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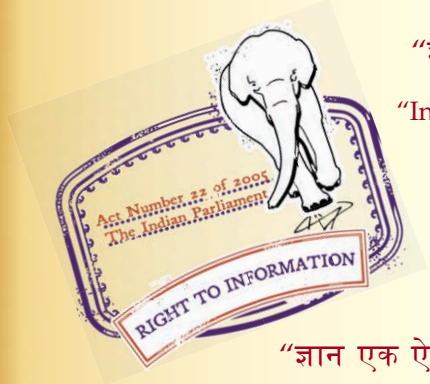

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(First Revision)

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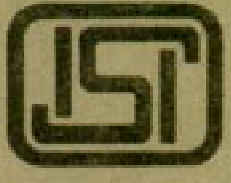

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SPECIFICATION FOR CHEMICALLY RESISTANT GLAZED STONEWARE PIPES AND FITTINGS

(First Revision)

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(*Continued on page* 32)

Indian Standard

SPECIFICATION FOR CHEMICALLY RESISTANT GLAZED STONEWARE PIPES AND FITTINGS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 4 May 1979, after the draft finalized by the Sanitary Appliances and Water Fittings Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard was first published in 1965. This revision of the standard has been taken up in order to review the same in the light of experience gained during the period that has elapsed since its publication.

0.2.1 In this revision test on crushing strength of pipes and dimensions for 200 and 250 mm internal diameter channel bends have been incorporated. Provisions of glazing have been amended to allow ceramic glaze in addition to salt glaze.

0.3 This standard covers the requirements for chemically resistant glazed stoneware pipes and fittings suitable for use under conditions where pipes which comply with normal drainage requirement may not be satisfactory because of severe conditions of acidity, which may result in chemical corrosion taking place. The standard has been prepared with a view to giving guidance to the industry engaged in the manufacture of chemically resistant pipes and fittings and to users interested in these appliances. The requirements for glazed stoneware pipes and fittings suitable for normal drainage purposes are covered in IS : 651-1971*.

0.4 A note on the jointing of chemically resistant pipes and fittings is given in Appendix A, for information.

---

1. SCOPE

1.1 This standard lays down the material and performance requirements for the following chemically resistant glazed stoneware pipes and fittings:

a) Straight pipes; and

*Specification for salt-glazed stoneware pipes and fittings (*third revision*).

b) Fittings:
   1) Taper pipes;
   2) Bends;
   3) Taper bends;
   4) Junctions;
   5) Half-section channels, straight and taper;
   6) Channel junctions;
   7) Channel bends;
   8) Channel interceptors;
   9) Gully traps; and
   10) Inspection pipes.

1.2 Dimensions of chemically resistant glazed stoneware pipes and fittings are grouped into two sections, namely, Section A and Section B. Section A covers dimensions of straight pipes and all such fittings which normally form a part of a pipe line and which are subject to the same conditions, specifications and tests as straight pipes. Section B includes dimensions of fittings which are commonly used and which do not form a part of the normal pipe line. The fittings in Section B being hand-moulded articles, their conformity to dimensional specifications is not required to be so accurate as for those in Section A.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 2781-1975* shall apply.

3. RIGHT- AND LEFT-HAND FITTINGS

3.1 A right-hand fitting is such that when viewed from the spigot towards the socket, the arm of a junction or the socket of a bend projects to the right (*see* Fig. 1A and 1B). A left-hand fitting is such that when viewed as above, the arm of socket projects to the left.

4. GENERAL QUALITY

4.1 All pipes and fittings shall be sound, free from visible defects which impair the strength, durability and serviceability. The glaze of pipes and fittings shall be free from crazing. The pipes and fittings shall give a sharp, clear note when struck with a light hammer.

*Glossary of terms relating to ceramic ware (*first revision*).

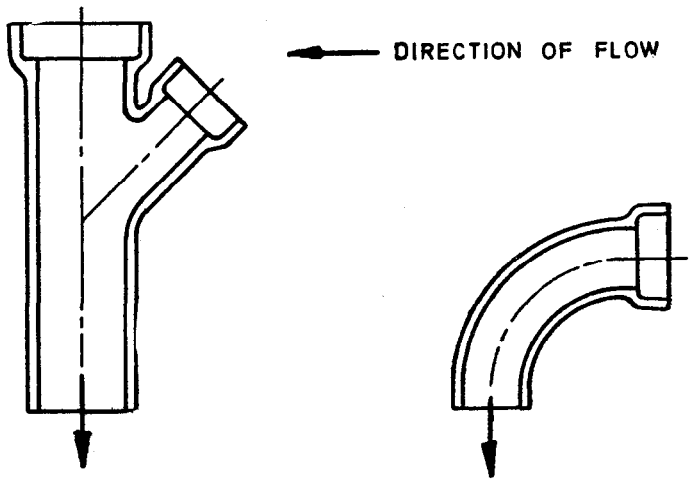


FIG. 1 RIGHT-HAND FITTINGS

4.2 For pipes and fittings, a maximum of 10 percent shall be acceptable, with any one of the following blemishes which do not impair the strength, durability and serviceability, provided these pipes and fittings satisfactorily pass the hydraulic test specified in **6.2**:

a) A thin chipping not exceeding one-quarter of thickness of the body and not exceeding 10 cm^2 on the outside of spigot or on either side of the socket;

b) One blister, unbroken, not more than 3 mm high nor more than 40 mm in largest dimension inside or outside of the pipe; and

c) Hairline surface cracks.

5. GLAZING

5.1 The interior and exterior surfaces of the pipes and fittings, which remain exposed, shall be glazed. The portions, which remain covered after jointing, may or may not be glazed. The glaze shall be:

a) salt glaze obtained by the action of fumes of volatized common salt on the material of the pipes and fittings during the process of burning, or

b) ceramic glaze consisting of glazing material applied prior to firing.

6. TESTS

6.1 Testing Facilities — The manufacturer shall, at his premises and at his own cost, provide the necessary gauges, supply and prepare all test pieces and supply all labour and apparatus for testing which may be necessary for carrying out the tests as required by this standard.

6.2 Hydraulic Test — When subjected to the hydraulic test at the manufacturer's works, straight pipes shall withstand an internal hydraulic test pressure of 0·3 MPa on the barrels, and fittings shall withstand a test pressure of 0·15 MPa without showing signs of injury or leakage. The pressure shall be applied at a rate not exceeding 0·075 MPa in 5 seconds, and full pressure shall be maintained for at least 5 seconds. Care shall be taken to ensure that all the air is extracted before the test is commenced.

