



ZPU MIĘDZYRZECZ PREINSULATED PIPE SYSTEM

**TO BE USED IN UNDERGROUND
THERMAL WATER UTILITIES**

Manual of Execution and Take Over

ZAKŁAD PRODUKCYJNO-USŁUGOWY

Międzyrzecz

**Polskie Rury Preizolowane Sp. z o. o.,
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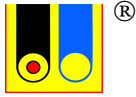
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1. Introduction

This manual deals with conditions execution and take over of *ZPU Międzyrzecz Sp. z o. o.* thermal utilities made from pipe of diameters between 20 and 1000 are subject to.

2. General Description of Thermal Utilities Made from Preinsulated Pipe and Fittings by ZPU Międzyrzecz Sp. z o. o.

Preinsulated *ZPU Międzyrzecz Sp. z o. o.* pipe and fittings meet the requirements set out by standards: PN-EN 253, PN-EN 448, PN-EN 488, PN-EN 489, PN-EN 1391

The usability in the construction sector as a construction material referred to as “Preinsulated *ZPU Międzyrzecz Sp. z o. o.* pipe and fittings with galvanised steel carrier pipe to be used in the construction of underground thermal utilities” has been confirmed by Technical Approval No AT-15-8451/2015 valid till 11 September, 2020, and issued by the Building Research Institute ITB, Warsaw.

Thermal utilities made from *ZPU Międzyrzecz Sp. z o. o.* pipe and fittings are laid directly in soil. Supplied to a construction site as pipe units, that is preinsulated straight or bend pipe, preinsulated fittings and fixtures, are furnished with monitoring system detecting pipe leaks and other equipment. On site, they are coupled into joints, that is a comprehensive joint structure allowing them to be successively connected into a line. Each operation on joint coupling should be performed in accordance with the Manual by *ZPU Międzyrzecz Sp. z o. o.*

3. Materials Incorporated in Preinsulated Thermal Utilities

In the construction of thermal utilities pipe sections straight or bend pipe specified in the *ZPU Międzyrzecz Sp. z o. o.* Product catalogue.

Pipe rerouting should be effected by means of inserted preinsulated fittings (elbows) or preinsulated bend pipe.

Fixtures: preinsulated ball valves.

Elongation compensation on thermal utilities is achieved by:

preinsulated elbows: using L-, Z- and U-shaped systems;

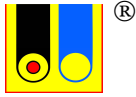
preinsulated compensation joints.

Compensation zones: they are in soft materials, e.g. mineral wool, soft PUR foam, foamed polyethylene, etc.

Prefabricated fixed points.

Main pipe branching off by preinsulated tees (straight, elevated, parallel) as well as TPE tees (cold inserted) and TPG tees (hot inserted).

Pipelines of different diameters are joined through a butt welded reduction unit.



Coupling unit: a joint is from PEHD polyethylene pipe or PEHD heat shrinkable pipe pulled onto the pipeline or a DX electrically welded coupling.

- the joint is sealed with a tape or heat shrinkable sleeve with heat shrinkable band or electrically welded;
- thermal insulation combines PUR polyurethane foam components A and B.

Thermal insulation is protected on end with a heat shrinkable cap end.

Pipe is closed at its end with an end cap, PUR polyurethane foam A and B components and heat shrinkable tape.

If a leak detection system is to be used, preinsulated pipe and fittings with already embedded monitoring wiring are to be used.

Pipe wall transition and through other construction obstacles have to be protected by e.g. rubber rings, and if a preinsulated lateral is to be connected to a traditional pipe a protective lateral, the so called adaptor, has to be used.

Supplied preinsulated pipe, fittings and fixtures, fixed points and other sections have to be checked prior to assembly and approved by technical supervisors.

4. Construction Plans and Specifications

The range and contents of construction plans and specifications is subject to legal provisions. Such plans and specifications should comply with the Building Law and additional requirements and conditions specified by Guidelines on designing thermal utilities made from **ZPU Międzyrzecz Sp. z o. o.** preinsulated pipe.

Preinsulated utilities should be build in compliance with its construction plans and specifications.

Any departure from construction specifications should be recorded in construction site logs or any other parallel document. Such departures should be agreed with:

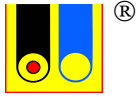
a utilities designer, representative of the contractor's dedicated service people, investor, and end-user or **ZPU Międzyrzecz Sp. z o. o.**

Compliance with specification documentation has to be monitored:

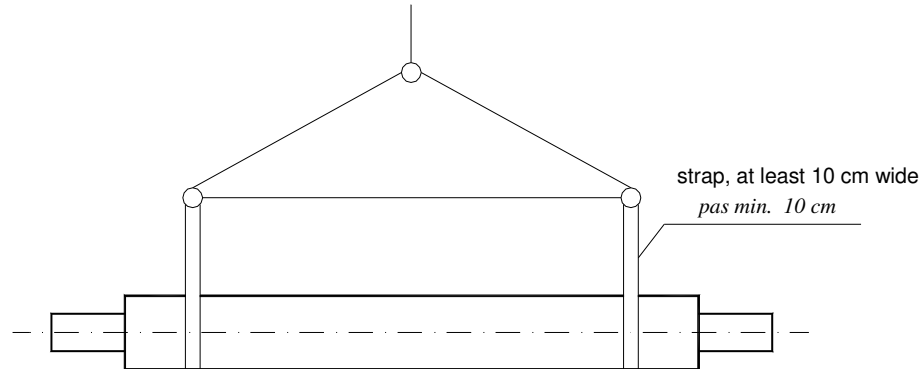
- continuously while construction works on thermal utilities are being supervised;
- when successive work phases are handed over;
- at the final take-over and acceptance.

5. Transport and Handling of Preinsulated Sections

Preinsulated pipe and other sections and materials have to be transported with care, protecting jacket pipe against any mechanical defects. At temperatures below -15°C preinsulated pipe should not be transported.

