RADPOL
PIPES

PRE-INSULATED
PIPE SYSTEM
INSTALLATION MANUAL

1 TASKS BEFORE PIPE INSTALLATION

1.1 Delivery

Pre-insulated pipes are delivered in 6 m, 12 m and 16 m sections by trucks.
The pipe ends as well as the ends of pre-insulated components are covered for the time of transport and storage with caps to ensure protection against contamination of the carrier pipe interior.
The buyer or recipient shall provide the necessary unloading equipment as well as a team for unloading operations.
The weights of pipe and piping components are specified in the product catalog in the corresponding tables. Do not carry out any unloading operations at an ambient temperature below –15°C.
The recipient shall check the method of the delivery and its compliance with the purchase order. The pre-insulated pipe and components in as shipped condition must be supported at equal spaces and secured against shifting.
The maximum allowable pressure on the casing of pre-insulated components during shipment and unloading comes to 0.3 MPa, and 0.2 MPa during storage.

All complaints related to delivery are to be filed with RAPDOL PIPES sp. z o.o.

1.2 Unloading

Pipes, Joints and valves shall be unloaded with maximum care.
They must not be dropped off the truck. The unloading operation must be carried out using lifting equipment that will not cause any damage to the pre-insulated pipe casing or dents in the foam material. The accessories used as well as the pre-insulated pipe lifting method should ensure pipe protection against excessive bending during unloading. No steel ropes or chains must be used for pipe unloading.
The pipes may be unloaded using forklifts provided that the pre-insulated components were stacked using spacers or were placed on pallets.
Examples of unloading methods using a crane or an overhead traveling crane are shown in fig. 1.

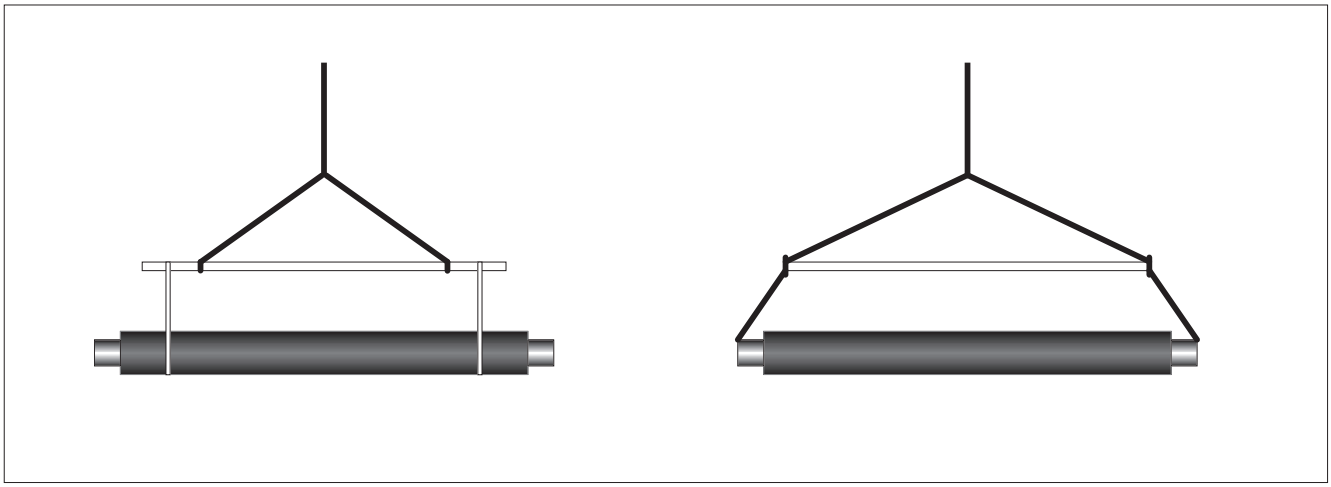


Fig. 1. Pre-insulated pipe unloading methods

1.3 Storage

Pipes in a stored condition should be laid horizontally on a flat base making contact with the base surface over their entire length. Alternatively, the pipes may be placed on timber supports spaced at maximum 2 m.
The supports should be at least 12 cm wide, whereas the height of a pipe stack must not exceed 1.5 m. The pipes shall be laid according to their size range.

An example of a storage method is shown in fig. 2.

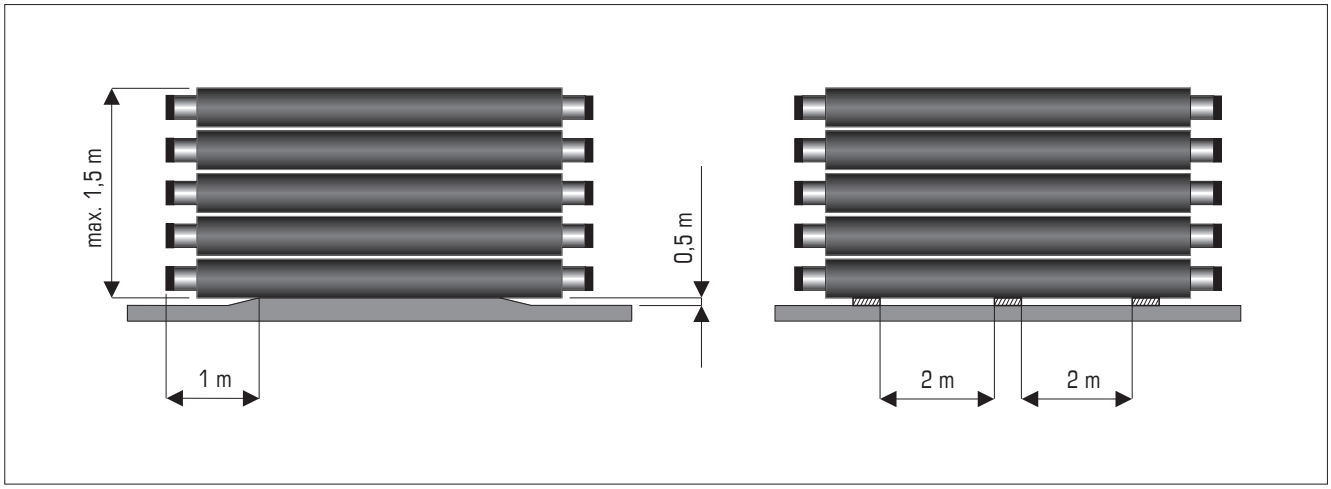


Fig. 2. Pre-insulated pipe storage rules

Pre-insulated joints and valves shall be stored on a flat base, preferably placed on pallets. Insulating kits, signaling systems and other accessories shall be protected against moisture. Joints shall be stored vertically. Heat-shrink materials shall be stored in dry rooms ensuring protection against sun and high temperature. During a long-term storage pre-insulated products shall be protected against direct exposure to sun, rain or snow.

Foam insulation chemicals (isocyanate and polyol) shall be stored in closed containers at a temperature of approx. 15°C. The chemicals must not be stored in rooms available to unauthorized persons, nor in office or staff welfare rooms. When handling the chemicals follow the guidelines specified in the manual provided.

Note
If the temperature of foam compounds drops down below +18°C, before application of the foam move the products to a warm room until they reach temperature of 18 to 22°C. Do not allow the "B" compound (isocyanate) temperature to drop down below +10°C since in such conditions the product crystallizes.

1.4 A list of special tools and equipment required for pre-insulated pipe install ation

Before pre-insulated pipe installation works the contractor shall provide their employees with the necessary tools, equipment and m aterials.

Tools or equipment	Application
Linen straps	For unloading or lowering pre-insulated pipes to a trench
LPG torch with a special nozzle and a gas cylinder fitted with a regulator	For shrinking heat-shrink joints and end caps
Pressure test kit	For testing joint leak-tightness
A fitter's knife	For cutting heat-shrink tape
A cone cutter and a drill	A 27 cone cutter for drilling or reaming holes for fused blanking plugs
A wood cutting or metal cutting saw	For PE pipe cutting
A chisel	For removing PUR foam
Wire brush	For cleaning steel pipes
1.0 m measure	For measuring pipes, joints and insulation length during joint installation
BS-AZ* pliers	For stripping insulation off the alarm signaling wires of the Brandes system
BS-QZ* pliers	For crimping ferrules over alarm signaling wires
Electric air heater*	For shrinking heat-shrink tubes over crimping ferrules
Cutting pliers	For cutting alarm signaling wires to length
BS-MH2*, BSMH3*, LH20S* testing devices	For measuring lengths of alarm signaling loops and insulation dryness
An ohmmeter**	For measuring resistance of measuring loops
Lx9024*** testing device	For measuring loop lengths and accumulation of moisture in foam with a impulse system
Tin and soldering paste***	For soldering crimping ferrules in the impulse alarm signaling system
Plug holder	For correct plug holding during heating and fusing with a joint
A vibratory compacter	For trench compaction and filling
Shielding plates	For foam shielding during welding works
Plug welding machine	For fusing plugs blanking off the fill openings in joints

* for installation and inspection of the resistance alarm signaling system
** in case of using the BS-MH2 testing device
*** for installation and inspection of the impulse alarm signaling system

Apart from the aforementioned tools and equipment the contractor shall also provide equipment for earthworks, welding works and relevant personal protection equipment (first aid kits, work gloves, helmets, etc.).

1.5 Excavation

A trench shall be provided so as to enable pipe placement as shown in fig. 3. The trench shall be provided with the following:

- at least 10 cm pipe bedding made of sand free of stones, debris and sharp-edged objects (sand of 0-8 mm in grain size, in a compacted condition)
- at least 10 cm backfill over a pipeline made of sand free of stones, debris and sharpedged objects
- at least 40 cm backfill measured, for example, from a road base course including sand backfill
- for non-cohesive soils, at depths over 1 m, it is recommended to provide a sloped trench

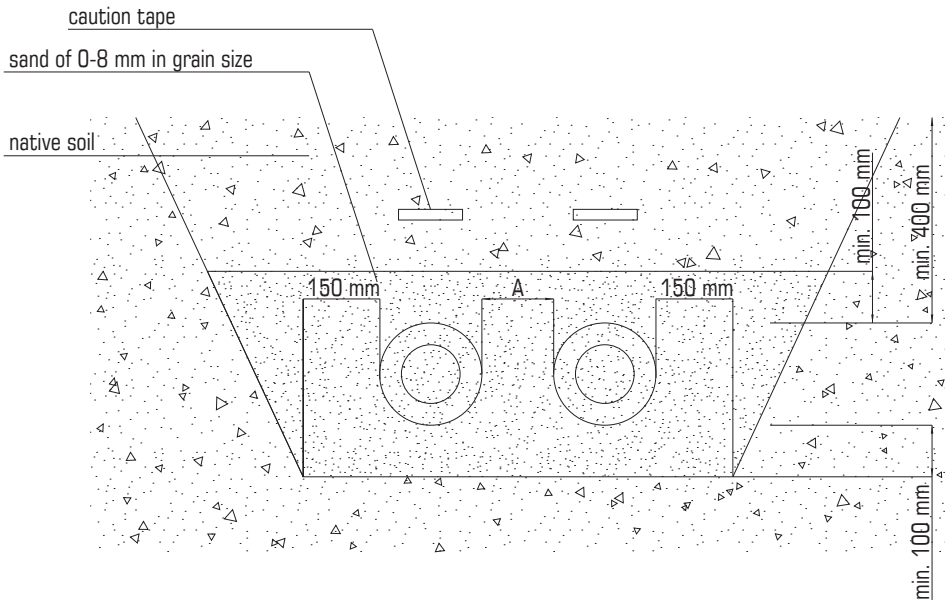


Fig. 3. Placement of pre-insulated pipes in a trench

A≥140 mm for DN<200 mm
A≥200 mm for DN≥200 mm
A≥250 mm for DN≥300 mm
The trench must be backfilled so that the filling and compaction do cause damage to pipes and joints.

Note

- *at branches provide at least a 40 cm backfill measured from the uppermost branch point*
- *in shallow areas where a 40 cm thick backfill is not possible or in areas exposed to high loads, use a reinforced concrete relief slab placed beneath the pipeline*
- *in case of periodic presence of groundwater or when placing the pipeline in an impervious soil, the trench depth shall be increased by 10 cm to enable placement of a drainage course*
- *it is recommended to lay the pre-insulated pipe system above the maximum groundwater level*

Wherever pipelines are constantly exposed to groundwater, water ingress at joints shall be prevented through the right choice of a special joint installation method:

- electric welding of joint
- radiation cross-linked heat-shrink joint double sealed with an adhesive and mastic

The trenches for pipe placement, including the base preparation, shall be consistent with the guidelines included in the design documentation. Construction works and the trench shoring methods shall comply with the applicable OH&S regulations and reference standards.Ordinance of the Minister of Infrastructure of February 6, 2003 on occupational health and safety during construction works (Journal of Laws of 2003 No. 47, item 401). PN-EN 13941 Design and installation of preinsulated bonded pipe systems for district heating.

1.6 Conflicts

A pre-insulated district heat distribution piping system may be placed both above and beneath buried utilities (but not in parallel). Detailed solutions for crossings shall be provided in the basic design. Trenching at crossings shall be performed manually with extra care.

1.7 Heat distribution piping system siting

The preferable piping system siting is away from roadways, except for lateral crossings.
Distance from buildings and structures.
The heat distribution piping system shall be routed at a suitable distance from buildings and structures enabling their repairs and replacement.

Minimum distance from buildings and structures

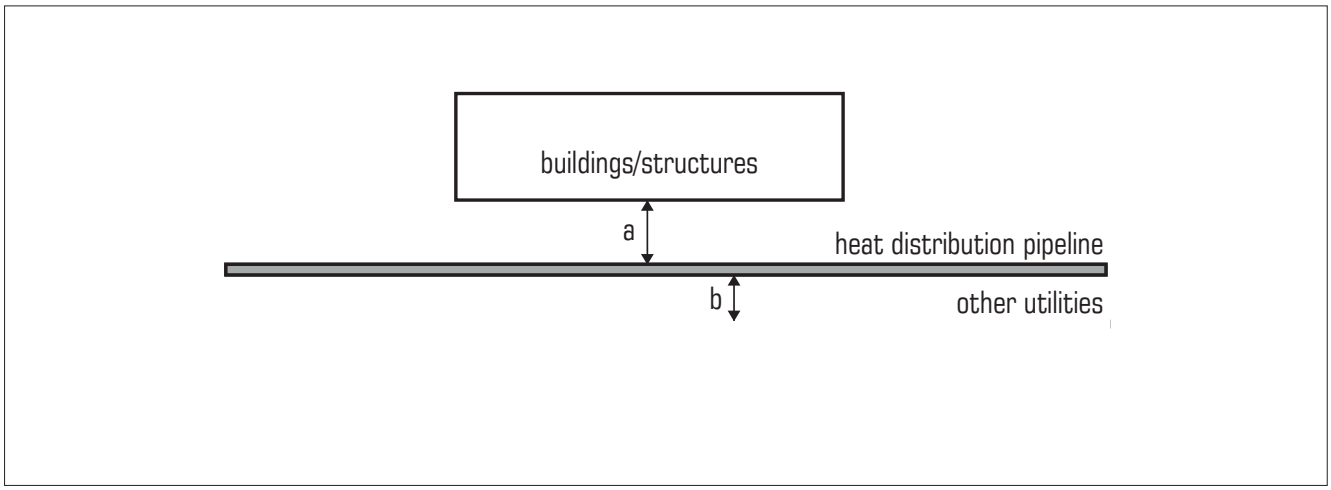


Fig. 4. Heat distribution piping system siting

- a width of the zone measured from a straight casing pipe side to buildings and structures
  for 32<DN<200 –> amin = 2.0 m
  for 250<DN<600 –> amin = 3.0 m
  for DN>600 –> amin = 5.0 m

- minimum distance from buried utilities

A heat distribution pipeline may be placed in parallel to buried utilities at a minimum distance (measured from the side of a pre-insulated pipe) specified below:

from a water line	bmin –> 1,0 m
from sewer piping	bmin –> 1,0 m
from trees	bmin –> 2,0 m
from a gas pipeline	bmin –> 1,0 m
from power cables	bmin –> 1,0 m

- crossings beneath circulation routes

crossings beneath roadways – it is recommended to route pipelines in encasement pipes; the encasement pipe type to meet the building permit design crossings beneath tramway tracks – ditto
crossings beneath railway tracks and sidings – to be decided and coordinated on a case-bycase basis.

2 PRE-INSULATED PIPE SYSTEM INSTALATION

2.1 Pre-insulated pipe system installation general guide lines

In order to ensure correct quality of a pre-insulated piping system installation it is necessary to follow a suitable installation seque nce:

- digging a trench as described in point 1.5, trench bottom grading works and sand
- bedding compaction to a suitable degree
- checking each pre-insulated component visually and in terms of alarm signaling system
- operation before placement in the trench
- placement of pipes and components inside the trench
- pipe welding and testing of welded joints
- connecting the alarm signaling system and routine inspections of each connected
- component based on a cumulative progress
- joint assembly installation w orks
- provision of expansion zones with the use of expansion pads
- backfilling of the trench using sand and native soil, and placement of a caution tape over a partially backfilled pipeline

2.2 Pipe placement

When proceeding with pipeline installation works place the pipes inside the trench. It is recommended to place the pipes on timber pads of approx. 10 cm in thickness, placed on the trench bottom at a maximum distance of 2 m between each other. Set the relevant levels by adding sand or by undermining the pads. The timber pads may be substituted with sand hills.
Prior to completion of the installation works remove the timber pads while placing the sand backfill.
When placing the pipes inside the trench bear in mind two ground rules:

1. The flow pipe must be always placed on the right-hand side looking from the heatsource.
2. The sensor wire in pre-insulated pipes must be always placed on the right-hand side looking from the heat source.

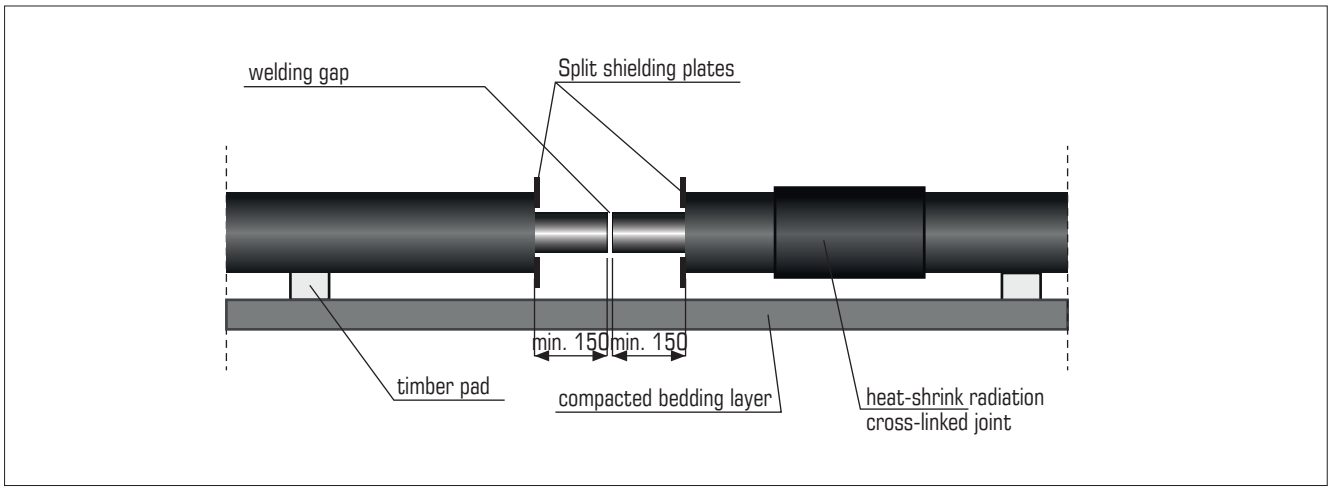


Fig. 5. Setting methods for welding ends

2.3 Erection of pipelines

Before proceeding with the welding works ensure that all the necessary components have been slipped over the pipes (heat-shrink joints, sealing rings, heat-shrink end cap). Before making a weld, the pipe in the area of the joint shall be cleaned to remove dirt, oil and water. For the time of welding works the surrounding area shall be shielded against wind and rain. At high air humidity and ambient temperature below 5°C the weld must be heated to avoid condensate formation. Welding can be performed at temperatures down to –5°C when using a heated tent. The pipes shall be positioned coaxially.
Small misalignment is allowed at the joint between steel pipes as specified below.

- for DN≤250 max 3°
- for DN300 max 2,5
- for DN400 max 1,5
- for DN500 max 1,0
- for DN600 max 0,8

During welding works the insulation foam of pre-insulated components as well as the casing must be protected against heat and welding spatter. If the flow pipeline is placed at a close distance to the return pipeline the adjacent pipeline must be protected by taking suitable measures. It is allowed to weld several pipeline components outside the trench and to lower the complete spool to the trench by taking care to prevent damage to the welded components and the casing.

Welding procedures must be defined and approved according to PN-EN ISO 15609-1 and PNEN ISO 15609-2. For pipes with a wall thickness of > 3 mm the recommended processes include arc welding with a coated electrode and a shielded metal arc welding. The welding ends must be prepared according to PN-ISO 6761 and PN-EN ISO 9692-2.Joints between pipeline sections with a variable wall thickness must be made according to PNEN 13941:2009+ A1:2010, chapter 7.5.6.1 table 10.

Once the welding works are complete test the welded joints and perform a pressure test. Depending on the designed performance class the individual welds shall be tested. General requirements are specified in PN-EN 13941. The recommended method is ultrasonic testing or radiographic testing for pipelines laid in constrained areas. Welds that do not meet specified requirements shall be repaired or removed. The required welding accuracy shall meet the requirements of PN-EN ISO 5817.

- at least C for DN < 400
- at least B for DN > 400

Pre-insulated galvanized pipes shall be joined using 18MF or 18XFC brazing alloys from Castolin and type 18 flux. The function of the flux is to:

- prevent oxidation of the zinc coating
- indicate that the galvanized pipe achieved the brazing alloy melting point (i.e. approx. 780°C) in the heated area
- deoxidation of harmful substances released during brazing

For brazing use an oxyacetylene torch set to a light oxidizing flame. Before brazing heat the brazing area previously covered with flux until the metal glows white. Next tack weld the pipes to be joined and proceed to brazing proper. Once the joint to be brazed achieves the brazing alloy melting point (approx. 780°C) the flux will clearly start to melt. This indicates that brazing alloy should be fed. It is recommended to protect the PU insulation with shielding plates during welding or brazing. An approximate quantity of brazing alloy required to make a single joint is specified in the table below.

