BS 5391-1:2006

BRITISH STANDARD

Acrylonitrile-butadiene-styrene (ABS) pressure pipe –

Part 1: Specification

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 19 and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 29 December 2006. 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 this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5391-1:1976, which is withdrawn.

Relationship with other publications

Attention is also drawn to BS 5392-1, which specifies requirements for ABS fittings for use with the pipe.

Information about this document

This British Standard can be referred to as BS 5391 instead of BS 5391-1 because there are no other parts to this standard. Future revisions of this standard will drop Part 1 from the identifier. In preparation for this, pipes conforming to this standard can be marked with "BS 5391" instead of "BS 5391-1".

For this revision, the nominal size dimensions specified in Table 1 conform to BS ISO 11922-2:1997 instead of BS 3867, which has been declared obsolescent. This revision also introduces nominal dimension sizes of 10 and 12.

Maximum sustained working pressures are based on a recommended working stress for the material of 7.5 MPa at a temperature of 20 °C when in pipe form and are specified in bars (where 1 bar = 10^5 N/m^2 = 100 kPa).

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.

Presentational 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 a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies requirements for pipe made from acrylonitrile-butadiene-styrene (ABS) polymer for the conveyance of liquid and gaseous fluids as well as solid matter in fluids.

This British Standard is applicable, for example, to pipes intended to be used for:

a) chemical plants;

b) industrial sewerage engineering;

c) power engineering (cooling and general-purpose water supply);

d) electroplating and pickling plants;

e) the semiconductor industry;

f) agricultural production plants;

g) water treatment;

h) potable water supply;

i) low temperature applications down to −40 °C.

NOTE Pipe conforming to this standard can be used for the transport of water intended for human consumption if it conforms to the relevant national, regional or local regulatory provisions applicable in the place of use. For products in the United Kingdom, attention is drawn to The Water Supply (Water Fittings) Regulations 1999 [1].

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 21, *Specification pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions)*

BS EN 743:1995, *Plastics piping and ducting systems – Thermoplastic pipes – Determination of the longitudinal reversion*

BS EN ISO 306:2004, *Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)*

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 method*

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*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 audit test
test performed by or on behalf of a certification body to confirm that the material, component, joint or assembly continues to conform to the requirements given in the standard and to provide information to assess the effectiveness of the quality system

[DD CEN/TS 1555-7:2003, **3.1.11**]

3.2 batch release test
test performed by the manufacturer on a batch of components, which has to be satisfactorily completed before that batch can be released

[DD CEN/TS 1555-7:2003, **3.1.9**]

3.3 certification body
impartial body, governmental or non-governmental, possessing the necessary competence and responsibility to carry out certification of conformity according to given rules of procedure and management

[DD CEN/TS 1555-7:2003, **3.1.1**]

3.4 lot
clearly identifiable sub-division of a batch for inspection purposes

[DD CEN/TS 1555-7:2003, **3.1.19**]

3.5 out of roundness
difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of the pipe

[BS ISO 11922-2:1997, **3.2.5**]

3.6 pipe batch
number of pipes, all of them the same nominal diameter and nominal wall thickness, extruded from the same compound and the same machine

NOTE The pipe batch is defined and identified by the pipe manufacturer.

[DD CEN/TS 1555-7:2003, **3.1.17**]

3.7 quality system
organizational structure, responsibilities, procedures and resources for implementing quality management

[DD CEN/TS 1555-7:2003, **3.1.4**]

3.8 quality plan
document setting out specific quality practices, resources and sequence of activities relevant to a particular product or range of products

[DD CEN/TS 1555-7:2003, **3.1.5**]

3.9 type test
test performed to prove that the material, component, joint or assembly is capable of conforming to the requirements given in the relevant standard

[DD CEN/TS 1555-7:2003, **3.1.6**]

4 Material

4.1 The material from which the pipe is made shall be acrylonitrile-butadiene-styrene (ABS) polymer.

NOTE If the pipe is intended for use with foodstuffs or pharmaceuticals, attention is drawn to the guidance given in British Plastics Federation publication, Plastics in contact with food – A guide *[2].*

4.2 The Vicat softening temperature of the material from which the pipe is made shall be determined in accordance with BS EN ISO 306:2004, method B50. The deformation temperature of the material shall not be lower than 90 °C.

