

8 Joining

8.1 General

In planning and installing PE pipe systems, the planning and/or installation organisations can select a series of different joining techniques. The nature of the load, the type of installation, the economics and the local conditions have large influences on the choice of appropriate connecting method. The nature of the pipe connection can have lasting positive and negative consequences for the manufacturing costs of a pipe system. Criteria for selecting the most appropriate joining technique are:

- operational reliability
- accessibility
- level of sealing
- effects of the medium to which it will be exposed
- cost outlay
- internal pressure load of the pipe system

The planner and fitter of plastic pipe systems can choose between a detachable and non-detachable connecting technique. Various procedures are available for possible solutions. The detachable connection contains elements that generally enable non-destructive disassembly and re-assembly without large additional expense.

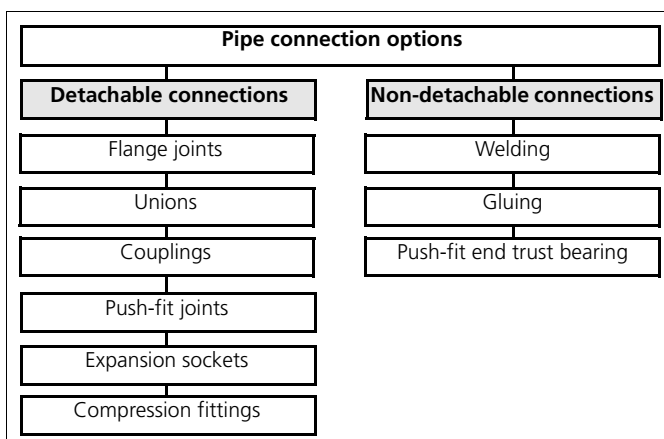


Figure 8.1 Detachable and non-detachable pipe connections

8.2 Detachable connections

8.2.1 General

In general, the group of detachable connecting elements for PE pipe systems consists of:

- flanges
- push-fit connections
- unions
- compression fittings

The individual joining techniques in this group will be discussed below.

8.2.2 Flange joints

Connections to such components as pumps or valves are normally made by means of flange joints. The elements of the flange joint used in plastic pipe construction are the stub flange, backing ring, gasket and bolts with washers (possibly lock washers) and hex nuts. Flange joints can be either backing ring connections or blind flange joints. A blind flange joint is usually used to seal the end of a pipe. The fixed flange variant is generally ruled out due to higher costs. A backing ring connection is, in most cases, the substantially less expensive variant whenever a direct comparison is made, and therefore fixed flange joints are only of limited significance in the choice of flange joints.

The backing rings used as connecting elements in the plastic pipe construction are constructed from metal materials (e.g. steel, aluminium), fibre glass reinforced plastic or a combination of plastic and metal. The ease of assembly involved in their use and especially the higher operating reliability give backing ring connections definite advantages over fixed flange joints.

