

इंटरनेट

मानक



### Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

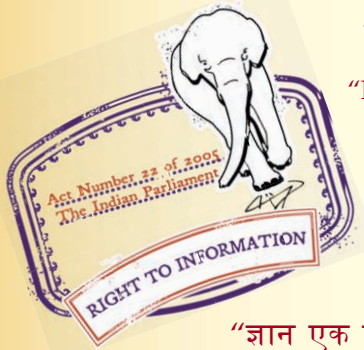
“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 8329 (2000): Centrifugally Cast (Spun) Ductile Iron Pressure Pipes for Water, Gas and Sewage [MTD 6: Pig iron and Cast Iron]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”





BLANK PAGE



भारतीय मानक

पानी, गैस और मलजल के लिये अपकेन्द्रित ढले (स्पन) तन्य  
लोहा के दाब पाइप — विशिष्टि  
( तीसरा पुनरीक्षण )

*Indian Standard*

CENTRIFUGALLY CAST (SPUN) DUCTILE IRON  
PRESSURE PIPES FOR WATER, GAS  
AND SEWAGE — SPECIFICATION  
( *Third Revision* )

ICS 23.040.10; 23.040.40

© BIS 2000

**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

## FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Pig Iron and Cast Iron Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1977 and then revised in 1990 and 1994. While revising this standard, in light of the experience gained during these years, the committee has decided to revise this standard taking note of the revision and publication of EN 545 : 1994 and ISO 2531 : 1998 (E).

In this revision the following main modifications have been made:

- a) Definition of various terms have been included to avoid ambiguity;
- b) Dimensions from *DN* 80 to *DN* 2000 have been incorporated aligning them with ISO 2531 : 1998 (E) and EN 545 : 1994;
- c) Thickness of Class *K7* and *K8* have been increased based on current International practice and method of production facilities in this country;
- d) Requirements for coating and lining have been modified;
- e) To have a proper control on the quality of the pipes, a clause on quality assurance has also been incorporated;
- f) The standard has been generally updated taking into account the modern trend in this respect in other International specifications particularly the current changes made in EN 545 : 1994 and ISO 2531 : 1998 (E); and
- g) As per current international practice, requirements of mass has been deleted from the standard.

Ductile iron, also called nodular iron or spheroidal graphite iron, is characterized by the presence of graphite in nodular or spheroidal form in the resultant casting. It differs from cast iron by greater tensile strength and its significant elongation at break. Ductile iron offers:

- a) high resistance against breakage due to impact;
- b) high tensile strength, comparable to that of mild steel so that the pipes can be used for higher working pressure;
- c) traditional corrosion resistance, comparable to that of cast iron; and
- d) lighter in mass as compared to cast iron pipes.

In order to have International co-ordination and harmonization with other International Standards, assistance has been derived from the following publications:

ISO 2531 : 1998(E)	Ductile iron pipes, fittings and accessories and their joints for water or gas application, issued by the International Organization for Standardization (ISO)
ISO 7186 : 1996(E)	Ductile iron products for sewage applications
ISO 4179 : 1985	Ductile iron pipes for pressure and non-pressure pipelines — Centrifugal cement mortar lining — General requirements
ISO 8179-1 : 1995	Ductile iron pipes — External coating: Part 1 Metallic zinc with finishing layer
ISO 8179-2 : 1995	Ductile iron pipes — External coating: Part 2 Zinc rich paint with finishing layer
ISO 8180 : 1985	Ductile iron pipes — Polyethylene sleeving

(Continued on third cover)

## *Indian Standard*

# CENTRIFUGALLY CAST (SPUN) DUCTILE IRON PRESSURE PIPES FOR WATER, GAS AND SEWAGE — SPECIFICATION ( *Third Revision* )

### 1 SCOPE

1.1 This standard specifies the requirements and associated test methods applicable to ductile iron pipes manufactured in metal (lined or unlined) or sand moulds and their joints for the construction of pipe lines:

- to convey water, sewage or gas
- to be installed below or above ground
- operated with or without pressure

#### NOTES

1 By sand it is to be understood, sand or mineral based materials used in foundry trade irrespective of the type of bonding agents.

2 All pressures are relative pressures expressed in MPa (1MPa = 10 bar).

1.2 This standard also specifies requirements for materials, dimensions and tolerances, mechanical properties and standard coatings and linings of ductile iron pipes.

1.2.1 This standard does not restrict the use of other types of joints or future developments of other joints as long as overall dimensions are maintained for reasons of safety and interchangeability.

1.3 The standard applies to pipes, which are:

manufactured with socketted, flanged or spigot ends for jointing by means of various types of gaskets, which are not within the scope of this standard, and normally to be delivered externally and internally lined and are suitable for fluid temperatures between 0°C and 50°C, excluding frost.

1.4 This standard does not include the provisions for fittings used with the pipes conforming to this standard. A separate standard IS 9523 covers the specification on such fittings.

1.5 Fittings conforming to IS 13382 may also be used with ductile iron pipes, when the pressure requirements matches.

### 2 REFERENCES

The following Indian Standards 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 below:

<i>IS No.</i>	<i>Title</i>
455 : 1989	Portland slag cement ( <i>fourth revision</i> )
638 : 1979	Sheet rubber jointing and rubber insertion jointing ( <i>second revision</i> )
1387 : 1993	General requirements for supply of metallurgical materials ( <i>second revision</i> )
1500 : 1983	Methods for Brinell hardness test for metallic materials ( <i>second revision</i> )
1608 : 1995	Mechanical testing of metals — Tensile testing ( <i>second revision</i> )
5382 : 1985	Rubber sealing ring for gas mains, water mains and sewers ( <i>first revision</i> )
6452 : 1989	Specification for high alumina cement for structural use
6909 : 1990	Specification for supersulphated cement
8112 : 1989	43 grade ordinary Portland cement ( <i>first revision</i> )
9523 : 1980	Ductile iron fittings for pressure pipes for water, gas and sewage
11606 : 1986	Methods of sampling of cast iron pipes and fittings
12330 : 1988	Sulphate resisting Portland cement
13382 : 1992	Cast iron specials for mechanical and push-on-flexible joints for pressure pipelines for water, gas and sewage

### 3 TERMINOLOGY

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

3.1 **Ductile Iron** — Type of iron used for pipes, in which graphite is present primarily in spheroidal or nodular form.

3.2 **Pipe** — Casting of uniform bore, straight in axis, having either socket, spigot or flanged ends.

**3.3 Fitting** — Casting other than a pipe which allows pipeline deviation, change of direction of bore. In addition flanged-sockets, flanged-spigots and collars are also classified as fittings.

**3.4 Accessory** — Any item other than a pipe or fitting which is used in a pipeline, such as:

- glands and bolts for mechanical flexible joints;
- glands, bolts and locking rings or segments for restrained joints.

NOTE — Valves and hydrants of all types are not covered by the term accessory.

**3.5 Flange** — Flat circular end of a pipe or fitting, extending perpendicular to its axis, with bolt holes equally spaced on a circle.

NOTE — A flange may be integrally cast, threaded-on or welded-on or adjustable; an adjustable flange comprises a ring, in one or several parts bolted together, which bears on an end joint hub and can be freely rotated around the pipe axis before jointing.

**3.6 Spigot** — Male end of a pipe or fitting.

**3.7 Socket** — Female end of a pipe to make the joint with the spigot of an adjacent component.

**3.8 Gasket** — Sealing component of a joint.

**3.9 Joint** — Connection between the ends of pipes in which a gasket is used to effect a seal.

**3.10 Flexible Joint** — Joint which provides significant angular deflection and movement parallel and/or perpendicular to the pipe axis.

**3.11 Push-on Flexible Joint** — A flexible joint in which an elastomeric gasket is located in the socket and the joint assembly is effected by entering the spigot through the gasket into the socket.

**3.12 Mechanical Flexible Joint** — Flexible joint in which sealing is obtained by applying pressure to the gasket by mechanical means, for example a gland.

**3.13 Restrained Joint** — Joint wherein a means is provided to prevent separation of the assembled joint.

**3.14 Flanged Joint** — Joint between two flanged ends.

**3.15 Nominal Size (DN)** — Numerical designation of size which is common to all components in a piping system. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

**3.16 Nominal Pressure (PN)** — A numerical designation expressed by a number which is used for reference purposes. All components of the same nominal size *DN* designated by the same *PN* number have compatible mating dimensions.

**3.17 Allowable Operating Pressure (AOP)** — Internal pressure, excluding surge, that a component can safely withstand in permanent service.

**3.18 Allowable Maximum Operating Pressure (MOP)** — Maximum internal pressure, including surge, that a component can safely withstand in service.

**3.19 Allowable Site Test Pressure (STP)** — Maximum hydrostatic pressure that a newly installed component can withstand for a relatively short duration, when either fixed above ground level or laid and backfilled underground, in order to measure the integrity and tightness of the pipeline.

NOTE — This test pressure is different from the system test pressure, which is related to the design pressure of the pipeline and is intended to ensure its integrity and leaktightness.

**3.20 Batch** — Quantity of castings from which a certain number of samples may be taken for testing purposes during manufacture.

