

Specifications for polyethylene pipe and fittings for water supply, drainage and sewerage under pressure

Background

Until the early 1980's, performance specifications for polyethylene pipes and fittings were prepared by the British Standards Institute (BSI). As new materials developed with better performance capabilities, the UK Water Industry introduced their own specifications to keep pace with innovation, mirroring in many aspects those being produced by the UK Gas Industry. These Water Industry Specifications (WIS) offered the opportunity for product testing and third-party certification. As advances were made in materials, so the WISs were updated and extended.

With the drafting of European Standards (or EuroNorms, EN), the Water Industry Specifications were used to formulate the UK's input into drafting. European Standards (EN) are adopted in the UK directly as British Standards (BS EN) and conflicting documents withdrawn. Therefore, PE pipes and fittings traditionally purchased to a British Standard (BS) or Water Industry Specification (WIS) should now meet the requirements of European Standards where they exist.

Where products or services are not covered by European or British Standards, such as the fusion jointing of polyethylene pressure pipeline systems and barrier pipe for use in contaminated land, the UK Water Industry continues to develop and support WISs to ensure best practice is followed and innovative products can be used.

The following guide has been prepared to provide information on specifications applicable to polyethylene pipe and fittings, for water supply, drainage and sewerage under pressure.

The British Plastics Federation (BPF) Pipes Group and its members strongly advise that compliance with the product standards listed in this guide is verified by a third-party certification scheme (for example, the BSI Kitemark or equivalent).

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Contact with drinking water

In the supply of drinking water to consumers, there are effectively three areas of application: public water supply system (water supplied by a water undertaker to a premises), private water supply system (water supplied from a private source to a premises), and the plumbing system in the premises. Each of these applications has different (but similar) requirements with respect to the suitability of the pipework for contact with drinking water.

Public water supply system: Products or substances in contact with water intended for domestic purposes or premises in which food is produced are subject to the requirements of *The Water Supply (Water Quality) Regulations 2000 in England, The Water Supply (Water Quality) Regulations 2010 in Wales, The Water Supply (Water Quality) Regulations (Northern Ireland) 2007* or *The Public Water Supplies (Scotland) Regulations 2014* as appropriate. **These apply to any part of the water supply system owned or operated by a water company typically up to the point where water enters a property.**

These legal provisions are enforced by the national regulators: the Drinking Water Inspectorate (DWI) in England and Wales; the Drinking Water Quality Regulator (DWQR) in Scotland; and the Drinking Water Inspectorate (DWI NI) in Northern Ireland. By mutual agreement, the DWI maintain a list of Approved Products on behalf of all regulators. This is published and updated regularly on the DWI's web site which represents the definitive list of all substances and products for which approval has been granted and may be introduced into a water supply system by a water undertaker. Polyethylene pipes can be found in Part B of the list, <http://dwi.defra.gov.uk/drinking-water-products/approved-products/index.htm>

For products with only a small surface area exposed to the water, it is permitted under the various water quality regulations listed above to demonstrate that the product does not give rise to unintended odour / flavour to the water and does not support the growth of microbial organisms. This is often referred to as "Regulation 31(4)(b)" – from regulations applying in England and Wales. Similar provisions exist in Scotland and Northern Ireland. In practical terms, products made of non-metallic materials can be shown to meet Regulation 31(4)(b) by testing to BS 6920 '*Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water*'.

Products or components tested to BS 6920 for use inside buildings and approved by WRAS, see Water in Buildings below, are commonly accepted by water undertakers as demonstrating compliance with "Regulation 31(4)(b)". WRAS Approved Materials are listed in the WRAS Materials Directory (<https://www.waterregsuk.co.uk>). Polyethylene components can be found in section 5240 of the list.

Examples of products with a small surface area exposed to the water are couplers and fittings, gaskets and seals. DWI Advice Sheet 8 provides further explanation: <http://dwi.defra.gov.uk/drinking-water-products/advice-and-approval/Advicesheet8.pdf>

Private water supply system: Products or substances in contact with water intended for domestic purposes or premises in which food is produced which has been sourced from a private borehole or well supply are subject to the provisions of the various private water supplies regulations in force across the UK.

