BRITISH STANDARD

BS 4346-1: 1969

Incorporating Amendment Nos. 1, 2, 3, 4 and 5

Specification for

Joints and fittings for use with unplasticized PVC pressure pipes —

Part 1: Injection moulded unplasticized PVC fittings for solvent welding for use with pressure pipes, including potable water supply

UDC 621.643.4:678.743.22

Co-operating organizations

The Plastics Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Board of Trade
British Electrical and Allied Manufacturers' Association
British Plastics Federation*
Electrical Research Association
Engineering Equipment Users' Association*
Ministry of Defence, Army Department*
Ministry of Defence, Navy Department*
Ministry of Public Building and Works, Building Research Station*
Ministry of Technology
Oil Companies Materials Association*
Plastics Institute
Post Office
Royal Institute of British Architects*
Royal Institute of Public Health & Hygiene
Rubber and Plastics Research Association of Great Britain
Society of Motor Manufacturers and Traders Ltd.
Surface Coating Synthetic Resin Manufacturers' Association

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Industrial Biological Research Association
British Mechanical Rubber Manufacturers' Association
British Rubber Manufacturers' Association Ltd.
British Waterworks Association
Chemical Industries Association
Copper Tube Fittings Manufacturers' Association
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Gas Council
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Institution of Municipal Engineers
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Institution of Water Engineers
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Ministry of Public Building and Works
National Brassfoundry Association
National Coal Board
National Federation of Plumbers and Domestic Heating Engineers
Plastic Pipe Manufacturers' Society
Water Companies Association
Water Research Association

This British Standard, having been approved by the Plastics Industry Standards Committee, was published under the authority of the Executive Board on 13th February 1969

The following BSI references relate to the work on this standard:
Committee references PLM/9, PLM/9/2
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Contents

Foreword

This standard makes reference to the following British Standards:

BS 2782, *Methods of testing plastics.*

BS 3505, *Unplasticized PVC pipe for cold water services.*

BS 3506, *Unplasticized PVC pipe for industrial uses.*

BS 9001, *Sampling procedures and tables for inspection by attributes for electronic parts of assessed quality.*

CP 310, *Water supply.*

CP 312, *Plastics pipework (thermoplastic material).*

CP 312-1, *General principles and choice of material.*

CP 312-2, *Unplasticized PVC.*

This British Standard has been prepared under the authority of the Plastics Industry Standards Committee. Where appropriate the requirements, including those for effect on water, are the same as specified in BS 3505[1)]. However, a stress relief test is included instead of a test for impact strength which is not considered to be meaningful when applied to fittings. No hydraulic proof test is included in the requirements but a suitable test procedure is laid down in CP 310[2)].

Dimensions are expressed in metric units but it has been decided to continue to designate the **nominal** size of fittings in inches, because it is thought that considerable confusion would be caused if these were changed to metric units at this stage.

The requirements for the effects of materials upon water quality have been updated to enable fittings complying with this British Standard to be acceptable to UK water undertaking.

Attention is drawn to CP 312[3)] which has been prepared to assist users in assessing the suitability of plastics pipes for particular purposes and to ensure their proper application.

Attention is drawn to other Parts of this standard, as follows:

— *Part 2: Mechanical joints and fittings, principally of unplasticized PVC.*

— *Part 3: Specification for solvent cement.*

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 7 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1) BS 3505, "*Unplasticized PVC pipe for cold water services*".

2) CP 310, "*Water supply*".

3) CP 312, "*Plastics pipework (thermoplastic material)*", Part 1, "*General principles and choice of material*", Part 2, "*Unplasticized PVC*".

1 Scope

1.1 This British Standard applies to injection moulded pipe fittings made from unplasticized polyvinyl chloride and of which one or more of joints is intended, for solvent welding to unplasticized polyvinyl chloride pressure pipes conforming to the dimensions of Table 1 of BS 3505[4] and Table 1 of BS 3506[5].

