SPIRO

Pre-insulated Pipes

ZPU MIEDZYRZECZ Sp. z o.o. System

EXECUTION OF INSULATION AND HERMETIZATION OF COUPLING UNIT [MANUAL]

Zakład Produkcyjno Usługowy
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Revision: June 2015

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1. INTRODUCTION.

This manual contains a description of execution of:

- Thermal insulation and hermetization of the coupling unit,
  Coupling cover – muff made of galvanized steel sheet, sealed with heat-shrink tape or heat-shrink band.
- Pre-insulated pipeline thermal insulation ends,
- Pre-insulated pipeline ends

2. GENERAL TERMS AND CONDITIONS OF EXECUTION OF THERMAL INSULATION AND HERMETIZATION.

1. Execution of thermal insulation and hermetization may only begin following:
   - Pipeline tightness test, as satisfactory,
   - Inspection and acceptance of welded couplings,
   - Execution of wire connections and technical testing, according to the "Connection of Signalling Cables" Manual, in case of a built-in pipeline leak detection system.
2. It is recommended that the thermal insulation and hermetization should be executed in favourable weather conditions: in dry, sunny weather and at the ambient temperature of over +5^{o}C. In case it is necessary to execute hermetization in high humidity (rainfall), respective activities should be performed under a portable shelter, e.g. a tarp tent.
3. Thermal insulation and hermetization may be executed by a trained employee, holder of a certificate authorizing the same to perform the abovementioned activities, as issued by ZPU Międzyrzecz Sp. z o.o.
4. The temperature of the surface of the service and casing pipes during execution of thermal insulation should be 30^{o}C ÷ 35^{o}C.
5. The polyurethane foam at the ends of the pre-insulated pipes should be dry, whereas the portion of the foam at the front of the insulation should be removed 3-5 mm in depth.
6. The service pipe in the coupling unit must be cleaned to remove impurities, dust, etc.
7. The surface of the casing pipe up to 25 cm from the end of the pipe must be cleaned and dried.
8. The coupling cover – a muff made of galvanized steel sheet and heat-shrink bands – must be put on the pre-insulated pipe, prior to welding the steel service pipe. It must be observed in particular that the ridge of the overlap situated on the muff made of galvanized steel sheet be directed downwards – as shown on the photos below. Such a location will prevent accumulation of rainfall in the overlap and penetration of moisture into the muff.

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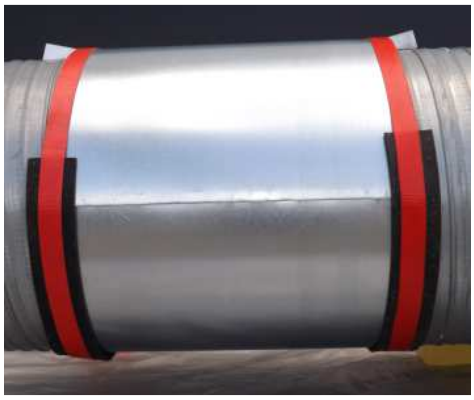

3. STORAGE AND WAREHOUSING.

1. All materials used for execution of the thermal insulation and hermetization of the coupling unit shall be stored in locked rooms.

2. The components A and B of the PUR foam, portioned in plastic bottles separately for each coupling, should be stored at a temperature over +20ºC and not exceeding +30ºC.

4. EXECUTION OF THERMAL INSULATION AND HERMETIZATION OF COUPLING UNIT.

COUPLING COVER – MUFF MADE OF GALVANIZED STEEL SHEET, SEALED WITH HEAT SHRINK TAPE OR HEAT SHRINK BAND.

4.1 Basic tools and materials.

1. The basic tools needed for execution of thermal insulation and hermetization of couplings on pre-insulated pipelines:
- Knife,
- Section of 40 * 4 band-iron, 20 cm in length,
- Metal-cutting saw,
- LPG blow torch,
- Wire brush,
- Hand scraper,

2. For execution of the insulation and hermetization of the coupling unit, the thermal insulation END and pipeline end, materials should be used which are included in the SPIRO ZPU MIEDZYRZECZ Sp. z o.o. Pre-Insulated Pipe Catalogue, marked as NS NKS, respectively:
- Muff or terminal muff,
- Components A and B of polyurethane foam,
- Heat-shrink tape and sealing tape or heat-shrink band,

and, in addition:

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- Felt cloth,
- Carbon tetrachloride or acetone.

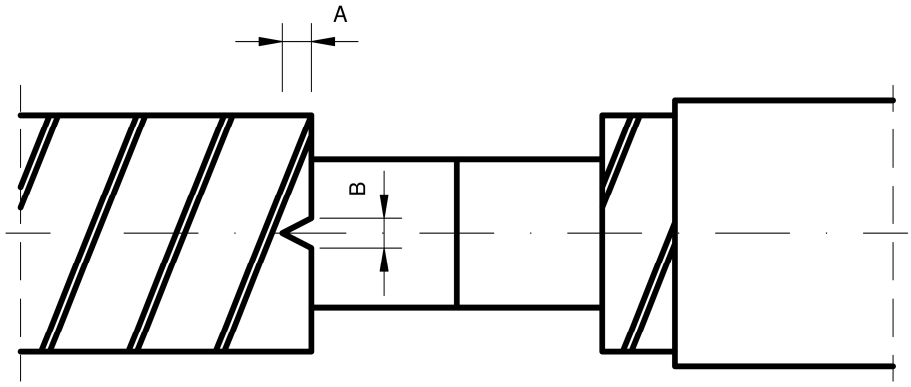
4.2 Preparatory and auxiliary activities.

