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Reprinted, incorporating Amendments Nos. 1 and 2

Specification for

Unplasticized PVC pipe and fittings for gravity sewers

Spécification des tuyaux et raccords en PVC non-plastifié pour les égouts à écoulement libre

Spezifikation für nicht plastizierte PVC-Rohre und -Formstücke für Abwasserkanäle durch Gefälle

British Standards Institution

Contents

Foreword

This British Standard has been prepared under the authority of the Plastics Standards Committee. Requirements are specified for unplasticized PVC pipe and fittings for underground sewers of either the combined or separate pipe systems intended for the disposal of surface water, domestic effluent and such effluent as is permitted by the statutory drainage authorities to be discharged into public sewers by the Public Health Act 1936, and of surface water and sewage as is permitted and defined by the Sewerage (Scotland) Act 1968. This standard covers pipe and fittings with nominal diameters in the range 200 mm to 630 mm inclusive. For sizes below 200 mm, see BS 4660.

Outside diameters included in this standard are in accordance with table 2 of BS 3867:1969 and are in technical agreement with ISO 161 Part 1. In the preparation of this standard attention has been given to the work of ISO/TC 138, Plastics pipes and fittings for the transport of fluids. In particular, the symbols used in tables and figures (see appendix H) are in accordance with the ISO standards prepared by this committee.

The preliminary document of similar scope under international study includes pipe with four different values of the standard dimension ratio (SDR), which is the ratio of the outside diameter of the pipe to its minimum wall thickness. In this standard only pipe with an SDR of 41 is specified; the thinner walled pipe of SDR 65 and SDR 51 is intended for specialized application, e.g. the relining of existing sewers whilst the thicker walled pipe of SDR 34 is intended for the particularly onerous duty found in some countries.

Pipe and fittings complying with the requirements of this standard and made in accordance with good commercial practice are clean, smooth and reasonably free from grooving and other defects likely to impair their performance. Furthermore, the ends of pipes and fittings made in accordance with good commercial practice are cleanly cut and square with the axis of the component and the pipes are reasonably straight.

Certification. It is strongly recommended that in view of the nature of this specification manufacturers and purchasers should make use of the certification facilities described on the inside back cover of this standard.

British Standard Specification for

Unplasticized PVC pipe and fittings for gravity sewers

1. Scope

This British Standard specifies requirements for unplasticized PVC pipe, fittings and accessories suitable for the construction of drains including foul and surface water sewers. The standard covers pipe and fittings with nominal diameters in the range 200 mm to 630 mm together with necessary joints and accessories. If it is proposed to use these pipes and fittings with untreated trade waste or with discharges at elevated temperatures, reference should be made to CP 312:Part 1 and/or to the manufacturer concerning the suitability of the material for the intended service.

2. References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3. Material

3.1 Except as provided for in clause **9**, the material from which the pipe and fittings are produced shall consist substantially of polyvinyl chloride. Only those additives may be used that are needed for the manufacture of the polymer and for its subsequent conversion into sound, durable extrusions or mouldings of good surface finish and mechanical strength, together with such pigments as are necessary to meet the requirements of clause **4.**

3.2 The use of the manufacturer's own clean rework material, complying with the requirements of this standard, is permissible. No other rework material shall be used.

4. Colour

Pipe and fittings made from unplasticized PVC shall be golden brown approximating to colour 414 of BS 381C:1980 or colour 06 D 45 of BS 4901:1976. The colour known as RAL 8023 is also acceptable.

The requirements of this clause need not apply to snap caps (see clause **9**) which may be supplied alternatively in black or grey as agreed between the purchaser and the supplier.

5. Dimensions and construction

5.1 Pipe

5.1.1 Pipe dimensions shall be in accordance with table 1.

5.1.2 Pipe shall normally be delivered in effective lengths (see figure 1) of 3 m, 6 m and 9 m. Other lengths may be supplied as agreed between the purchaser and the vendor.

5.1.3 The basic dimensions of integral sockets with sealing rings shall be in accordance with table 2 and figure 2.

5.1.4 The basic dimensions of integral solvent cement sockets shall be in accordance with table 3 and figure 2.

Table 1. Dimensions of pipe and fittings

All dimensions are in millimetres.

Nominal size*	Mean outside diameter† of pipe and spigots		Extreme individual outside diameter of pipes and spigots		Wall thickness *'e'* of pipes and of bodies and spigots of fittings‡
	Min.	Max.	Min.	Max.	Min.
200	200.0	200.6	196.3	204.3	4.9
250	250.0	250.7	245.4	255.4	6.1
315	315.0	315.9	309.2	321.8	7.7
(355)	355.0	356.0	348.4	362.6	8.7
400	400.0	401.0	392.5	408.5	9.8
(450)	450.0	451.0	441.5	459.5	11.0
500	500.0	501.0	490.5	510.5	12.2
(560)	560.0	561.0	549.3	571.7	13.7
630	630.0	631.0	617.9	643.1	15.4

* Non-preferred sizes are indicated in parentheses

† Mean outside diameter is defined as the arithmetic mean of any two diameters at right angles to each other.

‡ These values of wall thickness are for a standard dimension ratio (SDR) of 41 (see foreword).

5.2 Fittings

5.2.1 *Injection moulded fittings*

5.2.1.1 Fittings having sockets with sealing rings shall conform to the relevant dimensions given in tables 1 and 2 and figure 2, except that fittings or those parts of fittings not intended to come into contact with the fluid being transported are not required to comply with the wall thicknesses given in table 2. Typical fittings are schematically illustrated in figure 3.

The positions for measuring the wall thickness dimensions of a typical snap cap shall be as illustrated in figure 2a.

5.2.1.2 Fittings having solvent cement sockets shall be in accordance with tables 1 and 3 and figure 2. Typical fittings are schematically illustrated in figure 3.

5.2.2 *Fabricated fittings manufactured from pipe complying with this standard.* Sockets and spigot ends shall meet the requirements laid down for injection moulded fittings. In the case of long bends, fabricated by drawing pipe, minimum radii shall be in accordance with table 4 (see also figure 3). The wall thickness of such bends may be reduced to the values given for e_2 in table 2.

5.3 Chamfer. Spigot ends of pipes and fittings shall be chamfered.

Table 2. Dimensions of spigot ends and sockets with sealing rings (see figure 2)

All dimensions are in millimetres.