**3.21 Length** — Effective length of a pipe, as shown on the drawings of Table 2.

NOTE — For flanged pipes, the effective length is equal to the overall length and is noted *L*. For socketed pipes, the effective length is equal to the overall length minus the spigot insertion depth.

**3.22 Ovality** — Out of roundness of a pipe section; it is equal to  $100\{(A_1 - A_2)/(A_1 + A_2)\}$ , where  $A_1$  is the maximum axis and  $A_2$  the minimum axis of the pipe cross-section.

## 4 CLASSIFICATION

**4.1** Pipes have been classified as *K7*, *K8*, *K9*, *K10*, *K12*,... depending on service conditions and manufacturing process.

**4.2** The class designation shall comprise of:

- a) a prefix *K*.
- b) a whole number used for thickness class designation, [this is the selected coefficient inserted into the equation (1) in 4.3 depending on the service conditions].

**4.3** The wall thickness of pipe 'e' in mm shall be calculated as a function of the nominal diameter by the following equation with minimum of 5 mm for  $K = 7$ , 6 mm for  $K = 8$  and 7 mm for  $K = 12$ .

$$e = K(0.5 + 0.001 DN) \quad \dots (1)$$

where

*e* = wall thickness in mm,

*DN* = the nominal diameter, and

*K* = the whole number coefficient.

4.4 The value of *K* will depend on the following service conditions:

Nominal Dia	Service Conditions		
	Water Main	Sewers	Gas Mains
80 - 300	K9 - K12	K7 - K12	K9 - K12
350 - 600	K8 - K10	K7 - K10	K9 - K10
700 - 2 000	K7 - K10	K7 - K10	K9 - K10

4.5 For screwed or welded on flange pipes the minimum classes as per working pressure criteria are given below:

Minimum Class for Ductile Iron Flanged Pipes

Nominal Dia	Screwed on Flange Minimum				Welded on Flange Minimum			
	PN 10	PN 16	PN 25	PN 40	PN 10	PN 16	PN 25	PN 40
80 - 450	K9	K9	K9	K9	K9	K9	K9	K9
500 - 600	K10	K10	K10	K10	K9	K9	K9	K10
700 - 1 200	K10	K10	K10	—	K9	K9	K9	—
1 400 - 2 000	K10	K10	—	—	K9	K9	—	—

## 5 SUPPLY OF MATERIAL

The general requirements relating to the supply of material shall be as laid down in IS 1387.

## 6 JOINTS

The joint design and gasket shape are outside the scope of this standard.

### 6.1 Push-on-Joint

6.1.1 In case of push-on flexible joints, the spigot ends shall be suitably chamfered or rounded off to facilitate smooth entry of pipe in the socket fitted with the rubber gasket.

6.1.2 For high pressure mains where working pressure is greater than 2.4 MPa, suitable flexible joint may be preferred when the joint is restrained against axial movement.

### 6.2 Flanged Joint

6.2.1 The dimensions and tolerances of the flanges of pipes and fittings shall be such, so as to ensure the interconnection between all flanged components (pipes, fittings, valves) of the same *DN* and *PN* and adequate joint performance. Although it does not affect interconnection, the manufacturer shall indicate whether his products are normally delivered with fixed flanges or loose flanges.

6.2.2 Flanged joints for working pressure ratings of 1.0, 1.6, 2.5 and 4.0 MPa may be of screwed on flanged

4.5.1 Flanges for screwed on or Welded on Double Flanged Pipes should be preferably of Ductile Iron of 420 MPa minimum tensile strength and 5 percent minimum elongation at break and maximum hardness 250 HB.

4.6 Where pipes of classes other than those given in Table 1 are manufactured and supplied, the wall thickness shall be calculated as per formula (1) given in 4.3 and the pipes shall be marked in accordance with 17. Such pipes shall comply with all the requirements of this standard with the exception of wall thickness 'e' which will be as per the calculated wall thickness.

type or flanges may be welded on plain ended ductile iron pipes.

6.2.3 In case of ductile iron pipes with screwed on flanges or welded flanges, the flanges shall be at right angle to the axis of the pipe and shall be machined on face. The bolt holes shall be either cored or drilled.

6.2.4 The bolt hole circle shall be concentric with the bore and holes of the two flanges of the pipe shall be correctly aligned.

6.2.5 The flange can be of adjustable type where the flange comprises of a ring, in one or several parts assembled together, which bears on an end joint hub and can be freely rotated around the pipe axis before jointing.

6.2.6 The ductile iron pipes having screwed on flanges shall be sealed at the threaded joint between the pipe and the flange by a suitable sealing compound. Unless otherwise specified, the sealing compound applied to the threaded joint shall be suitable for use with 'raw' and potable water (up to a temperature of 100°C), gas and normal domestic sewage.

Alternative types of sealing compound, for pipes used for other duties such as carrying industrial effluents, chemicals and town gas, shall be compatible and may be the subject to agreement between the manufacturer and the purchaser.

6.2.7 For screwed on flanged pipes, the method of screwing and the exact form of thread are left to the



discretion of the manufacturer in view of the fact that flanges are never removed after screwing on the barrels of the pipes.

**6.2.8** Dimensions of screwed on flanges and welded on flanges for ductile iron pipes shall conform to the requirements of Tables 3, 4, 5 and 6.

### 6.3 Flexible Joints and Interconnection

Pipes with flexible joints shall be in accordance with 15 of this standard for their spigot external diameters *DE* and their tolerances. This provides the possibility of interconnection between components equipped with different types of flexible joints.

#### NOTES

1 For interconnection with certain types of joints operating within a tighter tolerance range on *DE*, the manufacturer's guidance may be followed as to the means of ensuring adequate joint performance up to the highest pressures (for example, measurement and selection of external diameter).

2 For interconnection with existing pipelines, which may have external diameters not in compliance with 15, the manufacturer's guidance may be followed as to the appropriate means of interconnection (for example, adaptors).

### 6.4 Restrained Joints

The design of restrained joints for ductile iron pipelines and its requirements shall be subject to agreement between the purchaser and the manufacturer as agreed at the time of enquiry and order. Their spigot external diameters *DE* and their tolerances shall be in accordance with requirements of 15.

## 7 MANUFACTURE

**7.1** The metal used for the manufacture of pipes shall be of good quality, commensurate with the mechanical requirements laid down in 10. It shall be manufactured by any method at the discretion of the manufacturer provided that the requirements defined in this standard are complied with.

**7.2** The pipes shall be stripped with all precautions to avoid warping or shrinkage defects, detrimental to their good quality. The pipes shall be sound and free from surface or other defects. Pipes showing small imperfections inherited with the method of manufacture, and which do not affect their serviceability, shall not be rejected on that account alone. Minor defects arising out of manufacturing process may be rectified, for example, by welding in order to remove surface imperfections and localized defects which do not affect the entire wall thickness provided that the repairs are carried out in accordance with a written assurance system and the repaired pipes comply with all the requirements of classes *K9* and *K10* with the approval of the purchaser.

**7.3** Pipes centrifugally cast shall be heat-treated in order to achieve the necessary mechanical properties and to relieve casting stresses caused due to the method of manufacture and repair work.

**7.3.1** If necessary the pipes may be subjected to reheat treatment to ensure that Brinell hardness does not exceed the specified value and the other mechanical properties specified in the standard are achieved.

## 8 RUBBER GASKET

**8.1** Rubber gaskets used with push-on-joints or mechanical joints shall conform to IS 5382.

**8.2** Material of rubber gaskets for push-on mechanical or flanged joints shall be compatible with the fluid to be conveyed at the working pressure and temperature.

**8.3** Rubber gaskets for mechanical joint for conveyance of town gas may be suitably protected so that the elastomer does not come in direct contact with the gas.

**8.4** Rubber gaskets for use with flanged joints shall conform to IS 638.

**8.5** While conveying potable water the gaskets should not deteriorate the quality of water and should not impart any bad taste or foul odour.

## 9 SAMPLING

**9.1** Sampling criteria for various tests, unless specified in this standard, shall be as laid down in IS 11606.

**9.2** The mechanical acceptance tests shall be carried out on samples of ductile iron pipes which shall be grouped in following batch sizes.

<i>DN</i> (mm)	<i>Maximum Batch Size</i>
80 – 250	200 Pipes
300 – 600	100 Pipes
700 – 1 000	60 Pipes
1 100 – 1 400	40 Pipes
1 600 – 2 000	30 Pipes

**9.3** In order to check compliance with the requirements specified in 10, a sample ring or bar shall be taken from the spigot end of pipe.

## 10 MECHANICAL TESTS

**10.1** Mechanical tests shall be carried out during manufacture. One test shall be conducted for every batch of production. The number of pipes for each batch shall be as laid down in 9.2. The results obtained shall be taken to represent all the pipes of that batch.

**10.1.1 Tensile Test**

of the test bar shall be as given below:

**10.1.2 The thickness of the sample and the diameter**

Castings Thickness mm	Test Bar, Method A Nominal Diameter mm	Test Bar, Method B		
		Nominal Area $S_0$ mm <sup>2</sup>	Nominal Diameter mm	Tolerance on Diameter mm
Centrifugally Cast Pipes:				
— less than 6	2.5	5.0	2.52	0.01
— 6 up to but not including 8	3.5	10.0	3.57	0.02
— 8 up to but not including 12	5.0	20.0	5.05	0.02
— 12 and over	6.0	30.0	6.18	0.03

**10.1.3** A sample shall be cut from the spigot end of the pipe. This sample may be cut perpendicular to or parallel with the pipe axis, but in case of dispute the parallel to axis sample shall be used.