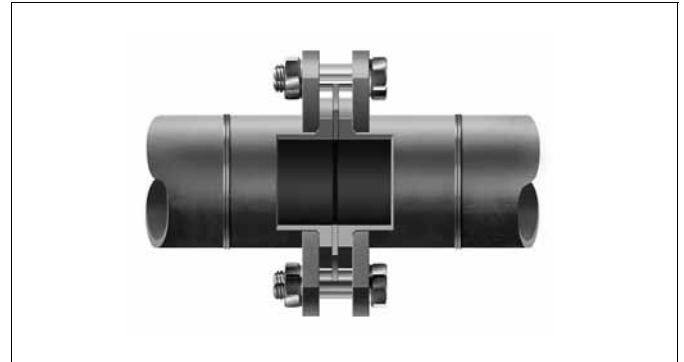


Figure 8.2 Flange joint

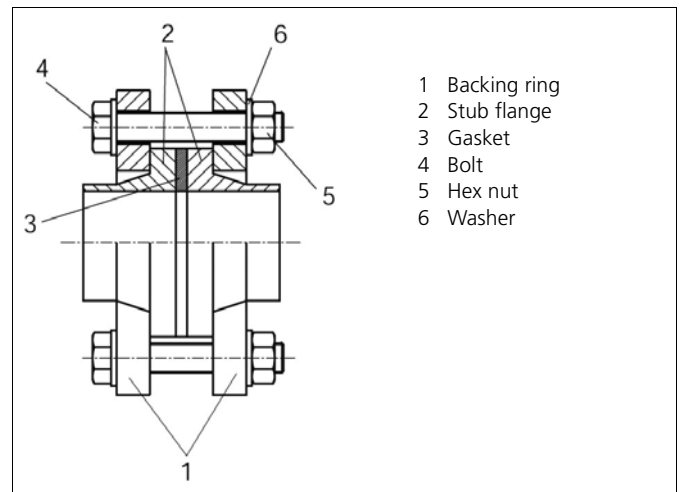


Figure 8.3 Cross-section of a flange joint

The gasket, nearly always in the form of a flat ring gasket, is available in various material and material qualities. Use is often made of gaskets composed of elastomers or elastomer compounds, such as neoprene, hypalon or viton. Hard gaskets have proven to be less suited or even unsuitable on account of their limited formability. The use of elastomer flat gaskets without steel inlays frequently results in leakage at higher internal pressures (e.g. during pressure testing). It is therefore recommended for use to be made of armoured gaskets with a convex cross-section. Their use is especially advisable when the internal pressure (operating pressure) comes close to the pipe's pressure rating. An additional improvement in the level of sealing is obtained when the inside of the gasket has the form of an O-ring. O-rings, double chamber gaskets, etc. are to be used in cases involving high internal pressures, especially when vacuums are involved as well. Gasket sizes are to be chosen so that the inside pipe diameter is not reduced by any excess gasket material, or that fissures can occur allowing fluid to penetrate the seal (with risk of sedimentation in the fissure!). During assembly, care must also be taken to ensure that the bolts are tightened evenly and the gasket and sealing surfaces are clean. Table 8.1 shows the standard values for the bolt torques in flange joints.

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Standard bolt torques in flange joints of thermoplastic pipes (DVS 2210 Part 1)

d _e (mm)	DN (mm)	Bolt tightening torque (Nm)		
		Flat ring gasket (p _{acc} ≤ 10 bar)	Profile gasket (p _{acc} ≤ 16 bar)	O-ring gasket (p _{acc} ≤ 16 bar)
20	15	15	10	10
25	20	15	15	15
32	25	15	15	15
40	32	20	15	15
50	40	30	15	15
63	50	35	20	20
75	65	40	20	20
90	80	40	20	20
110	100	40	20	20
125	100	40	20	20
140	125	50	30	30
160	150	60	40	35
180	150	60	40	35
200	200	70 ⁽¹⁾	50	40
225	200	70 ⁽¹⁾	50	40
250	250	80 ⁽¹⁾	55	50
280	250	80 ⁽¹⁾	55	50
315	300	100 ⁽¹⁾	60	55
355	350	100 ⁽¹⁾	70	60
400	400	120 ⁽¹⁾	80	65
450	500	190 ⁽¹⁾	90	70
500	500	190 ⁽¹⁾	90	70
560	600	220 ⁽¹⁾	100	80
630	600	220 ⁽¹⁾	100	80

⁽¹⁾ for p_{acc} ≤ 6 bar

Table 8.1 Bolt tightening torques for flat, profile and O-ring gaskets

8.2.3 Push-fit connection

A push-fit connection is the general name given to all spigot and socket connections. The push-fit socket to be used will be explained in the following section.



Figure 8.4 Push-fit spigot

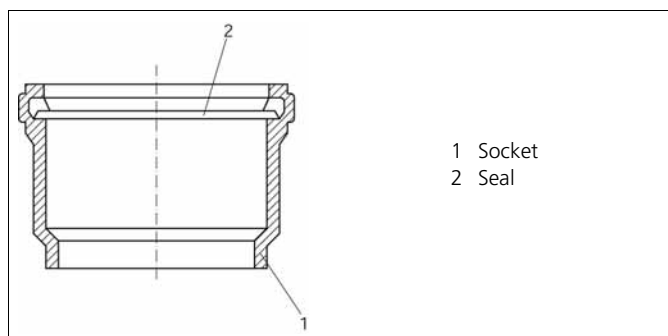


Figure 8.5 Cross-section of a connection with a push-fit socket

Push-fit and expansion sockets

The leak-tightness of a pipe connection with a push-fit and/or expansion socket is essentially achieved by applying the forces of a sealing element to the connecting pipe and/or fitting. In addition, the existing internal pressure helps to strengthen the radial sealing force. Small pipe deflections can be tolerated, as well as longitudinal movements corresponding to the distance that can be absorbed between the socket and seal seat.

Socket connections should only be used in pressure applications involving pipe systems that are free of underpressure. In principle, use is to be entirely avoided in pipe systems subject to internal pressure and another joining technique chosen.