Nominal size (outside diameter d_e) (see note 1)	Socket							Spigot end (see figure 4)
	d_1 min.	A min.	B min.	C max.	e min.	e_2 min.	e_3 min.	min. E
200	200.7	50	12	40	4.9	4.4	3.7	99
250	250.8	55	18	70	6.1	5.5	4.6	134
315	316.0	62	20	70	7.7	6.9	5.8	144
(355)	356.1	66	22	70	8.7	7.8	6.5	149
400	401.1	70	24	70	9.8	8.8	7.3	155
(455)	451.1	75	26	75	11.0	9.9	8.2	166
500	501.1	80	28	80	12.2	11.0	9.1	178
(560)	561.1	86	31	86	13.7	12.3	10.3	192
630	631.1	93	34	93	15.4	13.9	11.5	209

NOTE 1. Non-preferred sizes are indicated in parentheses.

NOTE 2. d_1 maximum depends on the shape, the dimensions and the hardness of the rubber rings, which are designed and fixed by the manufacturer.

NOTE 3. For constructions in which the rubber ring is firmly fixed in the groove of the socket the requirement for a minimum value for dimension B shall not apply.

Table 3. Dimensions of solvent cement sockets (see figure 2)

All dimensions are in millimetres.

Nominal size (outside diameter d_e)	d_2 min.	d_2 max.	A_1 min.	e min.	e_2 min.	Spigot end (see figure 4) E min.
200	200.1	200.6	76	4.9	4.4	99
250	250.1	250.7	94	6.1	5.5	134
315	315.3	315.9	116	7.7	6.9	134

NOTE. It is possible for the solvent weld technique to be used on larger diameters of pipes and fittings but it is essential that the manufacturer's special jointing instructions are strictly adhered to during construction.

6. Fittings

6.1 Range of fittings. Fittings covered by this standard include bends, sockets, reducers and branches. They shall comply with the relevant requirements given in clause 5 and tables 1, 2, 3 and 4. Examples of fittings are illustrated in figure 3. Other fittings complying with the relevant requirements of this standard are permitted, whether they are illustrated or not.

Table 4. Minimum radius (R) for long bends made from extruded pipe

All dimensions are in millimetres.

Nominal size (see note)	Minimum radius (R) (measured to the centre line)
200	905
250	1130
315	1425
(355)	1605
400	1805
(450)	2030
500	2255
(560)	2525
630	2840

NOTE. Non-preferred sizes are indicated in parentheses.

*See foreword for explanation of SDR.

6.2 Swept fittings. Fittings such as bends, branches or saddles for angles greater than 45° may be swept and in this case shall have a throat radius of not less than 60 mm (see figure 4).

6.3 Unequal fittings and adaptors

6.3.1 Where a fitting or adaptor provides for a transition between pipes and/or fittings of two nominal sizes of this standard, the wall thickness of each part of the fitting or adaptor shall comply with the requirements for the nominal size for that part.

6.3.2 Where a fitting or adaptor provides a transition between pipes and/or fittings complying with the requirements of this standard and pipes and/or fittings complying with the requirements of BS 4660, the wall thickness of each part of the fitting or adaptor shall comply with the requirements of the relevant standard.

6.3.3 The minimum wall thickness of the transition shall be 0.9 × e of the larger diameter end of the fitting or adaptor.

7. Marking

Each length of pipe and every fitting shall be clearly and durably marked to show the manufacturer's identification, the number of this British Standard (i.e., BS 5481), the nominal size and the reference SDR 41*.

8. Testing

8.1 Type tests

8.1.1 *General.* 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 pipe, joint or fittings. Such tests are required when a change is made in polymer composition or method of manufacture and in any case on a continuing basis to such a schedule as will ensure that each size and design of pipe, fittings and joint assembly is tested at least once in every five year period. A summary of the type tests is given in table 5.

Table 5. Type tests (clause references)

Requirement	Pipe	Moulded fittings	Fabricated fittings	Ring seal joints
Vicat softening point	8.1.2.1	8.1.2.2	—	—
Impact	8.1.3	—	—	—
Reversion	8.1.4	—	—	—
Stress relief	—	8.1.5	—	—
Stress rupture	8.1.5	—	—	—
Drop resistance	—	—	8.1.7	—
Negative pressure	—	—	—	8.1.8

8.1.2 *Vicat softening point.*

8.1.2.1 *Pipe.* When two random samples, taken from pipe, are tested by method 120B of BS 2782, the deformation temperature of each sample shall not be lower than 79 °C.

8.1.2.2 *Moulded fittings.* When two random samples, taken from moulded fittings of a given formulation, are tested by method 120B of BS 2782, the deformation temperature of each sample shall not be lower than 75 °C.

8.1.3 *Impact resistance requirement at* 20 °C *for pipe.* When tested by the method described in appendix G, samples of each combination of pipe size and material formulation shall have a true impact rate (TIR) below 10 % at a confidence level of 90 %. The test conditions shall be in accordance with table 6.

Table 6. Test parameters for impact resistance requirements

Nominal size	Mass of falling weight	Fall height
mm	kg	mm
200	4.0	2000 ± 10
250	5.75	2000 ± 10
315	7.5	2000 ± 10
>315	7.5	2000 ± 10

8.1.4 *Reversion requirement for pipe.* When three samples from each combination of pipe size and material formulation are tested by the method described in appendix A, at no point around a specimen shall the length change by more than 5 %. After testing, the specimens shall show no faults, e.g. cracks, cavities or blisters.

8.1.5 *Stress relief requirement for injection moulded fittings.* When tested at 150 °C as described in appendix B, a sample of each combination of fitting and material formulation shall not show excessive blisters, excessive delaminations, cracking or weld splitting. Weld lines may become more pronounced, e.g. through localized sinking, during the test but this in itself shall not constitute a 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 delaminations shall penetrate to a depth greater than 50 % of the wall thickness at that point.

For fittings moulded by end-gating techniques, e.g. ring or diaphragm moulds, cracks or delaminations in the wall of the fittings adjacent to the injection area shall not penetrate to a depth equivalent to more than 25 % of the socket depth.

The assessment of the depth of penetration shall be carried out by sectioning the specimen at the point of injection and measuring the depth to which these defects penetrate the thickness of the fitting.

8.1.6 *Stress rupture requirement for pipe.* When subjected to an internal hydrostatic pressure calculated from the hoop stress given in table 7, using the equation given in appendix C, samples of pipe shall sustain the appropriate pressure for the appropriate time, given in table 7, without failure. Three specimens of pipe of each combination of pipe size and material formulation shall be tested at 20 °C and a further three specimens at 60 °C.

Because of the practical difficulties in achieving the exact stress in the pipe in the test at a temperature of 60 °C, it is permissible for the stress to differ from that specified by ± 1 %. The corresponding minimum time to failure for the actual test stress shall be obtained from the regression curve corresponding to the equation:

$$\log(\text{stress}) = 1.2304 - 0.0768 \log(\text{time}).$$

Table 7. Test parameters for stress rupture requirement for pipe

Test temperature	Minimum time to failure	Hoop stress,	
		MN/m²	bar*
°C	h		
20 ± 1	1	42	420
60 ± 2	1000	10 ± 0.1	100 ± 1

8.1.7 *Drop requirements for fabricated fittings.* When tested by the method described in appendix D, fittings shall neither break nor crack. Three fittings of each type and size shall be tested.