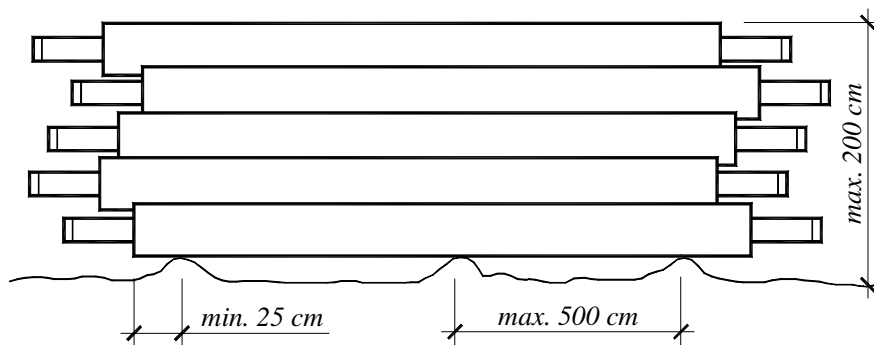


Slings used to lift preinsulated pipe should have straps 10 cm wide at least.



Pipe should not be lifted by means of steel ropes, ropes that may cause pipe surface to cave in or be scratched.

Preinsulated pipe should be stored on flat area. Steel pipe end should be covered. Lengthy period of exposure of polyurethane foam to water should be avoided.



Maximal height of stored pipe should not exceed 200 cm.

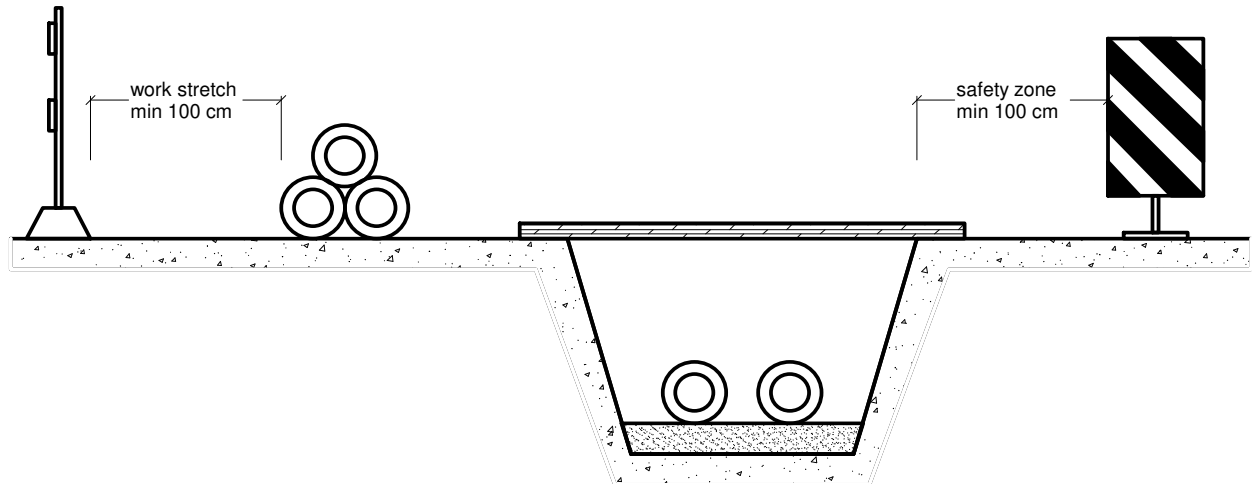
Preinsulated pipe and fittings should be protected against lengthy exposure to sunrays, excessive temperatures and UV radiation. Materials used to connect pipe sections, fixtures, small size preinsulated units, auxiliary materials have to be stored indoors.

Polyurethane foam fluid components have to be stored in heated room at temperatures between +15°C and +30°C.



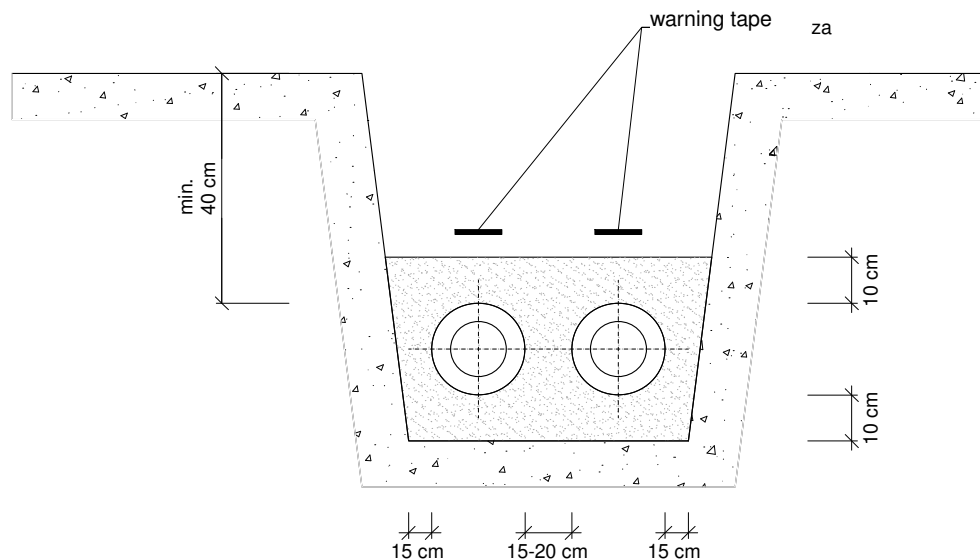
6. Earth and Auxiliary Works

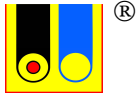
Earth, auxiliary and preparatory works related to measurements, work mobilisation etc have to be carried out in compliance with the general conditions specified in Volume I, WTWiO (English: Code of Practice for Execution and Acceptance of Works). A cross section of a typical trench, work strip, transport and safety area is showed in the diagram below.



A trench should be deep enough to allow for the covering layer to be at least 40 cm, while the side fill and hardcore layer under the pipe and above it should be at least 10 cm.

A trench should be wide enough to allow for at least 15 cm spacing between the pipes and at least 15 cm between a pipe and trench wall. For pipelines whose diameters exceed 200 mm the spacing between the pipes should be 20 cm.