Diameter of the pipeline	Brazing alloy quantity (in grams)
26,9/90	15
33,7/90	20
42,4/110	22
48,3/110	25
60,3/125	30
76,1/140	45
88,9/160	60
114,3/200	75

When installation pipes with alarm signaling wires position the pipe sections so that the measuring system wires (red wire for the resistance system, tinned wire for the impulse system) are located on the right hand side looking – from the h eat source:

- for pipes DN⩽400 the alarm signaling wires are to be positioned at "ten to two" (see fig. 6a)
- for pipes DN⩾500 the alarm signaling wires are to be positioned at "ten to two and twenty to four" (see fig. 6b)
- for pipes DN⩾800 the alarm signaling wires are to be positioned at "ten to two, quarter to three and twenty to four" (see fig. 6c)

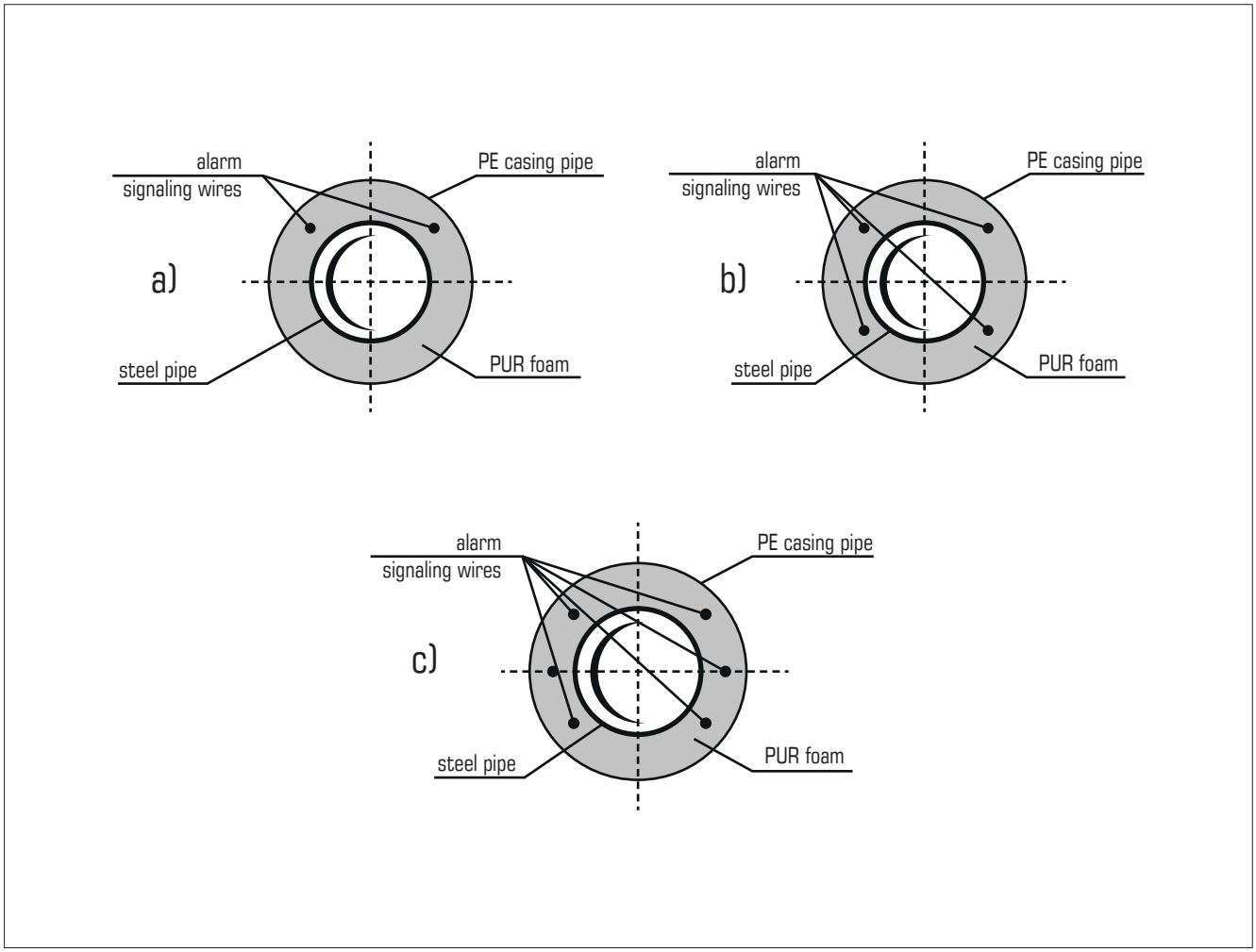


Fig. 6. Recommended positions of alarm signaling wires

Note the position of measuring system wires in line with fig. 6. This is important for operational reasons.

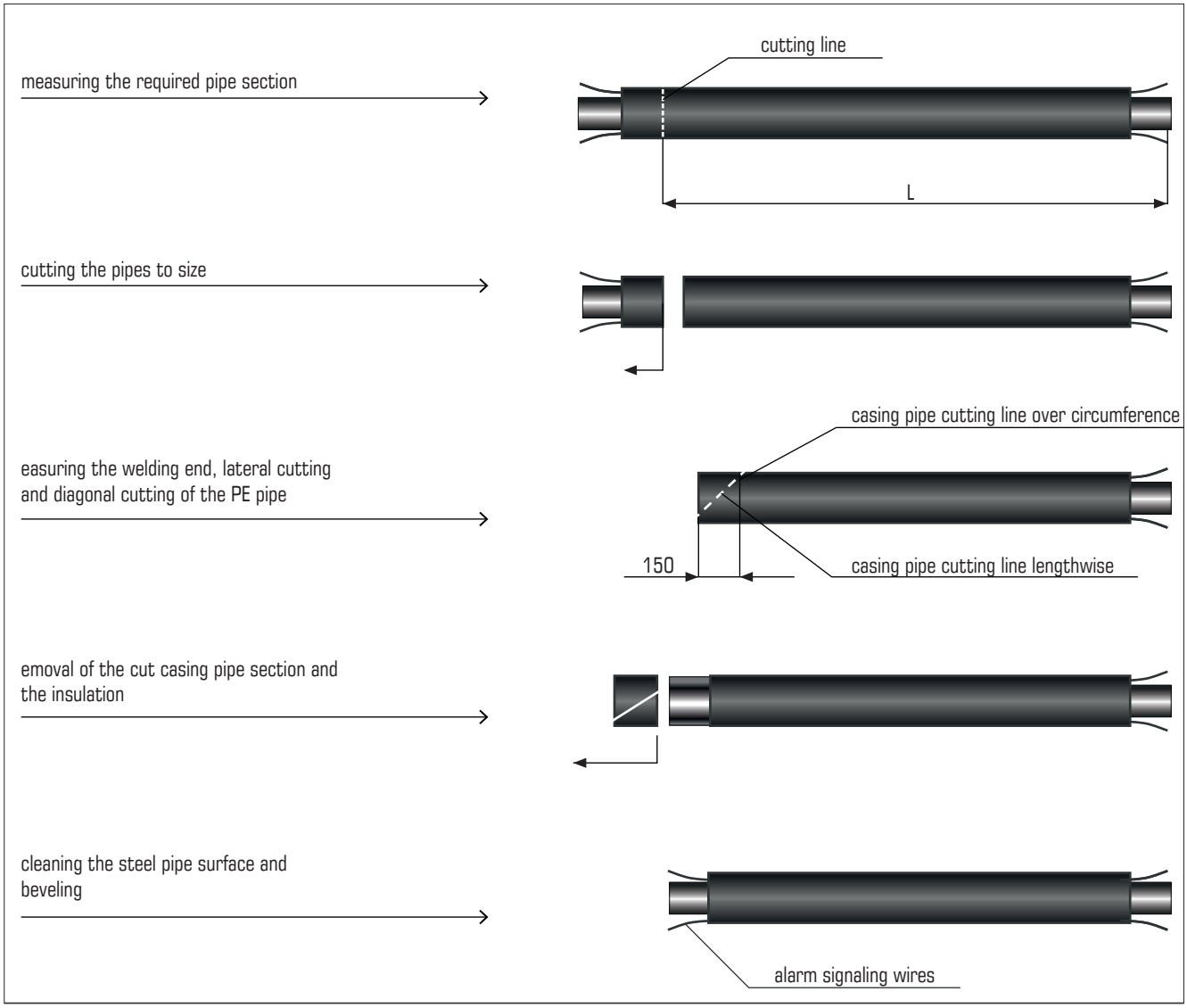
2.3.1 Cutting pipes to length

During installation works it may be necessary to cut the pipes to le ngth. In order to cut a pre-insulated pipe to length follow these instructions:

- measure a given section and mark the cutting point
- cut the pipe using any method, e.g. metal cutting saw
- measure 150 mm from the cut end and mark the distance on the casing pipe
- cut the PE pipe along the marked cutting line (e.g. by using a metal cutting saw) taking caution not to damage the alarm signaling wires
- make a diagonal cut on the removed casing pipe section
- after removing the casing pipe take off the PUR foam from the removed zone by using a knife, chisel, etc.; take care not to damage the alarm signaling wires
- thoroughly clean the steel pipe surface so as to avoid setting fire to foam residues or release of toxic gases
- bevel the steel pipe end, e.g. using an angle grinder

Note
Never cut the casing pipe and the insulating foam using a gas torch.

The individual stages of cutting the pipe to length are shown in the figures below:



2.4 Installation of the remaining pre-insulated compon ents

2.4.1 Installation of pre-insulated be nds

Pre-insulated bends are fitted in the same way as straight pipe sections.
We deliver pre-insulated bends made of factory-bent elbows (max. DN150) with a bending radius of R=30D and short radius elbows with a bending radius of 3D and 5D (marking as per PN-EN 1053-2) with welded shoulders. All pre-insulated bends are fabricated as "right-sided", i.e. turning right.
The alarm signaling system sensor wire is laid on the right-hand side following the flow direction.

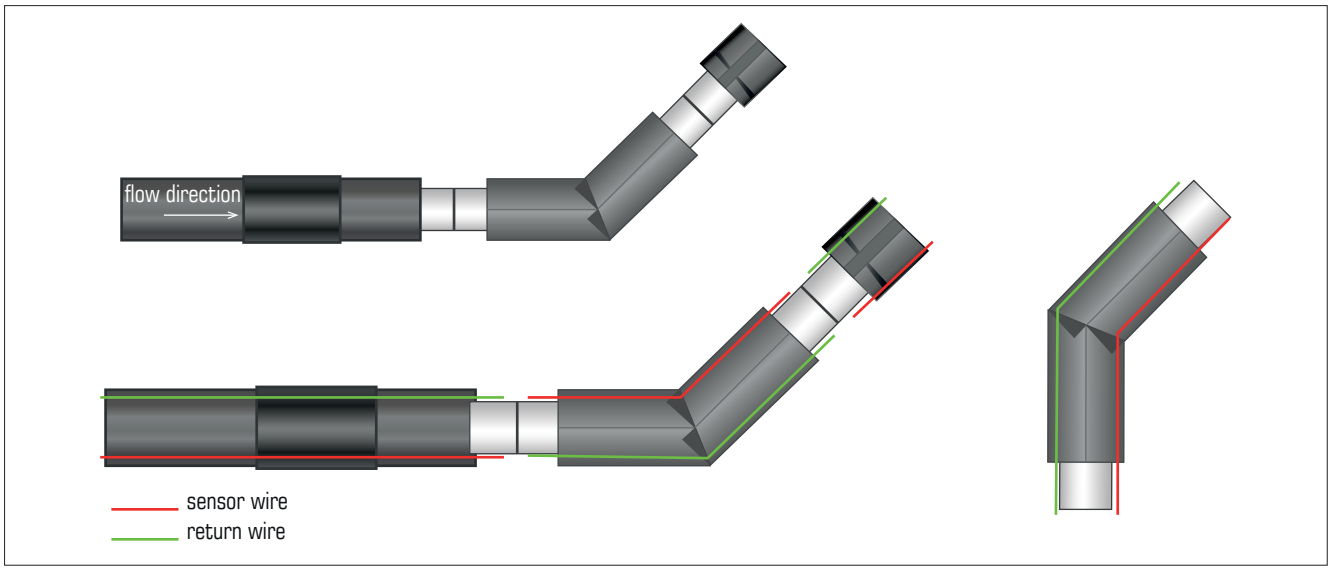


Fig. 12. Installation of a pre-insulated b end

2.4.2 Installation of pre-insulated branch p ipes

It is recommended to make riser branch pipes branching off upwards. We deliver perpendicular and parallel branch pipes. When installation the branch pipes note the follo wing:

- the branch pipe should be fitted outside an expansion zone of a piping system
- the branch pipe covering layer should be at least 40 cm thick (fig. 13).

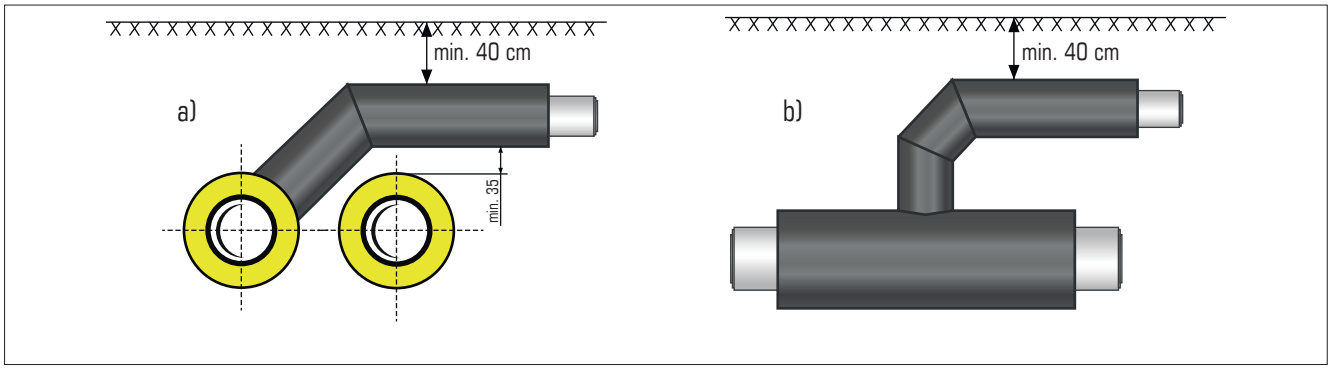


Fig. 13. Minimum thickness of a branch pipe covering layer a) perpendicular branch pipe b) parallel branch pipe

2.4.3 Making natural expansion joints of “U”, “L” and ”Z” type

U, L and Z-shaped natural expansion joints are provided using pre-insulated bends and straight pipe sections.
During installation works make sure to provide expansion zones, i.e. to cover all the expansion shoulders with expansion pads. The pads must be laid in areas of expected pipeline displacement just before backfilling, in line with the plan included in the design. Two types of expansion pads are used, namely type “A” profiled pads and type “B” flat pads.

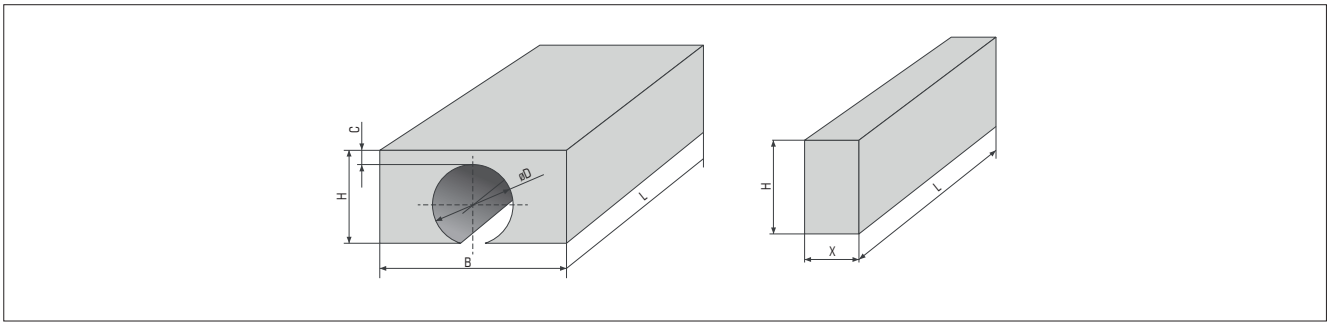


Fig. 14. a) type “A” expansion pad b) type “B” expansion pad

Type “A” expansion pads

Casing	D	B	L	H	C	Article
pipe OD	mm	mm	mm	mm	mm	number
904-125	125	265	1000	135	20	9605000000
1404-160	160	300	1000	170	20	9607000000
1804-200	200	340	1000	220	20	9608000000
2004-225	225	365	1000	235	20	9609000000
250	250	390	1000	280	20	9610000000
315	315	455	1000	335	20	9611000000
400	400	540	1000	430	20	9612000000
450	450	590	1000	480	20	9613000000

Type “B” expansion pads

Casing	L	H	C	Article
pipe OD	mm	mm	mm	number
1404-160	1000	250	100	9707000000
1804-200	1000	250	100	9708000000
2004-225	1000	250	100	9709000000
250	1000	250	100	9710000000
315	2000	450	100	9711000000
400	2000	450	100	9712000000
450	2000	450	100	9713000000
500	2000	560	100	9714000000
560	2000	560	100	9715000000
630	2000	630	100	9716000000
800	2000	800	100	9717000000
900	2000	1000	100	9719000000
1000	2000	1000	100	9720000000
1100	2000	1000	100	9721000000
1200	2000	4-450	100	9722000000

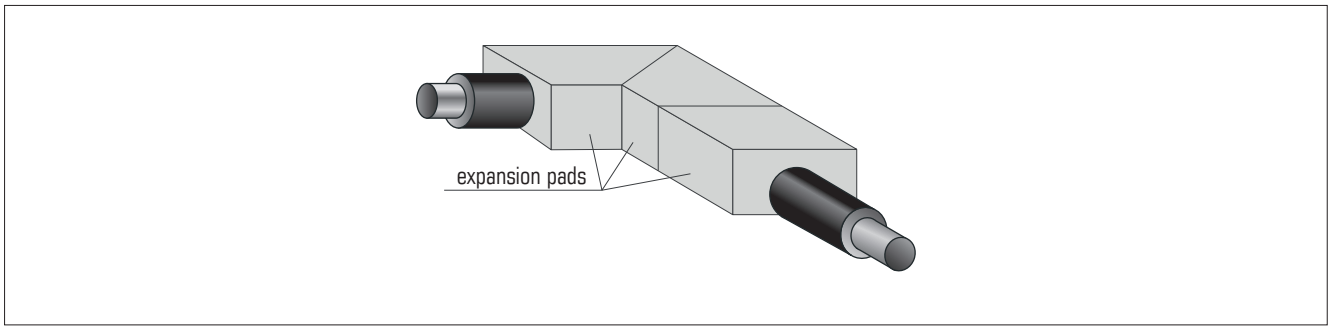
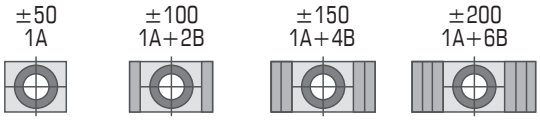
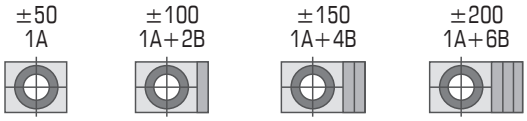


Fig. 15 Example of expansion pad laying method

Allowable displacement for expansion pads with preheating:



Allowable displacement for expansion pads with natural expansion.



2.4.4 Installation of bellows expansion joints

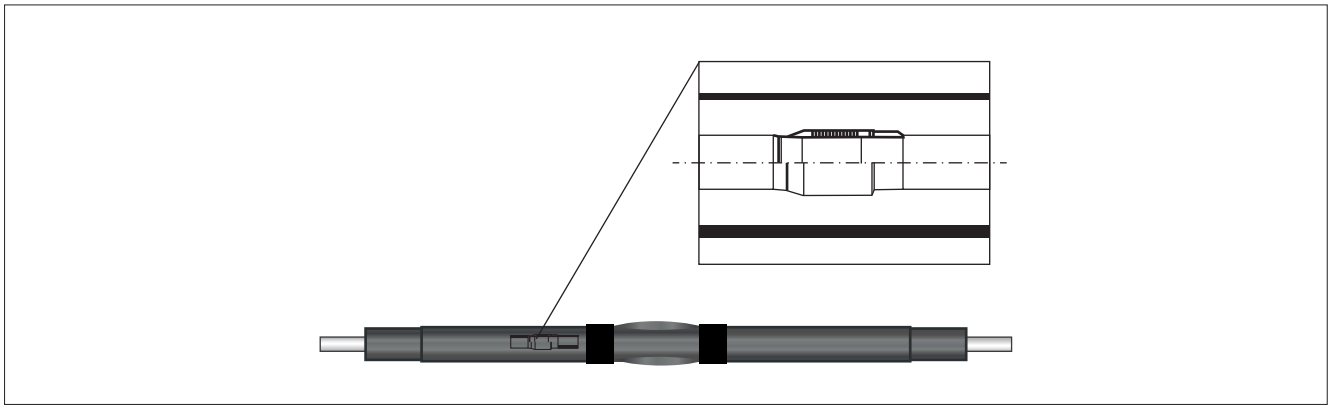


Fig. 16. Pre-insulated expansion joint

Pre-insulated bellows expansion joints are delivered to the site with the bellows in a fully extended position. The contractor has neither any means nor need to change the expansion joint setting.
Axial expansion joints are very sensitive to a pipeline misalignment. They require specific lengths of straight coaxial sections upstream and downstream the expansion joint of at least 12 m.
After tack welding the contractor should check alignment of the required pipeline sections upstream and downstream the expansion joint (fig. 17).

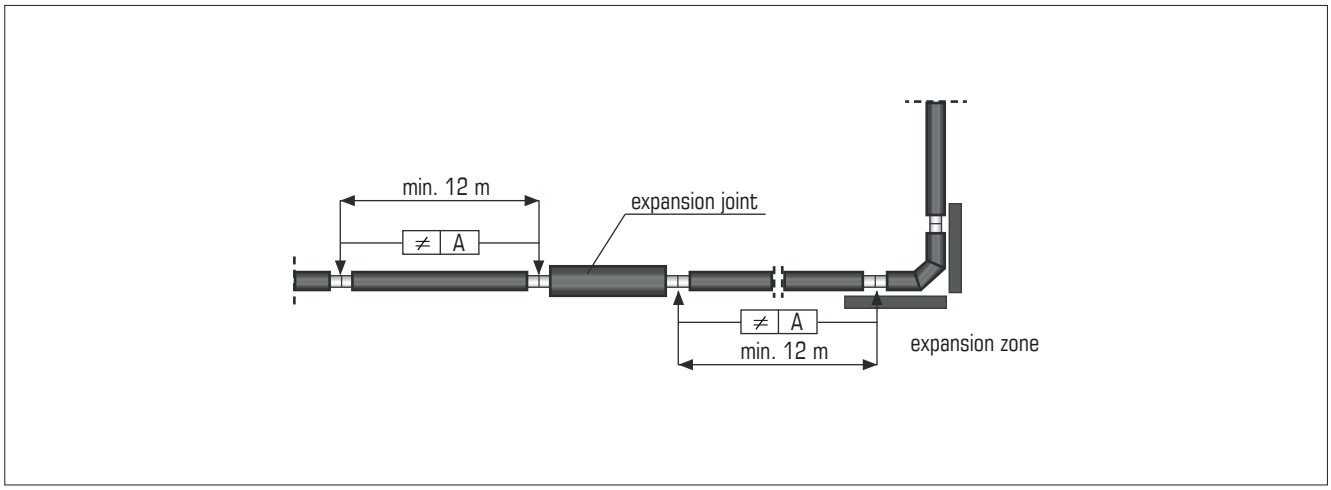


Fig. 17. Checking pipeline alignment in the expansion joint installation area

Note
Alignment should be checked against the steel pipes and not the casing pipe

Pre-insulated pipes are provided with a flexible insulation jacket halfway through the spool piece, which compensates movements of the casing pipe (fig. 18).

