



BSI Standards Publication

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

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Documents

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 28 February 2017. It was prepared by Subcommittee PRI/88/2, *Plastics piping for pressure applications*, under the authority of Technical Committee PRI/88, *Plastics piping systems*. A list of organizations represented on these committees can be obtained on request to their secretary.

Information about this document

This standard makes some reference to the suitability of pipework for conveying drinking water (potable water). The following regulations apply to the approval of substances and products used in the provision of public water supplies within the United Kingdom:

- WRAS. Regulation 31 of The Water Supply (Water Quality) Regulations 2000 (Statutory Instruments 2000 No 3184). England
- WRAS. Regulation 31 of The Water Supply (Water Quality) Regulations 2001 (Welsh Statutory Instruments 2001 No 3911(W.323). Wales
- SCOTLAND. Regulation 27 of The Water Supply (Water Quality) (Scotland) Regulations 2001
- NORTHERN IRELAND. Regulation 30 of The Water Supply (Water Quality) (Amendment) Regulations (Northern Ireland) 2009 (Statutory Rules of Northern Ireland 2009 No 246)
- Water Supply (Water Fittings) Regulations 1999, (England and Wales), the Water Byelaws 2000, (Scotland) and the current requirements for Northern Ireland apply.
- HSE. Health & Safety At Work Act 1974, and subsequent regulations.

This standard adopts the ISO classification of PE materials. PE100 is now used to describe HPPE grades. PE80 is now used to describe MDPE.

WARNING. This specification includes the use of substances and/or procedures that could be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

The requirements contained in this standard are not necessarily indicative of all the performance requirements, or the suitability of pipework for the extreme service conditions, that are occasionally encountered in the UK. In such circumstances, users of this standard are advised to seek confirmation of suitability from the manufacturers of the pipework components.

It is recommended that sampling be carried out by the designated test laboratory. It has been assumed in the drafting of this specification that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Production certification/inspection/testing

Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Appropriate conformity attestation arrangements are described in BS EN ISO/IEC 17025. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

Presentation conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with this British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies requirements for the materials, mechanical performance, dimensions, and effect on water quality of polyethylene pipes with an aluminium barrier layer, and associated fittings/joints for potable water supply installed in contaminated ground.

It is applicable to Type A and Type B pipes with nominal sizes up to and including 630 mm, with the following characteristics.

- a) Type A: pipes where one or more polymer layers form a core pipe which is designed to bear the stresses associated with long term hydrostatic pressure, with the aluminium layer and outer polymer layer being barrier and protection layers respectively, and regarded as not bearing stresses arising from internal pressure.
- b) Type B: pipes where one or more polymer layers and the aluminium layer bear the stresses associated with long term hydrostatic pressure.

NOTE See 4.2 for pressure classes.

This British Standard also covers the requirements for fittings and joints, manufactured by system manufacturers or others for use with one or more barrier pipe systems.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced documents (including any amendments) applies.

BS 5252, *Framework for colour co-ordination for building purposes*

BS 6920-2.2.1, *Suitability of non-metallic products in contact with water intended for human consumption with regard to their effect on the quality of the water – Part 2 – Methods of test – Section 2.1 – Odour and flavour of water for hoses, composite pipes and tubes*

BS 6920-2.2.2, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Part 2 – Methods of test. Section 2.2 – Odour and flavour of water – Method of testing odours and flavours imparted to water by multi-layered hoses and pipes*

BS 8561, *Specification for mechanical fittings for use in the repair, connection and renovation of pressurized water supply pipelines – Requirements and test methods*

BS EN 805, *Water supply – Requirements for systems and components outside buildings*

BS EN 12106, *Plastics piping systems – Polyethylene (PE) pipes – Test method for the resistance to internal pressure after application of squeeze-off*

BS EN 12201-1, *Plastics piping systems for water supply – Polyethylene (PE) – Part 1: General*

BS EN 12201-2, *Plastics piping systems for water supply – Polyethylene (PE) – Part 2: Pipes*

BS EN 12201-3, *Plastics piping systems for water supply – Polyethylene (PE) – Part 3: Fittings*