6.2.1 Every pipe and fitting, except channel fittings, shall be subject to the hydraulic test.

6.3 Absorption Test — The test pieces for testing shall be taken from the body of the pipe or the fitting but not from within 150 mm of the end. To avoid breaking sound articles, particularly in sizes 300 mm and above, special test pieces of the same materials may be manufactured and fired at the same time. Each test piece shall be of the whole thickness of the wall of the pipe or fitting and shall have two glazed surfaces, each having an area of not less than 50 cm^2 and not more than 130 cm^2 after cutting at least 150 mm from the extremities. The test pieces shall be dried at a temperature of not less than 150°C until no further loss of mass can be noted. They shall then be immersed in clean cold water, and the temperature raised to boiling point (100°C). The water shall be maintained at that temperature for one hour, and after it has been allowed to cool to room temperature, the test pieces shall be removed, carefully wiped with a dry cloth and then the determined mass. The percentage increase in mass of each test piece by absorption of water shall not exceed the following values:

Thickness of Pipe or Fitting mm	*Increase in Mass Percent*
Up to 20	3
20 „ 25	4
25 „ 32	5
32 „ 38	6
Over 38	8

6.3.1 The absorption test shall be carried out at the manufacturer's works.

6.4 Test for Acid Resistance — When tested for acid resistance in accordance with the procedure given in Appendix B, the loss in mass shall not exceed 1·5 percent.

6.5 Test for Alkali Resistance — The consumer or purchaser may specify at his option, in advance, the test for resistance of stoneware pipe to the action of magnesium sulphate in accordance with the procedure given in Appendix C. There shall be no evidence of pitting, softening, spalling or cracking in the pipe after the test.

6.6 Crushing Strength Test — When tested along the full length of the pipe barrel from shoulder to spigot, in accordance with Appendix D, the pipe tested shall have a minimum crushing strength of 16 kN per linear metre.

7. SAMPLING

7.1 The method of drawing representative samples of the material and the criteria for conformity shall be as prescribed in Appendix E.

8. MARKING

8.1 Every pipe and fitting shall have legibly impressed upon it before firing, the name or trade-mark of the manufacturer. The pipe shall also be stencilled or stamped with the words 'CHEMICALLY RESISTANT'.

8.1.1 Each pipe and fitting may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the *Indian Standards Institution (Certification Marks) Act*, and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

SECTION A DIMENSIONS OF PIPES

9. INTERNAL DIAMETER OF PIPES

9.1 The internal diameter of the pipes shall be as specified in col 1 of Table 1.

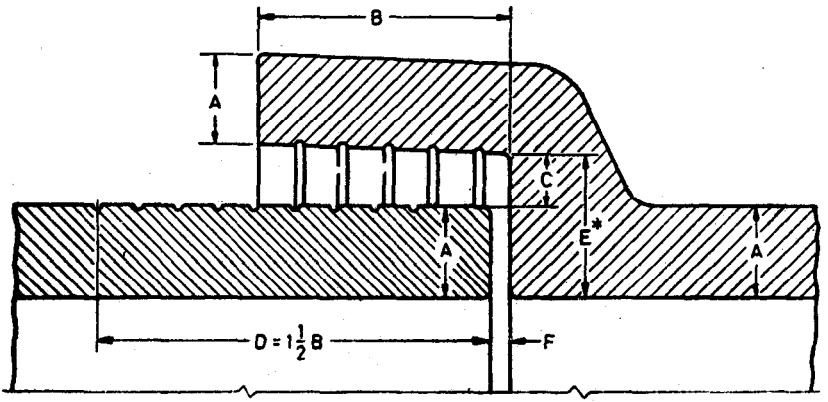
9.2 Permissible Variation — The internal diameter of the barrel of a pipe shall nowhere deviate from the internal diameter specified in col 1 of Table 1 by more than the following:

Internal Diameter of Pipe	*Permissible Variation from Diameter*
mm	mm
100	3
150	5
200	6
250 to 350	8
400 ,, 450	10
500 ,, 600	12

TABLE 1 DIMENSIONS OF BARRELS AND SOCKETS

(*Clauses* 9.1, 9.2, 10.1, 12.1, 12.1.1, 12.2, 13.1 *and* 17.1)

(All dimensions in millimetres)



Internal Diameter of Pipe	Mean Thickness of Barrel and of Socket, *Min*	Internal Depth of Socket, *Min*	Excess Shoulder Measurement, *Min*	Length of Grooving on Spigot, *Min*
	A	*B*	*C*	*D* (1½ *B*)
(1)	(2)	(3)	(4)	(5)
100	12	50	10	75
150	15	57	11	85·5
200	16	63	12	94·5
250	20	70	16	105
300	25	70	16	105
350	30	75	16	112·5
400	35	75	16	112·5
450	37	76	16	114
500	40	80	19	120
600	43	90	19	135

*E = Width of shoulder of socket which shall exceed the mean thickness of the barrel of the pipe (ascertained as in **10.1**) by not less than the values for *C* given in col 4.

10. THICKNESS OF BARRELS, SOCKETS AND BENDS

10.1 The thickness of the barrel and the socket pipes shall be not less than the mean thickness given in col 2 of Table 1. Such mean thickness of the barrels or sockets of any individual pipe shall be ascertained by making several measurements and adding the measured least thickness (not in the groove) to the greatest thickness and dividing the sum by two. The mean thickness of the barrel and socket shall be determined separately.

10.2 Permissible Variation — The difference between the measured least thickness and the greatest mentioned in **10.1** shall not exceed the amounts given below:

Internal Diameter of Pipe	*Permissible Variation in Thickness of Barrel and Socket*
mm	mm
Not exceeding 450	2
500 to 600	3

11. LENGTH AND STRAIGHTNESS OF BARRELS OF STRAIGHT AND TAPER PIPES

11.1 The length of the barrels of straight and taper pipes, junctions and half-section channels, exclusive of the internal depth of the socket, shall be 600, 750 or 900 mm.

11.2 Permissible Tolerance on Length — The permissible tolerance on length shall be not more than ± 10 mm for pipes of 600 and 750 mm length and ± 15 mm for pipes of 900 mm length.

11.3 Permissible Deviation from Straightness — The maximum permissible deviation from straightness of the barrel of a pipe, measured on the inside of the curve and tested by means of a straight-edge, for all diameters of pipe, shall be 5 mm for pipes of 600 mm in length, 6 mm for pipes of 750 mm length and 7 mm for pipes of 900 mm length.

12. TAPERS, BENDS AND JUNCTIONS

12.1 Internal diameters of taper pipes (*see d* and *D* of Fig. 2), half-section straight channels (*see D* of Fig. 3), half-section taper channels (*see d* and *D* of Fig. 4) and junctions (*see* Fig. 5 and Fig. 6), shall be selected from those given in col 1 of Table 1. Dimensions of bends shall be in accordance with Table 2 to Table 6.

