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(चौथा पुनरीक्षण)

Indian Standard

PRECAST CONCRETE PIPES (WITH AND WITHOUT REINFORCEMENT) — SPECIFICATION

(Fourth Revision)

ICS23.040.50;91.100.30

BUREAU OF INDIAN STANDARDS
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Price Group 11

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement Matrix Products Sectional Committee had been approved by the Civil Engineering Division Council.

Precast concrete pipes are widely used for water mains, sewers, culverts and in irrigation. This standard lays down the requirements of quality and dimensions for concrete pipes to serve as guidance to the manufacturers and users in producing and obtaining concrete pipes of suitable quality. Guidance regarding laying of concrete pipes is given in IS 783 : 1985 'Code of practice for laying of concrete pipes'.

In case liquid conveyed by the pipeline is likely to be harmful to concrete, necessary precautions should be taken.

This standard was first published in 1956 and subsequently revised in 1961, 1971 and 1988. The present revision has been taken up with a view to incorporating the modifications found necessary as a result of experience gained with the use of this standard. This revision also incorporates some of the important amendments issued to the last version of the standard including those relating to restricting the use of plain ended pipes and incorporation of detailed provisions regarding pipes manufactured by vibrated casting process and various decisions taken by the Sectional Committee from time to time.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PRECAST CONCRETE PIPES (WITH AND WITHOUT REINFORCEMENT) — SPECIFICATION

(Fourth Revision)

1 SCOPE

1.1 This standard covers the requirements for reinforced and unreinforced precast cement concrete pipes, of both pressure and non-pressure varieties used for water mains, sewers, culverts and irrigation. The requirements for collars are also covered by this standard.

NOTES

1 This standard covers the requirements for pressure and non-pressure pipes manufactured by spinning process and also non-pressure pipes of class NP3 and NP4 manufactured by vibrated casting process.

2 In addition to the requirements specified specifically for the collars, the requirements given in the following clauses shall also apply for the collars:

5.2, 5.3, 5.4, 5.5.1, 5.5.3, 5.5.4, 5.7, 5.8, 7.1, 7.2, 7.2.1, 7.2.2, 7.3, 7.3.1, 7.4, 8.2, 9.1, 9.1.1, 9.1.2, 9.1.3, 9.1.4, 12.1 and **12.1.1**.

1.2 Prestressed concrete pipes and pipes with non-circular section are not covered by this standard.

2 REFERENCES

The standards given in Annex A contain provisions which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Working Pressure — The maximum sustained internal pressure excluding surge, to which each portion of the pipeline may be subjected when installed.

3.2 Site Test Pressure — 1.5 times working pressure pertaining to the section or 1.1 times static pressure, whichever is more (surge pressure is to be controlled within 25 percent of pump head in case of pumping mains).

3.3 Hydrostatic Test Pressure — It is the maximum pressure which the pipe can withstand without any leakage when tested for hydrostatic pressure in accordance with this standard and IS 3597.

3.4 Surge (Water Hammer) Pressure — It is a pressure which is produced by a change of velocity of the moving stream and becomes maximum when there is a sudden stoppage which may be caused by the closing of a valve or by shutting down a pump station. Surge pressure is to be controlled within 25 percent of pump head.

4 CLASSIFICATION

4.1 For the purpose of this standard, concrete pipes shall be classified as under:

Class	*Description*	*Conditions Where Normally Used*
NP1	Unreinforced concrete non-pressure pipes	For drainage and irrigation use, above ground or in shallow trenches
NP2	Reinforced concrete, light-duty, non-pressure pipes	For drainage and irrigation use, for cross drains/culverts carrying light traffic
NP3	Reinforced and also unreinforced (in case of pipes manufactured by vibrated casting process) concrete, medium-duty, non-pressure pipes	For drainage and irrigation use, for cross drains/culverts carrying medium traffic
NP4	Reinforced and also unreinforced (in case of pipes manufactured by vibrated casting process) concrete, heavy-duty, non-pressure pipes	For drainage and irrigation use, for cross drains/culvert carrying heavy traffic
P1	Reinforced concrete pressure pipes tested to a hydrostatic pressure of 0.2 MPa (20 m head)	For use on gravity mains, the site test pressure not exceeding two-thirds of the hydrostatic test pressure
P2	Reinforced concrete pressure pipes tested to a	For use on pumping mains, the site test

Class	*Description*	*Conditions Where Normally Used*
P2	Reinforced concrete pressure pipes tested to a hydrostatic pressure of 0.4 MPa (40 m head)	For use on pumping mains, the site test pressure not exceeding half of the hydrostatic test pressure
P3	Reinforced concrete pressure pipes tested to a hydrostatic pressure of 0.6 MPa (60 m head)	For use on pumping mains, the site test pressure not exceeding half of the hydrostatic test pressure

NOTE — The uses are only by way of recommendations as a general guidance and the exact usage shall be decided by the engineer-in-charge.

4.2 Unreinforced and reinforced concrete non-pressure pipes shall be capable of withstanding a test pressure of 0.07 MPa (7 m head).

5 MATERIALS

5.1 For precast concrete pipes, materials complying with the requirements given in **5.2** to **5.8** shall be used.

5.2 Cement

Cement used for the manufacture of unreinforced and reinforced concrete pipes shall conform to IS 269 or IS 455 or IS 1489 (Part 1) (*see* Note 1) or IS 1489 (Part 2) or IS 8041 or IS 8043 or IS 8112 or IS 12269 or IS 12330.

NOTES

1 Unless otherwise specified by the purchaser, the type of cement to be used is left to the discretion of the manufacturer. Fly ash based cement conforming to IS 1489 (Part 1) with fly ash contents up to 25 percent is permitted for non-pressure pipe only.

2 Sulphate resisting Portland cement (*see* IS 12330) shall be used, where sulphate is predominant.

3 Site blending with fly ash up to a maximum of 25 percent may be carried out provided its uniform blending with ordinary Portland cement is ensured. Such blended cement shall be used only for non-pressure pipes. The fly ash used for blending shall be either from ESP or processed by established fly ash processing units and shall conform to Grade 1 of IS 3812. Specified requirements of concrete strength, permeability, hydrostatic test and three-edge bearing test shall be met to the satisfaction of customer before it is used for regular production.

5.3 Aggregates

Aggregates used for the manufacture of unreinforced and reinforced concrete pipes shall conform to **3** of IS 383. The maximum size of aggregate should not exceed one third thickness of the pipe or 20 mm, whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm the maximum size of aggregate should be 10 mm.

NOTE — It is preferable to have the size and grading of aggregates conforming to IS 383. It is also preferable that materials finer than 75 micron IS Sieve is restricted to 3.0 percent by mass.

5.4 Reinforcement

Reinforcement used for the manufacture of the reinforced concrete pipes shall conform to mild steel Grade 1 or medium tensile steel bars conforming to IS 432 (Part 1) or hard-drawn steel wire conforming to IS 432 (Part 2) or structural steel (standard quality) bars conforming to IS 2062.

NOTE — Wire fabric conforming to IS 1566 or deformed bars and wires conforming to IS 1786 or plain hard-drawn steel wire for prestressed concrete conforming to IS 1785 (Part 1) or IS 1785 (Part 2) may also be used. For such reinforcement maximum tensile stress shall be as given in **6.1.**

5.5 Concrete or Mortar

5.5.1 The concrete quality (concrete mix, maximum water-cement ratio, minimum cement content, etc) shall be as per IS 456 for at least very severe environment exposure condition. Design mix requirements shall be as per IS 456. However, in case of pipes cast by spinning process higher cement contents, more fines and higher water-cement ratio may be the need of the process. For non-pressure pipes, if mortar is used, it shall have a minimum cement content of 450 kg/m^3 and a compressive strength not less than 35 N/mm^2 at 28 days. For pressure pipes if mortar is used, it shall have a minimum cement content of 600 kg/m^3 and a compressive strength not less than 35 N/mm^2 at 28 days. However, in case of pipes manufactured by vibrated casting process, concrete shall have minimum compressive strength as indicated in Tables 4, 5, 7 and 8 for the respective classes of pipes.

Where the process of manufacture is such that the strength of concrete or mortar in the pipe differs from that given by tests on cubes, the two may be related by a suitable conversion factor. If the purchaser requires evidence of this factor, he shall ask for it before placing the order. The conversion factor for 28 days compressive strength for spun concrete may be taken as 1.25 in the absence of any data.

5.5.2 For pressure pipes, splitting tensile strength of concrete cylinders at 28 days, when tested in accordance with IS 5816, shall be not less than 2.5 N/mm^2.

5.5.3 Compressive strength tests shall be conducted on 150 mm cubes in accordance with the relevant requirements of IS 456 and IS 516.

5.5.4 The manufacturer shall give a certificate indicating the quantity of cement in the concrete mix.

5.6 Rubber Ring

Rubber ring chords used in pipe joints shall conform to Type 2 of IS 5382.

5.7 Water

Water used for mixing of concrete and curing of pipes shall conform to **5.4** of IS 456.

5.8 Chemical Admixtures

The admixtures, where used, shall conform to IS 9103.

6 DESIGN

6.1 General

Reinforced concrete pipes either spun or vibrated cast shall be designed such that the maximum tensile stress in the circumferential steel due to specified hydrostatic test pressure does not exceed the limit of 125 N/mm^2 in the case of mild steel rods, 140 N/mm^2 in the case of hard-drawn steel wires and high strength deformed steel bars and wires.

6.1.1 The barrel thickness shall be such that under the specified hydrostatic test pressure, the maximum tensile stress in concrete, when considered as effective to take stress along with the tensile reinforcement, shall not exceed 2 N/mm^2 for pressure pipes and 1.5 N/mm^2 for non-pressure pipes. But the barrel wall thickness shall be not less than those given in Tables 1, 2, 3, 6, 9, 10 and 11 subject to **8.2**(iii) for pipes manufactured by spun process. For pipes manufactured by vibrated casting process, the barrel wall thickness shall be as given in Tables 4, 5, 7 and 8.

6.1.2 Pipes of length above 3 m and up to 4 m may be supplied by agreement between the user and the supplier and for such pipes, the quantity of reinforcement shall be modified as per **6.1.2.1**.

6.1.2.1 *Longitudinal reinforcement*

Reinforced cement concrete pipes of lengths up to 4 m may be accepted if the longitudinal reinforcement is increased in proportion to the square of length compared with what is used for 3 m length as specified in Tables 2 to 11, except for Table 4 and 7.

For 'L' (in metre) length of pipe, longitudinal reinforcement shall be $L^2/3^2$ times the longitudinal reinforcement used for 3 m long pipes.

