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EAST AFRICAN STANDARD

Thermoplastics pipes and fittings for hot and cold water for domestic purposes and heating installations in buildings — Part 3: Specification for cross-linked polyethylene (PE-X) pipes and associated fittings

EAST AFRICAN COMMUNITY

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

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Introduction

BS 7291-3:2010, *Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings — Specification for crosslinked polyethylene (PE-X) pipes and associated fittings*

BS 7291-3:2010



BSI Standards Publication

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

Part 3: Specification for cross-linked polyethylene (PE-X) pipes 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BS 7291-3:2010 supersedes BS 7291-3:2006, which is withdrawn.

Relationship with other documents

Attention is drawn to BS 7291-2, which gives corresponding requirements for polybutylene (PB) pipes and associated fittings.

Attention is also drawn to BS 5955-8, which gives requirements and 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 and Annex B are normative. Annex C is informative.

1 Scope

This part of BS 7291 specifies general requirements and methods of test for cross-linked polyethylene (PE-X) 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 and Annex B. Annex C gives guidance on factory control procedures.

This British Standard specifies general requirements for materials to be used for or in the form of PE-X pipes, with or without a barrier layer or associated fittings and components. Particular requirements are also specified for PE-X pipe alone or jointed with push-fit and 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 PE-X 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 3412, *Methods of specifying general purpose polyethylene materials for moulding and extrusion*

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 7291-2, *Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings – Part 2: Specification for polybutylene (PB) pipes and associated fittings*

- 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 fitting – 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 ISO 1043-1, *Plastics – Symbols – Part 1: Basic polymers and their special characteristics*
- 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*
- ISO 6259-3, *Thermoplastics pipe – Determination of tensile properties – Part 3: Polyolefin pipes*

3 Materials

3.1 PE-X base material

Only material comprising a polyethylene plastic, specified in accordance with BS 3412 and with an "X" designation, shall be used in the production of PE-X pipe. The material used shall otherwise contain only pigment and those additives that are needed for its manufacture and subsequent conversion into pipes and/or fittings.

3.2 Reworked material

If reworked material other than PE-X is used in the manufacture of associated fittings, it shall comprise the manufacturer's own clean reworked material and be of the same grade as any material to which it is added. No other reworked material shall 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 fittings shall conform to 5.1, 5.2 and 5.3 inclusive, as applicable.

3.4 Material in the form of pipe

3.4.1 Opacity

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

3.4.2 Effect of materials on the quality of drinking water

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

3.4.3 Degree of cross-linking

When tested in accordance with Annex A, the degree of cross-linking shall not fall below that declared by the manufacturer.

3.4.4 Oxygen permeability

PE-X 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 PE-X 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).

Table 1 Dimensions of PE-X 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 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	1.8
18	17.9	18.1	1.7	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)} PE-X pipes conforming to the dimensions given in Table 1 are intended to be compatible with compression fittings conforming to BS EN 1254-2 or BS EN 1254-3.

Table 2 Dimensions of PE-X 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	1.8
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

4.1.2 Coil diameter

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

4.2 Mechanical and hydrostatic properties of PE-X pipes

4.2.1 Elongation

When tested in accordance with BS EN ISO 6259-1 using an ISO 6259-3 type 2 test piece, subject to the following conditions, the elongation at break from each of four test pieces shall be not less than 100%.

Testing shall be carried out using a rate of grip separation of (50 ± 5) mm/min. The four test pieces shall be punched from slit pipe such that the longitudinal axis of successive test pieces 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 4.9 MPa for a least 22 h;

or, and in case of dispute,

b) a circumferential stress of 4.7 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 have terminal fittings that subject the test piece to the end thrust induced by the internal pressure.

5 Fittings for PE-X pipes

5.1 Thermoplastic materials

Fittings for PE-X 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 7291-3.

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 PE-X pipes

5.4.1 Resistance to pull-out of assembled joint

When tested in accordance with Annex B, 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 12 MPa.

