



ZPU MIĘDZYRZECZ Sp. z o.o. SYSTEM PREINSULATED PIPES TO BE USED IN BURIED THERMAL UTILITIES

JOINT UNIT ASSEMBLY INSULATION AND SEALING

Zakład Produkcyjno Usługowy

Międzyrzecz

Polskie Rury Preizolowane Sp. z o. o.,
66-300 Międzyrzecz, ul. Zakaszewskiego 4

Phone +48 95 741 25 26, 742 33 00, 742 00 93

Fax +48 95 741 18 36, 742 33 02

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1 Introduction

This Manual describes the way the following are to be executed:

- thermal insulation and sealing of a joint unit.

Version 1: joint protection: a HDPE tube sleeve sealed with heat shrinkable tape;

Version 2: joint protection: a heat shrinkable HDPE tube sleeve sealed with heat shrinkable band;

- termination of thermal insulation on preinsulated pipe;
- termination of preinsulated pipe.

2 General Condition of Laying Thermal Insulation and Sealing

1. Thermal insulation and its sealing can only be made if:

- pipeline tightness test has yielded positive results;
- checks and acceptance inspection are positive;
- the wires have been connected and technical tests completed as required by the Manual of Monitoring Pipe Leak Monitoring System Wiring, if a pipe leak system has been incorporated.

A heat shrinkable sleeve prior to its full shrink wrap on site has to be packed in white foil and stored below 25°C in places protected against direct sunrays. Failure to satisfy that condition may result in deformations to the sleeve.

2. Thermal insulation and its sealing should only be made in favourable weather conditions: in a dry and sunny weather and ambient temperature above +5°C. Should there be a need to proceed with insulation works at increased air moisture (rainfalls), works should be performed under mobile roofing structures, e.g. a tarpaulin tent.
3. Thermal insulation and sealing works can be done by a skilled worker certified and authorised by ZPU Międzyrzecz Sp. z o.o. to perform such jobs.
4. The steel carrier and case pipe surface temperatures should be 30°÷35°C when the insulation works are in progress.
5. Polyurethane foam at preinsulated pipe ends should be dry, and insulation head should be stripped over 3÷5 cm.
6. The carrier pipe within the joint unit must be clean from dirt and dust.
7. The surface of case pipe over a length of 25 cm measured from the pipe end should be clean and dry.
8. A trench in places where the pipe joint has been insulated and sealed has to be widened and deepened by about 20 cm.



9. The joint unit HDPE tube sleeve or heat shrinkable tube sleeve made from HDPE and heat shrinkable bands have to be pulled onto the preinsulated pipe before the steel carrier pipe is welded.

3 Storage and Handling

1. All the materials used in joint insulation and sealing works should be stored in closed space.
2. The components A and B of PUR foam, batched in plastic containers separately each joint should be stored in temperatures above +15°C and not exceeding +30°C.
3. HDPE poly heat shrinkable sleeves packed in white foil should be stored at temperatures not exceeding 25°C and in places not exposed to direct sunlight.

4 Insulating and Sealing a Joint Unit

VERSION 1 – JOINT COVER: HDPE TUBE SLEEVE SEALED WITH HEAT SHRINKABLE TAPE

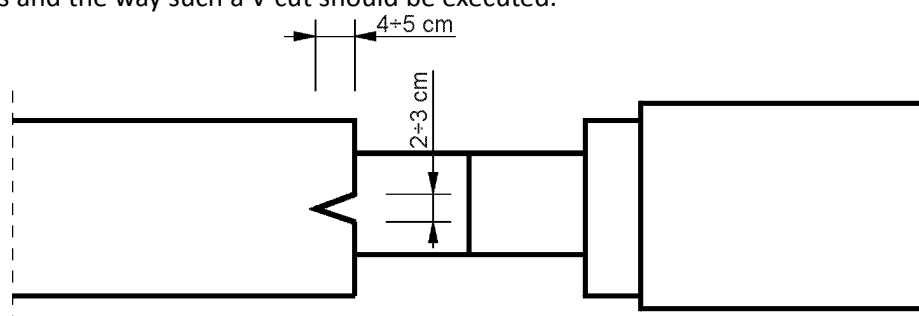
4.1 Basic tools and materials

1. Basic tools and materials necessary to lay down an insulation layer and its sealing on preinsulated pipes are:
 - knife;
 - hoop iron section 40×4, 200 mm long;
 - metal saw;
 - propane-butane burner;
 - wire brush;
 - scraper.
2. In order to insulate and seal a joint unit, terminate thermal insulation layer and terminate the pipeline the materials included in the ZPU Międzyrzecz Sp. z o.o. Catalogue, referred to as N, R and NK should be used:
 - sleeve; heat shrinkable sleeve, end cap;
 - the components A and B forming PUR foam;
 - heat shrinkable tape and closing tape;and, additionally:
 - sand paper;
 - felt cleaner;
 - carbon tetrachloride or acetone.



4.2 Preliminary and auxiliary steps

1. Begin laying thermal insulation with removing with a scraper or knife part of PUR insulation foam over 3 to 5 mm at the head of the preinsulated section.
If there are any monitoring wires embedded in the insulation, scraping has already been done before connecting the wires.
2. If welded joints were tested ultrasonically (the service pipe having been covered with grease), then the service pipe has to be degreased, e.g. with carbon tetrachloride.
3. Then the tube sleeve pulled onto the pipe has to be checked if it moves freely over the joint.
4. Cut out a triangular fill-in opening at the end of the preinsulated pipe and remove part of the casing pipe and foam. The drawing shows approximate dimensions and the way such a V-cut should be executed.