1. Execution of thermal insulation starts with removing, using a knife or a scraper, a part of the PUR foam insulation 3-5 mm in depth, from the front of the pre-insulated elements.
   If the pre-insulated elements have built-in signalling cables, then this activity should be performed before these wires are connected.

2. If a test of welded connections – with respect to weld defects – has been performed using an ultrasonic flaw detector (that is the media pipe has been covered with a lubricant at the weld), then the media pipe should be degreased using, e.g. carbon tetrachloride.

3. Next, we check if the muff made of galvanized steel sheet, which had previously been put on the pre-insulated pipe, moves freely on the coupling.

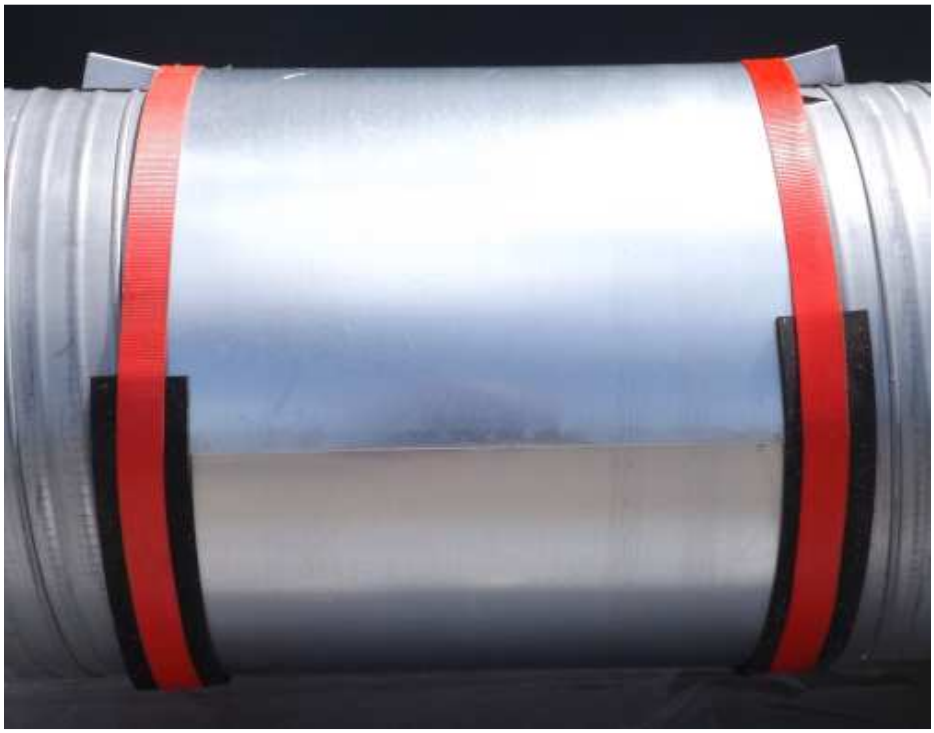
4. At the end of the pre-insulated pipe in the casing pipe, we cut a fill hole in the shape of a triangle and remove the material of the casing pipe together with the PUR foam.
   Cut dimensions:
   For casing pipe Dz < 400 - A = 4 ÷ 5 cm, B = 2 ÷ 3 cm;
   For casing pipe Dz ≥ 400 - A = 6 ÷ 7 cm, B = 4 ÷ 5 cm



4.3 Execution of thermal insulation of coupling unit.

The sequence of activities:

1. Put the muff on the coupling in such a way that the overlap on the SPIRO casing pipe in which the fill hole has been made is ca. 2-3 mm. Having put the muff on the welded joint, aluminium wedges must be put on lifting the muff upwards which will enable symmetrical location of the muff with respect to the casing pipes. The next activity is putting rubber straps, as well as webbing straps (recommended for casing pipe diameters below Ø 400 mm and arbitrarily for casing pipe diameters of Ø 400 mm and larger), which aim to minimize the outflow of the PUR foam while filling it inside the muff. Prior to the foaming, in places where PUR foam will flow out around the ends of the muff, an anti-adhesive agent is to be applied. The method of putting rubber and webbing straps is shown in the photo below.



2. If the thermal insulation is being executed at the ambient temperature of up to 20ºC, the surface of the service pipe and the muff should be heated up to the temperature of 30ºC – 40ºC, using an LPG blow torch.

3. Prepare components A and B of the polyurethane foam (PUR) for making the thermal insulation of the coupling – the temperature of the components A and B of the PUR foam immediately before pouring into the coupling should be 25°C ÷ 30°C. The components A and B of the PUR foam are put in plastic bottles, for each coupling separately, depending on the nominal diameter of the service pipe. Each bottle has a label describing the component type and the nominal diameter of the service pipe.