8.1.8 *Negative pressure requirement for ring seal joints only.* When tested by the method described in appendix E, a joint, whilst deformed, shall withstand a pressure of 25 ± 3 kN/m² below atmospheric pressure for 1 h without leakage. This test shall be applied to one joint for each size of pipe.

8.2 Quality control tests.

8.2.1 *General.* Quality control tests shall be carried out during manufacture to prove the quality of a production run of pipe or fitting as appropriate. A summary of the quality control tests is given in table 8.

*1 bar = 10^5 N/m² = 100 kPa.

Table 8. Quality control tests (clause references)

Requirement	Pipe	Moulded fittings	Solvent cement joints	Ring seal joints	Fabricated fittings
Dimensions	clause 5	clause 5	clause 5	clause 5	clause 5
Impact resistance	8.2.2	–	–	–	–
Reversion	8.2.3	–	–	–	–
Stress relief	–	8.2.4	–	–	–
Hydrostatic	–	–	8.2.5	–	–
Stress rupture at 20 °C	8.2.6	–	–	–	–

8.2.2 *Impact resistance requirement at* 20 °C *for pipe.* A programme of testing shall demonstrate that the pipe continues to comply with the requirements of **8.1.3.**

8.2.3 *Reversion requirement for pipe.* At least one sample shall be taken from each machine during every 8 h production run. When tested by the method described in appendix A, at no point around a specimen shall the length change by more than 5 %; after test, specimens shall show no faults, e.g. cracks, cavities or blisters.

8.2.4 *Stress relief requirement for injection moulded fittings.* At least one sample fitting shall be taken at random from each machine during every 8 h production run and each sample shall comply with the requirements of **8.1.5.**

8.2.5 *Hydrostatic pressure requirement for solvent cement joint assemblies.* Three samples of solvent cement joint assemblies shall be taken from each machine at least once in every 8 h production run. When tested by the method described in appendix F, each sample shall withstand a pressure of 70 kN/m² for 60 s without failure.

8.2.6 *Stress rupture requirement for pipe.* At least one sample shall be taken from each machine at least once during each 8 h production run. Each specimen shall comply with the requirements of **8.1.6** for the test at 20 °C.

9. Sealing components

9.1 Elastomeric sealing rings Sealing rings supplied with pipe or fittings shall comply with the requirements of BS 2494.

9.2 Other components Components, e.g. snap caps used to retain the sealing rings, may be manufactured from materials other than unplasticized PVC, e.g. polyethylene or polypropylene. These components shall comply with the requirements applicable to fittings and assemblies i.e. **8.1.3, 8.1.5, 8.1.8,** and **8.2.4.** For polyethylene components the stress relief test shall be carried out in accordance with appendix B except that the temperature of test shall be 110 ± 2 °C.