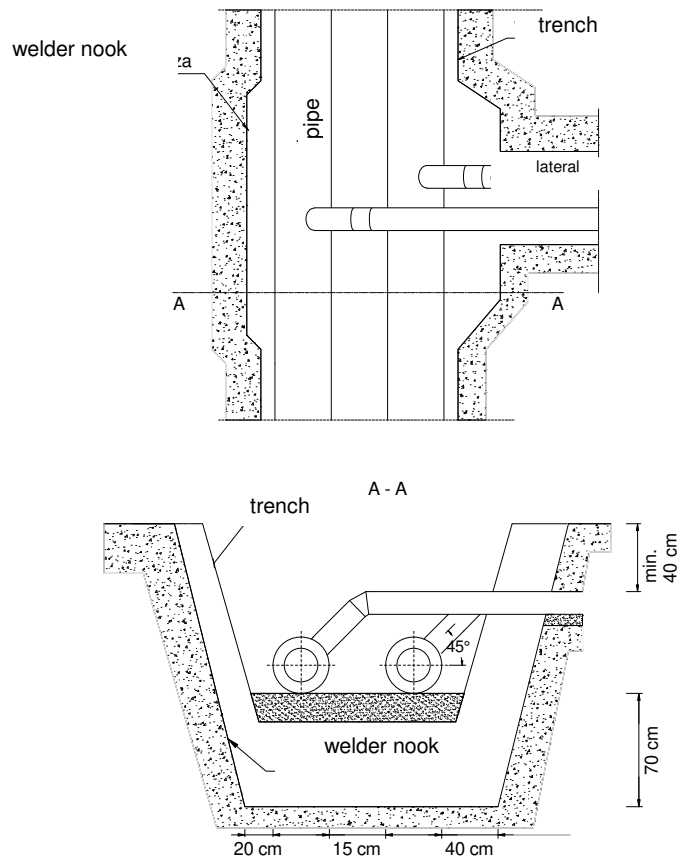


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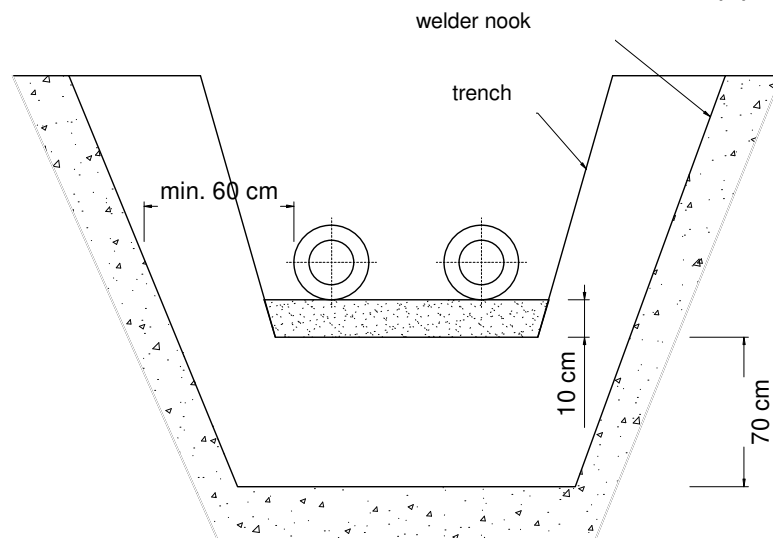
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In places where preinsulated sections are to be joined, branched off or where compensation joints are to be installed the trench should be widened and deepened suitably.

A welder should have access to sufficient room, that is a distance between the pipe and trench wall



which should be at least 60 cm, while that between the pipe and trench bed at least 70 cm.

Trench bed should be flat and graded at an angle given in the plans and specifications.

Trench bed invert level should not exceed +3 cm (negative tolerances are not allowed).

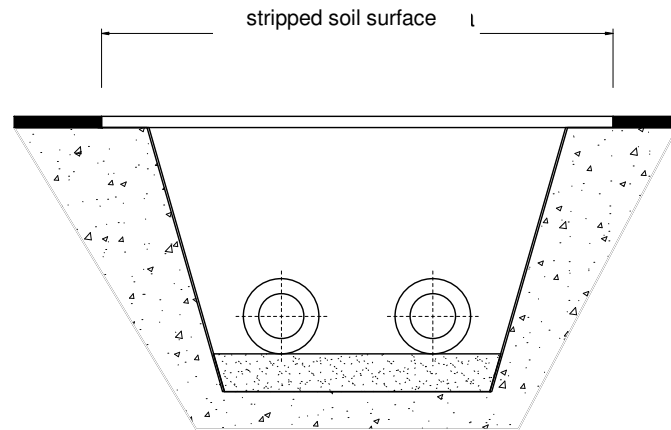


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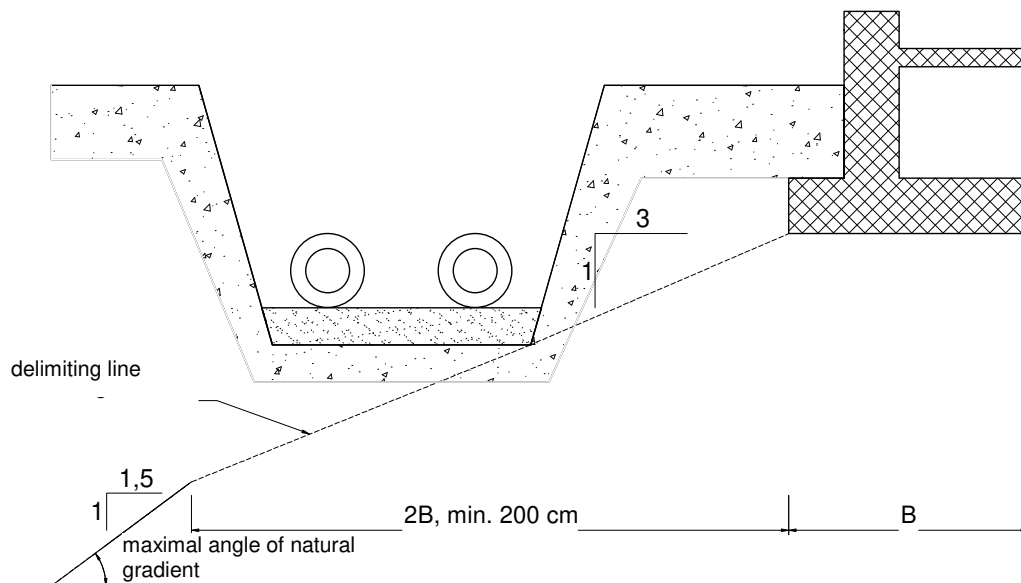
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Trench should be excavated in such a manner that the road pavement, buildings and structures and buried utilities remain undamaged.
The hardened surface should be stripped at such a distance from the trench that will allow it to remain undamaged.