6.1.3 Longitudinal reinforcement shall be provided to ensure rigidity and correct location of cages (grids) longitudinally and to limit the effects of transverse cracking. Minimum longitudinal reinforcement shall be as given in Tables 2, 3, 6, 9, 10 and 11 for pipes manufactured by spinning process. For reinforced pipes manufactured by vibrated casting process, the minimum longitudinal reinforcement shall be as given in Tables 5 and 8.

6.2 Reinforcement

The reinforcement in the reinforced concrete pipe shall extend throughout the length of the pipe and shall be so designed that it may be readily placed and maintained to designed shape and in the proper position within the pipe mould during the manufacturing process. The circumferential and longitudinal reinforcement shall be adequate to satisfy the requirements specified under **6.1**.

For non-welded cages spiral reinforcement of the same diameter shall be closely spaced at the end of the pipe for a length of 150 mm to minimize damage during handling. The spacing of such end spirals shall not exceed 50 mm or half the pitch whichever is less. Such spiral reinforcement at ends shall be part of the total spiral reinforcement specified in different tables.

6.2.1 The pitch of circumferential reinforcement shall be not more than the following:

a) 200 mm for pipes of nominal internal diameter 80 to 150 mm,

b) 150 mm for pipes of nominal internal diameter 200 to 350 mm, and

c) 100 mm for pipes of nominal internal diameter 400 mm and above.

The pitch shall also be not less than the maximum size of aggregate plus the diameter of the reinforcement bar used.

6.2.2 The quantity and disposition of steel in pipes may be decided by mutual agreement between the purchaser and the supplier; however, it shall be proved by calculations and tests that the quantity of the reinforcements conforms to all the requirements specified in the standard. In the absence of calculations and tests, the reinforcement given in Tables 2, 3, 6, 9, 10 and 11 for pipes manufactured by spinning process and in Tables 5 and 8 for pipes manufactured by vibrated casting process shall be used as minimum reinforcement subject to the requirements of **6.2.2.1**.

6.2.2.1 Tolerances given in IS 432 (Part 1), IS 432 (Part 2), and IS 2062 shall be applied to the minimum mass of longitudinal reinforcement specified in different tables. Total mass of longitudinal reinforcement shall be calculated taking into account the clear cover provided at each end of the pipe.

NOTE — For longitudinal reinforcement conforming to IS 432 (Part 2), tolerance on mass shall be calculated from the diameter tolerance.

6.2.3 If so required by the purchaser, the manufacturer shall give a certificate indicating the details relating to

quality, quantity and dispersion of steel in the pipes as well as the clear cover to the steel provided in the pipes.

6.3 Ends of Pipes

Spigot and Socket ended pipes shall be used for water mains, sewer, irrigation and culverts/cross drains. Whereas, flush jointed (NP3 and NP4) and collar jointed (NP2) pipes shall be used for culverts/cross drains only. The ends of concrete pipes used for water mains, sewer and irrigation shall be suitable for socket and spigot, roll on joints or confined gasket joints. Dimensions of spigot and socket for various classes of pipes shall be as given in Tables 12, 13, 14, 17, 18 and 19 for pipes manufactured by spinning process. However the dimension of spigot and socket shall be as given in Tables 15 and 16 in case of pipes manufactured by vibrated casting process. Reinforcement in socket of rubber ring jointed pipes shall be as given in Table 20. However, the ends of concrete pipes used for road culverts/ cross drains may be suitable for flush (NP3 and NP4) or collar joints (NP2) (*see* Fig. 1 and 2). For pipes of diameter up to 700 mm, external flush joint and for diameters above 700 mm, internal flush joint is recommended. Dimensions of collars for NP1 and NP2 class pipes shall be according to details given in Table 1 and Table 21 respectively. The reinforcement in collars shall be as given in Table 21. The end of the collar reinforcement shall have a full ring at both ends.

NOTES

1 Bends, junctions and specials for concrete pipes covered under this standard shall conform to the requirements of IS 7322.

2 Some typical arrangement of reinforcement in socket are illustrated in Fig. 3 and Fig. 4.

6.3.1 Only flexible rubber ring joints shall be used for the joints in (a) all pressure pipes and (b) all non-pressure pipes except when used for road culverts/ cross drains. The pipe joints shall be capable of withstanding the same pressures as the pipe.

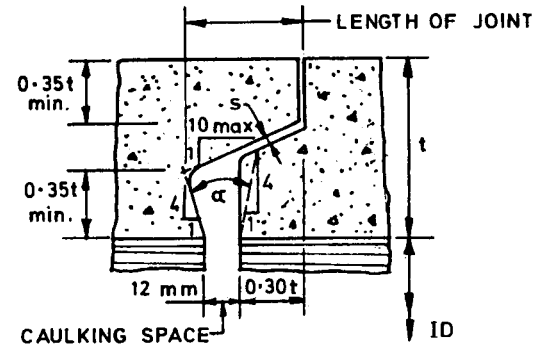
NOTE — The requirements of **6.3.1** does not imply that the collar shall also be tested for the test pressure for pipes specified in **4.1**, **4.2** and **10.2**.

6.4 Cover

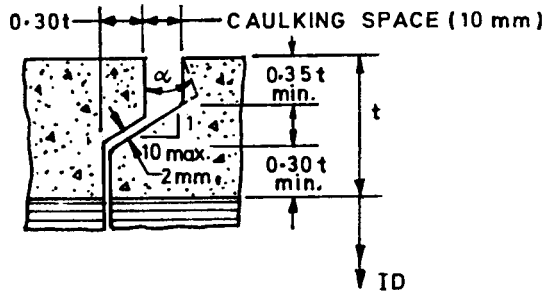
The minimum clear covers for reinforcement in pipes and collars shall be as given below:

Sl No.	*Precast Concrete Pipe/ Collar*	*Minimum Clear Cover,* mm
i)	Barrel wall thickness:	
	a) Up to and including 75 mm	8
	b) Over 75 mm	15
ii)	At spigot steps	5
iii)	At end of longitudinals	5

NOTE — An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of rustproof material or of steel protected against corrosion.



1A Internal Flush Joints



1B External Flush Joints

t – wall thickness.
s – 0.002 of intenal dia or 2 mm, *Min.*
ID – internal diameter.
α – included angle not more than 25° (only for design purpose not be measured).

FIG. 1 DETAILS OF FLUSH JOINTS

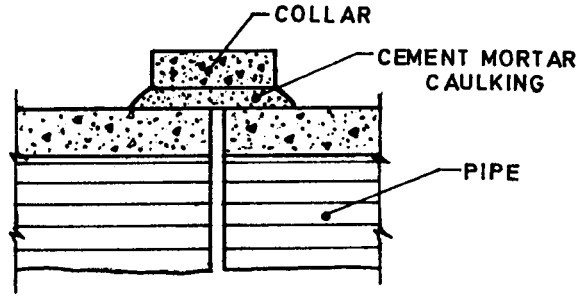


FIG. 2 COLLAR JOINT (RIGID)

7 MANUFACTURE

7.1 General

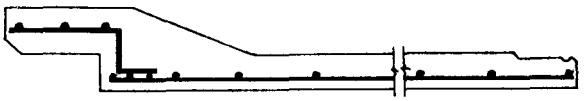
The method of manufacture shall be such that the forms and dimensions of the finished pipe are accurate within the limits specified in this standard. The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis.

7.2 Concrete Mixing and Placing

7.2.1 Concrete shall be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform

NOTE — No. of Z bars : Minimum half the number of longitudinals. Maximum equal to number of longitudinals.

3A Socket Cage Gonnected to Barrel Cage by Means of Z Bars



3B Socket Cage Longitudinals Suitably Bent for Connecting to Barrel Cage

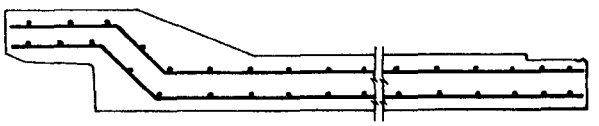
3C Cage made of Continuous Longitudinals

FIG. 3 TYPICAL ARRANGEMENTS OF REINFORCEMENT IN SOCKET FOR SINGLE CAGE

NOTE — No. of Z bars : Minimum half the number of longitudinals. Maximum equal to number of longitudinals.

4A Socket Cage Connected to Barrel Cage by Means of Z Bars

4B Socket Cage Longitudinal Suitably Bent for Connecting to Barrel Cage



4C Cage made of Continuous Longitudinals

FIG. 4 TYPICAL ARRANGEMENTS OF REINFORCEMENT IN SOCKET FOR DOUBLE CAGE (USE SUITABLE TYPE OF SPACERS)

distribution of the materials and the mass is uniform in colour and consistency, but in no case shall the mixing be done for less than 2 min.

7.2.2 Concrete shall be placed before setting has commenced. It should be ensured that the concrete is not dropped freely so as to cause segregation. The concrete shall be consolidated by spinning, vibrating, spinning combined with vibrations, or other appropriate mechanical means.

7.3 Reinforcement Cages

Reinforcement cages for pipes shall extend throughout the pipes barrel. The cages shall consist of spirals or circular rings and straights of hard-drawn steel wire or mild steel rod. Reinforcement cages shall be placed symmetrically with respect to the thickness of the pipe wall. The spirals shall end in a complete ring at both the ends of a pipe.

7.3.1 Pipes having barrel wall thickness 100 mm and above shall have double reinforcement cage and the amount of spirals steel in the outer cage shall be 75 percent of the mass of spiral steel in the inner cage, whilst the total shall conform to the requirements specified in the relevant tables of this standard. The mass of longitudinals in the outer cage and inner cage should be the same, that is equal to half the total mass of longitudinals specified in the relevant tables. The total longitudinal steel per pipe shall be as given in the relevant tables.

NOTE — It is preferable that single reinforcement cage should be located near the inner surface of the pipe with adequate clear cover.

7.3.2 Diagonal reinforcement may be provided in pipes, the cages for which are not welded so as to help in binding the cage securely. It shall, however, be ensured that the clear cover for any reinforcement is not below the limits specified in **6.4**. Diagonal reinforcement is a process requirement and shall not be counted against longitudinal and spiral reinforcement.

7.4 Curing

Curing shall be either by steam or by water or by a combination of steam and water, or by use of approved curing compounds. If water curing is used, the pipes shall be cured for a minimum period of 7 days in case of non-pressure pipes and 14 days in case of pressure pipes. In case of pipes where cement with fly ash or slag is used, the minimum period of water curing shall be 14 days. If steam curing is used, after that it shall be water cured for 3 days.