4.3 Laying thermal insulation of a joint unit

Follow these steps:

1. Pull a tube sleeve onto the joint in such a way that it overlaps the casing pipe in which a V-cut is made over about 2 to 3 cm.
2. If the thermal insulation is laid at an ambient temperature of up to +20°C, then the surfaces of both the carrier pipe and the tube sleeve should be heated up to temperatures between 30°÷40°C with a liquid propane-butane burner.
3. Make PUR foam components A and B ready to insulate the joint. The components A and B are batched in plastic containers separately for each joint depending on the carrier pipe nominal diameter. Each container has a label designating component type and carrier pipe nominal diameter.

Example:

COMPONENT A DN 65

Use as Component A for Joint of Nominal Diameter of 65 mm

COMPONENT B DN 65

Use as Component B for Joint of Same Nominal Diameter

1. The two components A and B for the same nominal diameters of carrier pipes make up one set of PUR components for a given joint.
Before starting work on joints check whether the batched components (container A – light colour, component B – dark colour) match the same nominal diameter and if the



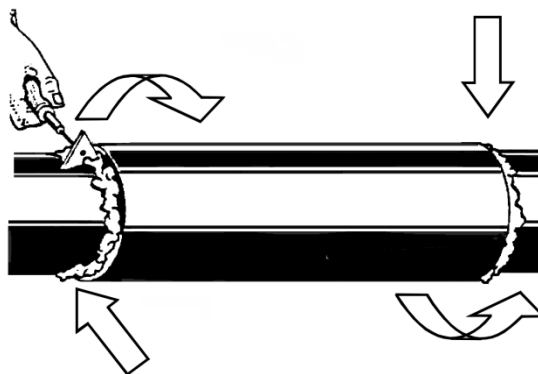
container contents match each other. Then pour the content of the container B into the container A. The order of pouring, that is whether A into B or B into A, is irrelevant, it has, however, to be remembered that both components should fit one container when mixed. Once the components have been poured into a container, and the container tightly closed, they should be mixed, and subsequently poured through a V-cut into the joint to be sealed. The time the components are poured, mixed and poured into a V-cut should not exceed 40 seconds.

2. Immediately on pouring the components A and B in liquid state the sleeve should be pushed upwards towards the V-cut and small wedges slid under the sleeve should be placed.
The sleeve should be placed over the joint symmetrically vis-à-vis the weld with at least 15 cm overlap on the case pipe.
3. The joint will fill itself up with PUR foam while its excess will come out as flashes. The foam has to be left for 3 to 6 hours to cure, then sealing of the joint can be started.

4.4 Sealing a joint unit

It is suggested and recommended that sealing works be performed on the following day. Follow these steps:

1. The first thing to be done when sealing is approached is to remove foam excess with a scraper and wire brush. Especially, see if flashes at the bottom – normally difficult to see – are thoroughly removed.



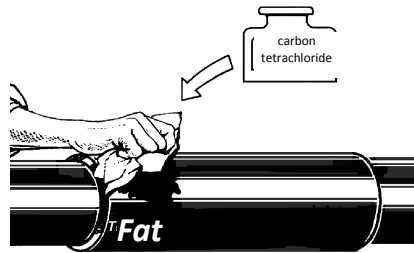
Removal of foam flashes

2. Once the foam flashes have been removed, the surfaces which will come into contact with sealing tape, that is on both ends of the tube sleeve and on the casing pipe next to the tube sleeve have to be degreased. It can be done with trichloromethylene, acetone or any other fat removing agent.
3. Then the tube sleeve and casing pipe in areas coming in contact with sealing tape should be roughed (external polyethylene layer should be scraped till the surface becomes grey and dull) with sand paper. The width of the rough area is presented in the drawing below.

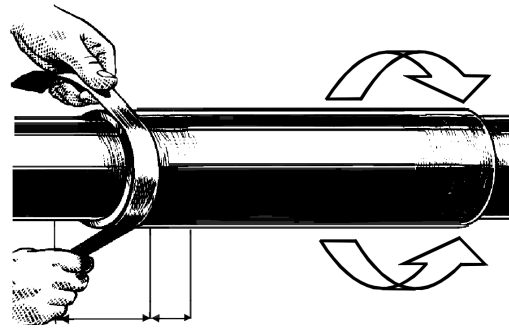


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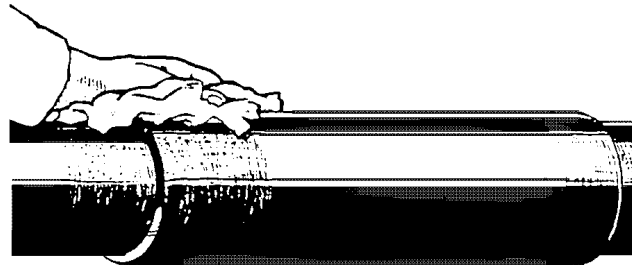


Tube sleeve and casing pipe being degreased



Casing pipe being roughened

4. The roughed surface should be cleaned from dirt and dried with felt.



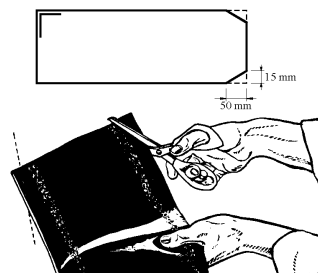
Drying up heat shrinkable application area

5. Preparing heat shrinkable tape (sealing tape) and closing tape (closing patch). Heat shrinkable tape should be cut into a length sufficient to let the tube sleeve be wrapped around and have both tape ends overlap over:

- casing pipe of diameters up to $\varnothing 200$ mm: **75 mm**;
- casing pipe of diameters between $\varnothing 225$ and $\varnothing 500$ mm: **100 mm**;

The closing tape should be cut to a length corresponding to the sealing tape width, that is if the sealing tape is 150 mm wide, then the closing tape should be cut to 150 mm.

