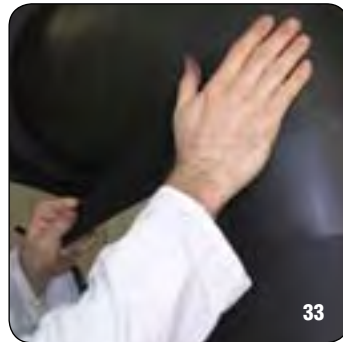
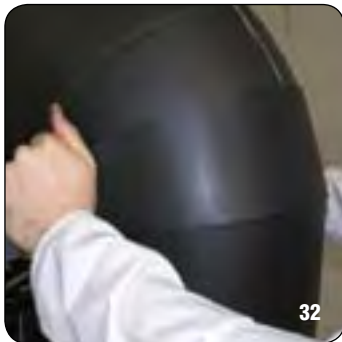


#### APPLYING MARINE SEALANT:

- a) Spread a 10 mm layer of marine sealant over both sides of all joints.
- b) Proceed carefully as indicated in figures 38 - 40 of the following page.

## MULTILAYER INSULATION, SPECIAL PARTS

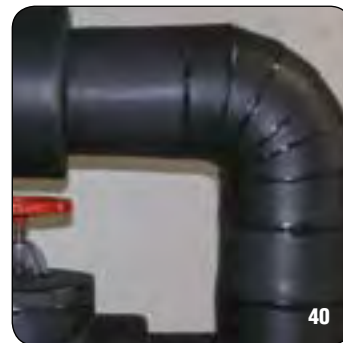
### FIXING THE K-FLEX IN CLAD COVERING ON THE ELBOWS



#### APPLYING K-FLEX IN CLAD COVERING ONTO THE ELBOWS

- a) Apply the preformed K-FLEX IN CLAD elbow segments onto the elbow by sealing them onto the elastomeric material with K-FLEX K- 420 glue.
- b) After applying the K-FLEX K-420 glue, wait until it is almost dry before fixing the segments onto the elbow.

- c) The elbow segments should be fixed onto the throat with (figs.33 and 34) K-FLEX K-420 glue.

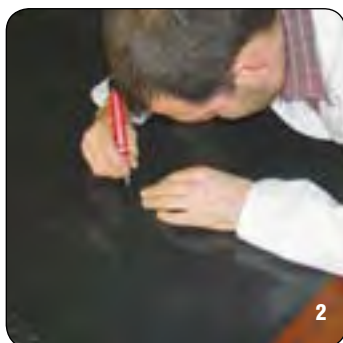


#### APPLYING:

- a) Spread a 10 mm layer of marine sealant over both sides of all joints.
- b) Proceed carefully as indicated in figures 38 - 40.

## MULTILAYER INSULATION, SPECIAL PARTS

### FIXING THE K-FLEX IN CLAD COVERING ON THE VALVE

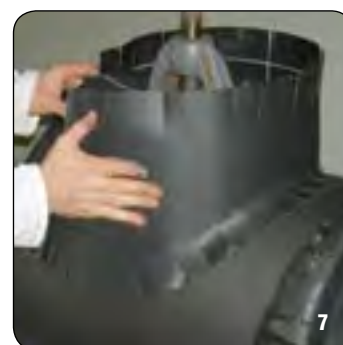
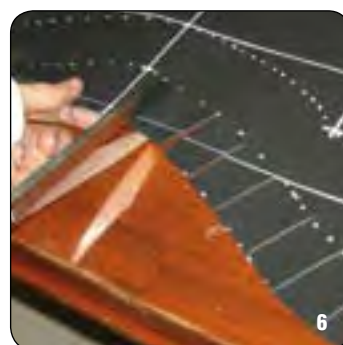


#### IN-CLAD COVERING: VALVES

To fix the K-FLEX IN CLAD covering on valves, proceed as follows:

- a) Measure the distance between the disc and the existing lagging at its nearest and furthest point, (fig. 1).
- b) Mark the two different measurements on the dividing lines of the tracing, as illustrated, then draw the intersecting lines from one extremity of the shape to the other, (fig. 2).

- c) Using the difference in the two lengths as a radius, draw circles around the ends of the lines. Using the arcs of the circles, draw a continuous line linking them up, as illustrated in figure 3.

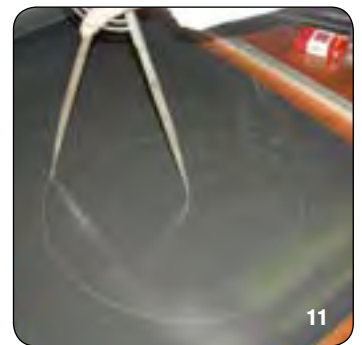


- d) Add a third line which will be used as a guide to make the fringes, (fig. 5).

- e) Proceed by making longitudinal cuts as shown in figure 6.
- f) Apply the K-FLEX IN CLAD covering as shown in figures 7 and 8.

## MULTILAYER INSULATION, SPECIAL PARTS

### FIXING THE K-FLEX IN CLAD COVERING ON THE VALVE



g) Use K-FLEX K-420 glue to fix the K-FLEX IN CLAD covering onto the insulation.

h) Apply the glue onto both the K-FLEX IN CLAD covering and the insulation with a brush, (fig. 9).