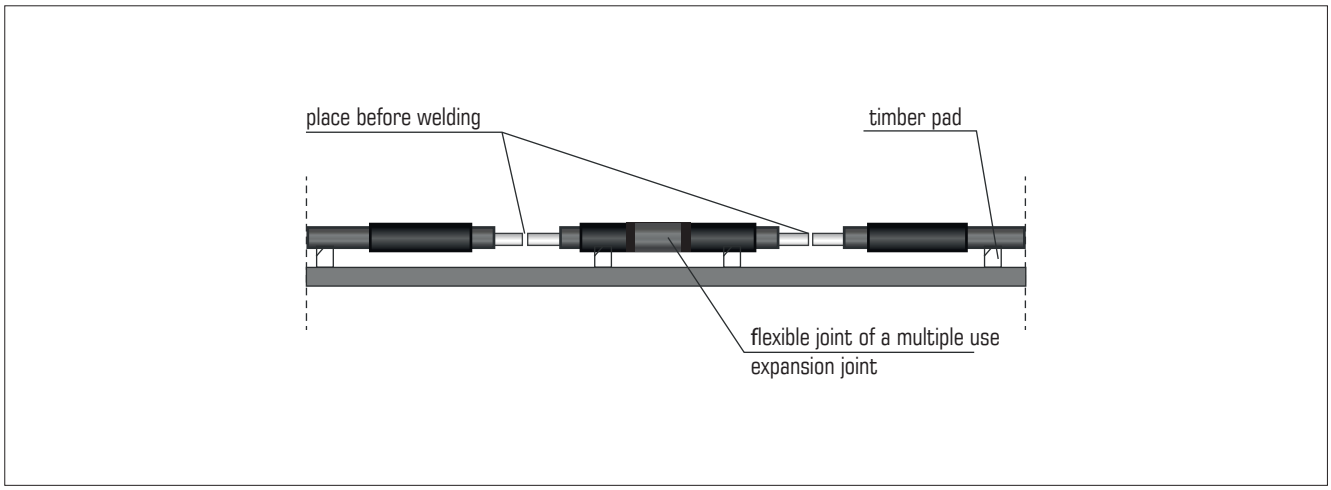


Fig. 18. Bellows expansion joint installation me thod

When installation bellows type expansion joints observe the following r ules:

- minimum length of straight sections upstream and downstream the expansion joint comes to 12 m
- minimum distance of an expansion joint end from the natural expansion zone comes to 12 m
- maximum misalignment of “A” along a straight section upstream and downstream the expansion joint comes to ±2 mm

2.4.5 Installation of disposable expansion joints

Disposable expansion joints are delivered as non pre-insulated (E type).

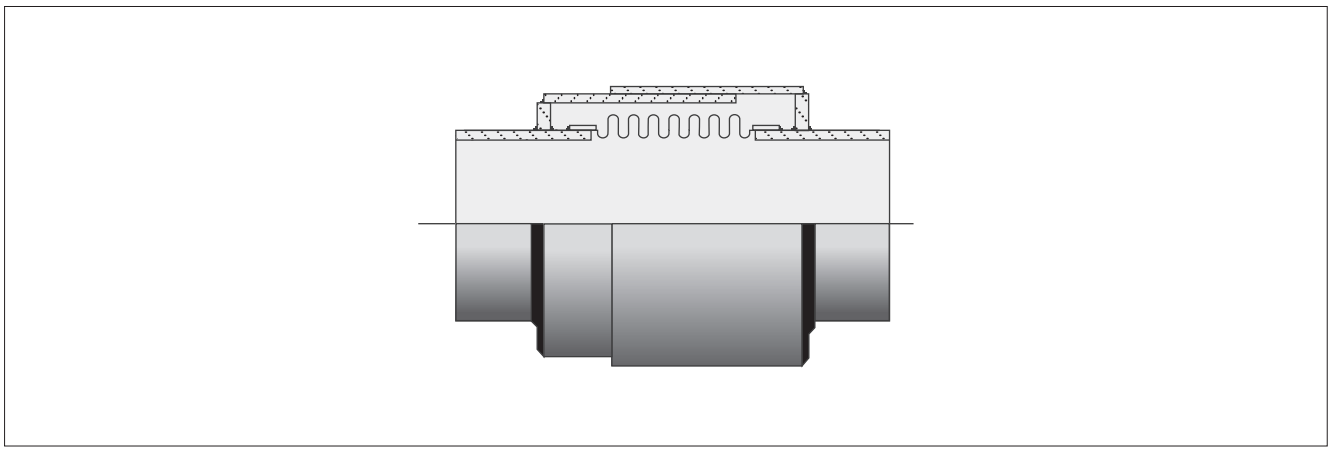


Fig. 19. E type expansion joint

Dimensions, expansion capacity and installation lengths for type E disposable expansion joints are specified in the technical catalog of RAPDOL PIPES sp. z o.o. Factory settings of expansion joints shall be changed each time before their installation, as per the calculated required pipeline elongation. To this aim remove tension bolts and compress the expansion joint to achieve the required position, if necessary. Disposable expansion joints are designed to provide the required tension during installation works in a hot condition (i.e. during preheating). Preheating is discussed in point 6.1.2.

Before welding a type E expansion joint check the relevant setting. Subsequently, pull a long PE joint and two PE heat-shrink bands over the pipeline section from any side of the expansion joint (fig. 17). Weld the ends. To insulate the welded expansion joint a long opentype joint for electric welding may be used. Once the weld quality is checked the expansion joint is ready for preheating. Preheating is one of the last installation steps and it is described in point 6 .1.2.
Changing the E type expansion joint setting requires great care and special equipment.

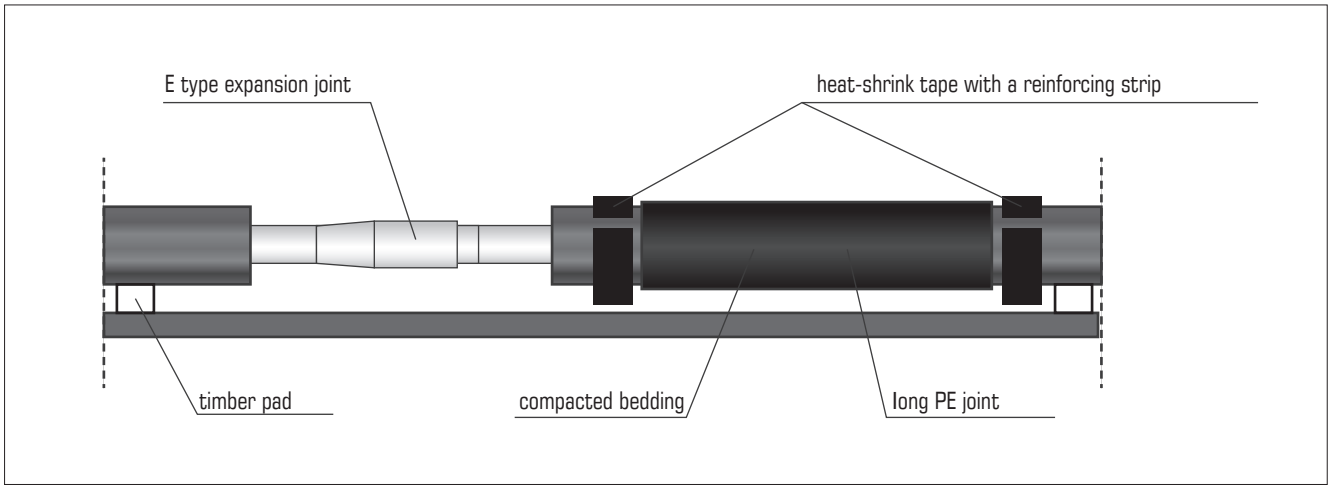


Fig. 20. E type expansion joint install ation

If it turns out during the heat distribution network installation works that the previous setting needs to be changed, this operation will be performed by a service team. An incorrect tension may result in the pipeline failure.

2.4.6 Installation of pre-insulated fixed points

Pre-insulated fixed points must be anchored to soil by providing a reinforced concrete thrust block (fig. 21). The block dimensions depend on forces acting on the fixed point and should be specified in the design. The concrete blocks shall be protected against moisture.

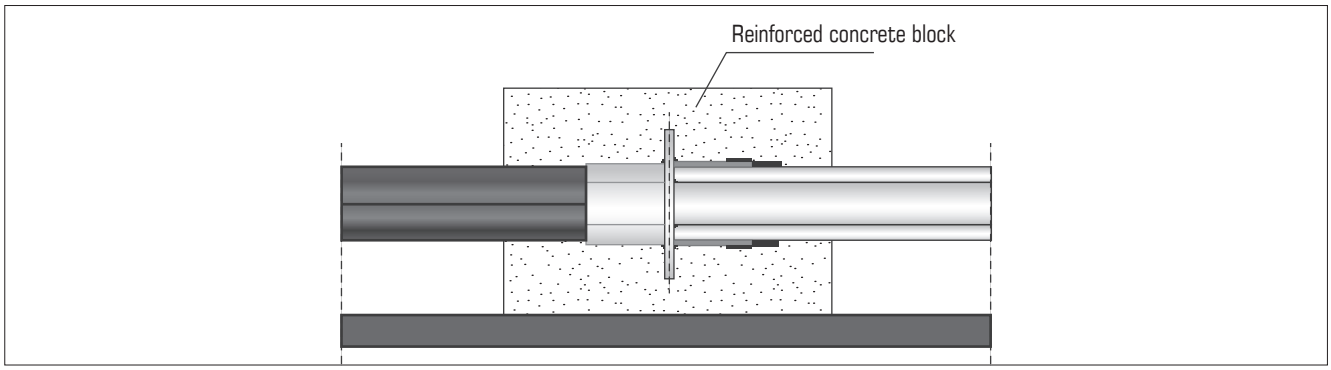
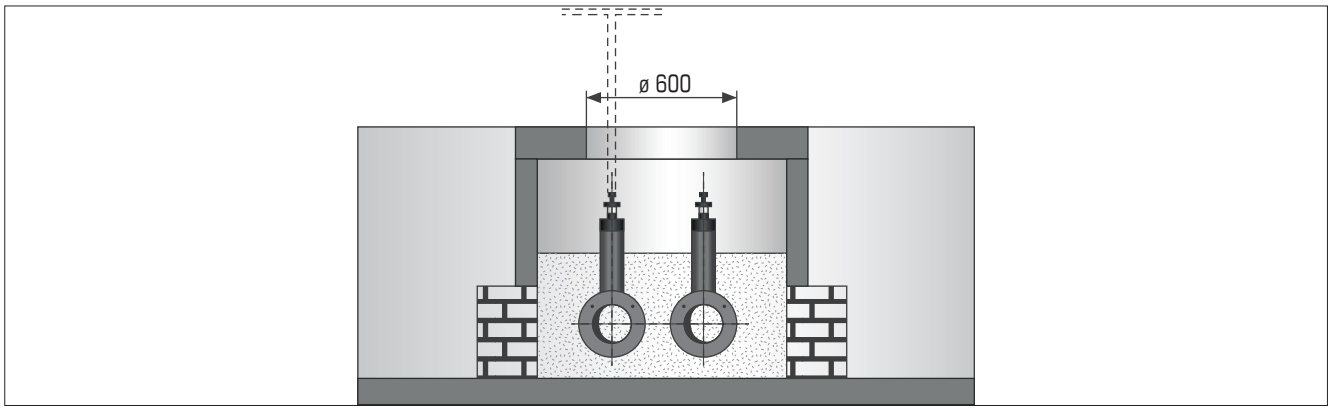


Fig. 21. Installation of pre-insulated fixed

If pipeline displacement is compensated using bellows expansion joints or using natural expansion joints of U, L or Z-type and the design provides for fixed points, concrete of the fixed point must be set and anchored to the soil before the first temperature change in the carrier pipe. When installation a pipeline with the use of preheating, the fixed point concreting works should be performed after preheating and achieving the theoretical pipeline elongation. Pipeline heating during installation works with the use of preheating should be continued until the concrete is set and backfilled with soil (point 6.1 of this manual). The pipeline thermal elongation is to be specified by the design engineer.

2.4.7 Installation of shut-off valves

Pre-insulated shut-off valves are provided with standard face-to-face dimensions of 1500 mm, regardless of the diameter, and with standard welding ends. The installation method for such valves is identical as in the case of a 1.5 m long p ipe.
Fig. 22. Installation o-fi npsreulated valves



It is recommended to install pre-insulated shut-off valves directly in the ground (at points not subject to displacement) with stems located in valve pits or hydrant boxes (fig. 22). The stem length shall enable operation of the valves from the ground level. Valves requiring a gearbox must be installed in chambers or pits.Shut-off valves shall be located outside the limits of roadways, parking areas and private premises.

2.4.8 Installation of drainage valves

There are two types of drains in production:

- top drains
- bottom drains

Top drains are to be installed directly in the ground. These may be interlocked with shut-off valves. It is possible to attach a quick fit coupling at a ball valve outlet port to enable quick connection of a drain pipe. Bottom drains shall be installed with a discharge towards pits enabling water discharge by gravity (fig. 23).

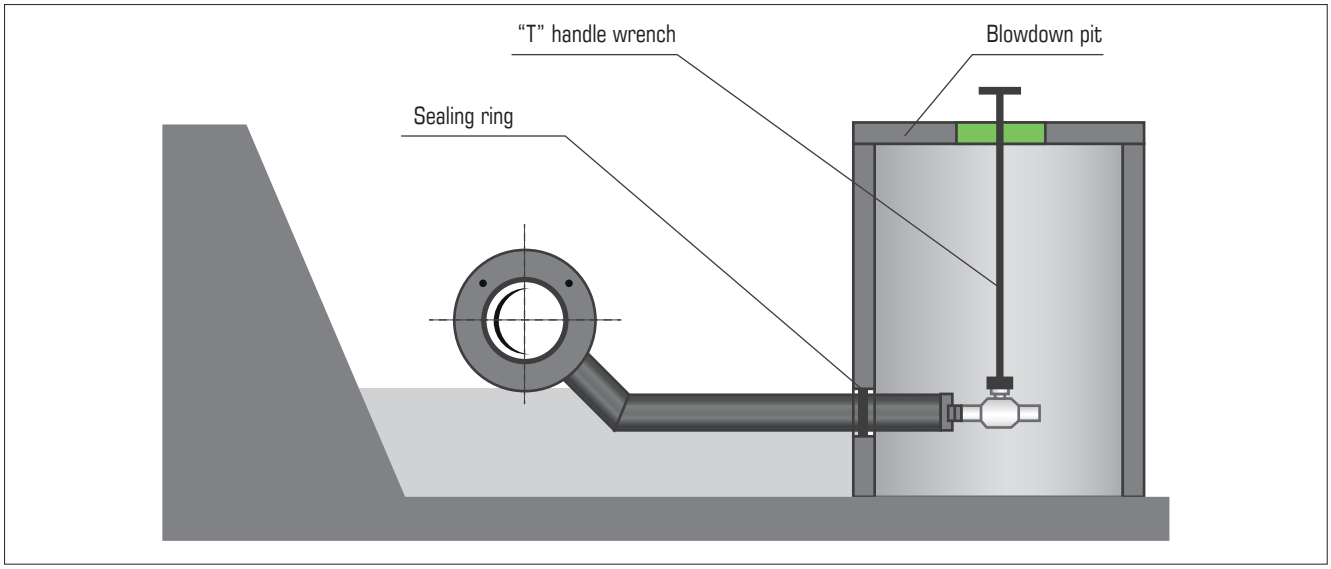


Fig. 23. Installation method for pre-insulated bottom dr ains

2.4.9 Installation of vent valves

Vents are used at the highest points of a heat distribution system. These may be combined with shut-off valves as a single component. Pre-insulated vents are installed directly in the ground with outlet pointing upwards. The ends of an outlet port may be provided with pressure-rated quick fit couplings, as in the case of drains, to enable attachment of a hose (fig. 24).

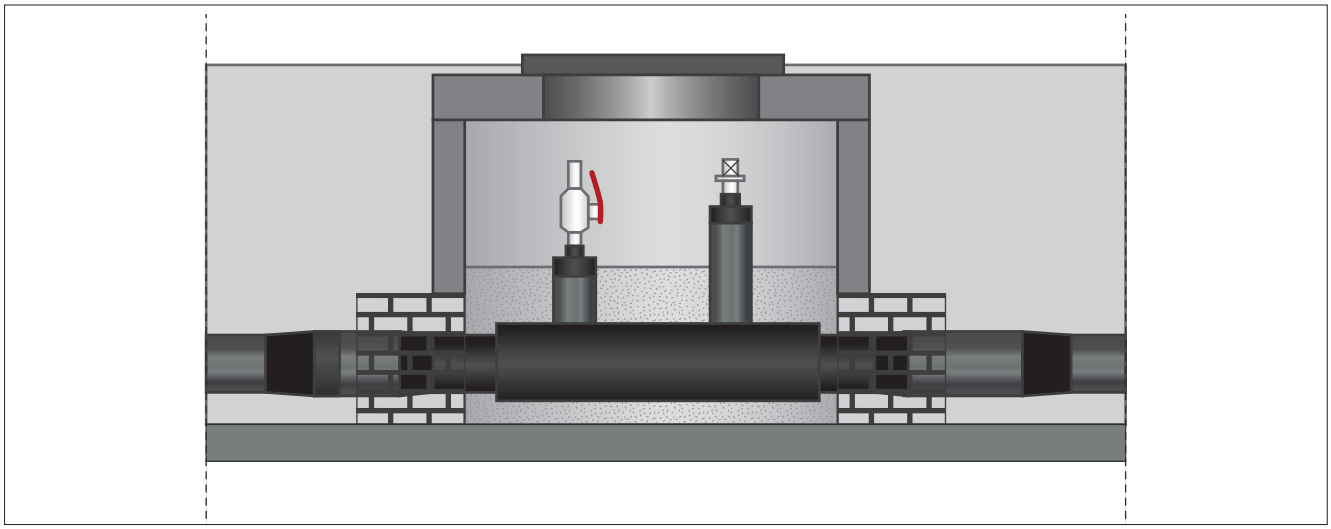


Fig. 24. Shut-off valve service pit

3 INSTALLATION OF RESISTANCE ALARM SIGNALING SYSTEMS FROM BRANDES

The resistance alarm signaling system used as part of RAPDOL PIPES sp. z o.o. technology has been designed by a German company named BRANDES. The system is based on a precise electric resistance comparison method. It enables detection of leaks at an early stage as well as finding the damage. There are two wires inside the pipe and the pre-insulated components laid in the PUR foam at "ten to two":

- a sensor wire (nickel-chromium wire) in red perforated PTFE insulation
- a copper return wire in green PTFE insulation

The wires are joined using crimping ferrules using heat-shrink tubes. The red wire must be always joined with another red wire. The same applies to joining green wires. The piping must be laid so that the sensor wire (red color) is always on the right-hand side looking from the heat source.

3.1 Joining alarm signaling wires

Following a positive pressure test result proceed with installation of alarm signaling system circuits as per a separate design. The alarm signaling wires shall be joined to form measuring loops of 1000 lin. m in length. The loop length corresponds to the length of a sensor wire. To join alarm signaling wires proceed as follows:

- straighten the wires located at the pipe ends and assess them in terms of damage.

Damaged wires must be removed. If necessary, extend an alarm signaling wire by joining it using the BS-QU ferrule with an identical wire cut to length, and by insulating it with BS-SRA heat-shrink tube

- cut the return wire so that it can be inserted to the crimping ferrule and to prevent excessive strain on the wire; keep a 2 cm spare length
- strip the red insulation off the sensor wire along a section corresponding to the crimping ferrule length as well as green insulation of the return wire along a section corresponding to half the length of the crimping ferrule Use the BS-AZ pliers (fig. 25) to strip the insulation

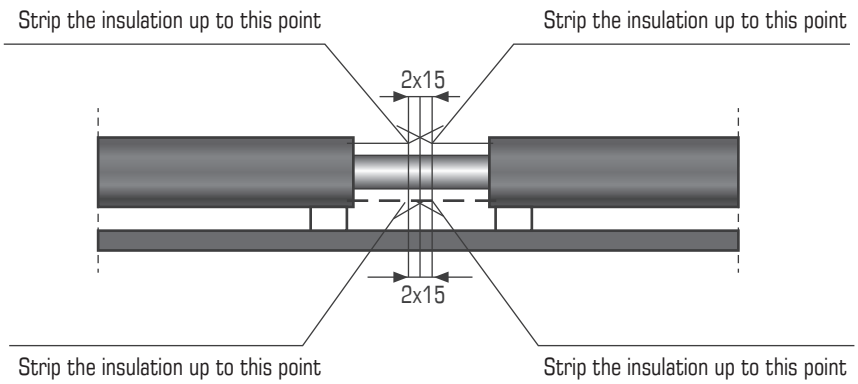


Fig. 25. Stripping insulation off the alarm signaling wires

- clean the wire ends using an abrasive paper
- place heat-shrink tubes (one tube per each connection)
- join the alarm signaling wires using crimping ferrules (as shown in the circuit diagram); crimp the ferrule using the BS-QZ pliers at two points (halfway through the distance between the ferrule center and its end, on both sides); the alarm signaling wires joining method is shown in fig. 26

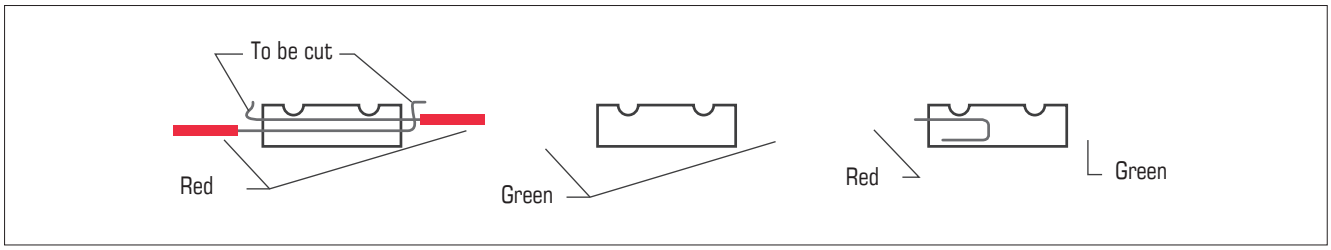


Fig. 26. Joining method for alarm signaling wires

- check strength of the connection by a gentle pull (fig. 23)

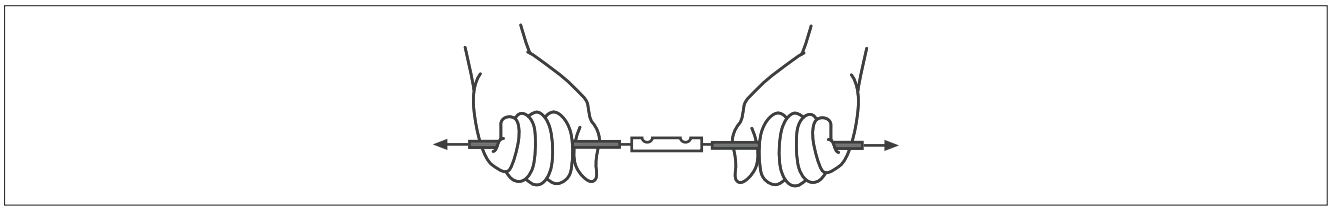


Fig. 27. Checking correct joining of the alarm signaling wires

- cut off spare lengths of the wires when joining the red sensor wires (fig. 26)
- slide over the heat-shrink tubes and shrink them using hot air (for this use an electric air heater for heat-shrink materials). A heat-shrink tube shrunk correctly should show no sings of burning, should be transparent and must be free of air bubbles trapped inside (fig. 28)

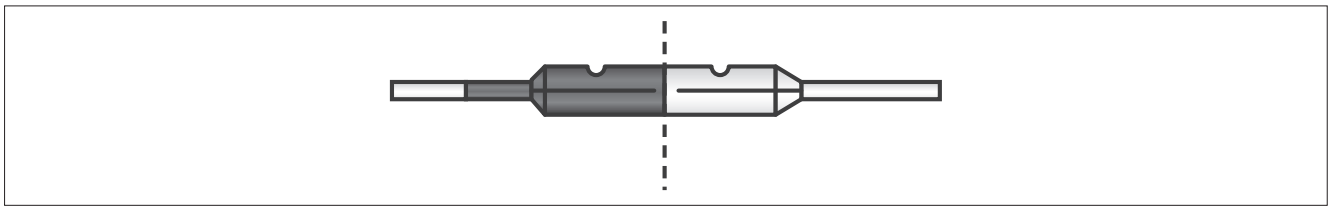


Fig. 28. A view showing the BS-SRA heat-shrink tube over the BS-QU crimping ferrule

A finished connection is to be placed on a spacer plate attached to the carrier pipe
When joining alarm signaling wires at branch points follow the “right-hand rule” (fig. 29).