Then proceed with heat shrinkable (sealing) tape whose corners should be cut off on one end of a cut off tape section. Dimensions of cut off corners are given in the drawing below:



Heat shrinkable tape cut off corner dimensions



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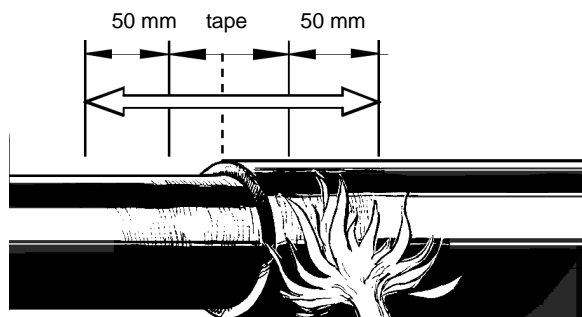


Closing tape corners, the so called closing patches, should be cut in such away that the cut off triangle have equal sides 2 mm long, that is considerably less than in the case of a closing tape.

Moreover, the four corners of the closing patch should be cut off.

6. Placing a heat shrinkable tape:

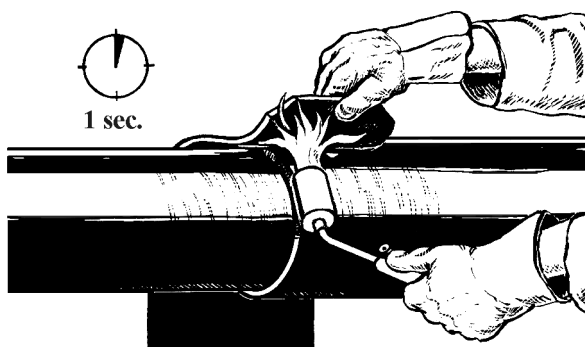
Direct a soft flame from a propane-butane burner onto the case pipe and tube sleeve and heat them up to the temperature of 50°C as shown in the picture below.



Heating up pipe and tube sleeve in the area where heat shrinkable type is to be applied

The inside of the heat shrinkable tape is lined with adhesive and is protected with a white foil. The protective foil has to be peeled off beginning from the place where the corners are cut off. Then, tape end has to be heated up with a burner for about 1 to 2 seconds.

These steps are illustrated below



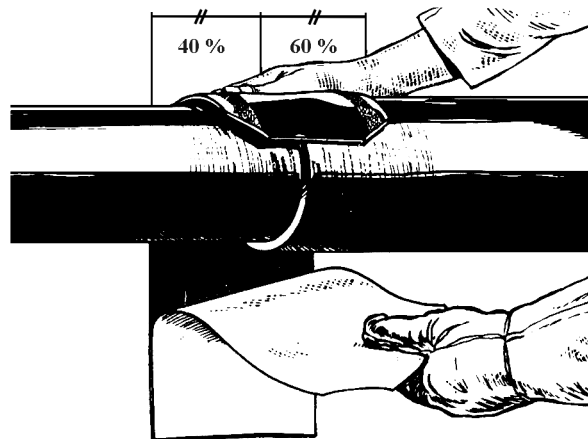
Preparing heat shrinkable tape

The heat shrinkable tape has to be placed with respect to the sleeve in such a manner that 60% of the tape width should be on the sleeve, while the remaining 40% on the case pipe side. The preheated up end of the heat shrinkable tape is then placed on the case pipe and onto the sleeve, that is on the polyethylene surface.



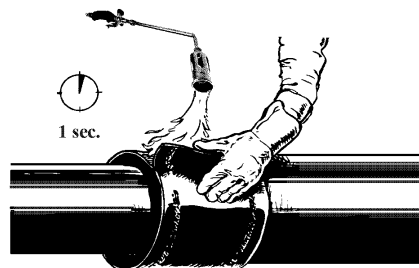
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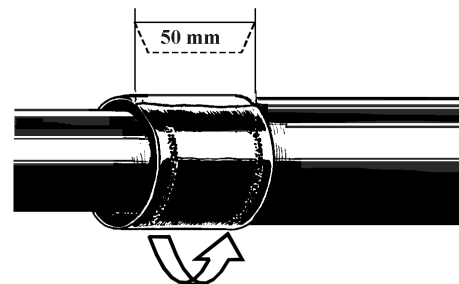


*Placement of heat shrinkable tape with respect to tube sleeve
– shifted by 1 cm towards tube sleeve*

Then the tube sleeve and case pipe have to be wrapped around with a heat shrinkable tape with protective foil being removed simultaneously from the internal side of the heat shrinkable tape. The free end of the heat shrinkable tape is glued in an overlapped manner to the previously glued end with corners cut off. The tape should not overlap over a distance more than 5 cm, so the end of the applied tape should cover the cut off corners. The heat shrinkable tape should be wrapped freely around the sleeve so that a play of about 5÷10 mm is left between the sleeve and the tape towards the lower part of the sleeve.