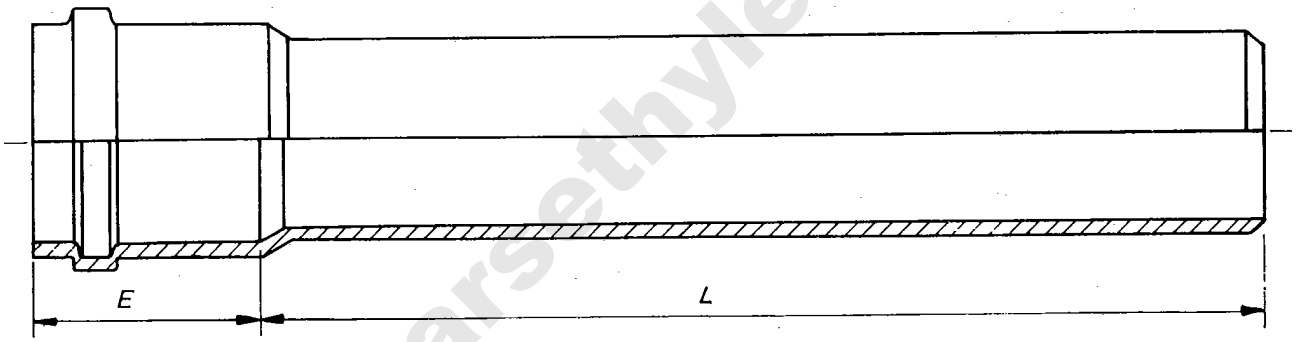


Figure 1. Effective length of pipe

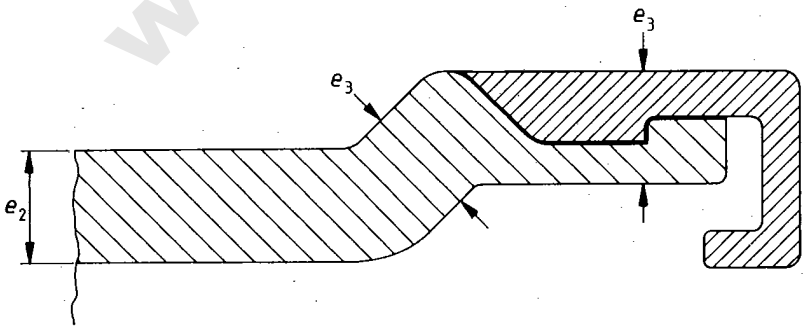
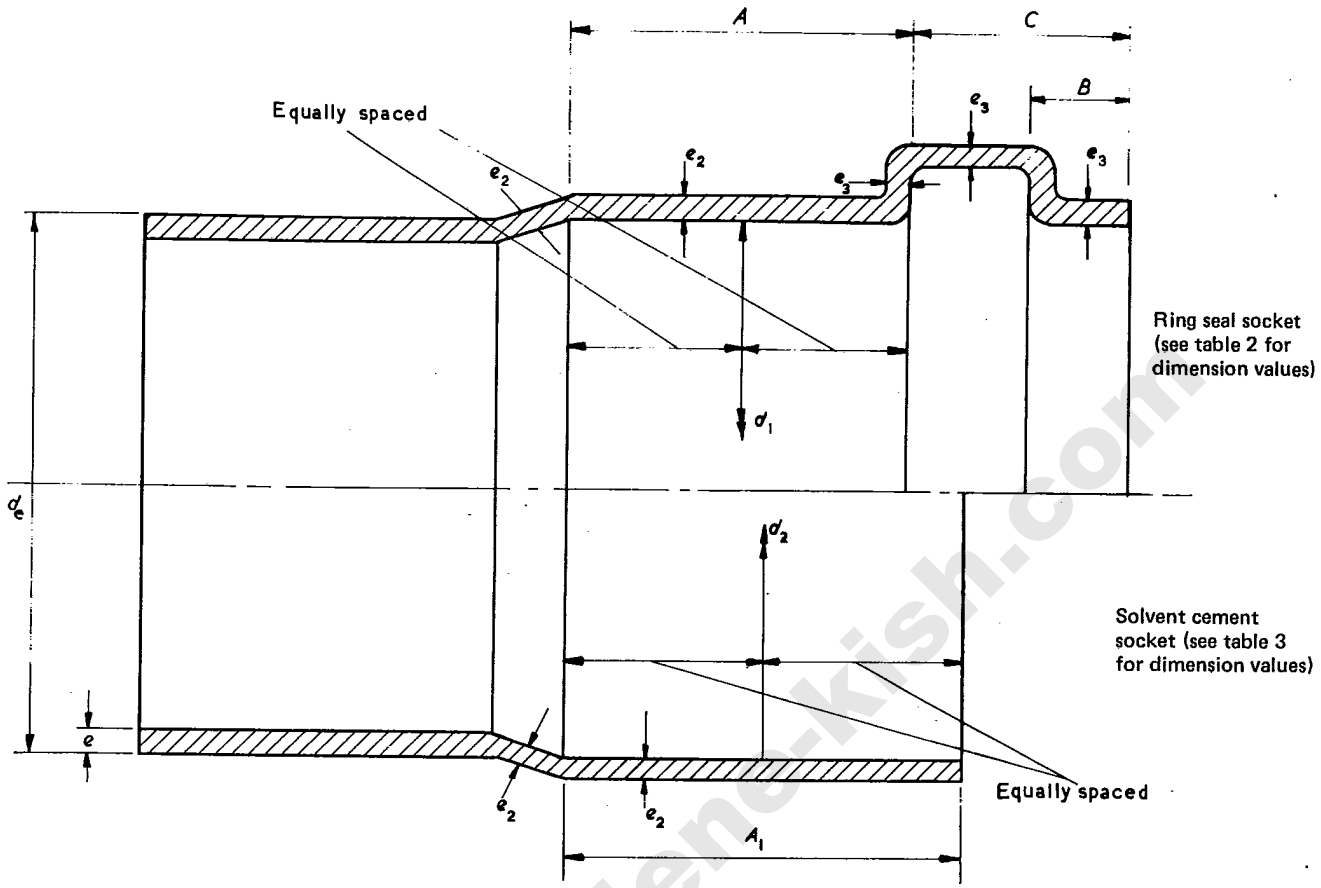
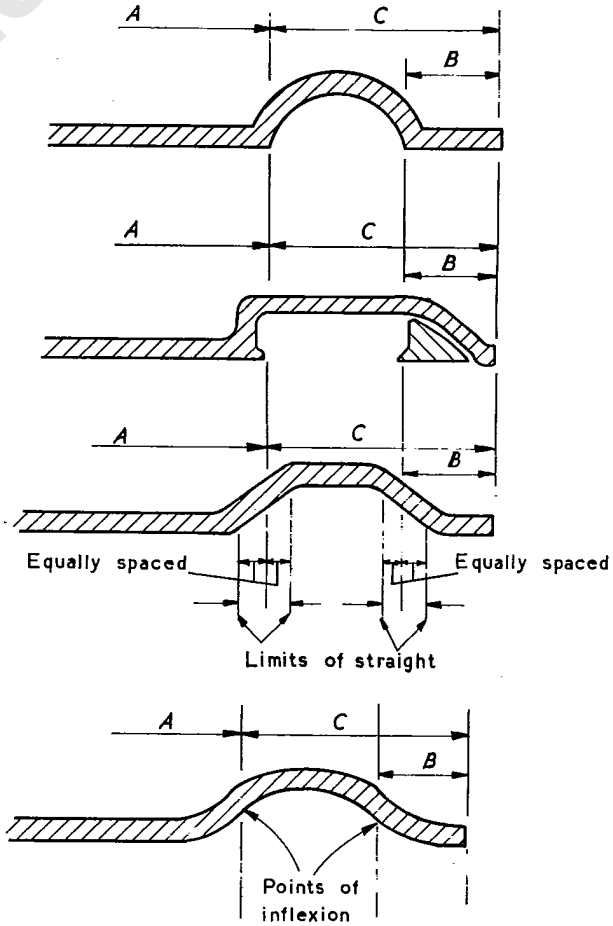


Figure 2a. Positions for measurement of snap cap wall thicknesses



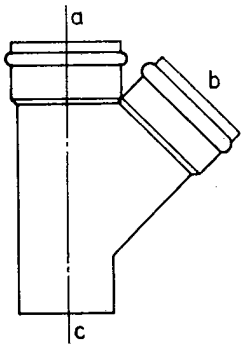


A selection of typical groove designs is illustrated for the purpose of defining dimensions *A B* and *C*. Other groove designs are possible and may be deemed to comply with the requirements of this standard provided dimensions *A B* and *C*, when measured in accordance with the principles shown, are in accordance with table 2. The values of e, e_2 and e_3 are given in table 2.

Some designs of sockets incorporate longer ring seals than those normally used with the groove designs shown. Further, some special seals incorporate integral sealing membranes. In the case of these longer or special seals the dimension *C* does not apply, provided that initial sealing action is achieved upon insertion of the pipe or spigot to a depth not greater than the maximum value of *C* (see table 2). Thereafter the pipe or spigot shall be capable of further insertion to a depth at least equivalent to the minimum value of *A* (see table 2).

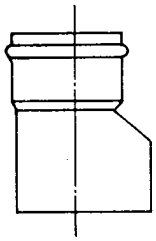
If a ring seal is retained by means of a snap cap there are no requirements to be complied with in respect of dimension *B* and dimension e_3 where there is no overlap of the snap cap with the body of the socket.

Figure 2. Socket dimensions

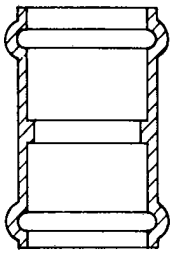


Junction

Sockets a and b may be equal or unequal. Sockets a and b may be for use with ring seals, solvent cement or they may be one of each type.
Spigot c may be alternatively a socket of the ring seal or solvent cement type.

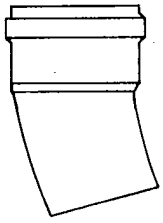


Level invert reducer

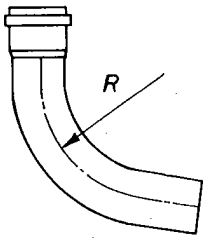


Double socket

A double socket may be made with or without a central register which may, or may not, be chamfered.
Although shown for use with ring seals the fitting may be made with either or both sockets suitable for jointing with solvent cement. In this case a central register is essential.