Excavations near the trench should be made above a line determined from a correlation presented in the diagram or by setting up shuttering as retaining walls as per the construction plans and specifications.

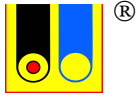


Buried utilities, uncovered for the duration of earth works, should be protected so that they could not be subjected to damage or faults, etc.

Work acceptance and take-over:

Prior to commencement of assembly works proper the completion of auxiliary and accompanying works has to be verified if consistent and compliant with the construction plans and specification and this manual.

Subject to verification are: trench excavation, protection of cable utilities within the trench.



7. Pipeline and Preinsulated Section Assembly

7.1 General Requirements

Thermal utilities made from preinsulated pipe and fittings can be laid down by qualified and trained personnel and continuously monitored by the designer and technical supervisors, both trained and authorized by *ZPU Międzyrzecz Sp. z o. o.*

It is suggested that preinsulated thermal utilities be constructed in favourable weather conditions. Welding of steel carrier pipe should be done at temperatures above 0°C, while insulation and sealing of the joint at temperatures not lower than +5°C. In drizzle or precipitation the sealing of joints should be done under cover, for instance under a foil tent.

7.2 Laying a Pipeline

Preinsulated pipelines should be laid down on a balancing layer of a medium or coarse sand hardcore layer at least 10 cm thick, on transverse sand hills.

During the installation of pre-insulated pipe, the trench should be kept dry and clean as well as protected from the inflow of surface or ground water. Mirror of the rainwater or groundwater should not come into contact with thermal insulation (polyurethane foam) of the preinsulated products until the installation of the connectors has been completed (encapsulation of the welded preinsulated pipe system).

Lowering of the preinsulated jacket pipe of diameters up to 160 mm can be done manually, while bigger diameters have to be lowered into a trench by a crane with strap slings (see Item 5.2.) Attention should be paid during the operation so that the jacket pipe is not damaged.

The distance between laid preinsulated pipelines should be at least 15 cm, for preinsulated pipelines in bigger diameters, distance should be at least 20 cm.

The distance between the pipe and the trench walls should be at least 15 cm.

Care should be taken when laying down preinsulated pipe furnished with leak monitoring wiring so that the insulated wire is at the 10 o'clock position, while the bare one at 2.00 o'clock (so that the manufacturer's tag could always be on one side of the joint).

The pipes should be laid with a slope to allow drainage of the district heating network; the slope of the network should be not be less than 3 ‰.

The difference in elevation of the laid pipe with respect to the specified projected values should not exceed +2cm.

7.3 Pipeline Assembly

The assembly of preinsulated pipe sections is performed directly in trench (in exceptional cases pipeline can be joined above trench).

If a pipeline is being assembled above trench, straight preinsulated sections have to be supported by 10×10 cm wooden blocks spaced every 2÷3 metres.

Prior to laying down preinsulated pipes and fittings in trench at a specified level, pipe ends should be stopped with a cap.

The admissible axial deviation for pipe sections at their joints should not exceed 3°.

Steel carrier pipes should be joined by arch welding.

Gas welding of steel carrier pipe is admissible is the wall thickness does not exceed 2.9 mm.

welding works should comply with general conditions specified in Volume III, WTWiO and the Manual "Steel Pipe Welding Technique - *ZPU Międzyrzecz Sp. z o. o.* System."



If gas welding is applied screens and guards protecting thermal insulation and jacket pipe (for instance a fire-proof blanket) from open fire should be used.

Prior to welding steel pipe ends should have their anti-corrosive coating removed by means of active deoiling solvent-free agents and remains of foam should be removed too (at a temperature of 175°C hazardous isocyanate vapour will be emitted).

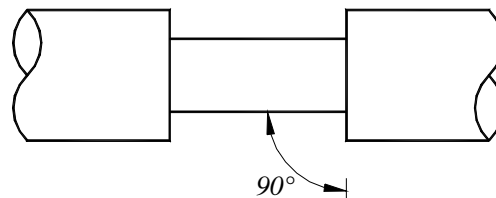
Rerouting should be effected by means of prefabricated fittings, preinsulated elbows or preinsulated bend pipe or bending pipe in situ.

Branching off should use prefabricated fittings - preinsulated tees.

Once welding works and tightness test have been completed the leak monitoring system should be installed on the pipeline, then joint casing and thermal insulation are formed and the whole joint is sealed as specified in the *ZPU Międzyrzecz Sp. z o. o.* Manual.

If a preinsulated pipe has to be shortened, part of its jacket pipe and thermal insulation have to be removed. A minimal length of steel carrier pipe uncovered should be 150 mm. A carrier pipe can be cut vertically to its longitudinal axis over its all circumference (taking care not to cut monitoring wiring, if embedded). Steel pipe should be cut with cutting disks.

Butt welded joint have to be tested as specified by the Manual "Quality Checks on Welded



Joints in Thermal Utilities Made from *ZPU Międzyrzecz Sp. z o. o.* preinsulated pipe."

The test scope and permissible weld fault class

Type of Test	Range of Tested Welds Performed by a Single Welder	Permissible Weld Fault Class according PN-EN ISO 5817:2007
External revision (PN-EN 970:1999)	100%	B
Ultrasonic testing (PN-EN 1714:2002)	25%	B
X-ray testing (PN-EN 1435:2001)	25%	B

In cases where welded joint will inaccessible upon completion of a pipeline (for instance running under a road), then 100% of welded joints should be subjected to testing.

