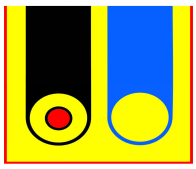

Pre-insulated Pipes for Underground Hot Water Networks
ZPU MIĘDZYRZECZ Sp. z o.o. System

MANUAL FOR EXECUTION AND HERMETIZATION OF COUPLING UNIT NT-Type Heat-Shrinkable Couplings

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1. Introduction

This manual contains a description of execution of:
Installation as well as thermal insulation and hermetization of the coupling unit under the trade name "NT" – heat-shrinkable sleeve, non-crosslinked and covered on the inside with an adhesive or mastic adhesive, sealed with heat-shrink bands – double sealed.

2. General terms and conditions of execution of thermal insulation and hermetization

2.1 Execution of thermal insulation and hermetization may only begin following:
- Pipeline tightness test, as satisfactory,
- Inspection and acceptance of welded couplings according to PN-EN ISO 17637 ("Non-destructive testing of welds - Visual testing of fusion-welded joints"), PN-EN ISO 17636-1 ("Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film"), PN-EN ISO 17640 ("Non-destructive testing *of* welds - Ultrasonic testing of welded joints"), PN-EN ISO 5817 ("Welding. Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded). Quality levels for imperfections"), PN-EN ISO 6520-1 ("Welding and allied processes. Classification of geometrical non-compliance welding in metals – Part1. Welding"),
- In case of a built-in pipeline leak detection system – having executed wire connections and after technical tests of the alarm system carried out in accordance with the manuals: *Pipeline Leak Detection. Impulse Warning System Connection*, *Pipeline Leak Detection – Connection of Signalling cables* or *Guidelines for Installation of BRANDES System for Pipes with Casing Made of Plastic*.

2.2 It is recommended that the sleeve installation, thermal insulation and hermetization of the coupling unit should be executed in favourable weather conditions:
– in dry, sunny weather,
– at the ambient temperature of over +5°C and not exceeding +35°C
– during windless weather.

In case it is necessary to execute coupling hermetization in unfavourable temperature conditions, high humidity (rainfall, thick fog) or strong wind, respective activities should be performed under a portable shelter, e.g. a tarp tent (protective tent).

2.3 The following are decisive for the durability and quality of the NT couplings to be executed:
– cleanliness of the bonded surfaces (lack of sand, dust, grease and other contaminants),
– dryness (there must be no moisture on the bonded surfaces),
– appropriate shrinkage of the ends of the heat-shrinkable sleeve (prevent overheating of polyethylene or underheating of the coupling end), as well as appropriate shrinkage of heat-shrink bands at both ends of the sleeve,

- maintaining appropriate temperature values of the PUR foam components (too cool coupling space while foaming results in incomplete coupling space fillings),
- foam component compounding accuracy and making full use of the mixture - PUR foam,
- pipe fitters' skill and experience.

2.4 Installation of the NT-type heat-shrinkable couplings may be executed only by trained staff, holders of training completion certificates issued by Zakład Produkcyjno Usługowy Międzyrzecz POLSKIE RURY PREIZOLOWANE Sp. z o.o., registered office at ul. Zakaszewskiego 4 in Międzyrzecz (Poland).

2.5 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 ca. 15 mm in depth.

2.6 The service pipe in the coupling unit must be cleaned to remove impurities, dust, etc.

2.7 The temperature of the surface of the service and casing pipes during execution of thermal insulation should be $30^{o}C \div 35^{o}C$.

2.8 The surface of the HDPE casing pipe of both bonded pre-insulated elements must be cleaned and dried along about 25 cm measured from the edge of the casing pipe at the coupling, and along a section of ca. 1 m where, prior to welding of the service pipes, the heat-shrinkable sleeve with heat-shrink bands will be drawn over.

2.9 The excavation at the site of execution of the thermal insulation and hermetization of the coupling unit must be widened and deepened by about 20 cm. During the process of laying of pre-insulated pipelines, the excavation should be kept dry and clean as well as protected against an inflow of surface water or groundwater. The table of rainwater or groundwater must not come into contact with thermal insulation (PUR foam) of pre-insulated products until the installation of the couplings (hermetization of pre-insulated pipeline welded joints) is completed.

2.10 The heat-shrinkable sleeve, protected with white foil (coupling cover), together with 2 pcs of heat-shrink bands suitable for a given sleeve size prior to welding of the service pipes, bonded pre-insulated elements, must be drawn over the previously cleaned and dried section (ca. 1 m) of the pre-insulated pipe.

3. Storage

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

2. The liquid components A and B of the PUR foam, portioned in plastic bottles separately for each coupling, should be stored at a temperature over $+15^{o}C$ and not exceeding $+30^{o}C$, in places not exposed to direct sunlight.

3. Heat-shrinkable sleeves, wrapped up in white foil, as well as heat-shrink band should be stored at a temperature below 25^{0}C, in a place not exposed to direct sunlight. Failure to meet the above requirements may result in deformation of the sleeve or deterioration of the heat-shrink materials.