4.3 When using reprocessable material, it shall be from either:

a) pipe manufactured in accordance with this standard; or

b) fittings manufactured in accordance with BS 5392-1.

5 Classification of pipe

Pipe shall be classified in accordance with Table 1, according to its suitability for threading and for maintaining a particular maximum sustained working pressure.

Table 1 **Classification of pipe**

Pressure class	**Working pressure** bar [A)]	**Suitability for threading**
Class B	6.0	Unsuitable for threading
Class C	9.0	
Class D	12.0	
Class E	15.0	
Class T	12.0	Suitable for threading in accordance with BS 21

NOTE The maximum sustained working pressures are based on the conveyance of water at a temperature of 20 °C. These pressures are the respective maximum sustained working pressures for which the classes of pipe are suitable for use.

A) 1 bar = 10^5 N/m^2 = 100 kPa

6 Dimensions

6.1 Pipe dimensions shall be measured in accordance with BS EN ISO 3126.

6.2 Pipe shall conform to the dimensions given in Table 2.

6.3 Pipe dimensions shall be designated by the nominal sizes in Table 2.

6.4 Pipe shall be supplied in straight lengths.

NOTE Pipe is normally supplied in 6 m lengths.

Table 2 **Dimensions**
Dimensions in mm

Diameter					**Wall thickness for a particular pressure class** [A]									
Nominal size	**Size group**	**Mean outside diameter** [B]		**Out of roundness of outside diameter** [C]	**Class B**		**Class C**		**Class D**		**Class E**		**Class T** [D]	
					6.0 bar		**9.0 bar**		**12.0 bar**		**15.0 bar**		**12.0 bar**	
		min.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
3/8	1	17.0	17.3	0.5	–	–	–	–	–	–	1.6	1.9	3.4	3.8
½		21.2	21.5	0.5	–	–	–	–	–	–	1.9	2.2	3.5	4.0
¾		26.6	26.9	0.5	–	–	–	–	–	–	2.4	2.8	3.5	4.0
1		33.4	33.7	0.5	–	–	1.9	2.2	2.5	2.9	3.0	3.5	4.2	4.8
1¼		42.1	42.4	0.6	–	–	2.4	2.8	3.1	3.6	3.8	4.3	5.1	5.8
1½		48.1	48.4	0.6	–	–	2.7	3.1	3.6	4.1	4.4	5.0	5.8	6.5
2		60.2	60.5	0.8	–	–	3.4	3.9	4.5	5.1	5.5	6.2	7.0	7.9
3	2	88.7	89.1	1.1	–	–	5.0	5.7	6.5	7.3	8.1	9.1	–	–
4		114.1	114.5	1.4	–	–	6.5	7.3	8.4	9.4	10.4	11.6	–	–
6		168.0	168.5	2.1	6.5	7.3	9.5	10.6	12.3	13.7	15.3	17.0	–	–
8		218.8	219.5	2.7	8.4	9.4	12.4	13.8	16.2	18.1	19.9	22.1	–	–
10	3	272.6	273.5	3.3	10.5	11.7	–	–	–	–	–	–	–	–
12		323.4	324.4	3.9	12.5	13.9	–	–	–	–	–	–	–	–

A) The values correspond to Grade V of BS ISO 11922-2:1997.
B) Mean outside diameter of a pipe is taken to be the arithmetic mean of any two perpendicularly opposed individual outside diameters. Alternatively, the mean outside diameter may be measured by means of a circumference tape.
C) The values correspond to 0.5 × Grade Q of BS ISO 11922-2:1997.
D) Class T pipe is intended only for threading. A maximum sustained working pressure of 12 bar applies when threading is carried out in accordance with BS 21.

7 Physical and mechanical characteristics

7.1 Appearance and colour

7.1.1 The internal and external surfaces of the pipe shall be smooth, clean and free from surface defects to an extent that would prevent conformity to this standard.

7.1.2 The ends of the pipe shall be cleanly cut and square to the axis of the pipe.

7.1.3 The colour of the pipe shall be agreed between manufacturer and purchaser.

NOTE Preferably, the colour should be grey.

7.2 Longitudinal reversion

7.2.1 Longitudinal reversion shall be tested in accordance with Annex A.

7.2.2 The maximum change of length, measured at any point around the pipe circumference, shall be 5% for pipe sizes 2 and above or 10% for pipe sizes up to and including 1½.