*Gluing the free end of the heat shrinkable
tape*



Forming a 5 cm overlap

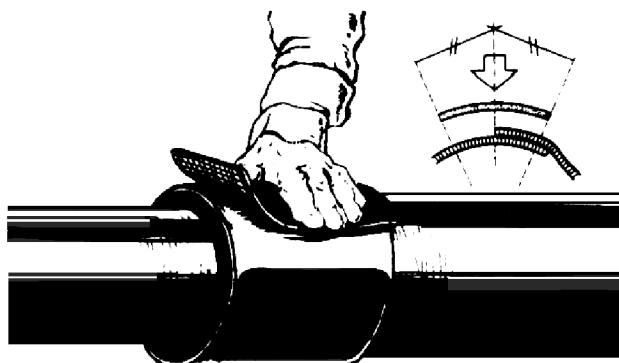
7. Applying a closing patch

The already formed overlap is applied a closing patch, prepared earlier. A closing patch is smooth and shining on one side and on the other is lined with fibrous material. The patch has to be applied with the smooth surface facing the heat shrinkable tape. The patch and its ends should be placed symmetrically with reference to the heat shrinkable tape edge.



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Placing a patch vis-à-vis overlap

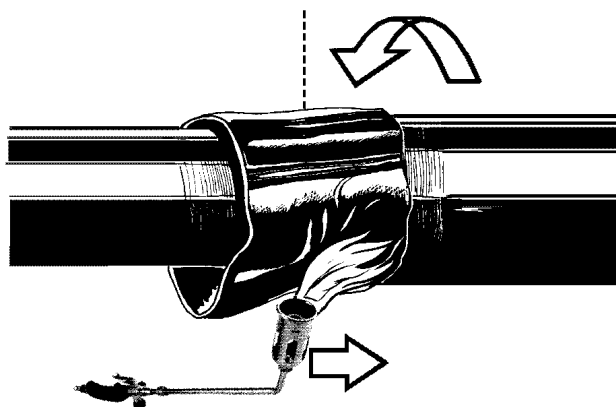
Before the patch is applied it has to be first heated up with a burner having the patch been previously placed onto the surface and rolled up with for instance a painter's roll. Once the patch has been placed it should be heated up and rolled up until small beads of black glue show up.

8. Shrinking a heat shrinkable sleeve

The patch glued to the heat shrinkable tape forms a heat shrinkable sleeve, which has now to be shrunk with a soft flame.

As a rule the shrinking should proceed by shrinking each sleeve from the tube sleeve side. Flame should be led in circular movements from the sleeve centre outwardly to the tube sleeve.

Now that the sleeve tightly clings to the tube sleeve its surface has to be pressed to the polyethylene surface until glue starts to flow uniformly from underneath. This is to ensure that the heat shrinkable sleeve is shrunk on the tube sleeve.



Shrinking a heat shrinkable sleeve from the sleeve end

When the sleeve is being shrunk on the side of the tube sleeve as shown above, further action depends on the atmospheric conditions.

Two situations should be taken into consideration:

- 1 – when the ambient temperature is below 20°C;
- 2 – when the ambient temperature is above 20°C.



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Situation 1 - temperature is below 20°C

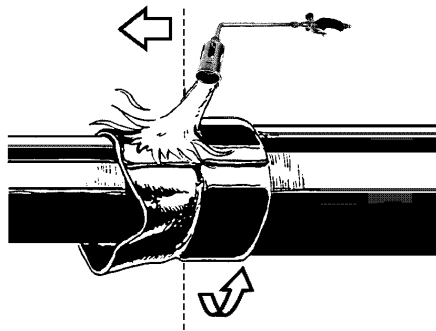
Now that the sleeve has been shrunk on the side of the tube sleeve, proceed with shrinking the remaining part of it on the side of the case pipe. Flame should be led in circular movements from the sleeve centre outwardly to the case pipe. Stop heating once the heat shrinkable sleeve has clung to the polyethylene surface. The heat shrinkable sleeve should be heated until it tightly clings to the polyethylene surface.

While the sleeve is being heated attention should be paid to the place where the closing patch is glued.

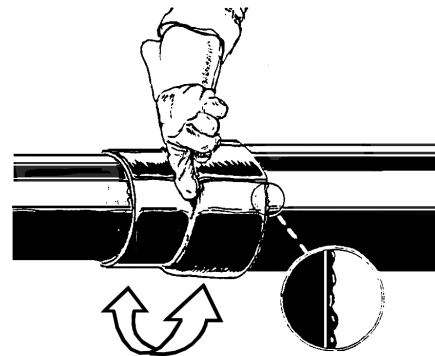
Once the sleeve has shrunk completely it should be pressed to the surface by means of a roller, minding in particular the overlapping area.

If correctly pressed up, the sleeve should show glue coming out uniformly on its circumference.

The edge formed by the sleeve already on the tube sleeve should be manually pressed down.



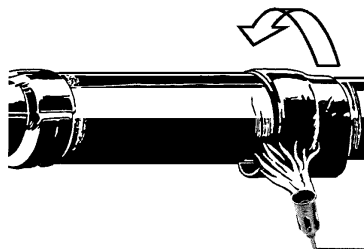
Shrinking the sleeve on the side of the case pipe



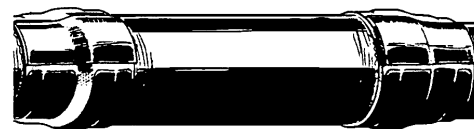
Pressing the sleeve down where the glue outflows

While the sleeve is being shrunk attention should be paid neither to overheat the heat shrinkable tape nor to burn it, likewise the joint itself cannot be excessively heated for it may lead to bulging.

The other end of the tube sleeve should be processed similarly as presented in the drawing below.