8 DIMENSIONS

8.1 Pipes

The internal diameter, barrel wall thickness, length, the minimum reinforcements and strength test requirements for different classes of pipes (*see* **4.1**), shall be as specified in Tables 1 to 11. Dimensions of collar for class NP1 and dimensions and

Table 1 Design and Strength Test Requirements of Concrete Pipes of Class NP1 — Unreinforced, Non-pressure Pipes

(*Clauses* 6.1.1, 6.3 *and* 8.1)

Internal Diameter of Pipes	Barrel Wall Thickness	Collar Dimensions		Minimum Length of Collar	Strength Test Requirements for Three Edge Bearing Test Ultimate Load Test
		Minimum Caulking Space	Minimum Thickness		
mm	mm	mm	mm	mm	kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)
80	25	13	25	150	15.3
100	25	13	25	150	15.3
150	25	13	25	150	15.3
200	25	13	25	150	16.4
225	25	13	25	150	16.4
250	25	13	25	150	16.4
300	30	16	30	150	17.6
350	32	16	32	150	18.4
400	32	16	32	150	18.8
450	35	19	35	200	21.9

reinforcement of collar for class NP2 shall be as per Tables 1 and 21 respectively. However, in case of pipes manufactured by vibrated casting process, the internal diameter, wall thickness, the minimum reinforcement (in case of reinforced pipes) and strength test requirements for different classes of pipes shall be as given in Tables 4, 5, 7 and 8. The manufacturer shall inform the purchaser of the effective length of spigot and socket, and flush jointed pipes that he is able to supply. For collar jointed pipes, effective length shall be 2 m or 2.5 m up to 250 mm nominal diameter pipes and 2.5 m, 3.0 m, 3.5 m or 4.0 m for pipes above 250 mm nominal diameter. Class NP3 and NP4 pipes of nominal internal diameter 900 mm and above, the effective length may also be 1.25 m.

NOTE — Pipes of internal diameter, barrel wall thickness and length of barrel and collar other than those specified in **8.1** may be supplied by mutual agreement between the purchaser and the supplier. In such case, the design of pipes submitted to the purchaser shall include all standard details as covered in Tables 1 to 11.

8.2 Tolerances

The following tolerances shall be permitted:

Sl No. *Dimensions* *Tolerances*

i) Overall length : ±1 percent of standard length

ii) Internal diameter of pipes:

a) Up to and including 300 mm : ±3 mm

b) Over 300 mm and up to and including 600 mm : ±5 mm

c) Over 600 mm : ±10 mm

iii) Barrel wall thickness:

a) Up to and including 30 mm : $^{+2}_{-1}$ mm

b) Over 30 mm up to and including 50 mm : $^{+3}_{-1.5}$ mm

c) Over 50 mm up to and including 65 mm : $^{+4}_{-2}$ mm

d) Over 65 mm up to and including 80 mm : $^{+5}_{-2.5}$ mm

e) Over 80 mm up to and including 95 mm : $^{+6}_{-3}$ mm

f) Over 95 mm : $^{+7}_{-3.5}$ mm

NOTE — In case of pipes with flexible rubber ring joints, the tolerance on thickness near the ends will have to be reduced. Near the rubber ring joints, the tolerance on thickness shall be as given in Tables 13 to 19 in case of pipes manufactured by spinning process and as given in Table 15 and Table 16 in case of pipes manufactured by vibrated casting process.

9 WORKMANSHIP AND FINISH

9.1 Finish

Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench, no opening between ends in contact shall exceed 3 mm in pipes up to 600 mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter.

9.1.1 The outside and inside surfaces of the pipes shall be dense and hard and shall not be coated with cement wash or other preparation unless otherwise agreed to between the purchaser and the manufacturer or the supplier. The inside surface of the pipe shall be smooth. For better bond, inner surface of the collar may be finished rough.

Table 2 Design and Strength Test Requirements of Concrete Pipes of Class NP2 — Reinforced Concrete, Light Duty, Non-pressure Pipes

(*Clauses* 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel	Load to Produce 0.25 mm Crack	Ultimate Load
mm	mm	Minimum number	kg/linear metre	kg/linear metre	kN/linear metre	kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	25	6	0.59	0.16	10.05	15.08
100	25	6	0.59	0.18	10.05	15.08
150	25	6	0.59	0.24	10.79	16.19
200	25	6	0.59	0.38	11.77	17.66
225	25	6	0.59	0.46	12.26	18.39
250	25	6	0.59	0.58	12.55	18.83
300	30	8	0.78	0.79	13.48	20.22
350	32	8	0.78	1.13	14.46	21.69
400	32	8	0.78	1.49	15.45	23.18
450	35	8	0.78	1.97	16.18	24.27
500	35	8	0.78	2.46	17.16	25.74
600	45	8	0.78	3.47	18.88	28.32
700	50	8	1.22	4.60	20.35	30.53
800	50	8	1.22	6.71	21.57	32.36
900	55	8	1.22	9.25	22.80	34.20
1 000	60	8	1.76	10.69	24.27	36.41
1 100	65	8	1.76	12.74	25.50	38.25
1 200	70	8	1.76	15.47	26.97	40.46
1 400	75	12	2.64	20.57	29.42	44.13
1 600	80	12 or 8+8	3.52	25.40	32.12	48.18
1 800	90	12 or 8+8	3.52	32.74	35.06	52.59
2 000	100	12+12	5.28	45.14	37.76	56.64
2 200	110	12+12	5.28	56.37	40.21	60.32

NOTES

1 If mild steel is used for spiral reinforcement, the weight specified under col 5 shall be increased to 140/125.

2 Soft grade mild steel wire for spirals may be used for pipes of internal diameters 80 mm, 100 mm and 150 mm only, by increasing weight to 140/84.

3 The longitudinal reinforcement given in this table is valid for pipes up to 2.5 m effective length for internal diameter of pipe up to 250 mm and up to 3 m effective length for higher diameter pipes.

4 Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col 4 by the length of the pipe and then deducting for the cover length provided at the two ends.

Table 3 Design and Strength Test Requirements of Concrete Pipes of Class NP3 — Reinforced Concrete, Medium Duty, Non-pressure Pipes

(*Clauses* 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel	Load to Produce 0.25 mm Crack	Ultimate Load
mm	mm	Minimum number	kg/linear metre	kg/linear metre	kN/linear metre	kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	25	6	0.59	0.16	13.00	19.50
100	25	6	0.59	0.22	13.00	19.50
150	25	6	0.59	0.46	13.70	20.55
200	30	6	0.59	0.81	14.50	21.75
225	30	6	0.59	1.03	14.80	22.20
250	30	6	0.59	1.24	15.00	22.50
300	40	8	0.78	1.80	15.50	23.25
350	75	8	0.78	2.95	16.77	25.16
400	75	8	0.78	3.30	19.16	28.74
450	75	8	0.78	3.79	21.56	32.34
500	75	8	0.78	4.82	23.95	35.93
600	85	8 or 6+6	1.18	7.01	28.74	43.11
700	85	8 or 6+6	1.18	10.27	33.53	50.30
800	95	8 or 6+6	2.66	13.04	38.32	57.48
900	100	6 + 6	2.66	18.30	43.11	64.67
1 000	115	6 + 6	2.66	21.52	47.90	71.85
1 100	115	6 + 6	2.66	27.99	52.69	79.00
1 200	120	8 + 8	3.55	33.57	57.48	86.22
1 400	135	8 + 8	3.55	46.21	67.06	100.60
1 600	140	8 + 8	3.55	65.40	76.64	114.96
1 800	150	12 +12	9.36	87.10	86.22	129.33
2 000	170	12 +12	9.36	97.90	95.80	143.70
2 200	185	12 +12	9.36	133.30	105.38	158.07
2 400	200	12 +12	14.88	146.61	114.96	172.44
2 600	215	12 +12	14.88	175.76	124.54	186.81

NOTES

1 If mild steel is used for spiral reinforcement, the weight specified under col 5 shall be increased to 140/125.

2 The longitudinal reinforcement given in this table is valid for pipes up to 2.5 m effective length for internal diameter of pipe up to 250 mm and up to 3 m effective length for higher diameter pipes.

3 Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col 4 by the length of the pipe and then deducting for the cover length provided at the two ends.

4 Concrete for pipes shall have a minimum compressive strength of 35 N/mm^2 at 28 days.

Table 4 Design and Strength Test Requirements of Concrete Pipes of Class NP3 — Unreinforced Concrete, Medium-Duty, Non-pressure Pipes Made by Vibrated Casting Process

(*Clauses* 5.5.1, 6.1.1, 6.3 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Minimum Barrel Wall Thickness	Strength Test Requirement for Three Edge Bearing Test, Ultimate Load
mm	mm	kN/linear metre
(1)	(2)	(3)
300	50	15.50
350	55	16.77
400	60	19.16
450	65	21.56
500	70	23.95
600	75	28.74
700	85	33.53
800	95	38.32
900	100	43.11
1 000	115	47.90
1 100	120	52.69
1 200	125	57.48
1 400	140	67.06
1 600	165	76.64
1 800	180	86.22

NOTE — Concrete for pipes shall have a minimum compressive strength of 45 N/mm² at 28 days.

Table 5 Design and Strength Test Requirements of Concrete Pipes of Class NP3 — Reinforced Concrete, Medium-Duty, Non-pressure Pipes Made by Vibrated Casting Process

(*Clauses* 5.5.1, 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Minimum Barrel Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel	Load to Produce 0.25 mm Crack	Ultimate Load
mm	mm	Minimum number	kg/linear metre	kg/linear metre	kN/linear metre	kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300	50	8	0.78	1.53	15.50	23.25
350	55	8	0.78	1.58	16.77	25.16
400	60	8	0.78	1.60	19.16	28.74
450	65	8	0.78	1.90	21.56	32.34
500	70	8	0.78	2.0	23.95	35.93
600	75	8 or 6+6	1.18	2.20	28.74	43.11
700	85	8 or 6+6	1.18	4.87	33.53	50.30
800	95	8 or 6+6	2.66	6.87	38.32	57.48
900	100	6+6	2.66	11.55	43.11	64.67
1 000	115	6+6	2.66	15.70	47.90	71.85
1 100	120	6+6	2.66	19.61	52.69	79.00
1 200	125	8+8	3.55	21.25	57.48	86.22
1 400	140	8+8	3.55	30.00	67.06	100.60
1 600	165	8+8	3.55	50.63	76.64	114.96
1 800	180	12+12	9.36	64.19	86.22	129.33
2 000	190	12+12	9.36	83.12	95.80	143.70
2 200	210	12+12	9.36	105.53	105.40	158.07
2 400	225	12+12	14.88	133.30	115.00	172.44

NOTE — Concrete for pipes shall have a minimum compressive strength of 35 N/mm² at 28 days.