1.2 Fittings complying with this standard are suitable for potable water supplies in conjunction with pipe complying with BS 3505, and may also be used for industrial purposes in conjunction with pipe complying with BS 3506.

2 Material

2.1 The material from which the fittings are made shall consist substantially of polyvinyl chloride to which may be added only those additives that are needed to facilitate the manufacture of the polymer and of sound, durable fittings, with good surface finish, mechanical strength and opacity. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic hazard, or to impair the chemical and physical properties of the fittings as defined in this standard.

2.2 *Text deleted.*

2.3 When tested in accordance with BS 2782:Method 120B[6], the deformation temperature of the material under load shall not be lower than 72 °C.

3 Dimensions

3.1 The sockets of the fittings shall conform to the dimensions specified in Table 1 taken at the mid point of the socket depth.

NOTE The minimum socket depths (L) have been calculated using the formula:

$L = 0.5\ D + 6$ mm (0.236 in)

where D = mean outside diameter of the pipe (see **1.1**). This is the formula given in ISO 727[7].

3.2 At no place shall the internal diameter of a socket be greater than the mouth internal diameter of the same socket. The diameter of the socket may decrease from mouth to root, for pipe nominal size ⅜ to 2½ the total included angle of taper shall not exceed 0° 40′, and for pipe nominal size 3 and above the total included angle of taper shall not exceed 0° 30′.

3.3 An out of roundness tolerance of ± 0.2 % is allowed on the mid mean socket internal diameter.

Table 1 — Socket dimensions (See Figure 1)

Nominal size	Minimum socket depth L	Mean socket internal diameter at mid point of socket depth	
		Minimum	Maximum
	mm	mm	mm
⅜	14.5	17.1	17.3
½	16.5	21.3	21.5
¾	19.5	26.7	26.9
1	22.5	33.5	33.7
1¼	27.0	42.2	42.4
1½	30.0	48.2	48.4
2	36.0	60.3	60.5
2½	43.5	75.1	75.3
3	50.5	88.8	89.1
4	63.0	114.2	114.5
5	76.0	140.1	140.4
6	90.0	168.2	168.5
7	103.0	193.7	194.0
8	115.5	219.0	219.4
9[a]	128.0	244.3	244.8
10[a]	142.5	272.8	273.4
12[a]	168.0	323.7	324.3

[a] Joints in these sizes require special techniques for solvent cementing and the advice of the manufacturer should be sought.

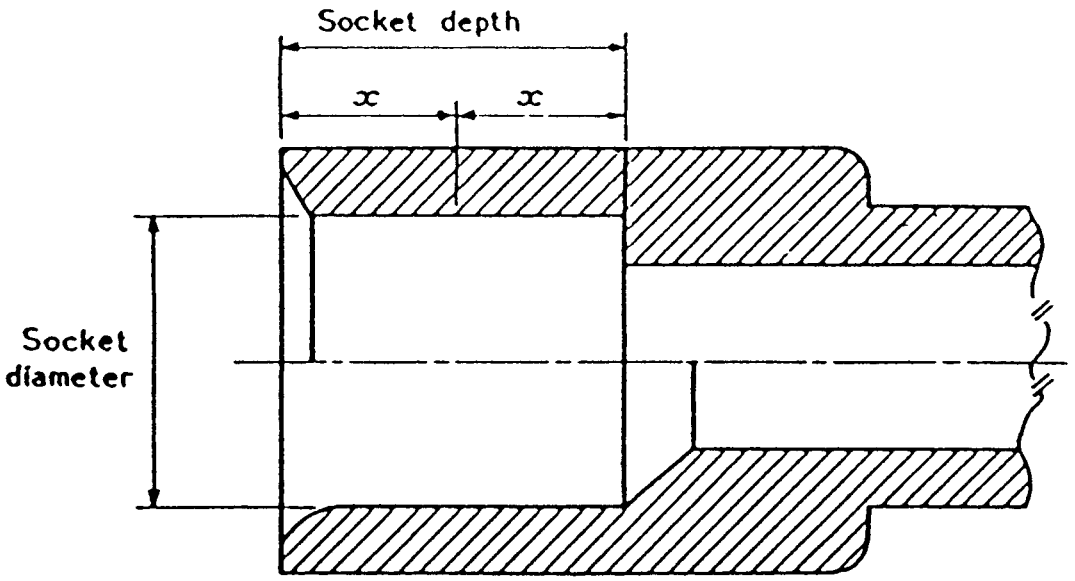
NOTE Where applicable, the spigot end(s) of a fitting shall have a minimum length equal to the minimum socket depth, and their diameter(s) shall conform to Table 1 of BS 3505:1968.