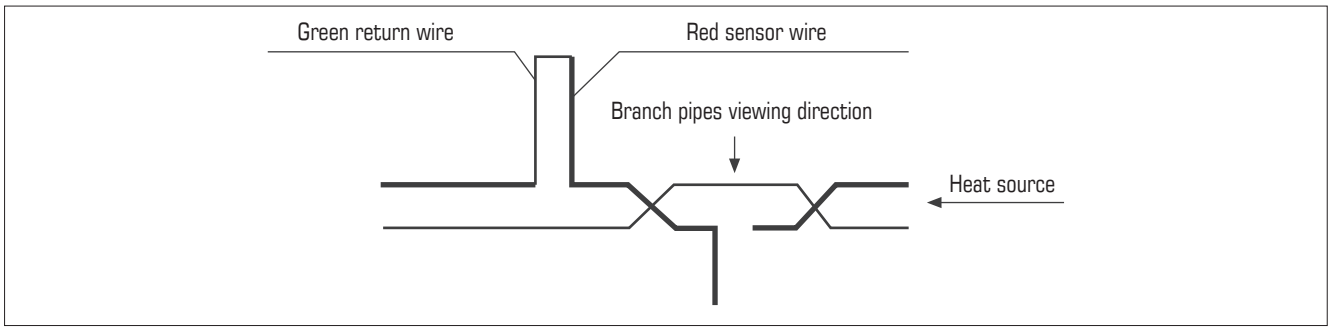


Fig. 29. Joining alarm signaling circuits

In order to join the alarm signaling wires of the branch pipe with the alarm signaling wires of the main line, fit the branch pipe section so that the sensor cable (red color) of the branch pipe is located on the right-hand side looking from the main line, and join it with the part of the main line sensor circuit branching off to the right; the branch pipe return wire (green color), in turn, is to be joined with the part of the main line sensor circuit (red color) that branches off to the left. Do not cut the green wire of the main line. The sensor wire in the flow pipe must be always laid on the right-hand side looking from the heat source.

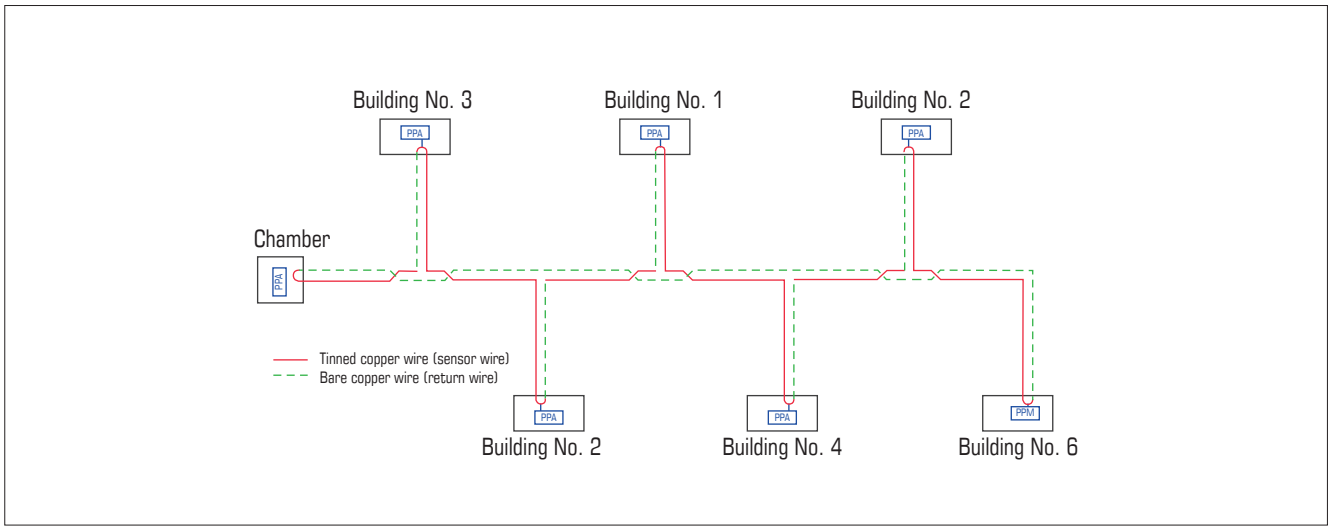


Fig. 30. Measuring loop with branch pipes

Due to the fact that we produce only one type of branch pipes and bends (i.e. right-sided) the alarm signaling wires must be crossed at leftward branch points or where the pipeline turns left. Make sure that the red wire passes over the green wire.

3.2 Checking correct installation of the alarm signaling wires

When joining the alarm signaling wires of the successive joints test the circuit section by section according to the following procedure:

- connect the alarm signaling wires at the pipeline end (i.e. short them)
- attach the connector to a clean steel pipe surface
- connect a special testing device (BS-MH3, LH20S) to the alarm signaling wires and the pipe by inserting the meter black wire terminals to the magnetic connector sockets and by connecting the red and blue wires with the pipe alarm signaling wires (fig. 26)
- if the testing device displays MH"0" along with a loop length value the alarm signaling system is installed correctly and the foam is dry; if the testing device indicates "C" or a message "Short circuit" is shown on the display this means a short circuit between the alarm signaling wire and the pipe; in case of an open alarm signaling circuit, in turn, the testing device will display "HI" or a message "Open loop" will appear
- reading examples (based on the BS-MH2 testing device) are shown in fig. 33; in case of incorrect reading find the fault, remove it and repeat the measurement.

The testing device operation is explained in the manual provided with the device. The measuring principle and the testing device connection to check the alarm signaling system in the pipeline fitted are shown in fig. 31.

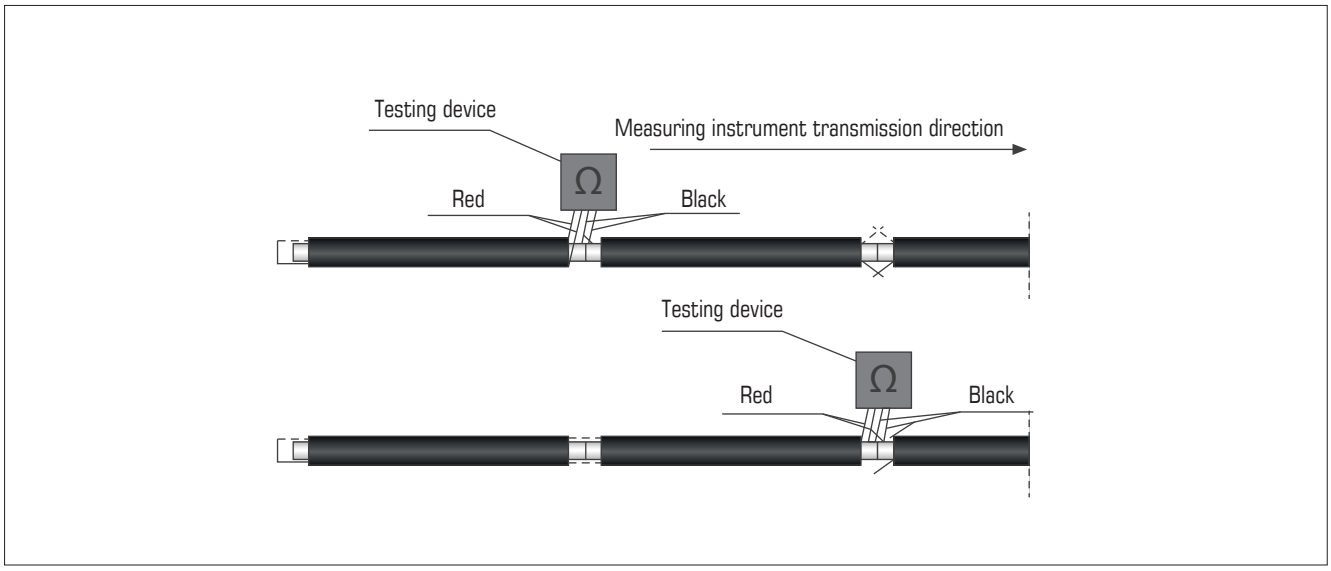


Fig. 31. Alarm signaling circuit testing principle (BS-MH3 testing device)

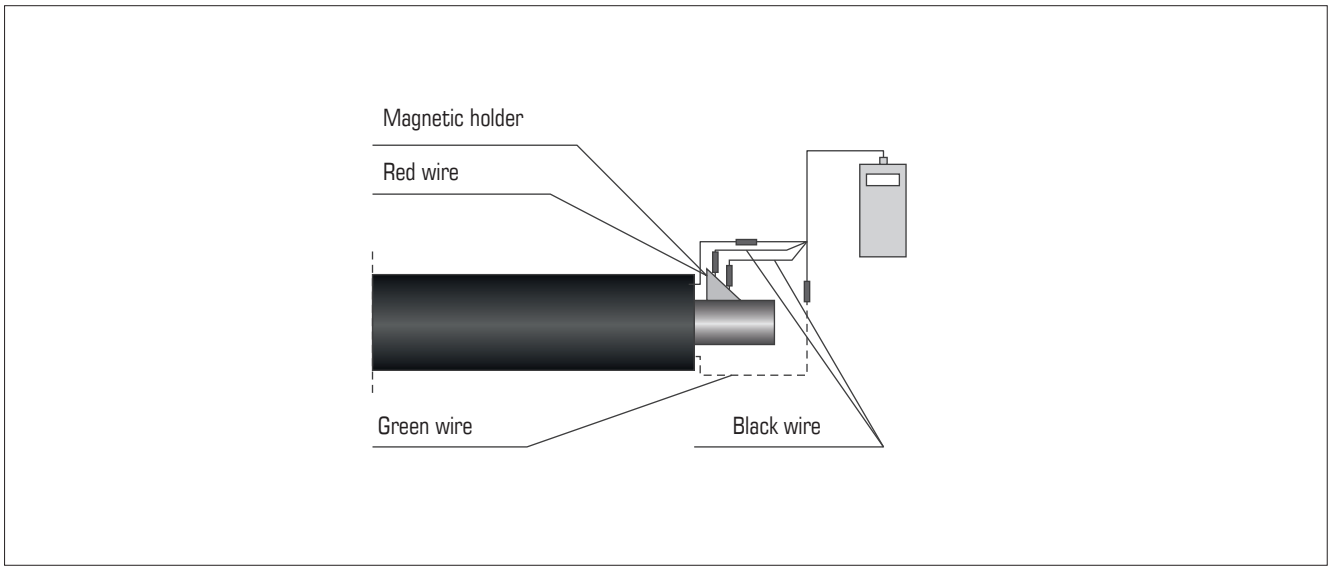


Fig. 32. Testing device connection method

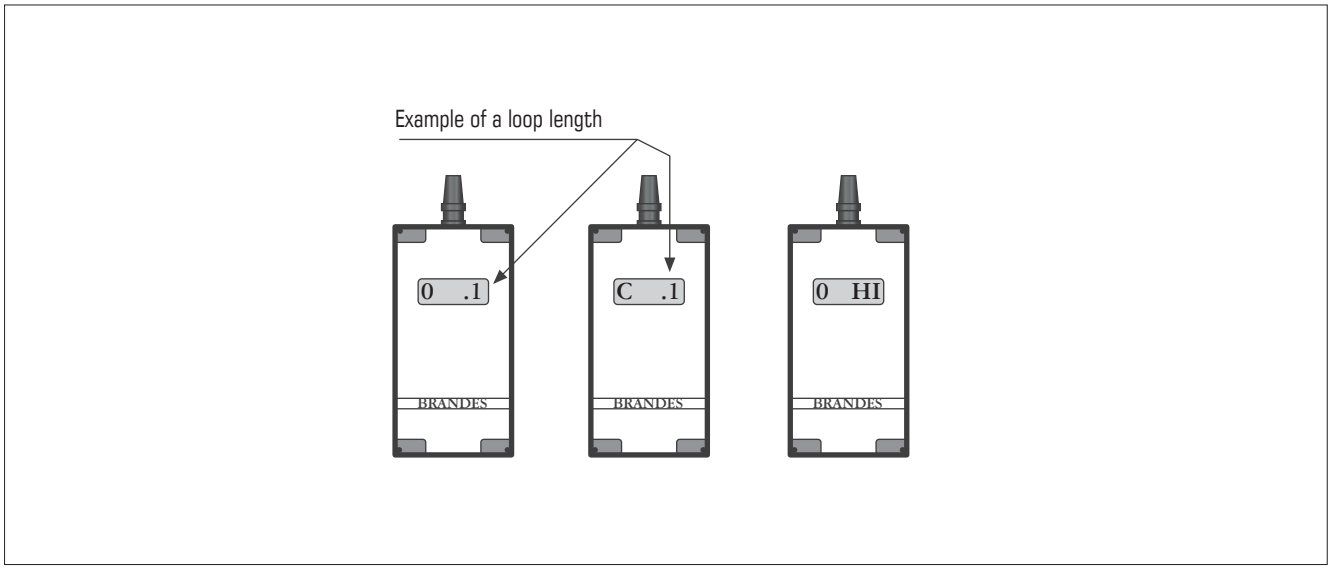


Fig. 33. Key indications on the testing device display

3.3 Drafting as-built documentation of the alarm signaling system

The installation company performing installation works for the pre-insulated pipe system with alarm signaling wires, should prepare the alarm signaling system as-built documentation on an ongoing basis (before installing joints at welded joints). The alarm signaling circuit is to be completed as per the design provided. Subsequently, number the joints along the designed alarm signaling circuit up to its terminal point by progressing from the point shown in the design (as the piping system measuring point used during operation – see fig. 34).A measuring report form for Brandes system is provided as Appendix No. 1.

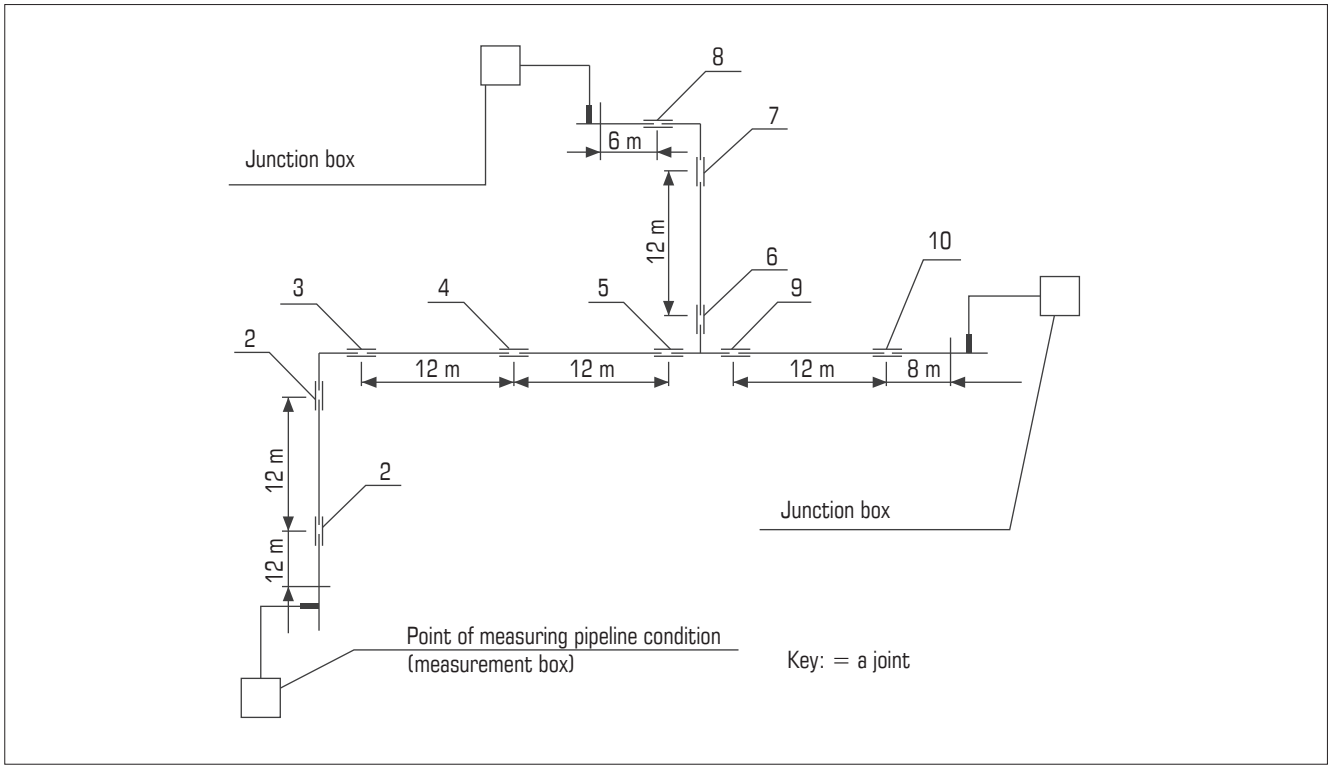


Fig. 34. The principle of marking connections in the pipeline assembly drawing

3.4 Terminating the alarm signaling circuits

The following necessary system components are delivered to enable alarm signaling circuit termination:

- crimping ferrules – 2 pcs. per a single loop termination
- heat-shrink tubes – 2 pcs. per a single loop termination
- wire connector – 1 pc. per a single loop termination
- two-conductor cable – 0.5 lin. m per a single loop termination
- four-conductor cable – 1.5 lin. m per a single loop termination
- BS-MD measurement box or BS-AD junction box – 1 pc. per a double loop termination

A two-conductor copper cable in a PTFE insulation is used to run up the alarm signaling wires from the pre-insulated pipe material. It is not allowed to terminate the alarm signaling wires (the sensor and return wires) outside the pre-insulated pipe material. The methods to terminate the alarm signaling circuits are shown in the following figures:

- loop start – connection via a measurement box – fig. 35
- loop end – connection via a junction box – fig. 36
- alarm signaling circuit termination diagram – fig. 37

