

Radius - Kelit
Infrastructure

Part of Radius Systems

FibreFlex

Installation guide

2017.11

FibreFlex

Pre-insulated flexible pipe system

B. Installation guide

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B1. System Overview

General

FibreFlex is a new class of bonded flexible pre-insulated pipe systems for district heating networks, which include a range of pre-insulated Thermoplastic Reinforced Service (TRS) pipes, specifically designed for use within district heating networks operating at temperatures up to 95°C (continuous up to 80°C) and pressures up to 10 bar.

The multilayer structure of FibreFlex pipes incorporates a high-modulus aramid fibre mesh reinforcement enabling the pipe to operate at higher internal pressure without the requirement to increase the pipe wall thickness. These thinner wall Thermoplastic Reinforced Service pipes, which are more flexible than conventional monolayer pipes, significantly increase the range of application and reliability of flexible pre-insulated plastic pipes for district heating systems.

FibreFlex service pipes have a multilayer pipe wall construction, comprising of a cross linked polyethylene PEX-a inner layer (cross-linked using the peroxide method), a high modulus Aramid fibre mesh reinforcement layer, an oxygen barrier, and additional high temperature thermoplastic adhesive layers needed to bond the individual major layers into a composite pipe structure.

The main purpose of TRS inner layer is to provide a leak-tight pipeline. The cross-linked PEX-a polyethylene material has been chosen for the inner layer due to its outstanding thermal and mechanical properties that are a requirement for district heating applications. Additionally PEX-a material offers excellent corrosion and chemical resistance.

The high modulus aramid fibre mesh reinforcement layer resists the applied stress resulting from the internal pressure within the pipe.

Applications

FibreFlex is a flexible pre-insulated TRS pipe system with a maximum continuous operating temperature of +80°C (maximum fluctuating temperature limit +95°C) and 10 bar design pressure. A range of service pipe diameters from 25 mm to 160 mm are available.

FibreFlex is an ideal solution for:

- Local district heating networks
- Low temperature City Heat networks
- Elevated pressure heating networks in hilly areas
- Agriculture applications
- Private domestic heating applications
- Other heated media transportation applications with operating temperatures and pressure limited by +95°C and 10 bar.

System advantages

FibreFlex pipe systems offer increased pipeline flexibility, both simplifying the design and installation of district heating networks especially where the pipe is to be installed in trenches with existing service pipes or where the pipe has to be routed around existing trees or buildings.

Compared to conventional flexible monolayer plastic solutions, FibreFlex pipes provide higher reliability and lower heat losses for district heating networks, combined with more flexible and convenient installation of pipelines.

FibreFlex pipes are suitable for installation without the need to design for complex thermal expansion; resulting in a much simplified system design as thermal compensators are not required for correct system operation.

FibreFlex flexible pre-insulated pipes are delivered to the installation site in long continuous lengths either as a coil or on a drum. Pipes can be supplied cut to the required length, significantly reducing both the on-site installation time and number of joints required to complete the system.

Overall, the long continuous flexible pipe lengths, combined with an easy-to-install non-welded fittings solution, enables long pipe lengths to be installed using narrow trenching techniques, offering significant on-site installation time and cost savings.

FibreFlex pipe systems are manufactured in accordance with Technical Specification OFI CERT ZG 200-2 Class A.

Further Information

This design and installation manual offers general information for the most common installation procedures. Should you require any further information on the FibreFlex or any other pipe system in the Radius-Kelit range, please contact your local Radius-Kelit representative.

B2. Design Parameters

General

Typically, the maximum heat load on a district heating network is only reached for a short period every year – this is normally when the outside temperature is at its very lowest level.

The larger the diameter of the network, the higher the cost for both the system installation and its operation. It is therefore best practice to size the distribution networks to meet the real annual heat demand profile and not for constant peak load.

The main factors for these operational costs are the heat and pressure losses in the network. Reducing the diameter of a network raises the velocity of the conveyed fluid, which increases the pressure loss, but also acts to lower the heat loss. It is imperative that networks are sized appropriately to minimise operational heat and pressure loss – reducing cost and unnecessary carbon emissions.

When dimensioning FibreFlex pipes, it is recommended to calculate the pump capacity available for the system as well as energy costs required for pump operation. As with the annual heat demand profile, maximum pumping capacity is also only required for a short period of time – typically a few days per year.

FibreFlex pipes have a low hydraulic roughness coefficient (0.007 mm), consequently the pressure loss in FibreFlex pipes is significantly smaller than when compared to similarly-sized traditional steel pipes. With this improved performance, FibreFlex pipes can be sized with a smaller internal diameter to reach the same value of pressure loss in a larger steel pipe.

The pressure loss values for each size of pipe, according to the required volume or heat demand are shown in paragraph A6 of the FibreFlex Product Catalogue.

Being naturally flexible, FibreFlex pipes can accommodate a more gradual change in direction, compared to the short-radius bends used in steel systems. This helps lower pressure losses and, in certain cases, can result in a smaller diameter of FibreFlex pipe being required.

B3. Network types

Branched Network

End users are supplied via branch connections made from the main arterial pipeline.

Advantages:

- flexible design;
- new users can be easily connected at a later date;
- branches can be designed and installed in preparation for future expansion.

Disadvantages:

- many branch connections.

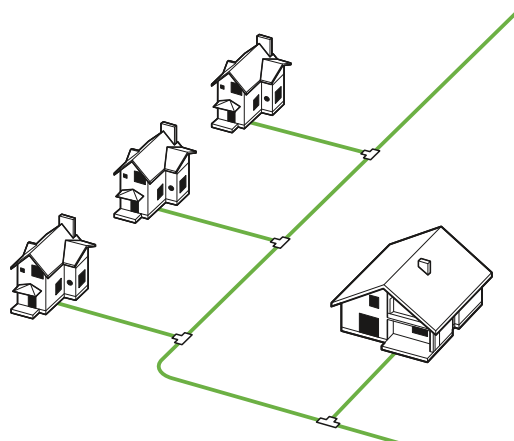


Fig. B3.1

Radial Network

A separate supply pipe is used to connect each end user to the heat source.

Advantages:

- requires smaller diameter pipes;
- no disruption to the supply of heat to other users if maintenance or repairs are carried out;
- possibility of independent heat regimes for end users;
- flexible connection of new users in the future without disrupting the heating service for existing connected users.

Disadvantages:

- many pipes to install (with flexible pre-insulated pipes it can be easily and quickly installed due to long continuous lengths of small dimension pipes);
- high-pressure losses in network.

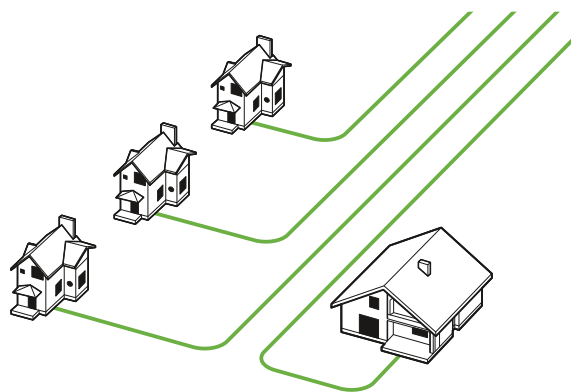


Fig. B3.2

Looped Network

Connecting end users is done by sequential pipe installation from one user to another.

Advantages:

- reduced number of connections to the main arterial pipe;
- minimum length of pipes required.

Disadvantages:

- dependence on neighbour end users.

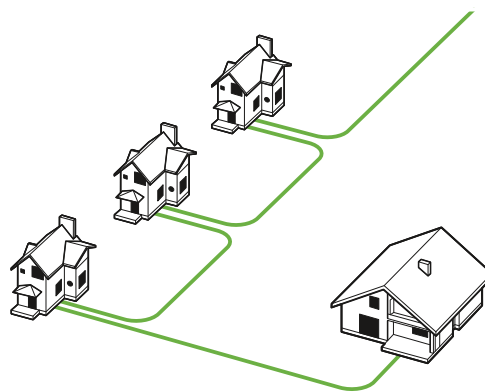


Fig. B3.3

B4. Pipe installation methods

Due to the flexibility of FibreFlex pipes, different methods of pipe installation are possible.

Open-trench installation

The most common and convenient method of pipe installation: pipes are laid in a carefully-prepared open trench.

Advantages:

- flexible installation without use of specialist equipment;
- can be easily used for connecting new users;
- ease of installation.

Disadvantages:

- disruption caused when crossing roads;
- open trenches can pose disruption and safety risks in urban areas.

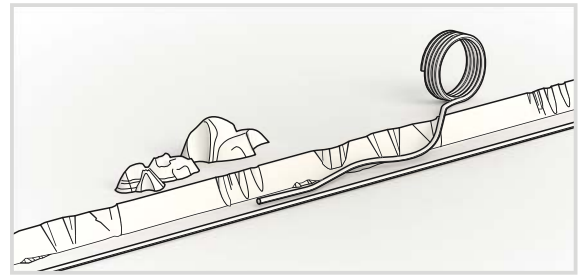


Fig. B4.1

In-channel installation

Using this method, FibreFlex pipes can be laid inside existing concrete ducts or other redundant pipelines without the need for costly excavations.

Advantages:

- cost-effective installation through existing ducts or pipelines;
- flexible and easy maintenance of pipelines;
- minimised excavation and reinstatement work.

Disadvantages:

- less choice of pipe route if using existing channels;
- constructing new channels is prohibitively expensive.

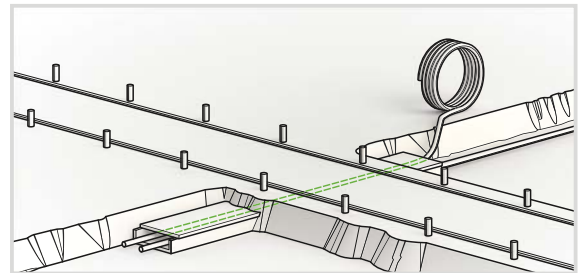


Fig. B4.2

B5. Requirements for pipe trenches

General requirements

The dimensions required for pipe trenches will vary according to the size and quantity of the pipes being installed, the proximity of other service/utility pipes and the compressive forces from surface traffic after installation.

When installing at depths requiring shoring of the trench sides for safe working (according to local/national regulations), the trench width will need to be increased accordingly. The sloping on the sides of a trench will also be determined by the local soil type and conditions.

Additional space will need to be provided to ensure that the installation conditions are undertaken in accordance with DIN 4124 - particularly where there are below-ground pipe connections such as branches.

Where several pipes are laid in a trench, they can be positioned side by side or one above the other. The side-by-side configuration is more common due to ease of installation, however, laying pipes one above the other will reduce installation costs due to narrower trenches. In both cases, the distance between pipes and between the pipes and trench walls needs to be at least 100 mm.

Where pipes are buried in roads, the road load classification shall not be greater than SLW 60 according to DIN 1072 (heavy six-wheel lorry, wheel load 100 kN, total load 600 kN). The depth of cover for FibreFlex pipes can vary from a minimum of 600 mm to a maximum of 2,600 mm. Where traffic loads are present, the minimum depth of cover shall not be less than 800 mm. Where traffic loads are not present, the minimum depth of cover shall not be less than 400 mm. Any projects requiring variation to these recommended cover heights will require static load analysis to prove there will be no adverse effects to the integrity of the pipe system.

Pipe laying

The bottom of the trench needs to be prepared to provide uniform support for the pipe along its whole length. Where there is a risk of soil subsidence, additional measures must be taken to ensure continued support for the pipe system.

For installation of FibreFlex pipes, additional working space in the trench is only required in the immediate area around a pipe connection.

The pipes must be laid on a pre-prepared bed of sand or fine gravel to a minimum depth of 100 mm and the grain size must not exceed 4 mm (in accordance with BS EN 13941). The pipe bedding must be levelled and evenly compacted to provide sufficient support.

This sand bed must be visually inspected to ensure that there are no stones or impurities that could damage the pipe system casing. Once inspected, the trench can be backfilled with sand or fine gravel to ensure a minimum 100 mm above and around the pipes – with the same level of compaction given as the bedding layer. Should other materials be used for bedding and backfilling, under normal circumstances grain size must not exceed 32 mm and sharp-edged grains shall be avoided – in accordance with BS EN 13941.

When pipes are laid one above the other, care must be taken to ensure the 100mm layer of compacted sand is maintained as detailed in Table B5.1.

Once the required pipe surround is compacted, the remaining trench can be initially backfilled with soil - ideally avoiding large stones that could pose a threat to the integrity of the pipe. During backfilling, warning tape must be installed at a distance between 200 and 500 mm above each pipe (or each pair of pipes) along the whole length of pipe.