Example:

COMPONENT A DN 65

refers to Component A intended for a coupling of the nominal diameter of 65 mm.

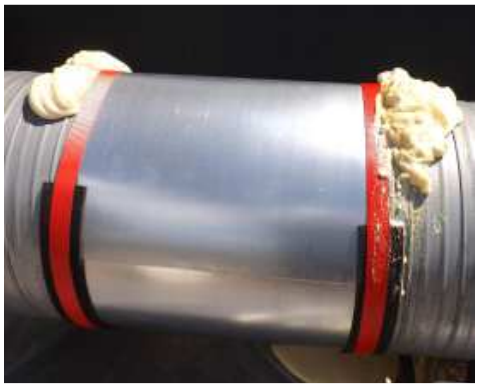
COMPONENT B DN 65

refers to Component B for a coupling of the same nominal diameter.

The two components A and B for the same nominal diameter of a service pipe comprise a set of PUR components for a given coupling.
The contractor executing the coupling thermal insulation is entrusted with a responsibility to check if the descriptions placed on the component A bottle (the light component) and the component B bottle (the dark component) belong to the same pair of nominal diameters and if the nominal diameter of the service pipe in the coupling corresponds to the nominal diameter placed on the plastic bottled containing the components. Afterwards, the content of the component B bottle is to be poured into the bottle containing the A component. The pouring may be done in any order, i.e. A into B or B into A. One should only make sure that having poured both components into one bottle, there is enough room that these go into this bottle. After the components are poured together and the cap is twisted closed, both components should be mixed and then poured through the fill hole, as cut out, into the space of the coupling being insulated. The time of pouring the components together, mixing and filling into the coupling, should not exceed 40 seconds.

4. Immediately after pouring the liquid components of the PUR foam, move the muff upwards and in the direction of the triangular fill cut and place small wooden wedges under the muff. The muff in the coupling should be placed symmetrically with respect to the welded connection, whereas the overlap on the casing pipe should measure about 15 cm.

5. The coupling poured over with the PUR liquid components will fill in on its own, flashing with stiff polyurethane foam around the muff ends (in the places where the rubber straps have not been installed). The thermal insulation, as made, should be left for a period of about 3 to 6 hours, after which it is possible to begin performing activities regarding hermetization of the coupling unit.

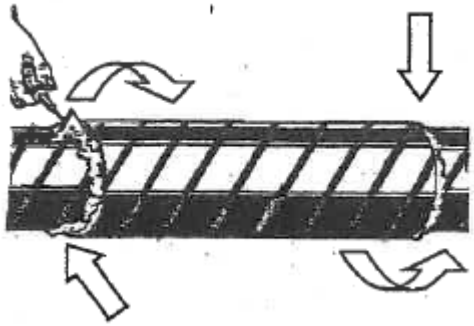


In case of making thermal insulation of SPIRO coupling units for casing pipe diameters of Ø 500 and higher, the foaming must be performed using a foaming machine.
In order to obtain the technical specification for the PUR foam used in couplings, please contact the system manufacturer, ZPU Międzyrzecz Sp. z o.o., every time.

4.4 Execution of hermetization of coupling unit.

It is advisable and recommended that the hermetization of the coupling unit should be executed on the next day, following performance of the thermal insulation of the coupling. Subsequent activities include, as follows:

1. The first activity while performing hermetization of a thermally insulated coupling is removing the foam flashes using a scraper and a wire brush.



Removing foam flashes.

2. Having removed the foam flashes, it is necessary to degrease the surfaces of adhesion of the airtight tape, i.e. at the ends of the muff pipe as well as on the casing pipe at the muff. The degreasing may be done using trichloromethylene, acetone or any other fat solvent.

3. Subsequently, the muff pipe and the casing pipe within the area of adhesion of the heat-shrink tape should be washed carefully and then dried.

4. Preparation of the heat-shrink tape (airtight tape) and the sealing tape, the so-called sealing patch. The length of the heat-shrink tape to be cut should be enough so that having wrapped the muff there is an overlap on the circumference (i.e. a tape-over-tape overlap) of, respectively:
   - For the casing pipe up to 200 mm in diameter – 75 mm,
   - For the casing pipe of 225 – 500 mm in diameter – 100 m.

   On the other hand, the sealing tape should be cut so that its length corresponds the width of the airtight tape, that is if the airtight tape is 150 mm in width, then the length of the sealing tape, as cut, should be 150 mm.
   Next, the corners of the heat-shrink tape should be cut off at one (any) end of the tape piece, as cut. The dimensions of the cut-off corners are presented in the drawing below.
   .

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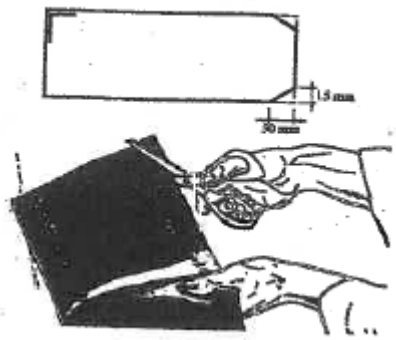
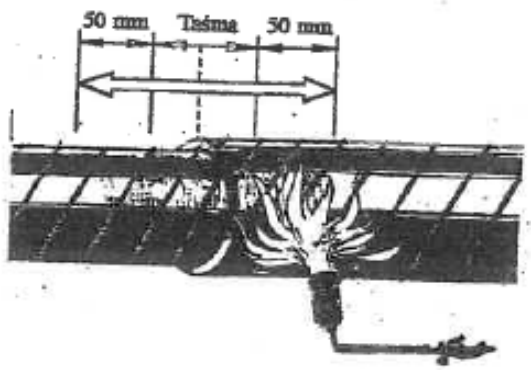


Dimensions of cut-off corners of heat-shrink tape.