4. Basic tools and materials

4.1 Basic tools necessary for execution of insulation and hermetization of coupling unit:

- power belt grinder – *Photo No 1*,
- wire brush – *Photo No 2*,
- foot pump – *Photo No 3*,
- knife or scraper – *Photo No 4*,
- hammer – *Photo No 5*,
- LPG blow torch – *Photo No 6*,
- thermometer to measure the temperature of the heat-shrinkable sleeve outside surface, e.g. pyrometer – *Photo No 7*,
- plug welder – *Photo No 8*,
- cordless drill with a bit to make filling holes 25 mm in diameter – *Photo No 9*,
- manual tapered end mill – *Photo No 10*,
- test pressure gauge with expansion plug – *Photo No 11*,
- foaming devices in case of mechanical filling of coupling space.

In case of installation of couplings with an alarm system, additional tools include:

- gas soldering iron – *Photo No 12*,
- combination pliers – *Photo No 13*,
- wire cutters – *Photo No 14*,
- resistance meter – *Photo No 15*.

The following pages present photographs of sample tools:

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Photo No 1 Power belt grinder

Photo No 2 Wire brush

Photo No 3 Foot pump

Photo No 4 Knife or scraper

Photo No 5 Hammer

Photo No 6 LPG blow torch

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Photo No 7 Pyrometer to measure temperature of heat-shrinkable sleeve - recommended

Photo No 8 Plug welder

Photo No 9 Cordless drill with a bit to make filling holes 25 mm in diameter

Photo No 10 Manual tapered end mill

Photo No 11 Test pressure gauge with expansion plug

Photo No 12 Gas soldering iron

Photo No 13 Combination pliers

Photo No 14 Wire cutters

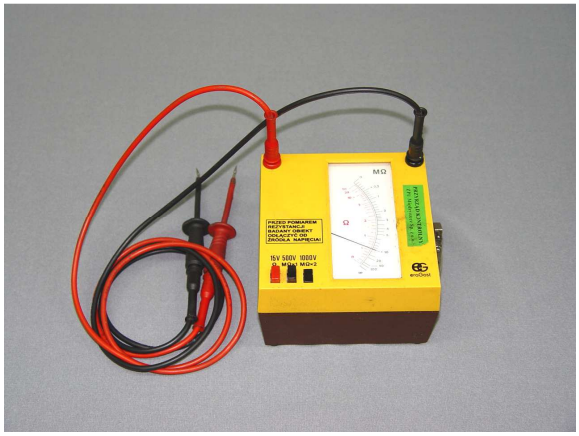

Photo No 15 Resistance meter

2. Thermal insulation and hermetization of the coupling unit should be made of materials included in the Product Catalogue, ZPU Międzyrzecz Sp. z o.o. System – Catalogue Symbol NT, namely:

– heat-shrinkable sleeve (wrapped up in white foil), manufactured with an adhesive - *Photo No 16*,
– 2 pcs of heat-shrink bands wrapped up in foil - *Photo No 17 and Photo No 18*
– components A and B of polyurethane foam, portioned in bottles - *Photo No 19*,
– electrically welded plugs and air vent plugs - *Photo No 20*.

Photo No 16 Heat-shrinkable sleeve wrapped up in white foil – applicable for NT type couplings

Photo No 17 Heat-shrinkable sleeve wrapped up in white foil and heat-shrink bands

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Photo No 18 Heat-shrink bands

Photo No 19 PUR foam (Component A+B)

a)

b)

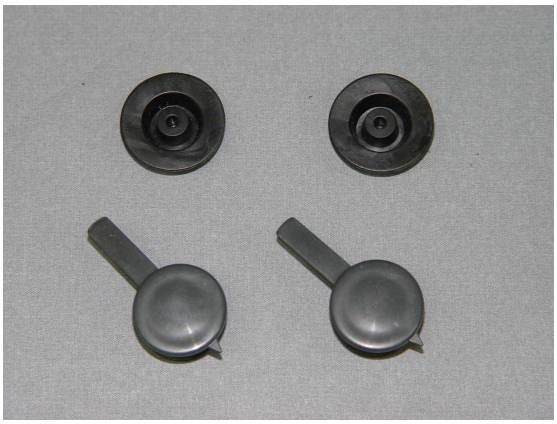

Photo No 20 Plugs:
- *a) electrically welded – non-crosslinked*
- *b) air vent plugs*

and additional supplementary materials:
- sandpaper,
- felt cleaning cloth,
- sponge or cloth,
- acetone or another degreaser,
- LPG,
- aluminium or wooden wedges - *Photo No 21*,
- protective gloves.

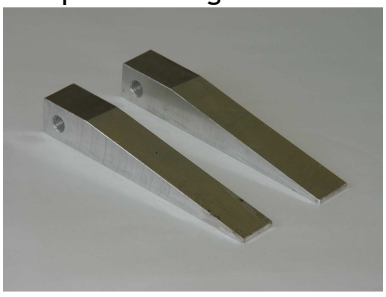

Photo No 21 Aluminium wedges

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5. Execution of thermal insulation and hermetization of HT-type shrinkable coupling

5.1 Preparatory and auxiliary activities

1. Installation of the NT coupling starts with removing, using a knife or a scraper, a part of the thermal insulation, the PUR foam insulation, up to 15 mm in depth, from the front of the pre-insulated elements *(Photo No 22)*.
   If the pre-insulated elements have built-in signalling cables, then this activity should be performed before these wires are connected.