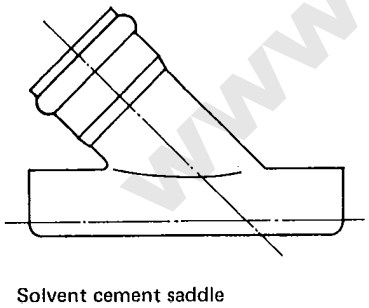


Short bend

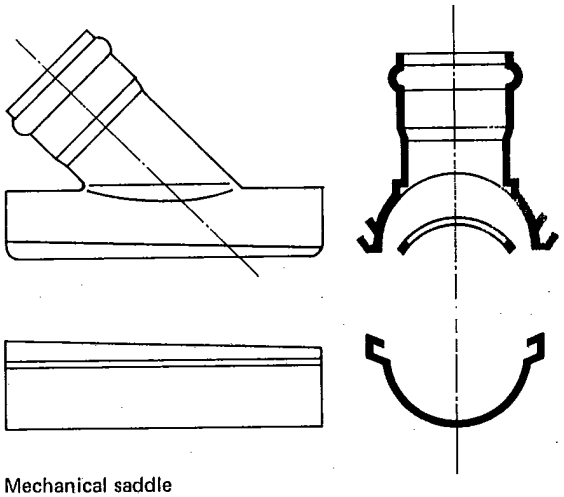


Long bend (see table 4)

Bends may be socket/spigot or double socket. Sockets may be of the ring seal or solvent cement type.



Solvent cement saddle



Mechanical saddle

Figure 3. Schematic illustrations of typical fittings (including saddles)

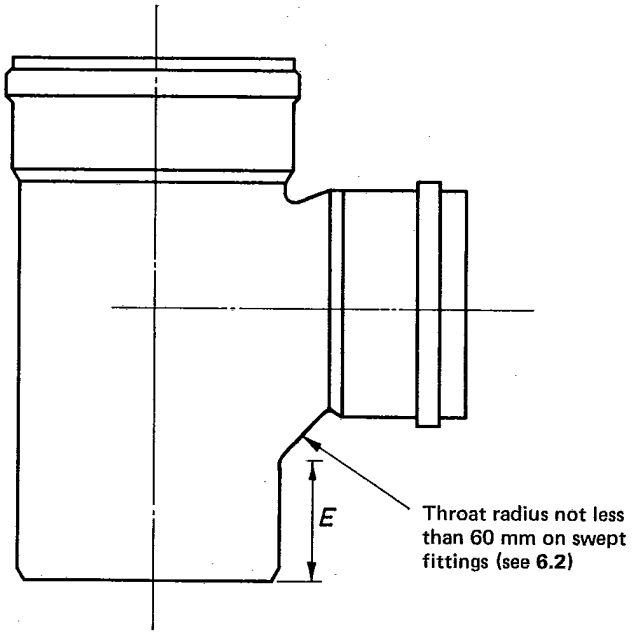


Figure 4. Spigot length of fitting

Appendix A

Heat reversion test for pipe

A.1 Apparatus. The apparatus shall consist of a thermostatically controlled bath which maintains the temperature of the heat transfer medium at 150 ± 2 °C. The heat transfer medium may be polyethylene glycol or a mineral oil free from aromatic hydrocarbons.

A.2 Form of test specimen. The test specimen shall consist of a length of pipe approximately 300 mm long. Two circumferential marks shall be scribed on the test specimen 100 mm apart in such a way that one of these marks is approximately 15 mm from one end of the specimen.

A.3 Procedure. Suspend the test specimen in the heat transfer medium by the end furthest from the scribed marks in such a way that both scribed marks are completely immersed. Take care that the specimen does not contact the sides or bottom of the bath.

Immerse the test specimen in the bath for a time determined as follows:

(a) for pipe of nominal size 200, 250 and 315: 15 min,

(b) for pipe of nominal size 355, 400, 450, 500 and 560: 30 min,

(c) for pipe of nominal size 630: 60 min.

After the specified immersion period, remove the specimen from the bath, lay it on its side and allow to cool to room temperature. Measure the distance between the two scribed marks along the surface of the pipe and calculate the percentage change in length. Inspect the specimen for any faults, e.g. cracks, cavities or blisters.

As an alternative, it is permissible to use an air circulating oven in which the test specimen shall be supported in such a way as to leave it free of external stresses. Increase the three immersion times given for the oil bath method detailed above to 30 min, 60 min, and 120 min, respectively. In this case, measure the immersion times from the time the oven regains a temperature of 150 ± 2 °C. Upon removal from the oven, allow the specimens to cool naturally to room temperature and determine the change in length.

Appendix B

Stress relief test for injection mouldings

B.1 General. 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.

B.2 Oven method

B.2.1 *Apparatus.* An electrically heated air oven with circulating fan, the whole interior of which is maintained, by thermostatic means, at a temperature of 150 ± 2 °C.

B.2.2 *Procedure.* Place the specimen in the oven standing on one socket mouth. The specimen may be supported if necessary by a simple jig that has been preheated in the oven.

Measure the time from the moment at which the oven regains the temperature of 150 ± 2 °C.

After one hour remove the specimen from the oven and allow it to cool naturally in air before examination.

B.3 Immersion method

B.3.1 *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, by thermostatic means, at a temperature of 150 ± 2 °C.

B.3.2 *Procedure.* Place the specimen in the bath standing on one socket mouth. Measure the time from the moment at which the bath regains a temperature of 150 °C. After 30 min, remove the specimen and allow it to cool naturally in air before examination.

B.4 Examination of specimens. Examine carefully each specimen after test for excessive blisters, delamination, cracking or signs of weld line splitting. Take special care in examining the areas around the point of injection.

Assess the depth of penetration of any defects by sectioning the specimen at the point of injection and measuring the depth to which the defects penetrate the thickness of the fitting.

Appendix C

Stress rupture test for pipe

C.1 Form of test specimen. Each piece of pipe shall have a free length between end fittings of 750 ± 10 mm.

C.2 Apparatus. The apparatus consists of a thermostatically controlled bath maintained at 20 ± 1 °C or at 60 ± 2 °C, as appropriate, and equipment that permits the application to the specimens of controlled internal hydrostatic pressure accurate to ± 2 %.

