

BS 7291-2:2010



BSI Standards Publication

Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings

Part 2: Specification for polybutylene (PB) pipe and associated fittings

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Foreword

Publishing information

This part of BS 7291 is published by BSI and came into effect on 30 April 2010. It was prepared by Subcommittee PRI/88/2/P3, *Plastics piping for hot and cold water*, under the authority of Technical Committee PRI/88, *Plastics piping systems*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

BS 7291-2:2010 supersedes BS 7291-2:2006, which is withdrawn.

Information about this document

PB polymer is widely known as Polybutylene. It is also referred to as Polybutene, Polybut-1-ene and Polybutene-1 (PB-1).

Attention is drawn to BS 7291-3, which specifies corresponding requirements for cross-linked polyethylene (PE-X) pipes and associated fittings.

Attention is also drawn to BS 5955-8, which specifies requirements and gives guidance on the correct application and installation of thermoplastics pipes and fittings for the conveyance of domestic hot and cold water.

Presentational conventions

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

Where optional recommendations are included, they are expressed in sentences in which the principal auxiliary verb is "should".

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

Product 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.

Assessed capability. Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

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 a British Standard cannot confer immunity from legal obligations.

In particular, attention is drawn to the following statutory regulations:

The Health and Safety at Work, etc Act 1974 [1]

The Water Supply (Water Fittings) Regulations 1999 [2]

Annex A, Annex B and Annex C are normative. Annex D is informative.

1 Scope

This part of BS 7291 specifies general requirements and methods of test for polybutylene (PB) pipe and fitting systems intended for use within buildings for the conveyance of cold water, including drinking water, and heated water for use in domestic hot and cold water distribution and heating installations. These requirements supplement the general requirements in BS 7291-1, which are also applicable.

NOTE 1 Before reading this part, it is essential to read BS 7291-1.

NOTE 2 Methods of test are given in Annex A, Annex B and Annex C. Annex D gives guidance on factory control procedures.

This standard specifies general requirements for materials to be used for, or in the form, of PB monolayer, multilayer or barrier pipes, and associated fittings and components. Particular requirements are also specified for PB pipe alone or jointed with push-fit, fusion or compression fittings conforming to BS 7291 or other British Standards intended for use with pipes conforming to this part.

This part of BS 7291 provides for pipes dimensioned to suit two established metric series: BS ISO 4065 for thermoplastics pipes generally and BS EN 1057, for compatibility with copper pipework systems widely used for these applications.

This British Standard is applicable only to Class "S" pipes and fittings.

It does not specify dimensional requirements for fittings because the performance requirements specified for fittings, when tested individually or in assemblies with pipe, are intended to ensure that the dimensions of the fittings are satisfactory for jointing purposes and pressure containment.

NOTE 3 Pipes and fittings of non-barrier PB are to some extent permeable to oxygen; hence, if they are used for the primary circuit(s) of a heating system, it might be beneficial to add a corrosion inhibitor to the fluids circulating therein. In such a case the manufacturer(s) of the pipe and/or fitting should, upon request, provide advice in accordance with BS 5955-8. This advice should include selection of a compatible corrosion inhibitor and/or methods for reducing the permeability.

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 document (including any amendments) applies.

BS 5214-2, *Specification for testing machines for rubbers and plastics – Part 2: Constant rate of force application machines*

BS 7291-1:2010, *Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings – Part 1: General requirements*

BS EN 681-1:1996, *Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanized rubber*

BS EN 1057, *Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating applications*

BS EN 1254-2, *Copper and copper alloys – Plumbing fittings – Part 2: Fittings with compression ends for use with copper tubes*

BS EN 1254-3, *Copper and copper alloys – Plumbing fittings – Part 3: Fittings with compression ends for use with plastics pipes*

BS EN 12294, *Plastic piping systems – Systems for hot and cold water – Test method for leaktightness under vacuum*

BS EN ISO 1043-1, *Plastics – Symbols – Part 1: Basic polymers and their special characteristics*