Photo No 22 Removal, using a knife or a scraper, a part of the thermal insulation, the PUR foam insulation, up to 15 mm in depth, from the front of the pre-insulated elements to be bonded

2. Clean the service pipe to remove impurities, e.g. sand, dust, grease, etc., and if in the course of testing of the welded joints the weld was covered with lubricant, then this place must be degreased e.g. with acetone or another degreaser.

3. The surface of the casing pipe on which the sleeve and heat-shrink bands will be shrunk (the place where these will be installed) must be cleaned to remove solid contaminants, dried and torn off with sandpaper. In order to do this, remove from the surface of the casing pipes a layer of polyethylene of 0.1 to 0.25 mm thick by means of abrasive machining along a section of ca. 250 mm starting from the end of the insulation of the pre-insulated element. The abrasive machining works should be performed using a hand power belt grinder with sand belt of 50 to 70 grit or by hand *(Photo No 23)*.

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Photo No 23 Sanding of the casing pipe of the pre-insulated element using a belt grinder with sand belt of 50 ÷ 70 grit

4. The surface of the casing pipe, at the connection of the HDPE pipe and the heat-shrinkable sleeve and the heat-shrink bands, along about 25 cm measured from the edge of the casing pipe, and, additionally, along a section of ca. 1 m – the place where the heat-shrinkable sleeve will be located when the white foil is taken off – must, in order to avoid it being contaminated, be cleaned with acetone to remove impurities and then dried with felt cloth *(Photo No 24)*.

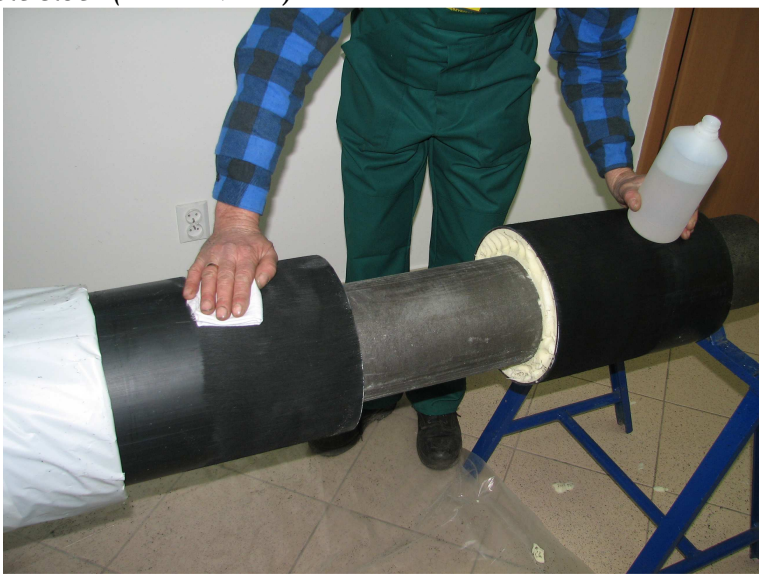

Photo No 24 Cleaning the casing pipe of the pre-insulated element with acetone

5. Connect the wiring of the alarm system (tinned copper with tinned copper and copper with copper) in accordance with the applicable rules included in the ZPU Międzyrzecz Sp. z o.o. System manual entitled *Pipeline Leak Detection. Impulse Warning System Connection; Wiring; Installation and Service Principles*. The wires must be connected by means of clamp couplings, and then soldered, checking the quality of the connection each time (conductor continuity and PUR foam insulation resistance between the wires

and the steel pipe). In case of a BRANDES alarm system, the alarm system wiring connection must be made according to the *Guidelines for Installation of BRANDES System for Pipes with Casing Made of Plastic*.

6. Prior to application of the sleeve upon the welded joint, the casing surface where the sleeve is shrunk must be heated with LPG blow torch flame. The temperature of the surface of the casing pipe should be minimum 40ºC one minute after the heating was stopped. The temperature of the casing pipe should be measured by a thermometer, either by contact or non-contact means.

5.2 Order of activities of NT-type heat-shrinkable sleeve installation

1. In order to provide for symmetrical location of the heat-shrinkable sleeve on the welded connection of the bonded pre-insulated elements, use a measure (folding measure ruler) and a white marker pen (a felt-tip or a correction pen) to mark the location of the outer edges of the heat-shrinkable sleeve *(Photo No 25)*:
   - measure the length of the sleeve, ”L” (e.g. for DN≤200mm, sleeve length is L= 600mm, for DN>200mm sleeve length is L=700mm),
   - measure the total length of steel pipe bare ends between the insulation fronts (e.g. 150mm+150mm=300mm for pre-insulated products with DN≤200mm, and for DN>200mm 200mm+200mm=400mm),
   - deduct the length of steel pipe bare ends from the sleeve length and divide the result by 2 (e.g. for DN≤200mm 600mm–300mm=300mm, hence 300mm/2= 150mm, and for DN>200mm 700mm–400mm=300mm, hence 300mm/2= 150mm),
   - the dimension calculated in this way (150mm), for the location of the outer edges of the heat-shrinkable sleeve, must be measured from the edges of the casing pipes of the bonded pre-insulated elements, and marked with a white pen.