5.4.2.2 Water or air (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 PE-X pipes

Pipes made of cross-linked polyethylene shall be clearly marked with the following information:

- the manufacturer's identification, as a clear text or logo;
- the number and date of this part of BS 7291, i.e. BS 7291-3: 2010¹⁾;
- the classification of the pipe, i.e. "Class 'S'";
- the nominal size in accordance with Table 1 or Table 2;
- the symbol for the pipe material, i.e. "PE-X";
- if a barrier pipe, the word "BARRIER";
- the manufacturer's traceability information.

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

6.2 Plastics fittings for use with PE-X pipes

Plastics fittings for use with cross-linked polyethylene pipes shall be marked with the following information:

- the manufacturer's identification, as a clear text or logo;
- the number and date of this part of BS 7291, i.e. BS 7291-3:2010;
- the classification of the fitting, i.e. "Class 'S'";
- the nominal size and the designation of the fitting or the nominal size of each socket or spigot thereon (see **5.3**);
- the fitting body material symbol, in accordance with BS EN ISO 1043-1, as applicable, e.g. PE-X, PSU.

¹⁾ Marking BS 7291-3:2010 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.

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 items a) to e), but which is omitted from the markings on the fitting.

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

Annex A (normative) Method of test for the degree of cross-linking

A.1 Principle

A test piece comprising at least one thin full cross-section from a pipe is weighed and then immersed in an extracting solvent at an elevated temperature for a designated period. After extraction, the residual test piece is removed, dried and reweighed. The amount of undissolved test piece material is taken to represent the proportion of cross-linked polymer in the pipe wall.

The results are affected by the presence of any other insoluble material, such as fillers, in which case the method remains applicable provided that the following conditions apply:

- a) the filler is not soluble in the solvent at the extraction temperature;
- b) the amount of filler present in the pipe compound is either known or can be determined;
- c) sufficient cross-linking has been achieved to prevent migration of the filler during the extraction.

NOTE It has been found that, at extraction levels up to 50%, the extractant usually remains clear and free from filler.

Since some oxidative degradation of the material can occur at the reflux temperature of the extractants, suitable anti-oxidant is added to the extractant to inhibit such degradation.

A.2 Apparatus

A.2.1 Round-bottom flask, with large mouth and ground-glass or cork joint.

NOTE For one or two simultaneous determinations, a 500 mL flask is suitable, but for a larger number of determinations at one time, which should not exceed six, a 2000 mL flask should be used.

A.2.2 Heating mantle, to fit the flask and with sufficient heating capacity to boil decalin or xylene, as appropriate (see A.3.1).

A.2.3 Reflux condenser, with a ground-glass or cork joint to fit into flask.

A.2.4 Ring stand and appropriate clamps.

A.2.5 Lathe, with a sharp blade suitable for machining the test piece from the pipe.

A.2.6 Brass or stainless steel 125 mm wire cloth.

A.2.7 Vacuum oven, with a vacuum source capable of creating an absolute pressure not greater than 6.5 kPa, and capable of maintaining a temperature of (150 ± 2) °C.

A.3 Reagents

A.3.1 Solvent: either decahydronaphthalene (decalin), boiling range 187 °C to 193 °C; or xylene, boiling range 136 °C to 140 °C.

A.3.2 Anti-oxidant: either 2,2'-methylene bis (4-methyl-6-tertbutylphenol) or suitable alternative.

A.4 Test piece

The test piece shall comprise one or more shavings of (0.2 ± 0.02) mm thickness cut from the end of a pipe section by a blade so that the width of the shaving corresponds to the wall thickness of the pipe and the length of the shaving(s) are not less than one circumference.

A.5 Procedure

Prepare a test piece holder by cutting a piece of the brass or stainless steel wire cloth measuring approximately 80 mm x 40 mm and folding it into a square measuring approximately 40 mm x 40 mm. Close two sides of this square by folding over approximately 6 mm of the edges of the cloth and staple the folds to form a pouch, open at the top. Weigh the pouch (m_1).

Cut the sample to provide a test piece consisting of one or more shavings conforming to A.4. Place approximately 0.3 g of these shavings in the weighed pouch previously constructed. Weigh the pouch containing the test piece (m_2). Close the open edge of the pouch and staple to form a cage; weigh the cage (m_3).

Place in a round-bottom flask sufficient clean solvent to immerse the cage and test piece completely (350 g in a 500 mL flask or 1 000 g in a 2 000 mL flask). To inhibit any further cross-linking of the test piece, add the anti-oxidant to the solvent to give a concentration of 1%.