[4] BS 3505, "*Unplasticized PVC pipe for cold water services*".

[5] BS 3506, "*Unplasticized PVC pipe for industrial uses*".

[6] BS 2782, "*Methods of testing plastics:Method 120B*".

[7] ISO 727, "*Socket fittings for pipes under pressure. Unplasticized polyvinyl chloride (PVC) fittings with plain sockets. Metric series*".



NOTE This drawing is only intended to define the terms used in Table 1 and is not intended to illustrate specific design features.

Figure 1 — Socket dimensions

4 Physical and chemical characteristics

4.1 Stress relief test. When tested by the method described in Appendix A, none of the specimens tested shall show blisters, excessive delamination or cracking, or signs of weld line splitting. The weld line or lines may become more pronounced during the test, but this shall not be deemed to constitute failure.

For fittings moulded by conventional techniques, special care shall be taken in examining the area around the point of injection, where no cracks or delamination shall penetrate to a depth greater than 20 % of the wall thickness. For fittings moulded by end gating techniques, e.g ring or diaphragm methods, any cracks or delaminations in the wall of the fitting adjacent to the injection area shall be parallel to the axis and shall not penetrate to a depth of more than 20 % of the socket depth. The assessment of the depth of penetration of cracks or delaminations shall be carried out by sectioning the specimen at the point of injection and measuring the depth to which these defects penetrate the wall thickness of the fitting.

4.2 Resistance to sulphuric acid. When tested by the method described in Appendix B, the mass of the fitting shall neither increase by more than 3.16 g nor decrease by more than 0.13 g. The effect of the acid on the surface appearance of the fittings (roughening, bleaching or blackening) shall be ignored.

4.3 Opacity. When tested in accordance with BS 2782:Method 1104 A[8)] the wall of the fitting shall not transmit more than 0.2 % of the visible light falling on to it.

4.4 Effect on non-metallic materials on water quality

When used under the conditions for which they are designed, non-metallic materials in contact with or likely to come into contact with potable water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

8) BS 2782, "*Methods of testing plastics*" Part 11:Method 1104 "*Measurement of opacity of thermoplastics pipes and fittings*".

Concentrations of substances, chemicals and biological agents leached from materials in contact with potable water, and measurements of the relevant organoleptic/physical parameters shall not exceed the maximum values recommended by the World Health Organization in its publication "*Guidelines for drinking water quality, Vol.1 Recommendations*" (WHO, Geneva, 1984)[9] or as required by the EEC Council Directive of 15 July 1980 relating to the quality of water intended for human consumption (Official Journal of the European Communities L229, pp 11–29)[9], whichever in each case is the more stringent.

NOTE 1 Requirements for the testing of non-metallic materials in these respects are set out in the UK Water Fittings Byelaws Scheme Information and Guidance Note No. 5-01-02, ISSN 0267-0313, obtainable from the Water Research Centre, Water Byelaws Advisory Service, 660 Ajax Avenue, Slough, Berkshire SL1 4BG.

NOTE 2 Pending the determination of suitable means of characterizing the toxicity of leachates from materials in contact with potable water, materials approved by the Department of the Environment Committee on Chemicals and Materials of Construction for use in Public Water Supply and Swimming Pools are considered free from toxic hazard for the purposes of compliance with this subclause. A list of approved chemicals and materials is available from the Technical Secretary of that Committee at the Department of the Environment, Water Division, Romney House, 43 Marsham Street, London SW 1P 3PY.