Photo No 25 Marking of the calculated dimensions while determining the location of the edge of the heat-shrinkable sleeve

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2. Directly before the shrinking of the sleeve, the white foil must be taken off the sleeve along the ca. 1 m long cleaned section of the casing pipe of the pre-insulated element *(Photo No 26)*.

Photo No 26 Removal of the white foil from the heat-shrinkable sleeve

3. Before placing of the sleeve onto the welded connection of the bonded pre-insulated elements, the surface of the casing pipes – the place where the sleeve is installed – must be heated with blow torch ”soft” flame so that the casing pipe surface temperature, one minute after the heating was stopped, should be minimum 40°C. The temperature of the casing pipe should be measured by a thermometer, either by contact or non-contact means.
4. Draw the heat-shrinkable sleeve over the connection symmetrically, so that the overlap on the casing pipe was equal at both ends, in accordance with the marking of the location of the sleeve edge, as previously made.
5. Having heated the base surface and pulled the heat-shrinkable sleeve over the welded joint, directly before the shrinking, take off the inner foil protecting the adhesive or mastic adhesive in the sleeve *(Photo No 27)*.

Photo No 27 Removal of the inner foil protecting the adhesive in the heat-shrinkable sleeve

6. Having taken off the inner foil protecting the adhesive in the sleeve, insert aluminium or wooden wedges lifting the heat-shrinkable sleeve upwards, which will enable symmetrical shrinking of the sleeve at the ends of the pre-insulated element sections being bonded *(Photo No 28)*.

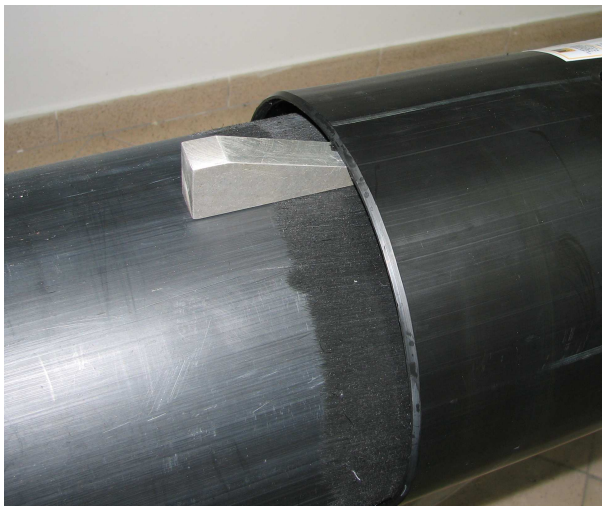

Photo No 28 Method of supporting the heat-shrinkable sleeve by means of wedges prior to the shrinking of the heat-shrinkable sleeve

7. Shrink the ends of the heat-shrinkable sleeve, along a section of ca. 15 cm, with LPG blow torch ”soft” flame *(Photo No 29 and 30)*.

   The heating of the sleeve ends should be done using blow torch ”soft” flame and should start along the sleeve circumference following a strip ca. 10 cm in width. The beginning of this strip is located ca. 5 cm from the edge of the sleeve, the end being ca. 15 cm from the edge of the sleeve. Afterwards, the sleeve edges should be shrunk (5 cm measured from the strip of ca. 10 cm, towards the sleeve edge) until the sleeve begins to stick tightly to the casing pipe of the pre-insulated element, along its entire circumference. The shrinking must be made by heating the sleeve evenly, in the circumferential direction, with blow torch ”soft” flame so as not to cause overheating of the sleeve and that the heat-shrinkable sleeve should become shrunk along the sections located on the casing pipes of the bonded pre-insulated elements. In order to avoid overheating of the heat-shrinkable sleeve during the execution of the shrinking activity, use a thermometer to measure the temperature of the sleeve outside surface. The temperature of the sleeve during shrinking should not exceed 110°C.

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Photos No 29 and 30 Shrinking of the ends of the heat-shrinkable sleeve with LPG blow torch "soft" flame

8. The surface of the shrunk ends of the heat-shrinkable around the circumference of the pre-insulated pipe and sleeve *(Photos No 31 and Nr 32)*.