BS EN ISO 1133, *Methods of testing plastics – Determination of melt flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics*

BS EN ISO 1167-1, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – Determination of the resistance to internal pressure – Part 1: General methods*

BS EN ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – Determination of the resistance to internal pressure – Part 2: Preparation of pipe test pieces*

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

BS EN ISO 6259-1, *Thermoplastics pipes – Determination of tensile properties – Part 1: General test method*

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

BS ISO 18553:2002, *Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds*

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

3 Materials

3.1 PB base material

Polybutylene used in the manufacture of pipes or of associated fittings shall comprise heat-stabilized PB prepared by the polymerization of not less than 85% butene-1 and not less than 95% of total olefins by mass; it shall otherwise contain only pigment and those additives that are needed for its manufacture and subsequent conversion into pipes and/or fittings conforming to this standard.

When the base material is tested in accordance with Annex A, the increase in melt flow rate after thermal ageing shall be no greater than 200%.

3.2 Reworked material

The manufacturer's own reprocessable material obtained during the product and works testing of products conforming to this standard can be used in the manufacture of pipes or associated fittings, in addition to virgin material. Reprocessable material obtained from external sources and recyclable material shall not be used.

3.3 Other materials

If materials other than those conforming to 3.1 or 3.2 are used for fittings or component parts of fittings, e.g. compression rings, the complete fitting shall conform to 5.1, 5.2 and 5.3 inclusive, as applicable.

3.4 Material in the form of pipe or fittings

3.4.1 Opacity

PB pipe and associated fittings shall conform to BS 7291-1:2010, 6.6.

3.4.2 Pigmentation

For thermoplastics components, when tested in accordance with BS ISO 18553:2002, any pigment dispersion shall be at least as uniform as that shown in photomicrograph B of BS ISO 18553, Annex B, i.e. only dispersion ratings comparable to photomicrographs A1, A2, A3 and B of BS ISO 18553:2002, Annex B, are acceptable.

NOTE No range of colour(s) is specified for pipes or fittings covered by BS 7291-2, but attention is drawn to 3.4.1, the requirement of which may be satisfied through incorporation of pigment(s).

3.4.3 Effect of materials on the quality of drinking water

All non-metallic parts of the system that will be contact with drinking water shall conform to BS 7291-1:2010, 6.1.

3.4.4 Oxygen permeability

PB pipes with a barrier layer shall have oxygen permeability conforming to BS 7291-1:2010, 6.7.

3.5 Elastomeric joint seals

If elastomeric joint seals are incorporated or used in joints, they shall conform to BS EN 681-1:1996, Table 3, type WB.

4 PB pipes

4.1 Dimensions

4.1.1 Diameter and wall thickness

When measured in accordance with BS EN ISO 3126, the diameter and wall thickness of the pipe shall conform to the limits given in Table 1 or Table 2, as applicable (see BS 7291-1:2010, Clause 5).

4.1.2 Coil diameter

The inside diameter of coils shall be not less than 20 times the nominal size of the pipe.

Table 1 Dimensions of PB pipes having nominal sizes and outside diameters consistent with those specified in BS EN 1057^{A)}

Nominal size	Mean outside diameter		Wall thickness	
	Minimum mm	Maximum mm	Minimum ^{B)} mm	Maximum mm
10	9.9	10.1	1.5	1.8
12	11.9	12.1	1.5	1.8
15	14.9	15.1	1.5 ^{C)}	2.0
18	17.9	18.1	1.8	2.0
22	21.9	22.1	2.0	2.3
28	27.9	28.1	2.6	2.9
35	34.9	35.1	3.2	3.5

^{A)} PB pipes conforming to the dimensions given in Table 1 are intended to be compatible with compression fittings conforming to BS EN 1254-2 and/or BS EN 1254-3.

^{B)} Pipe is required to be marked with the manufacturer's specified minimum wall thickness in mm, see 6.1e).