NOTE 3 Products manufactured for installation and use in the United Kingdom which are verified and listed under the UK Water Fittings Byelaws Scheme administered by the Water Research Centre (address as in note 1) are deemed to satisfy the requirements detailed in this subclause.

5 Hydraulic pressure tests

5.1 Long-term hydraulic test (Type test). When tested by the method described in Appendix **E.1**, the extrapolated 1 hour and 50 year failure pressures shall be respectively not less than 3.6 times and not less than 2.1 times the working pressures of the joint or fitting.

5.2 Short-term hydraulic test (Batch test). When tested by the method described in Appendix **E.2**, the joint or fitting shall withstand a pressure of 3.6 ± 0.1 times the working pressure for 1 hour without failure.

5.3 Joints and fittings that have been used for the hydraulic pressure tests are not suitable for subsequent use in service, and shall not be taken back into stock.

6 Sampling

6.1 Type tests. Type tests are intended to prove the suitability and performance of a new composition, a new compounding or processing technique, or a new design or size of joint or fitting. Such tests therefore need be applied only when a change is made in polymer composition or method of manufacture, or when a new size or type of fitting is to be introduced.

Type tests for compliance with Clauses **3** and **4.1** shall be carried out on three samples taken at random from each size, class and design of fittings. Type tests for compliance with **4.3** and **4.4** shall be carried out on three samples taken at random from the smallest size and lowest class of fitting (i.e. on fittings having the thinnest wall and greatest surface-area: mass ratio). Type tests for compliance with **4.2** shall be carried out on three samples taken at random from the complete size and class range of fittings.

All the fittings tested shall comply with the requirements for which they are examined. For examination for compliance with **5.1** the manufacturer shall take sufficient random samples to define the adequacy of the extrapolated 1 hour and 50 year failure pressures with a reasonable degree of confidence. Testing shall continue until it is established that the lower 95 % confidence limits for the extrapolated failure pressures at 1 hour and at 50 years equal or exceed the requirements specified in **5.1**.

6.2 Batch tests. Batch tests are spot tests carried out during manufacture to prove the quality of a production run of fittings, and shall be carried out by the methods specified in Clauses **3**, **4.1** and **5.2**.

6.2.1 From each production run, the manufacturer shall take at random the number of fittings required by Scheme 1 given in Appendix F for each test. Sampling of batches composed of not more than 90 fittings shall be subject to agreement between purchaser and vendor.

A batch is defined as the production of an injection moulding machine from the time it commences to produce fittings complying with this standard until it is closed down.

6.2.2 If all fittings pass the tests the production batch shall be deemed to comply with this standard.

6.2.3 If any fittings fail any of the tests, the manufacturer shall have the option of either:

1) retesting the production batch as above but on a number of fittings for each test according to Scheme 2 given in Appendix F, or

[9] Available from IIMSO.

2) dividing the production batch into several lots of any convenient size and testing from each lot the number of fittings for each test according to the requirements of Scheme 2 (i.e. applied to the size of each lot).

6.2.4 If the manufacturer chooses option 1), and if all the fittings pass the tests, the production batch shall be deemed to comply with this standard. If any fittings fail any test, the production batch shall be deemed not to comply with this standard.

6.2.5 If the manufacturer chooses option 2), the requirements of **6.2.4** shall apply to each lot.

NOTE 1 This sampling procedure 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 customer.

NOTE 2 Schemes 1 and 2 given in Appendix F are based on recommendations contained in BS 9001[10)] and Defence Guide DG-7-A, "Sampling Inspection" (April, 1966) issued by the Ministry of Defence and obtainable from H.M. Stationery Office.