Photo No 31 View of the heat-shrinkable sleeve following shrinking

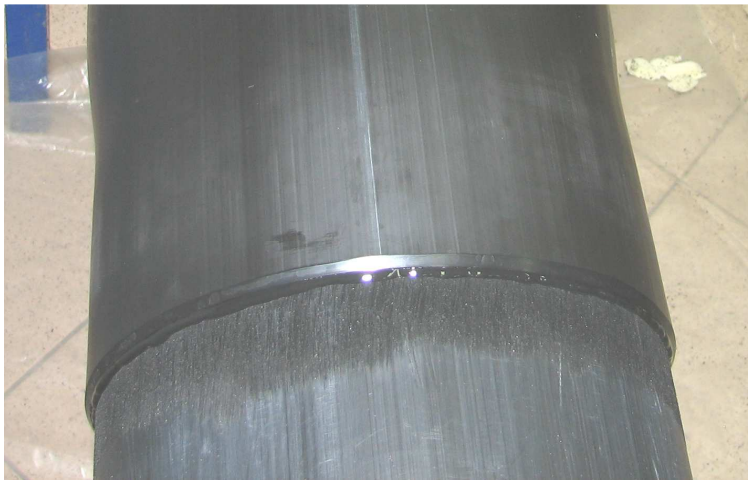

Photo No 32 View of adhesive binder flashes at the edge of the heat-shrinkable sleeve – the circumference of the pre-insulated pipe

6. NT coupling leak testing

A leak test of the NT-type coupling can start after it has cooled down, i.e. when the temperature on the surface of both ends of the heat-shrinkable sleeve (within strips of a minimum width of 150 mm at its shrunk ends) does not exceed 40°C. The lower the temperature of the NT coupling during the leak test the lower the risk of damage to the coupling (leakage) due to the leak test being performed too early.
The quality of the shrunk NT-type heat-shrinkable coupling depends on all factors comprising the technological process (i.e. the cleanness and dryness of the bonded surfaces and the fitter's experience).
The NT coupling leak-proof check should be performed in the following order:

6.1 Examine the external condition of the entire NT coupling visually and by touch. Attention should be paid so that:
- no creases, dents or cracks are admissible on the surface of the coupling,
- the surface of the entire coupling is smooth, with no visible discolouration.

6.2 In order to perform a leak test of the coupling with air or another inert gas, make, using a spade drill, one hole in the heat-shrinkable sleeve ø25mm in diameter to place a pressure gauge with an expansion plug. While drilling the hole, be careful not to damage the wiring of the alarm system.

The heat-shrinkable sleeve does not have factory-made vent-filling holes, therefore in order to perform the leak test it is necessary to make one hole in it for a pressure gauge with an expansion plug. The location of the hole depends on the diameter of the HDPE casing pipe of the bonded pre-insulated elements, because the hole, at a later stage of the coupling installation (having leak-tested the coupling successfully) will be used while executing thermal insulation as a filling inlet for PUR foam. For making thermal insulation of couplings installed on pre-insulated products with HDPE casing pipe diameter of ϕ>160 mm, it is necessary to drill two vent-filling holes ϕ25 mm, whereas

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for HDPE with a diameter of ϕ≤160mm one hole is sufficient, made at the stage of performing the coupling leak-test (there is no need to drill an additional vent-filling hole). Thus, in order to perform a leak test on a shrunk sleeve one hole must be executed, to be located:

- for HDPE ϕ≤160mm – in the middle of the sleeve length and on its upper surface,
- for HDPE ϕ>160 mm – at a distance of about 80 mm from the centre of the sleeve on its upper surface – as viewed from the side of the pre-insulated pipe *(Photo No 33)*.

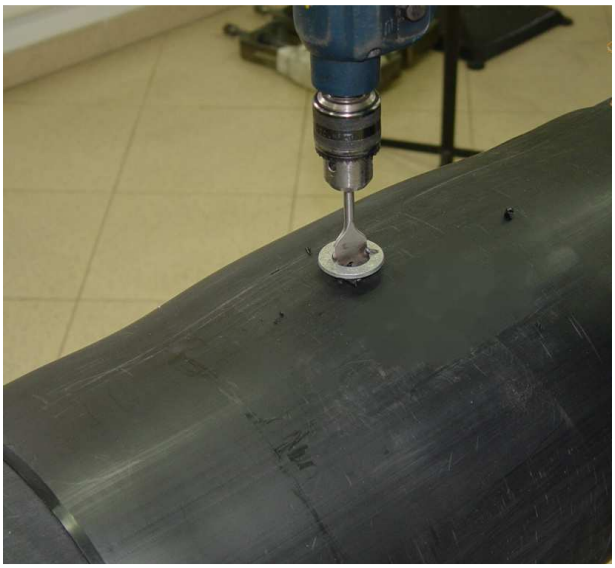

Photo No 33 Execution of a hole of 25 mm in diameter using a spade bit and a drill

6.3 Break the outer edges of the drilled hole with the diameter of ø25mm by means of a knife or scraper.

6.4 Mount a pressure gauge with an expansion cap in the hole made *(Photo No 34)*.

Photo No 34 Mounting of a pressure gauge

6.5 The tightness of the welded connections in the NT coupling should be verified using soapy water (i.e. de-ionized water solution containing ca. 3% of a detergent). Firstly, fill the coupling with air or another inert gas (N_2 or CO_2) to reach overpressure of 0.25 bar *(Photo No 35)*. If within two minutes the pressure demonstrated by the pressure gauge does not decrease by more than one graduation, the condition is met. Afterwards, using a brush or spray, apply the solution, as previously prepared, all over

the coupling edges, making a stable foam with brush strokes at the same time. The tightness of the coupling is to be inspected visually – the coupling is tight if there are no ”soap bubbles” on the sprayed surfaces of the coupling, nor is an increase in the volume of the foam observed.
Following such a leak test, one can proceed to shrink the heat-shrink bands (placed on the pipeline before the welded connections with the sleeve are executed) at both ends of the heat-shrinkable sleeve, and then to execute the thermal insulation of the coupling – filling the space of the NT-type coupling with polyurethane foam.