The corners of the sealing tape, the so-called sealing patch, should be cut off in a similar way, however the size of the cutting off should correspond to the sides of 2 mm x 2 mm triangle, so it should be much smaller than for the heat-shrink tape.
In addition, all four corners in the sealing patch should be cut off.

5. Placing the heat-shrink tape.
   The area of placement of the heat-shrink tape is heated with the LPG blow torch soft flame up to about 50°C.



Heating of pipe and muff in area of placement of heat-shrink tape.

The heat-shrink tape has a protective cover in the form of white foil on the inner side, i.e. the one impregnated with adhesive. The protective foil is to be unstuck, starting from this end where the corners have previously been cut off. Then, an end of the tape is to be heated up with the blow torch for ca. 1 – 2 seconds.

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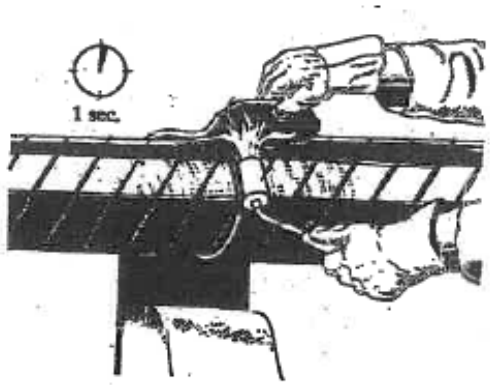
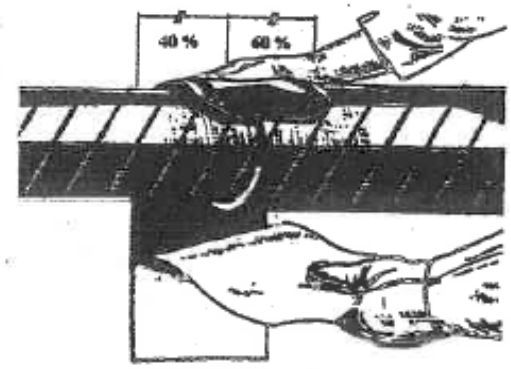


Preparation of heat-shrink tape.

The heat-shrink tape should be arranged with respect to the muff in such a way that 60% of the tape width was located on the muff, whereas the remaining 40% of the width was placed on the side of the casing pipe. The end of the heat-shrink tape which has previously been heated up should be stuck to the casing pipe and the muff, i.e. the polyethylene base.



Arrangement of tape with respect to muff

.

The next activity is wrapping the muff and the casing pipe with a heat-shrink band, simultaneously removing the foil protecting the inner side of the heat-shrink band. The free end of the heat-shrink band is stuck, overlapping, the previously stuck end with the corners cut off. The band overlap should not exceed 5 cm, so that the band end, as placed, should cover the corner cut-offs previously made. The heat-shrink band should be wrapped freely around the muff pipe, so that between the muff pipe and the band there is free space left of 5 to 10 mm, looking towards the lower part of the muff.

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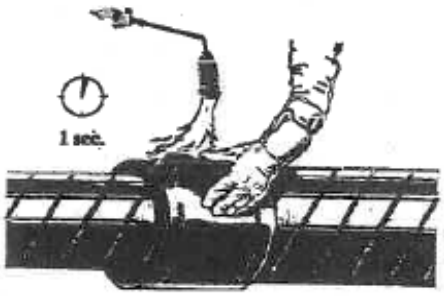
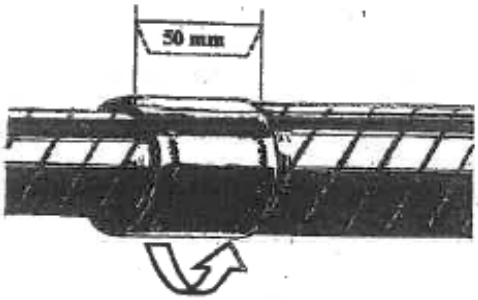
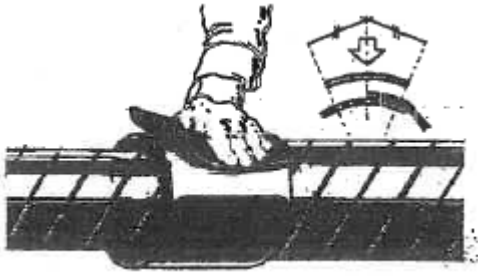


Sticking of free end of heat-shrink band.



Arranging overlap 5 cm in size.