Table 6 Design and Strength Test Requirements of Concrete Pipes of Class NP4 — Reinforced Concrete, Heavy Duty, Non-pressure Pipes

(*Clauses* 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel	Load to Produce 0.25 mm Crack	Ultimate Load
mm	mm	Minimum number	kg/linear metre	kg/linear metre	kN/linear metre	kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	25	6	0.59	0.24	22.1	33.15
100	25	6	0.59	0.36	22.1	33.15
150	25	6	0.59	0.74	23.3	34.95
200	30	6	0.59	1.30	24.6	36.90
225	30	6	0.59	1.64	25.2	37.80
250	30	6	0.59	1.98	25.5	38.25
300	40	8	0.78	2.71	26.4	39.60
350	75	8	0.78	3.14	29.8	44.70
400	75	8	0.78	3.52	33.9	50.90
450	75	8	0.78	3.88	36.9	55.30
500	75	8	0.78	5.96	40.0	61.20
600	85	8 or 6 + 6	2.34	9.63	46.3	69.40
700	85	8 or 6 + 6	3.44	14.33	52.2	78.30
800	95	8 or 6 + 6	3.44	21.20	59.3	89.10
900	100	6 + 6	3.44	27.13	66.3	99.40
1 000	115	8 + 8	6.04	35.48	72.6	108.90
1 100	115	8 + 8	6.04	43.76	80.4	120.60
1 200	120	8 + 8	6.04	53.07	88.3	132.40
1 400	135	8 + 8	9.36	77.62	104.2	156.40
1 600	140	12 + 12	9.36	108.97	119.6	179.50
1 800	150	12 + 12	14.88	150.22	135.3	203.00
2 000	170	12 + 12	14.88	151.79	135.3	203.00
2 200	185	12 + 12	14.88	160.90	142.2	213.30
2 400	200	12 + 12	14.88	216.96	155.0	232.50
2 600	215	12 + 12	14.88	258.93	166.7	250.00

NOTES

1 If mild steel is used for spiral reinforcement, the weight specified under col 5 shall be increased to 140/125.

2 The longitudinal reinforcement given in this table is valid for pipes up to 2.5 m effective length for internal diameter of pipe up to 250 mm and 3 m effective length for higher diameter pipes.

3 Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col 4 by the length of the pipe and then deducting for the cover length provided at the two ends.

4 Concrete for pipes shall have a minimum compressive strength of 35 N/mm^2 at 28 days.

Table 7 Design and Strength Test Requirements of Concrete Pipes of Class NP4 — Unreinforced Concrete, Heavy Duty, Non-pressure Pipes Made by Vibrated Casting Process

(*Clauses* 5.5.1, 6.1.1, 6.3 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Minimum Barrel Wall Thickness	Strength Test Requirements for Three Edge Bearing Test, Ultimate Load
mm	mm	kN/linear metre
(1)	(2)	(3)
300	50	26.4
350	55	29.8
400	60	33.9
450	65	36.9
500	70	40.0
600	75	46.3
700	85	52.2
800	95	59.3
900	100	66.3
1 000	115	72.6
1 100	125	80.4
1 200	135	88.3
1 400	155	104.2
1 600	180	119.6
1 800	205	135.3

NOTE — Concrete for pipes shall have a minimum compressive strength of 50 N/mm^2 at 28 days.

Table 8 Design and Strength Test Requirements of Concrete Pipes of Class NP4 — Reinforced Concrete, Heavy Duty, Non-pressure Pipes Made by Vibrated Casting Process

(*Clauses* 5.5.1, 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements			Strength Test Requirements for Three Edge Bearing Test	
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel	Load to Produce 0.25 mm Crack	Ultimate Load
mm	mm	Minimum number	kg/linear metre	kg/linear metre	kN/linear metre	kN/linear metre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
300	50	8	0.78	1.53	26.4	38.6
350	55	8	0.78	1.61	29.8	44.7
400	60	8	0.78	1.97	33.9	50.9
450	65	8	0.78	3.36	36.9	55.3
500	70	8	0.78	5.56	40.0	61.2
600	75	8 or 6 + 6	2.34	8.50	46.3	69.4
700	85	8 or 6 + 6	3.44	12.78	52.2	78.3
800	95	8 or 6 + 6	3.44	16.72	59.3	89.1
900	100	6 + 6	3.44	20.92	66.3	99.4
1 000	115	8 + 8	6.04	26.70	72.6	108.9
1 100	120	8 + 8	6.04	35.60	80.4	120.6
1 200	125	8 + 8	6.04	42.42	88.3	132.4
1 400	140	8 + 8	9.36	53.39	104.2	156.4
1 600	165	12 + 12	9.36	79.92	119.6	179.5
1 800	180	12 + 12	14.88	85.75	135.3	203.0
2 000	190	12 + 12	14.88	108.00	135.3	203.0

NOTE — Concrete for pipes shall have a minimum compressive strength of 35 N/mm^2 at 28 days.

Table 9 Design and Strength Test Requirements of Concrete Pipes of Class P1— Reinforced Concrete Pressure Pipes Safe for 0.2 MPa Pressure Test

(*Clauses* 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 6.3, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements		
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel
mm	mm	Minimum number	kg/linear metre	kg/linear metre
(1)	(2)	(3)	(4)	(5)
80	25	6	0.59	0.16
100	25	6	0.59	0.22
150	25	6	0.59	0.46
200	25	6	0.59	0.79
225	25	6	0.59	1.00
250	25	6	0.59	1.22
300	30	8	0.78	1.75
350	32	8	0.78	2.37
400	32	8	0.78	3.05
450	35	8	0.78	3.86
500	35	8	0.78	4.72
600	40	8	0.78	6.79
700	40	8	1.22	9.15
800	45	8	1.22	11.94
900	50	8	1.22	15.12
1 000	55	8	1.76	18.64
1 100	60	8	1.76	22.88
1 200	65	8	1.76	26.82

NOTES

1 Strength requirements for pressure pipes shall be the same as for NP2 class pipes.

2 If mild steel is used for spiral reinforcement, the weight specified under col 5 shall be increased to 140/125.

3 Soft grade mild steel wire for spirals may be used for pipes of internal diameters 80 mm, 100 mm and 150 mm only, by increasing weight to 140/84.

4 The longitudinal reinforcement given in this table is valid for pipes up to 2.5 m effective length for internal diameter of pipe up to 250 mm and up to 3 m effective length for higher diameter pipes.

5 Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col 4 by the length of the pipe and then deducting for the cover length provided at the two ends.

Table 10 Design and Strength Test Requirements of Concrete Pipes of Class P2 — Reinforced Concrete Pressure Pipes Safe for 0.4 MPa Pressure Test

(*Clauses* 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements		
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel
mm	mm	Minimum number	kg/linear metre	kg/linear metre
(1)	(2)	(3)	(4)	(5)
80	25	6	0.59	0.29
100	25	6	0.59	0.45
150	25	6	0.59	0.93
200	30	6	0.59	1.63
225	30	6	0.59	2.03
250	30	6	0.59	2.47
300	40	8	0.78	3.61
350	45	8	0.78	4.88
400	50	8	0.78	6.36
450	50	8	0.78	7.96
500	55	8	0.78	9.80
600	65	8	1.76	14.10
700	70	8	1.76	21.90
800	80	8 or 6 + 6	2.66	28.54
900	90	8 or 6 + 6	2.66	35.92
1 000	100	6 + 6	2.66	43.48

NOTES

1 Strength requirements for pressure pipes shall be the same as for NP2 class pipes.

2 If mild steel is used for spiral reinforcement, the weight specified under col 5 shall be increased to 140/125.

3 Soft grade mild steel wire for spirals may be used for pipes of internal diameters 80 mm, 100 mm and 150 mm only, by increasing weight to 140/84.

4 The longitudinal reinforcement given in this table is valid for pipes up to 2.5 m effective length for internal diameter of pipe up to 250 mm and up to 3 m effective length for higher diameter pipes.

5 Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col 4 by the length of the pipe and then deducting for the cover length provided at the two ends.

Table 11 Design and Strength Test Requirements of Concrete Pipes of Class P3 — Reinforced Concrete Pressure Pipes Safe for 0.6 MPa Pressure Test

(*Clauses* 6.1.1, 6.1.2.1, 6.1.3, 6.2.2, 7.3.2 *and* 8.1; and *Table* 20)

Internal Diameter of Pipes	Barrel Wall Thickness	Reinforcements		
		Longitudinal, Mild Steel or Hard Drawn Steel		Spirals, Hard Drawn Steel
mm	mm	Minimum number	kg/linear metre	kg/linear metre
(1)	(2)	(3)	(4)	(5)
80	25	6	0.59	0.45
100	25	6	0.59	0.66
150	25	6	0.59	1.39
200	35	6	0.59	2.49
225	35	6	0.59	3.10
250	35	6	0.59	3.78
300	45	8	0.78	5.49
350	55	8	0.78	7.52
400	60	8	0.78	9.78
450	70	8	0.78	13.06
500	75	8	0.78	15.96
600	90	8 or 6 + 6	2.66	22.63
700	105	6 + 6	2.66	30.82
800	120	6 + 6	2.66	39.46

NOTES

1 Strength requirements for pressure pipes shall be the same as for NP2 class pipes.

2 If mild steel is used for spiral reinforcement, the weight specified under col 5 shall be increased to 140/125.

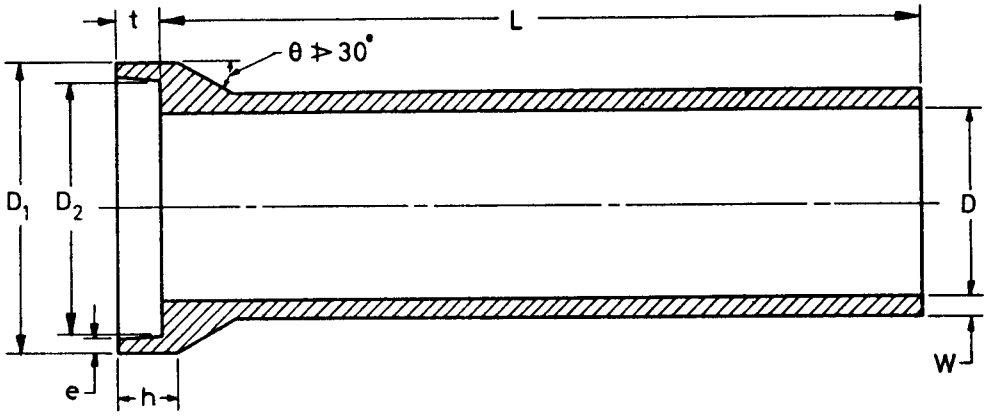
3 Soft grade mild steel wire for spirals may be used for pipes of internal diameters 80 mm, 100 mm and 150 mm only, by increasing weight to 140/84.