Water in buildings: For premises supplied by water from a water undertaker, products and substances are subject to the requirements of *The Water Supply (Water Fittings) Regulations 1999*, *The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009* and *The Water Supply (Water Fittings) (Scotland) Byelaws 2014*. **These apply from the point where water enters the premises (usually at the stop tap at the boundary) to the points of water use including plumbing systems, water fittings and water-using appliances.**

The Water Supply (Water Fittings) Regulations and Byelaws consider five aspects, one of which is contamination of the water supply. For non-metallic materials, testing is carried out to BS 6920 to assess whether they impart odour or flavour, cause a change in appearance of the water (colour or turbidity), promote microbial growth, leach substances harmful to human health or leach toxic metals.

The other four aspects are waste, misuse, undue consumption or erroneous measurement of water supplied. There are a series of mechanical performance tests which are carried out to ensure suitability as well as requirements for installation and use.

Further guidance and the list of approved products and materials is available at <https://www.wrasapprovals.co.uk/approvals-directory/>

NOTES:

Products or components tested to BS 6920 may be listed in the WRAS Materials Directory. Listing of materials or components in this directory should not be confused with WRAS Product Approval (and listed in the WRAS Products Directory) which, in addition to contact with drinking water, looks at all aspects of the water fittings regulations listed above.

WRAS Product Approval is the easiest way to demonstrate compliance with the water fittings regulations listed above. Tests are carried out in accordance with the Regulator's Specification and ensure a minimum level of mechanical performance and durability for a product conveying drinking water installed inside premises. The tests have not been designed to demonstrate fitness for purpose of the product in the applications for which it is designed and should not be confused with the product specifications described below.

Readers are reminded that the water fittings regulations apply to premises, where pipework might be owned and operated by the property owner or a water undertaker. For products in the water supply system outside of customers' premises and operated by a water undertaker, WRAS Product Approval is not a legal requirement (see Public Water Supply System above) but offers some confidence in mechanical performance and durability.

Product specifications

PE pipes and fittings for all mains and services, except those laid through land contaminated with organic chemicals, should be purchased to the relevant part of BS EN 12201.

PE pipes for laying in contaminated land should be purchased to BS 8588.

Both documents are summarised below.

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

BS EN 12201 is a five-part publication which identifies the requirements for a piping system and its components when made from polyethylene (PE). The scope covers piping systems intended to be used for water supply intended for human consumption, including the conveyance of raw water prior to treatment, drainage and sewerage under pressure, vacuum sewer systems, and water for other purposes.

Part 1: General specifies the overarching aspects of polyethylene (PE) pressure piping systems (mains and service pipes). It includes such items as definitions and characteristic of materials.

Part 2: Pipes specifies the characteristics of pipe made from polyethylene (PE100, PE80 and PE40).

Three pipe types are identified in Part 2:

- PE pipes including identification stripes
- PE pipes with co-extruded layers
- PE pipes with a peelable, contiguous thermoplastics additional layer on the outside of the pipe.

Part 2 sets out the geometrical and dimensional properties of pipes in the diameter range 16 mm to 2500 mm. It also covers ten different SDR (Standard Dimensional Ratio, the ratio of the nominal outside diameter to the nominal wall thickness), from SDR 6 to 41.

The mechanical and physical properties of PE pipes are specified together with appearance and marking requirements. Addition information on the selection and installation of piping systems and components in the UK.

Part 3: Fittings specifies the characteristics of fittings made from polyethylene (PE100 and PE80). It sets out the mechanical properties of fittings including any non-PE components, together with geometrical and marking requirements.

Fitting types identified in Part 3:

- Fusion fittings
 - Electrofusion fittings
 - Spigot end fittings (for butt fusion and socket electrofusion)
 - Socket fusion fittings
- Mechanical fittings
 - Compression fittings
 - Flange fittings
- Fabricated fittings

Part 4: Valves specifies the characteristics of valves or valve bodies made from polyethylene. It sets out the mechanical properties of valves including any non-PE components, together with geometrical and marking requirements.