6. Placing the sealing patch.
   Upon the overlap thus arranged, we place the previously prepared so-called sealing patch. The sealing patch has one side smooth and shiny, the other one being covered with a fibrous material. The patch is to be placed the smooth side to the bottom, i.e. the smooth side must touch the heat-shrink band. The arrangement of the patch with respect to the edge of the heat-shrink band overlap should be symmetrical.
   Sticking of the sealing patch begins with heating it up with blow torch flame, after it is put, in an appropriate way, to the surface and rolled out using a roller (or, e.g., a paint roller). Having placed the patch to the surface, the heating and rolling is repeated until small balls of black glue appear among the gaps in the fibrous material.



Arrangement of patch with respect to overlap.

7. Shrinking of the heat-shrink sleeve.
   Sticking of the sealing patch to the heat-shrink band results in making a heat-shrink sleeve which, subsequently, is to be shrunk with blow torch “soft” flame.
   Heat-shrink tapes with sealing patches may be replaced with heat-shrink bands – it must be remembered that the bands be pulled over the pipeline before welding the service pipe.
   As the principle with respect to shrinking of every heat-shrink sleeve, one should assume that shrinking of every sleeve begins on the side of the muff. We make circular movements with the blow torch flame, starting from the middle of the sleeve, towards the muff.

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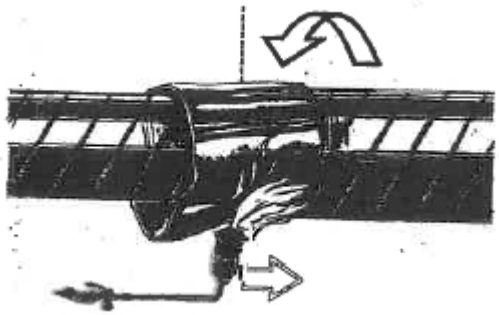
When the sleeve adheres tightly to the muff, we press its surface using a roller, until the black thermofusible glue flows out evenly at the ends of the sleeve. This activity aims to shrink the heat-shrink sleeve on the muff.

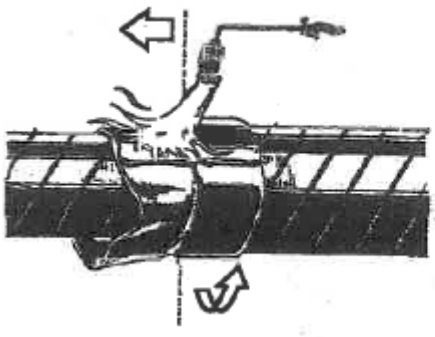


Shrinking of heat-shrink sleeve with respect to muff.

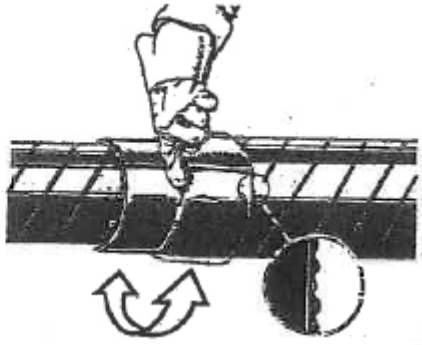
Having made the shrinking of the sleeve on the side of the muff, as shown above, further procedure with regard to the shrinking of the sleeve depend on the weather conditions.
Two situations are distinguished:
- **1** - when the ambient temperature is lower than 20ºC.
- **2** - when the ambient temperature is higher than 20ºC.

Situation 1: - the ambient temperature is lower than 20ºC.

Having shrunk the sleeve on the side of the muff, we proceed to shrink the remaining part of the sleeve on the side of the casing pipe. We make circular movements around the sleeve with the blow torch flame, starting from the middle, gradually moving towards the casing pipe. Heating up is continued until the heat-shrink sleeve closely (tightly) adheres to the polyethylene base.
While heating up the sleeve, one needs to be watchful to heat up carefully the place where the sealing patch has been stuck.
Next, after the sleeve has shrunk, using a roller (a paint roller), we accurately press the sleeve to the base, paying particular attention to the place where the overlap is situated.
Pressing the sleeve in a correct way will make the glue flow out evenly along the entire circumference of the sleeve.
In addition, one needs to press the sleeve manually where the end of the muff makes a threshold.



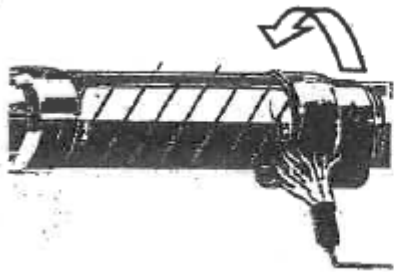
Sticking of sleeve on



Pressing sleeve at threshold.

casing pipe's side. *Flowing out of thermofusible glue.*

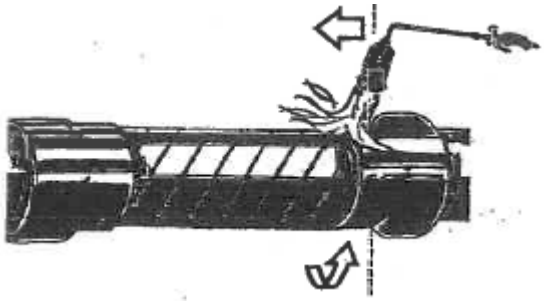
While shrinking the sleeve, one needs to be careful not to overheat the heat-shrink band, not to burn through its surface and not to heat the coupling excessively which results in swelling of the coupling.
The same course of activities is to be followed for the other end of the muff, as in the drawing below.