One-pipe system

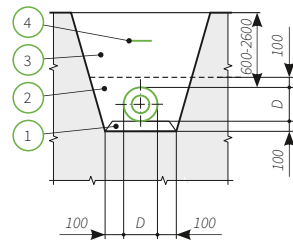


Fig. B5.1

1. Compacted bedding
2. Compacted surround
3. Backfill soil
4. Warning tape

Two-pipes system

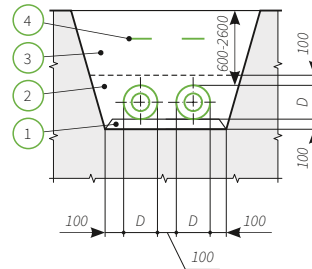


Fig. B5.2

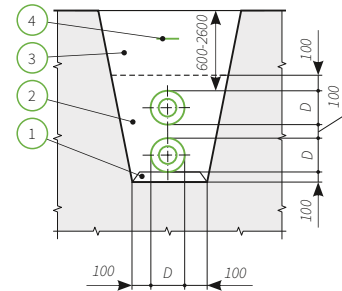


Fig B5.3

Four-pipes system

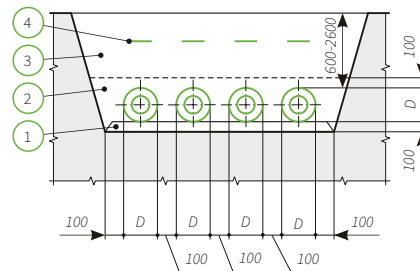


Fig. B5.4

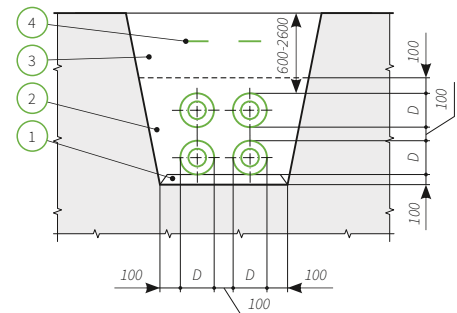


Fig. B5.5

B6. Building Entries

General

When passing through an external wall of a building or other similar structure, it is important that measures are taken to prevent ground water entering the building and that the casing of the FibreFlex pipe is protected from damage.

Buildings with basements provide the opportunity for a horizontal building entry through a below-ground wall. The entry is made through a core-drilled hole, ensuring that - in the case of multiple pipes - a minimum distance of 30 mm is left between each hole.

To ensure water tightness, a Wall Sleeve can be used to prevent the ingress of ground water at pressures up to 0.5 bar. To fit the Wall Sleeve, the diameter of the hole needs to be larger than the outer diameter of the Wall Sleeve. Table B6.1 details the required minimum hole dimension.

The Wall Sleeve is fitted with the narrower end of its wedge-shape pointing towards the outside face of the wall. The minimum distance from the exterior surface of the wall to the sleeve must be 80 mm. If the wall is thicker than 200 mm, two Wall Sleeves can be used - both oriented the same way (Fig. B6.2).

At least 100 mm of pipe insulation must be left protruding from the internal face of the wall. Once the pipe's position is determined, the space between the hole and the pipe's outer casing can be filled with an expanding mortar.

Where the termination is in a building without a basement, a pre-fabricated steel FibreFlex 90 Degree Bend Building Entry Pre-insulated can be used to provide a vertical termination that finishes above the finished floor level (Fig B6.3).

In the case of a vertical building entry, the Wall Sleeve shall also be used to ensure water tightness is maintained. In both scenarios, a slip-on or heat-shrink end cap can then be fitted to protect the exposed end of the pipe insulation.

For a more secure water tightness, especially in areas with high chance of flooding, Wall Compression Seal 80 shall be used instead of conventional Wall Sleeve (water pressure up to 1 bar). A PVC Pipe Sleeve can be additionally installed to provide a perfect bore hole for optimal wall compression seal tightness.

Wall Compression Seal40 can be used for additional water tight protection and for aesthetic reasons to cover gaps between the pipe and the hole through the wall or PVC sleeve (if fitted).

Wall sleeve and drilled hole sizes

Table B6.1

Pos	Jacket pipe dimension, mm	Wall sleeve outside diameter, mm	Minimum drilled hole diameter, mm
1	76	114	180
2	91	126	200
3	111	150	220
4	126	166	240
5	142	182	250
6	162	196	270
7	182	215	300
8	202	233	330

**Penetration
of walls thinner
than 200 mm**

1. Wall
2. Neoprene or other type of gasket against moisture
3. Expanding mortar
4. Wall Sleeve
5. PVC Pipe Sleeve
6. FibreFlex pipe
7. End Cap Heat Shrink
8. FibreFlex Press Weld Adaptor

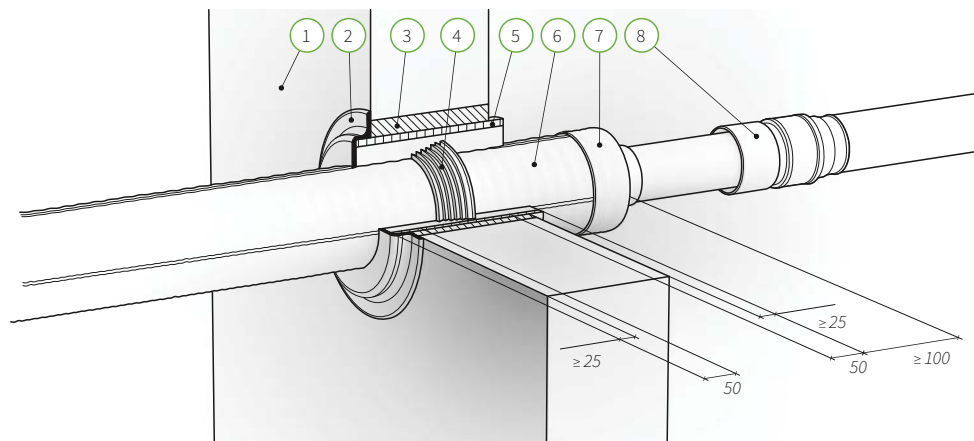


Fig. B6.1

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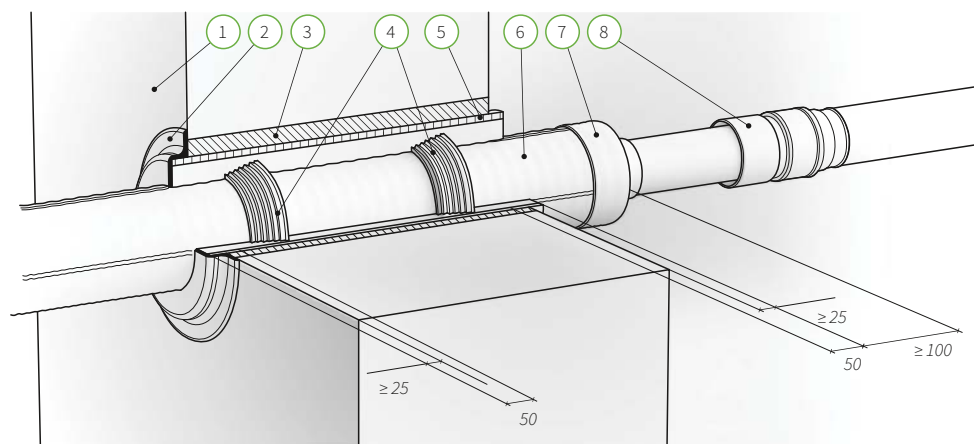


Fig. B6.2

Vertical building entry

1. FibreFlex pipe
2. FibreFlex 90 Degree Bend Building Entry Pre-insulated
3. Wall (basement)
4. Wall Sleeve
5. End Cap Heat Shrink

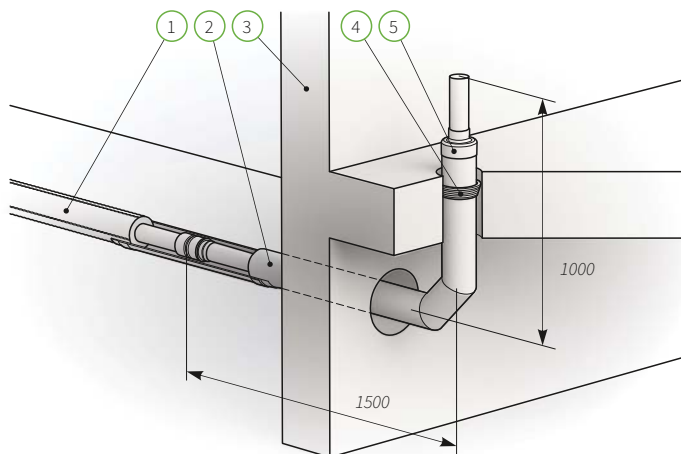


Fig. B6.3

Wall Compression Seal Installation

Required components and materials

1. PVC Pipe Sleeve (optional)
2. Mortar
3. Epoxy resin
4. Wall Compression Seal

Required tools

1. Hole cutter or core drill
2. Saw
3. Torque wrench

1. Drill a hole in the wall. If sleeving the hole with a PVC Pipe Sleeve, create a hole larger than the PVC Pipe Sleeve diameter. If not using a PVC pipe Sleeve, then simply drill the hole according to the required value in Table B6.2.

2. Cut the PVC Pipe Sleeve to the required wall thickness. Insert the PVC Pipe Sleeve and seal in place with mortar.
Attention! Always wear mask when cutting PVC Pipe Sleeve! Only use slow-speed cutting tools.

3. Seal the inside surface of the PVC Pipe Sleeve or core-drilled hole (if no using PVC Pipe Sleeve) with epoxy resin.

4. Fit the Wall Compression Seal on the casing of the FibreFlex pipe (Fig. B6.4). The Wall Compression Seal nuts must face the inside of the building unless access is restricted.
Please note that the Wall Compression Seal must be fitted before the pipe end is connected to the building's internal system.

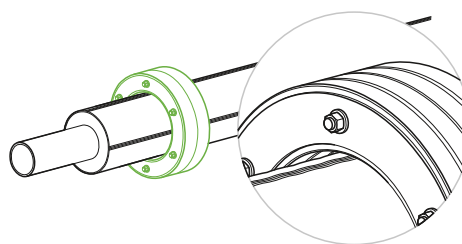


Fig. B6.4

5. Feed the pipe with the Wall Compression Seal in place through the hole in the wall (Fig. B6.5).

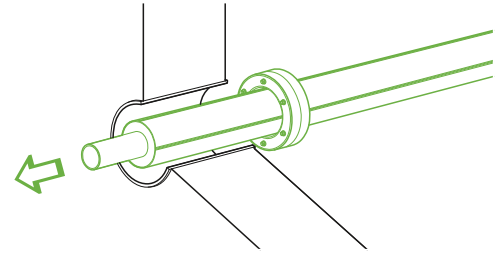


Fig. B6.5

6. Position the Wall Compression Seal level with the outside face of the wall (Fig. B6.6).

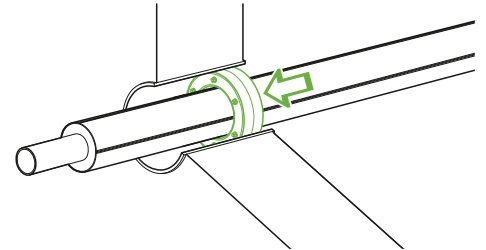


Fig. B6.6

7. Tighten the nuts using a torque wrench, ensuring that the correct sequence is observed from the diagram (Fig. B6.7) tightening opposite nuts.

Attention! The nuts have to be tightened gradually in a number of steps, not to exceed increases of 2 Nm per step. The maximum torque setting for the compression seals can be found in Table B6.2.

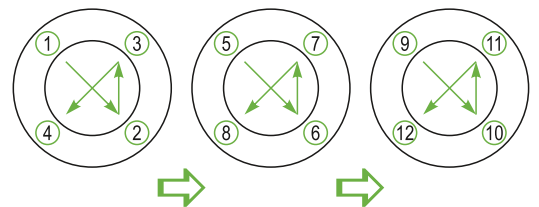
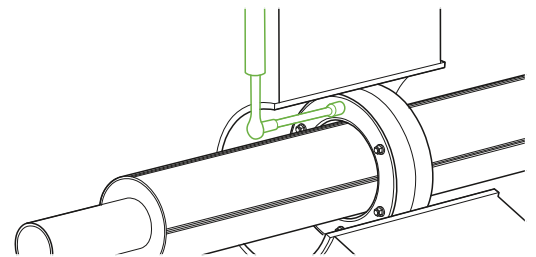


Fig. B6.7

Note. Additional Wall Compression Seal 40 can be used for aesthetic reasons to cover gaps between the pipe and the hole through the wall or PVC Pipe Sleeve (if fitted).

Wall Compression Seal installation parameters

Table B6.2

Pos	FibreFlex jacket pipe dimension, mm	PVC Pipe Sleeve / hole in wall inner diameter, mm	PVC Pipe Sleeve outer diameter, mm	Nut size	Nut tightening torque, Nm
1	76	150	158	M6	5
2	91	150	158	M6	5
3	111	200	210	M8	8
4	126	200	210	M8	8
5	142	200	210	M8	8
6	162	250	280	M8	8
7	182	250	280	M8	8
8	202	250	280	M8	8

Anchoring Pipe Terminations

To prevent movement and misalignment of the pipe from expansion forces, it is recommended to anchor the pipe's outer casing with brackets.

Attention!

The examples shown (Fig. B6.8 - Fig. B6.10) are for illustrative purposes and will vary according to the requirements and configuration of each project.

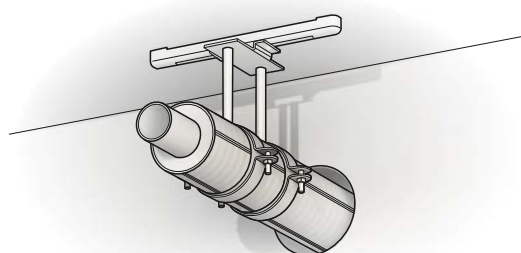


Fig. B6.8

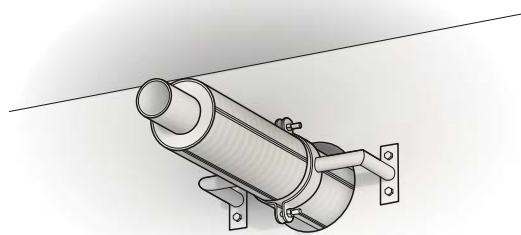


Fig. B6.9

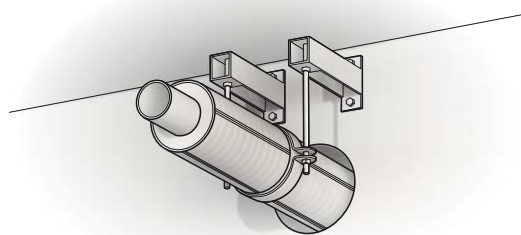


Fig. B6.10

Fix point

1. In-house heating pipe
2. Fixed point
3. FibreFlex press connector
4. FibreFlex pipe
5. Wall (basement)

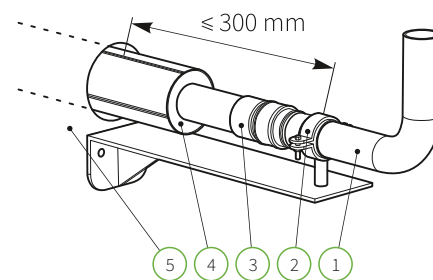


Fig. B6.11

When entering a building, the FibreFlex pipe end inside a building should not exceed 300 mm. Due to thermal expansion of the FibreFlex service pipe, the internal heating system shall be securely fixed close to its connection to the FibreFlex pipe. The fixed needs to be designed to sufficiently accommodate the forces listed in the table below for different dimensions of FibreFlex service pipe.