BS EN ISO 3126, *Plastic piping systems – Plastics components – Determination of dimensions*

BS EN ISO 9080, *Plastics piping and ducting systems – Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

BS EN ISO 12162, *Thermoplastic materials for pipes and fittings for pressure applications – Classification and designation – Overall service (design) coefficient*

BS EN ISO 13479, *Polyolefin pipes for the conveyance of fluids – Determination of resistance to crack propagation – Test method for slow crack growth on notched pipes (notch test)*

BS ISO 1167, *Thermoplastics pipes for the conveyance of fluids - Resistance to internal pressure – test method*

BS ISO 4065, *Thermoplastic pipes – Universal wall thickness table*

ISO 161-1, *Thermoplastics pipes for the conveyance of fluids – Nominal outside diameters and nominal pressures – Part 1: Metric series*

ISO 6259-1, *Thermoplastics pipes – determination of tensile properties and basic specifications – Part 1: General test method*

ISO 1043-1, *Plastics – Symbols and abbreviated terms – Basic polymers and their special characteristics*

ISO 6259-3, *Thermoplastics pipes – Determination of tensile properties and basic specifications – Part 3: Polyolefin pipes*

ISO 6964, *Polyolefin pipes and fittings – Determination of carbon black content*

ISO 11423-1, *Water quality – Determination of benzene and some derivatives – Part 1: Headspace chromatographic method*

ISO 11922-1, *Thermoplastics pipes for the transport of fluids – Dimensions and tolerances – Part 1: Metric series*

ISO 13953, *Polyethylene (PE) pipes and fittings – Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*

ISO 13954, *Plastics pipes and fittings – Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm*

ISO 13955, *Plastics pipes and fittings – Crushing decohesion test for polyethylene (PE) electrofusion assemblies*

ISO 17454, *Multilayer pipes – Test method for the adhesion of the different layers using a pulling rig*

ISO/TR 10837, *Determination of the thermal stability of polyethylene (PE) for use in gas pipes and fittings*

Other publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[N1]WIS 4-32-11, *Specification for thermoplastic end load resistant mechanical fittings for polyethylene pipes of nominal size $\leq 63\text{mm}$*

[N2]GREAT BRITAIN: DEPARTMENT OF THE ENVIRONMENT. *Determination of Very Low Concentrations of Hydrocarbons and Halonogenated Hydrocarbons in Water 1984-5*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN 805, ISO 1043-1 and the following apply.

3.1.1 barrier pipe

multi-layer pipe consisting of two polyethylene layers with an intervening aluminium barrier layer that together provide the necessary strength and resistance to permeation

3.1.2 barrier pipe system

compatible pipes and fittings used to convey or retain drinking water, for buried use in contaminated land

3.1.3 blank sample

reference sample of the test water taken for comparative analysis

3.1.4 butt fusion joint (using heated tool)

joint made by heating the planed ends of pipes or spigot end fittings (the surfaces of which match) by holding 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 under pressure to form a fusion joint

3.1.5 coiled pipe

pipe extruded in a multilayer coiled configuration with the layers strapped together to provide a stable unit without a supporting centre core

3.1.6 composite pipe

complete multi-layer barrier pipe construction

3.1.7 compound

homogeneous mixture of base polymer (PE) and additives

NOTE For example, anti-oxidants, pigments, carbon black, and UV-stabilizers.

[SOURCE: BS EN 12201:2011, 3.1.2.3]

3.1.8 contaminants

substances which might permeate through the pipe wall and/or infiltrate joints and affect the quality of the conveyed water

NOTE In the case of polyethylene, the most aggressive substances that are likely to be found in contaminated ground are hydrocarbon fuels. For the purpose of this specification a standard fuel simulant, ASTM D471 Fuel C, is used as a model contaminant.