Shrinking of second sleeve. *Coupling completed.*

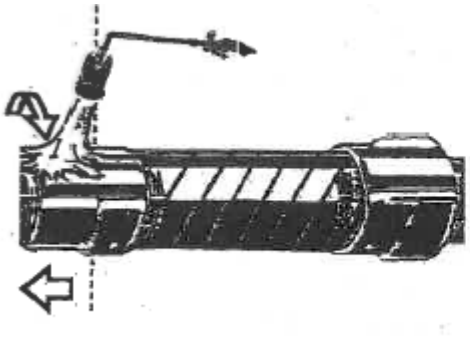
Situation 2: the ambient temperature is higher than 20^0.

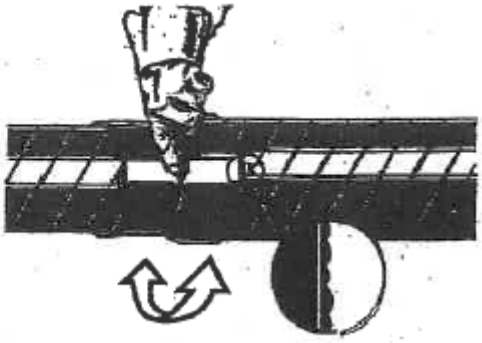
Having shrunk the sleeve on the side of the muff, we leave the remaining part of the sleeve on the side of the casing pipe not doing any activities here, and we proceed to perform the same activities on the second sleeve, i.e. shrinking on the muff's side.



Shrinking of second sleeve on muff's side.

Having completed the other heat-shrink sleeve at the other end of the muff, we go back to the first sleeve and make a shrinking on the side of the casing pipe, as presented above.

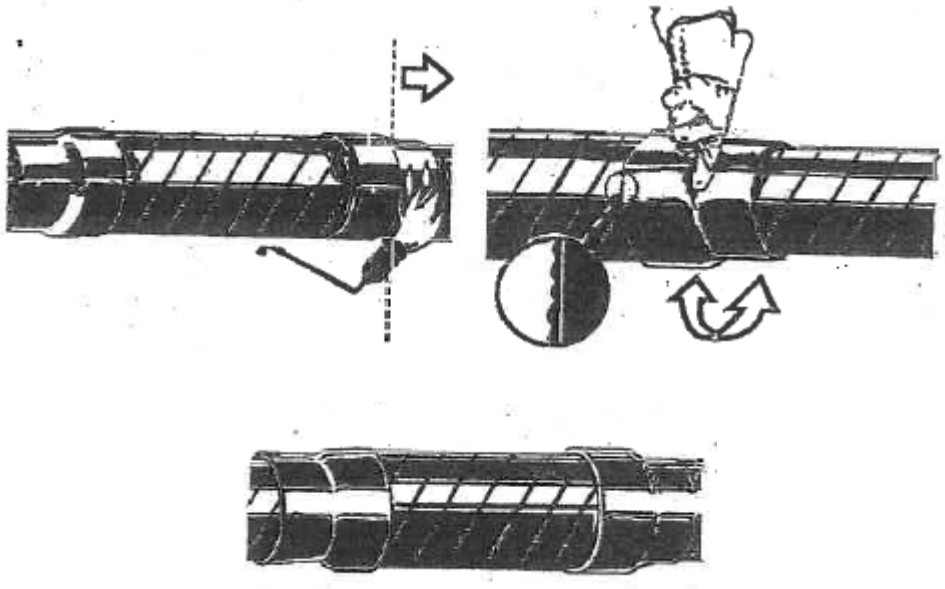




Shrinking of first sleeve. *Pressing sleeve at threshold.*

Thermofusible glue flowing out.

Having performed the shrinking of the first sleeve, alongside pressing carefully with a roller, we go back to the second sleeve shrunk on the muff, where we complete the shrinking on the side of the casing pipe. These activities are to be performed in the manner as described before.



Coupling completed.

Careful execution of the thermal insulation and hermetization of the coupling unit is crucial for durability of a hot water pipeline, as made.

In addition, the shrunk heat-shrink tapes or heat-shrink bands may be secured by using the ALU BAND.

Completed SPIRO couplings are not subject to a leakage test.

5. INSULATION AND HERMETIZATION OF PIPELINE END.

5.1. Preparatory and auxiliary activities.

1. Remove the top layer of the PUR foam from the front of the insulation of the elements in which the end is being made. The foam insulation – in like manner as in the execution of the coupling unit – should be removed 3-5 mm in depth.