Part 5: Fitness for purpose of the system. Part 5 specifies the performance requirements for the assembled piping system (the pipe and fittings in combination). This includes such aspects as leaktightness of joints, resistance to pull out under longitudinal forces, and hydrostatic strength of the combined system.

BS 8588: Polyethylene pressure pipe with an aluminium barrier layer and associated fittings for potable water supply in contaminated land – Size 20 mm to 630 mm

BS 8588 identifies the requirements for a piping system and its components when made from polyethylene with an aluminium barrier layer. Two pipe construction types are:

- Type A: where one or more polymer layers for a core pipe designed to bear the stress associated with long term hydrostatic pressure. The aluminium layer would then be applied externally to the core pipe.
- Type B: Where one or more polymer layers and the aluminium layer together bear the stresses associated with the long-term hydrostatic pressure.

BS 8588 sets out the material and mechanical properties, performance tests, jointing and supply requirements. An important aspect of this specification is the ability of the material to resist permeation by petroleum-based contaminants.

NOTES:

BS EN 12201 (all parts) and BS 8588 can be purchased through BSI (<http://shop.bsigroup.com/>).

BS EN 12201 does not provide an approach on field installation of PE pipes and fittings. Purchasers are directed to *Water Industry Specification WIS 4-32-08* for guidance on UK installation practices involving butt fusion or electrofusion jointing.

Pipeline performance

BS EN 12201 and BS 8588 set out the performance requirements for a product and/or system as designed by the manufacturer. In addition to these, there are some key publications covering the installation and commissioning of PE pipe systems which may be called up in contracts to ensure that pipelines are robust and reliable.

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

Purchasers of products to BS EN 12201 (all parts) are directed to Water Industry Specification WIS 4-32-08 for guidance on UK installation practices involving butt fusion or electrofusion jointing. This document specifies the equipment and jointing procedures for fusion welding of PE pipes and fittings.

It is strongly recommended that this specification is used for all fusion jointing to provide consistent and good quality workmanship.

IGN 4-01-03: Pressure testing of pressure pipes and fittings for use by public water suppliers

This guidance document details the procedure for the in situ testing of PE water and sewerage pressure pipelines laid in the UK. It is based on the requirements of BS EN 805 which offers advice on a range of test methods, the choice of which is left to the designer / water company. Modifications to the basic test method are also included for short lengths of rehabilitated pipe and testing of connections to the mains.

NOTES:

WIS 4-32-08 and IGN 4-01-03 have been updated with support from the BPF Pipes Group. They are available to download free of charge from Water UK's website (<http://standards-board.water.org.uk>).

Appendix A: Obsolete standards

THE BRITISH, WATER INDUSTRY AND EUROPEAN SPECIFICATIONS LISTED BELOW ARE NOW OBSOLETE AND SHOULD NOT BE USED FOR PURCHASING.

British Standards:

- BS 1972: Specification for polyethylene pipe (Type 32) for above ground use and cold water services
- BS 3284: Specification for Polyethylene pipe (Type 50) for cold water services
- BS 6572: Specification for blue polyethylene pipe up to nominal size 63 for below ground use for potable water
- BS 6730: Specification for black polyethylene pipes up to nominal size 63 for above ground use for potable water
- BS CP312, Parts 1, 2 & 3: Code of practice for Plastics pipework (thermoplastics materials)
- BS EN 13244: 2002: Plastic piping systems for buried and above ground pressure systems for water for general purposes, drainage and sewerage – Polyethylene (PE).