7.2.3 After testing, the pipe shall show no faults, e.g. cracks, cavities or blisters.

7.3 Resistance to heat ageing

7.3.1 Heat ageing shall be performed in accordance with Annex B.

7.3.2 After heat ageing, the pipe shall conform to **7.5** except that the mass of the weighted striker shall be reduced to 50% of the appropriate value given in Table D.2.

7.4 Resistance to weathering

7.4.1 Weathering shall be performed in accordance with Annex C.

7.4.2 After weathering, the pipe shall conform to **7.5** except that the mass of the weighted striker shall be reduced to 50% of the appropriate value given in Table D.2.

7.5 Impact resistance

7.5.1 Impact resistance shall be tested in accordance with Annex D.

7.5.2 A test specimen shall be deemed to have failed the test if it fractures or cracks through the complete wall thickness.

7.5.3 The overall performance of the pipe during testing shall be judged on the failure rate as follows.

a) If the first 14 specimens tested contain no failure the pipe batch shall be deemed to be satisfactory.

b) If the first 14 specimens tested contain four or more failures the pipe batch shall be deemed to be unsatisfactory.

c) If the first 14 specimens tested contain one, two or three failures a further 28 test specimens shall be tested; if during this further testing the total number of failures among the 42 specimens exceeds five, the pipe batch shall be deemed to be unsatisfactory.

7.6 Short-term hydrostatic resistance

7.6.1 Short-term hydrostatic resistance shall be tested in accordance with Annex E.

7.6.2 During testing, the pipe shall withstand the appropriate internal hydrostatic test pressure in Table 3, for at least 1 h without failure.

Table 3 **Short-term internal hydrostatic test pressures**

Pressure class of pipe	**1 h internal hydrostatic test pressure** bar [A)]
Class B	19.2
Class C	28.8
Class D	38.4
Class E	48.0
Class T	38.4

NOTE 1 Class T pipe is intended only for threading and has a maximum working pressure of 12 bar.

NOTE 2 Values of hydrostatic test pressure that are higher than those specified in this table may be used.

[A)] 1 bar = 10^5 N/m^2 = 100 kPa

7.7 Long-term hydrostatic resistance

7.7.1 Long-term hydrostatic resistance shall be tested in accordance with Annex F.

7.7.2 During testing, the fitting shall withstand the appropriate circumferential (hoop) stress in Table 4, for durations of (100 to 1 000) h and ⩾1 000 h without failure.

Table 4 **Long-term circumferential (hoop) stresses**

Pressure class of pipe	**Circumferential (hoop) stress** MPa	
	100 h test	**1 000 h test**
Class B	20.6	18.6
Class C		
Class D		
Class E		
Class T		

NOTE 1 Class T pipe is intended only for threading and has a maximum working pressure of 12 bar.

NOTE 2 Values of circumferential (hoop) stress that are higher than those specified in this table may be used.

7.7.3 The tests in Annex F shall be performed until a break occurs in the wall of the test piece, in which case the time to breakage shall be recorded. If a break occurs in the wall of the test piece at a distance of less than 10% of the free length of the test piece, the result shall be disregarded and the test repeated using another test piece.

7.8 Disposal of tested fittings

Pipe that has been used for hydrostatic pressure tests are not suitable for subsequent use in service and shall not be taken into stock or reprocessed.

8 Assessment of conformity

NOTE Guidance on the assessment of conformity is given in Annex G.

9 Marking

9.1 Pipe markings shall be printed or formed directly on the pipe in such a way that legibility is not affected by storage, weathering and handling.

9.2 Marking shall not initiate cracks or other types of defects that adversely influence the performance of the pipe to such an extent that the pipe cannot conform to this standard.

9.3 The size of the marking shall be such that the marking is legible without magnification.

9.4 Pipe shall be marked longitudinally with, as a minimum:

a) the manufacturer's name and/or trade mark;

b) the number of this British Standard, e.g. BS 5391[1)];

NOTE Future revisions of this standard will drop Part 1 from the identifier because there are no other parts to this standard. In preparation for this, pipes conforming to this standard are allowed to be marked with "BS 5391" instead of "BS 5391-1".

c) the pressure class as given in Table 1, e.g. Class E;

d) the nominal size, as given in Table 2, e.g. 4;

e) the material, i.e. ABS;

f) the manufacturer's information, including:

1) the batch number or the production period (year and month), in figures or in code form; and

2) if the manufacturer is producing at different sites, a name or code for each of the production sites.