4 The longitudinal reinforcement given in this table is valid for pipes up to 2.5 m effective length for internal diameter of pipe up to 250 mm and up to 3 m effective length for higher diameter pipes.

5 Total mass of longitudinal reinforcement shall be calculated by multiplying the values given in col 4 by the length of the pipe and then deducting for the cover length provided at the two ends.

Table 12 Spigot and Socket Dimensions of NP1 Class Pipes

(*Clause* 6.3)



All dimensions in millimetres.

D	*W*	D_1	D_2	*e*	*h*	*t*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	25	206	156	22	60	45
100	25	226	176	22	60	45
150	25	276	226	22	65	50
250	25	376	326	22	70	55
300	30	452	392	26	75	60
350	32	510	446	28	80	65
400	32	560	496	28	80	65
450	35	628	558	31	85	70

NOTE — The dimensions D_2, *h* and *e* shall conform to the values given in this table as these are critical dimensions. The following tolerances shall apply on the critical dimensions:

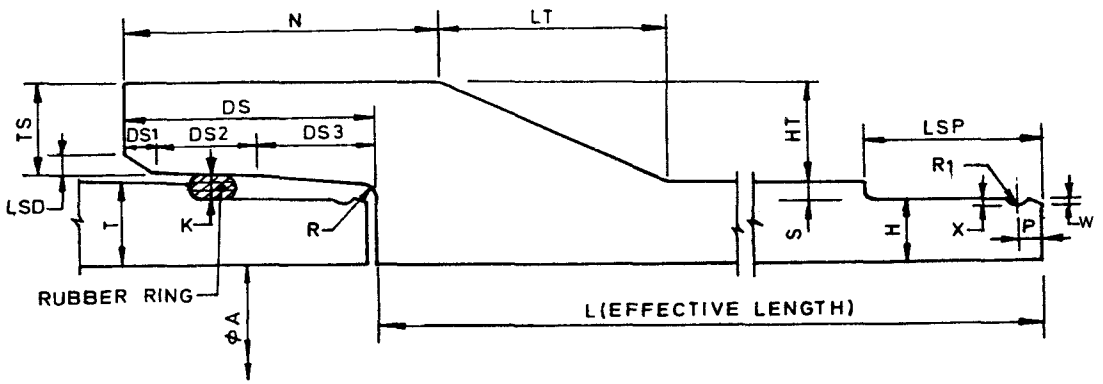
D_2 = ±3 mm for pipes up to and including 300 mm diameter.
±4 mm for pipes over 300 mm internal diameter.

h = ±3 mm for dimensions up to 60 mm.
±5 mm for dimensions above 60 mm.

e = ±2 mm for dimensions up to 30 mm.
±3 mm for dimensions above 30 mm.

Table 13 Spigot and Socket Dimensions of NP2 and P1 Class Pipes (Rubber Ring Roll on Joint)

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

Pipe Diameter ϕA	Rubber Ring Chord Diameter	Rubber Ring Internal Diameter	*T*	*TS*	*DS*	*DS1*	*DS2*	*DS3*	*R*	*LSD*	*K*	*N*	*LT*	*HT*	*LSP*	*P*	*S*	*H*	*X*	*W*	*R1*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
80	11	102	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
100	11	120	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
150	11	170	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
200	11	215	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
225	11	225	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
250	11	250	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
300	12	315	30	35	77	9	31	37	3	6	7	107	92	37	55	7.5	6	24	1	1	6
350	12	360	32	37	77	9	31	37	3	6	7	109	96	39	55	7.5	6	26	1	1	6
400	12	400	32	37	77	9	31	37	3	6	7	109	96	39	55	7.5	6	26	1	1	6
450	12	450	35	40	77	9	31	37	3	6	7	112	104	42	55	7.5	6	29	1	1	6
500	12	500	35	40	77	9	31	37	3	6	7	112	104	42	55	7.5	6	29	1	1	6
600	16	590	40	44	102	12	42	48	6	9	9.5	13.2	106	47	72	10	7.5	32.5	2	2	8
700	16	680	40	44	102	12	42	48	6	9	9.5	13.2	106	47	72	10	7.5	32.5	2	2	8
800	20	785	45	49	128	15	52	61	6	11	11.5	162	117	52	90	12.5	9.5	35.5	2	2	10
900	20	875	50	56	128	15	52	61	6	11	11.5	165	133	59	90	12.5	9.5	40.5	2	2	10
1 000	22	980	55	60	141	17	57	67	8	12	13.5	169	137	64	99	14	10.5	44.5	2	2	11
1 100	22	1 070	60	65	141	17	57	67	8	12	13.5	171	148	69	99	14	10.5	49.5	2	2	11
1 200	22	1 170	65	71	141	17	57	67	8	12	13.5	173	161	75	99	14	10.5	54.5	2	2	11
1 400	22	1 370	75	82	141	17	57	67	8	12	13.5	179	184	86	99	14	10.5	64.5	2	2	11
1 600	25	1 560	80	87	165	20	67	78	8	15	15	205	195	91	100	15	12	68	2.5	2.5	12
1 800	25	1 780	90	99	165	20	67	78	8	15	15	210	221	103	100	15	12	78	2.5	2.5	12
2 000	25	1 935	100	109	165	20	67	78	8	15	15	215	242	113	100	15	12	88	2.5	2.5	12
2 200	25	2 130	110	119	165	20	67	78	8	15	15	220	264	123	100	15	12	98	2.5	2.5	12

Table 13 (*Concluded*)

NOTES

1 Corners to be rounded off.

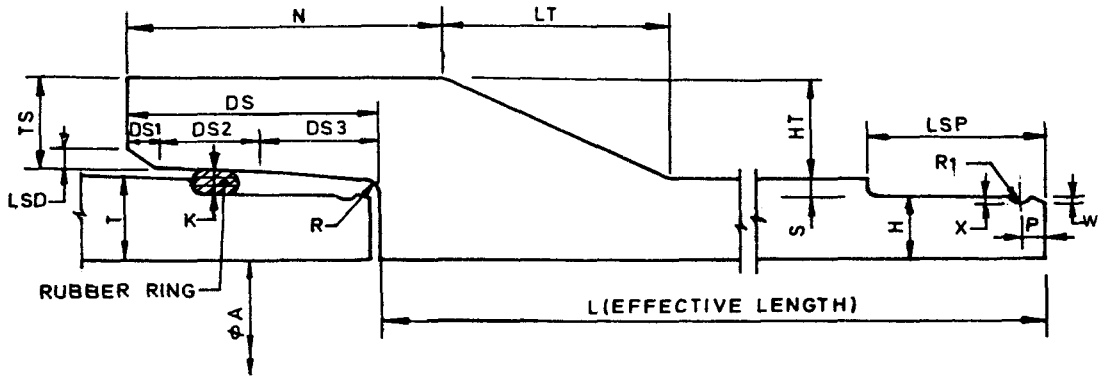
2 The dimensions *DS2, DS3, LSP, TS, T, H, S, HT* and *K* shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerances shall apply on the critical dimensions.

Dimensions	*Tolerances*
T and *HT*	Same as that of barrel wall thickness given in **8.2**
TS and *H*	Half the tolerance on barrel wall thickness given in **8.2**
DS2, DS3, LSP, K & S	The tolerance, in mm, shall be as given below:

Chord Diameter	*DS2*	*DS3*	*LSP*	*K*	*S*
11	± 2	± 3	± 4	± 1.25	± 0.75
12	± 2	± 3	± 4	± 1.25	± 0.75
16	± 2.5	± 3.5	± 5	± 2.00	± 1.25
20	± 3	± 4	± 5.5	± 2.25	± 1.50
25	± 4	± 5	± 7	± 3.25	± 2.00

Table 14 Spigot and Socket Dimensions of NP3 and NP4 Class Pipes (Rubber Ring Roll on Joint) from 80 to 900 mm Diameter

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

Pipe Diameter ∅A	Rubber Ring Chord Diameter	Rubber Ring Internal Diameter	T	TS	DS	DS1	DS2	DS3	R	LSD	K	N	LT	HT	LSP	P	S	H	X	W	R1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
80	11	102	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
100	11	120	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
150	11	170	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
200	11	230	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
225	11	255	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
250	11	275	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
300	12	340	40	51	90	12	42	36	6	7	7	130	130	53	55	7.5	6	34	1	1	6
350	16	435	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
400	16	480	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
450	16	525	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
500	16	570	75	75	120	16	56	48	8	10	10	158	135	78	72	10	8	67	2	2	8
600	20	675	85	85	150	20	70	60	10	12	12	193	153	88.5	90	12	10	75	2	2	10
700	20	765	85	85	150	20	70	60	10	12	12	193	153	88.5	90	12	10	75	2	2	10
800	20	875	95	95	150	20	70	60	10	12	12	197	171	98.5	90	12	10	85	2	2	10
900	20	970	100	100	150	20	70	60	10	12	12	200	180	103.5	90	12	10	90	2	2	10

Table 14 (*Concluded*)

NOTES

1 Corners to be rounded off.

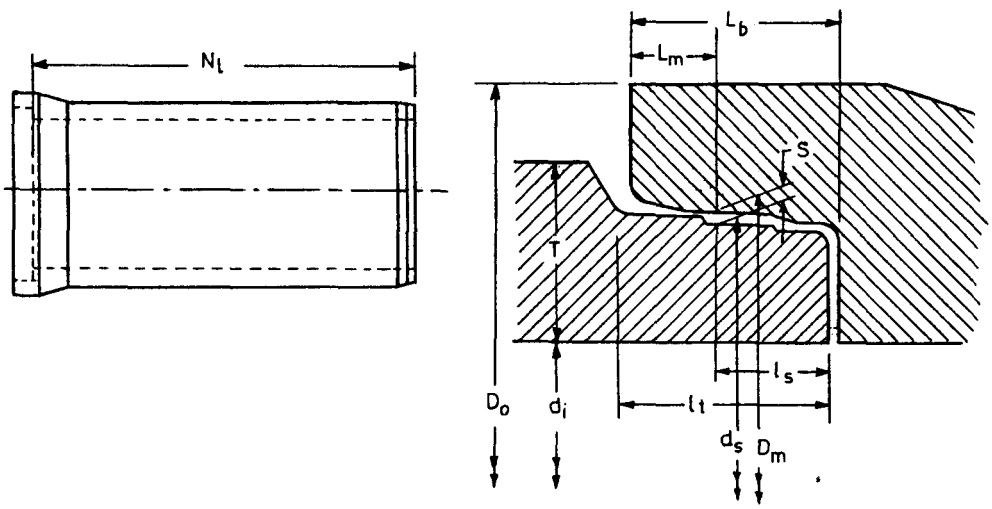
2 The dimensions *DS2, DS3, LSP, TS, T, H, S, HT* and *K* shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerances shall apply on the critical dimensions.