C.3 Procedure. Measure the minimum wall thickness and the mean outside diameter of each specimen and calculate the internal pressure to be applied from the formula:

$$P = \frac{2\,\delta\,t}{D - t}$$

where

P is the pressure to be applied (in bar)
δ is the hoop stress (in bar)
t is the minimum wall thickness (in mm)
D is the mean outside diameter (in mm)

Connect the specimen to the apparatus and apply the calculated internal hydrostatic pressure at a rate of increase so that it is reached within 30 s to 40 s of first applying pressure. Maintain the pressure with an accuracy of ± 2 % throughout the test for the time and at the appropriate temperature given in table 7.

Appendix D

Drop test for fabricated fittings

Drop the fitting freely, in random positions, from a height of 1 ± 0.05 m on to a flat concrete floor within 10 s of having been conditioned for 30 min at a temperature of 0 ± 1 °C. Examine the fittings for breaks or cracks.

Appendix E

Negative pressure test for ring seal joints

E.1 Apparatus. The apparatus shall be as illustrated in figure 5 and shall be capable of permitting the application of a constant force and a constant hydrostatic test pressure for a period of at least 1 h.

Figure 5 shows the apparatus with the pipe in the horizontal position but a disposition with the pipe in the vertical position is permissible. If the pipe is horizontal it is necessary to ensure that the annular space between the pipe and the socket is continuously flooded with water, e.g. by use of a suitable flange.

The distortion load shall be applied to a rocker on the top of a beam which is free to move in the vertical plane through the axis of the pipe. The effective beam length shall be equal to the nominal diameter of the pipe under test. The pipe assembly under test shall be placed so that the face of the socket housing the joint under test is 10 mm from the end of the load-bearing beam.

E.2 Procedure. Measure accurately the maximum socket inside diameter at the mouth of the joint and the minimum spigot outside diameter of the pipe. Take the difference of the two measurements. Carefully dry the interior of the test specimen before assembly. Apply a distorting load to the pipe so that the vertical movement of the load distribution plate is equal to the difference of the two measurements taken. Reduce the air pressure in the assembly to 25 ± 3 kN/m² below ambient pressure, and, if necessary, readjust the position of the load-bearing plate so that the distortion of the pipe is maintained at the level defined before the pressure was reduced. Maintain these conditions for one hour, during which time the annular space between pipe and socket mouth shall be kept filled with water.

At the end of this period examine the assembly for evidence of leakage by either of the following methods.

(a) Remove the assembly from the apparatus, dry the exterior thoroughly and then examine the interior for evidence of water penetration.

(b) After shutting off the source of negative pressure, maintain a static negative pressure (of 25 ± 3 kN/m²) for a further 10 min and, by means of a pressure gauge, determine if any leakage into the assembly occurs.

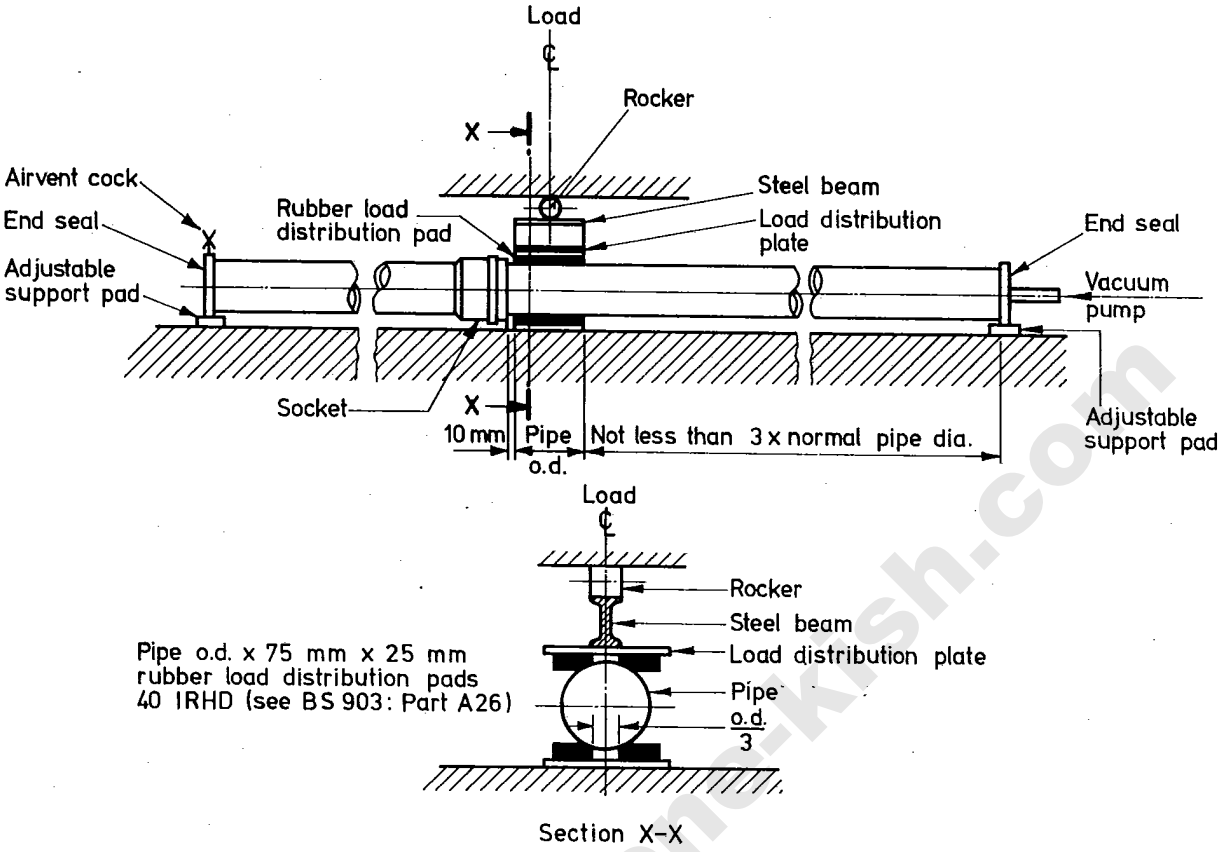


Figure 5. Essential features of apparatus for diameter distortion test with negative pressure

Appendix F

Hydrostatic pressure test for solvent cement joints

F.1 Apparatus. The apparatus shall consist of end sealing devices of size and method appropriate to the pipe system under test. The sealing devices shall be restrained to prevent their movement when pressure is applied. They shall not exert axial force on the system, prior to application of the test pressure.

One end of the sealing device shall be connected to the source of hydrostatic pressure. A bleed valve shall be provided to enable all air to escape when hydrostatic pressure is applied.

F.2 Procedure. Apply a pressure of 70 kN/m² and maintain it for 60 s. Examine the assembly for failure.