3.1.9 control piece

length of standard PE 80 or PE 100 pipe exposed to fuel during the permeation test

3.1.10 coupling

in-line connector supplied to connect one pipe to another, or pipework to equipment

3.1.11 core pipe

type A pipe without barrier layer and protective skin

3.1.12 design stress (σ_s)

allowable stress, in megapascals (MPa), for a given application, derived from the MRS by dividing it by the coefficient C

EXAMPLE

$$\sigma_s = \frac{\text{MRS}}{C}$$

3.1.13 drummed pipe

pipe extruded onto a rigid framed reel with a supporting centre core to which the pipe is anchored

3.1.14 electrofusion joint

joint between a PE electrofusion socket or saddle fitting and a pipe or a spigot end fitting

NOTE The electrofusion fittings are heated by the Joule effect of the heating element incorporated at their jointing surfaces, causing the material adjacent to them to melt and the pipe and fitting surfaces to fuse.

3.1.15 fusion compatibility

ability of two similar or dissimilar polyethylene materials to be fused together to form a joint

[SOURCE: BS EN 12201:2011, 3.1.5.5]

3.1.16 joint

mechanism or design of components within a fitting, that facilitate or achieve connection between fittings and a pipe or between fittings

3.1.17 leachate water

water extracted from the test piece after exposure to the contaminant and to be assessed for trace amounts of permeated contaminants

3.1.18 lower confidence limit (σ_{LCL})

quantity, with the dimensions of stress, which represents the 97.5% lower confidence limit of the predicted hydrostatic strength at temperature Θ and time T

NOTE It is expressed in megapascals.

[SOURCE: BS EN 1555-1:2010, 3.1.3.1]

3.1.19 maximum mean outside diameter ($d_{\text{em,max}}$)

maximum value for the mean outside diameter as specified for a given nominal size

3.1.20 maximum operating pressure (MOP)

maximum effective pressure of the fluid in the piping system, expressed in bar, which is allowed in continuous use, taking into account the physical and the mechanical characteristics of the components of a piping system

NOTE It is calculated using the following equation:

$$\text{MOP} = \frac{20 \times \text{MRS}}{C \times (\text{SDR} - 1)}$$

3.1.21 maximum wall thickness (at any point) (e_{max})

maximum value for the wall thickness at any point around the circumference of a component, as specified

- 3.1.22 mean outside diameter (d_{em})**
value of the measurement of the outer circumference of the pipe or spigot end of a fitting in any cross-section divided by π ($= 3.142$), rounded to the next greater 0.1 mm
- 3.1.23 minimum mean outside diameter ($d_{em,min}$)**
minimum value for the mean outside diameter as specified for a given nominal size
- 3.1.24 minimum required strength (MRS)**
value of σ_{LCL} , rounded down to the next smaller value of the R10 series or of the R20 series depending on the value of σ_{LCL}
NOTE R10 and R20 series are the Renard number series according to ISO 3 and ISO 497.
- 3.1.25 mean wall thickness (e_m)**
arithmetical mean of a number of measurements of the wall thickness, regularly spaced around the circumference and in the same cross-section of a component, including the measured minimum and the measured maximum values of the wall thickness in that cross-section
- 3.1.26 mechanical joint**
joint made by assembling a PE pipe with a fitting that generally includes a compression part to provide for pressure integrity and resistance to end loads, and a means of sealing to provide leaktightness
NOTE A support sleeve may be inserted into the pipe bore to provide a permanent support for the PE pipe to prevent creep in the pipe wall under radial compressive forces. The metallic part of this fitting can be assembled to a metallic pipe by screw threads, compression joints, welded or brazed flanges or by other means.
[SOURCE: BS EN 12201:2011, 3.1.5.4]
- 3.1.27 melt-mass flow rate (MFR)**
value relating to the viscosity of the molten material at a specified temperature and load, expressed in grams per 10 min (g/10 min)
- 3.1.28 minimum wall thickness (at any point) (e_{min})**
minimum value for the wall thickness at any point around the circumference of a component, as specified
- 3.1.29 nominal outside diameter (d_n)**
specified outside diameter, in millimetres, assigned to a nominal size (DN/OD)
- 3.1.30 nominal size, (DN/OD)**
numerical designation of the size of a component, other than a component designated by thread size, which is a convenient round number, approximately equal to the manufacturing dimensions in millimetres (mm) and related to the outside diameter
[SOURCE: BS EN 12201:2011, 3.1.1.1]
- 3.1.31 nominal size (D_n)**
nominal size, related to the outside diameter
- 3.1.32 nominal wall thickness (EN)**
numerical designation of the wall thickness of a component, which is a convenient round number, approximately equal to the manufacturing dimension in millimetres (mm)
NOTE For thermoplastics components, the value of the nominal wall thickness, EN, is identical to the specified minimum wall thickness at any point, e_{min} .