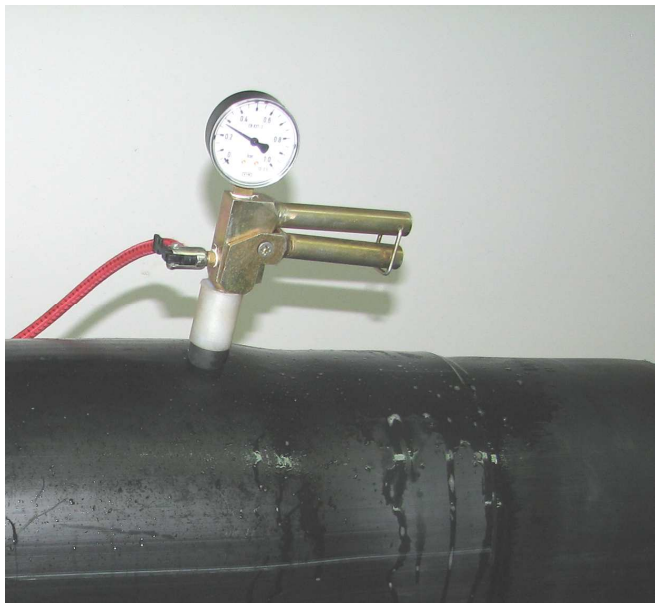

Photo No 35 Filling the coupling with air

7. Order of activities of NT-type coupling heat-shrink band installation.

1. Following execution of the shrinking of the sleeve ends and having leak-tested the coupling successfully, one should proceed to install the heat-shrink bands. First of all, the surfaces of the casing pipes and the heat-shrinkable sleeve – the place of the installation of the heat-shrink bands - must be prepared. These surface must be cleaned to remove impurities and then dried. To this end, first remove dust, dirt and water and degrease with acetone, then take off a layer of polyethylene of 0.1 to 0.25 mm thick by means of abrasive machining along a section of ca. ±150 mm(2x150mm) starting from the edge of the shrunk heat-shrinkable sleeve. The abrasive machining works should be performed by hand, using sandpaper of 50 to 70 grit *(Photo No 36)* or by means of a hand power belt grinder of this grit. Afterwards, the surfaces should be cleaned with acetone to remove impurities and then dried with felt cloth.

Photo No 36 Hand cleaning by means of sandpaper of 50 ÷ 70 grit of the place of the installation of the heat-shrink bands: the surfaces of the pre-insulated element and heat-shrinkable sleeve casing pipes

2. Prior to the shrinking of the heat-shrink bands on the sleeve, the casing pipe and the sleeve itself (in case the sleeve has cooled down to ambient temperature) must be heated up to a temperature of ca. 40°C, only then one can proceed to shrink the heat-shrink bands (*Photo No 37*).

Photo No 37 Heating of the cleaned sleeve and casing pipe to a temperature of ca. 40 ℃

3. Draw the heat-shrink bands symmetrically over the cleaned casing pipe and sleeve surfaces, then take off the foil protecting the bands against dirt *(Photo No 38)*.

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***Photo No 38** Putting the heat-shrink bands in place for installation and removing the dirt-protecting foil*

4. Having removed the foil protecting the bands against dirt, the bands are to be placed centrally on the edge of the heat-shrinkable sleeve – in a symmetrical way so that the centre of gravity of the band coincided with the end of the shrunk heat-shrinkable sleeve *(Photo No 39)*.

***Photo No 39** Placing the heat-shrink bands centrally on the edge of the heat-shrinkable sleeve*

5. Remove the inner dirt-protecting foil from the heat-shrink bands *(Photo No 40)*.

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Photo No 40 Remove the dirt-protecting foil from the inner surface of the heat-shrink bands

6. Shrink the heat-shrink band, starting on the side of the heat-shrinkable sleeve. For shrinking, use an LPG blow torch producing ”soft” flame. While shrinking with a blow torch, make circumferential movements, avoid direct heating of the sleeve *(Photos No 41 and Nr 42)*.

Photos No 41 and 42 Shrinking of the heat-shrink band on the sleeve’s side

7. Afterwards, the remaining part of the band must be shrunk on the pre-insulated pipe, in a way as provided in Paragraph 6, avoid direct heating of the casing pipe *(Photo No 43)*.