12.1.1 The barrels and branches of half-section channel junctions may be of any of the diameters shown in col 1 of Table 1, but the diameter of the branches shall not exceed that of the barrel diameter (*see* Fig. 7). The angle at junction shall be $45 \pm 3°$ or $90 \pm 3°$.

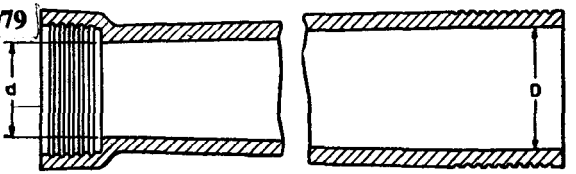


FIG. 2 CONNECTING TAPER TYPE

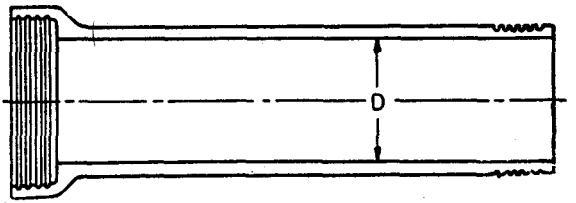


FIG. 3 HALF-SECTION STRAIGHT CHANNEL

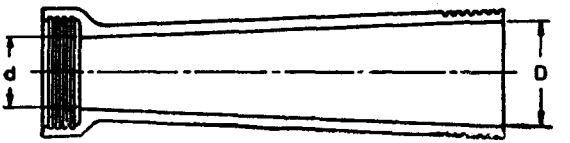
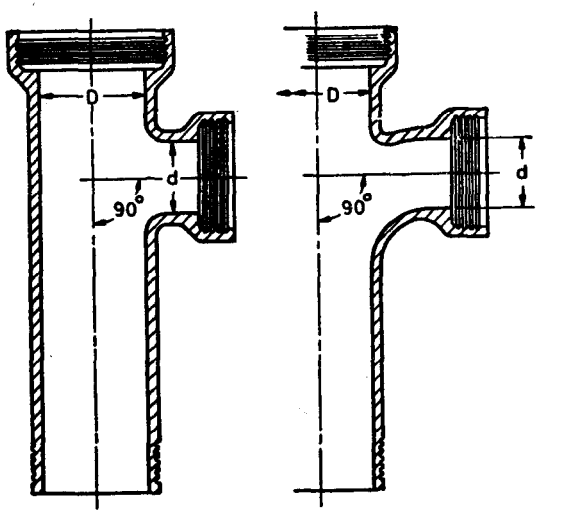


FIG. 4 HALF-SECTION TAPER CHANNEL

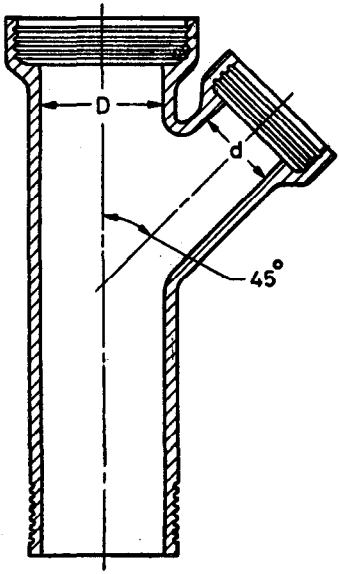


5A SQUARE TYPE

5B CURVED SQUARE TYPE

NOTE — The socket of the branch arm should be as close to the main socket as possible. The barrels and branches of junctions may be of any of the diameters shown in col 1 of Table 1, but the diameter of the branch shall not exceed that of the barrel diameter *D*. The length of the barrel may be 600 mm, 750 mm or 900 mm.

FIG. 5 JUNCTION WITH BRANCH AT AN ANGLE OF APPROXIMATELY 90°



NOTE — The socket of the branch arm should be as close to the main socket as possible. The barrels and branches of junctions may be of any of the diameters shown in col 1 of Table 1, but the diameter *d* of the branch shall not exceed that of the barrel diameter *D*. Branches up to and including 200 mm diameter form an angle of approximately 45° and branches over 200 mm diameter form an angle of approximately 55° to 60° to the barrel, according to size.

FIG. 6 JUNCTION WITH BRANCH AT AN ACUTE ANGLE

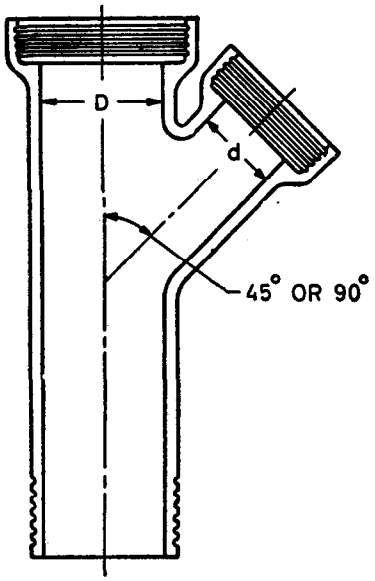


FIG. 7 HALF-SECTION CHANNEL JUNCTION

12.2 Taper pipes, and half-section taper channels may be ordered in any normal combination of diameters and lengths. The outer dimensions shall be within the limits of pipe sizes given in Table 1 and under **10** and **11**.

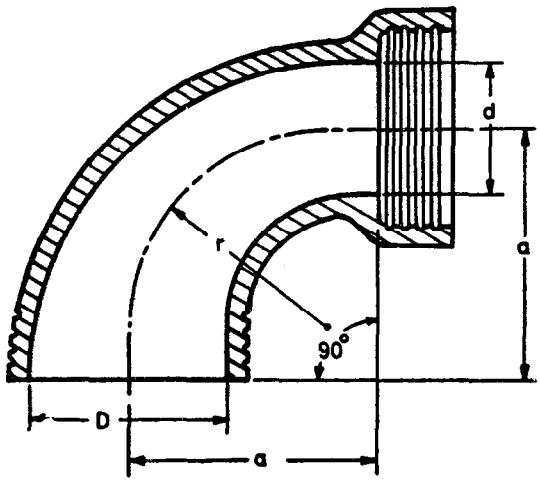
13. SOCKETS

13.1 The interior of the sockets shall be conical, having a minimum taper of 1 mm, measured on the diameter, per 15 mm length (that is 1 in 30), thus the diameter of a socket, 50 mm deep, will be at least 3 mm greater at the top than at the bottom. The depth of the sockets shall be in accordance with Table 1. The width of the shoulder of socket of any individual pipe or fitting shall exceed the mean thickness of the barrel by not less than the figures given in col 4 of Table 1.