6.3 Notwithstanding the requirements of **6.1** and **6.2** in respect of sampling for testing by the manufacturer, fittings tested by the purchaser or otherwise, subsequent to manufacture, shall comply with all the requirements of this standard.

7 Marking

7.1 All fittings shall be marked to show, in the order stated:

1) The manufacturer's identification.

2) The number of this British Standard, i.e. BS 4346-1.

3) The nominal size, as shown in Table 1.

4) The appropriate class of BS 3505 to which the pressure rating of the fitting corresponds.

NOTE The mark BS 4346-1 on or in relation to the product is a claim by the manufacturer that it complies with the requirements of the standard.

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[10)] BS 9001, "*Sampling procedures and tables for inspection by attributes for electronic parts of assessed quality*".

Appendix A Stress relief test

A.1 This test may be carried out either in an air oven or alternatively in a bath of polyethylene glycol, glycerol or a mineral oil free from aromatic hydrocarbons.

A.2 Test specimens. Three specimens of the type and size of fitting under test shall be selected at random.

A.3 Oven method

A.3.1 *Apparatus.* An electrically-heated air oven with circulating fan, the whole interior of which is maintained automatically at a temperature of 150 ± 4 °C.

A.3.2 *Procedure.* The specimens shall be placed in the oven standing on one socket mouth. The specimens may be supported if necessary by a simple jig that has been preheated in the oven.

The specimens shall be kept in the oven for a period determined as follows:

1) For fittings of wall thickness not greater than 8.6 mm − 60 min,
2) For fittings of wall thickness greater than 8.6 mm but not greater than 14.1 mm − 120 min.
3) For fittings of wall thickness greater than 14.1 mm − 240 min.

The time shall be measured from the time at which the oven regains the temperature of 150 °C.

After the specified heating period, the specimens shall be removed from the oven and allowed to cool naturally in air before examination.

A.4 Immersion method

A.4.1 *Apparatus.* A thermostatically-controlled bath in which the heat transfer medium is polyethylene glycol, glycerol or mineral oil free from aromatic hydrocarbons. The bath is stirred continuously and maintained automatically at a temperature of 150 ± 4 °C.

A.4.2 *Procedure.* The specimens shall be placed in the bath standing on one socket mouth. The specimen shall be immersed in the bath for a period determined as follows:

1) For fittings of wall thickness not greater than 8.6 mm : 15 min.
2) For fittings of wall thickness greater than 8.6 mm but not greater than 14.1 mm : 30 min.
3) For fittings of wall thickness greater than 14.1 mm : 60 min.

The time shall be measured from the moment at which the bath regains a temperature of 150 °C.

After the specified immersion period the specimens shall be removed from the bath, and allowed to cool naturally in air before examination.

Appendix B Test for resistance to sulphuric acid

B.1 Form of test specimens. The test specimens shall be cut from fittings or from sheet moulded from the same batch of material, and shall each have a total surface area of 45 ± 3 cm^2 (7.0 ± 0.5 in^2).

B.2 Apparatus. The apparatus shall consist of a bath of sulphuric acid at a concentration of 93 ± 0.5 % (m/m) capable of being automatically maintained at a temperature of 55 ± 2.0 °C for 14 days. Care shall be taken to avoid gradual concentration of the acid during the test due to evaporation losses, etc.

B.3 Procedure. Clean, wipe dry and weigh three specimens. Totally immerse them in the acid at the specified concentration and temperature for 14 days.

After the specified period, the specimens shall be removed, washed in running water for 5 minutes, wiped dry with a clean cloth and reweighed immediately.

The average change in mass shall not exceed the value given in **4.2**.

Appendix C Test for opacity

Text deleted

Appendix D Test for effect on water

Text deleted

Appendix E Hydraulic pressure tests

NOTE These tests are intended to establish the quality of the fittings therefore the result of a test in which there is a premature failure of any other component of the test specimen before the required pressure is reached shall be discarded and a further test specimen shall be prepared and tested.

