

# A trenchless installation procedure with optimum connections for PE pipes - Compact Pipe



*The Compact Pipe® polyethylene (PE) pipe system is manufactured in Germany and has been in use around the world for three decades. In Europe, special delivery of the 3.70 m large drums can be accomplished by road. For overseas customers, such deliveries take place using high-capacity containers shipped to Wavin Compact Pipe® licensees. The same requirements apply for installation anywhere in the world. The Aliaxis Deutschland GmbH range of polyethylene fittings complements the system and provides all the necessary connections for sewer laterals and pressure-pipe joints. The company investigated flexible connecting systems as long ago as the 1990s and now supplies a wide range of fittings. PE is already very well established and is used in both pressure and gravity sewer pipe applications. In trenchless applications, the overall "pipe and fitting" system examined here is capable with known reliability of meeting a requirement for a service-life of 100 years.*

## What is Close-Fit?

The principle is that there remains only a minimal annular gap between the liner and the original pipe after installation. High-density polyethylene (HDPE) pipes, which are shaped into a "C" immediately after production, while still hot, are used (**Figure 1**). The pipes are then wound on drums for transportation to the installation sites. Shaping into a "C" significantly reduces the cross-section of the pipe, making it possible to pull it into the existing pipe. Pulling is done using rope-winches.



**Figure 1:** PE liner ready for installation, mounted on drums for transportation

## Compact Pipe®

After pulling-in, the PE liner is heated using hot steam, and the so-called "memory effect" is activated – the liner "remembers" its original geometry and "rounds off" to its previous circular cross-section.

The application of heat then causes additional expansion of the PE pipe. Stabilising cooling under internal pressure completes the installation process. The original external pipe functions in this context as a casing or as "formwork", with the result that the internal PE pipe then remains tightly fitting (Close-Fit) inside the original pipe.

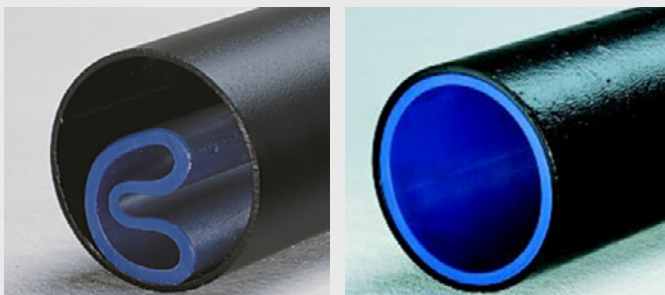
Due to the installation process, external diameters which diverge from the familiar standards for PE pipes result. Fittings for various purposes in connection systems are described below.

First, the pipe section to be rehabilitated is taken out of operation. The dimensions of the necessary insertion pit and reception pit are determined by the space requirements for the joining work within nominal diameters of between DN 150 and DN 500, complete with the necessary working space.

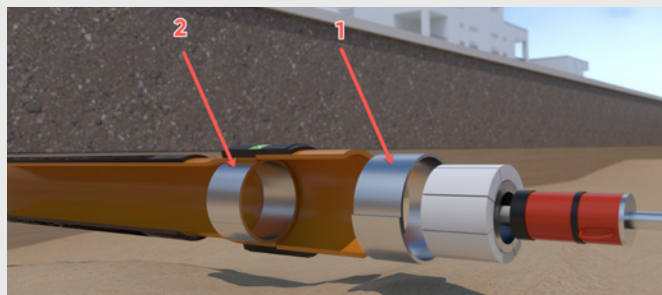
Small middle pits (so-called header pits) are made in pipe sections featuring branches and service/sewer laterals. Their dimensions also vary according to the space required for connecting work. After cutting out of the old pipe sections, inner pipe edges must be deburred and a chamfer applied.