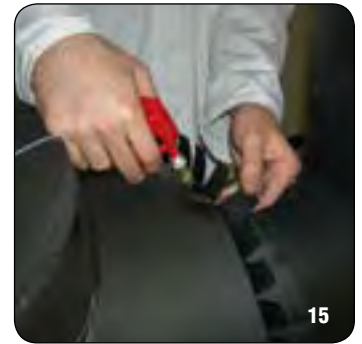
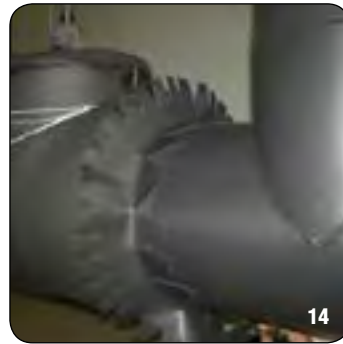
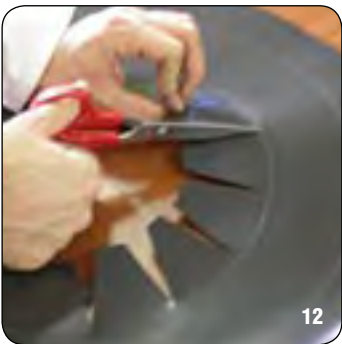
NB: Wait until the glue is almost dry before proceeding with the installation.

i) Using pressure, firmly seal down all the previously prepared fringes.

#### PREPARING K-FLEX THE IN CLAD SIDE DISKS OF THE VALVE

a) Measure the internal and external diameters of the valve

b) using a compass, mark out the measurements of both the internal and external diameters onto a sheet of K-FLEX IN CLAD. Add 5 cm to the to the external diameter and trace a third circle which will be used for the overlap, (fig. 11).



c) using a sharp knife, cut out around the external circumference to obtain the disk.

d) Make internal and external fringes in the disk as indicated in figures 12 and 13.

e) The disk is now ready to be mounted onto the valve, (fig. 14).

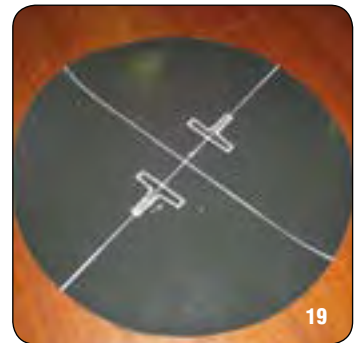
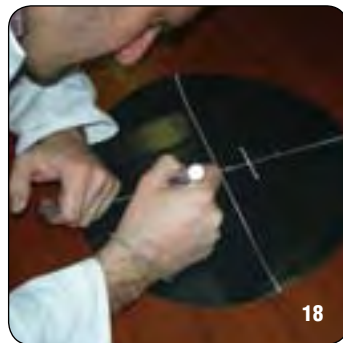
f) Repeat the operation to cover the other side of the valve.

g) Make an opening cut in the disk and slot it onto the valve.

h) Use K-FLEX K-420 glue to seal the disk onto the valve, (fig. 15).

## MULTILAYER INSULATION, SPECIAL PARTS

### FIXING THE K-FLEX IN CLAD COVERING ON THE VALVE



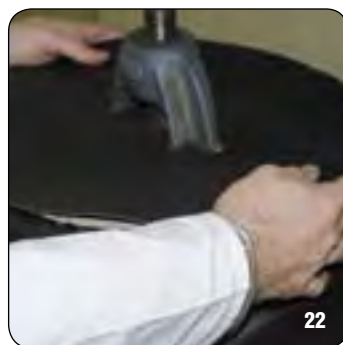
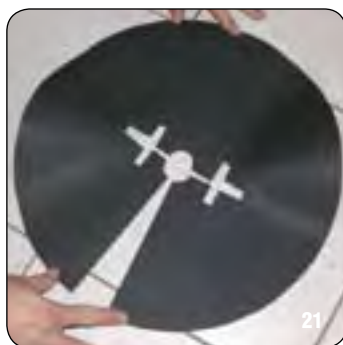
i) Using pressure, fix down the disk fringes, previously spread with K-FLEX K-420 glue, in order to obtain a perfect mechanical grip.  
j) When the disk is installed, it should appear as in figure 16.

d) On the previously prepared K-FLEX IN CLAD disk, carefully draw out the protruding parts of the valve's cover, (figs. 18 - 19).

#### K-FLEX IN CLAD VALVE COVER

Now proceed to make the valve cover with K-FLEX IN CLAD.

- a) with a compass, take the measurements of the valve's diameter
- b) transfer the measurements onto a sheet of K-FLEX IN CLAD.
- c) cut the disc as shown in figure 17.



e) With a sharp knife cut out the shapes and make an opening cut, (figs. 20 - 21).

f) proceed to install the disk, sealing it onto the valve with K-FLEX K-420 glue.