TABLE 2 DIMENSIONS OF ONE-QUARTER BENDS

(*Clause* 12.1)

(All dimensions in millimetres)

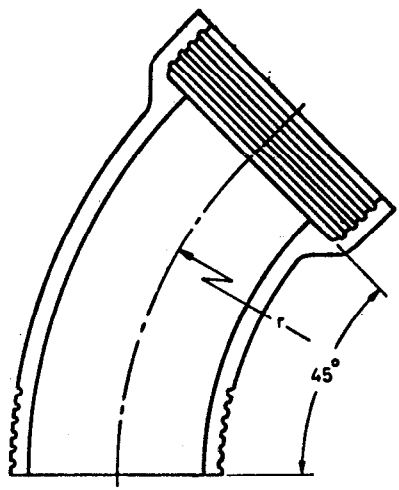


Internal Diameter	Short		Medium		Long	
	r	*a*	*r*	*a*	*r*	*a*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
100	90	140	150	190	215	255
150	150	190	190	230	230	265
200	—	—	215	265	—	—
250 and 300	—	—	255	305	—	—
350	—	—	390	465	—	—
400	—	—	420	495	—	—
450	—	—	455	530	—	—
500	—	—	490	570	—	—
600	—	—	550	640	—	—

TABLE 3 DIMENSIONS OF ONE-EIGHTH BENDS

(*Clause* 12.1)

(All dimensions in millimetres)

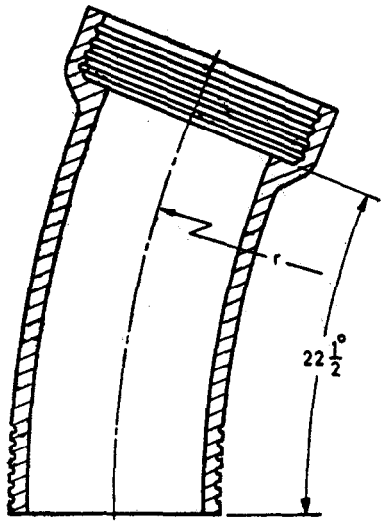


INTERNAL DIAMETER	SHORT	MEDIUM	LONG
	r	*r*	*r*
(1)	(2)	(3)	(4)
100	250	380	500
150	380	460	530
200	—	530	—
250 and 300	—	610	—
350	—	640	—
400	—	670	—
450	—	700	—
500	—	735	—
600	—	785	—

TABLE 4 DIMENSIONS OF ONE-SIXTEENTH BENDS

(*Clause* 12.1)

(All dimensions in millimetres)

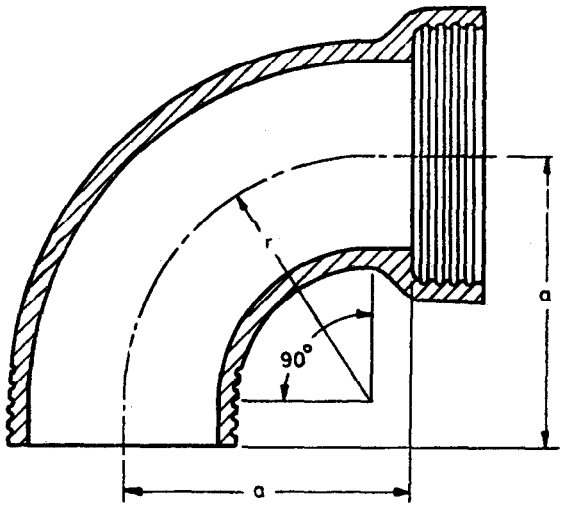


INTERNAL DIAMETER	
(1)	(2)
100	750
150	900
200	1 050
250 and 300	1 200
350	1 500
400	1 800
450	2 150
500	2 600
600	3 050

TABLE 5 DIMENSIONS OF ONE-QUARTER TAPER BENDS

(*Clause* 12.1)

(All dimensions in millimetres)



Internal Diameters			
d	*D*		
(1)	(2)	(3)	(4)
100	150	150	190
150	230	190	230

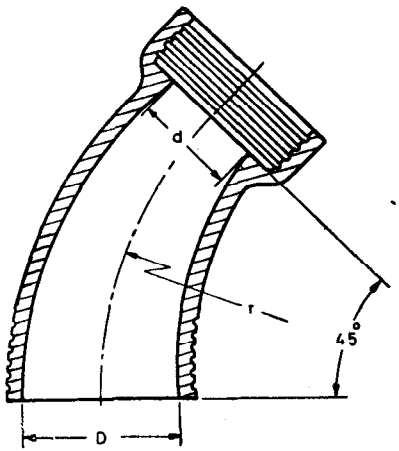
14. GROOVING

14.1 The interior of the sockets, and the exterior of the spigots shall be grooved circumferentially, and such grooving on the spigot shall be for a length equal to one and a half times the depth of sockets, and the depth of such grooves shall be between 1 mm and 2 mm.

TABLE 6 DIMENSIONS OF ONE-EIGHTH TAPER BENDS

(*Clause* 12.1)

(All dimensions in millimetres)



INTERNAL DIAMETERS		
d	*D*	
(1)	(2)	(3)
100	150	380
150	230	460

SECTION B DIMENSIONS OF FITTINGS

15. GENERAL

15.1 This section deals only with designs and dimensions of fittings and it does not embody specifications for quality. It includes inspection pipes (*see* Fig. 8) straight and taper channels, channel junctions and channel bends, channel interceptors and gully traps.

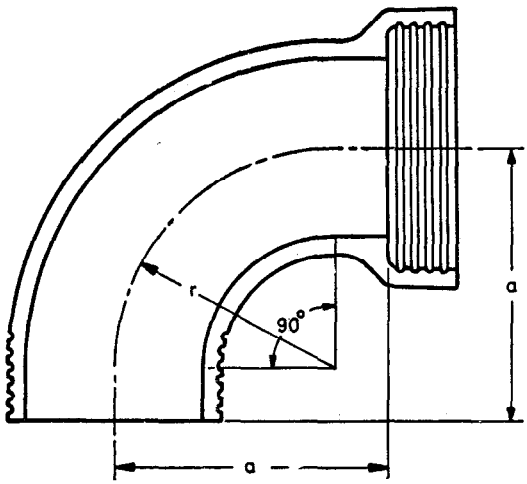
16. DIMENSIONS

16.1 The dimensions of fittings shall be as given in Tables 7 to 12 and Fig. 8 within practical limits without affecting the utility or serviceability of the fittings.