9.5 Pipe shall be marked at a frequency of not greater than 1 m, with each pipe being marked at least once.

9.6 If the marking is printed on the pipe, the colour of the printed information shall differ from the colour of the pipe.

10 Stocking and transport

For the purpose of stocking and transport, the pipe shall be protected from damage.

[1)] Marking BS 5391 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 solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Annex A (normative) Longitudinal reversion test

Longitudinal reversion shall be tested in accordance with BS EN 743:1995, Method A or Method B, using the test parameters given in Table A.1.

Table A.1 **Longitudinal reversion test**

Test method	**Test parameter** [A]		**Value**
BS EN 743:1995, Method A (liquid bath, using a suitable mineral oil)	Test temperature		150 °C
	Length of test piece		200 mm
	Immersion time	$e \leqslant 8$ mm	15 min
		8 mm $< e \leqslant$ 16 mm	30 min
		$e >$ 16 mm	60 min
BS EN 743:1995, Method B (in air)	Test temperature		150 °C
	Length of test piece		200 mm
	Exposure time	$e \leqslant 8$ mm	60 min
		8 mm $< e \leqslant$ 16 mm	120 min
		$e >$ 16 mm	240 min

BS EN 743:1995, Method A shall be used in cases of dispute.

When testing in accordance with BS EN 743:1995, Method A, polyethylene glycol shall not be used, however, mineral oils that are free from aromatic hydrocarbons are generally suitable for use as the heat transfer medium.

[A] e is the wall thickness of the pipe at any point.

Annex B (normative) Test for resistance to heat ageing

B.1 Form of test specimens

Each test specimen shall be taken from a pipe batch that has satisfied the impact strength test described in Annex D. Each specimen shall be a complete section of pipe (150 ± 10) mm long. The ends of each specimen shall be cut clean and square to the axis of the pipe.

B.2 Apparatus

B.2.1 *Oven*, electrically heated with a circulating fan, the whole interior of which is maintained automatically at a temperature of (100 ± 2) °C.

B.3 Procedure

Stand the test specimens vertically in the oven, supported if necessary by a simple jig that has been preheated in the oven. After $500\ ^{+16}_{0}$ h at a temperature of (100 ± 2) °C remove the specimens from the oven and allow them to cool. Impact test the specimens in accordance with Annex D, but using the lower striker mass specified in **7.3**.

Annex C (normative) Test for resistance to weathering

C.1 Form of test specimen

C.1.1 Only one size of pipe shall be tested and the pipe shall conform to size group 1 in Table 2.

NOTE This method of testing resistance to weathering is not dependent on of the size of the pipe being tested, therefore, alternative pipe sizes may be used.

C.1.2 Test specimens shall be taken from a pipe batch that has satisfied the impact strength test described in Annex D.

C.2 Apparatus

C.2.1 *Stand*, supporting the pipe at an angle of 45°, facing south (in the northern hemisphere) in an open location in such a manner that the specimen is exposed along its whole length.

C.3 Procedure

Mount the pipe in accordance with **C.2**. After exposure for 700 sunshine hours, remove the pipe. Impact test the specimens in accordance with Annex D, but using the lower striker mass specified in **7.4**.

NOTE A method of exposure to direct (natural) weathering is given in BS EN ISO 16871.

Annex D (normative) Test for impact resistance at 0 °C

D.1 Form of test specimen

D.1.1 Each specimen shall be a complete section of pipe, of a length equal to twice the nominal size or 150 mm, whichever is the greater, subject to a maximum length of 300 mm. The ends of the specimen shall be cut clean and square to the axis of the pipe.

D.1.2 For "round the clock" testing each specimen shall be marked with a longitudinal zero line and from this line the number of further lines stated in Table D.1 shall be marked equidistantly.

NOTE For pipe of nominal size 2 and over, specimens are subjected to impacts equally spaced around the pipe as an economy measure; this procedure is known as "round the clock" testing.

D.2 Apparatus

D.2.1 *Falling weight machine*, an example of which is shown in Figure D.1, consisting of the following.

a) A main frame that can be rigidly fixed in a true vertical position.

b) Guide rails, carried from the inside of the main frame, on side bearings that can be adjusted to keep them parallel and vertical.

c) A weighted striker that can fall freely within the guide rails and which is equipped with a hardened hemispherical striking surface 25 mm in diameter.

d) An appropriate set of weights that can be firmly attached to the striker to enable the combined mass of the striker and weight to be adjusted to the values given in Table D.2 and to half these values.

e) A specimen support, consisting of a 120° vee block at least 230 mm in length which is positioned below the guide rails so that the tip of the striker is not more than 2.5 mm from the axis of the vee block.