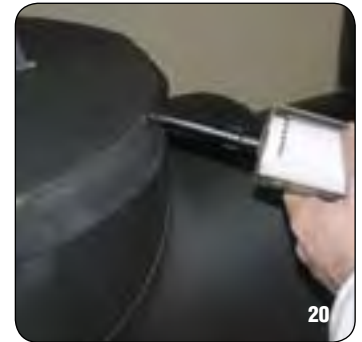
## MULTILAYER INSULATION, SPECIAL PARTS

### FIXING THE K-FLEX IN CLAD COVERING ON THE VALVE



g) proceed by spreading K-FLEX K 420 glue over all the valve's K-FLEX IN CLAD joints, (figs. 24 - 25 - 26).

h) Prepare a strip of K-FLEX IN CLAD sheet to apply around the valve's circumference as illustrated in figure 27.



i) Using K-FLEX K-420 glue, seal the K-FLEX IN CLAD strip onto the valve.

#### APPLYING MARINE SEALANT

- a) Spread a 10 mm layer of marine sealant over both sides of all joints.
- b) Proceed carefully as indicated in figure 20.

## SPECIAL PREFORMED MULTILAYER SECTIONS

INSTALLING ELBOWS, "T" CONNECTIONS, FLANGES AND VALVES





**PREFORMED "T" CONNECTION**



**PREFORMED ELBOW**

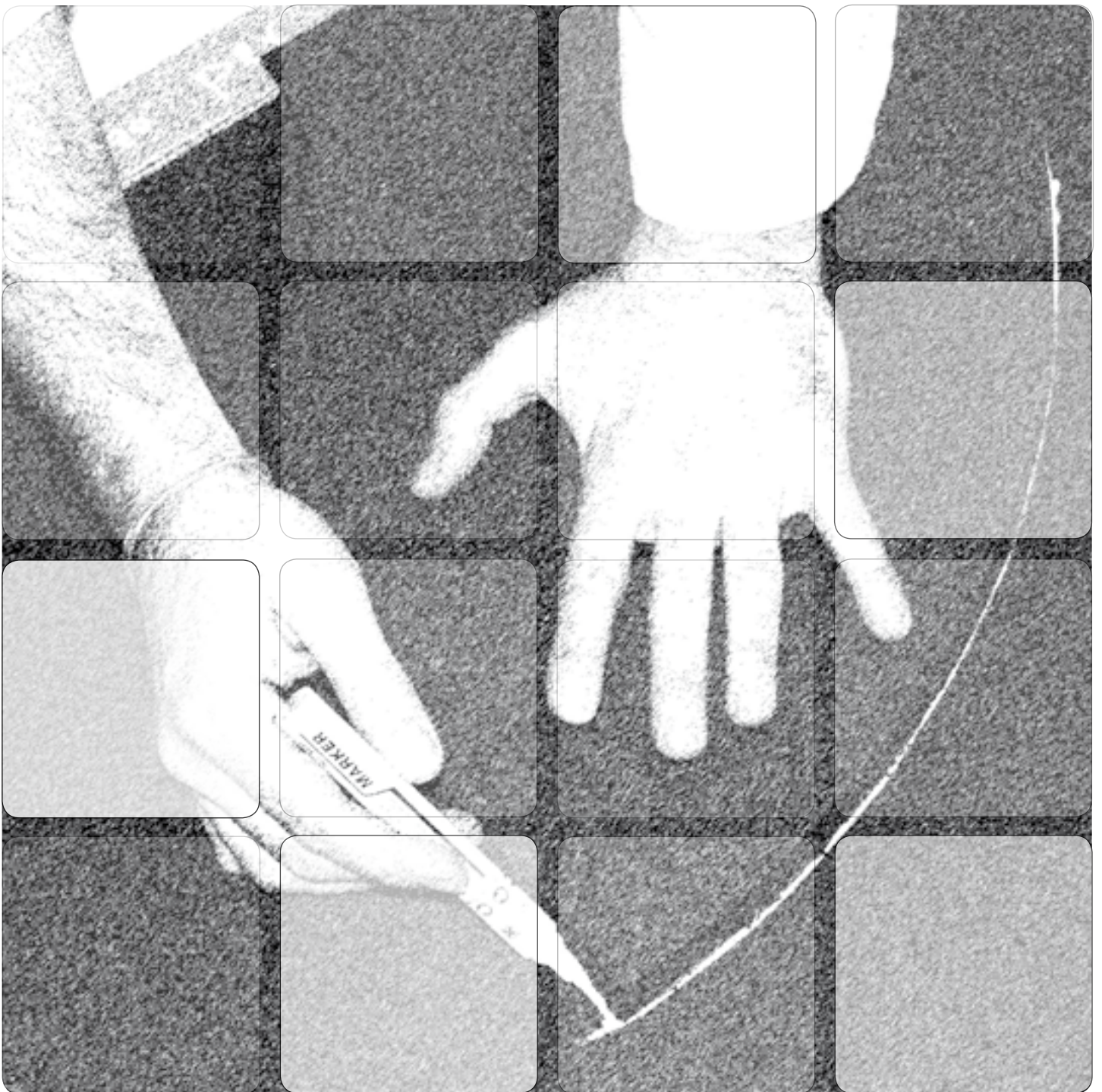


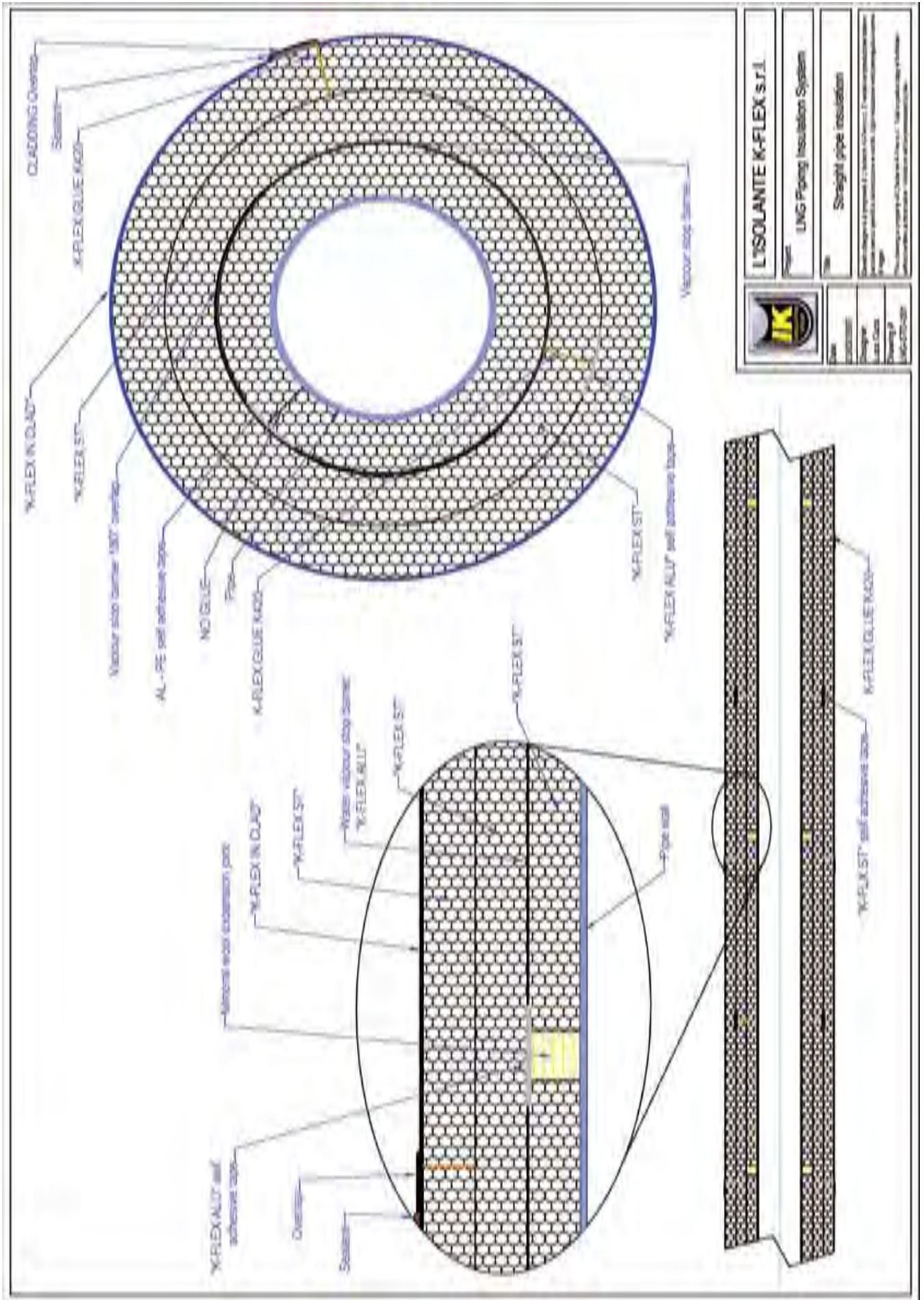
**PREFORMED FLANGE**

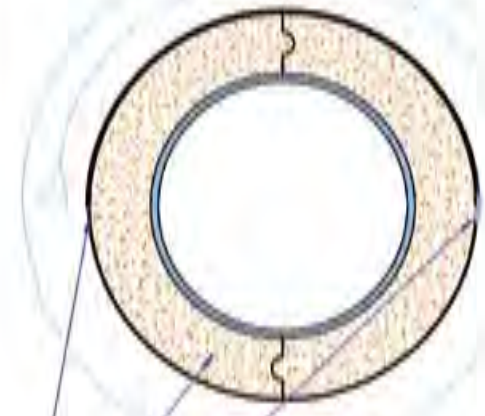
**THE SPECIAL MULTILAYER PREFORMED SECTIONS MUST BE INSTALLED IN THE FOLLOWING WAY**

- 1) Open the sections**
- 2) Install the first layer**
- 3) Install the vapour barrier**
- 4) Install the second layer using ST self-adhesive anticondensation tape**
- 5) Install the third layer**
- 6) Install the K-FLEX IN CLAD covering**
- 7) Apply marine sealant over all the joints**