^{C)} Maximum wall tolerance is minimum +0.3mm

Table 2 Dimensions of PB pipes having nominal sizes and outside diameters consistent with those specified in BS ISO 4065

Nominal size	Mean outside diameter		Wall thickness	
	Minimum mm	Maximum mm	Minimum mm	Maximum mm
10	10.0	10.2	1.5	1.8
12	12.0	12.3	1.5	1.8
16	16.0	16.3	1.5	2.1
20	20.0	20.3	1.9	2.2
25	25.0	25.3	2.3	2.7
32	32.0	32.3	2.9	3.3
40	40.0	40.4	3.7	4.2
50	50.0	50.5	4.6	5.2
63	63.0	63.6	5.8	6.5
75	75.0	75.7	6.8	7.6
90	90.0	90.9	8.2	9.2
110	110.0	111.0	10.0	11.2

4.2 Mechanical and hydrostatic properties of PB pipes

4.2.1 Elongation

4.2.1.1 When tested in accordance with BS EN ISO 6259-1 using an ISO 6259-3 type 2 test piece, subject to the conditions in 4.2.1.2, the elongation at break from each of four test pieces shall be not less than 125%.

4.2.1.2 Testing shall be carried out using a rate of grip separation of (50 ± 5) mm/min. Four test pieces shall be punched from the inside of the slit pipe so that the longitudinal axis of each successive test piece is parallel with that of the pipe and offset by 90° circumferentially from the axis of the preceding test piece. The thickness of the narrow parallel portion of each test piece cut from the pipe wall shall not deviate at any point by more than $\pm 2\%$ from its arithmetic mean.

4.2.2 Short-term hydrostatic pressure resistance of pipe at 95 °C

When one or more test pieces are tested in accordance with BS EN ISO 1167-1 and BS EN ISO 1167-2, using a test temperature of (95 ± 1) °C, pipe shall not burst when subjected to either:

a) a circumferential stress of 6.5 MPa for at least 22 h;

or, and in case of dispute,

b) a circumferential stress of 6.2 MPa for at least 170 h.

Water or, and in the case of dispute, air shall be used as the external environment. Test pieces shall be conditioned prior to testing in accordance with Annex B and have terminal fittings that subject the test piece to the end thrust induced by the internal pressure.

5 Fittings for PB pipes

5.1 Thermoplastics materials

Fittings for PB pipes shall be made from either:

a) a thermoplastics material conforming to BS 7291-1:2010, **6.1, 6.3, 6.4, 6.5** and **6.6**; or

b) any other plastics material, provided that the material:

- 1) comprises a virgin plastic and/or the manufacturer's own clean reworked plastic of the same grade as any plastics material to which it is added; and
- 2) conforms to BS 7291-1:2010, **6.1, 6.3, 6.4, 6.5** and **6.6**, and BS 7291-2.

5.2 Metallic fittings

Metallic fittings shall be either:

a) compression fittings conforming to BS EN 1254-2 and/or BS EN 1254-3, together with internal pipe support sleeves if specified by the pipe manufacturer; or

b) other metallic fittings, subject to their suitability by design for a service life of not less than 50 years under the service conditions specified in BS 7291-1:2010, Table 1, which conform to BS 7291-1:2010, **6.3, 6.4**, and **6.5** as applicable.

5.3 Designation of sizes of fittings

The nominal size of a fitting and the pattern of the fitting shall be designated in accordance with BS 7291-1:2010, **8.5**.

5.4 Mechanical and hydrostatic properties of fittings for PB pipes

5.4.1 Resistance to pull-out of assembled joint

When tested in accordance with Annex C, the socket(s) of the fitting shall retain the pipe(s).

5.4.2 Short-term hydrostatic pressure resistance at 20 °C of assembled fittings and pipes

5.4.2.1 When one or more fittings are tested in accordance with BS EN ISO 1167-1 and BS EN ISO 1167-2, subject to the conditions in **5.4.2.2**, the assembly shall withstand for at least 1 h at 20 °C without bursting or leaking a pressure that subjects the largest size of pipe for which the fitting is intended to a circumferential stress of 15.5 MPa.