Dimensions	*Tolerances*
T and *HT*	Same as that of barrel wall thickness given in **8.2**
TS and *H*	Half the tolerance on barrel wall thickness given in **8.2**
DS2, DS3, LSP, K & S	The tolerance, in mm, shall be as given below:

Chord Diameter	*DS2*	*DS3*	*LSP*	*K*	*S*
11	± 2	± 3	± 4	± 1.25	± 0.75
12	± 2	± 3	± 4	± 1.25	± 0.75
16	± 2.5	± 3.5	± 5	± 2.00	± 1.25
20	± 3	± 4	± 5.5	± 2.25	± 1.50

Table 15 Spigot and Socket Dimensions for NP3 Reinforced and Unreinforced + NP4 Reinforced Pipes Made by Vertical Vibrated Casting Process from 300 to 2 400 mm Diameter

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

d_i	G	R	T	D_o	l_t	L_b	d_s	D_m	L_m	l_s	s
300 ± 4	13	322	50	487 ± 4	112 ± 4	105 ± 2	370.07	386.07	49	50	8.00 ± 1.0
350 ± 5	13	370	55	555 ± 4	112 ± 4	105 ± 2	425.07	441.07	49	50	8.00 ± 1.0
400 ± 5	13	417	60	615 ± 4	112 ± 4	105 ± 2	480.07	496.07	49	50	8.00 ± 1.0
450 ± 5	13	465	65	680 ± 4	112 ± 4	105 ± 2	536.07	552.07	49	50	8.00 ± 1.0
500 ± 5	13	513	70	735 ± 4	112 ± 4	105 ± 2	590.07	606.07	49	50	8.00 ± 1.0
600 ± 5	13	609	75	850 ± 4	112 ± 4	105 ± 2	700.07	716.07	49	50	8.00 ± 1.0
700 ± 7	18	706	85	980 ± 5	141 ± 5	132 ± 3	808.00	830.00	61	65	11.00 ± 1.2
800 ± 7	18	803	95	1 100 ± 5	141 ± 5	132 ± 3	924.00	946.00	61	65	11.00 ± 1.2
900 ± 7	18	901	100	1 215 ± 5	141 ± 5	132 ± 3	1 036.00	1 058.00	61	65	11.00 ± 1.2
1 000 ± 7	18	998	115	1 330 ± 5	141 ± 5	132 ± 3	1 148.00	1 170.00	61	65	11.00 ± 1.2
1 100 ± 7	24	1 097	120	1 520 ± 6	155 ± 6	145 ± 3	1 262.00	1 291.30	72	63	14.65 ± 1.5
1 200 ± 7	24	1 195	125	1 640 ± 6	155 ± 6	145 ± 3	1 372.48	1 401.78	72	63	14.65 ± 1.5
1 400 ± 10	24	1 383	140	1 870 ± 6	155 ± 6	145 ± 3	1 590.91	1 620.21	72	63	14.65 ± 1.5
1 600 ± 10	24	1 578	165	2 100 ± 6	155 ± 6	145 ± 3	1 814.91	1 844.21	72	63	14.65 ± 1.5
1 800 ± 10	24	1 774	180	2 340 ± 6	155 ± 6	145 ± 3	2 040.00	2 069.30	72	63	14.65 ± 1.5
2 000 ± 12	28	1 850	190	2 380 ± 8	173 ± 8	168 ± 4	2 126.80	2 161.00	75	78	17.10 ± 1.8
2 200 ± 12	28	2 037	210	2 620 ± 8	173 ± 8	168 ± 4	2 341.80	2 376.00	75	78	17.10 ± 1.8
2 400 ± 12	28	2 224	225	2 850 ± 8	173 ± 8	168 ± 4	2 556.80	2 591.00	75	78	17.10 ± 1.8

NOTES

1 G is the diameter of the unstretched rubber chord, hardness 40 ± 5 IRHD , stretching 15 percent.

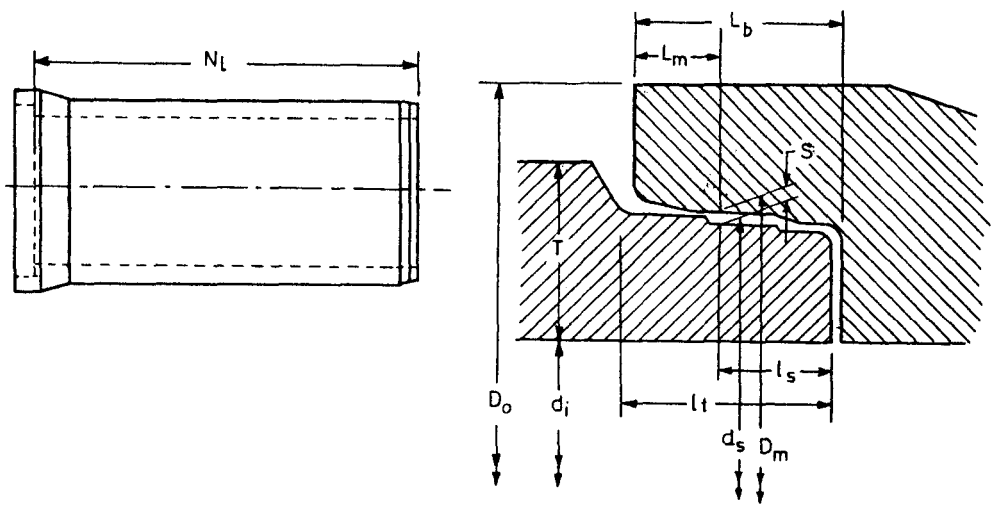
2 R is the inner diameter of the unstretched rubber ring.

3 T is the minimum barrel wall thickness.

4 d_s, D_m, L_m and l_s are nominal dimensions.

Table 16 Spigot and Socket Dimensions for NP4 Unreinforced Pipes Made by Vibrated Casting Process from 300 to 1 800 mm Diameter

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

d_i	G	R	T	D_o	l_t	L_b	d_s	D_m	L_m	l_s	s
300 ± 4	13	322	50	487 ± 4	112 ± 4	105 ± 2	370.07	386.07	49	50	8.00 ± 1.0
350 ± 5	13	370	55	555 ± 4	112 ± 4	105 ± 2	425.07	441.07	49	50	8.00 ± 1.0
400 ± 5	13	417	60	615 ± 4	112 ± 4	105 ± 2	480.07	496.07	49	50	8.00 ± 1.0
450 ± 5	13	465	65	680 ± 4	112 ± 4	105 ± 2	536.07	552.07	49	50	8.00 ± 1.0
500 ± 5	13	513	70	735 ± 4	112 ± 4	105 ± 2	590.07	606.07	49	50	8.00 ± 1.0
600 ± 5	13	609	75	850 ± 4	112 ± 4	105 ± 2	700.07	716.07	49	50	8.00 ± 1.0
700 ± 7	18	706	85	980 ± 5	141 ± 5	132 ± 3	808.00	830.00	61	65	11.00 ± 1.2
800 ± 7	18	803	95	1 100 ± 5	141 ± 5	132 ± 3	924.00	946.00	61	65	11.00 ± 1.2
900 ± 7	18	901	100	1 215 ± 5	141 ± 5	132 ± 3	1 036.00	1 058.00	61	65	11.00 ± 1.2
1 000 ± 7	18	998	115	1 330 ± 5	141 ± 5	132 ± 3	1 148.00	1 170.00	61	65	11.00 ± 1.2
1 100 ± 7	24	1 097	120	1 520 ± 6	155 ± 6	145 ± 3	1 262.00	1 291.30	72	63	14.65 ± 1.5
1 200 ± 7	24	1 195	125	1 640 ± 6	155 ± 6	145 ± 3	1 372.48	1 401.78	72	63	14.65 ± 1.5
1 400 ± 10	24	1 383	140	1 870 ± 6	155 ± 6	145 ± 3	1 590.91	1 620.21	72	63	14.65 ± 1.5
1 600 ± 10	24	1 578	165	2 100 ± 6	155 ± 6	145 ± 3	1 814.91	1 844.21	72	63	14.65 ± 1.5
1 800 ± 10	24	1 774	180	2 300 ± 6	155 ± 6	145 ± 3	2 040.00	2 069.30	72	63	14.65 ± 1.5

NOTES

1 G is the diameter of the unstretched rubber chord, hardness 40 ± 5 IRHD, stretching 15 percent.

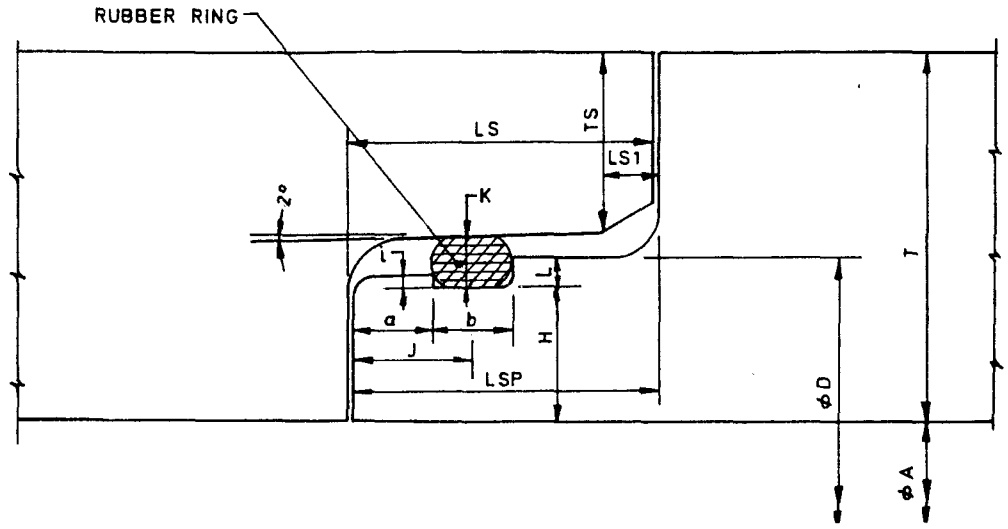
2 R is the inner diameter of the unstretched rubber ring.

3 T is the minimum barrel wall thickness.

4 d_s, D_m, L_m and l_s are nominal dimensions.