**10.1.4 Test Specimen**

A test bar shall be machined from each sample to be representative of the metal at the mid-thickness of the sample, with a cylindrical part having the diameters given in **10.1.2**.

The test bars shall have a gauge length at least five times the nominal test bar diameter. The ends of the test bars shall be such that they will fit the testing machine.

Two methods of measuring the tensile strength may be used at the manufacturer's option:

**Method A** — Machine the test bar to its nominal diameter  $\pm 10$  percent, measure the actual diameter before the test with an accuracy of 0.01 mm and use this measured diameter to calculate the cross-sectional area and the tensile strength; or:

**Method B** — Machine the test bar to its nominal area  $S_0$  within a specified tolerance on diameter (see **10.1.2**) and use the nominal area to calculate the tensile strength.

**10.1.5 Equipment and Test Method**

The samples shall be tested as per procedures laid down in IS 1608. The tensile testing machine shall have suitable holders or grips to suit the test bar ends so as to positively apply the test load axially.

**10.1.6 Test Results**

Test results shall comply with the requirements given below:

One test pieces obtained by cutting bars from spigot

end of one pipe selected for testing when tested in accordance with the methods specified in **10.1.4** shall satisfy the following requirements:

Nominal Diameter (DN) mm	Minimum Tensile Strength MPa	Minimum Elongation at Break, Percent
80 - 1 000	420	10
1 100 - 2 000	420	7

**NOTES**

- The 0.2 percent proof stress shall be measured when agreed to between the manufacturer and the purchaser at the time of enquiry and order. It shall not be less than 300 MPa.
- For ductile iron pipes upto DN 1 000 if the tensile strength of specimen is not found within limits, and microstructure reveals 75 percent ferrite with spheroidal graphite and percentage elongation  $\geq 7$ , it shall be taken as meeting the requirements of this standard.
- For pipes of size not less than DN 900, 0.2 percent proof stress  $\geq 270$  MPa is permitted provided that elongation at break is not less than 12 percent.
- The frequency of testing is related to the system of production and quality control used by the manufacturer.

**10.1.7** All pipes from which bars have been cut shall be accepted by the purchaser as complete lengths.

**10.2 Brinell Hardness Test**

When tested in accordance with IS 1500, the Brinell hardness shall not exceed 230 HB on the external un-machined surface.

**10.3 Retest**

**10.3.1** If test piece representing a batch (see **9.2**) fails in the test in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same batch. If both the test results satisfy the specified requirements, the batch shall be accepted. Should either of these additional test pieces fail in the test, the batch shall be deemed as not complying with this standard.

10.3.2 If test results do not satisfy the requirements of 10.1.6 the manufacturer shall:

In the case where the metal does not achieve the required mechanical properties, investigate the reason and ensure that all castings in the batch are either re-heat treated or rejected.

NOTE --- If sufficient evidence is available that the failure of the sample can be attributed to defect in test bar, fresh sample may be drawn and tested. If it passes, the batch is accepted; if not the manufacturer has the option to proceed as in 10.3.2.

11 HYDROSTATIC TEST

11.1 All pipes shall be tested hydrostatically at a pressure specified in Table 1. To perform the test, pressure shall be applied internally and shall be steadily maintained for a period of 10 s. The pipes shall withstand the pressure test and shall not show any sign of leakage, sweating or other defects of any kind.

11.1.1 It is recommended that the Hydrostatic test pressure at works 'p' be expressed in MPa as a function of the coefficient K (4.3) be calculated using the following formulae:

for DN 80 to 300  $p = 0.05 (K + 1)^2$   
 for DN 350 to 600  $p = 0.05 (K)^2$   
 for DN 700 to 1 000  $p = 0.05 (K - 1)^2$   
 for DN 1 100 to 2 000  $p = 0.05 (K - 2)^2$

11.1.2 When pipes are required to be tested for higher pressure, the test pressures are subject to agreement between the purchaser and the manufacturer at the time of enquiry and order.

11.2 Test shall be carried out before the application of surface coating and lining.

12 SIZES

12.1 The standard nominal diameters DN, of pipes and flanges followed in this standard are as follows :

80, 100, 125, 150, 200, 250, 300, 350, 400, 450,

500, 600, 700, 750, 800, 900, 1 000, 1 100, 1 200, 1 400, 1 600, 1 800 and 2 000 mm.

12.2 Critical dimensions for socket and spigot of pipes for push-on flexible joints and mechanical joints for classes K7, K8, K9 and K10 are given in Table 2.

12.3 Dimensions of flanged pipes centrifugally cast with screwed on flanges or welded flanges are given in Tables 3, 4, 5 and 6.

13 DIMENSIONS

13.1 Length

The standard working length of socket and spigot pipes shall be 4 m, 5 m, 5.5 m and 6 m and for flanged pipes shall be 4 m, 5 m and 5.5 m other lengths are available by agreement between the manufacturer and the purchaser.

13.2 Internal Diameter

The nominal values of the internal diameters of centrifugally cast pipes, expressed in millimetres are approximately equal to the numbers indicating their nominal sizes DN.

13.3 Wall Thickness

The nominal wall thickness of pipes shall be calculated as a function of the nominal size, DN, as given in the formula (1) in 4.3. The different nominal wall thickness are given in Table 2. Other thickness and class are possible for pipes by agreement between the manufacturer and the purchaser.

14 MATERIALS IN CONTACT WITH POTABLE WATER

When used under the conditions for which they are designed, in permanent or in temporary contact with water intended for human consumption, ductile iron pipes and their joints shall not have detrimental effects on the properties of the water for its intended use.

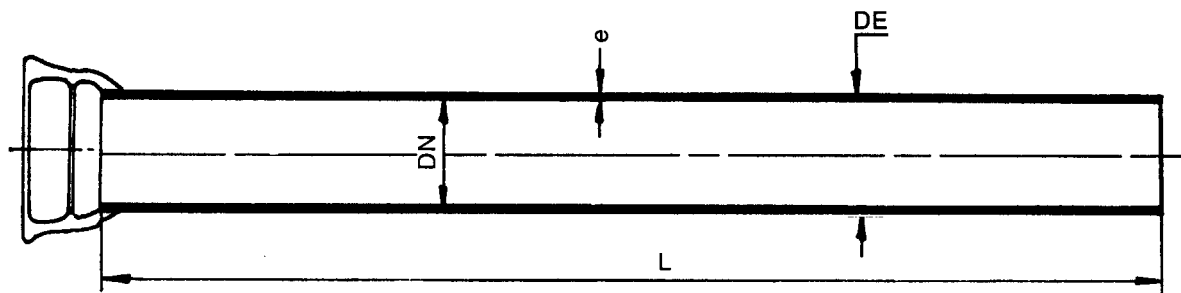
Table 1 Hydrostatic Test Pressure at Works for Ductile Iron Pipes  
(Clauses 4.6 and 11.1)

Nominal Diameter (DN) mm	Minimum Hydrostatic Test Pressure at Works , MPa						
	Centrifugally cast pipes with flexible joints				Pipes with screwed or welded-on flanges		
	Class K7	Class K8	Class K9, Class K10, Class K12	PN 10 Flange	PN 16 Flange	PN 25 Flange	PN 40 Flange
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
80 to 300	3.2	4.0	5.0	1.6	2.5	3.2	4.0
350 to 600	2.5	3.2	4.0	1.6	2.5	3.2	4.0
700 to 1 000	1.8	2.5	3.2	1.6	2.5	3.2	—
1 100 to 2 000	1.2	1.8	2.5	1.6	2.5	2.5	—

NOTE --- Recommended hydrostatic site test pressure and hydraulic working pressure are given in Annex E.

Table 2 Dimensions of Sockets and Spigot Pipes, Classes K7, K8, K9 and K10

(Clauses 3.21, 12.2, 13.3 and 15.3.2)



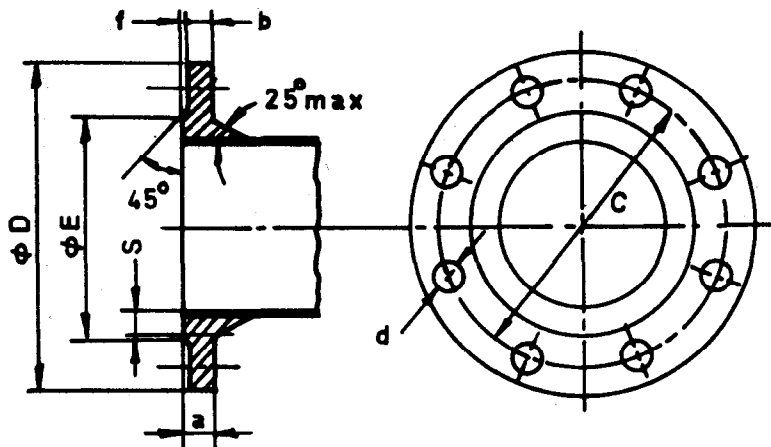
All dimensions in millimetres.