Table B6.3

Pos	FibreFlex service pipe dimension, mm	Maximum Force, N
1	25 - 40	3000
2	50 - 75	10 000
3	90 - 110	20 000
4	125 - 140	30 000
5	160	40 000

B7. Storage

Requirements for storage of pipes, fittings and accessories

For long-term storage, pipe coils must be placed on their side – on a generally level surface to ensure uniform support of the pipe. If the coils are stored on an incline, they must be secured to prevent movement.

If stored outside, it is recommended to cover the pipe coils with a suitable UV-resistant material – ensuring that adequate ventilation is provided to prevent overheating of the coil.

Pipe coils must not be stored in standing water or areas prone to flooding.

Ensure that the pipes are stored on a flat surface, free from sharp objects that can damage the pipe's outer casing.

Where available, timber, pallets, or sandbags can be used to store the pipe coils.

All fixing straps holding the pipe coil together must not be cut during transportation or storage to ensure safe handling.

The exposed ends of the pipe must be protected by factory-fitted protective caps. If not available, the ends of the pipe can be protected with two layers of polyethylene foil (with a minimum thickness of 100 microns) fixed in place with duct tape.

Pipe end protection must remain in place until the pipe connections are made.

Pipes, fittings and accessories must be kept at least one metre away from sources of heat, accelerants, explosive materials and any chemicals that can cause damage.

Fittings and accessories must be stored in their original packaging, ensuring that the clearly marked individual storage instructions are followed – such as keeping them clean and dry.

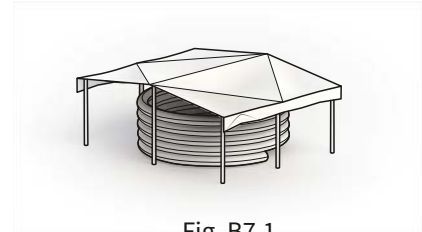


Fig. B7.1

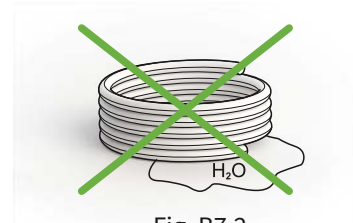


Fig. B7.2

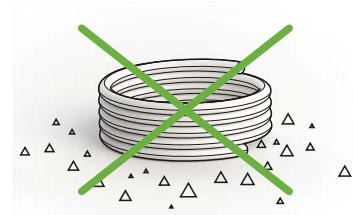


Fig. B7.3

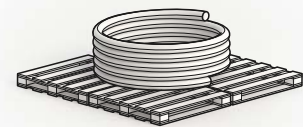


Fig. B7.4

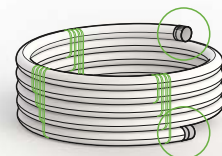


Fig. B7.5

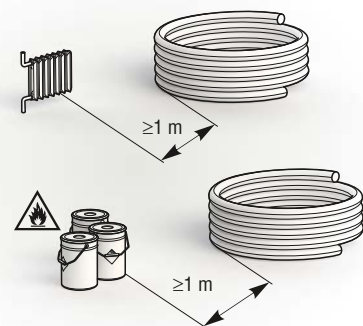


Fig. B7.6

B8. Transport

General recommendations for transporting pipes

Pipes, fittings and accessories can be delivered by any suitably-sized freight vehicle or container.

Pipes can be shipped in coils (Fig. B8.1.a) or on drums (Fig. B8.1.b).

Pipe coils must be laid on a flat surface that has no sharp edges or protrusions that could damage the pipe.

Pipes must be securely fixed using nylon webbing straps (minimum 50 mm wide) during transportation and under no circumstances can rope, chains or wire be used as they can damage the pipe's outer casing.

Delivery of pipes coiled on drums is available in some countries. They are transported using specially adapted drum trailers or on traditional low-load trailers. If delivered on a special drum trailer, the pipe can be directly uncoiled as installed, which cuts down on the requirements for site-based specialist handling equipment.

Drum trailers are available with single or double-coil configurations, with the latter requiring transportation by truck due to its weight. Pipe drums can hold two or more pipe sections per drum, consisting of different diameters, which helps to lower transportation costs.

Pipes are held on the drum by means of a series of fixing straps. These must not be cut during transportation and storage. Please contact your local Radius-Kelit service centre to see if drum delivery is available in your region.

Pipe coils can be transported vertically or horizontally. Care must be taken to avoid violent vibrations when driving over rough terrain.

Pipe coils can be transported in a pipe coil trailer, which can hold one pipe. This simplifies the uncoiling process as pipes can be directly fed into the pre-prepared trench.

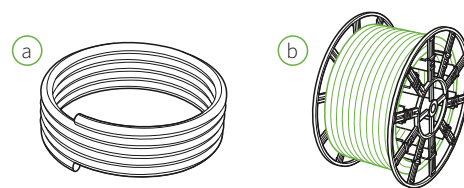


Fig. B8.1

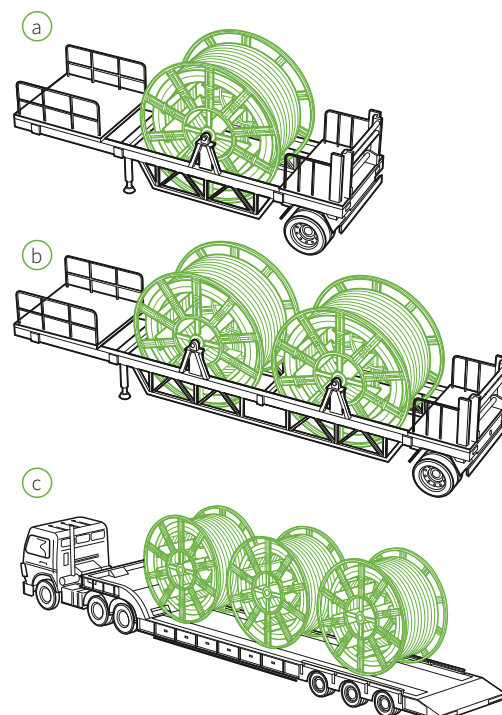


Fig. B8.2



Fig. B8.3



Fig. B8.4

General coil sizes

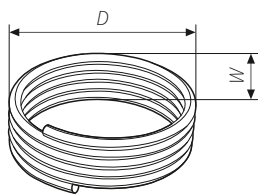


Fig. B8.5

Table B8.1

Pos	Pipe dimension	Coil size, D×W, mm	Maximum length of pipe in coil, m	Estimated weight of maxicoil (coil with max length of pipe), kg
1	25/91	2800×1200	550	690
2	32/91	2800×1200	550	740
3	40/111	2800×1200	410	780
4	50/111	2800×1200	410	810
5	63/126	2800×1200	300	710
6	75/142	2800×1200	225	660
7	90/162	2800×1200	149	600
8	110/182	2800×1200	86	430
9	125/202	2800×1200	80	480
10	140/202	2800×1200	80	500

Table B8.2

Pos	Pipe dimension	Coil size, D×W, mm	Maximum length of pipe in coil, m	Estimated weight of maxicoil (coil with max length of pipe), kg
1	25+25/111	2800×1200	410	740
2	32+32/126	2800×1200	300	680
3	40+40/142	2800×1200	225	650
4	50+50/162	2800×1200	149	530
5	63+63/182	2800×1200	86	390
6	75+75/202	2800×1200	80	460

B9. Loading, offloading and uncoiling pipes

Loading and offloading pipes

Loading and offloading of pipes has to be done carefully to avoid damage to the pipe's outer casing.

For offloading, it is necessary to use soft synthetic slings with a minimum width of 50 mm.

Steel cables, chains, wires and round ropes must not be used.

During loading and handling, please ensure that the pipe coils are lifted and under no circumstances can they be dragged.

If using a forklift truck, the forks must be suitably covered with a soft material (such as PE) to prevent damage to the pipe's outer casing. Also ensure that these protective pipes cannot slide off the forks.

During loading and offloading, pipe coils must be safely lifted and under no circumstances should the coils be dropped or dragged. Pipe coils can be rolled, but only where the surface is flat and free of sharp protrusions that could damage the pipe's outer casing. When manually handling, please ensure that the weight of the pipe coil is taken into account and sufficient labour is applied to ensure site safety.

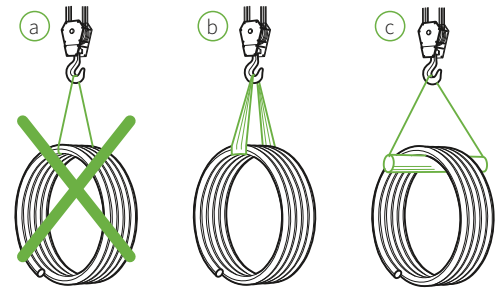


Fig. B9.1

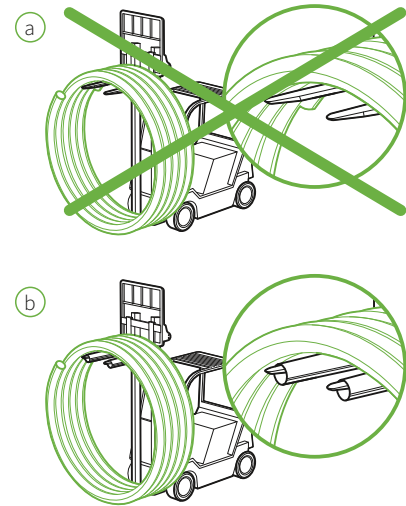


Fig. B9.2

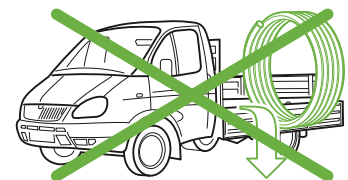


Fig. B9.3

Uncoiling pipes

Pipe coils are held together with a series of fixing straps that are located at a minimum of four equally-spaced positions around the circumference of the coil.

It is essential that the straps are cut in the correct sequence, as otherwise the coil could spontaneously unwind and cause, serious injuries and damage. Please refer to the diagram (Fig. B9.4) which shows where to start the uncoiling (2) by careful and controlled removal of the fixing straps.

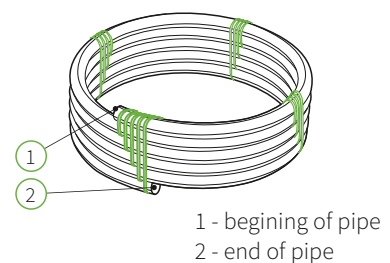


Fig. B9.4

Please ensure that the minimum bending radii values (see Table B9.1) are carefully observed to avoid damage to the pipe.

Uncoiling of pipe can be done manually by rolling the coil. During the uncoiling process, the pipe is laid either alongside the trench (Fig. B9.6.a) or directly into the pre-prepared trench (Fig. B9.6.b). Fixing straps need to be cut carefully and in the correct sequence as the pipe is unwound.

Care must be taken to avoid rolling the pipe coil over any sharp objects that could damage the pipe's outer casing. The uncoiled length of pipe can be held in place by means of carefully placed sand bags or other suitable materials.

When uncoiling sizes of FibreFlex with jacket pipe dimension over 142 mm, it is strongly recommended to use uncoiling devices such as trailers (Fig. B9.7) or uncoiling platforms (Fig. B9.8). Uncoiling devices can also be very helpful for any dimension of FibreFlex pipe in such cases, where access to the area of installation is limited or there are obstacles such as trees, lampposts and other street furniture, preventing the pipe coil being rolled alongside the trench.

When pulling the pipe along the trench during uncoiling, please ensure that the jacket pipe is not damaged by abrasion and punctured by sharp objects. Where possible, use pipe rollers, timber or sand bags to maintain the integrity of the casing.

Attention: As the pipe is pulled from the coil trailer by manpower or machine, care must be taken to avoid damaging the pipe by stretching.

Uncoiling from a pipe drum can be done directly from a drum trailer into the trench (Fig. B9.9). The pipe end can be pulled by means of a 50 mm wide synthetic sling directly into the trench, or alongside its length. Where a drum trailer is not available, a crane or site machine such as an excavator or telehandler can be used – if free rotation of the drum can be maintained.

Attention: extra care must be taken when cutting the last retaining strap as the pipe may spring rapidly. It is advisable to ensure that all site personnel are out of the area of potential trajectory.