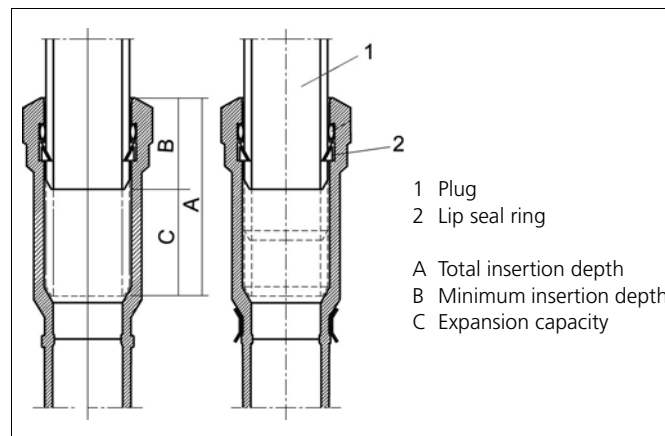


Figure 8.6 Functional principle of the expansion socket

8.2.4 Unions

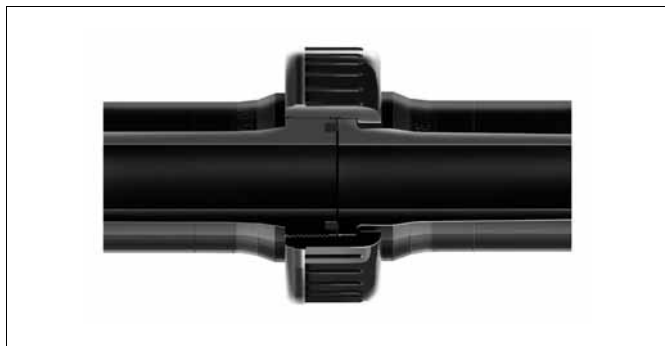


Figure 8.7 Screw-thread joint

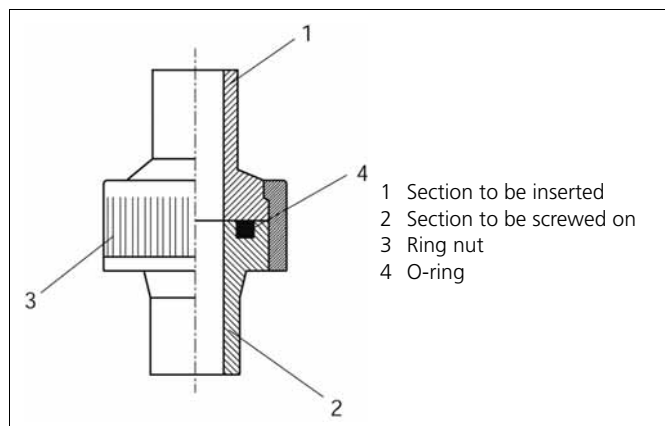


Figure 8.8 Cross-section of a union

These types of connecting elements are used in water lines as well as in transitions from plastic to other materials. The ease of assembly make them an especially valued connecting technique for small pipe sizes. Temperature effects can restrict application in pipe systems due to the flow behaviour of plastic. Each application must be carefully tested.

8.2.5 Compression fitting

Compression fittings are used to connect pipes in a quick and easy manner. A pressure chamber contains a sealing ring. Screwing in the fitting causes the sealing ring to be clamped against the pipe. NBR O-rings are used to connect the PE pipes. Special compression rings can be adopted to connect PE pipes with other types of material, such as PVC-U, PVC-C, PP, PE-X copper, lead and steel. Compression fittings are used in swimming-pool systems, for (drinking) water distribution, irrigation and telecommunications as well as in the mining industry and horticulture.