TABLE 7 DIMENSIONS OF HALF-SECTION ONE-QUARTER CHANNEL BENDS

(*Clause* 16.1)

(All dimensions in millimetres)

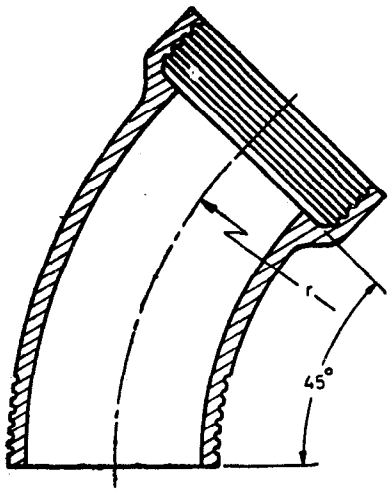


INTERNAL DIAMETER	SHORT		MEDIUM		LONG	
	r	*a*	*r*	*a*	*r*	*a*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
100	90	140	150	190	220	260
150	150	190	190	230	230	270
200	—	—	215	265	—	—
250	—	-	255	305	—	—
300	—	—	255	305	—	—
350	—	—	390	465	—	—
400	—	—	420	495	—	—
450	—	—	455	530	—	—
500	—	—	490	570	—	—
600	—	—	550	640	—	—

TABLE 8 DIMENSIONS OF HALF-SECTION ONE-EIGHTH CHANNEL BENDS

(*Clause* 16.1)

(All dimensions in millimetres)

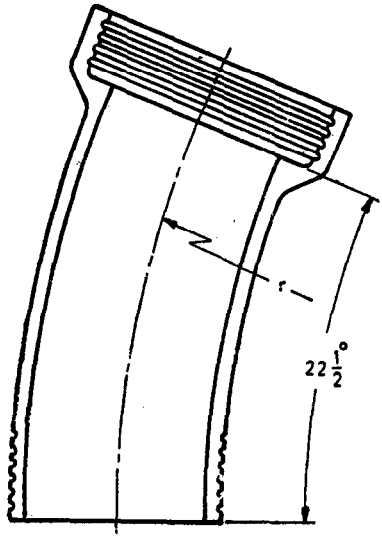


INTERNAL DIAMETER	SHORT	MEDIUM	LONG
	r	*r*	*r*
(1)	(2)	(3)	(4)
100	250	380	500
150	380	460	530
200	—	530	—
250	—	610	—
300	—	610	—
350	—	640	—
400	—	670	—
450	—	700	—
500	—	735	—
600	—	785	—

TABLE 9 DIMENSIONS OF HALF-SECTION ONE-SIXTEENTH CHANNEL BENDS

(*Clause* 16.1)

(All dimensions in millimetres)

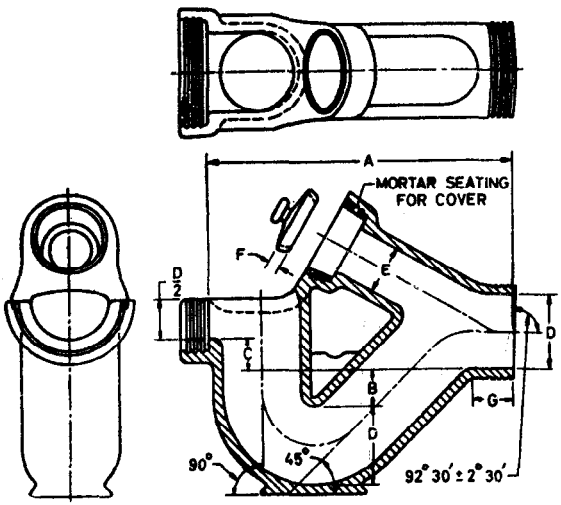


INTERNAL DIAMETER	r
(1)	(2)
100	750
150	900
200	1 050
250	1 200
300	1 200
350	1 500
400	1 800
450	2 150
500	2 600
600	3 050

TABLE 10 DIMENSIONS OF CHANNEL INTERCEPTORS

(*Clause* 16.1)

(All dimensions in millimetres)



INTERNAL DIAMETER *D*	*A*	*B*	*C*	*E*	*F*	*G*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
100	470	65	50	100	20	75
150	610	75	65	100	20	75

17. SPIGOTS AND SOCKETS OF FITTINGS

17.1 The spigots and sockets of fittings, except where otherwise provided for in this standard, shall conform to the appropriate corresponding dimensions of straight pipes and sockets given in Table 1.

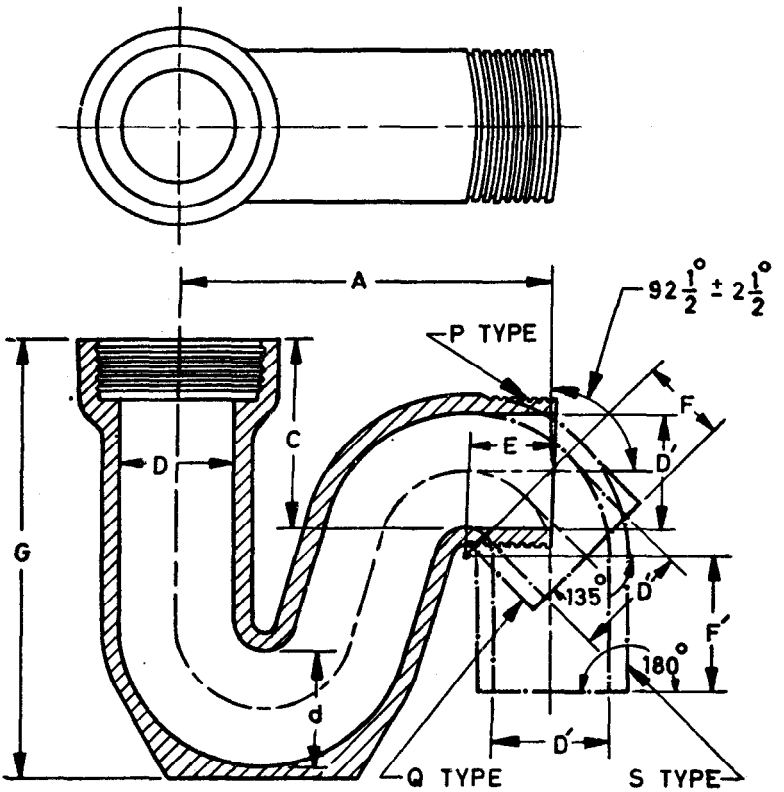
18. GROOVING

18.1 The interior of the sockets and the exterior of the spigots shall be grooved circumferentially. Where applicable such grooving on the spigots shall be for a length equal to one and a half times the depth of the sockets, and the depth of such grooves shall be not less than 1·5 mm.