Shrinking the sleeve on the side of the case pipe



Pressing the sleeve down where the glue outflows



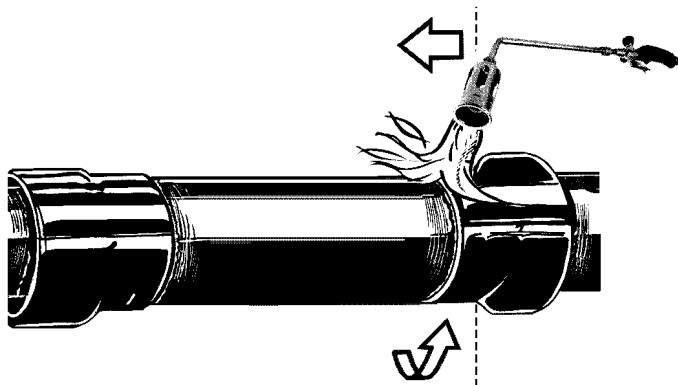
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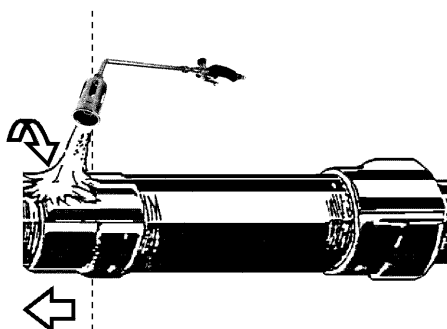
Situation 2 - temperature is above 20°C

Once the sleeve has been shrunk on the side of the tube sleeve, the other part of the sleeve on the case pipe should be left unattended, and the same procedure is to be repeated on the other sleeve, that is shrinking it on the side of the tube sleeve.

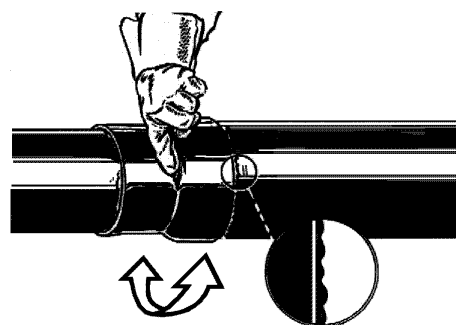


Shrinking the other sleeve on the sleeve side

Once the other heat shrinkable sleeve has been shrunk on the other end of the tube sleeve, return to the first sleeve and proceed with shrinking it on the side of the case pipe, as described above.

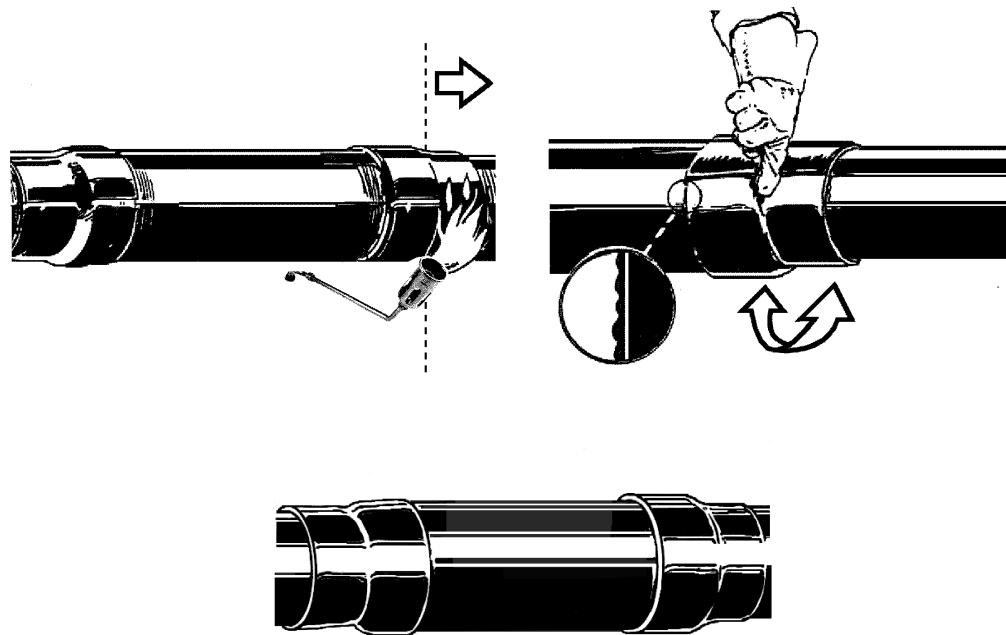


Shrinking the first sleeve



Pressing the sleeve down where the glue outflows

Once the first sleeve has been shrunk on its whole length and carefully pressed up with a roller, the other sleeve already shrunk on the tube sleeve should be processed in that manner that it is now being shrunk on the case pipe. Proceed as described above.



A complete joint

Care should be paid to proper execution of the thermal insulation and sealing of the joint assembly as this is crucial to the performance of the pipeline.