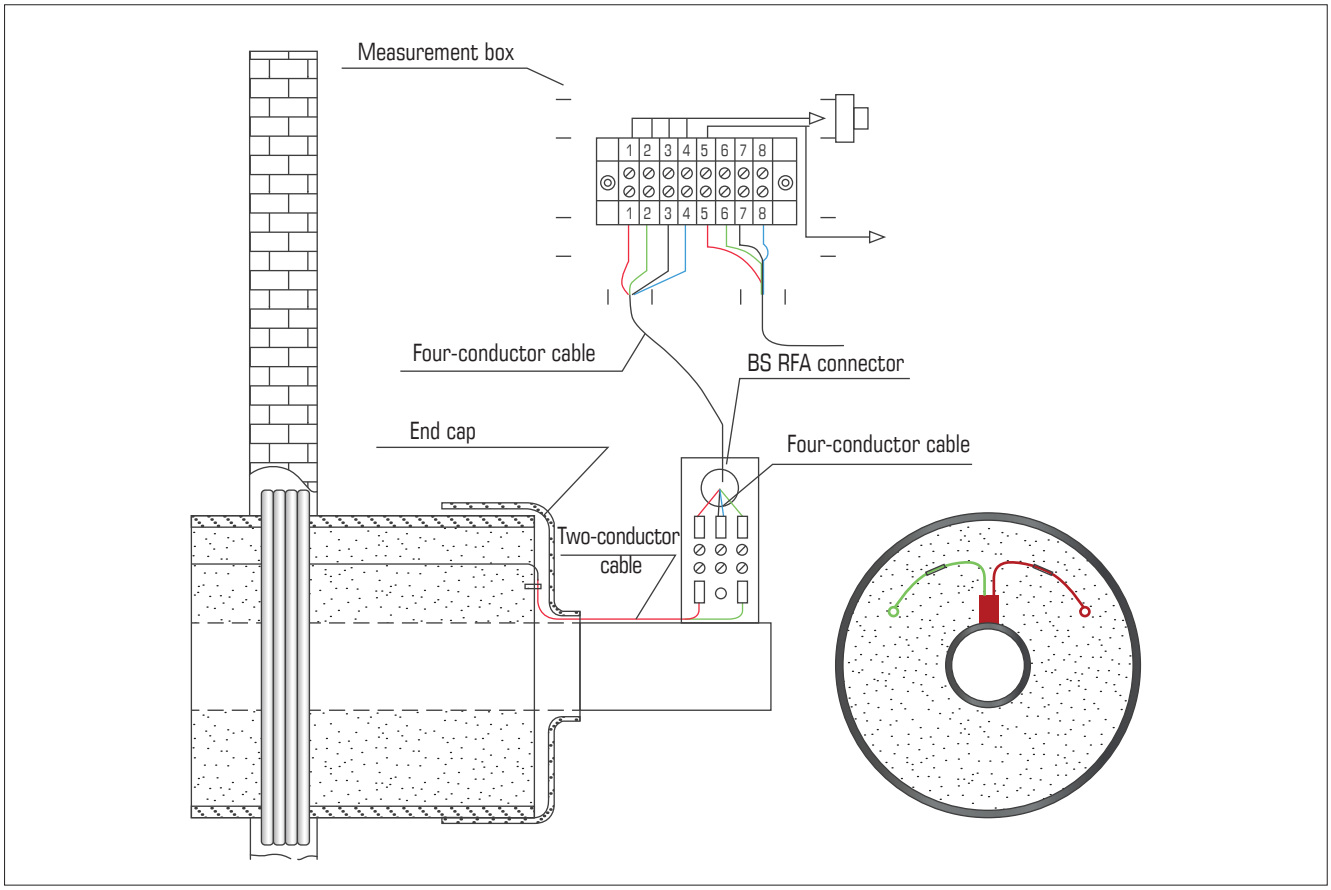


Fig. 35. Circuit termination with a measuring point

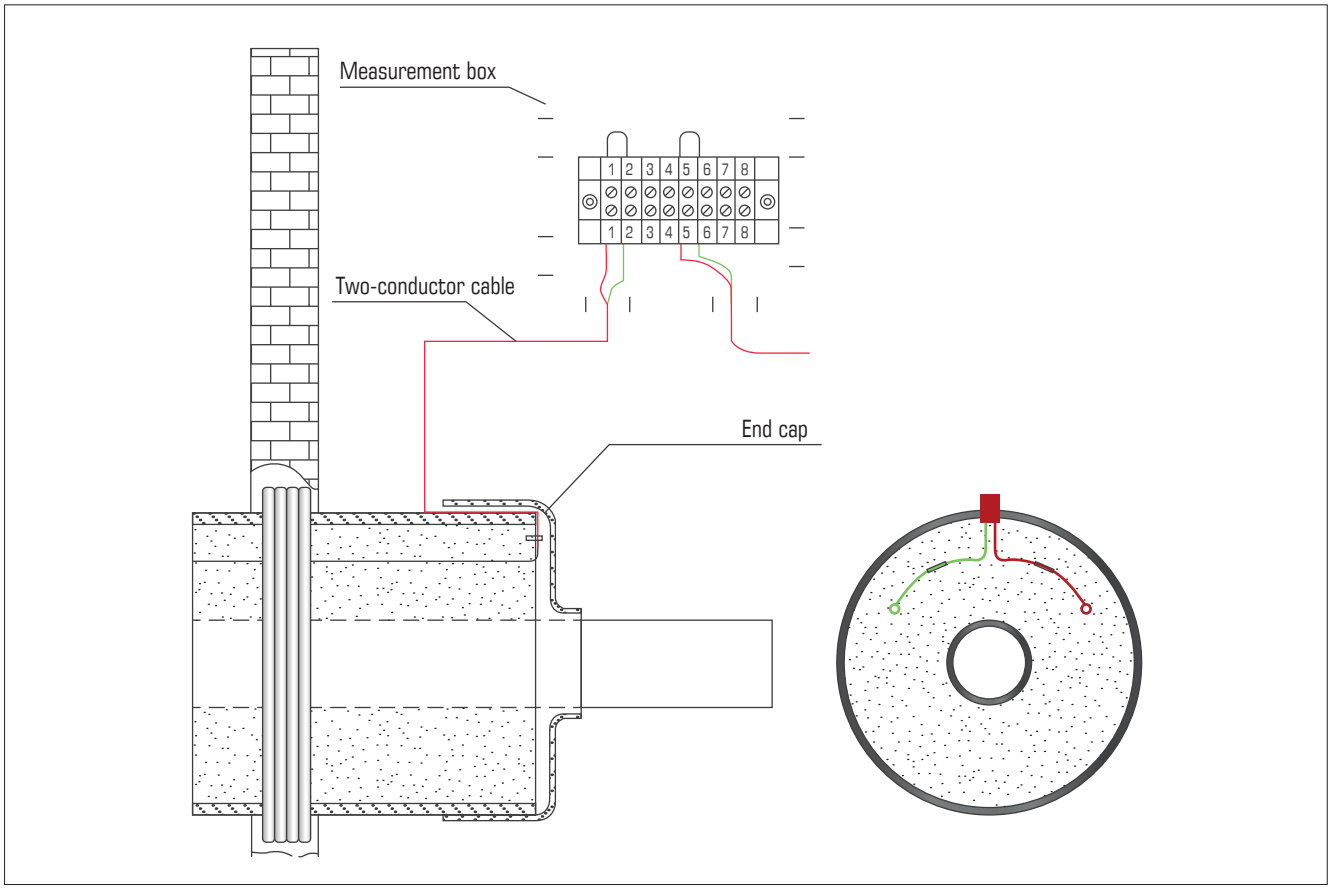


Fig. 36. Circuit termination with a junction box

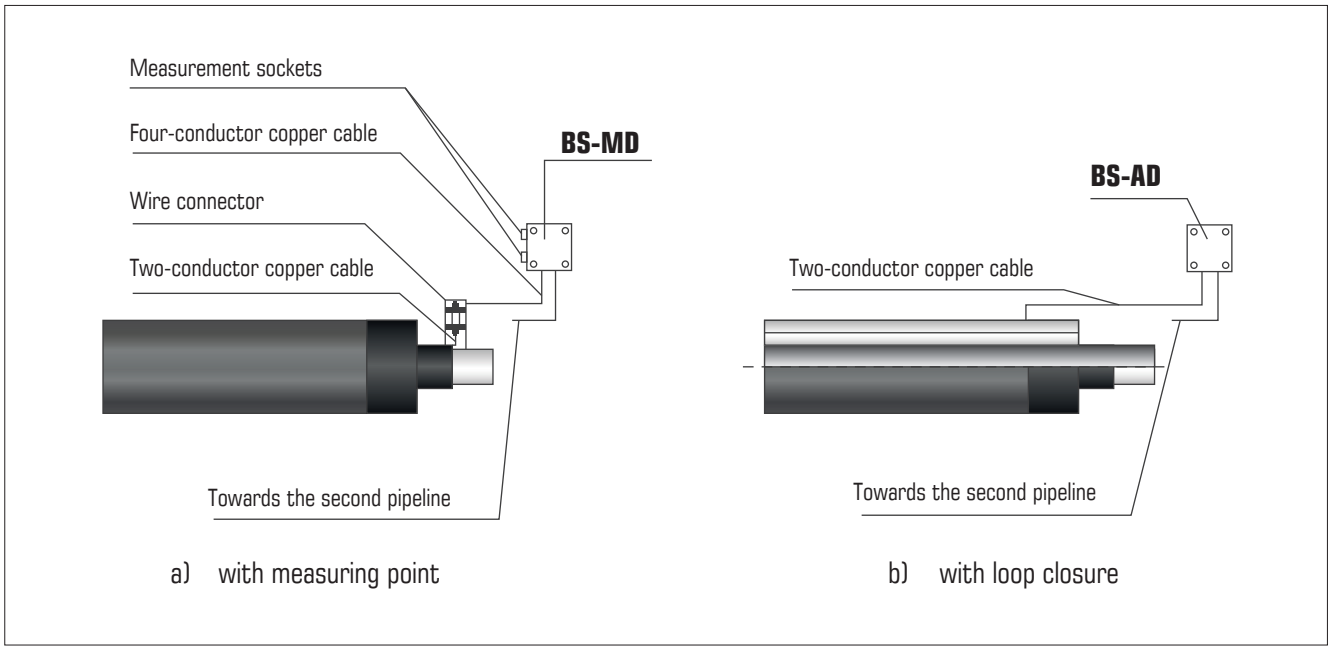


Fig. 37 Alarm signaling circuit termination diagram

In special cases the alarm signaling circuits may be terminated directly under the heat-shrink gasket or inside the joint by joining the sensor wire with the return wire.

Note
With no exceptions pipelines must be grounded against unexpected voltage in a pipe (therefore, in the measuring system as well), e.g. 220 V that would pose hazard to a person taking the measurement and to the measuring instrument itself. The complete works shall be finalized by drafting a measurement report signed by an authorized person (with a special training) and the site manager.

4 INSTALLATION OF IMPULSE ALARM SIGNALING SYSTEMS FROM CWA

The second type of the alarm signaling system used as part of RAPDOL PIPES sp. z o.o. technology is a impulse alarm signaling system. The alarm signaling system is composed of two copper wires of 1.5 mm^2 in cross-section laid in a thermal insulation 15 to 20 mm away from the steel pipe at "ten to two". One of the copper wires is tinned. The tinned wire functions as a sensor wire by convention. The wires are joined using crimping ferrules and by soldering. Copper wires of the alarm signaling system are joined to form loops with a maximum length of 2000 m (1000 m of pipeline length).

Straight pre-insulated pipe sections equipped with a impulse alarm signaling system shall be laid so that the tinned wire is always located on the right-hand side looking from the heat source.

The alarm signaling wires of the impulse system must not be crossed.
Fig. 38 (below) shows the method of connecting the alarm signaling loops with branch pipes

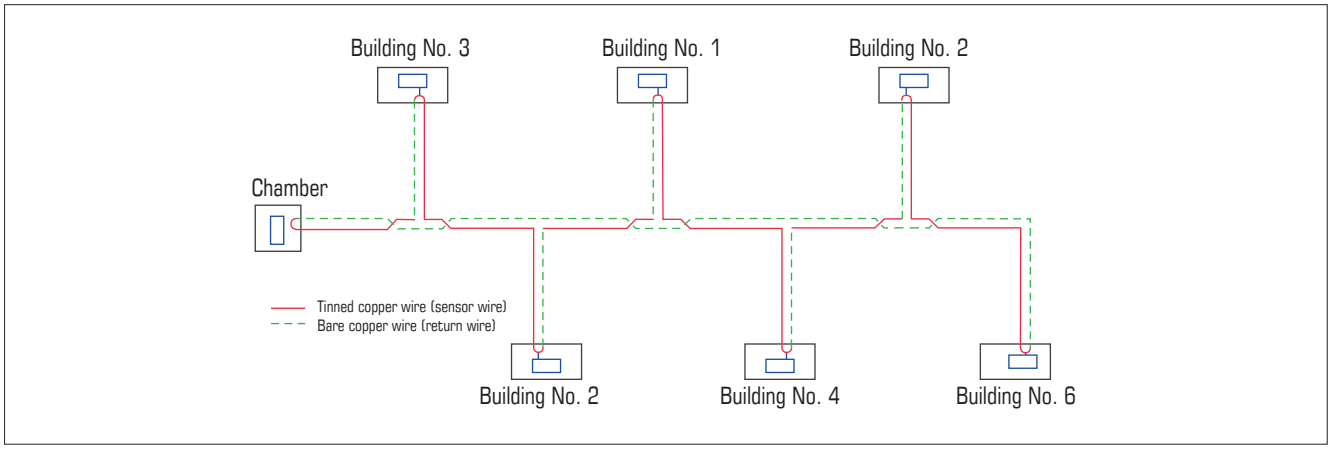


Fig. 38. Measuring loop with branch pipes

4.1 Joining alarm signaling wires

Following a positive pressure test result and removal of welding defects proceed with installation of alarm signaling system circuits as per a separate design.

To join alarm signaling wires proceed as follows:

- clean the wire ends using an abrasive paper
- insert the wires to a crimping ferrule on both sides
- crimp the ferrule on both ends
- solder the alarm signaling wires crimped inside the ferrule
- check strength of the connection by a gentle pull
- place a finished connection on a spacer plate attached to the carrier pipe

Soldering:

- unwind approx. 5 cm of solder wire and hold the wire reel above the ferrule
- using an LPG torch heat the ferrule until it loses luster
- touch the crimping ferrule with the solder wire (pre-coated with a soldering paste) on
- both sides; mind the cold joints – instead of the paste one may use tin with paste

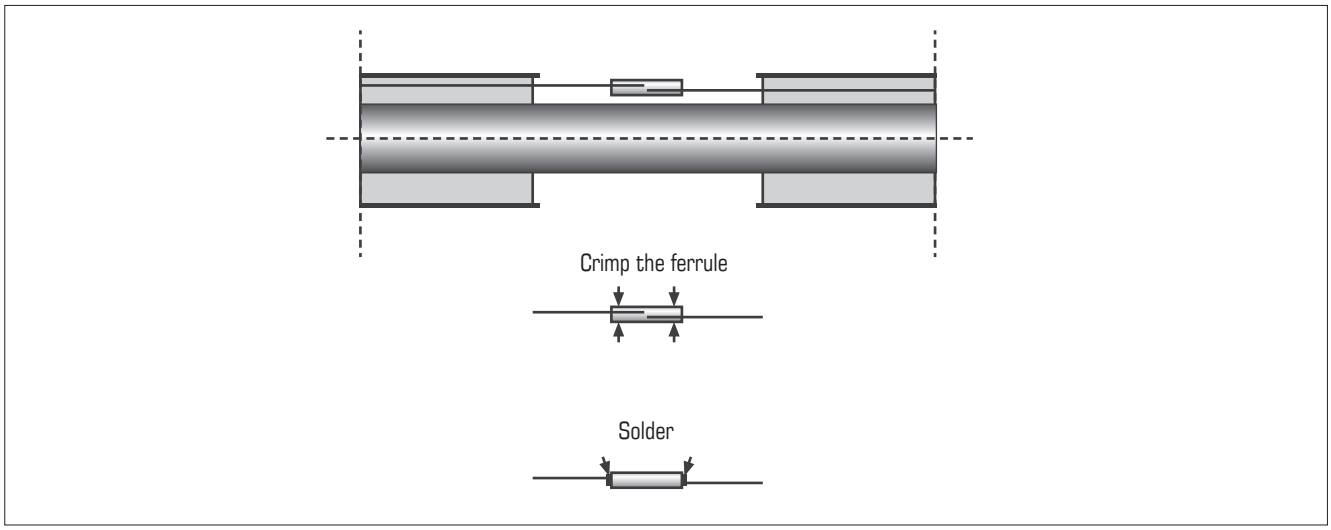


Fig. 39. Joining alarm signaling wires

4.2 Checking correct installation

It is recommended to check the connected components using a special LX 9024 testing device suitable for impulse systems. Using the testing device during the installation works facilitates correct installation of the alarm signaling circuit. The testing device requires connection to both wires of the alarm signaling system and the steel pipe. By making a single connection one may take a reading of the loop continuity (its length) and the thermal insulation moisture content.

Testing devices including operation manuals can be purchased from our company. Measured values are displayed on an LCD as text messages. The testing device connection method is shown below (fig. 40).

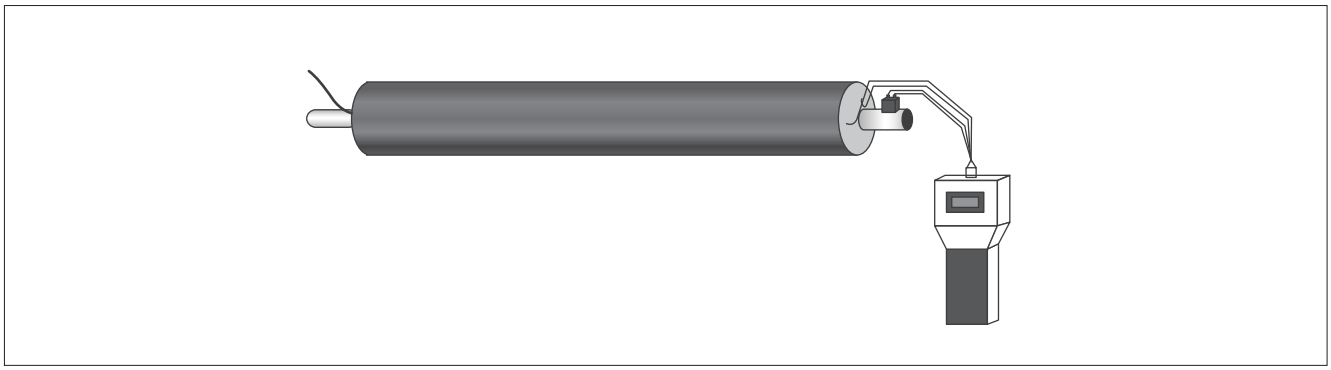


Fig. 40. Testing device connection with the alarm signaling circuit.

4.3 Development of the as-built documentation

The alarm signaling circuit is to be installed as per the design provided. The company performing the installation works for the pre-insulated piping system with alarm signaling wires, should prepare the alarm signaling system as-built documentation on an ongoing basis (before installing joints at welded joints). Subsequently, number the joints along the designed alarm signaling circuit by progressing from the point shown in the design (as the piping system measuring point used during operation – see fig. 41) up to its terminal point, and then mark the numbering pattern in a drawing comprising the documentation.

The complete works shall be finalized by drafting the alarm signaling system final report signed by the installationworks and measurement responsible as well as the site mana ger.

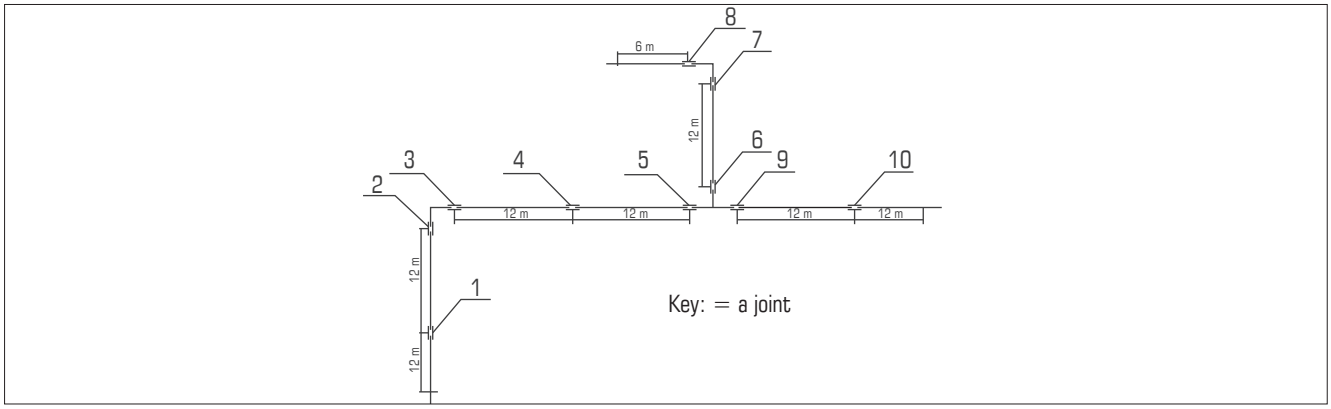


Fig. 41. The principle of marking insulated points in the pipeline assembly drawing

4.4 Terminating the alarm signaling circuits

The alarm signaling circuit can be terminated as follows:

- closing the loop in a joint or under the end cap (fig. 42)
- closing the loop outside the heat-shrink end cap
- closing the loop through a 67LV45 double junction box including a KE-001 cable (fig. 36, fig. 43)
- connecting the LPS-2i instrument (fig. 45)

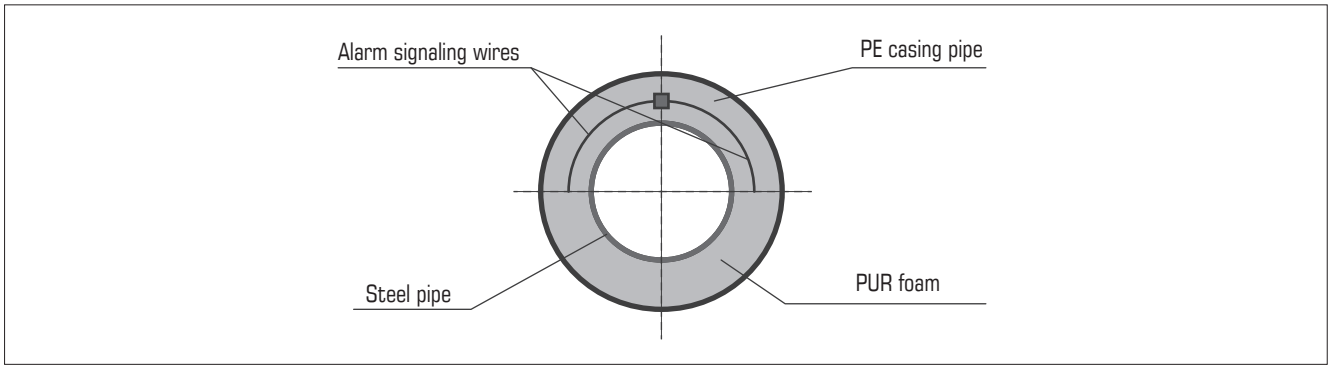


Fig. 42. Terminating the loop in a joint

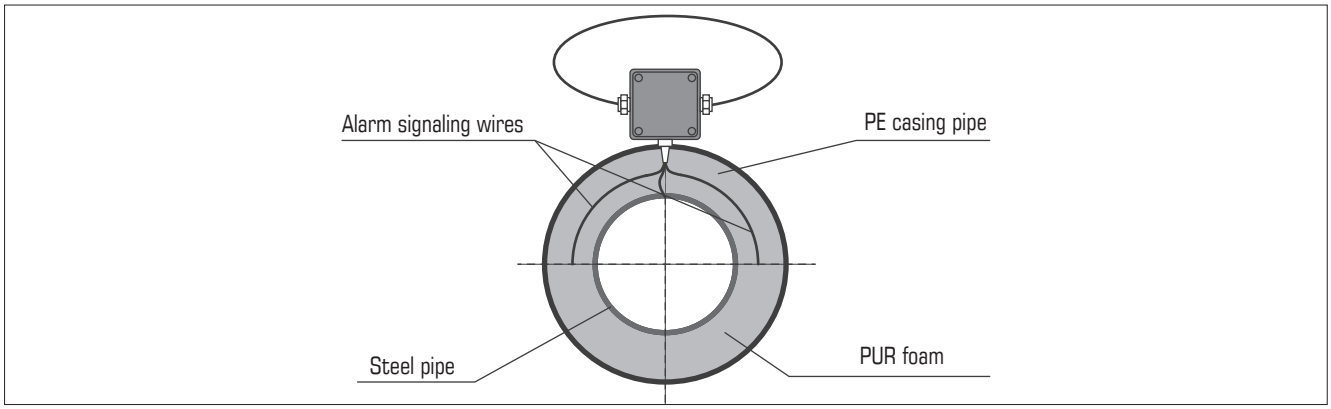


Fig. 43. Terminating the loop in a terminal box

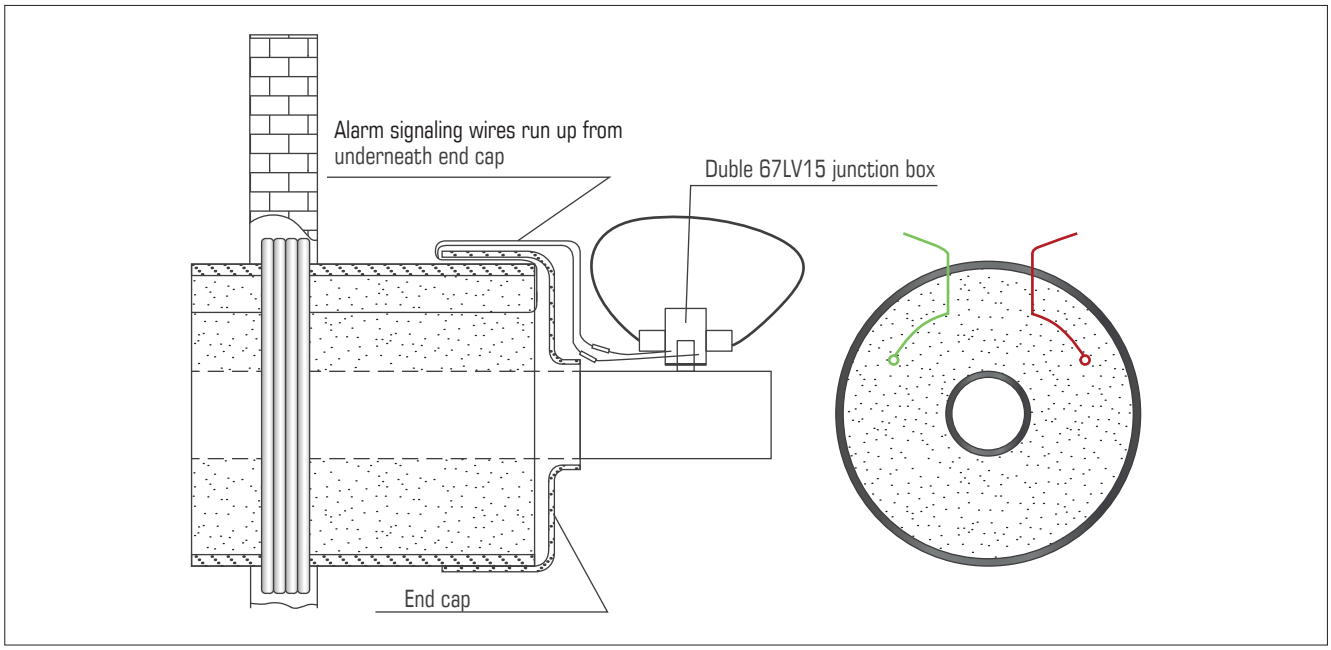


Fig. 44. Terminating the loop through 67LV45 junction box with KE-001 cable

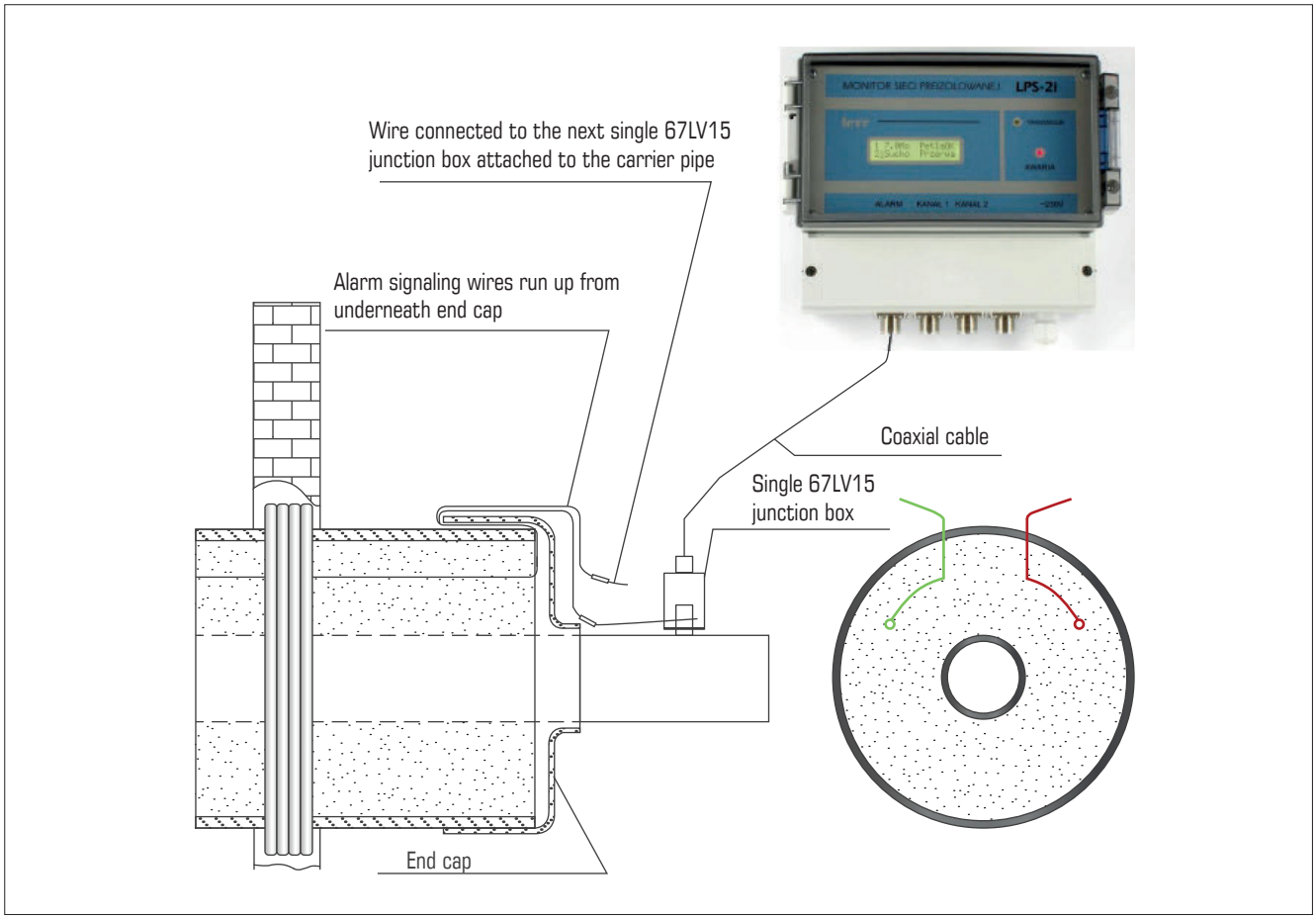


Fig. 45. LPS-2i instrument connection to the alarm signaling system

Note
With no exceptions pipelines must be grounded against unexpected voltage in a pipe (therefore, in the measuring system as well), e.g. 220 V that would pose hazard to a person taking the measurement and to the measuring instrument itself.