TABLE 11 DIMENSIONS OF ROUND MOUTH GULLY TRAPS

(*Clause* 16.1)

(All dimensions in millimetres)

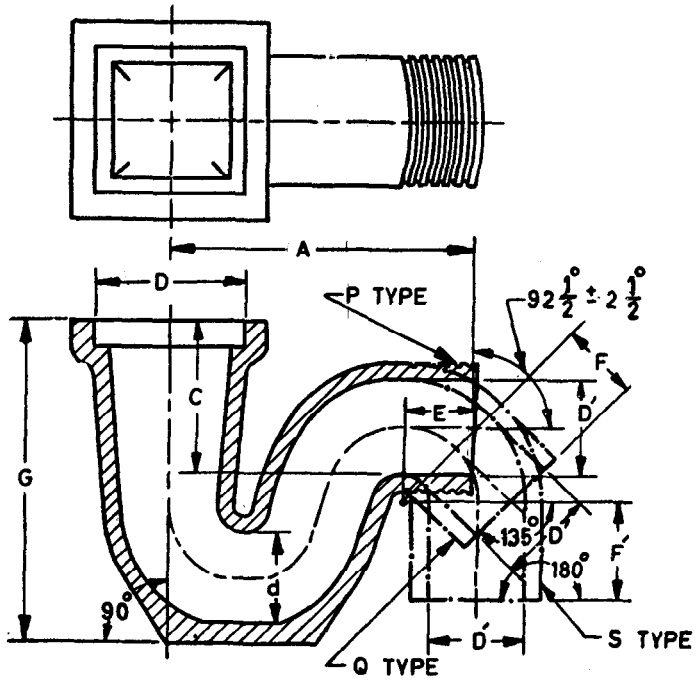


TYPE	SIZE	*A*	*C*	*d*	*D*	*D'*	*E*	*F*	*F'*	*G*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
P	100 × 100	330	165	100	100	100	75	—	—	360
	125 × 100	355	185	100	125	100	75	—	—	340
	150 × 100	343	200	100	150	100	75	—	—	385
Q	125 × 100	330	175	100	125	100	—	75	—	340
S	100 × 100	305	165	100	100	100	—	—	120	360
	150 × 100	343	200	100	150	100	—	—	115	385
	150 × 150	405	255	150	150	150	—	—	100	460

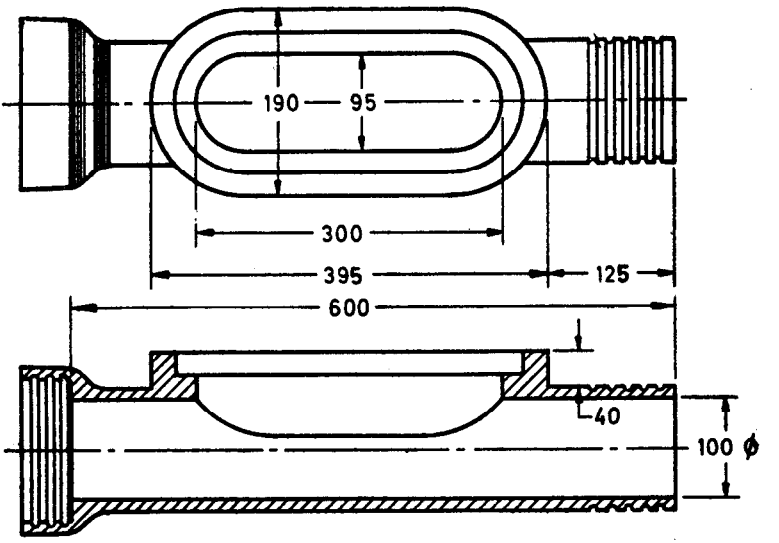
TABLE 12 DIMENSIONS OF SQUARE-MOUTH GULLY TRAPS

(*Clause* 16.1)

(All dimensions in millimetres)



TYPE	SIZE	*A*	*C*	*d*	*D*	*D'*	*E*	*F*	*F'*	*G*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
P	100 × 100	305	175	100	100	100	65	—	—	330
	125 × 100	265	165	100	125	100	60	—	—	345
	150 × 100	330	165	100	150	100	75	—	—	346
	180 × 100	320	200	100	180	100	65	—	—	380
	180 × 150	405	270	150	180	150	75	—	—	520
Q	125 × 100	330	165	100	125	100	—	80	—	345
S	125 × 100	290	165	100	125	100	—	—	100	345
	150 × 100	330	165	100	150	100	—	—	115	346
	180 × 150	445	275	150	180	150	—	—	125	520



(All dimensions in millimetres)

FIG. 8 INSPECTION PIPE

APPENDIX A

(*Clause* 0.4)

NOTE ON JOINTING

A-0. Particular attention should be paid to the jointing of chemically resistant stoneware pipes and fittings.

A-1. The jointing material used should be resistant to corrosive liquors and should adhere strongly to the ware. It should be inert to the action of subsoil water also.

A-2. In order to reduce the area of jointing material in contact with the liquor, the space between the end of the spigot and the shoulder of the socket (*see F* in Table 1) should be as narrow as practicable.

APPENDIX B

(*Clause* 6.4)

DETERMINATION OF RESISTANCE OF BODY TO ACIDS

B-0. PRINCIPLE

B-0.1 The material is ground and digested in concentrated acid and the resistance to acid is determined as the percentage of the ratio of the final mass after treatment to the initial mass.

B-1. REAGENTS

B-1.1 Concentrated Nitric Acid — conforming to IS : 264-1968*.

B-1.2 Concentrated Sulphuric Acid — conforming to IS : 266-1961†.

B-2. PREPARATION OF THE TEST SAMPLE

B-2.1 The test sample shall be taken from the body of the ware and shall be free from glaze. Crush the sample in a stoneware mortar and mix. Use the fraction which passes 850-micron IS Sieve and is retained by a 600-micron IS Sieve [*see* IS : 460 (Part I)-1978‡] for testing. The portion so collected shall be not less than 30 g and shall be washed free from dust as follows:

> Place the material in a porcelain basin and add about 150 ml of distilled water for each 30 g of sample. Place the basin and contents on a sand-bath and heat until the water is at boiling point; continue heating for one hour, taking care to avoid loss by spurting. Decant the water immediately and rinse the particles four times with cold distilled water. Dry the remaining material at 110°C to constant mass (about 4 hours will be normally sufficient).

B-3. PROCEDURE

B-3.1 Take 25 g of the prepared sample accurately within $\pm$ 1 mg and transfer in a 110-mm porcelain basin. Then add a mixture of 7 ml of nitric acid, 13 ml of sulphuric acid and 65 ml of distilled water. Place the basin and its contents on a sand-bath and heat carefully, avoiding spurting, till all nitric acid has evaporated and sulphuric acid starts fuming profusely.

*Specification for nitric acid (*first revision*).

†Specification for sulphuric acid (*revised*).

‡Specification for test sieves: Part I Wire cloth test sieves (*second revision*).

Cool the basin and contents. Add then 90 ml of distilled water and 10 ml of nitric acid (sp gr 1·42). Repeat the heating process, until the sulphuric acid again fumes strongly. Cool the basin and contents and decant the acid carefully. Then add about 150 ml of cold distilled water and heat up to boiling point and decant. The cycle of addition of fresh water, boiling and decantation shall continue until the decanted liquor is found to be free from sulphuric acid when tested with barium chloride solution. No particle shall be lost in the process. After the final decantation, dry the sample at 110°C to constant mass.