5 Insulating and Sealing a Joint Unit

VERSION 2 – JOINT COVER: HDPE TUBE SLEEVE SEALED WITH HEAT SHRINKABLE BAND

5.1 Basic tools and materials

1. Basic tools and materials necessary to lay down an insulation layer and its sealing on preinsulated pipes are:
 - knife, wire brush, scraper, hammer;
 - propane-butane burner;
 - a drill and \varnothing 25 mm bits;
 - a foaming device if joints are to be filled mechanically;
2. Insulate and seal with the materials included in the ZPU Międzyrzecz Sp. z o.o. Catalogue, referred to as NT, namely:
 - tube sleeve (packed in white foil);
 - heat shrinkable sleeve (as per Table 1 page 17);
 - the components A and B forming PUR foam, batched in separate bottles;
 - end caps;



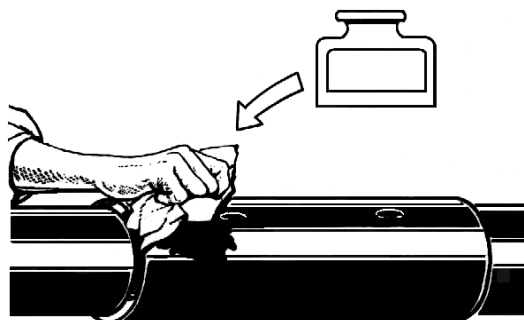
- FOP plugs;
- and, additionally:
- sand paper, felt cleaner, carbon tetrachloride or acetone;
 - propane-butane gas.

5.2 Preliminary and auxiliary steps

1. Begin laying thermal insulation with removing with a scraper or knife part of PUR insulation foam over 3 to 5 mm at the head of the preinsulated section.
If there are any monitoring wires embedded in the insulation, scraping has already been done before connecting the wires.
2. A carrier pipe within the coupling unit must be clean from dirt or dust, and if previously covered with grease for testing purposes, it should be degreased, e.g. with carbon tetrachloride.
3. The surface of the case pipe over a length of 25 cm measured from the pipe end should be cleaned and dried.
4. The case pipe surface where a tube sleeve and sleeve are to be placed should be heated with open flame from a gas burner. The temperature of the case pipe one minute after heating was topped should be at least 60°C.

5.3 Thermal insulation sequence

1. Remove foil, slip on the heat shrinkable tube sleeve so that it is symmetrically placed on the case pipe overlap.
2. Clean external surfaces from dirt, paying more attention to the lower side of the heat shrinkable tube sleeve joint which is lined with adhesive.



3. The ends of the heat shrinkable tube sleeve should now be shrunk with a soft flame over a length of 10÷15 cm.

Heating should be started with a small flame moved from the middle sideways (towards the tube edges) until uniform traces of glue begin showing up from under the edges, while the tube fits tightly. Proceed carefully paying attention not to overheat until 3÷4 cm from the case edge the heat shrinkable tube sleeve has shrunk.



JOINT UNIT ASSEMBLY INSULATION AND SEALING

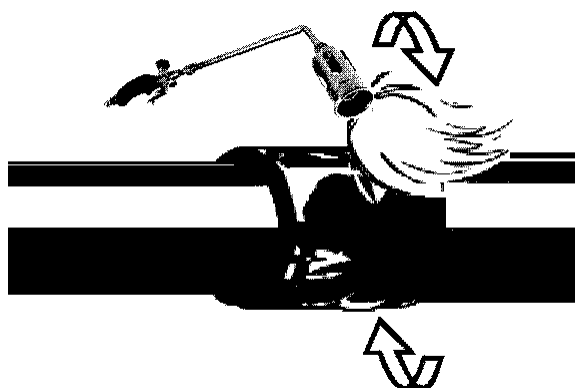
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4. Once the edges have been shrunk, bore a $\varnothing 25$ mm hole, clean the area of the insulation on the case pipe, remove the protective foil from the heat shrinkable tape and slip it onto the place which is to be insulated, with its centre located above the tube end.



5. The heat shrinkable tape now should be shrunk beginning from the tube. Apply a soft flame from a propane-butane burner. While heating move the flame in circular movements around the tape exercising care not to overheat.



6. Then proceed with shrinking the remaining part of the tape on the case pipe as described in Point 5 above, avoiding overheating.

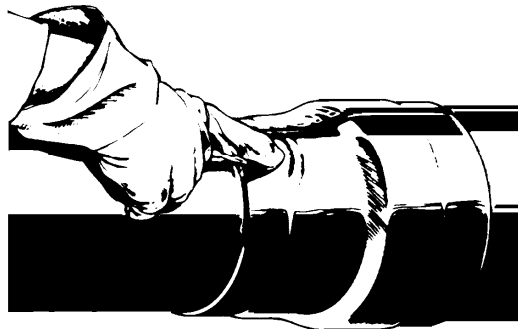


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- Now that the whole area of the tape has been shrunk it should be smooth, without caves, while the glue must be seen all around the tape circumference.



- Proceed with insulating the joint assembly pouring in the components A and B of PUR foam. The space over the joint has to be filled up with PUR foam minding that the temperature of the shrunk joint (glue) should not exceed 40°C. The components A and B, batched in bottles, should be mixed up either in a bottle or in a foaming device. Once mixed up, the liquid foam is poured through the hole in the space above the joint.



See to it that the volumes of the component A and B are correct – refer to the nominal diameter of the pipe.

The reference A DN 100 stands for a DN 100 pipe

Once both components A and B have been poured into the joint space, the hole should be blocked with a plug down to the first notch. The space now being vented and degassed, the plugs should be driven with a hammer to their full length.

9. Foam flashes have to be removed, the area around the plug cleaned, the plug head cut off and the very plug sealed with a FOPS cap.

The PUR foam filler gate can also be sealed with a fusion welded plug.

To weld in a plug the venting plugs have to be removed mechanically from the filler gates, then the openings should be thoroughly cleaned from the remaining PUR foam and the sleeve edges too. This has to be done by means of a scraper and sand paper. This will secure proper fusion of the plugs, therefore utmost care should be paid to this operation.