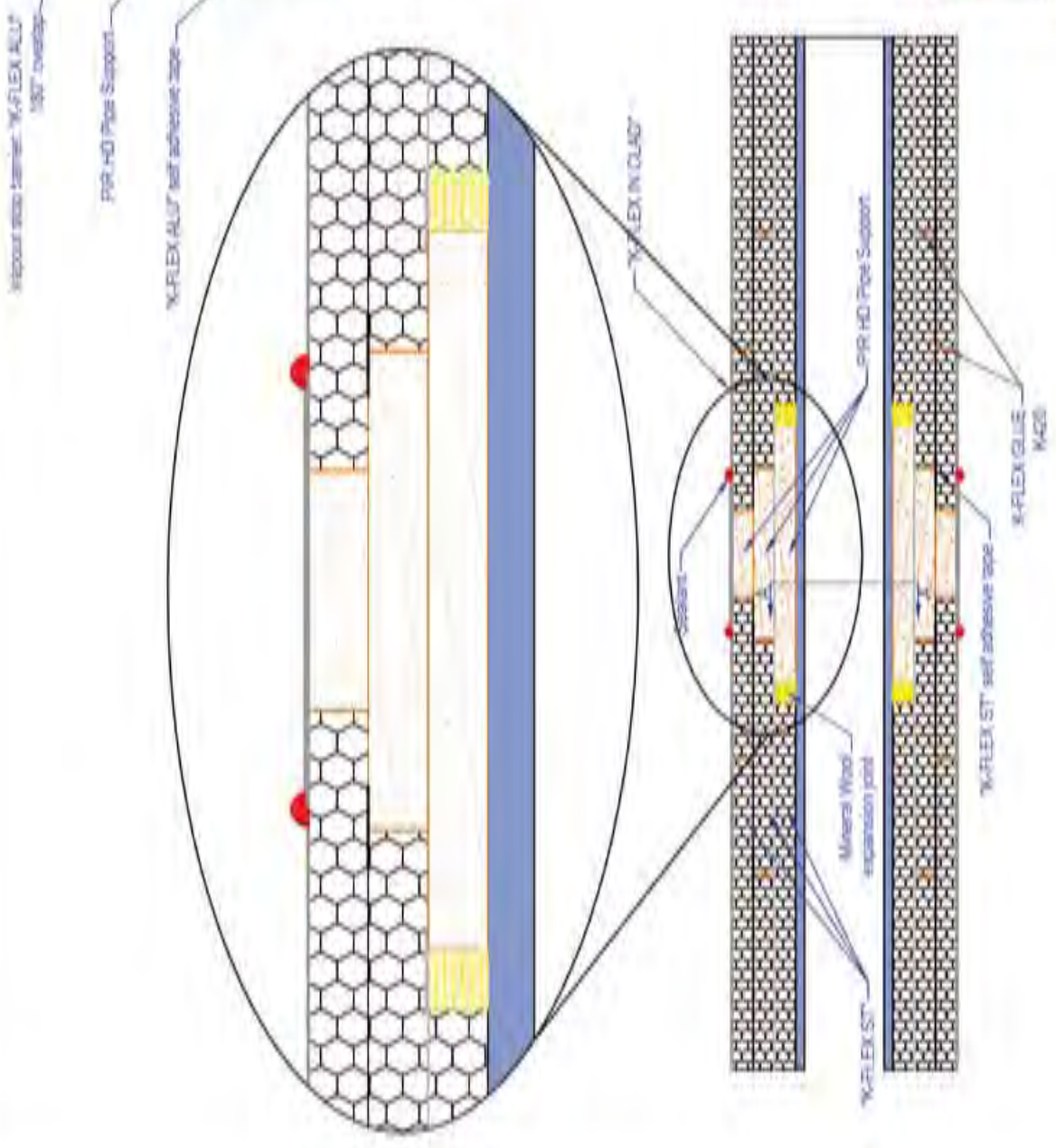
# LIST OF DRAWINGS



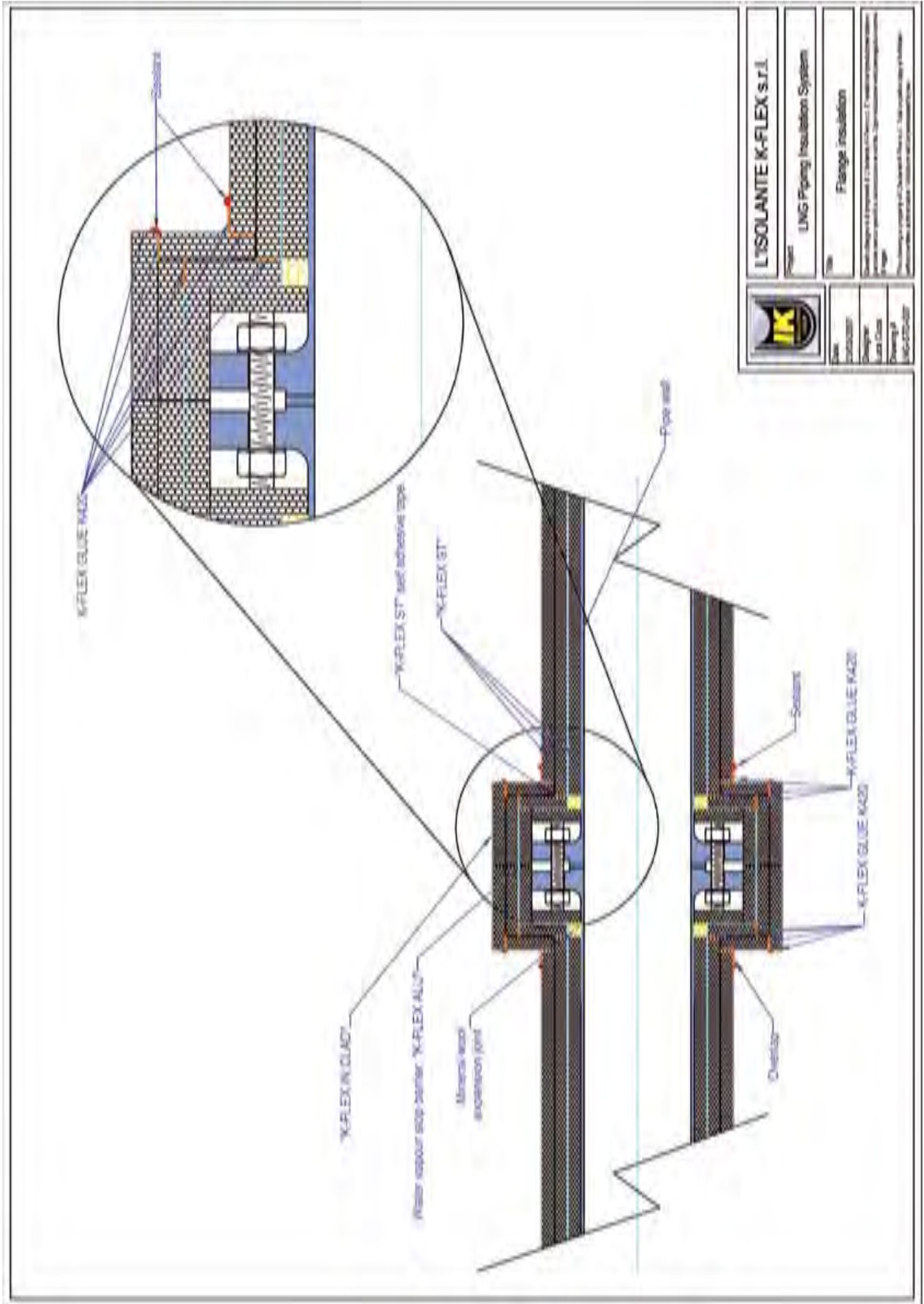


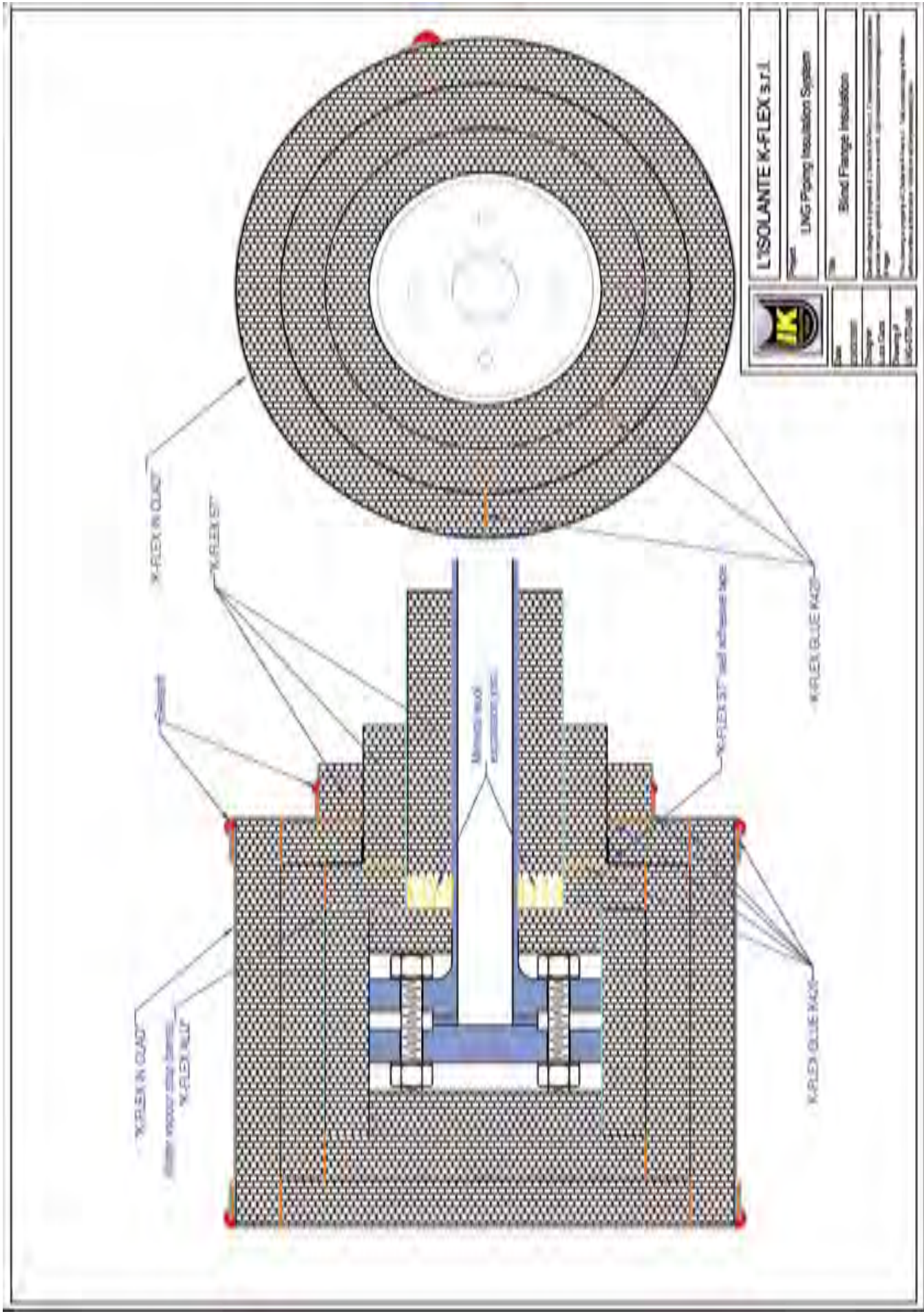