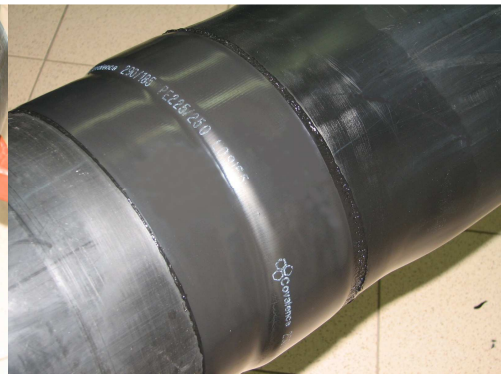
Photo No 43 Shrinking of the heat-shrink band on the casing pipe's side

8. The heat-shrink band located on the other side of the sleeve is to be shrunk in the same way as the first one *(Photo No 44)*.

Photo No 44 Shrinking of the heat-shrink band located on the other side of the sleeve

9. Having executed the shrinking, the surface of the band should be smooth, without hollows, and the binder – visible along the entire length of the edge *(Photos No 45 and*

10.



11.

12. ***Photos No 45 and 46 View of the heat-shrink band following shrinking, with a visible binder***

***46)*.**

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8. Execution of thermal insulation of NT-type coupling

8.1 In order to execute thermal insulation in the coupling for HDPE casing pipe diameter of ϕ>160 mm, it is necessary to drill an additional (second) filling hole ϕ 25 mm. The second filling hole it to be drilled using a spade drill at a distance of ca. 80 mm from the sleeve's axis of symmetry (the holes should be spaced symmetrically with respect to the centre of the sleeve). Make the second hole so as not to damage the alarm system wiring. For HDPE casing pipes with a diameter of $\phi\leq$160mm there is no need to execute an additional hole (the hole prepared for the leak test should be used for this purpose).

8.2 Next, prepare the liquid PUR foam components to execute the thermal insulation of the coupling. The components A and B of the PUR foam are provided in plastic bottles, separately for each coupling, depending on the nominal diameter of the service pipe (portioned in bottles). 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 (light) intended for a coupling with a nominal diameter of 65 mm.

COMPONENT B DN 65

refers to Component B (dark) for a coupling with the same nominal diameter.

The two components A and B for a service pipe of the same nominal diameter comprise a complete 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 bottle containing the components.

The temperature of the PUR foam components prior to foaming should be 20°C÷25°C. Before foaming, using a thermometer, check the temperature of the sleeve surface which should be ca. 30°C÷35°C. In case lower sleeve temperatures are reported, the sleeve should be heated carefully with a blow torch – "soft flame" – so that the desired surface temperature is reached of 30^{O}C ÷ 35^{O}C. The temperature of the sleeve during the process of foaming should not exceed 40°C.

The content of the bottle containing Component A (the smaller bottle) should be poured into the bottle with Component B (the bigger one). The pouring may be done in any order, i.e. A into B or B into A. One should make sure, however, that there is enough room for both components to go into the bottle in which they will be mixed *(Photo No 47)*.

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Photo No 47 Pouring of Component A into the bottle containing Component B of the PUR foam

After the components are poured together and the cap is twisted closed, both components should be mixed *(Photo No 48)*, and then poured through one of the filling holes into the space of the coupling being insulated *(Photo No 49)*. The time of pouring the components together, mixing and filling into the coupling, should not exceed 40 seconds altogether.

Photo No 48 Mixing of Components A and B of the PUR foam

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Photo No 49 Pouring of the PUR foam into the coupling space

8.3 Having poured the mixed components of the PUR foam into the space of the coupling, place the air vent plugs into the holes, i.e. 1 air vent plug for a HDPE casing pipe of a diameter of $\phi \leq 160$mm and 2 air vent plugs for a HDPE casing pipe $\phi > 160$ mm (relative to the number of vent-filling holes, as previously made), so as to catch the first notch of the plug, whereas the vent hole in the plug remains unobstructed *(Photos No 50 and 51)*.

Photos No 50 and 51 Placing air vent plugs in filling holes

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The process of coupling deaeration is continued until the first flash of the PUR foam appears in the plug vent hole. When the PUR foam appears in the vent hole, the plug must be hammered down. Small amounts (no more than 8 cm^3) of PUR foam flash from vent plug holes are admissible, after which the vent plugs must definitely be hammered down.

8.4 The thermal insulation, as executed, should be left for a period of 3 to 6 hours, until the PUR foam becomes chemically bonded.

8.5 Afterwards, proceed to execute hermetization of the coupling by means of electrically welded plugs.

9. Execution of hermetization of NT coupling by means of electrically welded plugs

9.1 Having executed the foaming of the coupling, the vent plugs must be mechanically removed from the filling holes – the places where electrically welded plugs will be installed *(Photos No 52 and 53)*.

