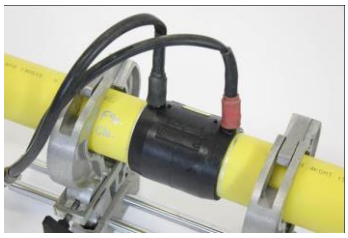
Joining of polyethylene pressure pipes for below ground gas applications

BACKGROUND

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

Butt fusion



Electrofusion

Mechanical

The BPF Pipes Group has prepared this short guide to identify the most common methods of joining for below ground gas applications across the size range 63 mm to 800 mm.

The relevant Gas Distribution Network (GDN[1]) or Independent Gas Transporter (IGT[2]) should be consulted prior to commencement of any work.

BUTT FUSION

Polyethylene pipes can be joined using electrically-heated plates to fuse pipe end 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, leaktight system.

Where spigot end fittings are to be connected to pipe by butt fusion, the fittings are specified to GIS:PL2-6 “Spigot end fittings for electrofusion and/or butt fusion purposes”.

GDNs and IGTs require that all butt fusion jointing is carried out to their policies and procedures to provide consistent and good quality workmanship. GIS:PL2-3 “Butt fusion machines and ancillary equipment” specifies the equipment and jointing procedures for fusion welding of PE pipes and fittings for gas applications.

[1] Gas Distribution Networks (GDNs) develop, operate and maintain gas transportation networks across the UK.

[2] Independent Gas Transporters (IGTs) develop, operate and maintain local gas transportation networks.

ELECTROFUSION

Electrofusion fittings have sockets that incorporate electrical heating wires which, when connected to the appropriate power source, fuse the fittings onto the end of the pipe without the need for additional heating equipment. Made correctly, electrofusion joints provide a fully end-load resistant, leaktight system.

In the UK, GDNs and IGTs currently specify electrofusion fittings to GIS:PL2-4 "Fusion fittings with integral heating element(s)". Class B fittings are suitable for polyethylene pipe systems up to 5.5 bar (GIS:PL2-2) and Class C up to 7 bar (GIS:PL2-8).

Where spigot end fittings are to be connected to pipe by electrofusion, the fittings are specified to GIS:PL2-6 "Spigot end fittings for electrofusion and/or butt fusion purposes".

GDNs and IGTs require that all electrofusion jointing is carried out to their policies and procedures to provide consistent and good quality workmanship. Electrofusion equipment is specified in GISECE/1 "Specification for electrofusion control boxes".

MECHANICAL FITTINGS

There are three main types of mechanical fittings used in the gas industry. Compression of the fitting onto the pipes is normally achieved by mechanical tightening of bolts or compression rings and sealing against gas pressure is accomplished by elastomeric seals or gaskets.

The three main types are:

1. Stub Flanges - used to connect polyethylene to metal pipes or valves.
2. Compression fittings - used to connect polyethylene to other PE or metal pipes.
3. Screw fittings such as service head adaptors and garden fittings - used to connect service pipes to property pipework.

Most mechanical fittings for polyethylene pipe are designed such that the end load which can be resisted by the joint is greater than the maximum axial forces assumed to be acting on the joint in service. A fully end load resistant system can be offered by the use of correctly specified flanges or dedicated products.

Mechanical fittings for use with polyethylene pipe in gas supply are manufactured to BS EN 1555-3 or GIS:PL3, as required.

Where mechanical fittings (e.g. spigot end fittings / stub flanges) are connected to the polyethylene pipe by butt fusion, the spigot end is specified to GIS:PL2-6, see Butt Fusion section above.

Ductile iron fittings for connection from PE to ductile iron should comply with BS EN 14525.

SELECTION OF JOINTS

Each of the three jointing methods can provide long-term, leak tight, solutions. To successfully realise the benefits of any jointing solution, it is strongly recommended that jointing be carried out by suitably trained operatives following best practice. Guidance can always be sought from manufacturers or the BPF Pipes Group (https://bpfpipesgroup.com/) on specific situations.

The tables below highlight the best solution for open cut and trenchless applications.

Installation method: Open Cut **Pipe: New pipe to GIS:PL2-2 for use at pressures up to 5.5 bar**			
Pipe size (Nominal Diameter)	**Preferred method of jointing**	**Reason for preference**	**Acceptable alternatives**
16 - 63	Electrofusion Mechanical	Long term reliability of joint and speed of assembly	-
75 - 180	Electrofusion	Long term reliability of joint and speed of assembly	Butt Fusion Mechanical
180 – 315	Butt Fusion	Long term reliability of joint and speed of assembly	Electrofusion
355 - 800	Butt Fusion	Long term reliability of joint	Electrofusion
Note: When connecting polyethylene pipe to ductile iron or steel pipes, in any nominal diameter, the only viable solution is mechanical jointing.			

Installation method: Open Cut **Pipe: New pipe to GIS:PL2-8 for use at pressures up to 7 bar**			
Pipe size (Nominal Diameter)	**Preferred method of jointing**	**Reason for preference**	**Acceptable alternatives**
16 - 63	Electrofusion Mechanical	Long term reliability of joint and speed of assembly	-
75 - 180	Electrofusion	Long term reliability of joint and speed of assembly	Butt Fusion Mechanical
180 – 315	Butt Fusion	Long term reliability of joint and speed of assembly	Electrofusion
355 - 630	Butt Fusion	Long term reliability of joint	Electrofusion
Note: When connecting polyethylene pipe to ductile iron or steel pipes, in any nominal diameter, the only viable solution is mechanical jointing.			

Installation method: Trenchless Pipe: New pipe to GIS:PL2-2 for use at pressures up to 5.5bar			
Pipe size (Nominal Diameter)	**Preferred method of jointing**	**Reason for preference**	**Acceptable alternatives**
Up to 180	Coiled pipe (no joints)	Integrity of pipe maintained and no obstruction to push-through	Butt Fusion
Above 180	Butt Fusion (externally debeaded)	Integrity of pipe maintained and no obstruction to push-through	-
Note: For connections made at excavation pits, the solutions for open cut should be applied			

Installation: Trenchless Pipe: New pipe to GIS:PL2-8 for use at pressures up to 7bar			
Pipe size (Nominal Diameter)	**Preferred method of jointing**	**Reason for preference**	**Acceptable alternatives**
Up to 180	Coiled pipe (no joints)	Integrity of pipe maintained and no obstruction to push-through	Butt Fusion
Above 180	Butt Fusion (externally debeaded)	Integrity of pipe maintained and no obstruction to push-through	-
Note: For connections made at excavation pits, the solutions for open cut should be applied			

REFERENCES

GISECE1 Specification for electrofusion control boxes

GIS/PL2-2 Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas — Part 2: Pipes for use at pressures up to 5.5 bar.

GIS/PL2-3 Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas — Part 3: Butt fusion machines and ancillary equipment.

GIS/PL2-4 Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas — Part 4: Fusion fittings with integral heating element(s).

GIS/PL2-6 Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas - Part 6: Spigot end fittings for electrofusion and/or butt fusion purposes.

GIS/PL2-8 Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas - Part 8: Pipes for use at pressures up to 7 bar.

GIS/PL3 Technical specification for self-anchoring mechanical fittings for polyethylene pipe for natural gas and suitable manufactured gas.

BS EN 1555-3 Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Fittings.

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.