5.4.2.2 Water or air (and air in the case of dispute) shall be used as the external environment. The assembly shall consist of test pieces comprising the fitting(s) and lengths of pipe of at least 100 mm, having terminal fittings that subject the assembly to the end thrusts induced by the internal pressure. The individual test pieces and the assembly shall be conditioned at the test temperature for at least 1 h immediately prior to pressurization.

5.4.3 Resistance to vacuum

5.4.3.1 When tested in accordance with BS EN 12294, subject to the conditions in **5.4.3.2**, the assembly shall maintain for 1 h ± 5 min at (20 ± 10) °C a vacuum of at least 0.1 bar absolute.

5.4.3.2 The whole assembly shall be submerged in water at ambient temperature to a depth of at least ten times the nominal diameter of the pipe or tube, with the ends of the pipe or tube clear of the water. All pipe ends, except one, shall be blanked off by suitable means, and the remaining pipe end connected to a suitable means of applying a vacuum to the assembly, with a vacuum gauge at the point of connection.

6 Marking and associated information

6.1 PB Pipes

Pipes made of polybutylene shall be clearly marked with the following information:

- a) the manufacturer's identification, as a clear text or logo;
- b) the number and date of this part of BS 7291, i.e. BS 7291-2:2010¹⁾;
- c) the classification of the pipe, i.e. "Class 'S'";
- d) the nominal size in accordance with Table 1 or Table 2;

¹⁾ Marking BS 7291-2:2010 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

- e) the manufacturer's specified minimum wall thickness in mm;
- f) the symbol for the pipe material, i.e. "PB";
- g) if a barrier pipe, the word "BARRIER";
- h) the manufacturer's traceability information.

NOTE The information should preferably be marked in the order given.

6.2 Plastics fittings for use with PB pipes

Plastics fittings for use with polybutylene pipes shall be marked with the following information:

- a) the manufacturer's identification, as a clear text or logo;
- b) the number and date of this part of BS 7291, i.e. BS 7291-2: 2010²⁾;
- c) the classification of the fitting, i.e. "Class 'S'";
- d) the nominal size and the designation of the fitting or the nominal size of each socket or spigot thereon (see 5.3);
- e) the fitting body material symbol, in accordance with BS EN ISO 1043-1, as applicable, e.g. PB or PVDF.

In cases where marking of the actual fitting is not practicable or is restricted, e.g. because of the size or form of the fitting, each fitting shall carry the manufacturer's identification and shall be supplied in a parcel or with a label marked with any of the information specified in 6.2, but which is omitted from the markings on the fitting.

NOTE The information should preferably be marked in the order given

²⁾ Marking BS 7291-2:2010 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Annex A (normative) Method of test for resistance to thermal ageing

A.1 Principle

The change in melt flow rate is determined for samples of PB material subjected to ageing in hot air, and expressed as a percentage of the melt flow rate of the unaged material.

A.2 Apparatus

A.2.1 *Circulating air oven*, capable of maintaining a temperature of (150 ± 2) °C.

A.2.2 *Cylindrical dishes*, having a flat base of (50 ± 5) mm diameter, deep enough to accommodate a test sample (see **A.3**), and resistant to temperatures of at least 160 °C.

A.3 Test samples

Each sample shall comprise (20 ± 0.5) g of the PB material from which the pipe or fittings are manufactured. At least eight such samples are required.

A.4 Procedure

A.4.1 Preheat the oven to a temperature of (150 ± 2) °C. Into each of four dishes, place one test sample and then put the laden dishes uncovered into the preheated oven. Maintain the oven temperature at (150 ± 2) °C. After 500 h remove the samples and allow them to cool to (20 ± 5) °C. Cut or granulate the thermally aged samples to approximately the same particle size as the four unaged samples.

A.4.2 Determine the melt flow rates of the four unaged samples and the four thermally aged samples in accordance with BS EN ISO 1133, using test condition D.