Appendix G

Test for impact resistance at 20 °C

G.1 Form of test specimen. Each test specimen shall be a length of pipe having undamaged ends, cut square to the longitudinal axis. Specimens shall be 200 ± 5 mm long. A straight line shall be drawn along the entire length of each specimen, randomly positioned on the pipe's circumference. Further lines to bring the total number to that given in table 9, shall be drawn, parallel to the first line, and equally spaced around the circumference.

Table 9. Number of equally spaced lines to be drawn on test specimens

Nominal size	Number of lines
mm	
200	12
250	12
315	16
355	16
400	24
455	24
500	24
560	24
630	24

G.2 Apparatus. A falling weight machine (a suitable form of which is shown in figure 6) shall be used and shall consist essentially of the following.

G.2.1 A main frame which can be rigidly fixed in a true vertical position.

G.2.2 Guide rails carried from the inside of the main frame, on side bearings which can be adjusted to keep them parallel and vertical.

G.2.3 A weighted striker which can fall freely within the guide rails and which is equipped with a hardened hemispherical striking surface 25 mm in diameter. The striking surface shall be free from flats and other imperfections. The combined mass of striker and weight shall be capable of adjustment to meet the requirements of **8.1.3.**

G.2.4 A specimen support comprising a 120 ° vee block, at least 200 mm in length, so positioned below the guide rails that the tip of the striker is not more than 2.5 mm from the axis of vee block.

G.2.5 A release mechanism such that the striker can fall through a height of 2000 ± 10 mm on to the top surface of the pipe specimen.

G.2.6 Means for maintaining a constant height of fall, by vertical movement of either the vee block, the release mechanism or the main frame, in order to accommodate different diameters of pipe.

G.3 Procedure. Prior to testing, condition the specimens at 20 ± 1 °C for at least 30 min. Testing should be carried out within 1 min of removal from the conditioning environment.

Set the impact testing machine to give a height of drop of 2000 ± 10 mm. Determine the weight to be used according to the pipe diameter (see table 6).

Place the first test specimen in the machine with one of the marked lines uppermost. Allow the weighted striker to fall freely on to the test specimen. If the specimen does not fail, as defined by cracking right through its wall thickness, rotate it until the next line becomes uppermost and in this position strike it again. Repeat this process so long as the specimen does not fail and until each line has been struck once. Test further specimens in the same manner. When any specimen fails simply remove it from the machine, record the number of blows and recommence the test using a further specimen.

There is no set number of specimens or strikes laid down. It is simply required that a definite result be obtained. Generally this will be achieved by testing four or five specimens but, on occasion, it will be necessary to proceed further.

G.4 Determination of result. Reference to figure 7 enables the number of strikes to be read off against the number of broken test pieces. If the true impact rate falls within region C (TIR above 10 %) the result is a failure. If the true impact rate falls within region A (TIR below 10 %) the result is a pass.

In the event of the result falling in region B testing should be continued until a positive result is obtained. Alternatively it will become clear that a result in region A is most unlikely and in this case the pipes shall be deemed to fail the test.

Appendix H

Explanation of symbols used in tables and figures

A is the socket length of a ring seal socket, i.e. the dimension from back of ring seal zone to commencement of socket root (see figure 2).

A_1 is the socket length of a solvent cement socket, i.e. the dimension from socket mouth to commencement of socket root (see figure 2).

B is the dimension from socket mouth to commencement of ring seal zone (see figure 2).

C is the dimension from socket mouth to back of ring seal zone (see figure 2).

d_e is the nominal outside diameter and nominal size and also the minimum permitted value for mean outside diameter (see table 2 and figure 2).

d_1 is the internal diameter at a distance $\frac{A}{2}$ behind the back of the ring seal zone (see figure 2).

d_2 is the internal diameter at a distance $\frac{A_1}{2}$ behind the socket mouth of a solvent cement socket (see figure 2).

E is the spigot length of fitting (see figures 1 and 4).

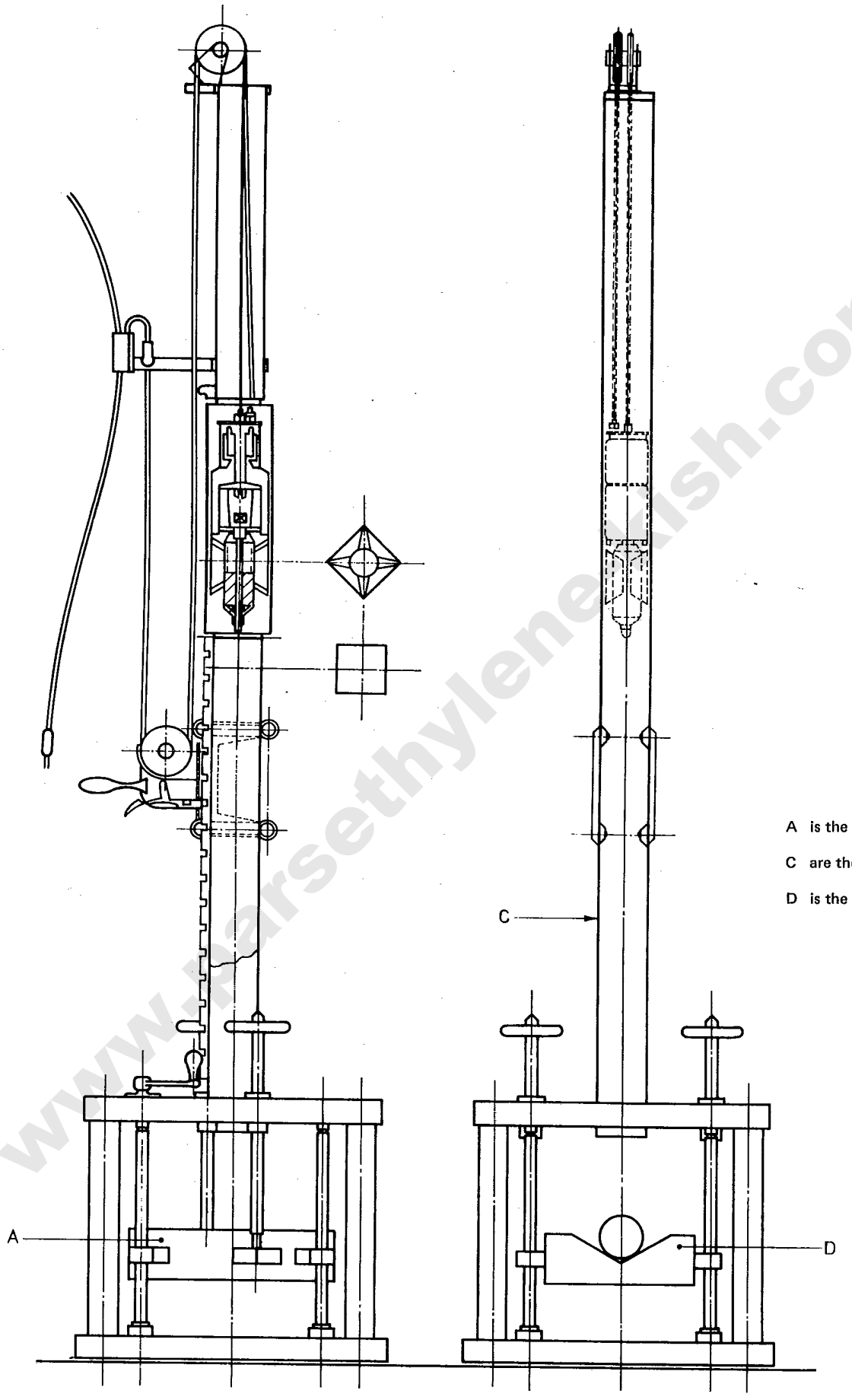
e is the wall thickness of pipe and body of fitting. Minimum values are given in table 2.