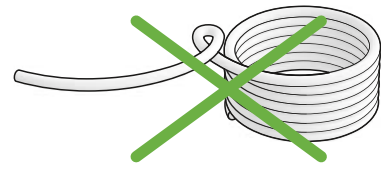


Fig. B9.5

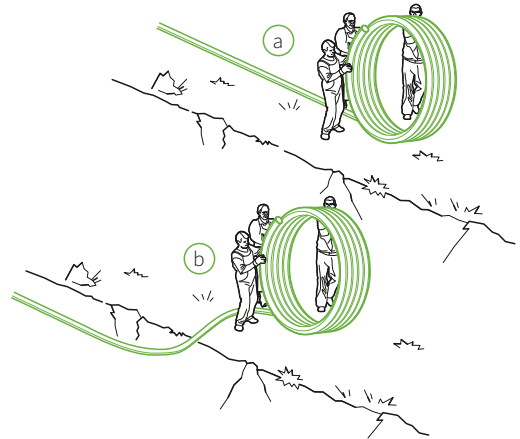


Fig. B9.6



Fig. B9.7

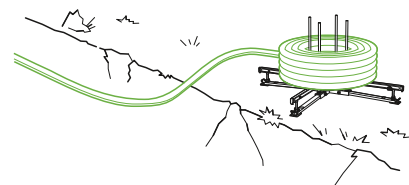


Fig. B9.8

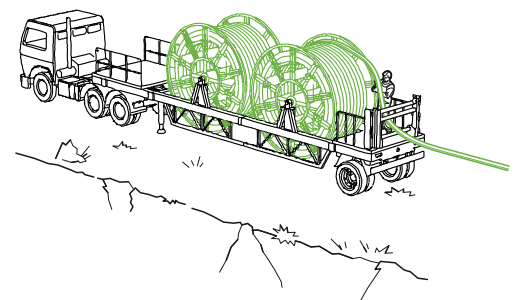


Fig. B9.9

For larger dimensions of pipe – with casings dimension over 142 mm – it is recommended to use a machine to pull the pipe from the drum trailer.

Attention: Care must be taken to prevent damage to the pipe from stretching.

It is strongly recommended to pull the pipe only with fixing synthetic slings with a minimum width of 50 mm at the end of the pipe.

In exceptional cases when pipe shall be pulled not at the end, the use of two soft synthetic slings with a minimum width of 50 mm is strongly recommended to avoid a possibility of pipe damage.

When pulling the pipe along the trench during uncoiling, please ensure that the outer casing is not damaged by abrasion and punctured by sharp objects. Where possible, use pipe rollers, timber or sand bags to maintain the integrity of then casing.

When uncoiling pipes in outside temperatures at or below 0°C, the pipe coils must be heated to ensure the correct conditions for safe uncoiling. It is therefore recommended to store the pipe coils in a warm place with temperatures above 20°C for at least eight to ten hours prior to installation.

Where warm storage facilities are not available on site, the pipe coils can be heated with hot air guns (air temperature up to 60°C). The pipe coils should be covered by insulating tents and hot air fed around the pipes and also inside the service pipe to provide a uniform temperature in the insulation foam. Failure to ensure that the correct temperature has been reached may result in the insulation foam cracking during the uncoiling process.

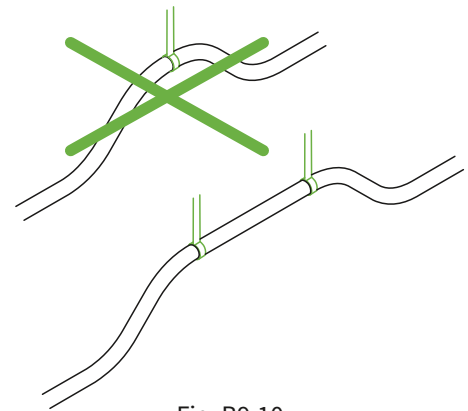


Fig. B9.10

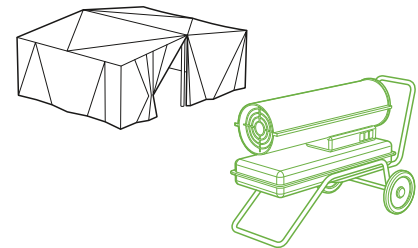


Fig. B9.11

Uncoiling of pipes with outside temperature below 0°C

FibreFlex pipe minimum bending radii

Table B9.1

Pos	Jacket pipe dimension, mm	Minimum bending radii, m
1	76	0.7
2	91	0.9
3	111	0.9
4	126	1.0
5	142	1.1
6	162	1.2
7	182	1.3
8	202	1.4
9	225	1.6

B10. Service Pipe Joints

General

The FibreFlex pipe system has a number of different types of compression connectors available for service pipe joints and transitions to other systems.

It is important to note that these connectors can only be fitted once and therefore cannot be undone or refitted. Whilst connectors are installed with a Radius-Kelit hydraulic press tool, industry standard press tools can be used for FibreFlex service pipe joints up to 110 mm diameter.

The following press (compression) connectors are available:

- FibreFlex Press Weld Adaptor – for connecting welded steel pipes to FibreFlex pipe.
- FibreFlex Press Coupler – for the straight connection of two FibreFlex service pipes.
- FibreFlex Press Thread Adaptor – for connecting threaded pipes to FibreFlex pipe.
- FibreFlex Press T-Branch – for branch connections from Fibreflex service pipes.
- FibreFlex Press 90 Degree Elbow – for sharp bends that cannot be achieved with the minimum bending radii of FibreFlex pipe.

The installation of the press connector requires the FibreFlex pipe end to be expanded before placing the steel insert into the pipe; this is followed by the compression of the steel outer sleeve onto the pipe's outer surface. For diameters up to and including 110mm, industry standard press tools may be used when installing FibreFlex press connectors to FibreFlex pipes. For diameters 25-40, 50-110 and 125-160mm, Radius-Kelit press tools are available.

Press connector design

Components:

- a) inner steel insert, which is placed into the FibreFlex pipe;
- b) outer steel sleeve, which is pressed over the outside of the pipe and compresses the service pipe onto the inner steel coupler.



Fig. B10.1

Types of FibreFlex pipe connectors

Table B10.1

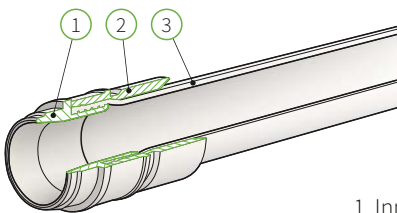
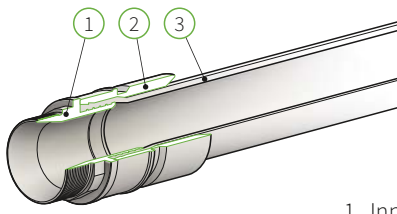
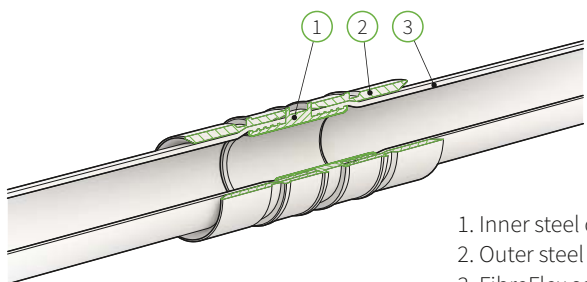
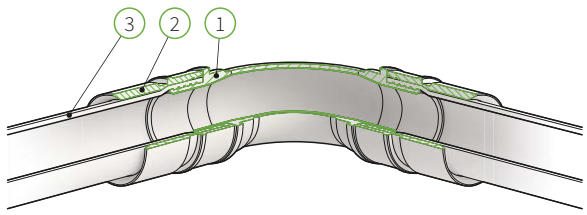
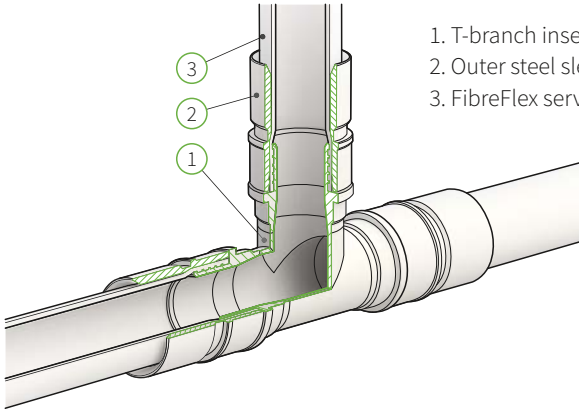
Pos	Type of connector, general characteristics	Drawing
1 Connections of FibreFlex pipes with steel pipes and details		
1.1	Connector FibreFlex Press Weld Adaptor Nomenclature A2.2 Installation B10.5	 <p>1. Inner steel insert with weld end 2. Outer steel sleeve 3. FibreFlex service pipe</p>
1.2	Connector FibreFlex Press Thread Adaptor Nomenclature A2.3 Installation B10.5	 <p>1. Inner steel insert with threaded end 2. Outer steel sleeve 3. FibreFlex service pipe</p>
2 Connections of two FibreFlex pipes		
2.1	Connector FibreFlex Press Coupler Nomenclature A2.4 Installation B10.5	 <p>1. Inner steel coupler 2. Outer steel sleeve 3. FibreFlex service pipe</p>
3 90 degree elbow		
3.1	Connector FibreFlex Press 90 Degree Elbow Nomenclature A2.6 Installation B10.9	 <p>1. 90 degree elbow 2. Outer steel sleeve 3. FibreFlex service pipe</p>

Table B10.1 (continuation)

Pos	Type of connector, general characteristics	Drawing
4 T-branch connection		
4.1	<p>Connector FibreFlex Press T-branch</p> <p>Nomenclature A2.7</p> <p>Installation B10.10</p>	 <p>1. T-branch insert 2. Outer steel sleeve 3. FibreFlex service pipe</p>

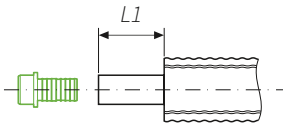
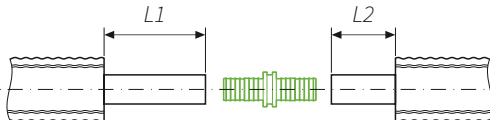
The installation of service pipe connections for FibreFlex pipes requires the outer casing and insulation to be removed in the joint area. The length of exposed service pipe required will vary according to the length of the connector and the dimensions of the press tool. Please refer to Table B10.2 for the recommended lengths.

Note: Care must be taken to ensure that the insulating sleeve required to join the outer casing is at least 200 mm longer than the exposed area of service pipe to provide the minimum 100 mm overlap with the outer casing at each end.

Note: When connecting two FibreFlex pipes together, the FibreFlex Press coupling must be fitted on the pipe cut to the length L1 the Table B10.2 first, then connected to the pipe measured to length L2. Failure to do this will prevent sufficient room for the correct operation of the press tool.

Minimum length of exposed service pipe for compression connector installation

Table B10.2

Pos	Service pipe size	L1, mm	L2, mm	Drawing
FibreFlex Press Weld (Treaded) End Adaptors, 90 Degree Elbows, T-branches				
1	25	135+30		
2	32	135+30		
3	40	135+30		
4	50	165+30		
5	63	185+30		
6	75	190+30		
7	90	200+30		
8	110	210+30		
9	125	235+30		
10	140	250+30		
11	160	260+30		
FibreFlex Press Couplers				
12	25	250+30	135+30	
13	32	250+30	135+30	
14	40	250+30	135+30	
15	50	250+30	165+30	
16	63	250+30	185+30	
17	75	250+30	190+30	
18	90	250+30	200+30	
19	110	250+30	210+30	
20	125	235+30	235+30	
21	140	250+30	250+30	
22	160	260+30	260+30	

* In case of FibreFlex Press Reduction Coupler installation, a larger dimension of Reduction Coupler shall be considered to evaluate recommended length L1.

B10.1. Preparation of the service pipe

Required tools

1. Tape measure
2. Marker
3. Knife
4. Hammer
5. Pipe cutter

Preparation of the service pipe

1. Measure and mark the length of exposed service pipe required according to Table B10.2.

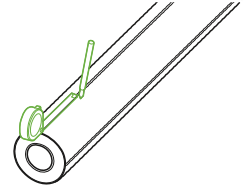


Fig. B10.1.1

2. Carefully cut the outer casing along the pipe axis up to the marked measurement.

Attention: care must be taken not to damage the surface of the service pipe.

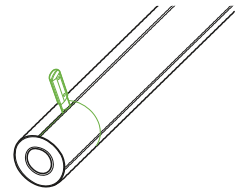


Fig. B10.1.2

3. Carefully cut around the circumference of the outer casing at the measured mark - again taking care not to damage the service pipe.

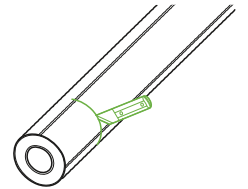


Fig. B10.1.3

4. Peel back the cut section of outer casing.

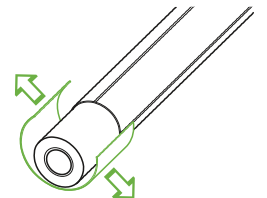


Fig. B10.1.4

5. Using a hammer, carefully remove the insulation foam from the service pipe.

Attention: do not damage the surface of the service pipe.

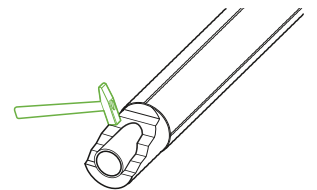


Fig. B10.1.5

6. To make the pipe end straight, cut 30 mm of service pipe with a suitable pipe cutter. Chamfer the inner edge of the service pipe with a knife or other suitable chamfer tool.