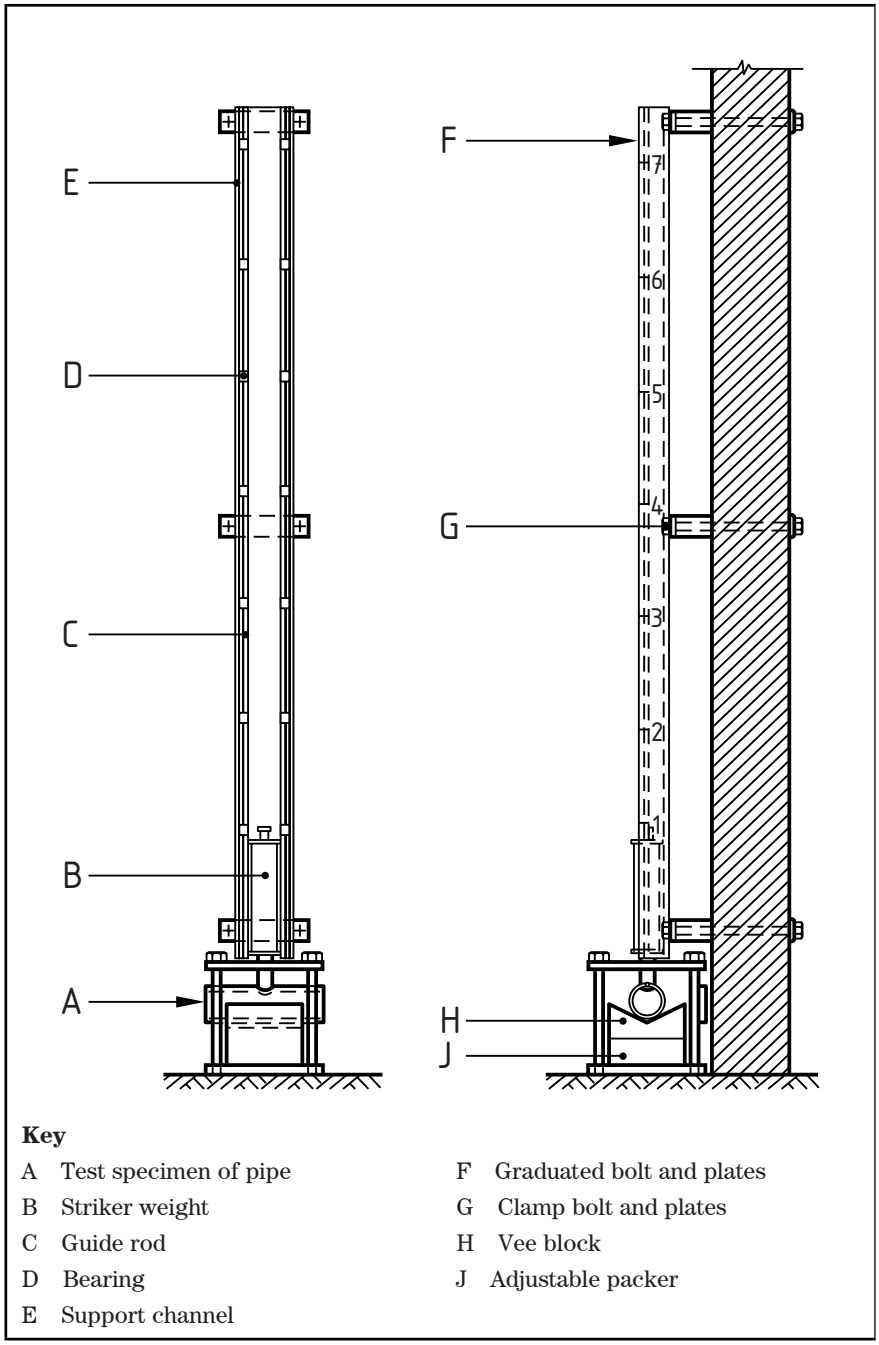
f) A release mechanism such that the striker can fall through a height of (2.00 ± 0.01) m on to the top surface of the pipe specimen.

g) Means for maintaining a constant height of fall by vertical movement of the vee block, the release mechanism or the main frame, in order to accommodate different pipe diameters.