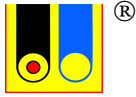
7.4 Burying Preinsulated Pipeline

Preinsulated pipelines should be backfilled with coarse and medium sand, fine gravel without clay, rubble and slit.

Preinsulated pipelines are backfilled in layers and begins with a sand backfill. If backfill material is to be compacted manually, then the thickness of a single backfill layer should not exceed 15 cm.

Sand side filling should be made in two layers.

The first layer is laid down up to the pipe axis, backfilling areas between pipelines, and then proceed with backfilling the area between the pipe and trench wall. This layer is to be rammed.



The other layer is laid down and compacted in a manner similar to the first layer was done up to a level at least 10 cm above the pipe axis. The compaction rate should be $I_D = 1.00 \pm 0,68$.

Once the side filling has been accomplished, the remaining part of the trench is to be backfilled with native soil (having removed rubble, roots, clay lumps and other dirt first).

7.5 Other Requirements

If preinsulated pipelines are to be laid down in places exposed to dynamic loads (exceeding 5.0 ton per axle), and if the covering layer is thinner than 40 cm, then in places determined in the construction plans and specifications reinforced concrete slabs, adjusted to accommodate expected loads, should be placed at least 30 cm above the pipeline.

The thermal utility should be marked with a warning tape placed some 30 cm above the pipeline.

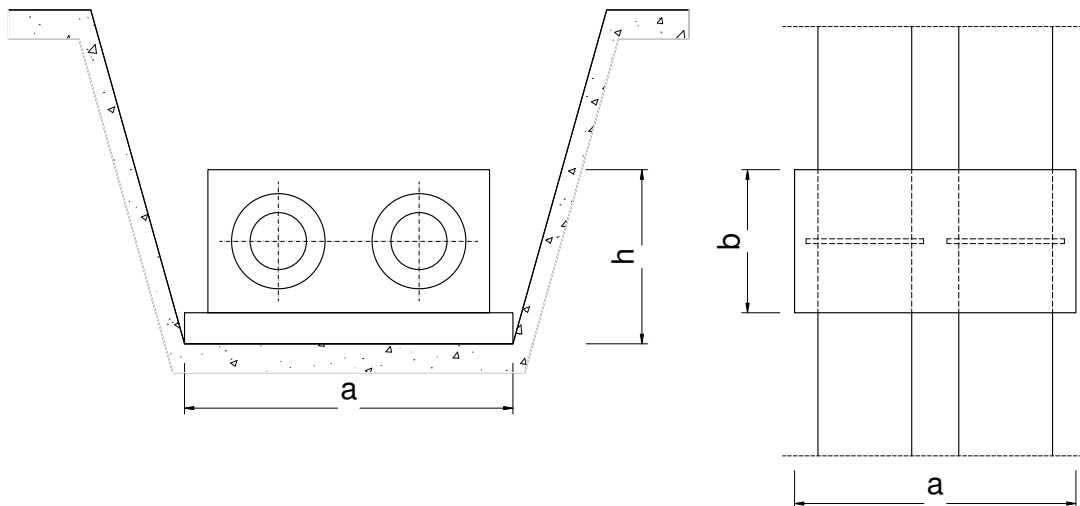
Before the pipe is side filled, the following should be performed:

- in compensation zones expansion joints;
- compensation zone should be placed only in areas defined in the construction plans and specifications where compensation units, elbows, laterals and reducing pipe are mounted;
- check on the alignment of pipeline;
- check on whether the pipeline gradient corresponds with that in the plans and specifications.

8. Assembly of Fixed Points

Fixed points are supplied as prefab units.

The assembly of a fixed point consists in welding a prefab unit into a pipeline in a place defined in the plans and specifications and on mounting that on concrete foundation.



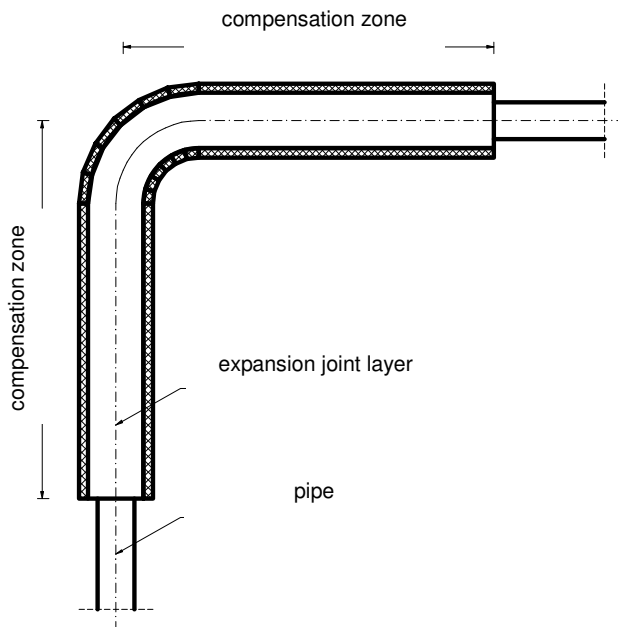
Concrete foundation has to be cast in concrete grade B-20, reinforced with steel rebars class A-iii, steel 34.

Foundation dimensions are given in the construction plans and specifications.

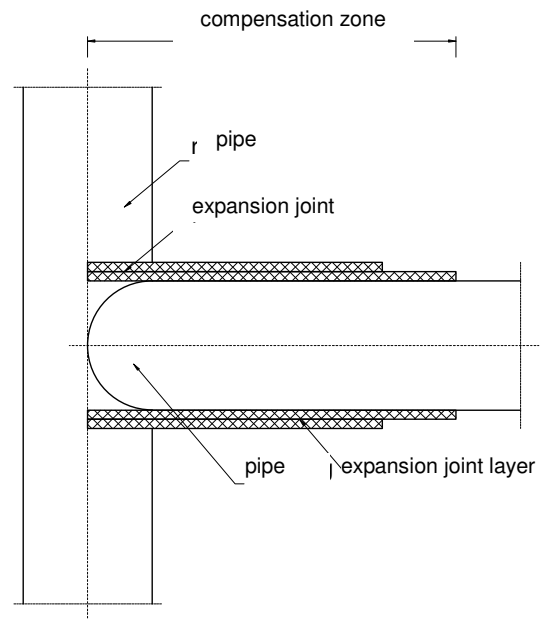
The manner and type of execution of concrete foundation protection against corrosive action as per Volume I WTWiO, should be adjusted to the degree of environment aggressiveness and type.