2. The surface of the service and casing pipes must be cleaned to remove dust and grease.

3. Having performed the above activities, we set about determining the location to place the end muff. In order to do it, the end muff must be drawn provisionally over the pipeline end, this being done in such a way the bottom

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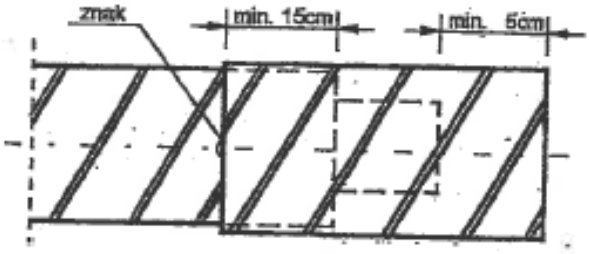
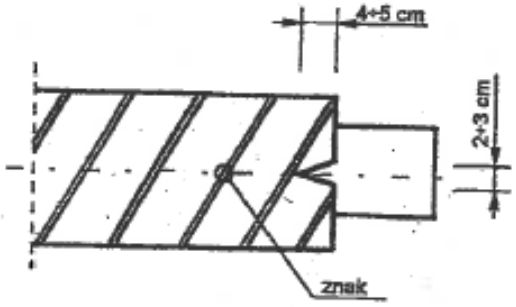
of the muff was situated no less than 5 cm from the end of the uninsulated service pipe. The location of the muff, as placed in such a way, with respect to the service pipe should be marked by making a scratch on the service pipe casing in the place where the muff ends. After establishing the place of the coupling, the muff is taken off. This operation aims to determine the place up to which the muff is to be drawn over after pouring the liquid PUR components into the space between the end muff and the service pipe. This situation is illustrated by the below figure.



Location of end muff prior to pouring liquid PUR components.

4. In the pre-insulated pipe insulation, we make a triangular cut with a saw, of the dimensions as presented in the drawing below. This cut will make an inlet opening for the liquid PUR components.



[znak – mark]

Dimensions of inlet opening in casing pipe.

The material of the casing pipe, together with the PUR foam situated in the cut, is to be removed by means of a knife.

5. Prepare a device to prevent the end muff from moving while foaming the PUR foam components poured into the inter-muff space.

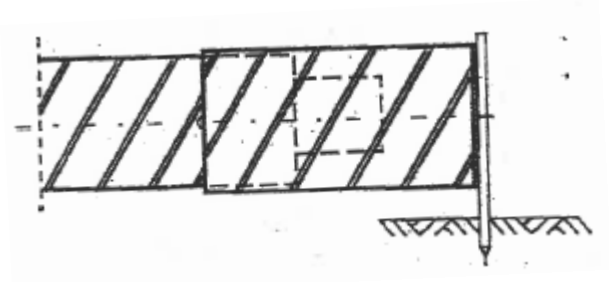
5.2. Execution of thermal insulation.

1. Draw the end muff over the inlet opening at the end of the casing pipe.
   The muff should come 2 to 4 mm over the end of the casing pipe, so that the inlet opening is not covered.

2. We set about preparing the end muff for pouring the PUR liquid components. If the ambient temperature is lower than 20°C, then the service pipe and the muff should be heated up to the temperature of about 50°C, using an LPG blow torch.

3. The next activity is mixing the liquid components A and B of the PUR foam by pouring them into one of the plastic bottles in which they have been delivered to the construction site and letting the liquid PUR components through the previously cut inlet opening into the inter-muff space. The time of execution of the pouring, mixing and letting the components into the inter-muff space should not exceed 40 seconds.

4. Having poured the components, the end muff is to be drawn over to the place which has been previously marked on the casing pipe, it is to such a location in which the bottom of the muff is situated no less than 5 cm from the end of the service pipe. We secure the muff in this position so that it does not slide in the opposite direction to the one in which it has been placed on the casing pipe.
   Having poured the liquid PUR components into the inter-muff space, the PUR foam will progress to fill this space on its own, which may be determined by foam flashes around the circumference of the end muff. The end muff as filled with the foam is to left for a period of 3 to 6 hours, before setting about the operation of hermetization of the muff.



Securing end muff after pouring liquid PUR components.

5.3. Execution of hermetization of pipeline end.

3 to 6 hours following the filling of the end with the PUR foam, we set about hermetizing the end muff with a heat-shrink tape. Hermetization of the end muff consists in making a heat-shrink band, in a way similar to hermetization of the coupling unit.

1. First we set about removing the foam flashes around the end muff. Excess foam is removed using a scraper, in a way similar to preparation of the coupling unit for hermetization.

2. Next, clean the surface layer of the casing pipe and the end muff within the area of adhesion of the heat-shrink tape.

3. Having the surface prepared as described above, we execute hermetization with the heat-shrink tape in similar way as it was done with respect to hermetization of the coupling unit – see the detailed description of the activities in 4.4 Execution of hermetization of coupling unit.

6. HERMETIZATION OF THERMAL INSULATION END.

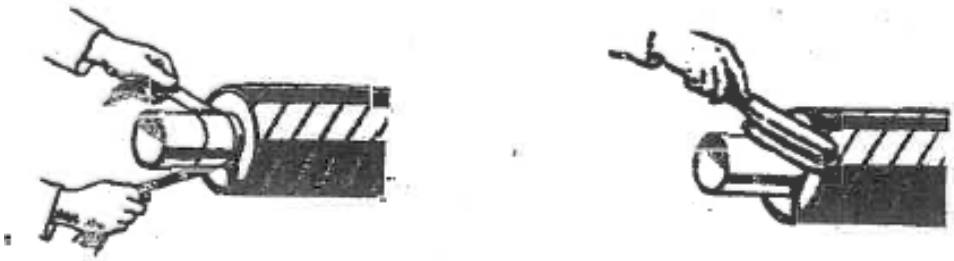
Hermetization of the thermal insulation of a pre-insulated pipeline is executed having crossed the dividing structures at the place where the insulation was finished.
Hermetized thermal insulation ends on pre-insulated pipelines aim to prevent penetration of moisture from the environment.