Table D.1 **Number of lines for "round the clock" testing**

Nominal size of pipe	**Number of equidistant lines to be drawn**
2	3
3	4
4	6
6	8
8	12
10	16
12	16

Figure D.1 **Suitable impact testing machine**



Key

A Test specimen of pipe
B Striker weight
C Guide rod
D Bearing
E Support channel
F Graduated bolt and plates
G Clamp bolt and plates
H Vee block
J Adjustable packer

D.3 Procedure

D.3.1 Adjust the total mass of the striker to the value, appropriate to the diameter of the pipe under test, given in Table D.2.

Table D.2 **Total mass of striker**

Nominal size of pipe	**Total mass of striker** kg
3/8	1
½	1.25
¾	2
1	2.25
1¼	2.5
1½	3
2	4
3	5
4	6
6	7
8	9
10	9
12	9

D.3.2 Condition each specimen in accordance with BS EN 743:1995, Method A or Method B, using the test parameters given in Table D.3.

Table D.3 **Conditioning of test specimens prior to impact testing**

Test method	**Test parameter** [A]		**Value**
BS EN 743:1995, Method A (liquid bath)	Test temperature		0 °C
	Length of test piece		200 mm
	Immersion time	$e \leqslant 8$ mm	15 min
		8 mm < $e \leqslant 16$ mm	30 min
		$e > 16$ mm	60 min
BS EN 743:1995, Method B (in air)	Test temperature		0 °C
	Length of test piece		200 mm
	Exposure time	$e \leqslant 8$ mm	60 min
		8 mm < $e \leqslant 16$ mm	120 min
		$e > 16$ mm	240 min

BS EN 743:1995, Method A shall be used in cases of dispute.

When testing in accordance with BS EN 743:1995, Method A polyethylene glycol shall not be used.

[A] e is the wall thickness of the pipe at any point.

D.3.3 Test individual specimens within 10 s of removal from the conditioning environment.

D.3.4 Allow the striker to fall freely through 2 m on to the pipe specimen that is mounted on the vee block support.

D.3.5 Subject specimens of nominal sizes from 3/8 to 1½ (inclusive) to a single strike only.

D.3.6 For pipe of nominal size 2 and above, place the pipe on the vee block so that one of the marked lines is uppermost. Then allow the weighted striker to fall freely on to the marked line on the pipe, as described in **D.3.4**.

D.3.7 If the specimen does not fail as a result of cracking or splitting, rotate the specimen until the next, marked line is uppermost on the vee block, and cause a second blow to be made by the striker. Repeat the process until all the marked lines have been tested, or until a failure is recorded.

D.3.8 If the required sequence of impacts has not been completed within 10 s, interrupt the procedure and immediately recondition the specimen at a temperature of (0 ± 1) °C for a further period of a least 10 min.

Annex E (normative) Short-term hydrostatic resistance test

Short-term hydrostatic resistance shall be tested in accordance with BS EN ISO 1167-1, using the test parameters in Table E.1 and test pieces conforming to BS EN ISO 1167-2.

Table E.1 **Parameters for short-term hydrostatic resistance testing**

Test method	**Test parameter**	**Value**
BS EN ISO 1167-1 (water-in-water)	Type of end cap	Type B
	Test temperature	(20 ± 1) °C
	Size of pipe	All
	Number of test pieces	1
	Hydrostatic test pressure	Table 3
	Type of test	Water-in-water
	Duration of test	⩾1 h
	Criteria for a failure	In accordance with **7.6.2**
BS EN ISO 1167-1 (water-in-air)	Type of end cap	Type B
	Test temperature	(20 ± 1) °C
	Size of pipe	All
	Number of test pieces	1
	Hydrostatic test pressure	Table 3
	Type of test	Water-in-air
	Duration of test	⩾1 h
	Criteria for a failure	In accordance with **7.6.2**

The BS EN ISO 1167-1 water-in-water type of test shall be used in cases of dispute.

When testing in accordance with the BS EN ISO 1167-1 water-in-water type of test, type A end caps may be used providing correlation can be demonstrated with the results obtained by using type B end caps, however, type B end caps shall be used in cases of dispute.