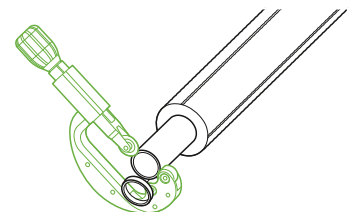


Fig. B10.1.6

B10.2. FibreFlex Press Weld (Thread) Adaptor installation

Required components and materials

1. FibreFlex Press Weld (Thread) Adaptor
 - Inner coupler - 1 pcs;
 - Outer sleeve - 1 pcs.
2. Steel pipe section (≥ 400 mm) - in case steel pipe welding is carried out later.
3. End Cap Heat Shrink (or End Cap).

Required tools

1. Welding machine (if the fitting is not welded initially)
2. Radius-Kelit press tool.
3. Wiper.
4. Gas burner with soft flame or heat gun.
5. Abrasive paper.
6. Alcohol cleaning wipes.

Pipe preparation

1. Before installation of a compression connector to the FibreFlex pipe, the building's pipe system must be welded to the internal side of the steel coupler. If the welding has to be done later, weld a short piece of steel pipe (at least 400 mm long), which can then be welded at a later time (Fig. B10.2.1).

Attention! To avoid overheating of the FibreFlex Pro service pipe, installation of a coupler before welding is strictly prohibited!

After welding, the following installation work can continue when the connector has cooled down to 40- 50°C.

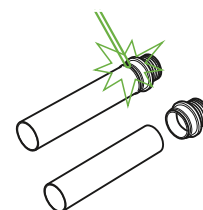


Fig. B10.2.1

2. Prepare the end of the pipe, following the instructions described in paragraph B10.1.
 3. Slide the Heat Shrink End Cap (or Heat Shrink Sleeve if the welding adaptor to a steel pre-insulated fitting) over the pipe (Fig. B10.2.2).
- Attention!** Do not remove the protective foil from the glue line inside the end cap before its installation. The end cap is only used when the pipe insulation is terminating.

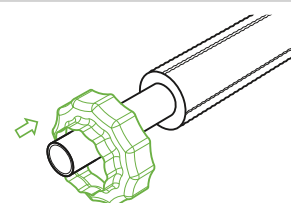


Fig. B10.2.2

FibreFlex Press Weld Adaptor installation

4. Place the outer sleeve to the service pipe with the skirt facing towards the end of the pipe. The press direction arrow marking on the sleeve should be pointing to the pipe end (Fig. B10.2.3).

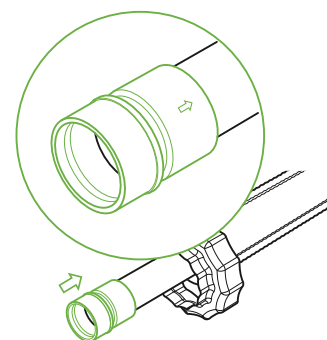


Fig. B10.2.3

5. Assemble the press tool with the correct size of expander head fitted.

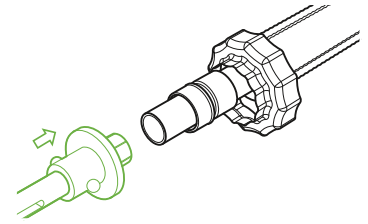


Fig. B10.2.4

6. Using the hydraulic pump, expand the pipe end (Fig. B10.2.5).
Hold the expander head inside the pipe for a period of 2 minutes to ensure the pipe expands. Release the pump's hydraulic pressure, rotate the expander head by 30 degrees and repeat the expansion process.

Attention! Monitor the pressure, do not exceed 45 MPa.

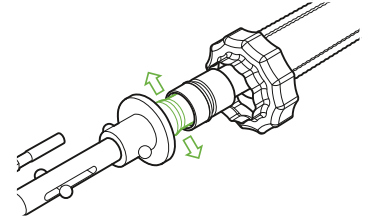


Fig. B10.2.5

7. Insert the welded inner steel coupler into the expanded service pipe (Fig. B10.2.6).
Attention! the inner coupler has to be inserted quickly before the pipe end shrinks back to its initial state.

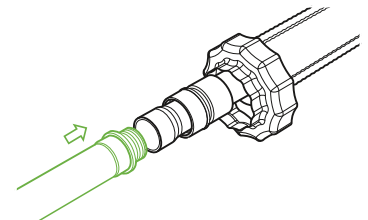


Fig. B10.2.6

8. Assemble the press tool with its press jaws (Fig. B10.2.7).
Securely locate the press jaws onto the collar of both: outer sleeve and inner coupler.

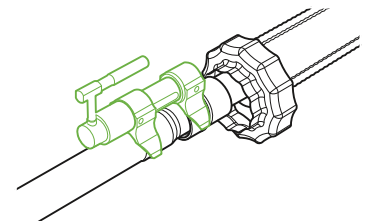


Fig. B10.2.7

9. Operate the pump to press the outer sleeve until it is snug with the inner coupler (Fig. B10.2.8).
During the process, please ensure that the inner coupler is fully inside the pipe without displacement.

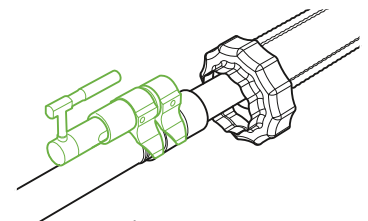


Fig. B10.2.8

10. Once the compression is completed, check to ensure that there are no gaps between the shoulder of the inner coupler and the outer sleeve (Fig. B10.2.9).
If a gap is present, repeat the process to close the gap.

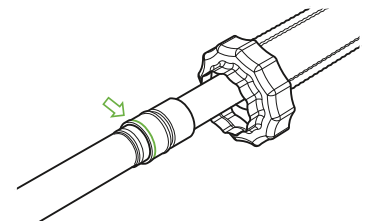


Fig. B10.2.9

Insulation of pipe end: installation of Heat-Shrink End Cap

11. Ensure that at least 100 mm of the pipe's outer casing is clean and free of dust and dirt. Rough up this area with abrasive paper and clean with alcohol wipes.

Clean the service pipe between the compression connector and the exposed end of the insulation, using alcohol wipes.

Remove the protective foil from the inside of the Heat Shrink End Cap to expose the adhesive surface.

Shrink the end cap by uniformly heating it with the help of a gas burner or heat gun. Continuously move the flame from one area to another by rotating the gas burner around the pipe. Avoid overheating the end cap by heating any one area too long.

The distance between gas burner and end cap surface should be around 100-150 mm.

The gas burner flame has to be adjusted according to weather conditions:

- when it is not windy and the ambient temperature is above +5 °C, the use of a yellow-coloured flame is recommended;
- when it's windy and/or the ambient temperature is below +5 °C, the use of a blue-coloured flame is recommended.

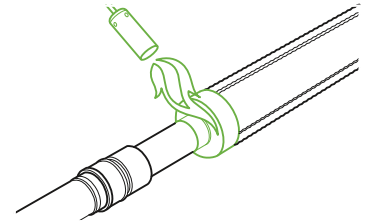


Fig. B10.2.10

B10.3. FibreFlex Press Coupler installation

Required components and materials

1. FibreFlex Press Coupler
 - Inner coupler- 1 pcs;
 - Outer sleeve - 2 pcs.
2. Sleeve Heat Shrink (or Insulation Shell Straight)

Required tools

1. Radius-Kelit press tool.

Pipe preparation

1. Prepare the pipe end, following the instructions described in paragraph B10.1.
2. Carefully align the two pipes to be connected.
3. Before the installation of the FibreFlex Press Coupler, slide the Heat Shrink Sleeve with shrinking bands to one of the pipes (If an Insulation Shell Straight is used, place it on the pipe after the coupler is completely pressed).
Attention! Do not remove the protective foil from the Heat Shrink Sleeve before its installation.

FibreFlex Press Coupler installation

4. **Attention!** The FibreFlex Press Coupler shall be installed first on the pipe with longer exposed service pipe end (see Table B10.2).

Place the outer sleeve onto the service pipe with the skirt toward the pipe end with the cut insulation layer.

When fitting a FibreFlex Press Reducing Coupler, take care to determine the correct configuration of the outer steel sleeve and the relevant pipe size (Fig.B10.3.1).

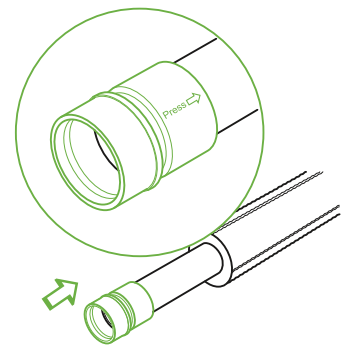


Fig. B10.3.1

5. Assemble the press tool with the appropriately sized expander head. Insert the expander head into the service pipe until snug (Fig. B10.3.2).

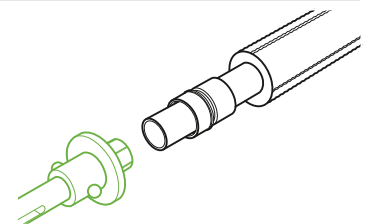


Fig. B10.3.2

6. Expand the pipe end with the use of the hydraulic pump. Hold the expanded head inside the pipe for 1-2 min to ensure correct plastic deformation (Fig. B10.3.3).

Release the hydraulic pump pressure, rotate the expander head by 30 degrees and repeat the expansion process.

Attention! The control pressure on the manometer should not exceed 45 MPa.

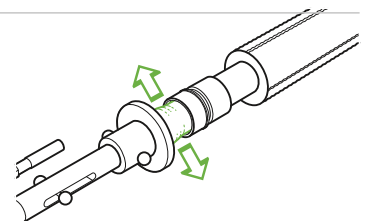


Fig. B10.3.3

7. Insert the inner coupler into the expanded pipe end (Fig. B10.3.4).

Attention! The inner steel coupler has to be inserted quickly before the pipe end shrinks back to its initial state.

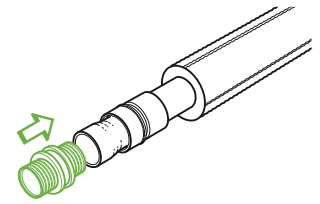


Fig. B10.3.4

8. Assemble the press tool with press jaws (Fig. B10.3.5). Securely locate the press tool jaws onto the collars of both connector sleeves.

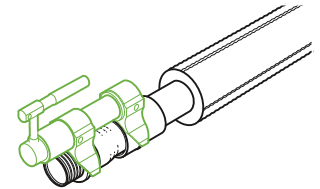


Fig. B10.3.5

9. Using the pump, press the outer sleeve until it is snug with the inner coupler (Fig. B10.3.6). During the pressing process, please ensure that the inner coupler is firmly located inside the pipe without displacement.

After the pressing has been completed, check that there are no gaps between outer sleeve and inner coupler. If gaps are present, repeat the process to close the gap.

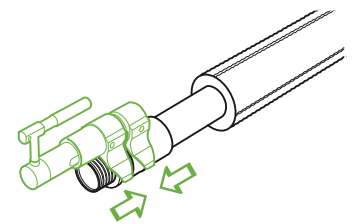


Fig. B10.3.6

10. Put the outer sleeve on the second service pipe with the same orientation as described in step 4.

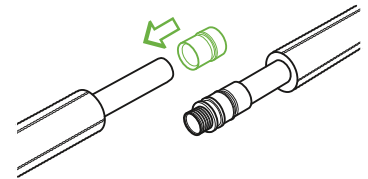


Fig. B10.3.7

11. Assemble the press tool with the correctly-sized expander head. Insert the expander head into the service pipe until snug (Fig. B10.3.8).

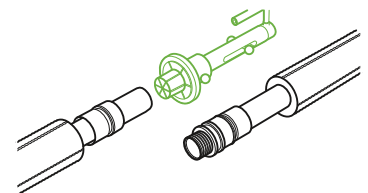


Fig. B10.3.8

12. Expand the end of pipe as per step 6.

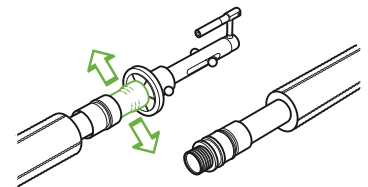


Fig. B10.3.9

13. Insert the inner coupler into the expanded pipe end (Fig. B10.3.10).

Attention! The inner steel coupler has to be inserted quickly before the pipe end shrinks back to its initial state.

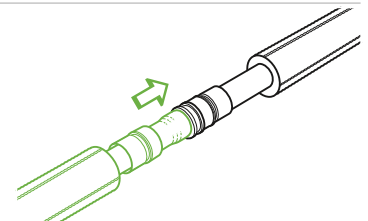


Fig. B10.3.10

-
14. Assemble the press tool with the appropriate press jaws (Fig. B10.3.11).
Locate the press jaws as detailed in step 8.

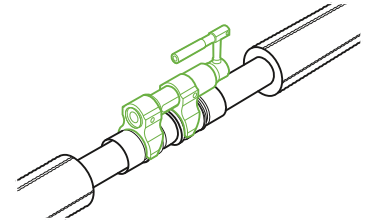


Fig. B10.3.11

-
15. Using the pump, press the outer sleeve until it is snug with the inner coupler (Fig. B10.3.12). During pressing process, please ensure that the inner coupler is firmly located inside the pipe without displacement.
- After pressing has been completed, check that there are no gaps between outer sleeve and inner coupler. If gaps are present, repeat the process to close the gap.

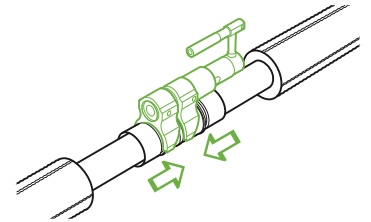


Fig. B10.3.12

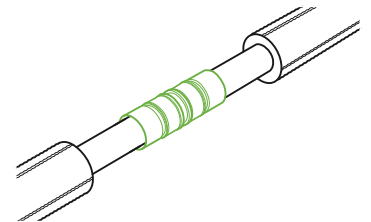


Fig. B10.3.13

B10.4. FibreFlex Press 90 Degree Elbow Installation

Required components and materials

1. FibreFlex Press 90 Degree Elbow
 - Elbow 90 degree - 1 pcs;
 - Outer steel sleeve - 2 pcs.

Required tools

1. Radius-Kelit press tool.

Pipe preparation

1. Prepare the pipe end, following the instructions described in Paragraph B10.1.
2. Align the connecting pipes with the elbow.