Photos No 52 and 53 Removing vent plugs from the filling holes

9.2 Using a scraper, remove the foam under the edges of the holes ca. 5 mm in depth *(Photo No 54)*.

Photo No 54 Removal of PUR foam from the filling holes ca. 5 mm in depth

9.3 Using a manual tapered end mill, bevel the edges of the filling holes *(Photo No 55)*.

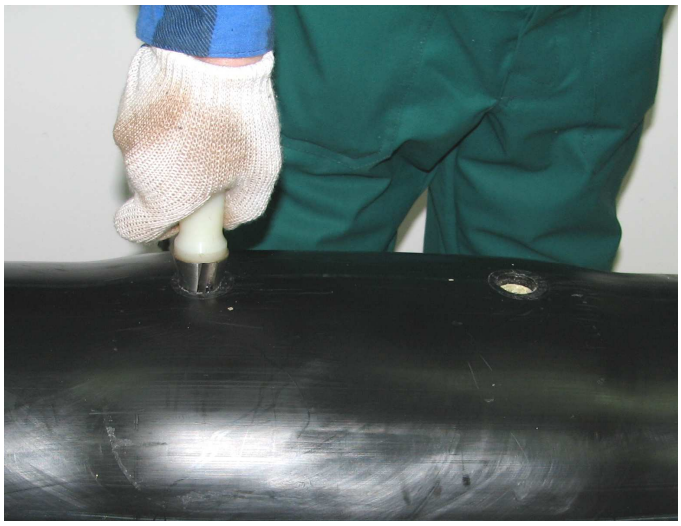

Photo No 55 Bevelling of the edges of the filling holes using a manual tapered end mill

9.4 Carefully clean the edges of the filling holes and the surface of the sleeve around these holes of any remains of the polyurethane foam, degrease with a clean cloth with a solvent (acetone) and dry thoroughly *(Photo No 56)*. The cleaning of the places of installation of the welded plugs must be executed wearing clean cotton gloves. These activities must be performed with particular caution, because proper execution of the coupling hermetization depends on how accurately they are performed.

Photo No 56 Cleaning of the filling holes: the place where the welded plugs are installed

9.5 Degrease the plug with a clean cloth (felt cloth) and a solvent (acetone), and then dry thoroughly.

Warning: The below activities must be performed with particular caution, because proper installation of the plug, as well as ensuring appropriate durability and the tightness of the coupling, depends on how accurately they are performed.

9.6 The plug installation activities should start with heating the base (the edge of the filling hole in the muff) and the degreased plug, as placed in the welder, for 1 minute. While heating the edge of the filling hole and the plug, the plug welder control should be set in such a way that the actual temperatures on the welder head were 220-230°C. The actual temperature should be verified by means of direct measurement, using a thermometer, by contact. *(Photo No 57)*.

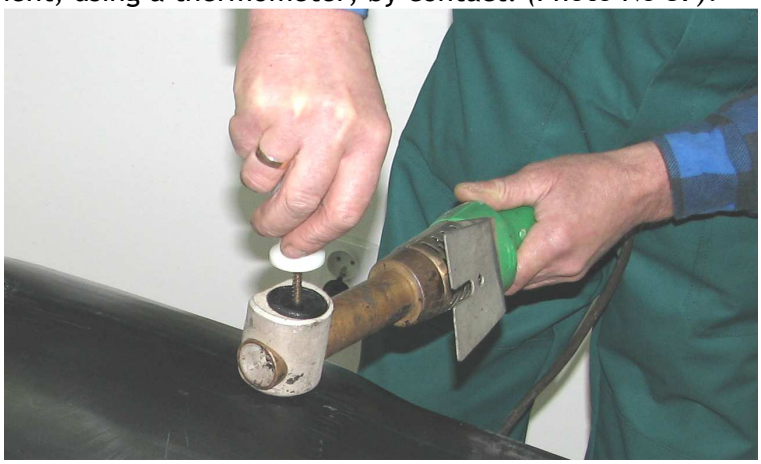

Photo No 57 Heating up to achieve softening of the filling hole edge and the plug conical surface by means of a plug welder

9.7 Next, press the heated plug quickly and strongly into the filling hole and keep it there, pressing in a motionless way, avoiding, in particular, swaying and twisting of the plug – until the softened surface of the plug and hole cools down and hardens *(Photos No 58 and 59)*.

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Photos No 58 and 59 Placing the heated plug in the filling hole of the coupling

9.8 Level the surface of the plug, so as to avoid its extensive sticking over the surface of the muff. A properly welded plug must adhere tightly to the sleeve material, must not be pressed too deep and should not protrude more than 1 mm ÷ 2 mm over the outer surface of the sleeve. Even flashes of the melted material of the plug and the filling hole edges are an indication of proper welding and tightness of the coupling *(Photo No 60)*.

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Photo No 60 View of a properly installed welded plug

The second plug is to be installed in the same way as the first one.

The coupling should not be loaded mechanically until its surface cools down to ca. 25÷30ºC, i.e. a temperature which enables it to be touched.

Warning: ***In case of application of pre-insulated products equipped with an alarm system, a control measurement of the alarm system must be taken in order to check for proper wiring connection within the executed coupling.***

10. Important additional information

10.1 This Manual does not contain all necessary information regarding the installation of NT-type heat-shrinkable couplings, and in particular it does not substitute for a training at the premises of ZPU Międzyrzecz Sp. z o.o. on the installation thereof and does release from the obligation to participate in this training.

10.2 Persons executing the installation of NT-type heat-shrinkable couplings are obliged to acquire appropriate qualifications and expertise as necessary to install NT couplings and are fully responsible for proper installation of these couplings.