Nominal Diameter <i>DN</i>	External Diameter <i>DE</i>	Barrel Wall Thickness 'e'			
		K7	K8	K9	K10
80	98	5	6	6.0	6.0
100	118	5	6	6.0	6.1
125	144	5	6	6.0	6.3
150	170	5	6	6.0	6.5
200	222	5	6	6.3	7.0
250	274	5.3	6	6.8	7.5
300	326	5.6	6.4	7.2	8.0
350	378	6.0	6.8	7.7	8.5
400	429	6.3	7.2	8.1	9.0
450	480	6.6	7.6	8.6	9.5
500	532	7.0	8.0	9.0	10.0
600	635	7.7	8.8	9.9	11.0
700	738	9.0	9.6	10.8	12.0
750	790	9.7	10.0	11.3	12.5
800	842	10.4	10.4	11.7	13.0
900	945	11.2	11.2	12.6	14.0
1 000	1 048	12.0	12.0	13.5	15.0
1 100	1 152	14.4	14.4	14.4	16.0
1 200	1 255	15.3	15.3	15.3	17.0
1 400	1 462	17.1	17.1	17.1	19.0
1 600	1 668	18.9	18.9	18.9	21.0
1 800	1 875	20.7	20.7	20.7	23.0
2 000	2 082	22.5	22.5	22.5	25.0

NOTE — For tolerances refer to 15.

**Table 3 Dimensions of Standard Flange Drilling for Screwed Flanges and Welded Flange (PN 10)**

(Clauses 6.2.8 and 12.3).



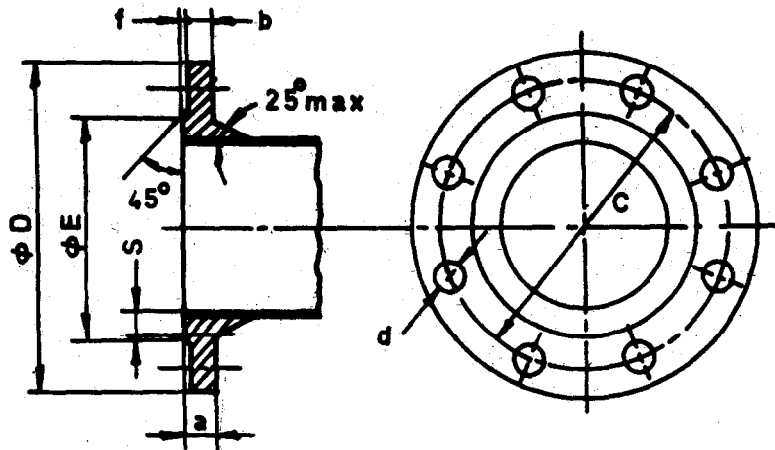
All dimensions in millimetres.

Nominal Diameter	Dimensions							Holes		Bolt Size
	DN	D	E	C	b	f	a	S	Number	
80	200	132	160	19	3	32	15	4	19	M16
100	220	156	180	19	3	32	15	8	19	M16
125	250	184	210	19	3	32	15	8	19	M16
150	285	211	240	19	3	32	15	8	23	M20
200	340	266	295	20	3	34	15	8	23	M20
250	395	319	350	22	3	48	16	12	23	M20
300	445	370	400	24.5	4	52	17.5	12	23	M20
350	505	429	460	24.5	4	52	19.5	16	23	M20
400	565	480	515	24.5	4	60	19.5	16	28	M24
450	615	530	565	25.5	4	63	20	20	28	M24
500	670	582	620	26.5	4	68	21	20	28	M24
600	780	682	725	30	5	75	24	20	31	M27
700	895	794	840	32.5	5	82	24	24	31	M27
750	960	857	900	34	5	87	24	24	31	M27
800	1 015	901	950	35	5	90	24.5	24	34	M30
900	1 115	1 001	1 050	37.5	5	98	26.5	28	34	M30
1 000	1 230	1 112	1 160	40	5	105	28	28	37	M33
1 100	1 340	1 231	1 270	43	5	114	30	28	37	M33
1 200	1 455	1 328	1 380	45	5	120	31.5	32	40	M36
1 400	1 675	1 530	1 590	46	5	123	32	36	43	M39
1 600	1 915	1 750	1 820	49	5	132	34.5	40	49	M45
1 800	2 115	1 950	2 020	52	5	141	36.5	44	49	M45
2 000	2 325	2 150	2 230	55	5	150	38.5	48	49	M45

**NOTES**

- 1 The method of screwing and the exact form of thread shall be left to the discretion of the manufacturer as the flanges are never removed after screwing on the barrels of the pipes.
- 2 If so required the screwed flanges may be spot welded on the back side after screwing.
- 3 Dimensions 'a' and 'S' are for guidance only.
- 4 Unless otherwise specified, flanges shall be of ductile iron.

**Table 4 Dimensions of Standard Flange Drilling for Screwed Flanges and  
Welded Flange (PN 16)**  
(Clauses 6.2.8 and 12.3)



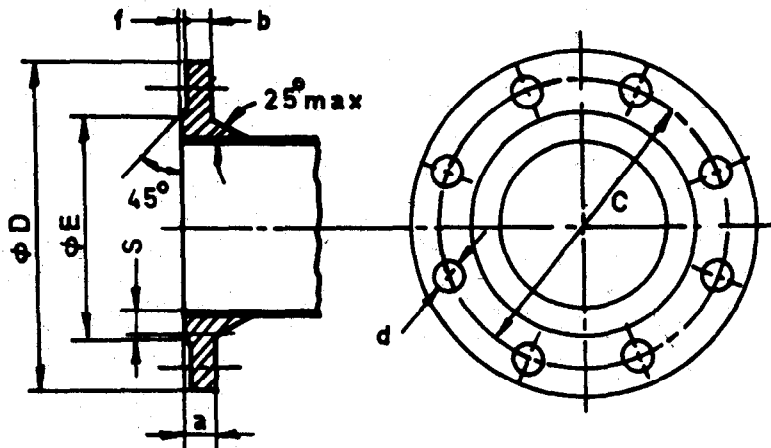
All dimensions in millimetres.

Nominal Diameter	Dimensions							Holes		Bolt Size
	DN	D	E	C	b	f	a	S	Number	
80	200	132	160	19	3	32	15	8	19	M16
100	220	156	180	19	3	32	15	8	19	M16
125	250	184	210	19	3	32	15	8	19	M16
150	285	211	240	19	3	32	15	8	23	M20
200	340	266	295	20	3	34	16	12	23	M20
250	400	319	355	22	3	48	17.5	12	28	M24
300	455	370	410	24.5	4	52	19.5	12	28	M24
350	520	429	470	26.5	4	68	21	16	28	M24
400	580	480	525	28	4	72	22.5	16	31	M27
450	640	548	585	30	4	78	24	20	31	M27
500	715	609	650	31.5	4	82	25	20	34	M30
600	840	720	770	36	5	93	27.5	20	37	M33
700	910	794	840	39.5	5	103	27.5	24	37	M33
750	970	857	900	41	5	108	28	24	37	M33
800	1 025	901	950	43	5	114	30	24	40	M36
900	1 125	1 001	1 050	46	5	124	32.5	28	40	M36
1 000	1 255	1 112	1 170	50	5	135	35	28	43	M39
1 100	1 355	1 218	1 270	53.5	5	144	37.5	32	43	M39
1 200	1 485	1 328	1 390	57	5	156	40	32	49	M45
1 400	1 685	1 530	1 590	60	5	165	42	36	49	M45
1 600	1 930	1 750	1 620	65	5	180	45.5	40	56	M52
1 800	2 130	1 950	2 020	70	5	195	49	44	56	M52
2 000	2 345	2 150	2 230	75	5	210	52.5	48	62	M56

#### NOTES

- 1 The method of screwing and the exact form of thread shall be left to the discretion of the manufacturer as the flanges are never removed after screwing on the barrels of the pipes.
- 2 If so required the screwed flanges may be spot welded on the back side after screwing.
- 3 Dimensions 'a' and 'S' are for guidance only.
- 4 Unless otherwise specified, flanges shall be of ductile iron.

**Table 5 Dimensions of Standard Flange Drilling for Screwed Flanges and Welded Flange (PN 25)**  
(Clauses 6.2.8 and 12.3)



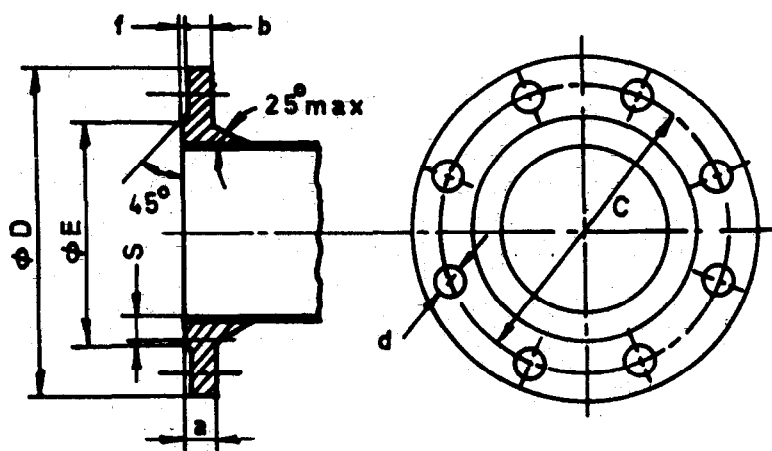
All dimensions in millimetres.