A.5 Calculation of results

Calculate the percentage increase in melt flow rate, M , using the following equation:

$$M = 100 \times \frac{M_t - M_0}{M_0}$$

where:

M_t is the mean melt flow rate (in g/600 s) of the thermally aged samples;

M_0 is the mean melt flow rate (in g/600 s) of the unaged samples.

A.6 Test report

The test report shall include:

- a) the identification of the material under test;
- b) a reference to this method of test, i.e. BS 7291-2:2010, Annex A;
- c) the mean melt flow rate of the unaged samples;
- d) the percentage increase in the mean melt flow rate of the thermally aged samples;
- e) the date of testing.

Annex B (normative) Crystallization, transformation and conditioning: Test procedure

Precondition PB pipes and fittings in accordance with a) or b) as follows, using a) in case of dispute, followed in either case by conditioning in accordance with c).

- a) Precondition the individual pipe or fitting by storage at $(20 \pm 5)^\circ\text{C}$ for 10 days, or at least until the requirements of 4.2.1, 4.2.2 and 5.4.2 are met.
- b) Precondition the individual pipe or fitting by treatment in a pressure vessel at $(2\,000 \pm 200)$ bar for (10 ± 1) min.
- c) Prior to testing, condition the test piece or test assembly at the test temperature for at least 1 h.

NOTE Because of the slow crystallization, transformation and shrinkage which takes places after PB plastics are cooled from the melt, it is necessary to delay physical testing after extrusion or moulding until this morphological transition is complete. Under normal circumstances preconditioning in accordance with a) is sufficient, but mouldings with section thicknesses greater than 10 mm might require an extended preconditioning period. The alternative preconditioning procedure b) is provided for reference to obtain indicative results relatively quickly where necessary.

Annex C (normative) Method of test for resistance to pull-out of assembled joints

C.1 Apparatus

C.1.1 The apparatus shall consist of one of the following.

C.1.2 *Testing machine*, conforming to BS 5214-2, together with grips capable of subjecting the test assembly to a constant longitudinal force.

C.1.3 *Frame*, with means for suspending a test piece together with a stirrup at the lower end to hold the weight(s) with which to apply the specified force (see C.3).

C.2 Test assembly

The test assembly shall comprise a straight coupling assembled with two pieces of pipe of the appropriate nominal size in accordance with the manufacturer's instructions after conditioning in accordance with Annex B with two pieces of pipe of the appropriate nominal size. Each pipe shall be at least 100 mm in length. Separate combinations shall be assembled for each type of pipe for which the fittings are designed.

C.3 Procedure

Secure the test assembly in the apparatus and apply gradually over a period of 30 s the appropriate force given in Table C.1 or Table C.2, as applicable. Hold the test assembly in constant tension for a period of 1 h at (20 ± 3) °C.

NOTE The pull-out test forces have been calculated using the following formula:

$$F = 1.5\pi\sigma_{\phi}(D^2 - d^2) / 4$$

where:

F is the applied force (in N);

σ_{ϕ} is the design circumferential stress for PB at 20 °C, i.e. $\sigma_{\phi} = 6.3$ MPa;

D is the nominal outside diameter of the pipe (in mm);

d is the internal diameter of the pipe (in mm):

$$d = D - 2e$$

where:

e is the minimum wall thickness of the pipe (in mm).

Table C.1 Pull-out test forces for joints of pipes conforming to Table 1 and/or associated fittings

Nominal size	Force
mm	N
10	380
12	470
15	705 ^{A)}
18	870
22	1 190
28	1 960
35	3 020

^{A)} This value has been set to match the requirements of the WRAS test code sheet 1314.11 [3].