Annex F (normative) Long-term hydrostatic resistance test

Long-term hydrostatic resistance shall be tested in accordance with BS EN ISO 1167-1, using the test parameters in Table F.1 and test pieces conforming to BS EN ISO 1167-2.

Table F.1 **Parameters for long-term hydrostatic resistance testing**

Test method	Test parameter	Value
BS EN ISO 1167-1 (water-in-water)	Type of end cap	Type B
	Test temperature	(20 ± 1) °C
	Size of pipe	All
	Number of test pieces	1
	Min. circumferential (hoop) test pressure	Table 4
	Type of test	Water-in-water
	Duration of test	First test: >100 h Second test: ⩾1 000 h
	Criteria for a failure	In accordance with **7.7**
BS EN ISO 1167-1 (water-in-air)	End caps	Type B
	Test temperature	(20 ± 1) °C
	Size of pipe	All
	Number of test pieces	1
	Min. circumferential (hoop) stresses	Table 4
	Type of test	Water-in-air
	Duration of test	First test: >100 h Second test: ⩾1 000 h
	Criteria for a failure	In accordance with **7.7**

The BS EN ISO 1167-1 water-in-water type of test shall be used in cases of dispute.

When testing in accordance with the BS EN ISO 1167-1 water-in-water type of test, type A end caps may be used providing correlation can be demonstrated with the results obtained by using type B end caps, however, type B end caps shall be used in cases of dispute.

Annex G (informative) Guidance for the assessment of conformity

G.1 Type tests

G.1.1 General

G.1.1.1 Type tests should demonstrate that the pipes conform to all the requirements of this standard.

G.1.1.2 In the case of new systems, for which no type tests have been carried out, and which are not covered by other relevant standards, all characteristics should be type tested.

G.1.1.3 Relevant type tests should be carried out whenever there is a change in design, or in material and when there is an extension of the product range. The relevant characteristics should be tested, as agreed between the certification body and manufacturer.

*NOTE The criteria for identifying a change in material are given in **G.5**.*

G.1.1.4 The manufacturer's quality plan should specify the design, applicable tolerances, materials and product range.

G.1.1.5 The characteristics given in **G.1.2** and **G.1.3** should be type tested at the stated minimum sampling frequency.

G.1.2 Type testing of material

The characteristics of material given in Table G.1 should be type tested.

Table G.1 **Characteristics of material that require type testing**

Characteristic [A]	**Requirements**	**When relevant?**				**Sampling procedure**	**Number of test pieces**
		New design	**Change in design**	**Change of material**	**Extension of the product range**		
Resistance to weathering	**7.4**	Yes	No	Yes	No	Once per material	–
Long-term hydrostatic resistance	**7.7**						

[A] Conformity to the requirements of these characteristics may be declared by the raw material producer.

G.1.3 Type testing of pipes

The characteristics of pipes given in Table G.2 should be type tested.

Table G.2 **Characteristics of pipes that require type testing**

Characteristic [A]	**Requirements**	**When relevant?**				**Sampling procedure**	**Number of test pieces**
		New design	**Change in design**	**Change of material**	**Extension of the product range**		
Dimensions	Clause **6**	Yes	Yes	Yes	Yes	Once per size and pressure class	1
Appearance and colour	**7.1**	Yes	Yes	Yes	Yes	Once per size group	1
Longitudinal reversion	**7.2**	Yes	Yes	Yes	Yes	Once per size group and pressure class	1
Heat ageing	**7.3**	Yes	Yes	Yes	Yes	Once per size group and pressure class	1
Impact resistance	**7.5**	Yes	Yes	Yes	Yes	Once per size group and pressure class	Refer to Annex D
Short-term hydrostatic resistance	**7.6**	Yes	Yes	Yes	Yes	Once per size group and pressure class	1
Long-term hydrostatic resistance	**7.7**	Yes	Yes	Yes	Yes	Once per size group and pressure class	1
Marking	Clause **9**	Yes	No	No	Yes	Once per size and pressure class	1

[A] Conformity to the requirements of these characteristics may be declared by the raw material producer.

G.2 Batch release tests

G.2.1 General

G.2.1.1 The characteristics given in **G.2.3** should be batch release tested at the stated minimum sampling frequency.

G.2.1.2 All tests should be carried out for each start up of the production facility of a pipe. A restart after production has been suspended should not be considered as an interruption of a continuous production, provided this period of interruption does not exceed a maximum period to be defined in the manufacturer's quality plan.