Table 17 Spigot and Socket Dimensions of NP3 and NP4 Class Pipes from 1 000 to 2 600 mm Diameter (Rubber Ring Confined Joint)

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

Pipe Diameter ∅A	Rubber Ring Chord Diameter	Rubber Ring Internal Diameter	T	TS	LS	LS1	K	LSP	a	b	J	H	i	L	∅D
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1 000	20	920	115	58.0	114	20	13	114	25	28	39	42	4	9	1 102
1 100	20	1 003	115	58.0	114	20	13	114	25	28	39	42	4	9	1 202
1 200	20	1 095	120	60.5	114	20	13	114	25	28	39	44.5	4	9	1 307
1 400	25	1 275	135	67.5	114	20	16	114	25	35	42.5	50	4	10	1 520
1 600	25	1 445	140	72.5	114	25	16	114	25	35	42.5	50	4	10	1 720
1 800	25	1 620	150	77.5	114	25	16	114	25	35	42.5	55	4	10	1 930
2 000	25	1 810	170	87.5	114	25	16	114	25	35	42.5	65	4	10	2 150
2 200	25	1 995	185	95.0	114	25	16	114	25	35	42.5	72.5	4	10	2 365
2 400	25	2 180	200	102.5	114	25	16	114	25	35	42.5	80	4	10	2 580
2 600	25	2 360	215	110.0	114	25	16	114	25	35	42.5	87.5	4	10	2 795

Table 17 (*Concluded*)

NOTES

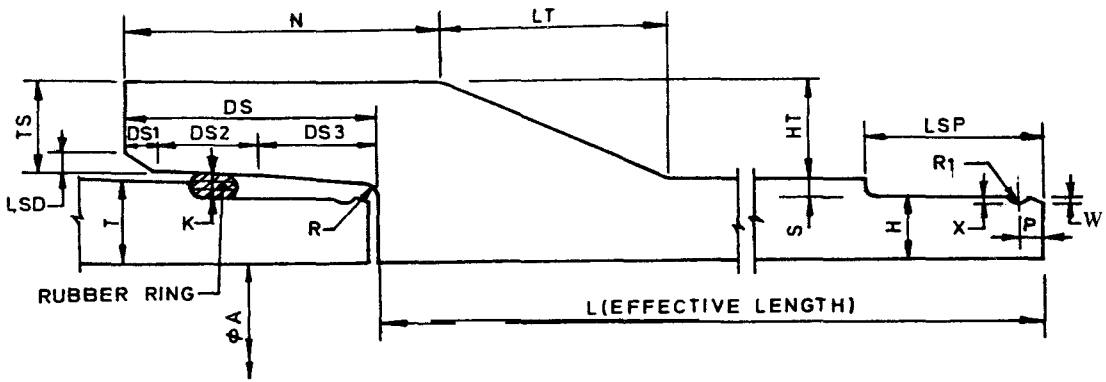
1 Corners to be rounded off.

2 The dimensions *LS*, *LSP*, *TS*, *T*, *H*, *L*, *b* and *K* shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerances shall apply on the critical dimensions.

Dimensions	*Tolerances*
LS and *LSP*	±7 mm
T	Same as that of barrel wall thickness given in **8.2**
H and *TS*	Half the tolerance on barrel wall thickness given in **8.2**
L	±0.5 mm
b	±1 mm for 28 mm and ±1.5 mm for 35 mm
K	±1.75 mm for 20 mm rubber ring chord diameter ±2.5 mm for 25 mm rubber ring chord diameter

Table 18 Spigot and Socket Dimensions of P2 Class Pipes (Rubber Ring Roll on Joint)

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

Pipe Diameter ϕA	Rubber Ring Chord Diameter	Rubber Ring Internal Diameter	*T*	*TS*	*DS*	*DS1*	*DS2*	*DS3*	*R*	*LSD*	*K*	*N*	*LT*	*HT*	*LSP*	*P*	*S*	*H*	*X*	*W*	R_1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
80	11	102	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
100	11	120	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
150	11	170	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
200	11	230	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
225	11	255	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
250	11	275	30	38	83	11	38	34	5	6.5	6.5	113	97	39.5	50	7	5.5	24.5	1	1	5.5
300	12	340	40	51	90	12	42	36	6	7	7	130	130	53	55	7.5	6	34	1	1	6
350	12	400	45	57	90	12	42	36	6	7	7	135	145	59	55	7.5	6	39	1	1	6
400	12	450	50	61	90	12	42	36	6	7	7	140	155	63	55	7.5	6	44	1	1	6
450	12	500	50	61	90	12	42	36	6	7	7	140	155	63	55	7.5	6	44	1	1	6
500	12	525	55	67	90	12	42	36	6	7	7	145	170	69	55	7.5	6	49	1	1	6
600	16	640	65	79	120	16	56	48	8	10	9.5	185	185	82	72	10	7.5	57.5	2	2	8
700	16	740	70	84	120	16	56	48	8	10	9.5	190	195	87	72	10	7.5	62.5	2	2	8
800	20	845	80	96	150	20	70	60	10	12	12	230	225	100	90	12.5	9.5	70.5	2	2	10
900	20	970	90	108	150	20	70	60	10	12	12	240	250	112	90	12.5	9.5	80.5	2	2	10
1 000	22	1 060	100	120	165	22	77	66	11	13	13	265	265	124	99	14	10.5	89.5	2	2	11

Table 18 (*Concluded*)

NOTES

1 Corners to be rounded off.

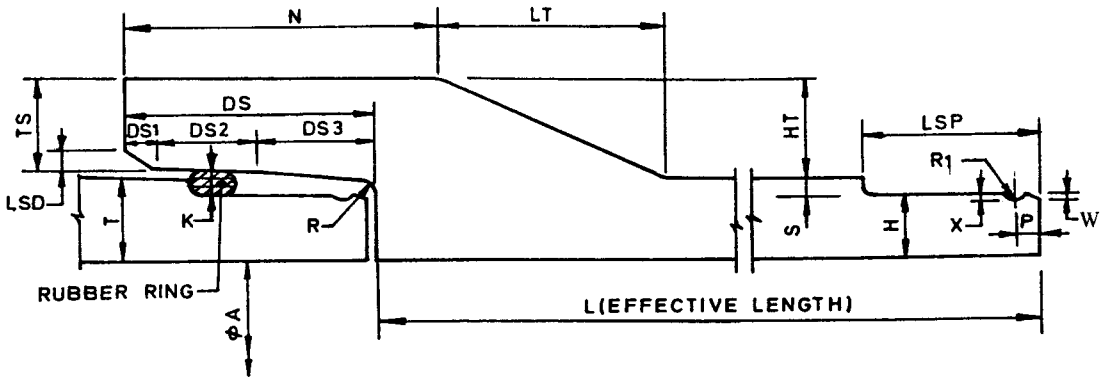
2 The dimensions *DS2, DS3, LSP, TS, T, H, S, HT* and *K* shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerances shall apply on the critical dimensions.

Dimensions	*Tolerances*
T and *HT*	Same as that of barrel wall thickness given in **8.2**
TS and *H*	Half the tolerance on barrel wall thickness given in **8.2**
DS2, DS3, LSP, K & S	The tolerance, in mm, shall be as given below:

Chord Diameter	*DS2*	*DS3*	*LSP*	*K*	*S*
11	± 2	± 3	± 4	± 1.25	± 0.75
12	± 2	± 3	± 4	± 1.25	± 0.75
16	± 2.5	± 3.5	± 5	± 2.00	± 1.25
20	± 3	± 4	± 5.5	± 2.25	± 1.50
22	± 3.5	± 4.5	± 6	± 2.75	± 1.50

Table 19 Spigot and Socket Dimensions of P3 Class Pipes (Rubber Ring Roll on Joint)

(*Clauses* 6.3 *and* 8.2)



All dimensions in millimetres.

Pipe Diameter ∅A	Rubber Ring Chord Diameter	Rubber Ring Internal Diameter	*T*	*TS*	*DS*	*DS1*	*DS2*	*DS3*	*R*	*LSD*	*K*	*N*	*LT*	*HT*	*LSP*	*P*	*S*	*H*	*X*	*W*	R_1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
80	11	102	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
100	11	120	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
150	11	170	25	32.5	70	8	28	34	3	5.5	6.5	95	84	34	50	7	5.5	19.5	1	1	5.5
200	11	230	35	45	83	11	38	34	5	5.5	6.5	120	115	46.5	50	7	5.5	29.5	1	1	5.5
225	11	255	35	45	83	11	38	34	5	5.5	6.5	120	115	46.5	50	7	5.5	29.5	1	1	5.5
250	11	275	35	45	83	11	38	34	5	5.5	6.5	120	115	46.5	50	7	5.5	29.5	1	1	5.5
300	12	340	45	60	90	12	42	36	6	7	7	135	150	62	55	7.5	6	39	1	1	6
350	12	400	55	75	90	12	42	36	6	7	7	145	190	77	55	7.5	6	49	1	1	6
400	12	450	60	80	90	12	42	36	6	7	7	150	200	82	55	7.5	6	54	1	1	6
450	12	525	70	95	90	12	42	36	6	7	7	160	240	97	55	7.5	6	64	1	1	6
500	12	570	75	100	90	12	42	36	6	7	7	165	250	102	55	7.5	6	69	1	1	6
600	16	680	90	120	120	16	56	48	8	10	9.5	190	275	123	72	10	7.5	82.5	2	2	8
700	16	805	105	140	120	16	56	48	8	10	9.5	200	320	143	72	10	7.5	97.5	2	2	8
800	20	915	120	160	150	20	70	60	10	12	11.5	240	365	164	90	12.5	9.5	110.5	2	2	10

Table 19 (*Concluded*)

NOTES

1 Corners to be rounded off.

2 The dimensions *DS2, DS3, LSP, TS, T, H, S, HT* and *K* shall conform to the values given in this table as these are critical dimensions. Other dimensions are for guidance only. The following tolerances shall apply on the critical dimensions.