E.1 Long-term hydraulic test (Type test)

E.1.1 *Apparatus.* A temperature-controlled water bath or air space maintained at 20 ± 1 °C, and equipment that permits the joint or fitting to be subjected to an internal hydraulic pressure to an accuracy of ± 2 %.

E.1.2 *Form and preparation of test specimen.* The specimen shall be a run of pipe incorporating a complete joint or fitting assembly. It shall be made up by solvent welding to each spigot or socket of the joint or fitting a piece of PVC pipe at least 250 mm, or twice the nominal pipe size, in length (whichever is the greater). The pipes shall comply with BS 3505[11)] and shall have a working pressure not less than that of the joint or fitting. The open ends of the pipes shall be closed with end caps, provided with connections for the entry of water under controlled pressure.

E.1.3 *Procedure.* The specimen shall be made up and then left empty and undisturbed to mature at ambient temperatures for at least 14 days (or for a longer period if recommended by the solvent cement manufacturer). The matured specimen shall be mounted in the apparatus and conditioned for 1 hour at 20 ± 1 °C. The hydraulic test pressure shall then be applied and achieved within 30 to 40 seconds of first admitting pressure and shall be maintained with an accuracy of ± 2 %. The test shall be continued in the apparatus until the pipe, joint or fitting fails.

The specimen shall be made up and mounted in the apparatus in such a way that it is subjected throughout the test to the full end thrust produced by the applied hydraulic pressure.

E.1.4 *Assessment of results.* Each test result shall be entered on a log(pressure) versus log(time) graph. When sufficient results, with failure times extending over a range from about 1 hour to 1 000 hours, have been obtained they shall be subjected to regression analysis so as to obtain representative extrapolated 1 hour and 50 year pressure levels. These extrapolated levels shall meet the requirements of **5.1**.

The extrapolated pressure levels shall be obtained by substituting the appropriate values for log(time) in the linear regression equation for log(time) upon log(pressure). The regression equation shall be calculated by the method of least squares.

E.2 Short-term hydraulic test (Batch test)

E.2.1 *Apparatus.* A temperature-controlled water bath or air space maintained at 20 ± 1 °C, and equipment that permits the joint or fitting to be subjected to an internal hydraulic pressure to an accuracy of ± 2 %.

E.2.2 *Form and preparation of test specimen.* The specimen shall be a complete joint or fitting. The open ends of the joint or fitting may be closed internally with male plugs and flexible seals such as O- or U-section rubber rings. The plugs may be retained in place by a jig or former, and shall be provided with connections for the entry of water under controlled pressure.

E.2.3 *Procedure.* The specimen shall be mounted in the apparatus and conditioned for 1 hour at 20 ± 1 °C. The hydraulic test pressure shall then be applied and achieved within 30 to 40 seconds of first admitting pressure and shall be maintained with an accuracy of ± 2 % for a period of 1 hour.

11) BS 3505, "*Unplasticized PVC pipe for cold water services*".

Appendix F Sampling quantities

Scheme 1

Number of fittings in batch	Number of specimens for each test	Number of fittings failures for	
		Batch acceptance	Batch rejection
91 to 150	3	0	1
151 to 280	3	0	1
281 to 500	3	0	1
501 to 1 200	5	0	1
1 201 to 3 200	5	0	1
3 201 to 10 000	5	0	1
10 001 to 35 000	5	0	1
35 001 to 150 000	8	0	1

Scheme 2

Number of fittings in batch	Number of specimens for each test	Number of fittings failures for	
		Batch acceptance	Batch rejection
91 to 150	3	0	1
151 to 280	5	0	1
281 to 500	5	0	1
501 to 1 200	5	0	1
1 201 to 3 200	8	0	1
3 201 to 10 000	8	0	1
10 001 to 35 000	8	0	1
35 001 to 150 000	13	0	1

Appendix G Method for the determination of organotin as tin in aqueous solution

Text deleted

Appendix H Specification for solvent cements for use with injection moulded unplasticized PVC fittings for solvent welding

Text deleted

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