Then using a plug welder device – a special heating device to be purchased from ZPU Miedzyrzecz Sp. z o.o. – should be preheated up to the point where the opening edge and the conical surface of the plug become soften and then the plug should be driven into the venting opening and keep it until it cools down and the softened surface hardens. A properly fused plug has to be tightly clung to the sleeve material sticking out for 1 to 2 mm above the generating line of the sleeve.



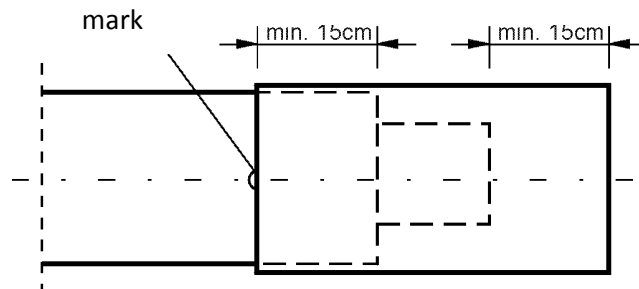
The joint should be free from any load until the area has cooled down to 25÷30°C so it can be touched.

6 Sealing and Insulating the Pipe End

To terminate the pipeline use the end cap, the PUR foam components A and B and heat shrinkable tapes – catalogue reference number NK – in accordance to the Product Catalogue ZPU Miedzyrzecz Sp. z o.o. System.

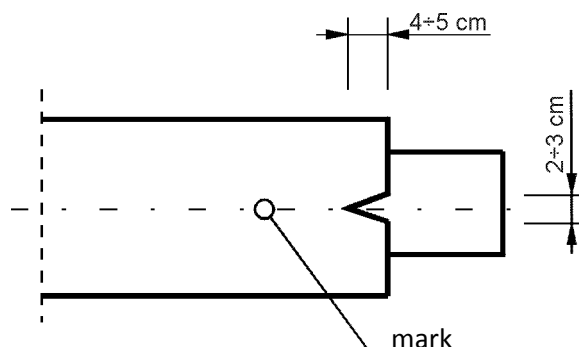
6.1 Preliminary and auxiliary steps

1. The top PUR insulation foam has to be removed from the insulation heads on those elements which are to be joined. Foam has to be removed – as in the joint assembly – over 3 to 5 mm from the head.
2. The case pipe area which has been made bare is now to be cleaned from dirt and fat.
3. Once these operations have been completed the exact location of the end cap has to be established. To do that, place an end cap temporarily in such a manner so that the distance from its bottom to the end of bare carrier pipe be no less than 5 cm. Then in that position, mark the edge contour of the end cap on the carrier pipe case. Then the end cap is removed. This should allow to establish the distance over which the cap has to be pressed onto the pipe once the PUR foam components A and B have been poured into the space between the carrier and case pipes. This is illustrated below:



Placing the end sleeve prior to pouring liquid PUR components

4. Cut out a V shape in the preinsulated pipe insulation. Its dimensions are indicated in the drawing below. The V cut will form a PUR foam filler gate.



Dimensions of the filler gate in the case pipe

The case pipe excess material and PUR foam in the opening are removed with a knife.

5. The end cap has to be secured in its position while the components A and B are poured in and foam is formed. It can be achieved by means of a pole or a retaining wall made from wood and fixed in the trench bed or trench wall.

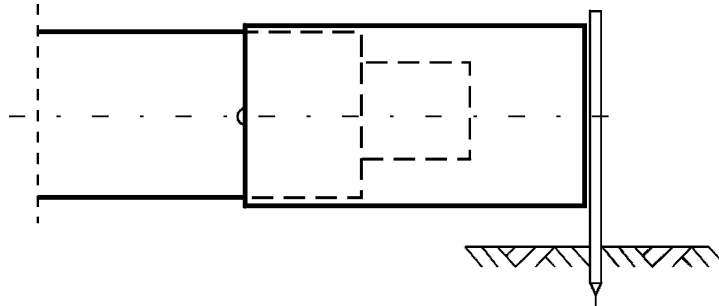
6.2 Making thermal insulation

1. The end cap is placed onto the foam filler gate near the pipe end.
The cap should go any deeper than 2 to 4 mm on the case pipe end so that it does not obscure the runner.
2. Now the end cap should be prepared prior to pouring in PUR foam. If the ambient temperature is below 20°C then the carrier pipe and the end cap should be heated with flame up to 50°C.
3. Then the components A and B should be mixed. This is done by pouring both components into one of the bottles in which they were delivered to the site, and then the mixed up components are poured through the filler gate into the space between the cap and tape. The time allowed for mixing and pouring in the liquid PUR foam into the space should not exceed 40 seconds.
4. Once the mixed components have been poured in, the end cap should be pressed down to the mark on the case pipe, that is to such a place where the distance from its bottom up to carrier pipe end does not exceed 5 cm. In this position the cap is to be secured against accidental dislocation in the direction opposite to that in which it was slid onto the case pipe.
After the PUR liquid foam has been poured into the space between the enclosing el-



ements, foaming will begin on itself confirmed by excess of foam coming out from under the cap end.

The end cap filled with foam has to be left untouched for 3 to 6 hours before the cap joint is to be sealed.



The end cap secured once liquid PUR components have been poured in

6.3 Sealing the pipe terminal

After 3 to 6 hours after the terminal is filled with PUR foam the pipe end can be sealed with heat shrinkable tape. This is done by placing a heat shrinkable tape in a similar way as it is done in the case of sealing a joint assembly.