FibreFlex Press 90 Degree Elbow installation

3. All of the required steps for the installation of a FibreFlex Press 90 Degree Elbow follow the same procedure as the FibreFlex Press Coupler (see Paragraph B10.3).

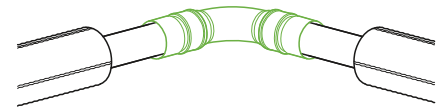


Fig. B10.4.1

B10.5. FibreFlex Press T-Branch installation

Required components and materials

1. FibreFlex Press T-Branch
 - T-Branch coupler - 1 pcs;
 - Outer steel sleeve - 3 pcs.

Required tools

1. Radius-Kelit press tool.

Pipe preparation

1. Prepare the pipe end, following the instructions described in Paragraph B10.1.
2. Align the connecting pipes with the T-branch.

FibreFlex Press T-Branch installation

3. All of the required steps for the installation of a FibreFlex Press T-branch follow the same procedure as the FibreFlex Press Coupler (see Paragraph B10.3).

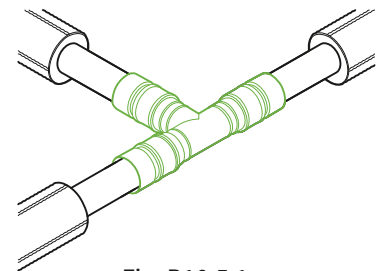


Fig. B10.5.1

B11. Pre-insulated Joints

General

The FibreFlex pipe system has a range of pre-insulated fittings, which terminate with a pre-welded FibreFlex Pro Adaptors; this enables connection to be made to the FibreFlex pipe without the need for on-site welding.

The FibreFlex Pro Press Weld Adaptor consist of three parts:

- inner steel insert;
- polymer sleeve;
- outer steel sleeve.

The installation of this type of press connector does not require the FibreFlex pipe end to be expanded before placing the steel insert into the pipe, which is critical when installing pre-insulated fittings; polymer sleeve is compressed between steel outer sleeve and pipe's outer surface, which provides required compression of FibreFlex carrier pipe for reliable connection.

The following pre-insulated fittings are available:

- FibreFlex Pro 90 Degree Bend Pre-Insulated (DUO) - for short-radius bends that cannot be achieved with the minimum bending radius of FibreFlex pipes;
- FibreFlex Pro T-Branch Pre-insulated (DUO) - for branch connections from FibreFlex pipes.
- FibreFlex Pro 90 Degree Bend Building Entry Pre-insulated (DUO) - for FibreFlex pipeline vertical building entry;
- FibreFlex Pro Y-connector UNO to DUO Pre-insulated - for connecting FibreFlex DUO pipe with two single FibreFlex pipes;
- FibreFlex Pro Valve Pre-insulated - for FibreFlex pipeline shut off.

For diameters up to and including 110 mm, industry standard press tools may be used when installing FibreFlex Pro pre-insulated fittings to FibreFlex pipes. For diameters 25-40, 50-110 and 125-160mm, Radius-Kelit press tools are available.

Press connector design

Components:

- a) Inner steel coupler, which is placed inside FibreFlex pipe;
- b) Polymer Sleeve, which is placed between FibreFlex service pipe and Outer Sleeve to provide required compression of FibreFlex carrier pipe for reliable connection
- c) Outer steel sleeve, which is pressed over the Polymer Sleeve and compresses the Polymer Sleeve and the service pipe onto the inner steel coupler.

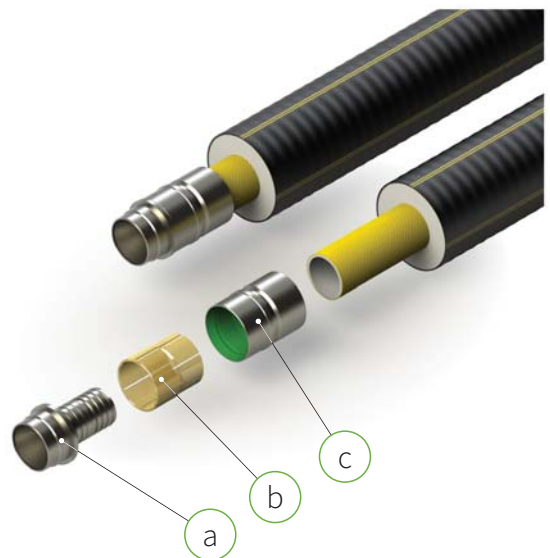


Fig. B11.1

Types of FibreFlex Pro Pre-insulated joints

Table B11.1

Pos	Type of connector, general characteristics	Drawing
1 Connecting two pipes FibreFlex at an angle of 90 degrees		
1.1	Connector FibreFlex Pro 90 Degree Bend Pre-Insulated Nomenclature A3.3 Installation B11.1	<p>1. FibreFlex pipe 2. Outer steel sleeve 3. FibreFlex Pro 90 Degree Bend Pre-Insulated</p>
1.2	Connector FibreFlex Pro 90 Degree Bend Pre-Insulated DUO Nomenclature A3.4 Installation B11.1	<p>1. FibreFlex DUO pipe 2. Outer steel sleeve 3. FibreFlex Pro 90 Degree Bend Pre-Insulated DUO</p>
2 T-branch connection		
2.2	Connector FibreFlex Pro T-Branch Pre-Insulated Nomenclature A3.5 Installation B11.1	<p>1. FibreFlex pipe 2. Outer steel sleeve 3. FibreFlex Pro T-Branch Pre-Insulated</p>

Table B11.1

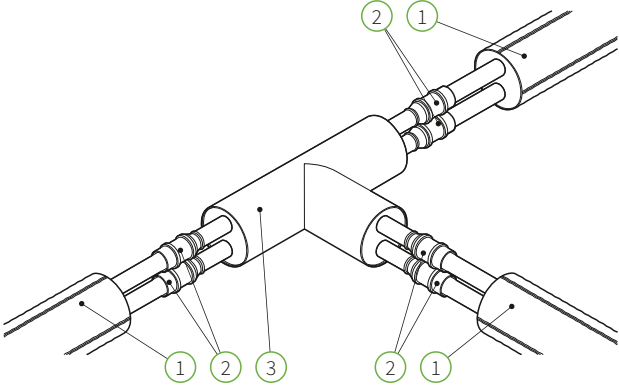
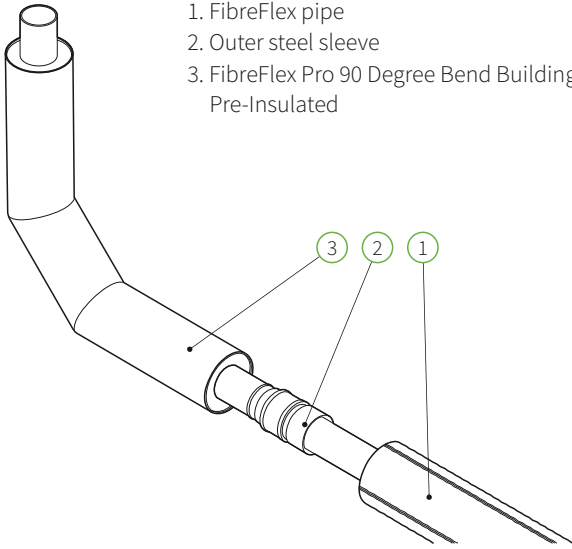
Pos	Type of connector, general characteristics	Drawing
2.2	Connector FibreFlex Pro T-branch Pre-Insulated DUO Nomenclature A3.6 Installation B11.1	 <p>1. FibreFlex DUO pipe 2. Outer steel sleeve 3. FibreFlex Pro T-Branch Pre-Insulated DUO</p>
3 Building entry		
3.1	Connector FibreFlex Pro 90 Degree Bend Building Entry Pre-Insulated Nomenclature A3.7 Installation B11.1	 <p>1. FibreFlex pipe 2. Outer steel sleeve 3. FibreFlex Pro 90 Degree Bend Building Entry Pre-Insulated</p>

Table B11.1

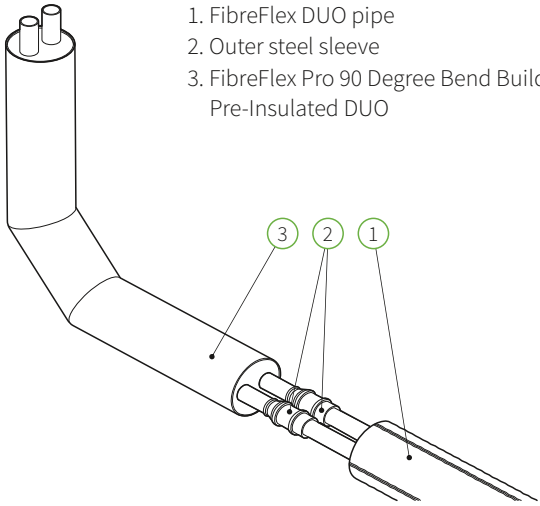
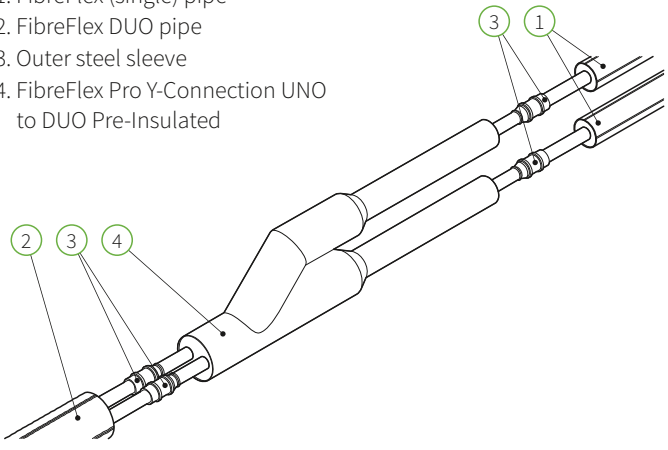
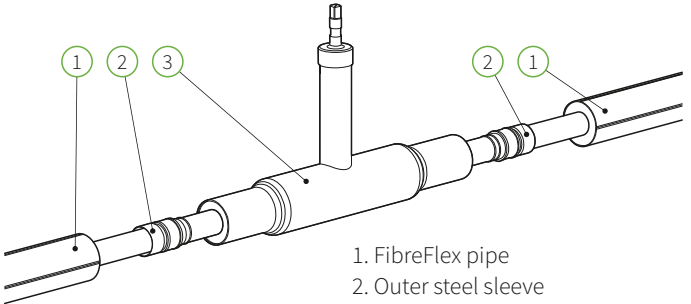
Pos	Type of connector, general characteristics	Drawing
3.2	<p>Connector FibreFlex Pro 90 Degree Bend Building Entry Pre-Insulated DUO</p> <p>Nomenclature A3.8</p> <p>Installation B11.1</p>	 <ol style="list-style-type: none"> 1. FibreFlex DUO pipe 2. Outer steel sleeve 3. FibreFlex Pro 90 Degree Bend Building Entry Pre-Insulated DUO
4 DUO pipe connection with two single pipes		
4.1	<p>Connector FibreFlex Pro Y-Connection UNO to DUO Pre-Insulated</p> <p>Nomenclature A3.9</p> <p>Installation B11.1</p>	 <ol style="list-style-type: none"> 1. FibreFlex (single) pipe 2. FibreFlex DUO pipe 3. Outer steel sleeve 4. FibreFlex Pro Y-Connection UNO to DUO Pre-Insulated

Table B11.1

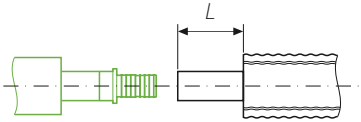
Pos	Type of connector, general characteristics	Drawing
5 Shut off valves		
5.1	Connector FibreFlex Pro Valve Pre-Insulated Nomenclature A3.9 Installation B11.1	 <p>1. FibreFlex pipe 2. Outer steel sleeve 3. FibreFlex Pro Valve Pre-Insulated</p>

The installation of service pipe connections for FibreFlex pipes requires the outer casing and insulation to be removed in the joint area. The length of exposed service pipe required will vary according to the length of the connector and the dimensions of the press tool. Please refer to Table B11.2 for the recommended lengths.

Note: Care must be taken to ensure that the insulating sleeve required to join the outer casing is at least 200 mm longer than the exposed area of service pipe to provide the minimum 100 mm overlap with the outer casing at each end.

**Minimum length
of service pipe
released from
insulation for
connection to
FibreFlex Pro
pre-insulated
fittings**

Table B11.2

Pos	Service pipe size	L, mm	Drawing
Connections to steel pre-insulated connectors			
1	25	135+30	
2	32	135+30	
3	40	135+30	
4	50	165+30	
5	63	185+30	
6	75	190+30	
7	90	200+30	
8	110	210+30	
9	125	235+30	
10	140	250+30	
11	160	260+30	

B11.1. FibreFlex Pro pre-insulated fittings installation

The installation process for FibreFlex Pro T-Branch Pre-Insulated is described below. Installation for all other types of FibreFlex Pro pre-insulated fittings is identical, and therefore does not require separate description.

Required components and materials

1. FibreFlex Pro T-branch Pre-insulated
 - Pre-insulated T-branch - 1 pcs;
 - Polymer Sleeve - 3 pcs;
 - Outer steel sleeve - 3 pcs.