9. Compensation Zones

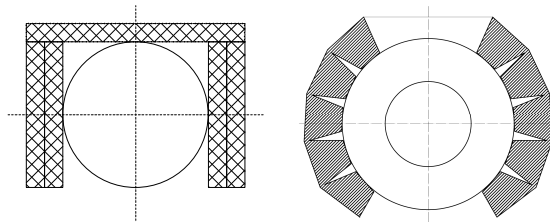
Compensation zones have to be set up in places where 45° and straight elbows, laterals and reducing pipes are to be mounted.



Compensation zones allow a pipeline to self expand under working conditions and protect the line against damage.



Compensation zones should feature expansion joints filled with one of several layers of soft material, for example this can be achieved by wrapping the pipe with mineral wool, soft PUR foam or by surrounding the pipe with PUR claddings.

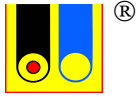


Before the pipeline is backfilled, expansion joints have to be protected against their relocation, e.g. by binding with $\varnothing 1$ mm soft wire or earlier covering with sand.

Do not mechanically compact the soil in the network compensation zones, i.e. above the pre-insulated elbows, over the tee rejects, over the axial compensators and reducers.

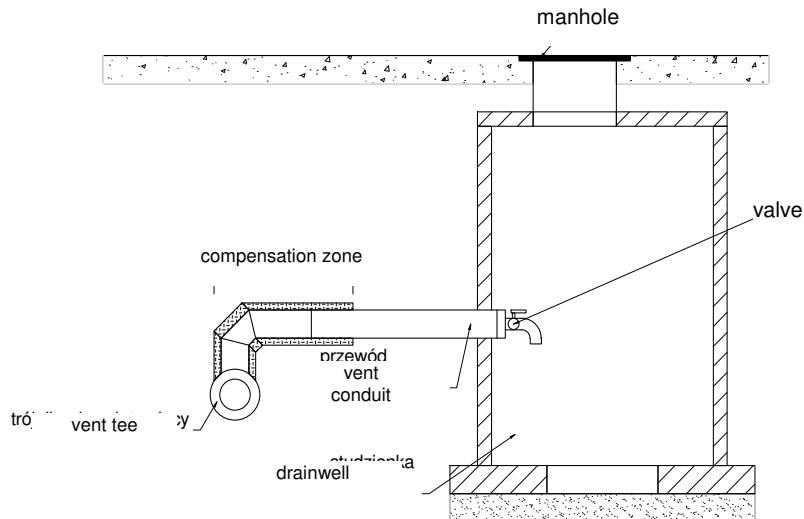
Mechanically, the sand subgrade should be compacted under the fittings located in the compensation zones, however the sand bed and soil above these fittings should be compacted manually so as to allow free operation of the pipeline within the compensation zones.

The length of a compensation zone and thickness of an expansion joint are given in the construction plans and specifications.



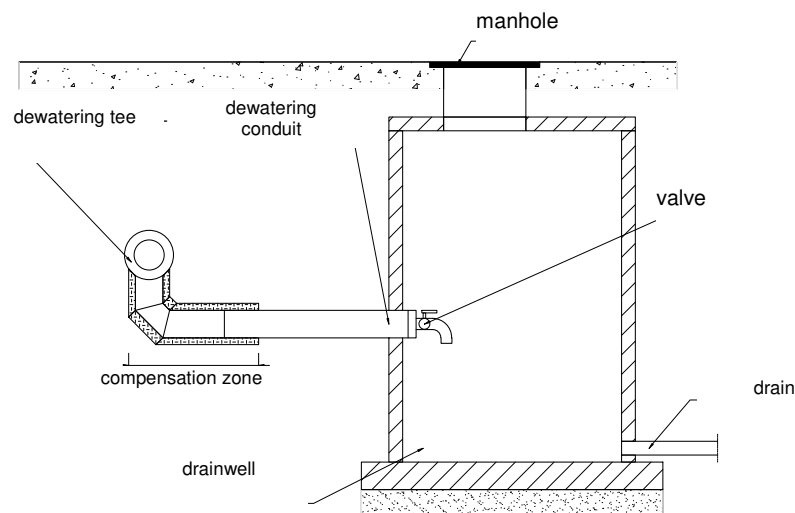
10. Setting up Dewatering and Venting Conduits

Dewatering conduits have to be placed in the lowermost and venting ones in the topmost pipeline points. Their outlets should be in the drainwell or sewers. The coupling of dewatering and venting conduits with the pipeline is obtained through setting in preinsulated tees (strain or vent tees).

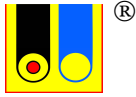


The venting and dewatering conduits should be in compensation zones.

Thermal insulation front areas, venting and dewatering conduits, inserted into the well should be protected with heat shrinkable end caps.



Wells should be made from prefabricated concrete tubes of a diameter no less than 100 cm, and its height will depend on the dept of the pipeline. Cast iron covers (manhole covers) light type should be mounted on a concrete reducer or on a slab. External wall surfaces have to be protected against corrosive action due attention being paid to soil water aggressiveness or soil aggressiveness (e.g. using Bitizol R and P).