Dimensions	*Tolerances*
T and *HT*	Same as that of barrel wall thickness given in **8.2**
TS and *H*	Half the tolerance on barrel wall thickness given in **8.**
DS2, DS3, LSP, K & S	The tolerance, in mm, shall be as given below:

Chord Diameter	*DS2*	*DS3*	*LSP*	*K*
11	± 2	± 3	± 4	± 1.25
12	± 2	± 3	± 4	± 1.25
16	± 2.5	± 3.5	± 5	± 2.00
20	± 3	± 4	± 5.5	± 2.25

Table 20 Weight of Spirals (Hard Drawn Steel) in Socket of R/R Joint RCC Pipes of Different Classes (kg/Number)

(*Clause* 6.3)

Internal Diameter of Pipes mm	NP2 Class	NP3 Class	NP4 Class	P1 Class	P2 Class	P3 Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	0.08	0.08	0.08	0.08	0.08	0.08
100	0.09	0.09	0.09	0.09	0.09	0.09
150	0.12	0.12	0.12	0.12	0.12	0.15
200	0.14	0.14	0.21	0.14	0.21	0.35
225	0.15	0.15	0.26	0.15	0.26	0.43
250	0.16	0.16	0.31	0.16	0.31	0.51
300	0.45	0.45	0.53	0.45	0.53	0.84
350	0.51	0.64	0.64	0.51	0.74	1.24
400	0.56	0.71	0.71	0.56	0.99	1.66
450	0.63	0.76	0.76	0.63	1.23	2.26
500	0.68	0.87	1.08	0.68	1.57	2.85
600	0.81	1.00	2.12	1.52	2.88	4.74
700	0.92	2.16	3.02	1.79	3.96	6.79
800	1.14	2.87	4.67	2.04	6.28	9.99
900	1.50	4.06	6.03	2.63	8.29	—
1 000	1.91	—	—	3.33	1.29	—
1 100	2.34	—	—	4.08	—	—
1 200	2.80	—	—	4.90	—	—
1 400	3.82	—	—	—	—	—
1 600	5.64	—	—	—	—	—
1 800	7.25	—	—	—	—	—
2 000	11.78	—	—	—	—	
2 200	12.88	—	—	—	—	—

NOTES

1 Longitudinal reinforcement shall be proportional to the length of socket cage as given in Tables 2 to 11.

2 If mild steel is used for spiral reinforcement, the weight specified above shall be increased to 140/125.

9.1.2 The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.

9.1.3 Pipes shall be free from local dents or bulges greater than 3.0 mm in depth and extending over a length in any direction greater than twice the barrel wall thickness.

9.1.4 Pipes may be repaired, if necessary, because of accidental injury during manufacture or handling and shall be accepted if in the opinion of the purchaser, the repairs are sound and appropriately finished and cured, and the repaired pipe conforms to the requirements of this specification.

9.2 Deviation from Straight

The deviation from straight in any pipe throughout its effective length, tested by means of a rigid straight edge as described in IS 3597 shall not exceed, for all diameters, 3 mm for every metre run.

10 TESTS

10.1 Test Specimens

All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under this standard.

10.1.1 During manufacture, tests on compressive strength of concrete cubes shall be done as described in IS 516. For pressure pipes, splitting tensile strength tests of concrete cylinders shall be carried out as described in IS 5816. The manufacturer shall supply, when required to do so by the purchaser or his representative, the results of compressive tests of concrete cubes (*see* **5.5.1**) and split tensile tests of concrete cylinder (*see* **5.5.2**) made from the concrete used for the pipes. The manufacturer shall supply cylinders or cubes for test purposes required by the purchaser, and such cylinders or cubes shall withstand the tests prescribed in **5.5.1** and **5.5.2**. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure (*see* **4.1**). For non-pressure pipes, 2 percent of the pipes shall be tested for hydrostatic test pressure.

10.2 The specimens of pipes selected in accordance with **10.1** shall be subjected to the following tests in accordance with IS 3597:

a) Hydrostatic test,

Table 21 Design Requirements of Reinforced Concrete Collar for Pipes of Class NP2

(*Clauses* 6.3 *and* 8.1)

Nominal Internal Diameter of Pipe	Collar Dimensions			Reinforcements		
	Minimum Caulking Space	Minimum Thickness	Minimum Length	Longitudinal, Mild Steel or Hard Drawn Steel		Spiral, Hard Drawn Steel
				Minimum number	Weight	
mm	mm	mm	mm		kg/collar	kg/collar
(1)	(2)	(3)	(4)	(5)	(6)	(7)
80	13	25	150	6	0.08	0.07
100	13	25	150	6	0.08	0.08
150	13	25	150	6	0.08	0.10
200	13	25	150	6	0.08	0.12
225	13	25	150	6	0.08	0.14
250	13	25	150	6	0.08	0.16
300	16	30	150	8	0.11	0.22
350	16	32	150	8	0.11	0.25
400	16	32	150	8	0.11	0.27
450	19	35	200	8	0.15	0.40
500	19	35	200	8	0.15	0.60
600	19	40	200	8	0.15	0.70
700	19	40	200	8	0.23	1.05
800	19	45	200	8	0.23	1.85
900	19	50	200	8	0.23	2.05
1 000	19	55	200	8	0.33	2.25
1 100	19	60	200	8	0.33	3.09
1 200	19	65	200	8	0.33	4.11
1 400	19	75	200	12	0.50	5.08
1 600	19	80	200	12 or 8 + 8	0.67	6.55
1 800	19	90	200	12 or 8 + 8	0.67	9.00
2 000	19	100	200	12 + 12	1.00	12.15
2 200	19	110	200	12 + 12	1.00	13.30

NOTES

1 If mild steel is used for spiral reinforcement, the weight specified under col 7 shall be increased by a factor 140/125.

2 Soft grade mild steel wire may be used as reinforcement for collars of pipes of nominal internal diameter up to 250 mm only, by increasing the weight by a factor 140/84. Where only soft grade mild steel wire is used for making collar cages, the weight of reinforcement shall be total weight of col 6 and 7 multiplied by 140/84. This is allowed as a process requirement.

3 Internal diameter of collar to suit the actual diameter of pipes with minimum caulking space as given in col 2.

b) Three-edge bearing test, and

c) Permeability test.

10.2.1 The permeability test when conducted in accordance with the method described in IS 3597 shall meet the requirement of final permeability, which shall not exceed 0.3 cm^3.

NOTE — It is recommended that initial absorption should not exceed 2.0 cm^3 and the difference in any two readings during initial absorption should not be more than 0.8 cm^3.

11 SAMPLING AND INSPECTION

11.1 Scale of Sampling

11.1.1 *Lot*

In any consignment, all the pipes of same class, same size and belonging to the same mix of concrete shall be grouped together to constitute a lot.

11.1.2 For ascertaining the conformity of the material to the requirements of this specification, samples shall be tested from each lot separately.

11.1.3 The number of pipes to be selected from the lot shall depend on the size of the lot and shall be according to Table 22.

11.1.3.1 These pipes shall be selected at random. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

11.2 Number of Tests and Criteria for Conformity

11.2.1 All the pipes selected according to **11.1.3** shall be inspected for dimensional requirements (*see* **8**), finish (*see* **9.1**) and deviation from straight (*see* **9.2**). A pipe failing to satisfy one or more of these requirements shall be considered as defective.

11.2.1.1 The lot shall be declared as conforming to these requirements if the number of defectives found

Table 22 Scale of Sampling and Permissible Number of Defectives

(*Clauses* 11.1.3, 11.2.1.1 *and* 11.2.2)

No. of Pipes in the Lot	For Requirement Under Clauses 8 and 9		Samples Size for Test Under Clause 10.2 (Excluding Ultimate Load Test)
	Sample Size	Permissible Number of Defectives	
(1)	(2)	(3)	(4)
Up to 50	8	0	2
51 to 100	13	1	3
101 to 300	20	2	5
301 to 500	32	3	7
501 and above	50	5	10

in the sample does not exceed the number of defectives given in col 3 of Table 22.

11.2.2 The lot having found satisfactory shall be further subjected to the tests given under **10.2** except ultimate load test. For this purpose, the number of pipe given in col 4 of Table 22 shall be selected from the lot. These pipes shall be selected from those that have satisfied the requirements given in **11.2.1**. For ultimate load test, the number of pipes to be checked shall be according to mutual agreement between the purchaser and the manufacturer. However, ultimate load test shall not be done for a lot size of 20 pipes or less.

11.2.2.1 The lot shall be declared as conforming to the requirements of this specification if there is no failure under **11.2.2**.

12 MARKING

12.1 The following information shall be clearly marked on each pipe:

a) Indication of the source of manufacture,
b) Class and size of pipe,
c) The words 'SPUN PIPE' or 'VIBRATED CAST PIPE (UNREINFORCED)' or 'VIBRATED CAST PIPE (REINFORCED)' as may be applicable, and
d) Date of manufacture.

The above information shall be clearly marked on outside only for pipes up to and including 350 mm internal diameter, and both outside and inside for pipes above 350 mm internal diameter.

12.1.1 Each pipe may also be marked with the Standard Mark.

12.1.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standard Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
269 : 1989	Specification for 33 grade ordinary Portland cement (*fourth revision*)	456 : 2000	Plain and reinforced concrete — Code of practice (*fourth revision*)
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (*second revision*)	516 : 1959	Method of test for strength of concrete
432	Specification for mild steel and medium tensile steel bars and hard-drawn steel wires for concrete reinforcement	1489	Specification for Portland pozzolana cement
		(Part 1) : 1991	Fly ash based (*third revision*)
		(Part 2) : 1991	Calcined clay based (*third revision*)
(Part 1) : 1982	Mild steel and medium tensile steel bars (*third revision*)	1566 : 1982	Specification for hard-drawn steel wire fabric for concrete reinforcement (*second revision*)
(Part 2) : 1982	Hard-drawn steel wire (*third revision*)	1785	Specification for plain hard-drawn steel wire for prestressed concrete
455 : 1989	Specification for Portland slag cement (*fourth revision*)	(Part 1) : 1983	Cold drawn stress relieved wire (*second revision*)

IS No.	*Title*
(Part 2) : 1983	As drawn wire (*first revision*)
1786 : 1985	Specification for high strength deformed steel bars and wires for concrete reinforcement (*third revision*)
2062 : 1999	Steel for general structural purposes — Specification (*fifth revision*)
3597 : 1998	Methods of test for concrete pipes (*second revision*)
3812 : 1981	Specification for fly ash for use as pozzolana and admixture (*first revision*)
4905 : 1968	Methods for random sampling
5382 : 1985	Specification for rubber sealing rings for gas mains, water mains and sewers (*first revision*)
5816 : 1999	Splitting tensile strength of concrete — Method of test (*first revision*)
7322 : 1985	Specification for specials for steel cylinder reinforced concrete pipes (*first revision*)
8041 : 1990	Specification for rapid hardening Portland cement (*second revision*)
8043 : 1991	Specification for hydrophobic Portland cement (*second revision*)
8112 : 1989	Specification for 43 grade ordinary Portland cement (*first revision*)
9103 : 1999	Concrete admixtures — Specification (*first revision*)
12269 : 1987	Specification for 53 grade ordinary Portland cement
12330 : 1988	Specification for sulphate resisting Portland cement

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