Nominal Diameter	Dimensions							Holes		Bolt Size
	DN	D	E	C	b	f	a	S	Number	Dia (d)
80	200	132	160	19	3	30	15	8	19	M16
100	235	156	190	19	3	33	15	8	23	M20
125	270	184	220	19	3	37	15	8	28	M24
150	300	211	250	20	3	40	16	8	28	M24
200	360	274	310	22	3	44	17.5	12	28	M24
250	425	330	370	24.5	3	49	19.5	12	31	M27
300	485	389	430	27.5	4	56	22	16	31	M27
350	555	448	490	30	4	57	24	16	34	M30
400	620	503	550	32	4	64	25.5	16	37	M33
450	670	548	600	34.5	4	69	27.5	20	37	M33
500	730	609	660	36.5	4	73	29	20	37	M33
600	845	720	770	42	5	83	33.5	20	40	M36
700	960	820	875	46.5	5	84	33.5	24	43	M39
750	1 020	883	940	50	5	100	34	24	43	M39
800	1 085	928	990	51	5	102	35.5	24	49	M45
900	1 185	1 028	1 090	55.5	5	112	39	28	49	M45
1 000	1 320	1 140	1 210	60	5	118	42	28	56	M52
1 100	1 420	1 240	1 310	65.5	5	120	45	32	56	M52
1 200	1 530	1 350	1 420	69	5	138	48.5	32	56	M52
1 400	1 755	1 560	1 640	74	5	148	52	36	62	M56
1 600	1 975	1 730	1 860	81	5	162	56.5	40	62	M56
1 800	2 195	1 980	2 070	88	5	176	61.5	44	70	M64
2 000	2 425	2 210	2 300	95	5	190	66.5	48	70	M64

**NOTES**

- 1 The method of screwing and the exact form of thread shall be left to the discretion of the manufacturer as the flanges are never removed after screwing on the barrels of the pipes.
- 2 If so required the screwed flanges may be spot welded on the back side after screwing.
- 3 Dimensions 'a' and 'S' are for guidance only.
- 4 Unless otherwise specified, flanges shall be of ductile iron.

**Table 6 Dimensions of Standard Flange Drilling for Screwed Flanges and  
Welded Flange (PN 40)**  
(Clauses 6.2.8 and 12.3)



All dimensions in millimetres.

Nominal Diameter	Dimensions							Holes		Bolt Size
	DN	D	E	C	b	f	a	S	Number	
80	200	132	160	19	3	43	15	8	19	M16
100	235	156	190	19	3	48	15	8	23	M20
125	270	184	220	23.5	3	51	16.5	8	28	M24
150	300	211	250	26	3	52	18	8	28	M24
200	375	284	320	30	3	62	21	12	31	M27
250	450	345	385	34.5	3	67	24	12	34	M30
300	515	409	450	39.5	4	73	27.5	16	34	M30
350	580	465	510	44	4	76	31	16	37	M33
400	660	535	585	48	4	83	33.5	16	40	M36
450	685	560	610	50	4	89	35	20	40	M36
500	755	615	670	52	4	95	36.5	20	43	M39
600	890	735	795	58	5	106	40.5	20	49	M45

#### NOTES

- 1 The method of screwing and the exact form of thread shall be left to the discretion of the manufacturer as the flanges are never removed after screwing on the barrels of the pipes.
- 2 If so required the screwed flanges may be spot welded on the back side after screwing.
- 3 Dimensions 'a' and 'S' are for guidance only.
- 4 Unless otherwise specified, flanges shall be of ductile iron.



## 15 TOLERANCES

### 15.1 Diameter

#### 15.1.1 External Diameter

The values of the external diameter (*DE*) of the spigot end of socket and spigot pipes and when measured circumferentially using a diameter tape shall confirm to the requirements specified in 12. The positive tolerance is + 1 mm and applies to all thickness classes of pipes.

The negative tolerance of the external diameter depends on the design of each type of joint and maximum negative tolerance is specified in this standard.

**Table 7 External Diameter *DE* (mm)**  
(Clause 15.1.1)

<i>DN</i> (1)	Nominal (2)	Tolerance (3)
80	98	+1, -2.2
100	118	+1, -2.8
125	144	+1, -2.8
150	170	+1, -2.9
200	222	+1, -3
250	274	+1, -3.1
300	326	+1, -3.3
350	378	+1, -3.4
400	429	+1, -3.5
450	480	+1, -3.6
500	532	+1, -3.8
600	635	+1, -4
700	738	+1, -4.3
750	789	+1, -4.4
800	842	+1, -4.5
900	945	+1, -4.8
1 000	1 048	+1, -5
1 100	1 152	+1, -6
1 200	1 255	+1, -6.2
1 400	1 462	+1, -6.6
1 500	1 565	+1, -7
1 600	1 668	+1, -7.4
1 800	1 875	+1, -8.2
2 000	2 082	+1, -9

**15.1.2** For requirement of interchangeability all pipes should be within the tolerance specified. Push-on flexible joints may need closer tolerance for its effective performance. Such tolerance should be specified by the manufacturer for the type of joint and the nominal size considered, if required, in their catalogue.

**15.1.3** In addition, the ovality (*see* 3.22) of the spigot end of pipes shall:

- remain within the tolerances on *DE* for *DN* 80 to 200;
- not exceed 1 percent for *DN* 250 to *DN* 600 or 2 percent for *DN* above 600.

**NOTE** — The manufacturer's guidance will be followed as to the necessity and means of ovality correction; certain types of flexible joints can accept the maximum ovality without need for spigot re-rounding prior to jointing.

**15.2** Up to size *DN* 300 the external diameter of the barrel of pipes supplied shall be within the tolerance specified, starting from spigot end of pipe to the section at one metre from it so that the pipe can be cut and the short length can be used.

**15.2.1** Above size *DN* 300 subject to the agreement between the purchaser and the manufacturer some of the pipes may be ordered in accordance with 15.2. These pipes may be especially marked by a continuous longitudinal line. Such pipes so specially supplied may be cut and used as short length pipes.

### 15.3 Tolerance on Ovality

**15.3.1** Pipes shall be as far as possible circular internally and externally. The tolerance for out-of-roundness of the socket and spigot ends in the jointing zone for push-on-joint is given in Table 8 and for mechanical joint is given in Table 9.

**15.3.2** In case of oval spigot ends for push-on-joints (*DE*), the minor axis is permitted to be less than the minimum allowable diameter by the value given below provided the mean diameter *DE* measured by circumferential tape, comes within the minimum allowable dimensions of *DE* (Table 2) after applying the tolerance.

**Table 8 Allowable Ovality for Push-on-Joint Pipes**  
(Clause 15.3.1)

Nominal Diameter <i>DN</i> mm (1)	Allowable Difference Between Minor Axis and <i>DE</i> , <i>Min</i> mm (2)
80 to 300	1.0
350 to 600	1.75
700	2.0
750 to 800	2.4
900 to 1 000	3.5
1 100 to 1 200	4.0
1 400 to 1 600	4.5

**15.3.3** Mechanical joint will accept some degrees of spigot ovality but the measured difference between the maximum and minimum axis of individual spigots shall not exceed the values given in Table 9.

### 15.4 Tolerance on Thickness

The tolerance on the wall thickness (*e*) and the flange thickness (*b*) of the pipes shall be as follows:

Dimensions	Tolerance, mm
i) Wall thickness ( <i>e</i> )	$-(1.3 + 0.001 DN)^{1)}$
ii) Flange thickness ( <i>b</i> )	$\pm (2 + 0.05b)$

<sup>1)</sup> The tolerance given is subject to minimum thickness against classes *K7*, *K8* and *K12* given in 4.3. No limit for the plus tolerance is specified.

**Table 9 Allowable Ovality for Mechanical Joint Pipe**

(Clauses 15.3.1 and 15.3.3)

Nominal Diameter <i>DN</i>	Maximum Ovality of Spigot of External Diameter <i>DE</i>
mm (1)	mm (2)
80 to 150	5
200 to 350	10
400 to 500	20
600 to 800	30
900 to 1 000	40
1 100 to 1 400	50
1 600 to 2 000	60

### 15.5 Tolerance on Length

The tolerance on length of pipes shall be as follows:

Type of Casting	Tolerance mm
i) Socket and spigot and plain ended pipes	± 100
ii) Flanged pipes	± 10

**15.5.1** Of the total number of socket and spigot pipes to be supplied in each diameter, the manufacturer may supply up to 10 percent in length shorter than the specified length as follows:

Specified Length m	Decrease in Length m
i) Up to 4	0.5, 1
ii) Over 4	0.5, 1, 1.5, 2

### 15.6 Permissible Deviation from a Straight Line

The pipes shall be reasonably straight. When the pipe is rolled along gantries, separated by distance approximately two-thirds the length of the pipe to be checked, the maximum deviation from a straight line in mm shall not be greater than 1.25 times the

length  $L$ , in metres of the pipe; thus:

$$f_m \leq 1.25 \times L$$

where

$f_m$  = maximum deviation from straight line, and  
 $L$  = length of the pipe.