B-4. CALCULATION

B-4.1 Resistant to acid $= \frac{\text{Final mass in grams}}{\text{Initial mass in grams}} \times 100.$

APPENDIX C

(Clause 6.5)

TEST FOR ALKALI RESISTANCE

C-0. PRINCIPLE

C-0.1 The resistance of stoneware pipes to alkali is determined by reacting it with magnesium sulphate solution.

C-1. PREPARATION OF SAMPLE

C-1.1 Test samples measuring not less than 75 cm^2 and not more than 130 cm^2 shall be broken from the stoneware pipe. The samples shall be sound, free from cracks or surface defects.

C-2. REAGENTS

C-2.1 Magnesium Sulphate Solution — saturated. Conforming to IS : 2730-1964*.

C-3. PROCEDURE

C-3.1 Heat the magnesium sulphate solution (sp gr 1·295 to 1·308) to the boiling temperature. Place the test sample in a wire basket and

*Specification for magnesium sulphate (epsom salts).

submerge it into the boiling solution; continue heating for two hours. Then remove the sample and bring it to a constant mass in a drier or oven at a temperature not less than 110°C. Subject the test sample to at least five cycles, using fresh solution for each cycle. After the completion of five cycles remove the sample from the solution, wash it and bring it to constant mass in a drier or oven at a temperature not less than 110°C.

C-3.2 There shall be no evidence of pitting, softening, spalling or cracking.

APPENDIX D

(*Clause* 6.6)

CRUSHING STRENGTH TEST

D-1. CRUSHING STRENGTH TESTING MACHINE

D-1.1 While the pipe to be tested is supported in a horizontal position on two bearings parallel to its axis, the load shall be applied to it along the length of the barrel through a third bearing on top of the barrel (*see* Fig. 9).

D-1.2 Any testing machine, having a device that will apply the load at a uniform rate of about 30 kN/m/per minute, or in increments of not more than 50°N at the same rate, may be used for making the test.

D-1.3 The testing machine shall be substantial and rigid throughout so that the distribution of the load will not be affected appreciably by the deformation or yielding of any part. The bearings shall be as specified in **D-1.4**, **D-1.5**, **D-1.6** and **D-2.1** and shall be attached to the machine so as to receive and uniformly transmit maximum loads required in the tests without lost motion, vibrations, or sudden shock. The machine and bearings shall be designed to transmit the load in a vertical plane through the longitudinal centre lines of the bearings and pipe.

D-1.4 The three bearings shall consist of a lower member, being a rigid beam on which two bearing strips are symmetrically disposed parallel to a vertical plane passing through the longitudinal axis of the pipe, and an upper member also being a rigid beam, on which one bearing strip is centred and disposed so that it lies in the vertical plane passing through the longitudinal axis of the pipe (*see* Fig. 9).

D-1.5 The beam on which the bearing strips are disposed shall be structural steel beams having moments of inertia about the vertical and horizontal axis of the cross section not less than those of IS beam 250 mm × 200 mm × 40 kg/m and with a width of flange not less than 200 mm.

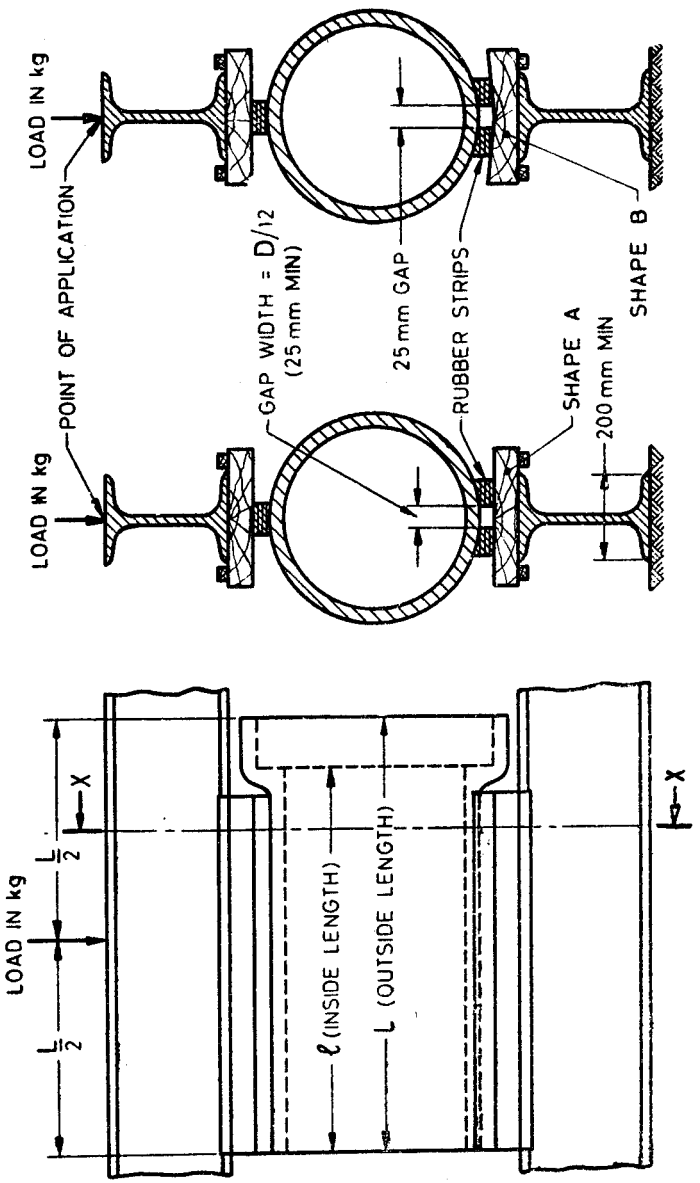


FIG. 9 CRUSHING TEST RIG

D-1.6 Mild steel, teak or similar hardwood shall be used to face the upper flange of the bottom beam. The facing shall be straight and free of warping or twisting and shall be centrally located on the flange of the beam by means of hardwood strips attached to its lower face and in contact with the edges of the flange. The cross section of the facing may have either of two shapes at the discretion of the pipe manufacturer.

Shape A shall be rectangular 280 × 25 mm minimum, without a joint. Shape B is shown in Fig. 10.

A similar facing of shape A may be used to face the lower flange of the upper beam if desired.