Boil the solvent vigorously to ensure good agitation of the solution; 20 to 40 drops per minute falling from the condenser when using 1 000 g of solvent may be regarded as a satisfactory boiling rate. Suspend the cage and test piece in the solvent so that the bottom of the cage is almost touching the bottom of the flask; a small wire attached to the cage and extending through the reflux condenser may be used for suspending the cage. Extract the test piece for $(6 \text{ h} \pm 5)$ min in decalin or $(12 \text{ h} \pm 5)$ min in xylene.

Immediately after extraction place the cage and test piece in a vacuum oven preheated to and maintained at (150 ± 2) °C. Dry the test piece to a constant weight at an absolute pressure not greater than 6.5 kPa. Cool the cage and test piece in a desiccator and weigh (m_4).

If the fraction of the filler in the material is not known, determine this by normal chemical methods.

A.6 Calculation of results

Calculate the proportion of insoluble PE-X material, in per cent (mass/mass), as follows.

Insoluble proportion (in %)

$$\begin{aligned}
 &= \frac{\text{residual mass of test piece after extraction}}{\text{original mass of test piece} - \text{mass of filter}} \times 100 \\
 &= \frac{m_4 - m_3}{(m_2 - m_3) - F(m_2 - m_1)} \times 100 \\
 &= \frac{m_4 - m_3}{(1 - F)(m_2 - m_1)} \times 100
 \end{aligned}$$

where:

- m_1 is the mass of the pouch (sealed on three sides, one side open);
- m_2 is the mass of the test piece and the pouch (sealed on three sides, one side open);
- m_3 is the mass of the test piece and the cage after being stapled shut;
- m_4 is the mass of the test piece and the cage after extraction and drying;
- F is the fraction of xylene- or decalin-insoluble filler in the polyethylene compound.

Express the degree of cross-linking as the proportion of insoluble PE-X material in per cent (m/m).

A.7 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 7291-3:2010, Annex A;
- c) the size of the pipe under test;
- d) the degree of cross-linking, in per cent;
- e) the declared design minimum degree of cross-linking, in per cent;
- f) the date of testing.

Annex B (normative)

Method of test for resistance to pull-out of assembled joints

B.1 Apparatus

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

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

B.2 Test assembly

The test assembly shall comprise a straight coupling assembled with two pieces of pipe of the appropriate nominal size, assembled in accordance with the manufacturer's instructions. 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.

B.3 Procedure

Secure the test assembly in the apparatus and apply gradually over a period of 30 s the appropriate force given in Table B.1 or Table B.2, as applicable. Hold the test assembly in constant tension for a period of 1 h at $(20 \pm 3)^\circ\text{C}$.

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 PE-X at 20 °C, i.e. $\sigma_{\phi} = 6.3 \text{ MPa}$;

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

Nominal size	Force
	N
10	380
12	470
15	600
18	870
22	1 190
28	1 960
35	3 020

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

Nominal size	Force
	N
10	380
12	470
16	760
20	1 020
25	1 550
32	2 500
40	3 900
50	6 200
63	9 800
75	13 700
90	19 900
110	29 600

B.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 7291-3:2010, Annex B;
- 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 C (informative) **Guidance on factory quality 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 C.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 C.1 Applicability of requirements and test methods

Product	Property	Clause	Method	Test type	
				Type test	Batch release test
Pipes	Material	3.1		x	
Fittings	Material	3.1, 3.2, 5.1 and 5.2		x	
Pipes	Degree of cross-linking	3.4.3	BS 7291- 3:2010, Annex A	x	x ^{A)}
Pipes	Oxygen permeability	3.4.4	BS 7291- 1:2010, 6.7	x	
Elastomeric jointing seals	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	4.1.2		x	
Pipes	Elongation at break	4.2.1	BS EN ISO 6259-1	x	
Pipes	Short-term hydrostatic pressure resistance at 95 °C	4.2.3	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- 1:2002, Annex B	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) This test can be an agreed indirect test method.

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.

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- [1] GREAT BRITAIN: The Health and Safety at Work, etc Act 1974, The Stationery Office: London.
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