### 15.7 Flanges

**15.7.1** Tolerances for the various dimensions of flanges shall be as given in Tables 10, 11, 12 and 13.

### 16 COATING

**16.1** Pipes shall be normally delivered internally and externally coated.

### 16.2 External Protection

By agreement between manufacturer and the purchaser, any one of the following protection may be applied depending upon the external condition of use:

Metallic zinc with finishing layer as included in Annex A.

Zinc rich paint with finishing layer, as included in Annex A.

Bituminous paint: as included in Annex C.  
External Sleeving (Annex D).

NOTE — Unless and until agreed to between the purchaser and manufacturer the requirement of coatings and sleeving shall comply with the requirements contained in this standard.

**16.2.1** The polyethylene sleeves may be supplied, for encasement of the pipes at site, along with the pipes if ordered by the purchaser at the time of enquiry and order. This encasement shall so designed that prevent contact between pipe and the surrounding backfill and bedding material. Details as given in Annex D.

### 16.3 Internal Linings

By agreement between manufacturer and the purchaser, the following lining may be applied depending on the internal conditions of use:

**Table 10 Tolerances on the External Diameter 'D and E'**  
(Clause 15.7.1)

<i>DN</i>	80	100	125	150	200	250	300	350	400	450	500	600	700	750
Tolerance on <i>D</i>	± 4.5		+5.5, -2.5				+ 6.5, -3.5				+ 7.5, -4			
Tolerance on <i>E</i>	± 4		± 4.5				± 5				± 5.5			

<i>DN</i>	800	900	1 000	1 100	1 200	1 400	1 600	1 800	2 000
Tolerance on <i>D</i>	+ 7.5, -4		+ 8.5, -4			+10, -5		+12, -6	
Tolerance on <i>E</i>	± 5.5		± 5.5			± 6.0		± 6.0	

- Portland cement (with or without additives) mortar, as included in Annex B.
- Blast furnace slag cement mortar as included in Annex B.
- High alumina (calcium aluminate) cement mortar as included in Annex B.
- Cement mortar with seal-coat: as included in Annex B.
- Bituminous paint as included in Annex C.

NOTE — Unless and until agreed to between the purchaser and the manufacturer, the requirement of internal lining shall comply with the requirements contained in this standard.

**Table 11 Tolerances on Raised Face Height (*f*)**  
(Clause 15.7.1)

All dimensions in millimetres.

Height of Raised Face ( <i>f</i> ) (1)	Tolerance (2)
3	+1.5, -2.0
4	+2, -3.0
5	+2.5, -4.0

**Table 12 Tolerances on Thickness on Flange (*b*)**  
(Clause 15.7.1)

All dimensions in millimetres.

Type of Flange (1)	Tolerance (2)
Integrally cast flanges	$\pm (3 + 0.05 b)$
Welded and screwed on flanges	$\pm (2 + 0.05 b)$

**Table 13 Tolerances on Flange Drilling**  
(Clause 15.7.1)

All dimensions in millimetres.

Dimension (1)	Bolt Hole Diameter, Tolerance		
	19 to 28 (2)	31 to 56 (3)	Above 62 (4)
Bolt hole diameter, <i>d</i>	+2, -0	+3, -0	+4, -0
Pitch circle diameter, <i>C</i>	$\pm 2$	$\pm 2.8$	$\pm 4.8$
Centre to centre of adjacent bolt holes	$\pm 2$	$\pm 2.8$	$\pm 4.8$

## 17 QUALITY ASSURANCE

### 17.1 General

The manufacturer shall be able to demonstrate the conformity of the product to the requirement contained

in this standard by controlling the manufacturing process and by carrying out the various tests as specified in this standard.

### 17.2 Quality Assurance System

The manufacturer shall control the quality of the product during their manufacturing process by a system of process control in order to comply with the technical requirements contained in this standard. Wherever possible, statistical sampling techniques should be used to control the process so that the product is produced within the specified limits.

## 18 MARKING

18.1 Each pipe shall have as cast or stamped or legibly and indelibly painted on it with the following appropriate marks:

- a) Indication of the source of manufacture;
- b) The nominal diameter;
- c) Class reference;
- d) The last two digits of the year of manufacture;
- e) The non-standard length of the pipe if specially ordered;
- f) Where applicable, an indication of length over which the pipe is suitable for cutting on site; and
- g) A short white line at the spigot end of each pipe with push-on joint in sizes *DN* 700 and above, to indicate the major axis of the spigot.

NOTE — Manufacturers may recommend that spigot end of such pipes be jointed with the major axis in the vertical position.

### 18.1.1 Marking may be Done

- a) on the socket faces of pipe centrifugally cast in metal mould, and
- b) on the outside of the socket or on the barrel of pipe centrifugally cast in sand mould.

### 18.2 BIS Certification Marking

The pipes may also be marked with the Standard Mark.

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

## ANNEX A

(Clause 16.2)

### ZINC COATING

#### A-1 PIPE SURFACE CONDITION

The pipe surface shall be dry and free from rust or any non-adhering particles or foreign matter such as oil or grease. Metallic zinc shall be applied on to the oxide external surface of the pipe.

NOTE – The zinc is normally applied on the pipe with oxide skin but, at the manufacturer's option, it may applied on a blast cleaned pipe surface.

#### A-2 MATERIALS

The coating materials are metallic zinc with content of at least 99 percent by mass.

#### A-3 METHOD OF APPLICATION

The metallic zinc coating shall be applied by a spraying process in which metallic zinc material is heated to a molten state and projected in small droplets by spray guns onto surface. The zinc rich paint coating shall be applied by a spraying or a brush process onto the pipe surface in case of repair only.

#### A-4 COATING CHARACTERISTICS

**A-4.1** The metallic zinc coating shall cover the outside diameter of the pipe and shall be free from such defects as bare patches or lack of adhesion.

**A-4.2** Damaged areas of zinc coating caused by handling are acceptable provided that the damage is less than 5 cm<sup>2</sup>/m<sup>2</sup> of coated surface and provided that the minor dimensions of the damaged area do not exceed 5 mm.

#### A-5 ZINC COATING MASS

The average mass of zinc coating shall be not less than 130 g/m<sup>2</sup> with a local minimum of 110 g/m<sup>2</sup>.

#### A-6 DETERMINATION OF ZINC COATING

Manufacturing process control system shall specify the frequency of this test. A rectangular token is attached along the pipe axis before passing it through the zinc coating equipment. After coating and trimming the minimum token sizes shall be either:

- a) 250 mm × 100 mm, or
- b) 500 mm × 50 mm.

The average mass of zinc coating  $M$  expressed in

grams per square metre, is calculated by mass difference of the token before and after zinc coating from the following formula:

$$M = \frac{C(M_2 - M_1)}{A}$$

where

$M_1, M_2$  = mass in grams before and after zinc coating measured to an accuracy of 0.1 g,

$A$  = area of the token in square meter, and

$C$  = correction factor depending on the material of the token taking into account difference in surface roughness between the token and the pipe surface.

The value of  $C$  shall be determined by the manufacturer and specified when required in test documents.

#### A-7 REPAIRS OF THE ZINC COATING

Areas left uncoated, for example under the test token and coating damaged in excess of 5 cm<sup>2</sup>/m<sup>2</sup> of coating shall be repaired by either:

- a) a metallic zinc spray.
- b) by application of zinc rich paint containing more than 90 percent zinc by mass in the dried film: mean mass of the applied paint shall not be less than 150 g/m<sup>2</sup>.
- c) Flanges of welded flanged pipes and welded parts of the flanges shall be coated with zinc rich paints (90 percent).

#### A-8 FINISHING LAYER

After metallic zinc coating or zinc rich paint coating the pipe shall be given a finishing layer of bituminous paint or synthetic resin compatible with the zinc coating.

Application of this finishing layer may be done by any proven process such as spraying or brush coating at the manufacturer's choice. It shall uniformly cover the zinc coating and be free from bare patches or lack of adhesion.

The mean dry film thickness of the finishing layer shall not be less than 70 μm with nowhere less than 50 μm.

## ANNEX B

(Clause 16.3)

## CEMENT MORTAR LINING

## B-1 MATERIALS

## B-1.1 Cement

The cement used for the lining shall conform to the existing standards on cement. The type of cement to be used is to be mutually decided between the purchaser and manufacturer. Normal recommendations are:

- a) Portland cement (as per IS 8112 or IS 455) mortar lining perform rather well and have an expected life of approximately 50 years in soft water with moderate amount of aggressive CO<sub>2</sub> and when pH is within 6 to 9. Longer service life can be obtained by increasing the mortar lining thickness.
- b) Where cement mortar lining may be exposed to sulphate attack, ordinary Portland cement should be replaced by sulphate resisting Portland cement (as per IS 12330 or IS 6909). The sulphate concentration limit for sulphate resisting Portland cement is approximately 3 000 mg/litre, the same as blast furnace slag cement which naturally possess a good resistance to sulphate attack. For sea water transmission blast furnace slag cement which has C<sub>3</sub>A content below 3 percent can be used.
- c) High alumina cement (as per IS 6452) mortar lining is suitable for continuous use of pH between 4 and 12 and no severe damage occur after occasional exposure to pH 3 to 4 and 12 to 13.
- d) The recommended type of cement used for lining are as given in Table 14.