**SECTION A-A FIRST LAYER DETAIL**

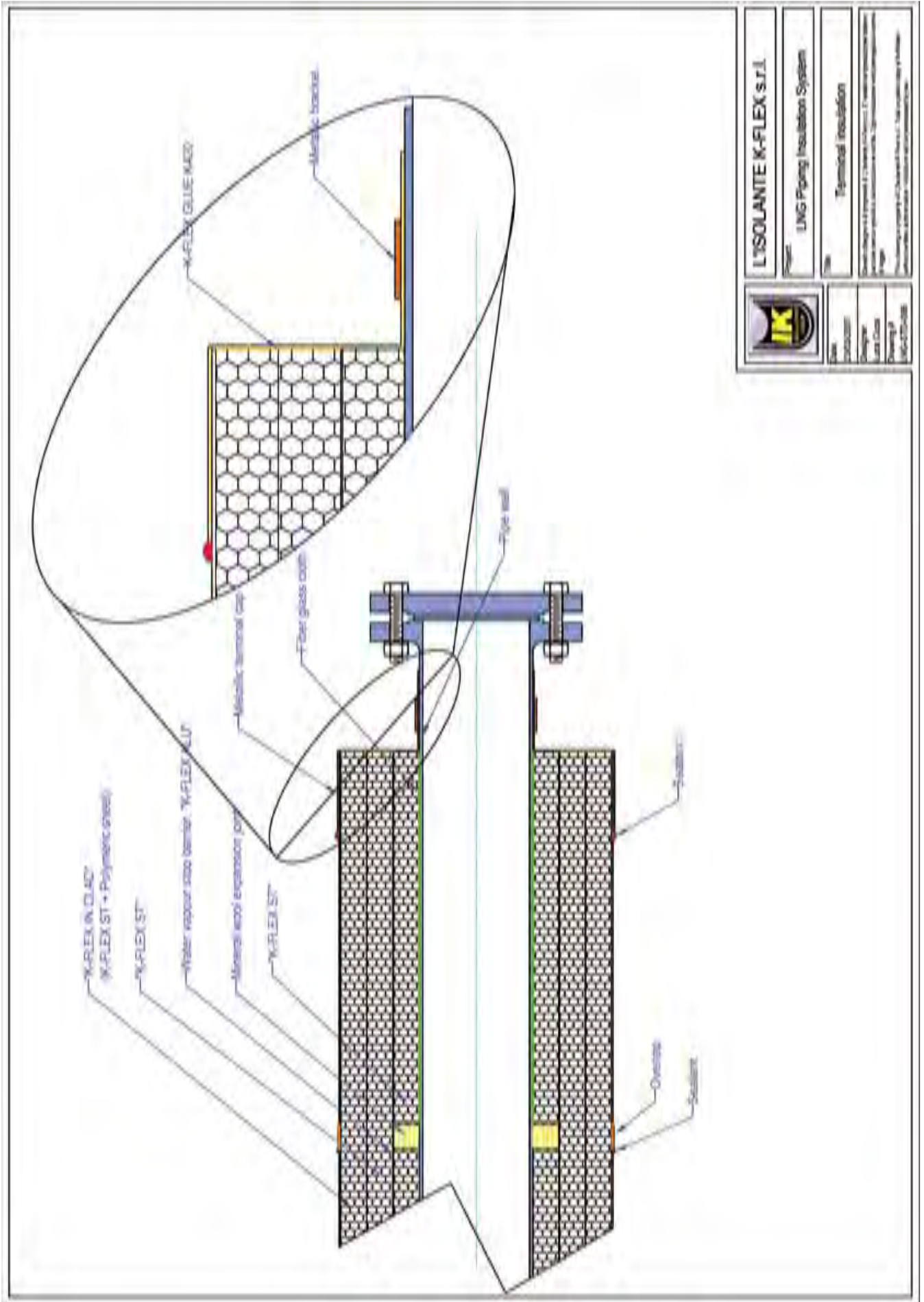


<b>L'ISOLANTE K-FLEX s.r.l.</b>	
Product	LNG Piping Insulation System
Material	PFR PIPE SUPPORT
Standard	EN 15925-1
Manufacturer	L'ISOLANTE K-FLEX s.r.l. - Via Industriale 1 - 20139 Milano (MI) - Italy







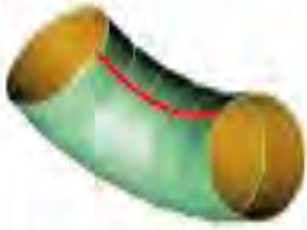


L'ISOLANTE K-FLEX s.r.l.