1. First foam flashes formed around the end cap should be removed. This is done by means of a scraper as it is done when a joint assembly is made ready for sealing.
2. The case pipe bare and terminal tube sleeve ends should be roughed with sand paper where the heat shrinkable tape has to be applied.
3. The surfaces are now ready and sealing can be done with a heat shrinkable tape just like it is done when a joint assembly is sealed – see the detailed description in Point 5.3. “Thermal insulation sequence.”

7 Sealing the thermal insulation end

Thermal insulation is necessary when the preinsulated pipeline has to pass through building envelope elements in places where the insulation is terminated.

The insulation when sealed will stop moisture getting into it from the environment. The insulation has to be sealed whenever there is a possibility of it being flooded with water and when relative humidity is close to 100% either periodically or continuously.

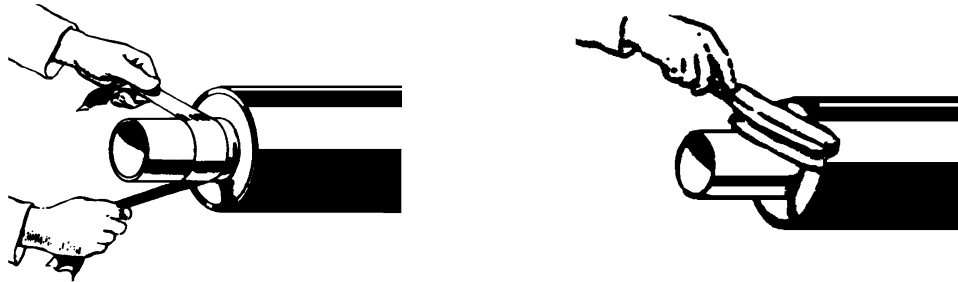
7.1 Necessary materials and tools

An End-Cap (heat shrinkable), Product Catalogue Reference No. **E**, **System ZPU Międzyrzecz Sp. z o.o.** is required to seal up the thermal insulation. The tool kit is identical to that which is needed to isolate and seal up the joint unit. A list of such tools is given on page 2 of this manual.



7.2 Sealing PUR insulation

1. The first thing that has to be done prior to sealing the PUR foam insulation is preparing the surface to which the heat shrinkable sleeve will adhere. This is done by cleaning the carrier pipe from the anticorrosive layer, dirt, fat and other similar contaminants, and doing the same on the internal surface of the case pipe over a distance of 5 cm from the head of the insulation along the pipe axis. Use a wire brush and sand paper.



Preparing case pipe and carrier pipe surface prior to the application of an End-Cap

2. The next step consists in heating up the carrier and case pipes. This can only be done when there is no moisture warning signal wire on the pipe. If such wires are embedded in the insulation, the warning system has to be first shut off or the wires output from the insulation and hooked up to the moisture warning device as indicated in the Manual "Alarm Wiring" for the **ZPU MIĘDZYRZECZ SP. Z O.O. SYSTEM**.

These operations completed, the carrier and case pipes should now be heated up. The end of the carrier pipe is to be heated with a soft flame from a gas burner over a distance of 5 cm from the insulation head up to 60°C. The case pipe is to be heated similarly: over a distance of 5 cm yet up to 40°C.

When the elements are being heated up avoid burning the alarm wiring and thermal insulation.



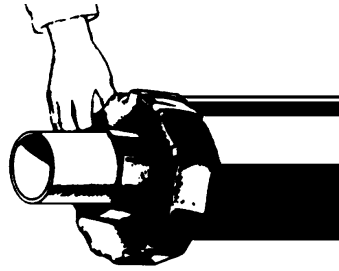
Heating up a carrier pipe (60°C) and case pipe (40°C)

3. Now a heat shrinkable end cap is slid onto the carrier pipe and case pipe in such a manner that the head of the case pipe comes in touch with the internal flat surface of the heat shrinkable end cap.



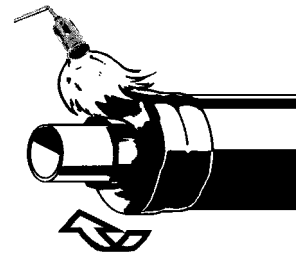
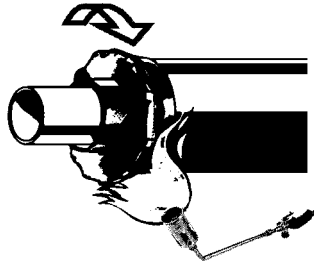
JOINT UNIT ASSEMBLY INSULATION AND SEALING

System ZPU Międzyrzecz Sp. z o.o.
Telefon +48 95 741-25-26, 742-33-00, 742-00-93,
fax. +48 95 742-33-01, 742-33-02



Position of the End-Cap prior to heating it up

4. This being done, proceed to shrink the cap. With a soft flame in circular movements the heat shrinkable sleeve is being shrunk over the case pipe. The shrinking begins from its external edge on the side of the case pipe and gradually the flame is moved towards the thermal insulation head.



Shrinking the End-Cap from the carrier pipe side

Once the cap has been properly shrunk on the case pipe, its other part places on the carrier pipe is to be heated up. Just like in the case of it being heated up on the case pipe this is done with a soft flame in circular movements until the sleeve clings to the surface tightly and uniformly to the carrier pipe.



The cap executed this way has perfect sealing qualities.

If the thermal insulation head from which alarm system wires are output is to be sealed, the sealing procedure should begin with shrinking the sleeve from the carrier pipe end and completing the procedure on the case pipe.

Care should be exercised not to break the tight transition of the alarm wire (a Bakelite gland) inserted into the sleeve.