## B-1.2 Sand

The sand used shall have a controlled granulometric distribution from fine to coarser elements; it shall be clean and shall be composed of inert, hard, strong and

stable granular particles.

The fine fraction comprising particles passing through a sieve of aperture size 0, 125 mm shall not be more than 10 percent by mass.

The fraction comprising grains up to a maximum diameter equal to one-third of the normal thickness of the mortar lining shall not be less than 50 percent by mass.

The coarsest fraction (comprising particles which do not pass through a sieve of the aperture size closest to half the normal thickness of the mortar lining) shall not exceed 5 percent by mass.

## B-1.3 Water

The water used for the preparation of the mortar shall not contain substances deleterious to the mortar nor to the water it is eventually intended to transport in the pipe. The presence of solid mineral particles is, however, admissible provided that these requirements are still fulfilled.

## B-1.4 Mortar

The mortar of the lining shall be composed of cement, sand and water.

Additives, which shall be specified, may be used, provided that they do not prejudice the quality of the coating and that of the transported water.

The mortar shall be thoroughly mixed and shall have a consistency which results in a dense and homogeneous lining.

The mortar shall contain by mass at least one part of cement to 3.5 parts of sand.

## B-2 CONDITION OF THE INTERIOR SURFACE OF THE PIPE BEFORE APPLICATION OF THE LINING

All foreign bodies, loose scale or any other material

Table 14 Recommended Type of Cement Used for Lining  
(Clause B-1.1)

Water Characteristics	Portland Cement	Sulphate Resisting Cements (Including Blast-Furnace Slag Cements)	High Alumina Cement
(1)	(2)	(3)	(4)
i) Minimum value of pH	6	5.5	4
ii) Maximum content (mg/l) of:			
Aggressive CO <sub>2</sub>	7	15	No limit
Sulphates (SO <sub>4</sub> <sup>-</sup> )	400	3 000	No limit
Magnesium (Mg <sup>++</sup> )	100	500	No limit
Ammonium (NH <sub>4</sub> <sup>+</sup> )	30	30	No limit

which could be detrimental to good contact between the metal and the lining shall be removed from the surface to which the lining is to be applied.

The inner surface of pipe shall also be free of any metal projections likely to protrude beyond 50 percent the thickness of the lining.

### B-3 APPLICATION OF THE LINING

The cement mortar lining at works is applied by a centrifugal spinning process or a centrifuged sprinkler or a combination of both methods.

Apart from the inner surface of the joint, the parts of the pipe coming into contact with the transported water shall be entirely covered with mortar.

Once centrifuging is finished, the lining shall be cured at temperatures greater than 4°C. Any loss of water from the mortar by evaporation shall be sufficiently slow so that hardening is not impeded.

### B-4 REPAIR OF LINING

Repairs to damaged or defective areas are allowable. The damaged mortar shall first be removed from these areas. Then the defective part shall be repaired by using, for example, a trowel with fresh mortar so that a continuous lining having a constant thickness is again obtained.

For the repair operation, the mortar shall have a suitable consistency, if necessary, additives may be included to obtain good adhesion against the side of the existing undamaged mortar.

### B-5 THICKNESS OF THE LINING

The normal thickness of the lining and the minimum permissible mean and local values are given in the Table 15.

At the pipe ends, the lining may be reduced to values below the minimum thickness. The length of the chamfer shall be as small as possible but, in any case, shall be less than 50 mm.

### B-6 DETERMINATION OF LINING THICKNESS

The thickness of the lining is checked on the freshly centrifuged mortar by the insertion of a steel pin, or on the hardened mortar by means of a non-destructive method of measurement. The thickness of the lining shall be measured at both ends of the pipe in at least one section perpendicular to the pipe axis.

### B-7 SURFACE CONDITION OF THE HARDENED LINING

The surface of the cement mortar lining shall be uniformly smooth. Only isolated grains of sand are allowed to appear on the surface of the lining.

The lining shall be such that it cannot be dislodged with pressure of hand and shall be free from corrugations or ridges that could reduce the thickness of the lining to less than the minimum value at one point, as specified in the Table 16.

**Table 15 Thickness of the Lining**  
(Clause B-5)

All dimensions in millimetres.

DN	Thickness		Maximum Crack Width / Radial Displacement
	Nominal Value	Tolerance	
(1)	(2)	(3)	(4)
80 to 300	3.0	-1.5	0/8
350 to 600	5.0	-2	1/0
700 to 1 200	6.0	-2.5	1/2
1 400 to 2 000	9.0	-3	1/5

NOTE — Fitting ends may have a chamfer of maximum length 50 mm.

**Table 16 Minimum Bore Clearance Cement Mortar Lining of Ductile Iron Pipe**  
(Clause B-7)

DN	Minimum Bore of Cement Mortar Lined Pipe (mm)
(1)	(2)
80	67.0
100	87.0
150	137.0
200	187.0
250	237.0
300	287.0

NOTE — For other DN the minimum bore should not be less than 15 mm from nominal dia.

On contraction of the lining, the formation of cracks cannot be avoided. These cracks, together with other isolated cracks which may result from manufacture or may develop during transportation, are acceptable up to a width given in the above.

### B-8 SEAL-COAT

#### B-8.1 General

When specified the cement lining shall be given a seal-coat of bituminous material or any other epoxy based material compatible with cement mortar lining. Other seal-coat materials may be used, but they shall be agreed on at the time of purchase and shall be specified on the purchase order.

The purpose of seal-coat is to minimize lime leaching of the cement mortar as well as to restrict the unwanted rise in pH value of the transmitted water.

When the pipes are to be used for conveying potable water the inside coating shall not contain any constituent soluble in such water or any ingredient which could impart any taste or whatsoever to the potable water after sterilization and suitable washing of the mains.

## ANNEX C

(Clause 16.2)

## BITUMINOUS COATING

## C-1 GENERAL

Unless otherwise agreed between the purchaser and manufacturer, all pipes shall be coated externally and internally with the same material. (Bituminous coatings are either hot applied or cold applied.)

## C-2 GENERAL CHARACTERISTICS

**C-2.1** Coating shall not be applied to any pipe unless its surfaces are clean, dry and free from rust.

**C-2.2** Unless otherwise agreed between the purchaser and the manufacturer all pipes shall be coated externally and internally with the same material. The method of coating shall be as per usual practice of the manufacturer. The coating material shall set rapidly with good adherence and shall not scale off.

The mean thickness of the coating shall be not less than 70  $\mu\text{m}$  and the local.

Minimum thickness shall be not less than 50  $\mu\text{m}$ .

**C-2.3** Where the coating material has a bitumen base, it shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 65°C but not so brittle at a temperature of 0°C as to chip off when scribed with a penknife.

**C-2.4** When the pipes are to be used for conveying potable water the inside coating shall not contain any constituent soluble in such water or any ingredient which could impart any taste or whatsoever to the potable water after sterilization and suitable washing of the mains.

**C-2.5** Pipes with or without sockets and flanges which are imperfectly coated or where the coating does not set or conform to the required quality, the coating shall be removed and the pipes/flanges recoated.

## ANNEX D

(Clause 16.2.1)

## POLYETHYLENE SLEEVING

## D-1 MATERIAL

## D-1.1 Characteristics

The material used for making the film is polyethylene or a mixture of polyethylenes and/or ethylene and olefin copolymers.

Its density shall be between 910 and 930  $\text{kg/m}^3$ .

## D-1.2 Additives and Impurities

If protection against ultra-violet rays is required, the material shall be stabilized by the addition of an appropriate product: if carbon black is used for this purpose the addition shall be in the range of 2 to 3 percent by mass.

## D-2 DIMENSION

## D-2.1 Width

The nominal flat width of the tube or flat or flat sheet is specified in Table 17.

## D-2.2 Thickness

The nominal thickness of the sleeving shall be not less than 200  $\mu\text{m}$  and not more than 250  $\mu\text{m}$  unless otherwise agreed.

**Table 17 Layflat Width of Tubular Polyethylene Film for Various Sizes of Iron Pipe**  
(Clause D-2.1)

Nominal Internal Diameter of Pipe in mm	For Use with Pipeline Incorporating Flexible Joints
80	350
100	350
150	450
200	550
250	650
300	700
350	800
400	1 100
450	1 100
500	1 350
600	1 350
700	1 750
750	1 750
800	1 750
900	2 000
1 000	2 000
1 100	2 500
1 200	2 500
1 400	2 750
1 500	2 750
1 600	3 100
1 800	3 600
2 000	4 000

NOTE — Actual layflat width of the tubular film shall not differ from the nominal by more than  $\pm 2.5$  percent.

The negative tolerance on the nominal thickness shall not exceed 10 percent.

If necessary, it is permitted to use thicker sleeving or double sleeving.

### D-3 MECHANICAL PROPERTIES

Tensile strength of the film in the longitudinal and transverse direction shall be not less than 8.3 MPa.

### D-4 ELONGATION

The elongation at fracture of the film in the longitudinal and transverse directions shall be not less than 300 percent.

### D-5 DIELECTRIC STRENGTH

The dielectric strength of the film should be 31.5 V/ $\mu\text{m}$  minimum.