Water Industry Specifications:

- WIS 04-32-03: Specification for blue polyethylene (PE) pressure pipe for cold potable water (Nominal sizes 90 to 1000 for underground or protected use).
- WIS 04-32-09: Specification for black polyethylene pressure pipes for potable water above ground or sewerage (Nominal sizes 90 to 1000).
- WIS 04-32-12: Specification for PE80 and PE100 electrofusion fittings for nominal sizes up to and including 630mm
- WIS 04-32-13: Specification for blue higher performance polyethylene HPPE/PE100, pressure pipes nominal size 90 to 1000, for underground or protected use for the conveyance of water intended for human consumption.
- WIS 04-32-14: Specification for PE80 and PE100 electrofusion fittings for nominal sizes up to and including 630.
- WIS 04-32-15: Specification for PE80 and PE100 spigot fittings and drawn bends for nominal sizes up to and including 1000.
- WIS 04-32-17: Polyethylene pressure pipes for pressurised water supply and sewerage duties.
- WIS 4-32-19: Polyethylene pressure pipe systems with an aluminium barrier layer for potable water supply in contaminated land size 25 to 630mm

Appendix B: Commonly used terms

Current terms

PE 80	<p>PE resin for manufacture of pipes and fittings with long-term strength, known as the minimum required strength (MRS), of 8 MPa. Typically used for pipes up to a maximum of 180mm diameter.</p> <p>Note: Prior to the adoption of international standards, PE pipe materials were designated by their density, so PE80 might be referred to as Medium Density Polyethylene or MDPE pipe. These terms are not recognised in the product standard.</p>
PE 100	<p>PE resin for manufacture of pipes and fittings with long-term strength, known as the minimum required strength (MRS), of 10 MPa.</p> <p>Note: PE100 might be referred to as High Density Polyethylene, HDPE or HPPE, High Performance Polyethylene pipe. These terms are not recognised in the product standard.</p>
Barrier pipe	<p>PE pressure pipe with an aluminium barrier layer. The pipe is used as part of a system of compatible pipes and fittings used to convey or retain drinking water for buried use in contaminated land.</p> <p>Note: PE / Al / PE pipe may be referred to as a 'composite' pipe, meaning a multi-layer pipe construction. This is not to be confused with fibre-reinforced composite pipe.</p>
Co-extruded pipe	<p>PE pressure pipe manufactured using a co-extrusion technique, as part of the extrusion process. The black inner and outer polyethylene materials are homogeneously bonded together under high temperature and pressure resulting in a single layer pipe wall construction. The colour of the outer layer is application specific. The outer layer is NOT removed during preparation for electrofusion jointing and should not be a 'scrape to depth' or damage indicator.</p>
Peelable pipe	<p>PE pressure pipe with a peelable thermoplastic layer on the outside of the pipe. The additional external layer (skin) is applied during the manufacturing process and protects the pipe during handling, transportation, installation, and reinstatement. A short section is removed using the manufacturer's recommended tool to provide a clean surface for fusion jointing.</p> <p>Note: Peelable pipe might be referred to as 'skinned' pipe. Peelable pipe might incorrectly be referred to as 'coated pipe' - this term should not be used.</p>
Factory sealed pipe	<p>Coiled PE pressure pipe that is sealed on both ends, as part of the manufacturing process without the use of chemical sterilisation. The seal safeguards the bore of the pipe from contamination during storage, transportation and installation, up to the point of connection. Factory sealed pipes are intended to overcome the requirement for pre-chlorination and only require the final chlorination process before they are put into service. The internal bore of the factory sealed pipe remains factory clean for 12 months, after which time it should be treated as a conventional pipe.</p>
Fusion jointing	<p>Technique to join pipes and / or fittings until the PE material reaches fusion temperature causing the pipe and fitting surfaces to fuse.</p>
Butt fusion	<p>Fusion jointing technique to join ends of pipes or spigot end fittings by holding the surfaces them against a flat heating plate until the PE material reaches fusion temperature, removing the heating plate quickly and pushing the two softened ends against one another.</p>
Electrofusion	<p>Fusion jointing technique using the Joule effect of the heating element incorporated at the jointing surface of an electrofusion fittings, causing the material adjacent to the fitting to melt and the pipe and fitting surfaces to fuse.</p>