e_2 is the wall thickness of parts of a socket as indicated in figure 2. Minimum values are expressed in terms of e.

e_3 is the wall thickness of parts of a socket as indicated in figure 2. Minimum values are expressed in terms of e.

L is the effective length of pipe (see figure 1).

R is the centre line radius of long bends (see figure 3).

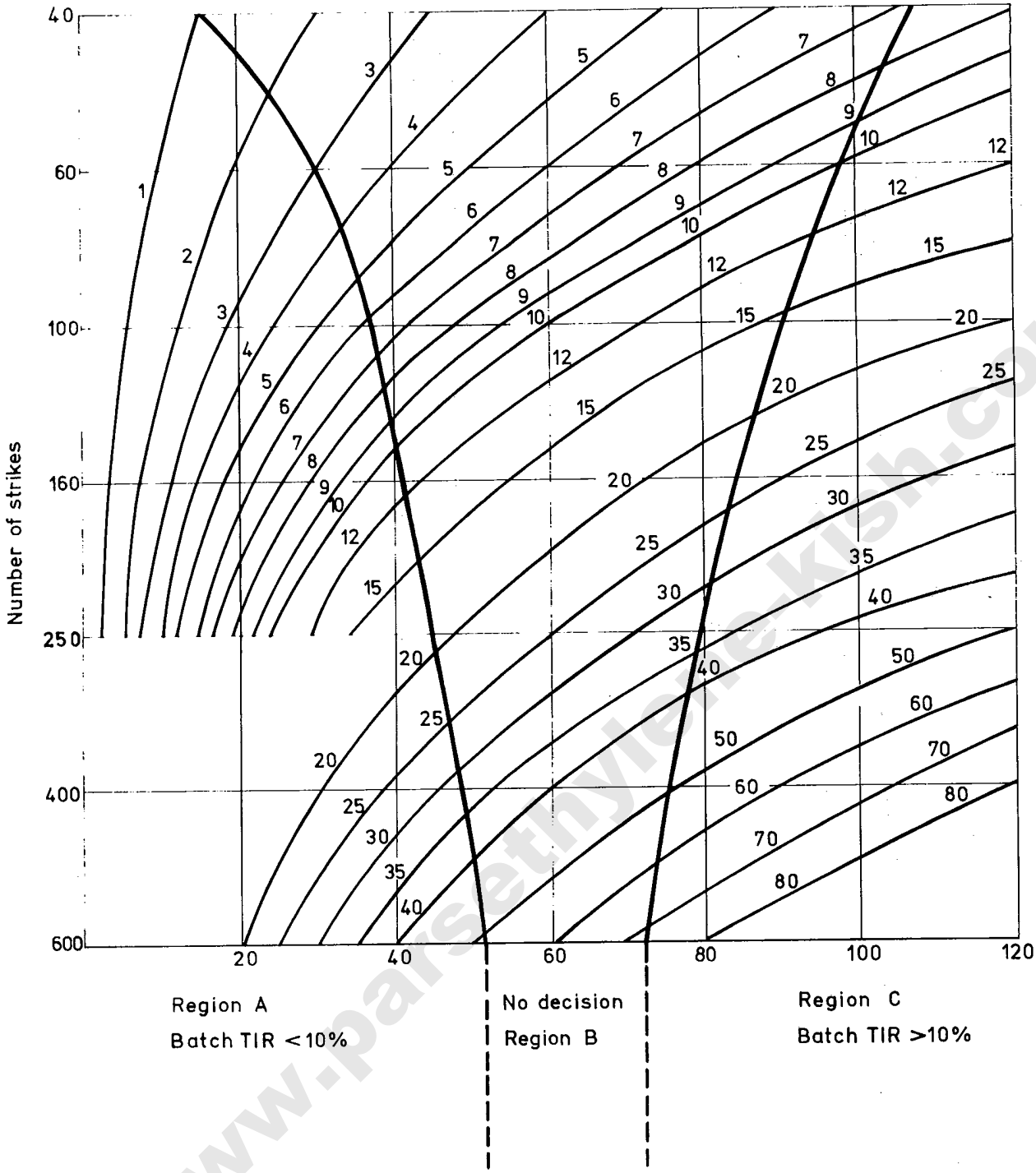


A is the test piece of pipe

C are the guide rails

D is the vee block

Figure 6. Suitable type of impact testing machine



Example of use of graph

If in 100 strikes there are 20 broken test pieces the TIR lies within region C and the batch TIR >10 %, i.e. a failure is recorded. If in 100 strikes there are 12 broken test pieces the TIR lies within region B and no decision can be made about a pass or failure until further strikes are made. In this case the number of strikes should be increased until a definite conclusion can be reached.

If in 100 strikes there are 5 broken test pieces the TIR lies within region A and the batch TIR <10 %, i.e. a pass is recorded.

Figure 7. Chart for true impact rate (TIR) for test at 20 °C
(Showing the number of strikes needed to obtain a 10 % TIR with a 90 % confidence limit)

Standards publications referred to

BS 381C	Colours for specific purposes
BS 903	Methods of testing vulcanized rubber Part A26 Determination of hardness
BS 2494	Materials for elastomeric joint rings for pipework and pipelines
BS 2782	Methods of testing plastics
BS 3867	Outside diameters and pressure ratings of pipe of plastics materials
BS 4660	Unplasticized PVC underground drain pipe and fittings
BS 4901	Specification for plastics colours for building purposes
CP 312	Plastics pipework (thermoplastics materials) Part 1 General principles and choice of material
ISO 161/1	Thermoplastics pipes for the transport of fluids — Nominal outside diameters and nominal pressures Part 1 Metric series

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Water Companies Association
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