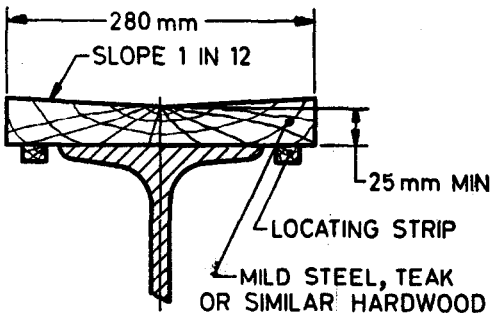


FIG. 10 DETAIL OF ALTERNATIVE FACING

D-2. BEARING STRIPS

D-2.1 The bearing strips shall consist of rubber cut or formed from material having sufficient hardness. The strips shall be of rectangular cross section having a width of 50 mm and a thickness of not less than 25 mm or more than 40 mm. The two bottom strips shall be of equal thickness.

D-2.2 The single top bearing strip shall be used with the 50 mm dimension in contact with the pipe. It may be positioned on the bearing by the use of wood or metal strips along its outside edges, provided the thickness of the positioning strips does not exceed one-half of the thickness of the rubber bearing strip.

D-2.3 The two lower bearing strips shall be laid on the 50 mm dimension and may be positioned on the bearing with wood or metal strips between them and adjacent to their outside edges, provided the thickness of these positioning strips does not exceed one-half of the thickness of these rubber bearing strips. The two strips shall be parallel and, when used with a facing of shape A, shall be spaced a distance apart of approximately 1 mm per 12 mm of pipe diameter but in no case less than 25 mm. When used with shape B, they shall be parallel and 25 mm apart for all pipe diameters.

D-2.4 The rubber bearing strips may be attached to the facings, or in the case of the single upper strip, directly to the upper beam, by adhesive if desired, provided such method of attachment results in the strip remaining firmly fixed in position when carrying the maximum load.

D-3. APPLICATION OF LOAD

D-3.1 The load shall be applied to the top bearing at a point distant from the spigot end of the pipe equal to one half of the overall length of the pipe including the socket if any. The test load shall be applied to the top bearing in such a way that the bearing is free to rotate in vertical plane through the longitudinal centre line, of the top and bottom bearings. In testing a pipe that is not straight it shall be placed between the bearings in the position that appears to give the most favourable bearing conditions for fair test.

D-3.2 The loading of the pipe shall be a continuous operation, and the pipe shall not be allowed to stand under load longer than is required to apply the load and record the observations.

D-4. EVALUATION OF CRUSHING STRENGTH

D-4.1 The ultimate crushing strength in N per linear metre shall be calculated by dividing the total applied load at fracture by the inside length of the barrel of the sample broken.

APPENDIX E

(*Clause* 7.1)

SAMPLING OF PIPES AND FITTINGS

E-1. SCALE OF SAMPLING

E-1.1 Lot — In any consignment, all the pipes or fittings of the same type, size and manufactured under similar conditions of production shall be grouped together to constitute a lot.

E-1.2 The number of pipes or fittings to be selected at random from the lot depends upon the size of the lot and shall be in accordance with col 1 to 4 of Table 13.

TABLE 13 SAMPLE SIZE AND CRITERIA FOR CONFORMITY

Lot Size	Sample	Sample Size	Cumulative Sample Size	General Quality (4.1) and Dimensions (Sections A & B)		Minor Blemishes (4.2)	
				a_1	r_1	a_2	r_2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Up to	150	First 13	13	0	2	2	5
		Second 13	26	1	2	6	7
151 ,,	300	First 20	20	0	3	3	7
		Second 20	40	3	4	8	9
301 ,,	500	First 32	32	1	4	5	9
		Second 32	64	4	5	12	13
501 ,,	1 000	First 50	50	2	5	7	11
		Second 50	100	6	7	18	19
1 001 ,,	3 000	First 80	80	3	7	11	16
		Second 80	160	8	9	26	27
3 001 and above		First 125	125	5	9	17	22
		Second 125	250	12	13	37	38

E-2. NUMBER OF TESTS

E-2.1 All the pipes or fittings selected as in **E-1.2** shall be inspected for general quality (*see* **4.1**), and dimensions (*see* Section A and Section B).

E-2.2 The number of pipes or fittings to be tested for absorption (*see* **6.3**), for resistance to action of acids (*see* **6.4**) and of alkali (*see* **6.5**), if prescribed, and crushing strength (*see* **6.6**) shall be as given below:

Lot Size	*Number of Pipes to be Tested*
Up to 150	2
151 ,, 300	3
301 ,, 500	4
501 ,, 1 000	5
1 001 ,, 3 000	7
3 001 and above	8

These pipes may be selected at random from those already selected in **E-1.2** and suitable test specimens shall be selected from them.

E-3. CRITERIA FOR CONFORMITY

E-3.1 A lot shall be considered as conforming to the requirements of this specification, if the conditions mentioned in **E-3.2** to **E-3.5** are all satisfied.

E-3.2 General Quality (*see* **4.1**) **and Dimensions (Section A & Section B)** — The number of pipes and fittings in the first sample (*see* col 2 and 3 of Table 13) shall be first selected and subjected to inspection for general quality and dimensions. If in the first sample, the number of defectives, that is, those failing either for general quality or dimensions, is less than or equal to the corresponding acceptance number a_1 (col 5), the lot shall be considered as conforming to the requirements of general quality and dimensions. If the number of defectives in the first sample is greater than or equal to the corresponding rejection number r_1 (col 6), the lot shall be considered as not conforming. If the number of defectives in the first sample lies between the corresponding a_1 and r_1, a second sample (*see* col 2 and 3) shall be selected and subjected to inspection. If in the combined sample, the number of defectives is less than or equal to the corresponding acceptance number a_1, the lot shall be considered conforming, and if the number of defectives is greater than or equal to the corresponding rejection number r_1, the lot shall be considered as not conforming.

E-3.3 Minor Blemishes (*see* **4.2**) — The number of pipes and fittings in the first sample (*see* col 2 and 3 of Table 13) shall be first selected and subjected to inspection for blemishes which do not impair the strength, durability and serviceability. If in the first sample the number of defectives is less than or equal to the corresponding acceptance number a_2 (col 7), the lot shall be considered as conforming to the requirements. If the number of defectives in the first sample is greater than or equal to the corresponding rejection number r_2 (col 8), the lot shall be considered as not conforming. If the number of defectives in the first sample lies between the corresponding a_2 and r_2, a second sample (*see* col 2 and 3) shall be selected and subjected to inspection. If in the combined sample, the number of defectives is less than or equal to the corresponding acceptance number a_2, the lot shall be considered conforming, and if the number of defectives is greater than or equal to the corresponding rejection number r_2, the lot shall be considered as not conforming.

E-3.4 For absorption test, the mean and the range of the test results obtained shall be calculated and (mean + 0·6 range) shall be less than or equal to the maximum limit.

E-3.5 For resistance to action of acids and of magnesium sulphate, if prescribed, and crushing strength test all the test specimens shall satisfy the requirements of the test.

(*Continued from page* 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	webes	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

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