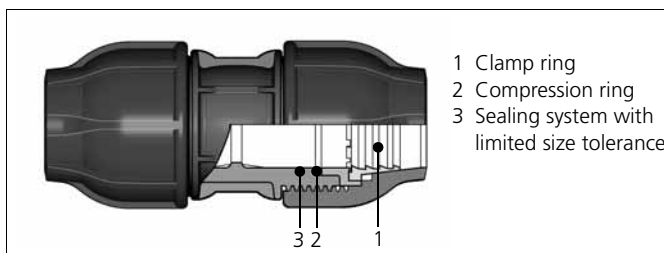


Figure 8.9 Compression fitting

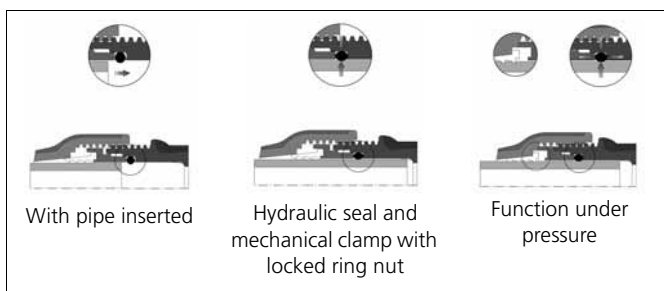


Figure 8.10 Compression principle

8.3 Non-detachable connections

8.3.1 General

Non-detachable joining techniques are the most commonly used connection techniques in PE pipe construction. Welding is an extremely important form of connection used for PE fitting in plastic pipe construction. For this reason, welding has been made the focus of this Specification Manual and, on account of its importance, will be discussed in a separate chapter.

8.3.2 Welding

Welding has a special significance in pipe installation as well as in the production of PE shafts, tanks and special welded components. Many of the welding techniques described in chapter 9 are based on the principles in the DVS guidelines and have been adopted either directly or in analogous forms.

8.3.3 Gluing

Up to now, gluing has not been used in PE pipe construction. The characteristics of the plastics in question (polyolefin) make them unsuitable for glued connections (due to their "waxiness"), as their surfaces are not softened by adhesives. Special multi-component adhesives allow only limited connections to be formed that cannot be subject to mechanical loads and that are technically insignificant.

8.3.4 Push-fit socket end thrust bearing

Push-Fast is a unique spigot and socket type water joining system, which combines the benefits of PE pipe with the ease of conventional push-fit joints. Unlike most spigot and socket type systems, Push-Fast has a specially designed and patented socket, which incorporates a tough thermoplastic 'grip' ring located in a tapered groove. This allows the joint to resist end-thrust generated by the internal pressure and eliminates the need for anchors or thrust blocks.



Figure 8.11 Section through assembled Push-Fast Joint showing grab ring and sealing

Push-Fast heads can easily be butt-welded to pipe lengths and coils. It is quick and easy to install. Suitable for underground pipe systems in subsidence areas and to limited space installation. The pipe system is immediately serviceable after assembly.

The performance of the Push-Fast joint depends on the efficiency of the seal between the elastomeric sealing ring, the pipe and the socket. Damage to the pipe or fittings or the presence of dirt or grit will adversely affect the performance of the joint.

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8.4 Chapter summary

Connection method	In plastic pipe construction, there are two types of connecting techniques: detachable and non-detachable.
Detachable connection technique	Detachable connections can be easily disassembled and re-assembled without destroying the connection.
Non-detachable connection technique	Disassembly usually involves destruction of at least one of the connecting elements.
Flange connections	Can be fixed or backing ring connections. Backing ring connections consist of the components: stub flange, backing ring and gasket. A combination of stub flange, backing ring, blind flange and gasket can be used to seal pipes. At higher loads, backing ring connections are preferable to fixed flange connections.
Seals	Seals are needed to seal connections between two connecting elements. In the flange connections used in plastic pipe construction, flat gaskets (with and without steel inlays) and O-rings are mostly used. The material of the seal is adaptable to the flow medium.
Push-fit and expansion sockets	These are simple detachable connections. However, they should only be used in pressureless (under and overpressure free) pipe systems. They are therefore appropriate for pressureless drainage and/or sewerage systems.
Unions	Unions are quick connection devices. They are detachable connections and enable simple assembly, disassembly and re-assembly without special implements and tools.
Welding	Welding is one of the most commonly used joining techniques in plastic pipe construction. Various plastic welding procedures are used to manufacture fittings from pipes and pipe segments, joints made of pieces of pipe, as well as plastic shafts, tanks and other special components. Welding processes non-detachable connection techniques.
Gluing	Gluing is only very conditionally meaningful and possible as an appropriate joining technique for polyolefin materials. A bond is produced only with special multi-component adhesives. These glued connections are not at all capable of withstanding mechanical loads.
Push-fit socket end thrust bearing	Plug and socket type water jointing system with push fit joints. A tough thermoplastic 'grip' ring located in a tapered groove allows the joint to resist end-thrust. It is quick and easy to install. No anchors or thrust blocks required. Suitable for ground subsidence areas and to limited space installation. Immediately serviceable.