Required tools

1. Radius-Kelit press tool.

Pipe preparation

1. Prepare the pipe end, following the instructions described in Paragraph B10.1.
2. Align the connecting pipes with the pre-insulated T-branch.

3. Before the installation of a FibreFlex Pro T-Branch Pre-insulated, ensure that the Heat Shrinks Sleeves and heat shrink bands are located over the pipes being connected.
Attention! Do not remove the protective foil from the Heat Shrink Sleeve before its installation.

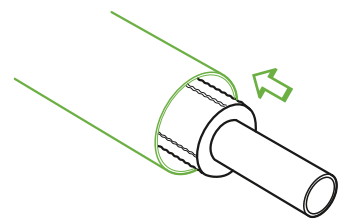


Fig. B11.1.1

FibreFlex Pro T-Branch Pre-Insulated installation

4. Place the outer sleeve onto the service pipe with the skirt toward the pipe end with the cut insulation layer. The press arrow marking on the sleeve should be pointing towards the pipe end (see Fig. B11.1.2).

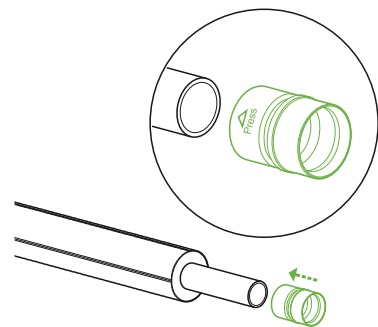


Fig. B11.1.2

5. Place the polymer sleeve onto the service pipe with the thinner side facing towards the outer sleeve.

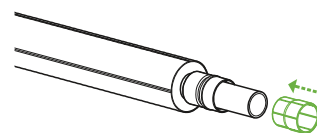


Fig. B11.1.3

6. Place the inner insert of the pre-insulated T-Branch coupler into the pipe end (Fig. B11.1.4).

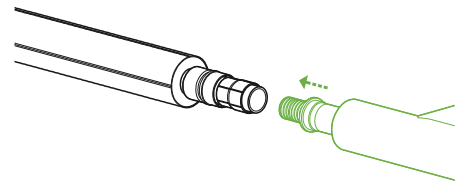


Fig. B11.1.4

7. First slide the polymer sleeve toward the pre-insulated Branch until it is snug with the inner coupler, then slide the outer sleeve in the same direction to place it over the polymer sleeve (Fig. B11.1.5).

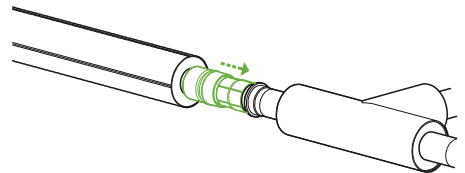


Fig. B11.1.5

8. Assemble the press tool with its press jaws. Securely locate the press jaws onto the collar of both the outer sleeve and inner coupler. For joint dimensions 110 and larger there are two collars on the outer sleeve, therefore the compression process is done with two steps: on the first step install the press tool jaws on the outer sleeve collar located closest to the pre-insulated T-branch's inner connector, when the press tool jaws reach the smaller gap in between, release the pump pressure and install the press tool jaws onto the outer sleeve collar furthest from the pre-insulated T-branch's inner coupler.

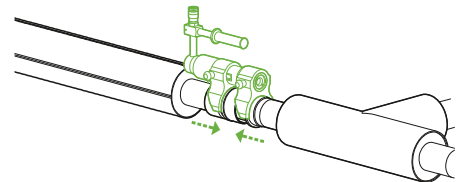


Fig. B11.1.6

9. Operate the pump to press the outer sleeve until it is snug with the inner coupler. During the process, please ensure that the inner insert of the pre-insulated T-branch coupler is fully inside the pipe without displacement..

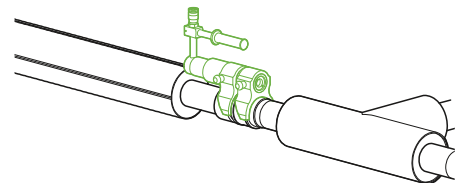


Fig. B11.1.7

10. Once the compression process is complete, check to ensure that there are no gaps between the shoulder of the inner coupler and the outer sleeve. If a gap is present, repeat the process to close the gap.

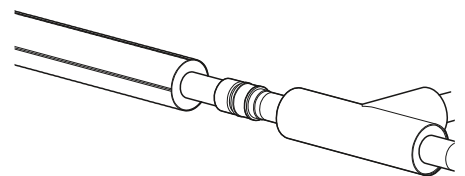


Fig. B11.1.8

B12. Outer Casing Joints and Insulation

General

For the insulation of joints, polyurethane (PUR) foam is used, which is formed by mixing two components: polyol with penthane (component A) and isocyanate (component B). These components are mixed together in a carefully-measured ratio, which causes a chemical reaction resulting in simultaneous foaming of a synthesized polymer.

Components A and B are delivered in plastic bottles with certain pre-determined volumes of each component required to ensure the correct density of foam insulation for the corresponding size of casing joint.

Attention! Safety measures must be observed during work with PUR components. Protective clothing, covering both the operative's skin and hair, rubber gloves, safety shoes, respirator and protective glasses must be used.

Properties of polyurethane foam and its components

Table B12

Properties	Component A (polyol with penthane)	Component B (isocyanate)
Components		
Colour	clear	dark brown
Density (at 20°C), kg/m ³	1100	1220
Viscosity (at 25°C), mPa·s	250	200
Polyurethane (foamed)		
Density, kg/m ³	> 50	
The volume fraction of closed cells, %	> 90	
Thermal conductivity (at 50°C), W/(m·K)	< 0,032	
Ratio by volume, A:B	1 : 1.4	
Reaction time start, s	55	
Mixing time, s	30	
Mixture filling time, s	30	
Usage recommended temperature, °C	18-23	

Required components and materials

PUR mixture preparation

1. PUR liquid components:
 - Component A (polyole with penthane) in plastic bottle
 - Component B (isocyanate) in plastic bottle

1. Open both plastic bottles containing the liquid PUR components.

Decant Component A (polyole with penthane) to the bottle containing Component B (isocyanate) completely, taking care not to spill Component A (Fig. B12.1).

Attention! Care must be taken when handling the PUR liquids and appropriate protective clothing, gloves, eye protection and a respirator must be worn at all times.

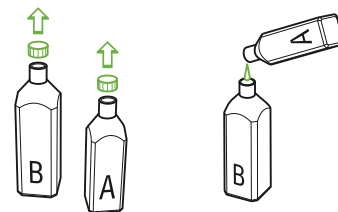


Fig. B12.1

2. Close the bottle containing both liquids with the cap. Mix the two components by vigorously shaking the bottle for 30 seconds (Fig. B12.2).

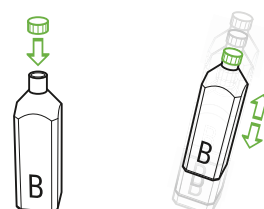


Fig. B12.2

3. Pour the mixed liquids into the hole in the casing joint sleeve (Fig. B12.3).

Attention! To prevent the foaming process taking place inside the mixing bottle, the liquid must be poured within 30 seconds after mixing has been completed.

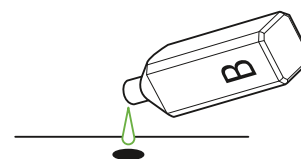


Fig. B12.3

B12.1. Insulating Casing joints with Insulation Shell

Process of insulating illustrated by an example of T-Branch

Required components and materials

1. Insulation Shell T-Branch
 - Bottom half shell - 1 pcs;
 - Upper half shell - 1 pcs;
 - Sealing ring - 3 pcs ;
 - Collar - 1 pcs ;
 - Side locking set - 1 psc;
 - Cap with air vent - 3 pcs
2. PUR liquid components.

Required tools

1. Wiper.
2. Alcohol cleaning wipes

Preparation

Position the sealing rings over the outer casing of the connecting pipes with the wider part of ring facing towards the connection (Fig. B12.1.1).

Attention! These sealing rings must be put in place before the service pipe connector is fitted.

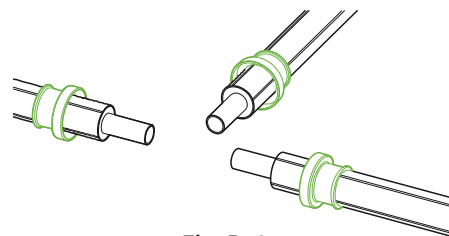


Fig. B12.1.1

Installation of Insulation Shell T-Branch

1. Place the bottom half-shell under the installed FibreFlex Press T-Branch (Fig. B12.1.2).

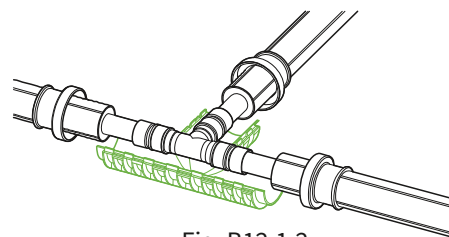


Fig. B12.1.2

2. Place the upper half-shell above the FibreFlex Press T-Branch, ensuring that the locking plugs along the adjoining surfaces of the half-shells fit each other (Fig. B12.1.3). For ease of installation, the outer locking plugs are made longer than the others.

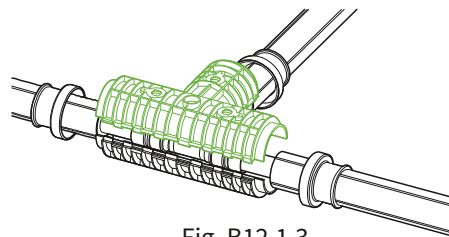


Fig. B12.1.3

3. Join the half-shells by clicking all locking plugs (Fig. B12.1.4).

Attention! It is recommended to press the locking plugs from outside to inside.

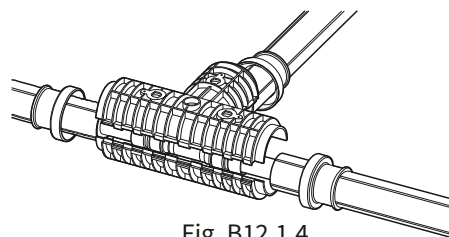


Fig. B12.1.4

4. Clean casing pipe around the ends of the Insulation Shell and the inner surface of the sealing rings - ensuring that they are free from dust and dirt.
When clean, pull the sealing rings over the ends of the Insulation Shell (Fig. B12.1.5).

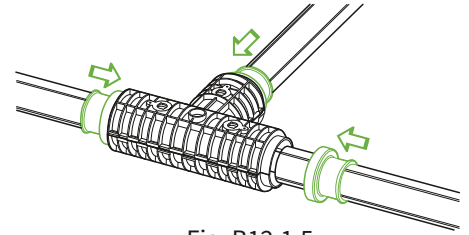


Fig. B12.1.5

5. Fix the sealing rings onto the Insulation Shell ends with collars that are joined by a latching system (Fig. B12.1.6).

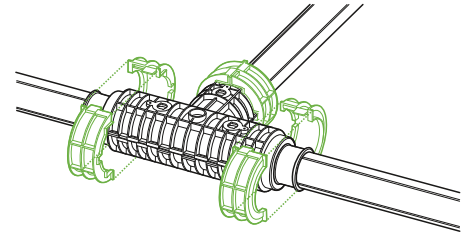


Fig. B12.1.6

6. Secure side-locking clips around the perimeter of the Insulation Sleeve (Fig. B12.1.7).

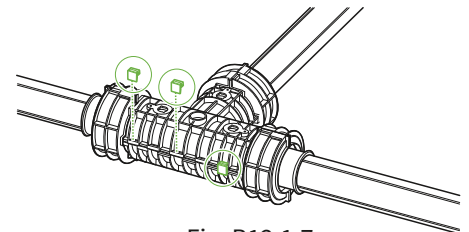


Fig. B12.1.7

Insulation of connection

7. Determine which of the three holes for PUR mixture is at the highest point as this will be left open (Fig. B12.1.8). Close the two remaining holes with caps - ensuring that the air vents are closed.

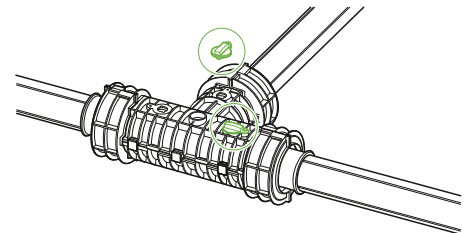


Fig. B12.1.8

8. Prepare the PUR foam mixture, carefully following the instructions in Paragraph B12. Pour the PUR mixture inside the half-shell sleeve (Fig. B12.1.9), using the open hole identified in step 7.

Attention! Use respirator, working gloves and protective glasses during work with the PUR mixture.

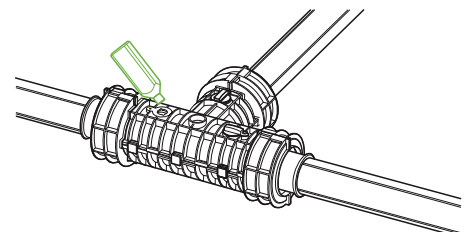


Fig. B12.1.9

9. Close the filling hole with a cap, ensuring that the air vent hole remains open (Fig. B12.1.10).

Attention! Double-check that the air vent remains open.

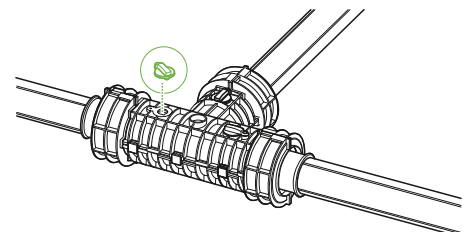


Fig. B12.1.10

10. Wait approximately 10 minutes for the PUR foaming and curing. Close the air vent with rubber cap (Fig. B12.1.11).

Attention! The speed at which the chemical reaction between the two foaming liquids takes place will vary according to the ambient temperature. In warmer temperatures, the reaction time is shorter.