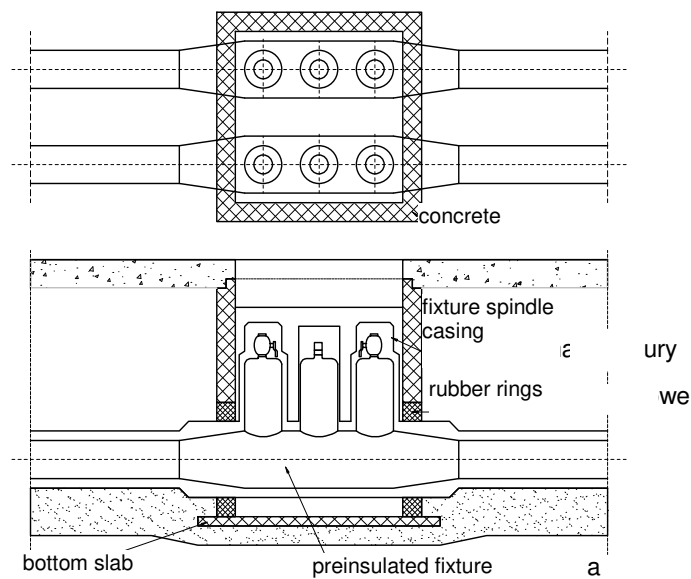
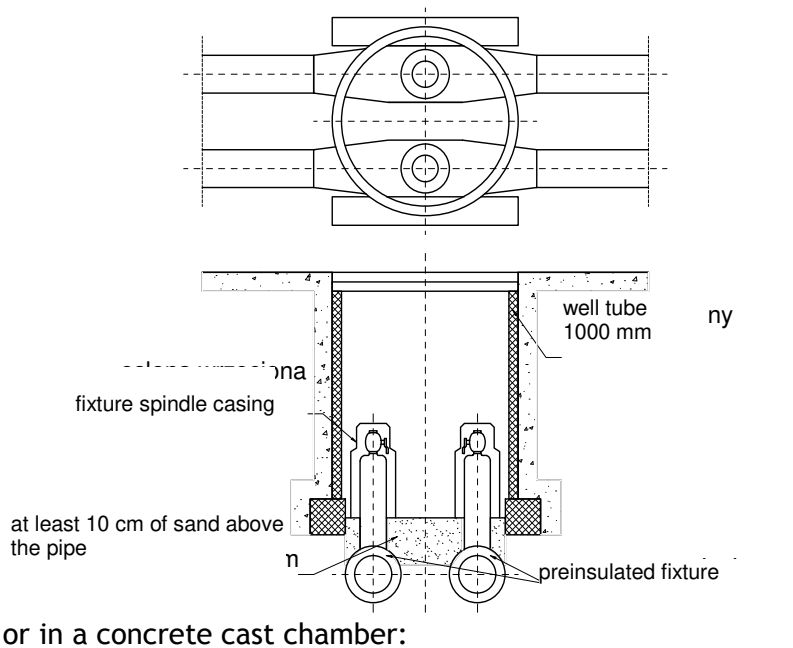


11. Installing Fixtures

ZPU Międzyrzecz Sp. z o. o. systems use shutoff, vent and strain ball valves as fixtures.

Fixtures are installed by welding preinsulated valves within the pipeline, setting up spindle housing and a street box or setting up \varnothing 600 mm concrete tube casing.

It is suggested that preinsulated fixtures mounted on a pipeline above 125 mm in diameter should be cased in concrete tube wells of a diameter at least 1000 mm:





12. Pipe Wall Transition, Connections With Operating Pipelines and Pipe Closing

12.1 Wall Transition

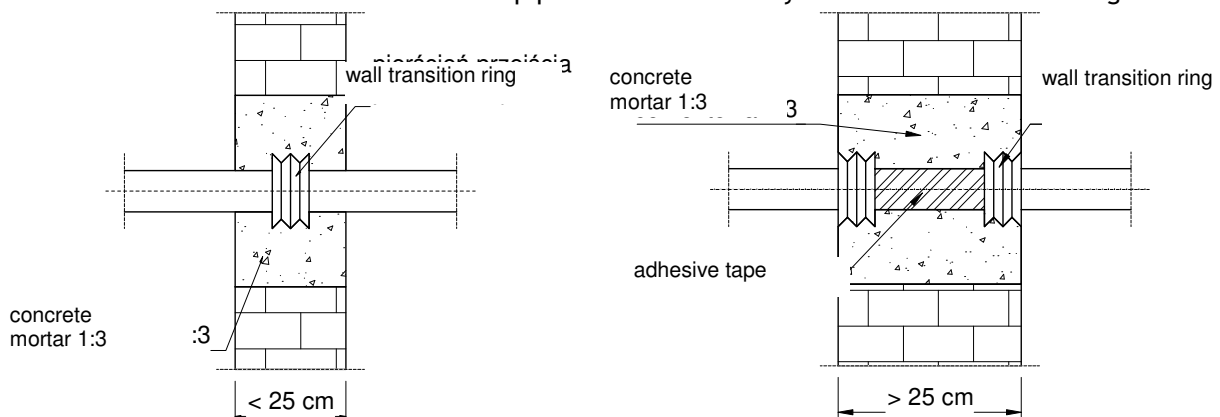
A pipeline crossing a building or a chamber wall should be cased in a sealing ring and adhesive tape, the so called tight transition.

Once a transition opening has been made, a sealing ring has to be pulled on a preinsulated pipe and set up symmetrically with respect to the wall. For walls not thicker than 25 cm one ring is sufficient, otherwise use two rings and adhesive tape (gas tape).

On completion of the assembly works on the pipeline and provided tightness tests are positive, the transition wall opening should be sealed with concrete.

12.2 Connecting Pipe with Operating Pipe

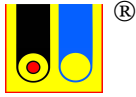
Connection with a conventional pipeline is made in way similar to that of inserting a service



lateral within a conventional thermal utility, that is by welding a carrier pipe within the pipeline and providing thermal insulation and its protection.