5 INSULATION WORKS

5.1 Insulating welded joints (installation of joints)

Before insulation works at welded joints ensure that:

- the leakproof test has been performed and that defects revealed in the course of the test (if any) have been removed
- the alarm signaling system has been completed and its measurement produced satisfying results

To insulate welded joints the following types of joints are delivered:

- heat-shrink radiation cross-linked joints
- heat-shrink joints
- PE with a heat-shrink tape and a reinforcing strip
- for electric welding

Heat-shrink radiation cross-linked, heat-shrink joints and PE joints must be slipped over the pipes before welding. Sealing the joints and foam filling may be performed only by professionals trained by the joint manufacturer.

5.1.1 Heat-shrink radiation cross-linked joints

The heat-shrink radiation cross-linked joints are made of high dens ity radiation cross-linked polyethylene. The PE joints are provided with areas marked during the cross-linking process and secured against cross-linking to make openings for fusing blanking plugs after filling the PE joint with foam. The openings are made during the joint manufacturing process. The joints are delivered to a site complete with two vent plugs, two blanking plugs for electric fusing, a cleaning cloth and a installation manual. Bearing in mind the fact that cross linked polyethylene is not a weldable material and cannot be drilled at any random point of the joint. Depending on the actual needs the joints may be delivered with a seal in the form of an adhesive applied in the factory over the interior heat-shrink sleeve surface (MDKW), in the form of mastic (MDMW) or in the form of mastic and adhesive (MDPW).

Advantages:

- robust, leak-tight and flexible
- easy to fit
- resistant to high flame
- resistant to aging
- applied at temperatures from –55 to 125°C
- plug fusing zones without cross-linking

Joint preparation

- Slip the heat-shrink joint still in a factory packaging over one of the pipes (fig. 46).
- Weld the pre-insulated pipes and check tightness as well as correct quality of the weld.
- Connect the alarm signaling wires (if applicable) according to the manual provided by the manufacturer.
- Remove dirty PUR foam from the faces of the joined components to a depth of approx. 1-2 cm.

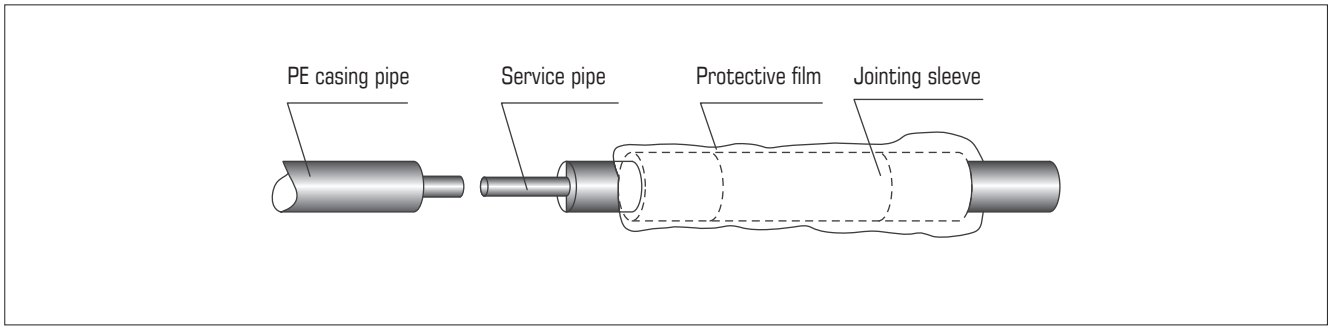


Fig. 46. Slipping the joint over a pre-insulated pipe

Joint installatio n

Note
If an alarm signaling system is used the joint may be fitted only after taking correct measurements from the joint installation point in both directions (after terminating the system loops)

- Place the heat shrink jointat the center of the joint to be insulated and mark its ends on the casing.

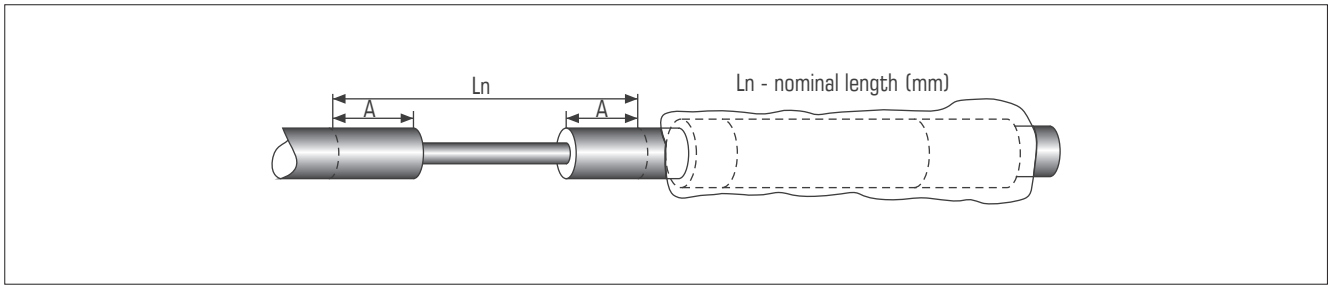


Fig. 47 Marking joint ends on the casing

Clean the pre-insulated pipe casing surface off dirt and dust (dry if necessary) and then grind it using an abrasive paper (grade 68-80) on both sides of the joint to be insulated.

- Degrease and clean the PE casing in the joint shrinking are a using the cleaning cloth.
- Heat the casing pipe in the joint installation areas up to approx. 60°C. For heating use an LPG torch with an adjustable flame. Use a low flame (fig. 48).

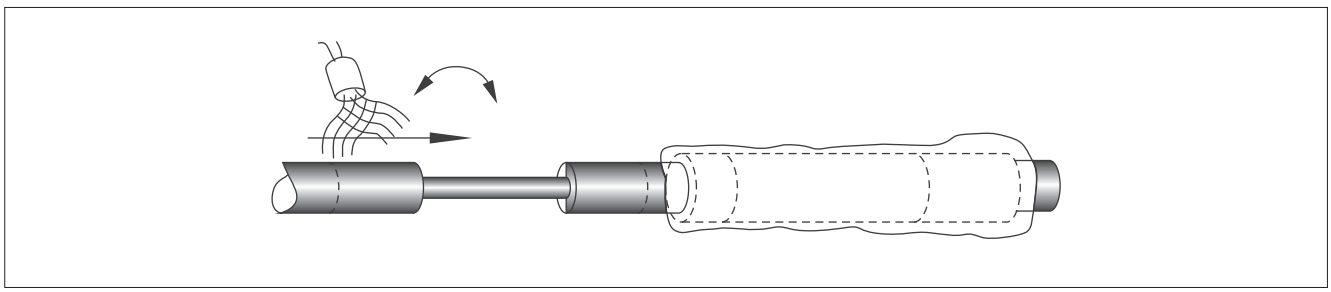


Fig. 48. Preheating

Remove the protective film from the heat-shrink joint surface (without removing the foil from inside the joint) and slide the joint over to the point previously marked on the casing. Slide the joint with the protective film left inside it. Remember to remove straps of the foil protecting the mastic located inside the joint on the edges. Start the heat-shrink jointing sleeve shrinking process from the interior surface of the shrinking zone and then move towards the joint edge. Shrink the joint by evenly heating

it around the pipe centerline and by moving the torch towards the joint edge (fig. 49). Use a stable yellow flame for shrinking. Shrinking is to be done so as to achieve concentricity of the joint and the pipe. Repeat the sequence for the other end of the joint. Handle the flame with caution lest it damages the pre-insulated pipe casing. The shrinking process may be finalized once the shrunk ends of the joint are completely smooth and the joint shrinks on either side of the mastic. In case of MDKW joints (with adhesive) the adhesive will flash over the circumference. Leave the joint until it cools down completely.

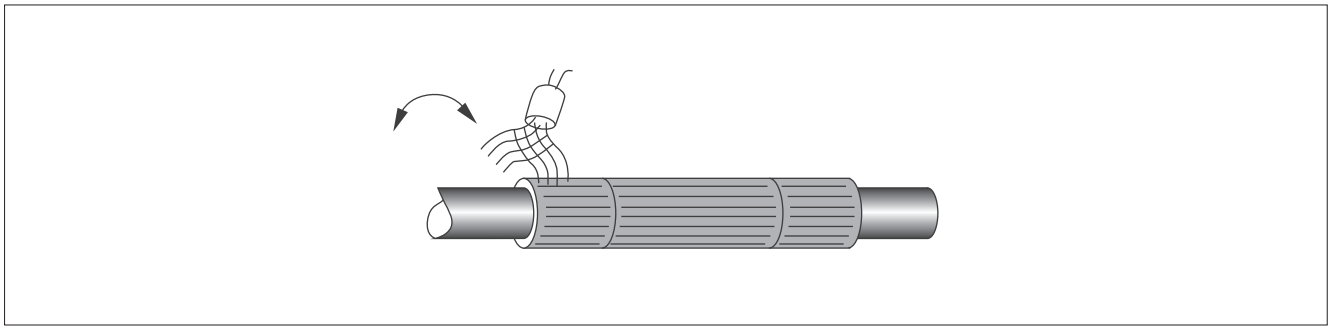


Fig. 49. Joint shrinking

Foam application at the joint

- Perform a pressure test with air at 0.2 bar for the duration of 2 minutes. The pressure test can be performed at the joint temperature below 40°C (if required by the Investor).
- Fill the joint with measured and mixed PUR foam compounds (polyol and isocyanate – fig. 50), and secure the filler openings with vent plugs (fig. 51). The joint filling foam is delivered in measured retail packed sets for a given diameter, with a corresponding instruction manual (see point 5.4.2). Joints of larger diameters should be foam-filled using foam units (see point 5.4.1).

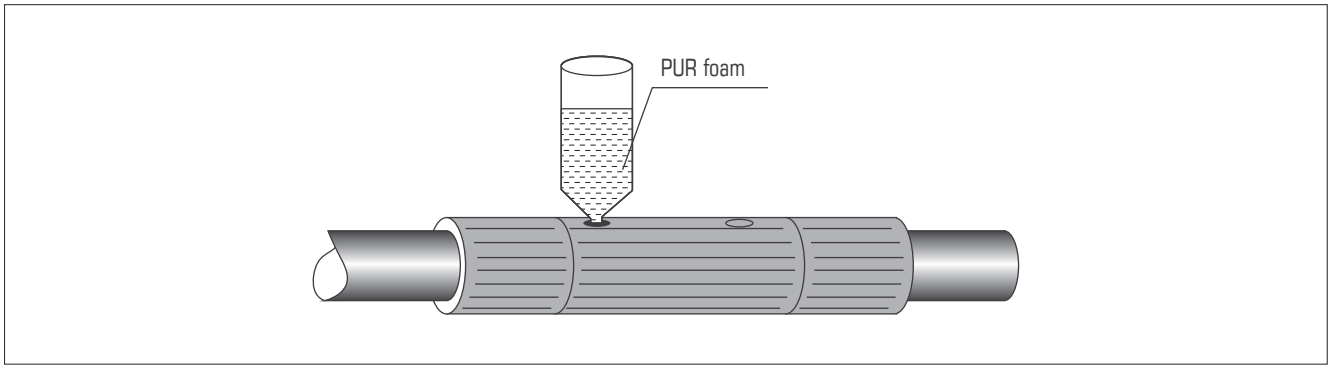


Fig. 50. Foam application at the joint

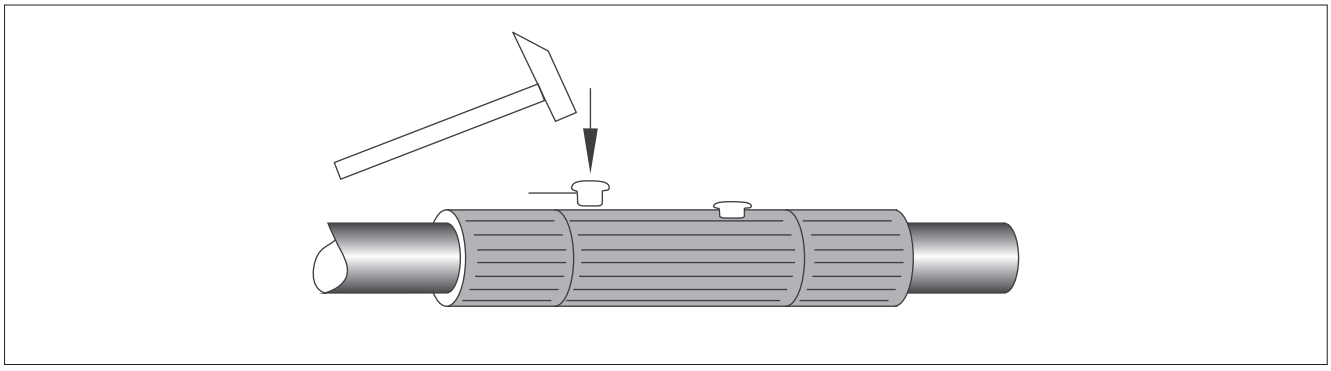


Fig. 51. Driving the vent plugs

Fusing blanking plugs

- Once the PUR foam hardens and the joint cools down remove the vent plugs.
- Using a cone cutter to ream the opening to Ø27 (fig. 52).
- Fuse the plugs using a plug heater (fig. 52).

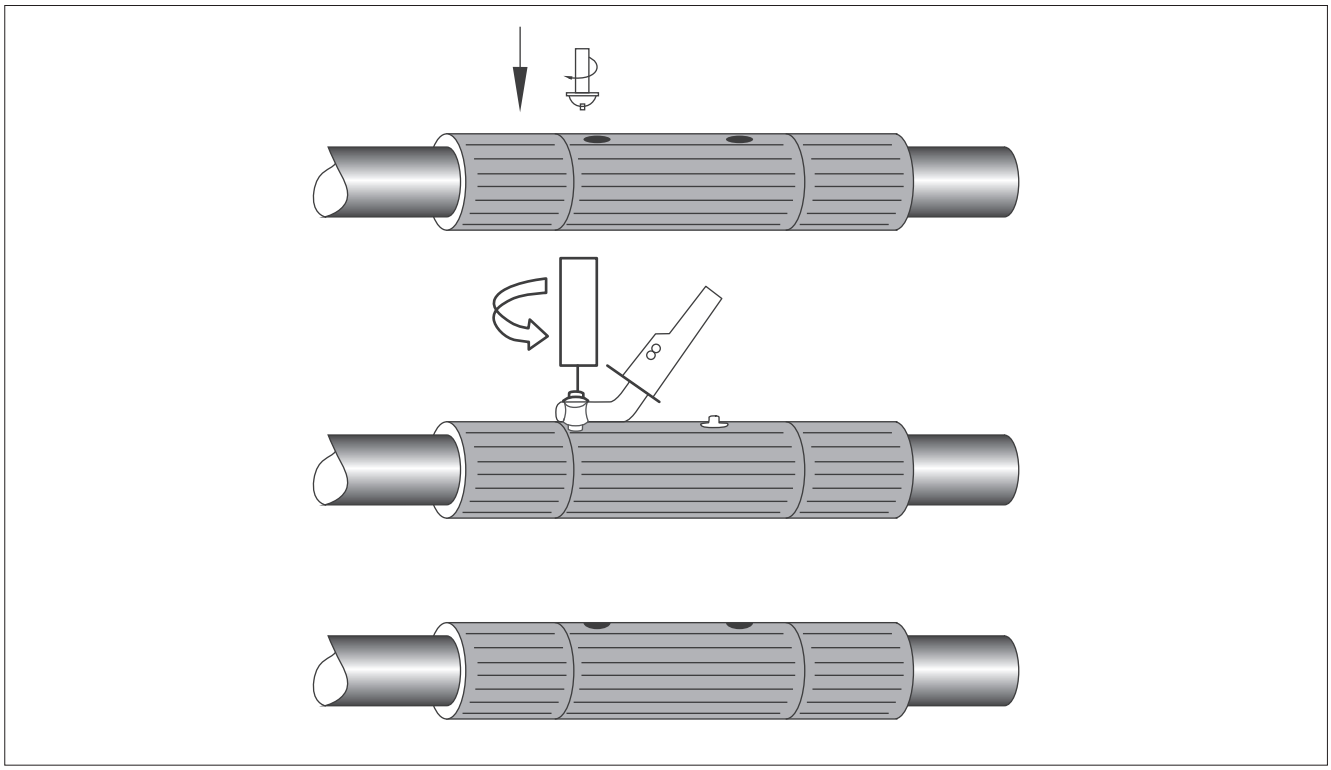


Fig. 52. Reaming the openings with a cutter and fusing the blanking plugs

5.1.2 Noncross-linked heat-shrink joints

Noncross-linked heat-shrink joint are made of high density polyethylene and blow-molded. These joint are delivered without pre-drilled filler openings. When placing the order please remember to include vent plugs and blanking plugs for electric fusing. Polyethylene retains its weldability. The joints may be delivered with a separate seal or a seal applied in the factory over the interior heat-shrink joint sleeve surface. It is recommended to provide an additional joint seal by applying and shrinking a heat-shrink tape at the point of contact between the joint and the casing pipes. The joint installation procedure is the same as the one described above. An additional sequence includes filler opening drilling before the joint shrinking process. Once the shrinking process is complete and the joint cools down (joint temperature below 40°C), perform an obligatory pressure test with air at 0.2 bar for the duration of 2 minutes. Depending on the foam application method used, apply foam at the joint as per point 5.4.1 or 5.4.2. This type of joints is not recommended for a common use. A heat-shrink joint with heat-shrink tapes fitted is shown in fig. 53

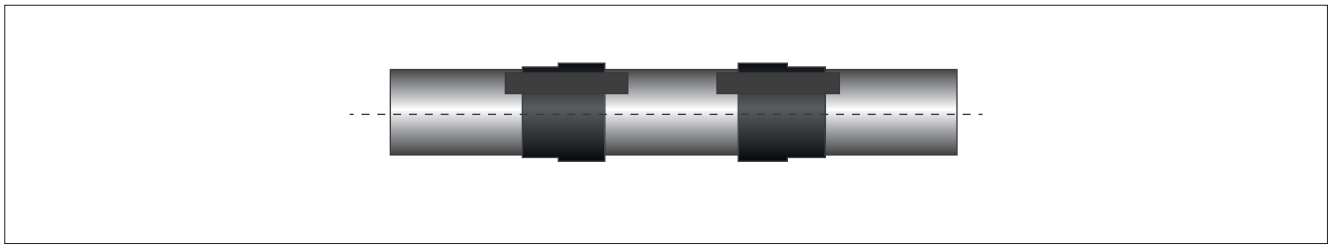


Fig. 53. Noncross-linked heat-shrink joint with additional sealing.

5.1.3 Polyethylene joints

The polyethylene joints are made of HDPE pipes with a diameter slightly larger than the pipe casing and then cut to a required length (usually 50 cm). These joints are delivered without pre-drilled filler openings. When placing the order please remember to include vent plugs, blanking plugs for electric fusing and the heat-shrink tape. The joints are usually used for repairs of a damaged casing. In such a case the joint is cut through and fitted over a previously welded joint or a place of damage. Welding of the cut joint requires a manual extruder machine and a service personnel to operate it. This type of joint is not recommended for a common use. A polyethylene joint with heat-shrink tapes fitted is shown in fig. 54.