Table C.2 Pull-out test forces for joints of pipes conforming to Table 2 and/or associated fittings

Nominal size	Force
mm	N
10	380
12	470
16	760
20	1 020
25	1 550
32	2 550
40	3 900
50	6 200
63	9 800
75	13 700
90	19 900
110	29 600

C.4 Test report

The test report shall include the following information:

- a) the identification of the pipes and/or fitting(s) under test;
- b) a reference to this method of test, i.e. BS 7291-2:2010, Annex C;
- c) the size of the pipes and/or fittings under test;
- d) a report of whether or not the pipe and socket combination(s) under test separated.
- e) the date of testing.

Annex D (informative) Guidance on factory control procedures

The following guidance on the nature of the requirements and test methods specified in this part of BS 7291 is provided to assist in the preparation of quality plans for the manufacture of pipes or fittings conforming to this and other parts of BS 7291.

The applicability of specific requirements and associated methods of test to different types of pipe or fitting is summarized in Table D.1, in which each requirement is classified as being considered particularly suitable for type test and/or batch release test (BRT) purposes.

Type tests are intended to prove the suitability and performance of a material composition, a compounding or processing technique or a design or size of pipe, fitting or joint assembly. Such tests should be performed when any introduction or change is made in one or more of those aspects, but they may be performed more frequently by incorporation into a plan for monitoring the consistency of manufacture.

Batch release tests are carried out during and/or following manufacture to monitor the quality of a product item as applicable. Certain test methods and associated requirements have been included because of the practicality and speed with which they can be performed in conjunction with a production process compared with some of the type tests.

Some of the requirements in this standard are relevant to both type test and BRT purposes, e.g. those for dimensions.

Table D.1 Applicability of requirements and test methods

Product	Property	Clause	Method	Test type	
				Type test	Batch release test
Pipes and fittings	Material	3.1 and 3.2		x	
Fittings	Material	3.2, 3.3, 5.1 and 5.2		x	
Pipes and fittings	Resistance to thermal ageing	3.1	BS 7291- 2:2010, Annex A	x	
Pipes and fittings	Pigmentation	3.4.2	BS 2782 Method 1106A, Figure 1	x	
Pipes	Oxygen permeability	3.4.4	BS 7291- 1:2010 6.7	x	
Elastomeric joint rings	All	3.5	BS EN 681-1:1996, WB	x	
Pipes	Dimensions	4.1.1	BS EN ISO 3126	x	x
Flexible pipes	Coil diameter	4.1.1		x	
Pipes	Elongation at break	4.2.1	BS EN ISO 6259-1	x ^{A)}	
Pipes	Short term hydrostatic pressure resistance at 95 °C	4.2.2	BS EN ISO 1167-1 and BS EN ISO 1167-2	x	x
Assembled pipes and fittings	Resistance to pull-out of assembled joint	5.4.1	BS 7291- 2:2010, Annex C	x	
Assembled pipes and fittings	Short-term hydrostatic pressure resistance at 20 °C	5.4.2	BS EN ISO 1167-1 and BS EN ISO 1167-2	x	x
Assembled pipes and fittings	Resistance to vacuum	5.4.3	BS EN 12294	x	
Pipes and fittings	Marking and associated information	Clause 6		x	x

^{A)} These tests are conducted after completion of 10 days preconditioning as defined in Annex B.

Bibliography

Standards publications

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

BS 5955-8, *Plastics pipework (thermoplastics materials) – Part 8: Specification for the installation of thermoplastics pipes and associated fittings for use in domestic hot and cold water and space heating systems in buildings*

BS 7291-3, *Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings – Part 3: Specification for crosslinked polyethylene (PE-X) pipes and associated fittings*

BS EN ISO 9000, *Quality management systems*

BS EN ISO 15876-1, *Plastics piping systems for hot and cold water installations – Polybutylene (PB) – Part 1: General*

BS EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

Other publications

- [1] GREAT BRITAIN: The Health and Safety at Work, etc Act 1974, London: The Stationery Office: London.
- [2] GREAT BRITAIN: The Water Supply (Water Fittings) Regulations 1999, No. 1148, London: The Stationery Office: London.
- [3] WRAS: Test code sheet 1314.11. Issue 1. August 1994.

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