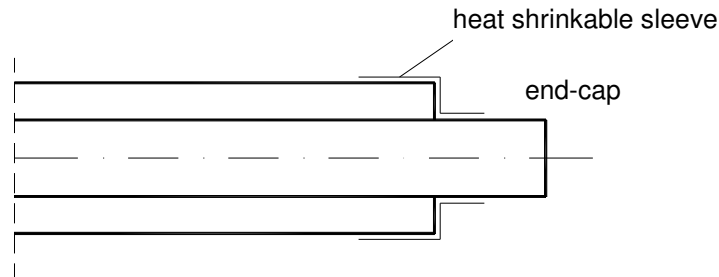
Inclusion into the operating preinsulated pipeline, due to various methods of thermal pipeline execution, has to be done in the manner defined in the construction [plans and specifications].

The method described underneath refers to thermal utilities in *ZPU Międzyrzecz Sp. z o. o.* natural method I. It consists in cutting a section preinsulated pipe, whose length should equal the length of the tee passage, out of the operating pipeline, and by welding in a preinsulated tee. Before the tee is welded in, end caps should be pulled onto both ends of the existing pipe, which will further be used in making the thermal insulation and coupling sealing.



12.3 Ending thermal insulation

To work out thermal insulation end sections heat shrinkable sleeves are used. To shrink a sleeve follow the steps specified in the manual “Laying Insulation and Sealing up a Coupling Joint; ZPU Międzyrzecz Sp. z o. o. System.”



12.4 Closing a Pipeline

Before a pipeline is closed, the carrier pipe opening should be plugged. Once a tightness test has proved positive, the preinsulated pipe end should be plugged with an end cap in such a way that the stretch of thermal insulation between end cap bottom and carrier pipe end is 5 cm for pipes up to 200 cm in diameter, and 7.5 cm for bigger diameters.

All works connected with laying thermal insulation and tight sealing of the end cap have to be in accordance with the guidelines presented in the manual “Laying Insulation and Sealing up a Coupling Joint; ZPU Międzyrzecz Sp. z o. o. System.”

13. Take Over and Acceptance of Works

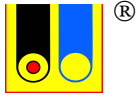
Prior to handing over the completed works they should be subjected to process quality inspection: tightness, hydraulic tests and pipe flushing.

Quality inspection covers:

- verification of the quality material and fixtures used in the construction of the utility;
- checking if the utility is consistent with its design;
- checking on the quality of the performed works and compliance with the technical specifications;
- verification of welders' qualifications and inspection of performed welds;
- inspection of workmanship and verification of qualifications of the workers who laid thermal insulation and sealed the joint;
- inspection of the execution of the monitoring circuits;
- inspection of the anticorrosion protection;
- checking on utility tightness;
- verification of as-built drawings submitted by the contractor;
- seeing if faults and defects found have been corrected.

While inspection is in progress, the following should be checked:

- correctness of compaction of bedding material surrounding the pipe;



Manual of Execution and Take Over

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- correctness of execution of compensation zones, and in particular the lengths and widths of expansion joints and whether their spacing complies with the plans and specifications;
- correctness of execution of fixed points and compensation joints;
- monitoring wiring conductivity and their resistance value and carry out trial alarm by the monitoring device.

Tightness tests should be performed over a section not exceeding 500 m and tightness should be tested to 1.5 times the pipeline working pressure. A tightness test should be carried out at a temperature above zero, by filling the pipeline with water 24 hours prior to a test. Test results will be considered satisfactory if over the testing period, that is between 45 minutes and 1 hour, for each section subjected to testing, no pressure drop has been noticed on the gauge, while welded seams have shown no trace of water leaks or exudation. The shortest period over which the pressure should not vary is 15 minutes. When heated water is applied in tightness testing, a pressure drop due to water volume reduction resultant from water cooling should be accounted for.

Upon expiry of the testing time, the pressure should be reduced down to the working pressure, and then welded joint should be tapped with a hammer not heavier than 1.5 kg on a handle not longer than 500 mm. Tapping should be on the weld itself, but on a pipe near the weld. Faulty places should be cut out, cleaned, welded and subjected to another hydraulic test.

Upon completion of the tests a written certificate should be filed, confirming complacency with the required specifications.

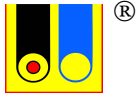
Prior to commissioning the pipeline, it should be thoroughly flushed through. The manner in which such flushing is to be performed shall be given in the construction plans and specifications.

14. Technical Information

The application of preinsulated pipe and fittings has been specified in general above, whilst details referring to design, execution and take over of networks are presented in:

1. Guidelines Static and Design Calculations
ZPU Międzyrzecz Sp. z o. o. System
2. Manual Detection of Pipe Leaks
Connection of Pulse Monitoring System in Thermal Utilities
ZPU Międzyrzecz Sp. z o. o. System
3. Manual Manual of Execution and take Over
ZPU Międzyrzecz Sp. z o. o. System
4. Manual Joint Unit Assembly Insulation and Sealing
ZPU Międzyrzecz Sp. z o. o. System
5. Manual Manual of Steel Pipe Welding
ZPU Międzyrzecz Sp. z o. o. System
6. Manual Steel Pipe Connection Welding Quality Inspection
ZPU Międzyrzecz Sp. z o. o. System
7. Manual DX Joints electrically welded
ZPU Międzyrzecz Sp. z o. o. System
8. Manual DT Type Heat Shrinkable Joints Electrically Welded
ZPU Międzyrzecz Sp. z o. o. System

Note: We convert heat system specifications so that they could meet the requirements of the *ZPU Międzyrzecz Sp. z o. o.* technology solutions.



15. Trade Information

Manufacturer and Seller:

ZAKŁAD PRODUKCYJNO USŁUGOWY

Międzyrzecz

Polskie Rury Preizolowane

Sp. z o. o.,

ul. Zakaszewskiego 4

66-300 Międzyrzecz,

Phones:

Fax +095 742 33 01, 742 33 02

Secretary: +095 741 25 26, 742 00 93, 742 33 00

Trade Service: +095 742 33 23, 742 33 38

Supplies: +095 742 33 46, 742 33 56

e-mail: zpu@zpum.pl www.zpum.pl

When placing orders please specify carrier pipe steel grade (St 37.0, or P235GH), type of heat insulation, type of polyurethane embedded moisture detection system or its lack, and for pipes specify their length and quote Catalogue Reference Number. If products are to be made-to-order, dimensions have to be agreed separately.