6.1. Necessary tools and materials.

The material necessary to execute hermetization of PUR thermal insulation is the heat-shrink sleeve, Catalogue Symbol R – according to the **"Product Catalogue" – *ZPU MIĘDZYRZECZ* System**. The set of necessary tools is identical to the one for making the insulation and hermetization of the coupling unit. The list of these tools is to be found on Page 2 of this work.

6.2. Execution of PUR insulation hermetization.

1. The first activity while performing hermetization of the PUR insulation is preparation of the base to which the heat-shrink sleeve will adhere. This preparation consists in removing the anti-corrosion coating, dust, grease and similar impurities off the service pipe, and cleaning the surface of the casing pipe about 5 cm from the end of insulation, along the pipe axis. This activity is performed using sandpaper and a wire brush.



Preparation of service and casing pipe surface prior to application of heat-shrink sleeve.

2. Next, the service pipe and the casing pipe must be heated. These activities are performed if the pre-insulated pipe has no moisture detection system built in. If there is a detection system in the insulation, then the system circuit must be closed or the wiring led out of the insulation and into a fault annunciator prior to the heating procedure, in accordance with the **"Detection System Connection Instructions" – *ZPU MIĘDZYRZECZ Sp. z o.o.* System**.

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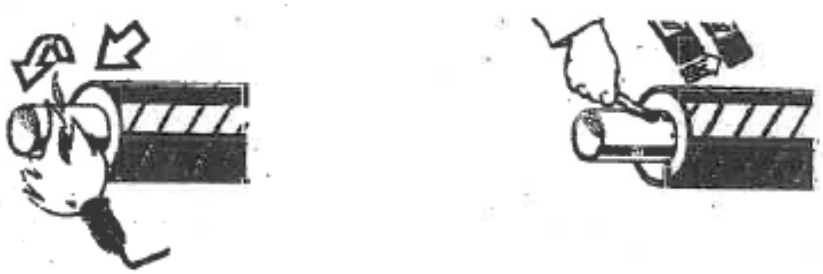
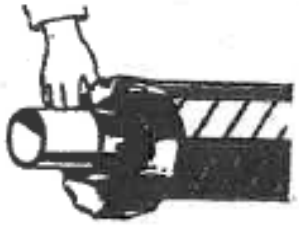
Having performed the abovementioned activities, we set about heating the service and casing pipes. We heat the service pipe with the blow torch soft flame along about 5 cm – from the front of the insulation – up to the temperature of 60°C. The casing pipe is heated in a similar manner – along a section of 5 cm – from the end of the pipe – up to the temperature of 40°C. While heating, caution must be taken not to burn the thermal insulation or damage the detection system wiring.



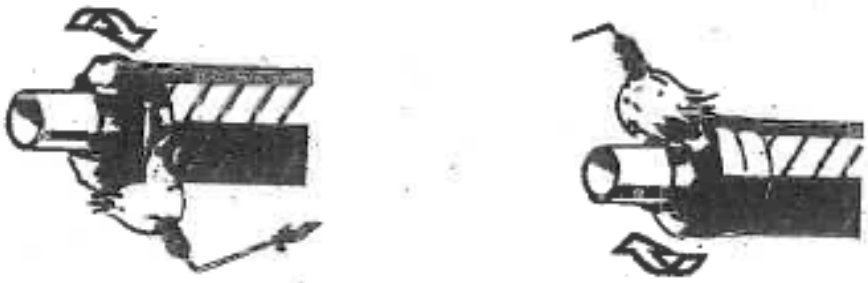
Heating of service (60°C) and casing (40°C) pipes

3. Now the heat-shrink sleeve is drawn over the service pipe and casing pipe in such a way that the front part of the casing pipe touches the internal flat part of the heat-shrink sleeve.



Position of heat-shrink sleeve prior to heating.

4. Then we set about shrinking the sleeve. With the blow torch soft flame, we heat – making circular movements – the heat-shrink sleeve on the casing pipe. The shrinking of the sleeve begins from the outermost edge on the side of the casing pipe and gradually move towards the front of the thermal insulation.



Shrinking of sleeve on casing pipe's side.

Having shrunk the sleeve on the casing pipe, we set about heating the part of the sleeve resting. In a way similar to the casing pipe side, we perform the

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heating with the blow torch soft flame, circular movements, until the sleeve adheres tightly and uniformly to the service pipe.

Shrinking of sleeve on service pipe's side.

Such a sleeve, after cooling down, has excellent hermetization characteristics
In case hermetization is executed of the end of thermal insulation out of which the pipeline leak detection system wiring is led, we begin the shrinking of the heat-shrink sleeve from the side of the service pipe, to be finished on the casing pipe.
During the shrinking of the sleeve, caution must be taken not to damage the passage of the impervious conduit (bakelite choke) as fixed within the sleeve.