- 3.1.33 out-of-roundness (ovality)**
expressed as either difference between the maximum and the minimum outside diameter in the same cross-section of a pipe or spigot, rounded off to the nearest 0.1mm for pipes, or this measurement as a percentage of the mean pipe diameter, d_{em} , for coils
- 3.1.34 outside diameter (at any point) (d_e)**
value of the measurement of the outside diameter through its cross-section at any point of the pipe, rounded to the next greater 0.1 mm
- 3.1.35 overall service (design) coefficient or safety factor (C)**
coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confident limit
- 3.1.36 own reprocessable material**
material prepared from clean rejected unused pipes, fittings or valves, including trimmings from the production of pipes, fittings or valves, that will be reprocessed in a manufacturer's own plant after having been previously processed by the same manufacturer in the production of components
NOTE By, for example, injection-moulding or extrusion.
- 3.1.37 pipe batch**
number of pipes, all of them of the same nominal outside diameter, wall thickness and marking, extruded from the same compound on the same machine.
NOTE The pipe batch is defined and identified by the pipe manufacturer.
- 3.1.38 reference piece**
assembly of pipe and fittings not exposed to fuel during the permeation test
- 3.1.39 reference temperature**
temperature for which the piping system is designed
NOTE It is used as the base for further calculation when designing a piping system or parts of a piping system for operating temperatures different from the reference temperature.
- 3.1.40 standard dimension ratio (SDR)**
numerical designation of a pipe series, which is a convenient round number, approximately equal to the dimension ratio of the nominal outside diameter, d_n , and the nominal wall thickness, EN
- 3.1.41 technical data file**
document containing the manufacturer's type test results, statements of conformity to this British Standard, product descriptions and definitions, compatibility information, applicable guidance and relevant supporting information
- 3.1.42 test panellist**
individual, employed by the test house that carries out the water quality testing, who has demonstrated sensitivity to odours and flavours in water commonly associated with non-metallic materials
- 3.1.43 test piece**
assembly of pipe, joints and fittings for permeation testing

3.1.44 test water

potable water to be used in assessing the resistance to permeability of the test piece

3.1.45 virgin material

material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable materials have been added

3.1.46 wall thickness (at any point) (e)

wall thickness at any point around the circumference of a component rounded to the next greater 0.1 mm

NOTE The symbol for the wall thickness of fittings and valve bodies at any point is E .

[SOURCE: BS EN 12201:2011, 3.1.1.9]

3.1.47 wall thickness tolerance

permitted difference between the wall thickness at any point, e , and the nominal wall thickness, EN

NOTE $EN = e_{min}$

3.2 Symbols

For the purposes of this British Standard, the following symbols apply.

C	overall service (design) coefficient
d_e	outside diameter (at any point)
d_{em}	mean outside diameter
$d_{em,max}$	maximum mean outside diameter
$d_{em,min}$	minimum mean outside diameter
d_n	nominal outside diameter
e	wall thickness (at any point) of a pipe
e_m	mean wall thickness
e_{max}	maximum wall thickness (at any point)
e_{min}	minimum wall thickness (at any point)
EN	nominal wall thickness
σ_s	design stress
σ_{LCL}	lower confidence limit (MPa)

3.3 Abbreviations

For the purposes of this British Standard, the following abbreviations apply.

DN/OD	nominal size outside diameter related
LCL	lower confidence limit
MFR	melt mass-flow rate
MOP	maximum operating pressure
MRS	minimum required strength
PE	polyethylene
SDR	standard dimension ratio