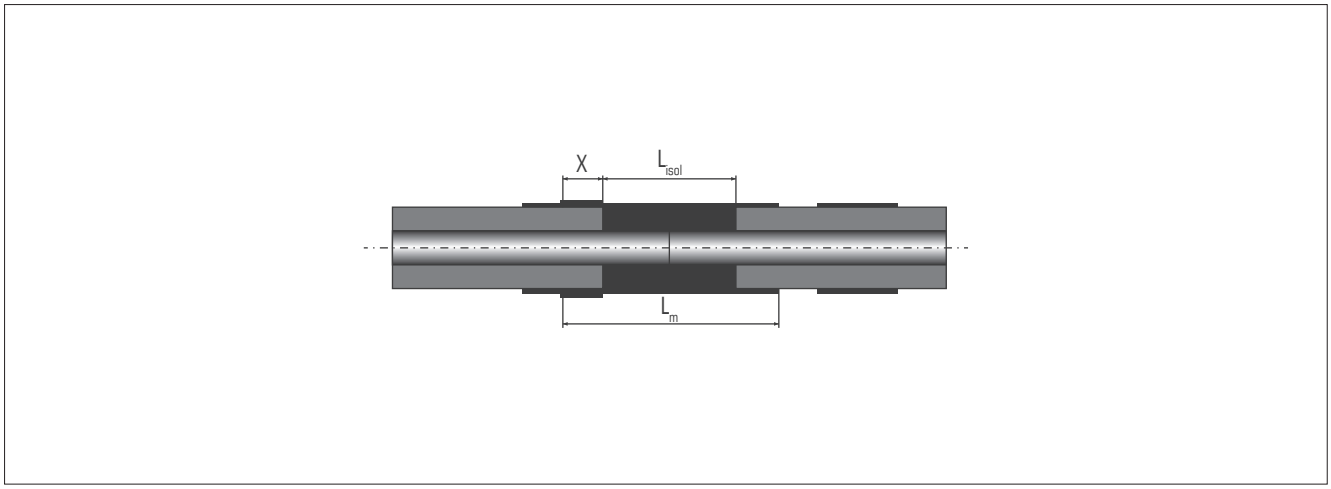


Fig. 54. Welded joint insulation

To insulate a welded joint proceed as follows:

- remove the front PUR foam layer from the ends of the joined components to a depth of approx. 2 cm
- mark the joint reach on the casing of welded components
- degrease and remove dirt from the surfaces on which heat-shrink tapes are to be fitted
- fit the cut joint and weld the cut line using a manual extruder machine
- place the joint at the center of the joint
- improve adhesion of the joint and the casing by grinding the surface meant for the bands using an abrasive paper (grade 40-80); remove the polyethylene swarf
- unreel and measure a required length of the heat-shrink tape considering a 10 cm overlap (for a given outside diameter of the casing pipe and the PE joint – see table 5)
- heat the polyethylene joint and the casing pipe (at the taping point) up to 40-50°C; wrap the measured section of the heat-shrink tape around the insulated area (leaving a spare length at the bottom), remove the protective film from the internal surface, and weld the longitudinal seam using an LPG torch by pressing it with a metallic roller; do not shrink
- heat the internal surface of the heat-shrink strip by holding it in a welding glove
- after placing the strip at the heat-shrink tape overlap press-fit it using the roller; do not shrink the band yet – let it cool down and in the meantime prepare the heat-shrink tape band at the other end of the joint
- heat the heat shrink tape evenly using an LPG torch (yellow flame), starting from the middle of the tape and by progressing towards the outer edges and from the bottom to the top section; make sure no air bubbles become entrapped; a small bitumen flash should flow from underneath the heat-shrink tape over its circumference on both sides (the heat-shrink tape must make a close contact with the pipe casing)
- make a vent opening as close to the shrunk band as possible
- repeat the sequence with the second tape
- once the tape cools down perform a pressure test (as specified in point 5.1.2); depending on the foam application method used, apply foam at the joint as per point 5.4.1 or 5.4.2

After completing the aforesaid activities the joint is ready for foam application.

Note
Shrinking must be carried out in welding gloves to avoid hand burns.
The quantity of heat-shrink materials required to complete the heat-shrink band on the site, depending on the nominal diameter of the casing pipe (and the corresponding outside diameter of the casing pipe), is specified in table 5.

Table 5. Schedule of heat-shrink tape quantities to complete a heat-shrink band

Casing pipe OD	Heat-shrink tape length per a single band	Heat-shrink tape width	Reinforcing strip length
mm	m	mm	mm
90	0.4	150	150
110	0.5	150	150
125	0.55	150	150
140	0.6	150	150
160	0.65	150	150
200	0.8	150	150
225	0.95	150	150
250	1	150	150
315	1.25	255	230
400	1.55	255	230
450	1.7	255	230
500	1.9	255	230
560	2.1	255	230
630	2.4	300	300
710	2.7	300	300
800	3	300	300
900	3.4	300	300
1000	3.6	300	300
1100	4	300	300
1200	4.2	300	300

Note
Two bands are required for one joint. Therefore, when planning material quantities double the values from table 5 for each joint of a specific diameter.

5.1.4 Joints for electric welding

Joints for electric welding (open type) are made of HDPE sheets with embedded resistance heaters at the circumference and lengthwise. They are commonly used to insulate welded joints at pipelines of larger diameters, e.g. > DN400. Such joint are fitted by a service team with suitable equipment (a welding machine from the joint manufacturer) for welding polyethylene. To obtain a correct polyethylene welding quality of the joint and the casing their melt flow ratios (MFR) must not differ significantly. Depending on the joint type, make sure that the set in cludes vent plugs and blanking plugs for electric fusing. Once the joint is welded and cools down perform an obligatory pressure test. Depending on the foam application method used, apply foam at the joint as per point 5.4.1 or 5.4.2.

5.1.5 Joints for elect ric welding (Ewelcon)

Joints for electric welding are provided with detailed instructions from the manufacturer.

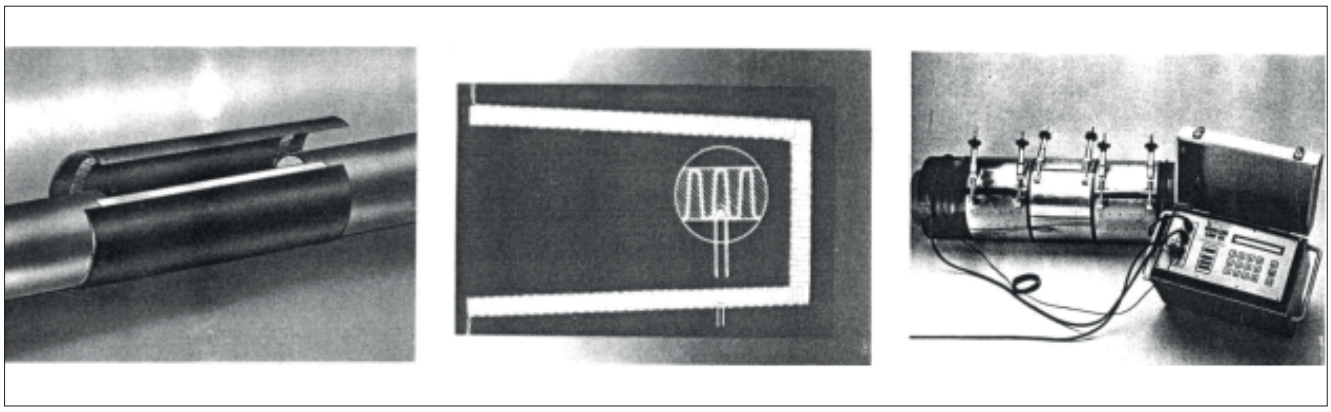


Fig. 55. A joint for electric welding (EWELCON)

5.1.6 Joints for electric welding (Kamitech)

Joints for electric welding are provided with detailed instructions from the manufacturer.

5.1.7 End joints

End joints are used to close the ends of pre-insulated pipes that are temporarily out of service before backfilling the pipeline.

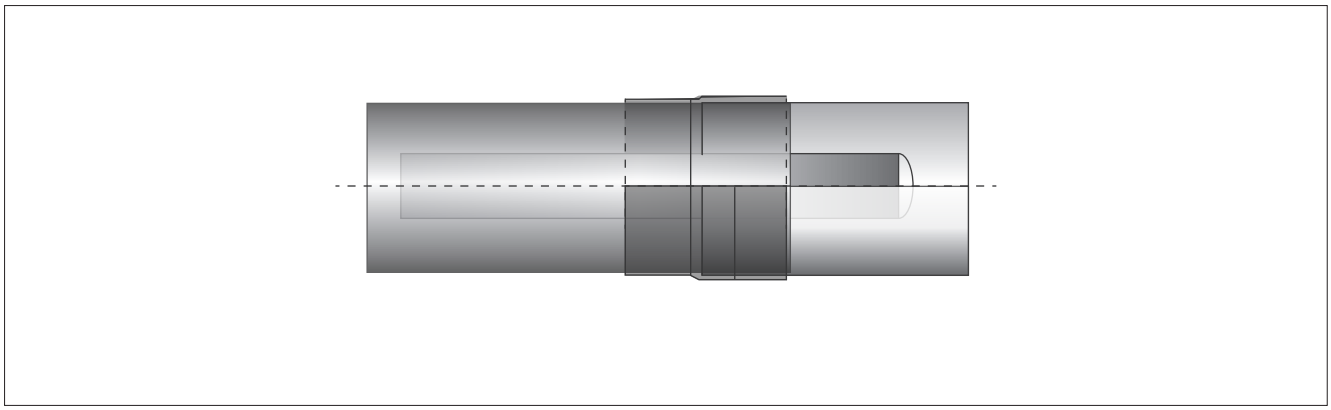


Fig. 56. End joint

A HDPE end joint should besealed with a heat-shrink tape (fig. 56).
The end joint sealing sequence is described in point 5.1.3 describing installation works for polyethylene joints.

5.2 Pre-insulated pipe end sealing process

The pre-insulated pipe ends are fitted with heat-shrink end cap to protect thermal insulation against ingress of moisture (fig. 57).

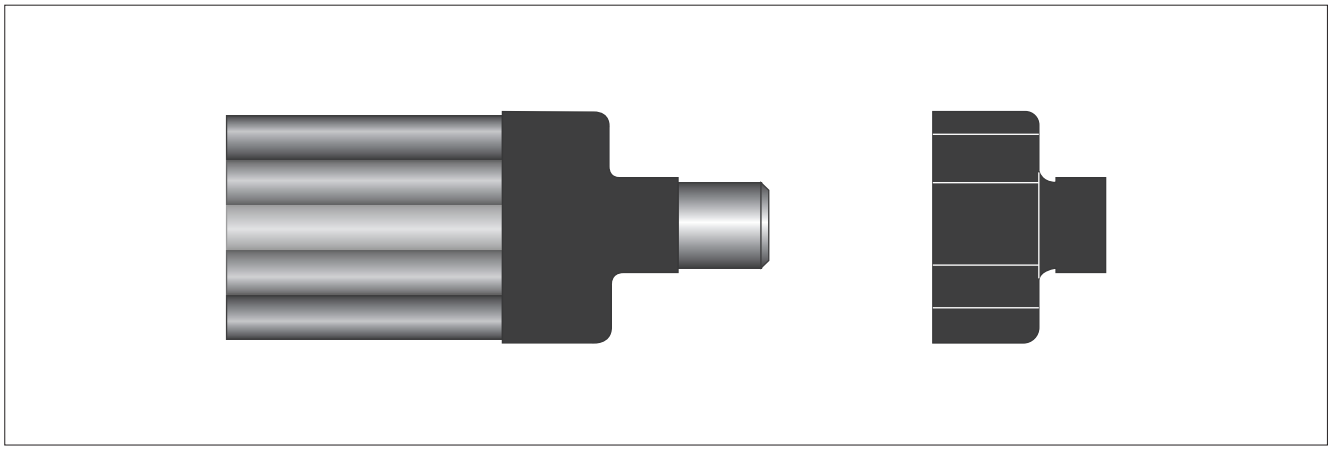


Fig. 57. Heat-shrink end cap installation m ethod

Before welding a pre-insulated pipe with a conventional pipe the pre-insulated pipe end is to be fitted with a heat-shrink end cap suitable for a given diameter.

The end cap shrinking procedure is as follows:

- complete the alarm signaling system installation at the pipeline
- run up the alarm signaling wires from underneath the end cap or if thus specified in the design terminate the alarm signaling loop under the end cap
- check the PE casing edge for smooth surface without burrs – if necessary smooth it
- use a wire brush to remove rust, grease, etc. from the steel pipe surface
- clean the casing pipe and the steel pipe using an abrasive paper; remove swarf and dust; run up the alarm signaling wires, if any
- put additional mastic where the alarm signaling wires are run up
- fit a shielding plate on the pipe on the side of foam insulation and heat the steel pipe up to approx. 60°C
- remove the shielding plate and position the heat-shrink end cap for shrinking
- shrink the end cap over the casing pipe using an LPG torch by taking care not to burn the alarm sign aling wires
- shrink the end cap over the steel pipe

The heat-shrink end cap installation works are completed correctly when the surface of the shrunk material is smooth and makes a tight contact with the casing as well as the carrier pipe surface. If the steel pipe is to be welded shield the end cap using a shielding plate.

5.3 Sealing pre-insulated pipe penetrations through walls

Pipeline penetrations through the walls are secured using rubber sealing rings. The rubber rings ensure tightness at the penetration and enable pipeline movements. A secured penetration is shown in fig. 51.

The sealing ring installation procedure is as fol lows:

- remove foreign objects (if any) from the ring internal surface
- clean the casing at the point of contact with the sealing ring and grease it (e.g. using a machine grease)
- slip the sealing ring over the casing pipe (position it correctly in the wall)
- wrap a lube tape around the casing pipe
- set the sealing ring in concrete by securing the casing pipe with a PE film lest the falling concrete smears the casing pipe in the process
- remove the film

Note
If the wall thickness exceeds 20 cm use two sealing rings – one from the building exterior and the other one from the building interior. Use a lube tape between the rings.

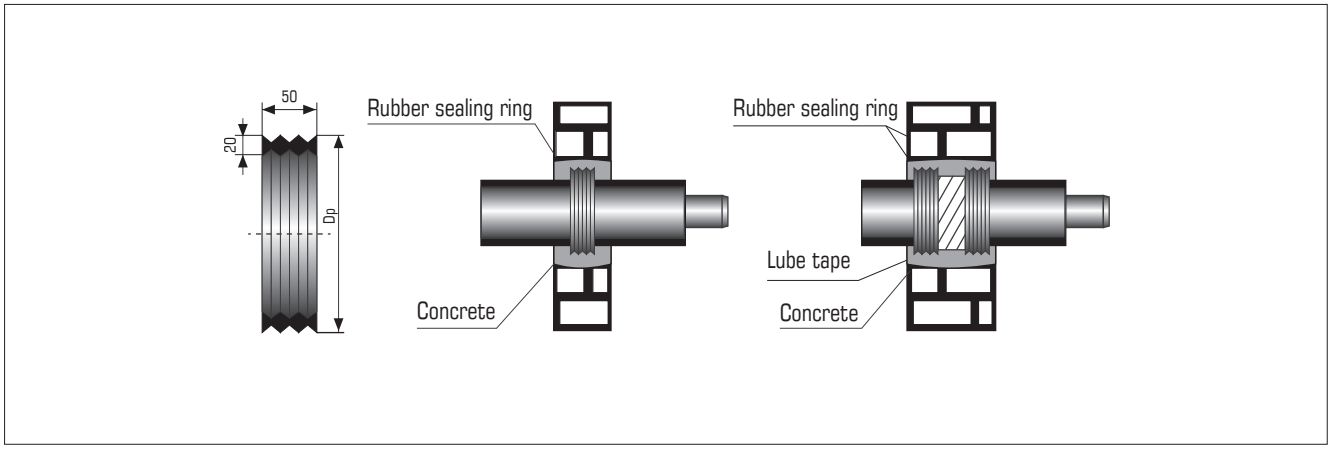


Fig. 58. Penetration through space dividers

5.4 Foam application

Regardless of the selected foam application method, avoid moisture at joint and too low ambient temperature drops during this process. The best foam quality is achieved on a warm and dry day. Under special circumstances the foam may be applied on a rainy day under a tent, though, and by carefully drying the joint using an LPG torch. Preparation of the retail packed foam compounds and handling them before the foam application process is described in point 5.4.2.

Note
During the foam application process use personal protection equipment (safety glasses, shield, asafety gloves, etc.).

5.4.1 Foam application using a foam unit

Site joints are insulated with a two-compound PUR foam from a mobile foam unit. The unit is equipped with a foam nozzle used to inject foam into a joint fitted over a joint (fig. 59).

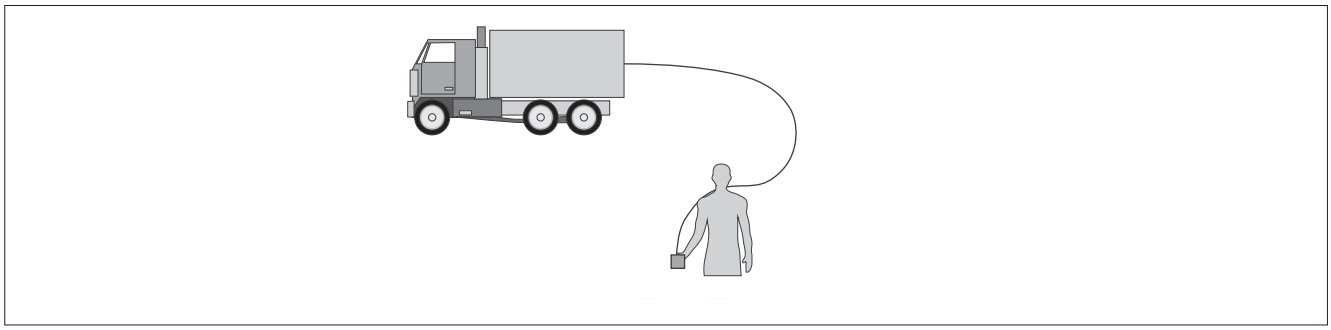


Fig. 59. Joint joint foam filling

The sequence of foam application and blanking the joint openings:

- drive a vent plug into one of the joint filler openings
- fill the joint with foam through the other filler opening
- drive a vent plug into the second joint filler opening
- once the PUR foam hardens remove the vent plugs
- clean the joint to remove foam residues and ream the openings using a Ø27 cone drill
- fuse the fusible plugs using a plug heater Heat the plug and the joint opening until the polyethylene material flashes. Subsequently, press the plug into melted surface of the opening and hold it until it cools down.

5.4.2 Preparing the foam and manual foam application

With a smaller scope of works or when performing repairs at the piping system where time matters the foam may be prepared and applied without the foam unit using a manual method.
For this purpose use the retail packed foam with compounds "A" (polyol) and "B" (isocyanate) dedicated to a given diameter:

- shake the bottle containing the "B" compound and pour the content to the bottle with the "A" compound
- after capping the bottle tightly keep shaking it strongly for 15 to 20 seconds
- a mixture thus prepared is to be poured into a joint straight away
- blank the foam filling openings with special vent plugs
- once the PUR foam hardens and the vent plugs are removed clean the joint to remove foam residues and ream the openings using a Ø27 cone drill
- fuse the fusible plugs using a plug heater Heat the plug and the jointing sleeve opening until the polyethylene material flashes. Subsequently, press the plug into melted surface of the opening and hold it until it cools down.

When mixing the compounds and filling the joint strictly observe the instructions from the manufacturer.

Note
If the temperature of foam compounds drops down below +18°C, before application of the foam move the products to a warm room until they reach temperature of 18 to 22°C. Do not allow the "B" compound (isocyanate) temperature to drop down below +10°C since in such conditions the product crystallizes.

6 CHOSEN PROBLEMS RELATED TO CONSTRUCTION OF PRE-INSULATED HEAT DISTRIBUTION PIPING SYSTEMS

6.1 Preheating

In addition to the traditional methods of thermal elongation compensation consisting in the use of natural expansion joints or bellows expansion joints, preheating is used in construction of pre-insulated heat distribution piping systems. Preheating consists in bringing a pipeline to a zero stress condition at a temperature different from the one at which the installation works are perform ed.

Preheating can be performed:

- without concrete fixed points
- with concrete fixed points
- in an open trench
- with disposable expansion joints

6.1.1 Preheating in an open trench

A pipeline (long straight sections of max. > 2L without expansion zones) in a fully assembled condition is preheated before backfilling to a design preheating temperature value. The preheating temperature comes to 70°C at an operating temperature of 130°C and installation temperature of 10°C. Preheating is carried out as long as it takes for the pipeline to achieve the calculated theoretical elongation value at measuring points (e.g. at elbows, at free ends, etc.). Once the pipeline achieves the calculated elongation value the trench is backfilled and the fixed points are set in concrete without reducing the temperature. The preheating process is stopped after backfilling the pipeline completely or after the concrete at fixed points is set and backfilled. It is possible to use heating water as the heat source, which in summer achieves the temperature of 70°C. A pipeline in an assembled and backfilled condition immobilized by soil or fixed points at a temperature of 70°C has a zero stress value. At 130°C the stress value will come to –150 MPa, whereas at the installation temperature to +150 MPa. Bearing in mind the fact that a pipeline assembled in this manner operates under stress ranging from +150 MPa to –150 MPa, and may not be uncovered or cut.

6.1.2 Preheating with disposable expansion joints

If upon assembly the pipeline needs to be backfilled immediately due to the site conditions and the design provides for preheating of long straight sections (max. > 2L) then disposable bellows expansion joints are fitted (i.e. the so called E type joints as shown in fig. 54). Before installation the E type joints must be preset according to the basic design. The E type joints are fitted at locations indicated in the basic design. The pipeline heating is to be started when the pipeline is backfilled and the E type joints are still uncovered (fig. 53). The pipeline preheating temperature is to be specified by the design engineer. The pipeline preheating may be finalized once all the expansion joints achieve the calculated elongation (i.e. will close) and are welded. Following this process the expansion joints are to be insulated (fig. 54) and the trench is to be backfilled. From now on the expansion joints form a straight pipe section and the pipeline operates under stress, and may not be uncovered or cut.

Fig. 60. Preheating with a latched expansion joint

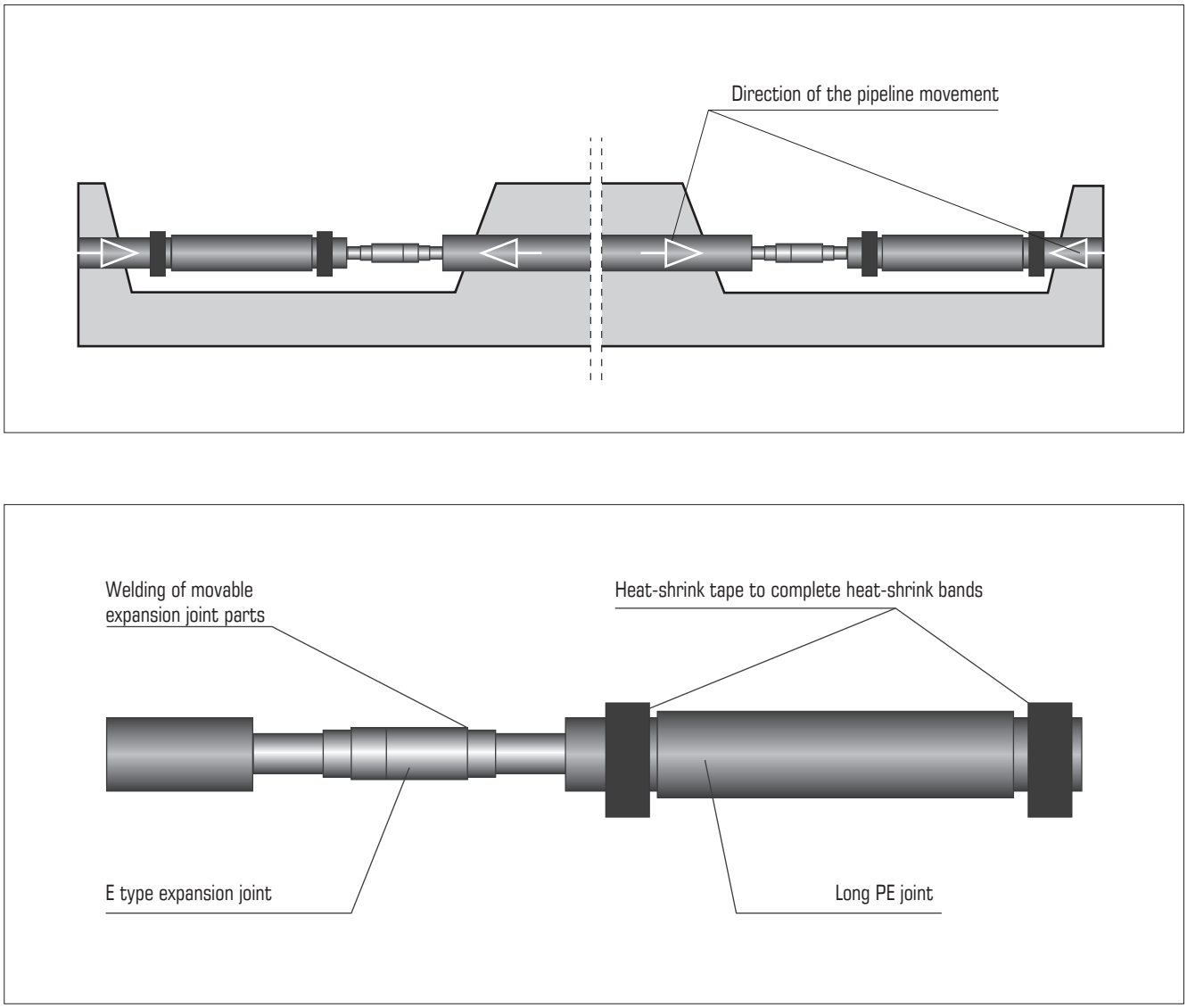


Fig. 61. Welding of E type expansion joint casing

6.2 Constructing a pre-insulated branch pipe from an existing pre-insulated pipeline

A new branch pipe from an existing pre-insulated pipeline may be constructed in different ways:

- by welding in a prefabricated and pre-insulated tee joint (this requires draining water from the pipeline completely and removing an approx. 1.5 m section of the existing pipeline)
- by making a "cold" tie-in (for this the area marked around the tie-in must be isolated and partially drained of water, and a previously prepared branch pipe elbow must be welded in)
- by making a "hot" tie-in on a live pipeline using a special "hot tapping" device (fig. 62)

In case of using the last two methods the pre-insulated pipe material at the branch pipe must be replaced. The method of replacing the pre-insulated pipe material must be consistent with the description in the basic design.