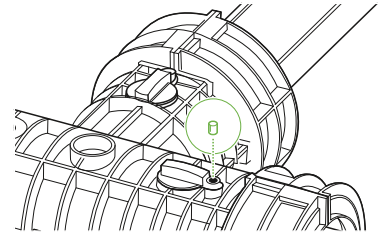


Fig. B12.1.11

B12.2. Sleeve Heat Shrink Installation

Required components and materials

1. Sleeve Heat Shrink set:
 - heat shrink sleeve - 1 pcs;
 - heat shrink band - 3 pcs;
 - plug - 1 pcs;
 - adhesive band - 1 pcs;
2. PUR liquid components - 1 pcs.

Required tools

1. Wiper.
2. Alcohol cleaning wipes.
3. Abrasive paper.
4. Tape measure.
5. Marker.
6. Gas burner.
7. Drill driver with 23mm drill bit.
8. Air pump with pressure gauge.
9. Pump adapter plug.
10. Soapy water solution in a spray bottle.

Preparing actions

1. Before the service pipe compression connection is made, slide the heat shrink sleeve with heat shrink bands over the pipe outer casing (Fig. B12.2.1), ensuring that the joint area is clean and free from dust and dirt.
Attention! Do not remove the protective foil from the Heat Shrink Sleeve and heat shrink bands before installation.

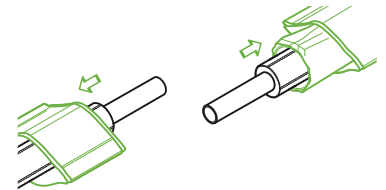


Fig. B12.2.1

Installation of Heat-Shrink Sleeve

2. Lightly roughen the surface of the outer casing ends using abrasive paper for a minimum length of 200 mm from the end of the outer casing on both pipes. Clean this surface with alcohol wipes.

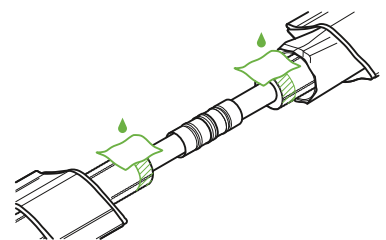


Fig. B12.2.2

3. Position the heat shrink sleeve over the middle of the joint area and mark its position on the outer casing of each pipe (Fig. B12.2.3).

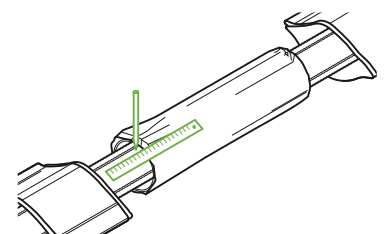


Fig. B12.2.3

4. Remove the protective foil (not transparent) from the adhesive bands. Wrap them around the entire circumference of the outer casing between the marked lines and outer casing ends on both pipes (Fig. B12.2.4).

Attention! Do not remove the transparent protection foil from adhesive bands.

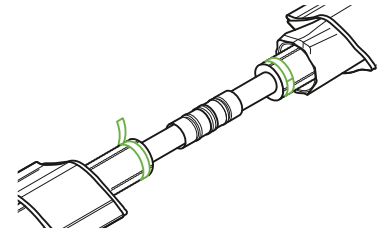


Fig. B12.2.4

5. Remove protection foil from the sleeve (Fig. B12.2.5). Slide the Heat Shrink Sleeve over the joint area, aligning it with the previously marked lines from step 3.

The inner surface of the Heat Shrink Sleeve should be clean and dry.

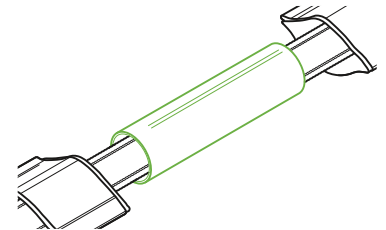


Fig. B12.2.5

6. Shrink the sleeve down with the use of a gas burner, moving the flame from the middle to the ends of the sleeve all around the pipe circumference (Fig. B12.2.6).

The distance between the gas burner and the Heat Shrink Sleeve should be around 100-150 mm.

The gas burner flame has to be adjusted according to weather conditions:

- when it is not windy and the ambient temperature is above +5°C, the use of a yellow-coloured flame is recommended;
- when it is windy and/or the ambient temperature is below +5°C, the use of a blue-coloured flame is recommended.

After shrinking, the sleeve must tightly fit both pipe ends.

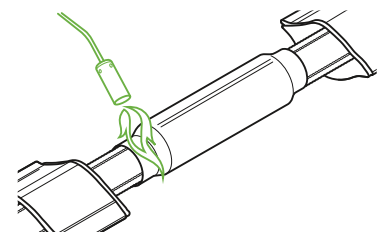


Fig. B12.2.6

7. Lightly abrade the ends of the sleeve and the outer casing with abrasive paper for a minimum length of 150 mm in both directions (Fig. B12.2.7). Clean this area with alcohol wipes.

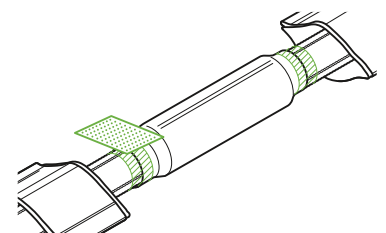


Fig. B12.2.7

8. Position the heat shrink band so that its centre is directly over the end of the Heat Shrink Sleeve (Fig. B12.2.8). Remove the protective foil from the inner surface of the heat shrink band.

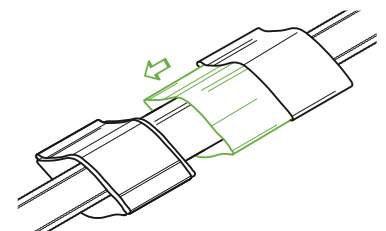


Fig. B12.2.8

9. Using a gas burner, shrink down the heat shrink band, ensuring that the flame is moving continuously - evenly heating around its circumference (Fig. B12.2.9). It is important to keep the flame moving to prevent localised overheating. The distance between the gas burner and heat shrink band surface should be around 100-150 mm. Repeat the same steps to shrink down the second band.

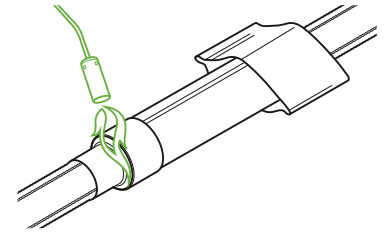


Fig. B12.2.9

Heat insulation

10. Mark a dot in the top middle of the Heat Shrink Sleeve (Fig. B12.2.10).

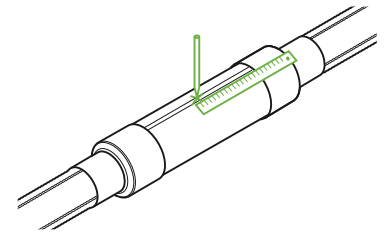


Fig. B12.2.10

11. Drill a 23 mm diameter hole in the area marked for filling the sleeve with PUR (Fig. B12.2.12).

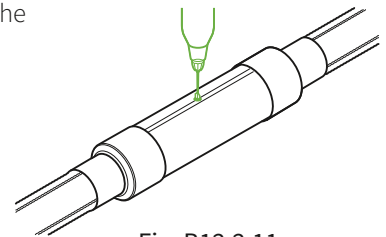


Fig. B12.2.11

12. Spray soapy water solution around the joint areas. Connect the air pump adaptor with pressure gauge into the hole drilled in step 11 and connect the air pump (Fig. B12.2.12). Pump the air pressure in the sleeve up to 0.3 Bar, and visually inspect all joint areas for soap bubbles appearing. If necessary, spray additional soapy water solution. If bubbles appear, the Heat Shrink Sleeve joint is not sufficiently tight. To fix this, remove the air pressure from the joint and apply additional heat to the heat shrink band. Repeat the pressure test process to verify that the joint is tight. If a leak still remains, heat shrink jacket repair bands can be used. Repeat the air pressure test to verify joint tightness.

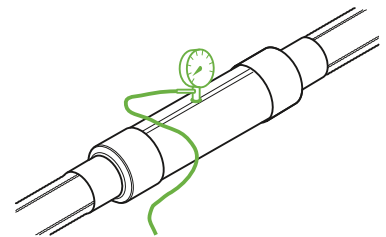


Fig. B12.2.12

13. Carefully mix the PUR liquid components (follow the instruction on Paragraph B12, ensuring that all of the safety equipment is used). Carefully pour the mixed liquids into the hole in the Heat Shrink Sleeve (Fig. B12.2.13).

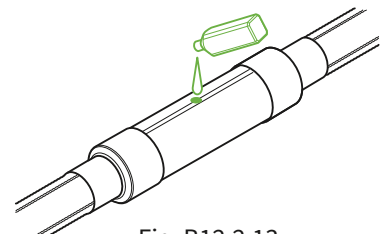


Fig. B12.2.13

14. Insert the sleeve venting plug into the hole (Fig. B12.2.14). Wait for 15 to 20 minutes. After a small amount of foam has appeared in the venting plug, wait for an additional 30 minutes.

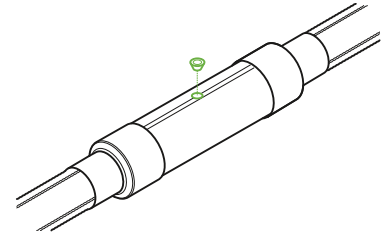


Fig. B12.2.14

15. Cut the dried foam from the sleeve with a knife. Lightly abrade the middle 150 mm section of Heat Shrink Sleeve, ensuring all of the pipe's circumference is prepared (Fig. B12.2.15). Warm up the prepared area using a gas burner.

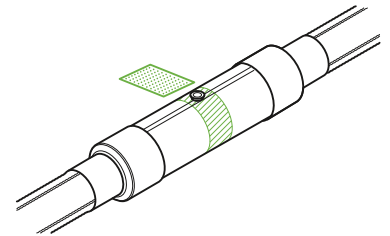


Fig. B12.2.15

16. Position the heat shrink band directly over the prepared section of pipe around the plug (Fig. B12.2.16). Remove the protective foil from the inner surface of the heat shrink band.

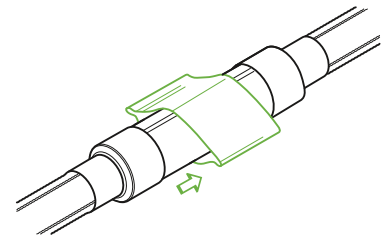


Fig. B12.2.16

17. Using a gas burner, shrink-down the heat shrink band in the same way described in step 6 (Fig. B12.2.17).

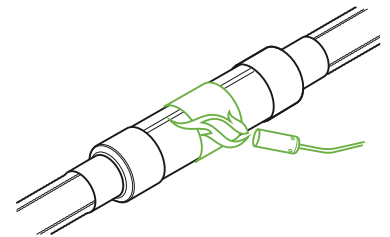


Fig. B12.2.17

B13. Pressure Test Recommendations

General

Pressure test is a mandatory service which must be performed for any installed or maintained pipe system before the pipe system operation starts.

To insure leak-proof of connections, it is strongly recommended to perform a pressure test before all the fittings are insulated.

For Radius-Kelit flexible pre-insulated plastic pipe systems (KELIT PEX, FibreFlex, FibreFlex Pro) pressure test shall be conducted according to DIN 1988 part 2.

The pressure test consists of two parts: preliminary test and main test.

Preliminary test

In the preliminary test, the pressure of 1.5 times of maximum operating pressure is applied to the examined pipeline three times with a period of 10 minutes between peaks and after the last peak. Due to plastic pipe expansion from the applied pressure and temperature, the pressure in the pipe system will gradually fall after each peak. 10 minutes after the third pressure peak, the pressure drop during the following 30 minutes should be measured. During this preliminary test the pressure drop shall not exceed 0.6 bar.

No leakage of pipe connections shall be observed during the preliminary test.

Main test

The main test must be carried out immediately after the preliminary test. The pressure drop during the following 120 minutes (2 h) shall be measured and this pressure drop shall not exceed 0.2 bar.

No leakage of pipe connections shall be observed during the main test.

Note: Local pressure test requirements may differ from the pressure test procedure described above.

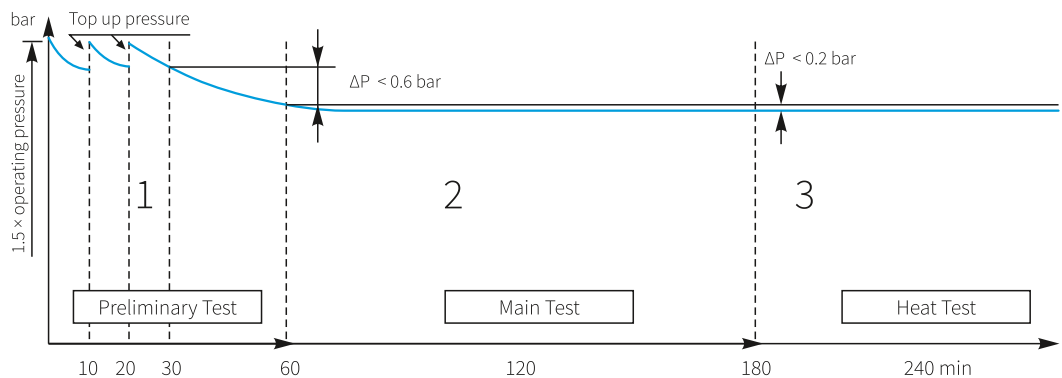


Fig. B13.1

Notes



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