

## Joining of polyethylene pressure pipes for below ground water applications

### Background

Polyethylene pressure pipes for water and gas applications can be joined by one of three methods: electrofusion, butt fusion or mechanical fittings (including flanges).



**Electrofusion**



**Butt fusion**



**Mechanical fitting**

The advantages of an integrated, end-load resistant system are best achieved by fusion welding carried out by skilled operatives. However, there are some circumstances where mechanical joining is more suitable.

**The BPF Pipes Group has prepared this short guide to identify the preferred method of joining for a range of applications, together with the reasoning for that recommendation and any suitable alternatives.**

### Electrofusion

Electrofusion fittings for use with polyethylene pipe (to BS EN 12201-1) in water supply and sewerage systems under pressure are manufactured to BS EN 12201-3. They have sockets that incorporate electrical heating wires which, when connected to the appropriate power source, fuse the fittings into the pipe without the need for additional heating equipment. Made correctly, electrofusion joints provide a fully end-load resistant system.

### Butt fusion

Polyethylene pipes and fittings can be joined using electrically heated plates to fuse the surfaces together. To ensure reliable welds, butt fusion should only be used to join pipes of the same diameter / thickness and polyethylene grade. Made correctly, butt fusion joints provide a fully end-load resistant system.

WIS 4-32-08: Issue 4 specifies the equipment and jointing procedures for fusion welding of PE pipes and fittings. It is strongly recommended that WIS 4-32-08 is used for all fusion jointing to provide consistent and good quality workmanship.

### Mechanical fittings

Mechanical fittings can be used to join polyethylene to polyethylene, or polyethylene to other pipe materials. Compression of the fitting onto the pipes is normally achieved by mechanical tightening of bolts or compression rings and sealing against water pressure is accomplished by elastomeric seals or gaskets.

Mechanical fittings for use with polyethylene pipe (to BS EN 12201-1) in water supply and sewerage systems under pressure are manufactured to BS EN 12201-3. Fittings for connection to ductile iron pipe need to meet the requirements of BS EN 14525. Most mechanical fittings for polyethylene pipe are designed such that the end load which can be resisted by the joint is greater than that maximum axial forces assumed to be acting on the joint in service (i.e. Type 2 as defined by IGN 4-01-02). A fully end load resistant system can be offered by flanges or specialist products (i.e. Type 1 as defined by IGN 4-01-02).

### Selection of joints

Each of the three jointing methods can provide long-term, leak tight, solutions.

**The table below highlights the best solution for any given condition.**

To successfully realise the benefits in the table, it is strongly recommended that jointing be carried out by suitably trained operatives following best practice set out in the Plastic Pipes Liaison Group’s paper [“Practical Steps to Achieving Zero Interruptions, Zero Leaks”](#). Guidance can always be sought from manufacturers or the BPF Pipes Group on specific situations.

Pipe: New pipe to BS EN 12201-1 (PE100 - PE 100 or PE80 - PE80) Installation: Open Cut Trench			
Pipe size (Nominal Diameter)	Preferred method of joining	Reason for preference	Acceptable alternatives
20 - 63	Electrofusion	Long term reliability of joint and speed of assembly	Mechanical
75 - 180	Electrofusion	Long term reliability of joint and speed of assembly	Mechanical Butt Fusion
180 – 315	Electrofusion	Long term reliability of joint and speed of assembly	Mechanical Butt Fusion
355 - 630	Electrofusion Butt Fusion	Long term reliability of joint	Mechanical
630 - 1200	Butt Fusion	Better where pipe ovality is large	Electrofusion

<b>Pipe: New pipe to WIS 4-32-19 for laying in contaminated land</b>			
<b>Installation: Open Cut</b>			
<b>Pipe size (Nominal Diameter)</b>	<b>Preferred method of joining</b>	<b>Reason for preference</b>	<b>Acceptable alternatives</b>
20 - 63	Mechanical	Speed of assembly on service sizes, barrier maintained	Electrofusion
75 - 180	Electrofusion Mechanical	Reliability and barrier maintained	-
180 – 315	Electrofusion	Reliability and barrier maintained	-
355 - 630	Electrofusion	Reliability and barrier maintained	-

<b>Pipe: New pipe to BS EN 12201-1 (PE100 - PE 100 or PE80 - PE80)</b>			
<b>Installation: Trenchless (pull-through)</b>			
<b>Pipe size (Nominal Diameter)</b>	<b>Preferred method of joining</b>	<b>Reason for preference</b>	<b>Acceptable alternatives</b>
Up to 180	Coiled pipe (no joints)	Integrity of pipe maintained and no obstruction to pull-through	Butt fusion
Above 180	Butt Fusion	Strength of joint and no obstruction to pull-through	-
Note: joining at excavation pits / end of coils as open cut recommendations			

When connecting polyethylene pipe to ductile iron, PVC-U or steel, in any nominal diameter, the only viable solution is mechanical jointing.

### **Complementary guidance**

[Guidance on current specifications for polyethylene pipes for water supply is provided by the BPF Pipes Group.](#)

## References

**WIS 4-32-08:** Specification for the fusion jointing of polyethylene pressure pipelines systems using PE80 and PE100 materials.

**IGN 4-01-02:** The determination of end-loads for the performance testing of pipeline fittings.

All WISs and IGNs are available to download free of charge from Water UK's website (<http://www.water.org.uk/publications/WIS-IGN>).

**BS EN 12201:** Plastic piping systems for water supply and sewerage under pressure – Polyethylene (PE).

- Part 1: General
- Part 2: Pipes
- Part 3: Fittings
- Part 4: Valves
- Part 5: Fitness for purpose

**BS EN 14525:** Ductile iron wide tolerance couplings and flange adaptors for use with pipes of different materials: ductile iron, grey iron, steel, PVC-U, PE, fibre-cement.

British Standards can be purchased through BSI (<http://shop.bsigroup.com/>).