LNG Piping Insulation System

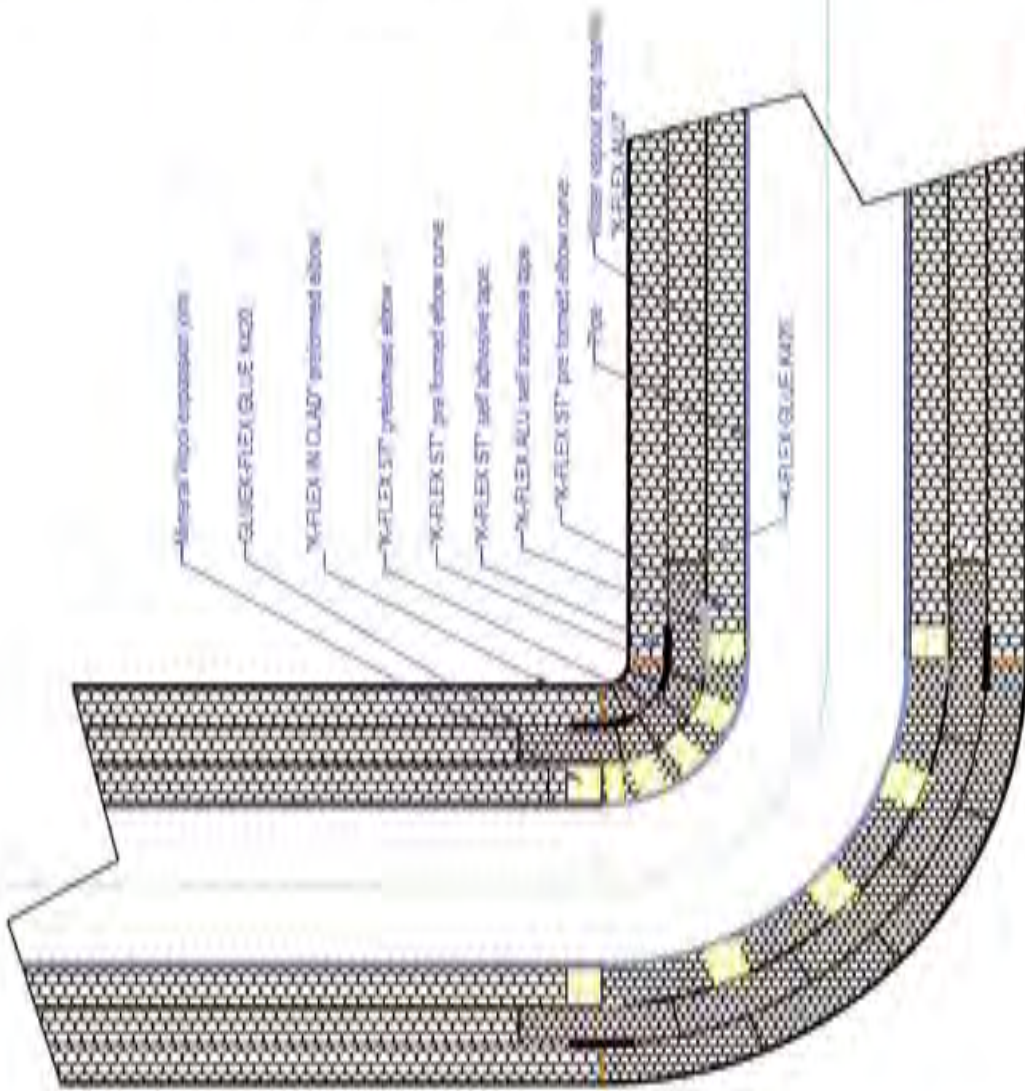
Terminal insulation

Code: 1000000000  
 Design: 1000000000  
 Last Date: 1000000000  
 Drawing P: 1000000000  
 Rev: 1000000000



Pre formed curve is supplied glued. Cut along red lines for mounting, then Glue it again

Pre formed insulation for elbow curve pipe assembling



L'ISOLANTE K-FLEX s.r.l.

LNG Piping Insulation System

Elbow insulation

Technical drawing of the elbow insulation system, showing the assembly of the pre-formed insulation on a pipe elbow. The drawing includes a 3D perspective view and a cross-sectional view. The cross-section shows the pipe, the pre-formed insulation (K-FLEX ST), the self-adhesive tapes (K-FLEX ALU and K-FLEX ST), and the final assembly with the K-FLEX GLUE K-FLEX. The drawing is labeled with 'IK' and 'L'ISOLANTE K-FLEX s.r.l.'.

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Technical drawing of the elbow insulation system, showing the assembly of the pre-formed insulation on a pipe elbow. The drawing includes a 3D perspective view and a cross-sectional view. The cross-section shows the pipe, the pre-formed insulation (K-FLEX ST), the self-adhesive tapes (K-FLEX ALU and K-FLEX ST), and the final assembly with the K-FLEX GLUE K-FLEX. The drawing is labeled with 'IK' and 'L'ISOLANTE K-FLEX s.r.l.'.