G.2.1.3 The manufacturer should specify a pipe batch or lot in his quality plan.

NOTE A batch will not normally be longer than one month.

G.2.2 Sampling frequency and retest procedure

G.2.2.1 A pipe batch or lot should only be released for supply when all the relevant tests and inspections given in Table G.2 have been carried out at least once and have been successful.

G.2.2.2 If any pipe fails in respect of any characteristic, the batch or lot should be rejected, or the retest procedures should be performed for the characteristic on which the pipe failed.

G.2.2.3 The manufacturer should have the option of either of the following retest procedures.

a) Retesting the pipe batch, but on a tightened inspection procedure (e.g. special inspection level S-2 instead of S-1). Or

b) Dividing the pipe batch into several lots of any convenient size and testing each lot on a tightened inspection procedure.

G.2.2.4 If the manufacturer chooses **G.2.2.3**a) and if the pipes pass the tests, the pipe batch should be deemed to conform to the requirements of this standard. If any of the pipes fail any of the tests, the pipe batch should be deemed not to conform to the requirements of this standard.

G.2.2.5 If the manufacturer chooses option **G.2.2.3**b), the requirements should apply to each lot. If the pipes pass the tests, the lot should be deemed to conform to the requirements of this standard. If any of the pipes fails any of the tests, the lot should be deemed not to conform to the requirements of this standard.

G.2.2.6 Procedures for dealing with rejected pipe should be detailed in the manufacturer's quality plan.

*COMMENTARY ON **G.2.2***

*The sampling procedure described in **G.2.2** is designed to be undertaken by the manufacturer, at his works. Additional specimens may be tested and witnessed at the works by arrangement at additional cost to the purchaser.*

Recommendations for special inspection levels S-1 and S-2 and for tightened inspection procedures are contained in BS 6001-1:1999.

G.2.3 Batch release testing of pipes

The characteristics of pipes given in Table G.3 should be batch release tested.

Table G.3 **Characteristics of pipes that require batch release testing**

Characteristic	Requirements	Minimum sampling frequency per production line	Number of test pieces	Retest procedure
Dimensions	Clause **6**	Automatically, or every 4 h	1	**G.2.2**
Appearance and colour	**7.1**	Once per 8 h		
Longitudinal reversion	**7.2**	Once per 24 h		
Impact resistance	**7.5**	Once per 24 h		
Short-term hydrostatic resistance	**7.6**	Start up only		
Marking	Clause **9**	Once per 8 h		

G.3 Audit tests

G.3.1 General

The nominal pipe sizes and pipe pressure classes selected for tests should be primarily those that have not previously been selected for audit testing. Samples should preferably be taken from the largest volume of production, per size group.

NOTE If third-party certification is involved, all relevant characteristics specified in this standard may be audit tested. Minimum sampling frequencies are given in Table G.4.

G.3.2 Audit testing of pipes

The characteristics of pipes given in Table G.4 should be audit tested.

Table G.4 **Characteristics of pipes that require audit testing**

Characteristic	Requirements	Minimum sampling frequency per production line	Number of test pieces
Dimensions	Clause **6**	Once per year, one size group and one pressure class	1
Appearance and colour	**7.1**		
Longitudinal reversion	**7.2**		
Impact resistance	**7.5**		
Short-term hydrostatic resistance	**7.6**		
Marking	Clause **9**		

G.4 Sampling after delivery

*NOTE The guidance given in **G.1**, **G.2** and **G.3** is related to the production of the pipe. The guidance is intended for use by a manufacturer or certification authority carrying out tests at the time of manufacture or up to three months from delivery to the purchaser on pipe that has been stored in accordance with the manufacturer's instructions since delivery.*

G.5 Conditions for the change of material

G.5.1 For the purpose of defining a change of material, the conditions given in Table G.5 should apply.

G.5.2 If third-party certification is involved, the relevant characteristics given in Clause **7**, as applicable, should be retested as agreed between certification body and manufacturer.

Table G.5 **Conditions for the change of material**

Type of material change	**Conditions**
Change of grade	Change of raw material producer
	Change of polymerization process
	Change in chemical nature of the co-monomer
Additives (e.g. pigments, stabilizers)	±30% change in proportion of any additive
	Change of chemical characteristic or type

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Standards publication

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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