Fig. 62. Constructing a branch pipe on a hot pipeline

6.3 The following are figures showing the method of connecting a pre-insulated piping system with a conventional piping system.

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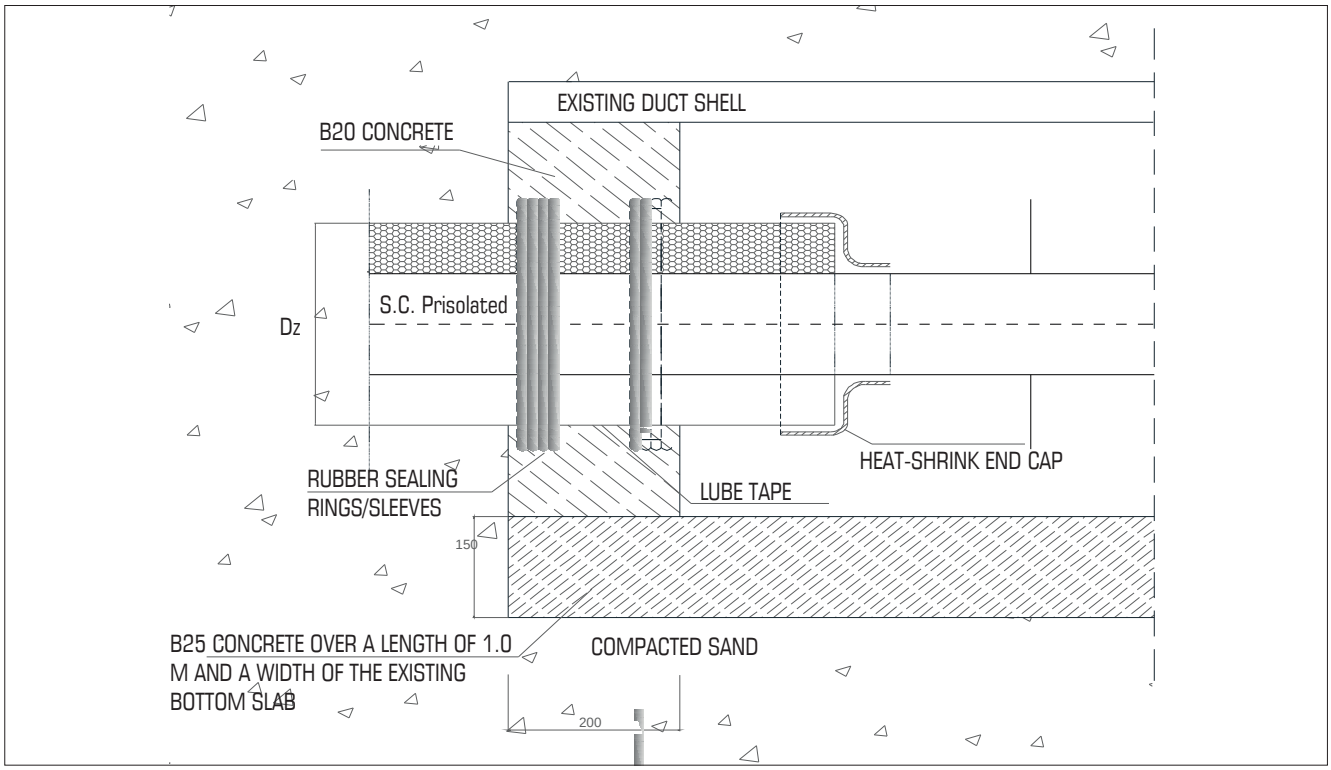


Fig. 63. Connection between a pre-insulated piping system and a conventional piping system

6.4 Constructing a branch pipe from a pre-insulated piping system towards an existing conventional pipeline laid in a duct

The following figure shows the method of connecting a branch pipe from a pre-insulated piping system towards a conventional piping system.

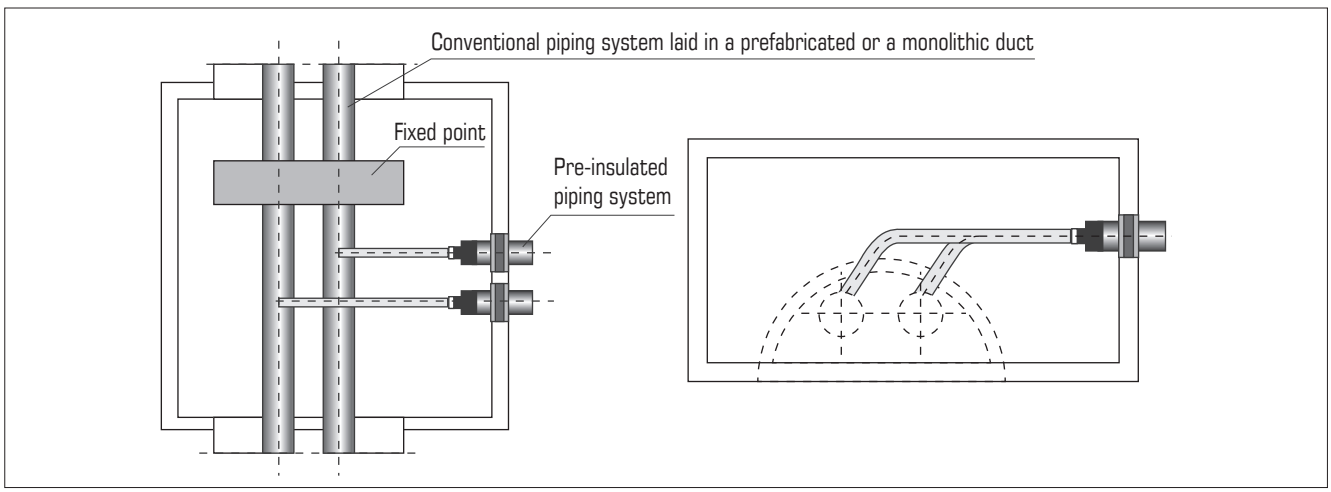


Fig. 64 Constructing a branch pipe from a pre-insulated piping system towards a conventional piping system

6.5 Constructing a conventional branch pipe from an existing pre-insulated piping system

The following figure shows the method of connecting a conventional branch pipe with a preinsulated piping system.

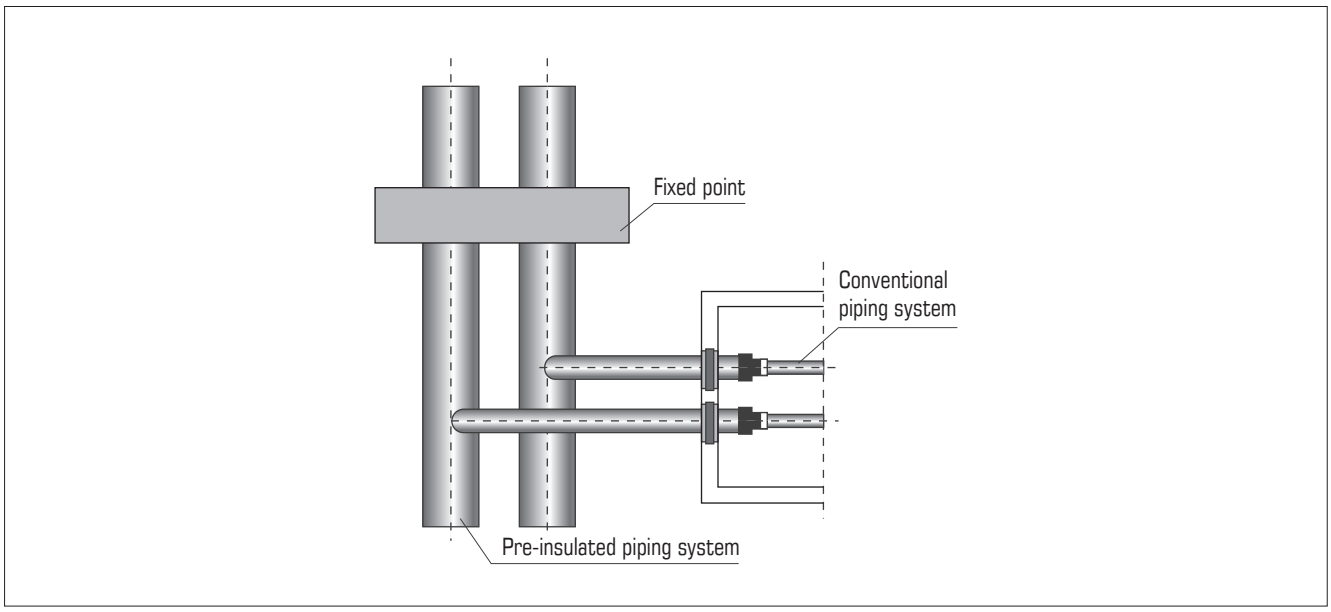


Fig. 65 Constructing a branch pipe towards a conventional piping system from a pre-insulated piping system

6.6 Backfilling of the excavation

Following the final inspection of a heat distribution line and removal of defects found during the inspection proceed with the trench backfilling works. For this purpose perform the following sequence:

- remove timber pads from underneath the pipeline if used for pipe placement inside the trench
- remove sharp-edged objects (installation tools and equipm ent)
- backfill the pipes with a 100 mm thick layer of sand free of stones, debris, etc. and compact the sand; measure the sand layer thickness from the upper edge of the casing pipe
- subsequently, fill the trench with the native soil by compacting it in layers every 10 cm to achieve density specified in the design
- after placing approximately 30 cm of the backfill over each pipeline lay a black caution tape
- provide a casing at the valves connection points as required by the piping system user

Selection of a vibratory compacter – required weight:

- when compacting in layers of 10 cm in thickness – 32 kg
- when compacting in layers of 20 cm in thickness – 50 kg

7 FINAL NOTES

- RAPDOL PIPES sp. z o.o. may refuse to provide a guarantee if the contractor is found to be unprepared for work in terms of qualifications (lack of training) or equipment (lack of appropriate instruments and tools).
- On the other hand, RAPDOL PIPES sp. z o.o. undertakes to provide all technical assistance (consulting, engineering, training, etc.) or to carry out certain works using their own service teams.
- For installationworks, engineering and training issues please contact the sales office of RAPDOL PIPES sp. z o.o. at ul. Nocznickiego 33 in Warsaw.
- In order to ensure correct quality of works as part of RAPDOL PIPES sp. z o.o. technology, RAPDOL PIPES sp. z o.o. organizes trainings for the management, supervisors and fitters.
- RAPDOL PIPES sp. z o.o. reserves the right to control the installation works within the framework of the guarantee provi ded.

Appendix No. 1 – MEASURING REPORT FOR BRANDES SYSTEM

PROTOKÓŁ POMIAROWY

Projekt _____

Zamawiający _____ Nr prot. _____

_____

Odcinek _____

Szkic pętli

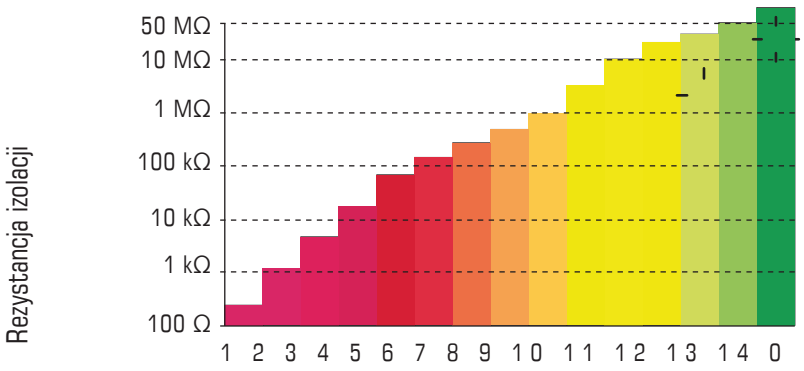
⊗ Punkt pomiarowy — przewód czujnikowy (czerwony) — przewód powrotny (zielony)

1. Dane ogólne

– dł. przewodu rurowego [m]
– opór elektryczny [Ohm]

2. Wyniki pomiarów BS-MH:
– stopień MH
–długość [km]

	zasilanie		powrót	
	góra	dół	góra	dół



Zlecenie montażowe
Rezystancja instalacji cieplnej co najmniej

Dł. Przew. Rurowego Mh Stopień

do 300 m	0
300 do 500 m	14
500 do 800 m	13
800 do 1000 m	12

BS-MH Stopień 12 (>10 MOhm)

Uwagi

Kier. budowy: _____

Sprawdził _____

Data _____

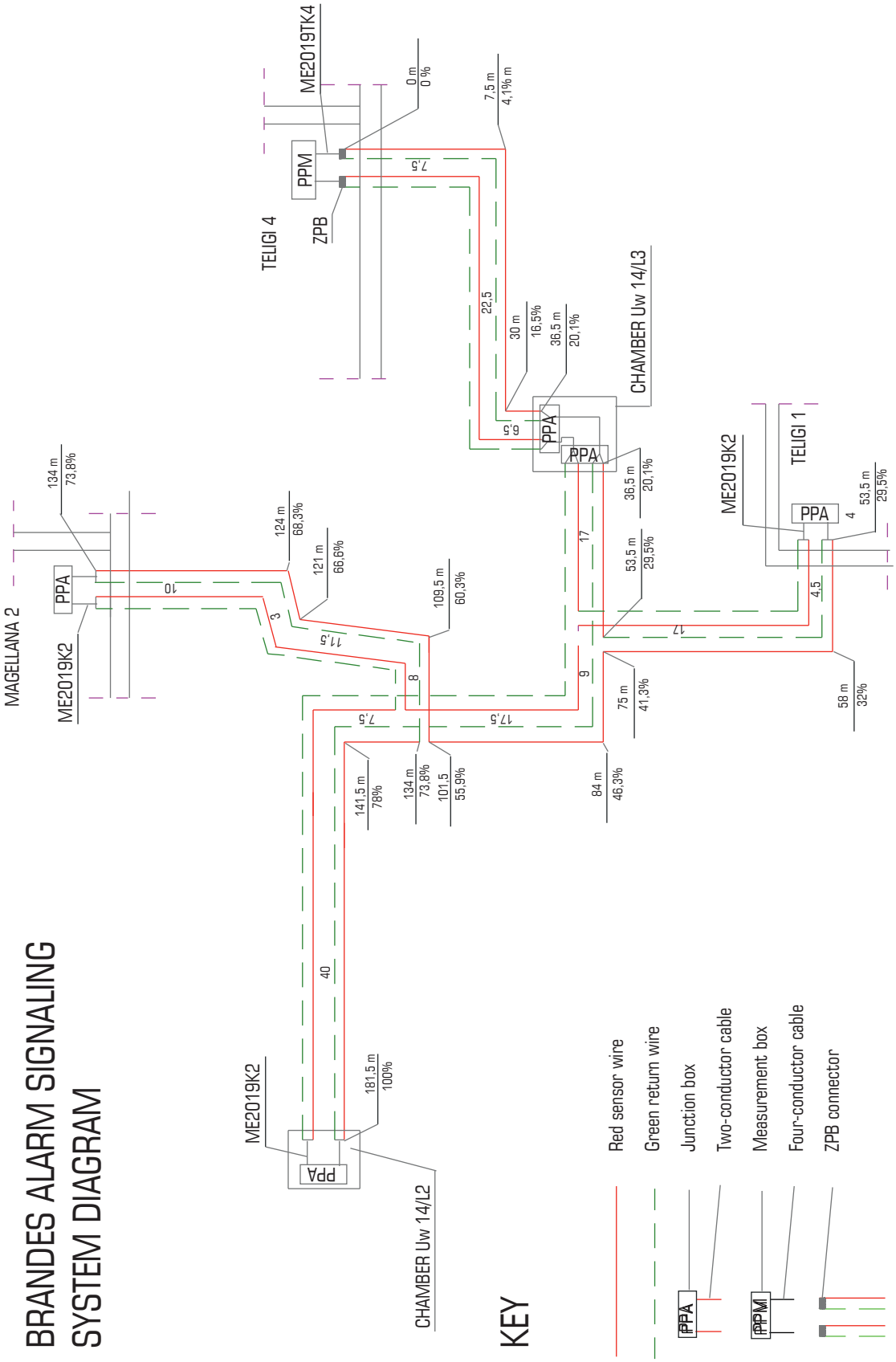
Pomiaru dokonano dn.: _____

przez: _____

Firma:

MEASURING REPORT FOR BRANDES SYSTEM	
Project	
Employer	
Section	
Report No.	
Section	
Loop sketch	
Metering point	
Red sensor wire	
Green return wire	
General data	
Supply	
Return	
INSTALLATION RECOMMENDATIONS	
Top	
Bottom	
Minimum resistance of thermal	
insulation	
Pipe length (m)	
Electrical resistance (Ohm)	
Pipe length	
MH degree	
300 up to 500 m	
BS-MH measurement result:	
Degree	
Length	
BS-MH degree 12 (> 10 MOhm)	
notes	
Site Manager	
Checked by	
Date	
Measurement date:	
By	
Company	
Insulation resistance	

Example of Brandes alarm signaling system diagram



Appendix No. 2 – MEASURING REPORT FOR CWA SYSTEM (IMPULSE SYSTEM)

Projekt _____

Zamawiający _____ Nr prot. _____

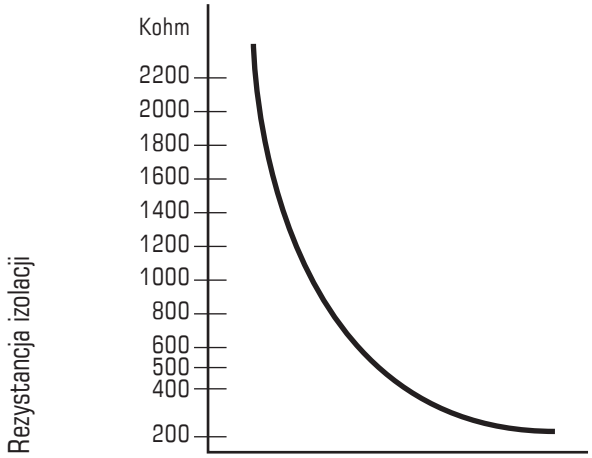
_____

Odcinek _____

Szkic pętli

1. Dane ogólne

	zasilanie		powrót	
– dł. przewodu rurowego [m]	góra	dół	góra	dół
– opór elektryczny [Ohm]				
– opór izolacji [kOhm]				



Zlecenie montażowe
Minimalna rezystancja instalacji cieplnej:
200 000 kOhm/L,
gdzie L – długość rury [m]

Uwagi

Kier. budowy: _____

Sprawdził _____

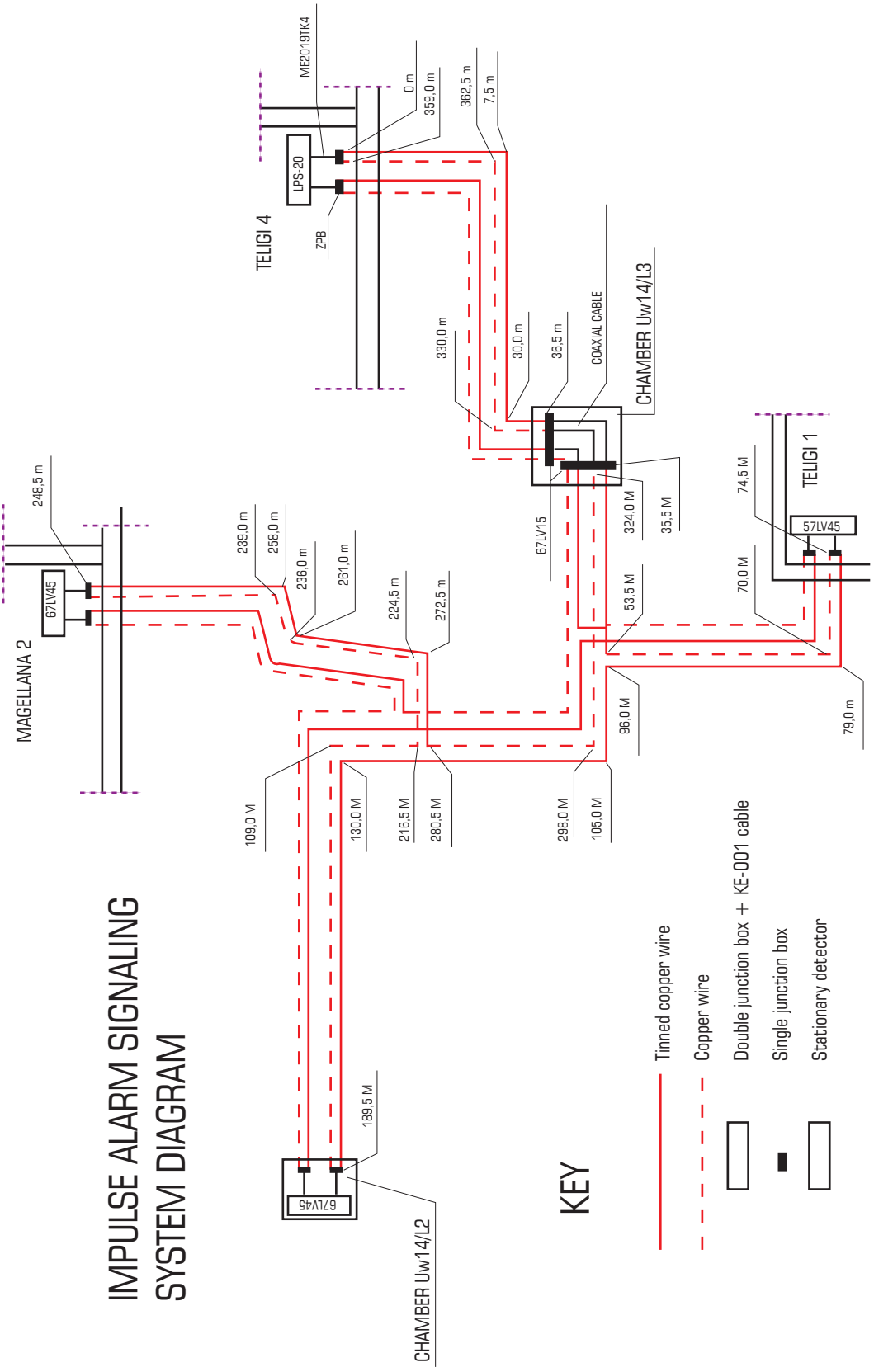
Data _____

Pomiaru dokonano dn.: _____

przez: _____

Firma:

Example of impulse alarm signaling system diagram



RADPOL PIPES

PIPE SOLUTIONS

PRE-INSULATED SYSTEMS

RADPOL PIPES SP. Z O.O.

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