The execution of changes of direction and bends in many cases do not conform to as-built records. After cleaning and calibration of the existing pipe, these areas must be inspected. Compact Pipe® can be installed into the following changes of direction:

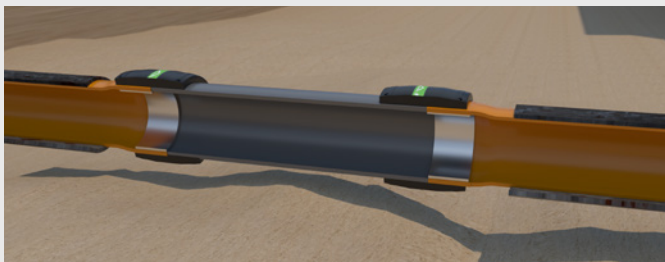
- » < 22.5° with no restrictions
- » < 45° with min. radius of old pipe = 5 x DN Compact Pipe®
- » < 90° with min. radius of old pipe = 8 x DN Compact Pipe®



**Figure 2:** The Close-Fit principle



**Figure 4:** Installation of support sleeve using expander, with REM relining coupler



**Figure 3:** UB couplers with no inner stop, with support sleeves and PE-pipe fitting piece in accordance with standard



**Figure 5:** Temporary support using expander during fusion

These points must be removed in case of excessively tight radii and/or misalignments in the original pipe. Here, too, inner pipe edges must be deburred and a chamfer applied. During pulling-in, the Compact Pipe® passes through the open pipe sections of the insertion pit, receiving pit and intermediate shafts. Casings are fitted to these sections during reversion to original cross-section. After removal of the casings, connecting work on the Compact Pipe® can be accomplished or the Compact Pipe® remains like a conventional PE pipe in the soil bedding.

A sand bedding is recommended for all back-filling work on the open pipe sections, both with and without PE connecting fittings.

### Jointing technology

It is possible to differentiate in principle between two types of connection. Selection of the coupler depends on the size of the PE liner. If the external diameters are extremely close to standardised PE external diameters (DN 200, 225, 250, 280, 350, 400, 500), couplers with no SDR 11/17 (UB) inner stop can be used (**Figure 3**). If the differences are greater (DN 150, 175, 300), the relining transition coupler SDR 17 (REM) should be selected (**Figure 4**). In both cases, the liner is then rounded off again and kept at this dimension by means of expanders and support sleeves.

Both UB and REM feature separate, so-called bifilar fusion zones. In practice, these are what make possible the types of connection described above (**Figure 5**, **Figure 6**). Both couplers also feature a pre-heat technology which assures that the gaps between the pipe and the coupler are reduced. A positive effect is initiated when the PE pipe is heated and expands radially. A uniform minimal gap is generated and assures optimum fusion results.

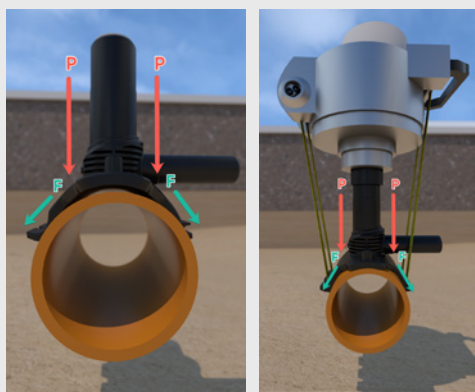


**Figure 6:** REM relining transition coupler d 110 / DN 100 with pre-heat barcode. Sizes d 160 / DN 150 and d 315 / DN 300 have the same structure and are also available.





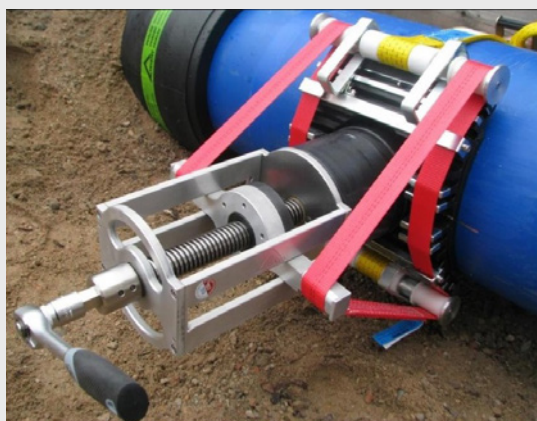
**Figure 7:** FIXBLOC clamped in position during fusion



**Figure 8:** The top-loading principle



**Figure 9:** Clamping of RED SNAP and top-loading compared



**Figure 10:** Clamping of SA UNI using the UNITOP clamping unit

### **Fixing using FIXBLOC**

After installation, the PE liner is able to move axially as a result of temperature differences and may be drawn into the old pipe. This can be countered by the FIXBLOC fixation attached to the PE liner to assure simple and reliable fusion. Thanks to its compact design and large fusion zone, high tensile and shearing forces of up to 40 kN can be absorbed. FIXBLOC can be installed very easily using commercially available tension belts, after which a suitable fusion unit, such as the FRIAMAT, for example, can be used for fusion (**Figure 7**). The number of fixings necessary depends on the manufacturers' (e.g. Compact Pipe®) specifications.

### **Connections to the PE liner**

The PE liner adapts to fill the existing cross-section of the old pipe. The external diameters thus diverge from the standardised external diameters for PE pipes. For this reason, commercially available fittings, valves and saddle elements cannot be positioned on the PE liner without further consideration, since they are all designed for use with standardised dimensions (in accordance with DIN 8074, for example).

Special clamping systems make it possible to solve these challenges in a professional manner. A defined force is applied to the fitting centrally and from above until it contacts with the PE liner with no gap and is geometrically locked (**Figure 8**). Thanks to its great flexibility, the PE fitting can also adapt to any ovality of the liner. The RED SNAP quick-release mechanisms should be previously removed when using DAA RED SNAP pressure tapping tees and DAV RED SNAP pressure tapping valves. This can be done very easily with a single movement of the hand. This "lower clamp element" is replaced with the tension belt of the FRIATOP clamping unit in the case of top-loading (**Figure 9**).

This principle functions reliably provided the "smaller" fitting is used for clamping, e.g. DAA d 140 on a d 150 PE liner. The fitting is sufficiently flexible and remains stress-free (without clamping) on the PE liner after fusion. Larger saddles make it possible to avoid T-piece joints. They are installed, depending on the main pipe and branch dimensions, using the UNITOP clamping unit or using the vacuum system (VL) (**Figure 10, Figure 11, Figure 12**).

### **Current projects**

The Compact Pipe® procedure can be used in the rehabilitation of gas, water and waste-water pipes. A few examples are shown below:

Gas: In Berlin-Spandau, Stehmeyer & Bischof GmbH & Co. KG installs Compact Pipe®, for example, using DN 500, PE 100 material. This is a Close-Fit installation for NBB Netzgesellschaft Berlin-Brandenburg mbH & Co. KG (**Figure 3, Figure 13, Figure 14**). Water: MAX BÖGL has installed for Stadtwerke München (SWM) Compact Pipe®, for example, in various nominal diameters. PE 100-RC materials were used. The only slight restrictions for local residents and traffic were greatly appreciated (**Figure 15**). Wastewater: DIRINGER & SCHEIDEL Rohrsanierung GmbH & Co. KG is performing sewer rehabilitation work using the Compact Pipe® procedure for the City of Willich, for example. Connection to the new PE manholes is accomplished using an expander (**Figure 5**).

Further interesting references for pressure-line and sewer rehabilitation projects are featured by RSC ROHRBAU UND SANIERUNGS GMBH COTTBUS, Geiger Kanaltechnik GmbH & Co. KG and Ludwig Pfeifer Rohr- und Kanalsanierung.

There are over 30 licensed contractors for Wavin Compact Pipe® all over the world. The procedure requires extensive equipment, including a steam-boiler and control units.

### Conclusion / Prospects

PE Close-Fit liners have come increasingly into use in recent years. The benefits are readily apparent:

- » Extremely short installation times with little underground work, relieving the burden on local residents and motorists. General reduction in consumption of resources.
- » PE liners with standard-conformant materials properties are manufactured in the maker's plant and installed in accordance with the manufacturer's specification.
- » PE liners with standard-conformant materials properties are manufactured in the maker's plant and installed in accordance with the manufacturer's specification. PE 100, PE 100 (RT - raised temperature) and PE 100 (RC resistance to cracking) are available.
- » Extremely long service-lives of up to 100 years.
- » Complete range of fittings available, covering all practical requirements. A homogeneously welded PE piping system with no plug-in connections is thus achievable.
- » Pressure-pipe approved materials for PE liners and fittings.

For further information email  
[info@publicsewerservices.co.uk](mailto:info@publicsewerservices.co.uk)

or give us a call on 0800 252663

**Public Sewer Services Limited**  
Rochehall Way  
Rochford  
Essex SS4 1JU



Figure 11: SA UNI with a d 160 / DN 150 flange



Figure 12: Vacuum-clamped SA VL



Figure 13, Figure 14, Figure 15