## ANNEX E

(Table 1)

### HYDROSTATIC SITE TEST PRESSURES AND HYDRAULIC WORKING PRESSURE

E-1 Suggested maximum hydrostatic site test pressure and maximum hydraulic working pressure (exclusive of surge and inclusive of surge) may be followed as under:

DN (mm)	K9			K10		
	Allowable Operating Pressure (Excluding Surge) AOP	Allowable Maximum Operating Pressure (Including Surge) MOP	Allowable Site Test Pressure (STP)	Allowable Operating Pressure (Excluding Surge) AOP	Allowable Maximum Operating Pressure (Including Surge) MOP	Allowable Site Test Pressure (STP)
	MPa	MPa	MPa	MPa	MPa	MPa
80	6.4	7.7	9.6	6.4	7.7	9.6
100	6.4	7.7	9.6	6.4	7.7	9.6
125	6.4	7.7	9.6	6.4	7.7	9.6
150	6.4	7.7	9.6	6.4	7.7	9.6
200	6.2	7.4	7.9	6.4	7.7	9.6
250	5.4	6.5	7.0	6.1	7.3	7.8
300	4.9	5.9	6.4	5.6	6.7	7.2
350	4.5	5.4	5.9	5.1	6.1	6.6
400	4.2	5.1	5.6	4.8	5.8	6.3
450	4.0	4.8	5.3	4.5	5.4	5.9
500	3.8	4.6	5.1	4.4	5.3	5.8
600	3.6	4.3	4.8	4.1	4.9	5.4
700	3.4	4.1	4.6	3.8	4.6	5.1
750	3.3	3.9	4.4	3.7	4.4	4.9
800	3.2	3.8	4.3	3.6	4.3	4.8
900	3.1	3.7	4.2	3.5	4.2	4.7
1 000	3.0	3.6	4.1	3.4	4.1	4.6
1 100	2.9	3.5	4.0	3.2	3.8	4.3
1 200	2.8	3.4	3.9	3.2	3.8	4.3
1400	2.8	3.3	3.8	3.1	3.7	4.2
1 500	2.7	3.2	3.7	3.0	3.6	4.1
1 600	2.7	3.2	3.7	3.0	3.6	4.1
1 800	2.6	3.1	3.6	3.0	3.6	4.1
2 000	2.6	3.1	3.6	2.9	3.5	4.0



*(Continued from second cover)*

ISO/DIS 10803 : 1997(E)	Design method for ductile iron pipes
ISO/DIS 10804:Part-1/1994	Restrained joint system for ductile iron pipelines: Part 1 Design rule and type testing
EN 545 : 1994	Ductile iron pipes, fittings accessories and their joints for water pipelines.
EN 598 : 1995	Ductile iron pipes, fittings, accessories and their joints for sewerage applications
EN 969 : 1996	Ductile iron pipes, fittings, accessories and their joints for gas pipeline

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, 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.

## Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

### Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

### Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc : No. MTD 6 (4227).

### Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

### BUREAU OF INDIAN STANDARDS

#### Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002  
Telephones : 323 01 31, 323 33 75, 323 94 02

Telegrams : Manaksanstha  
(Common to all offices)

#### Regional Offices :

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	{ 323 76 17 323 38 41
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi CALCUTTA 700 054	{ 337 84 99, 337 85 61 337 86 26, 337 91 20
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160 022	{ 60 38 43 60 20 25
Southern : C. I. T. Campus, IV Cross Road, CHENNAI 600 113	{ 235 02 16, 235 04 42 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	{ 832 92 95, 832 78 58 832 78 91, 832 78 92
Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM.	

**AMENDMENT NO. 1 SEPTEMBER 2001**  
**TO**  
**IS 8329 : 2000 CENTRIFUGALLY CAST (SPUN)**  
**DUCTILE IRON PRESSURE PIPES FOR WATER, GAS**  
**AND SEWAGE — SPECIFICATION**

*( Third Revision )*

*( Page 3, clause 4.4 )* — Delete.

*( Page 3, clause 6.1.2 )* — Substitute the following for the existing clause:

**‘6.1.2 For high pressure mains where working pressure is substantial, depending on site condition, suitable flexible joint may be preferred where the joint is restrained against axial movement.’**

*( Page 4, clause 7.2, lines 14 and 15 )* — Substitute the following for the existing:

**‘all the requirements of clauses 10 and 11.’**

*( Page 5, clause 10.1.6, Note 2 )* — Substitute the following for the existing:

**‘2 For ductile iron pipes up to DN 1 000, if the microstructure reveals 75 percent ferrite with spheroidal graphite and percentage elongation higher than or equal to 7, it shall be taken as meeting the requirement of this standard when the tensile strength of the specimen is within the specified limit.’**

*( Page 6, clause 11.1.1, line 1 )* — Insert ‘minimum’ before ‘Hydrostatic test’.

*( Page 6, clause 11.2 )* — Substitute the following for the existing clause:

**‘11.2 Test shall be carried out before the application of surface coating and lining except zinc coating, which may be applied before the hydrostatic test.’**

*( Page 6, clause 12.2 )* — Substitute the following for the existing clause:

**‘12.2 The critical external diameter of spigot of pipes for push-on flexible joint and mechanical joint for all classes are given in Table 2 for reasons of safety and interchangeability.’**

( Pages 8, 9, 10 and 11, Tables 3, 4, 5 and 6 ) — Delete the existing column 'a'. Title 'b' of the column may be read as 'a'. The letter 'b' in the sketch may be omitted.

( Page 12, clause 15.4 ) — Substitute the following for the existing:

The tolerance on wall thickness (e) and flange thickness (b) of the pipes shall be as follows:

<i>Sl No.</i>	<i>Dimension</i>	<i>Tolerance, mm</i>
i)	Wall thickness (e) up to 6 mm	-1.3
ii)	Wall thickness (e) above 6 mm	$-(1.3 + 0.001 DN)^1$
iii)	Flange thickness (b)	$\pm (2 + 0.05b)$

<sup>1</sup>The tolerance given is subject to minimum thickness against all classes given in 4.3. No limit for the plus tolerance is specified.'

( Page 12, clause 15.4 ) — Insert a new clause after 15.4:

**15.4.1** Pipe wall thickness compliance shall be demonstrated by the manufacturer, he may use combination of various means such as:

- Direct wall thickness measuring or gauging by suitable requirements such as mechanical or ultrasonic equipment.
- The frequency of testing is related to the system of production and quality control used by manufacturer.

( Page 13, clause 16.1 ) — Substitute the following for the existing:

**16.1** Unless otherwise agreed between the manufacturer and the purchaser, all pipes shall be delivered with an external bituminous coating in accordance with provisions of Annex C.'

( Page 13, clause 16.2, line 8 ) — Delete the sentence 'Bituminous paint : as included in Annex C'.

( Page 17, Table 15, col 4 ) — Substitute the following for the existing values:

'0.8, 1.0, 1.2 and 1.5' respectively.

(Page 19, Annex E) — Substitute the following for the existing:

**ANNEX E**  
(Table 1)

**HYDROSTATIC SITE TEST PRESSURES AND  
HYDRAULIC WORKING PRESSURE**

DN (mm)	Allowable Operating Pressure (excluding surge) AOP				Allowable Maximum Operating Pressure (including surge) MOP				Allowable Site Test Pressure (STP)			
	K7	K8	K9	K10	K7	K8	K9	K10	K7	K8	K9	K10
MPa				MPa				MPa				
80	0.8	6.4	6.4	6.4	1.25	7.7	7.7	7.7	1.75	9.6	9.6	9.6
100	0.8	6.4	6.4	6.4	1.25	7.7	7.7	7.7	1.75	9.6	9.6	9.6
125	0.8	6.4	6.4	6.4	1.25	7.7	7.7	7.7	1.75	9.6	9.6	9.6
150	0.8	6.4	6.4	6.4	1.25	7.7	7.7	7.7	1.75	9.6	9.6	9.6
200	0.8	1.0	6.2	6.4	1.25	1.5	7.4	7.7	1.75	2.0	7.9	9.6
250	0.8	1.0	5.4	6.1	1.25	1.5	6.5	7.3	1.75	2.0	7.0	7.8
300	0.8	1.0	4.9	5.6	1.25	1.5	5.9	6.7	1.75	2.0	6.4	7.2
350	0.8	1.0	4.5	5.1	1.25	1.5	5.4	6.1	1.75	2.0	5.9	6.6
400	0.8	1.0	4.2	4.8	1.25	1.5	5.1	5.8	1.75	2.0	5.6	6.3
450	0.8	1.0	4.0	4.5	1.25	1.5	4.8	5.4	1.75	2.0	5.3	5.9
500	0.8	1.0	3.8	4.4	1.25	1.5	4.6	5.3	1.75	2.0	5.1	5.8
600	0.8	1.0	3.6	4.1	1.25	1.5	4.3	4.9	1.75	2.0	4.8	5.4
700	0.8	1.0	3.4	3.8	1.25	1.5	4.1	4.6	1.75	2.0	4.6	5.1
750	0.8	1.0	3.3	3.7	1.25	1.5	3.9	4.4	1.75	2.0	4.4	4.9
800	1.0	1.0	3.2	3.6	1.5	1.5	3.8	4.3	2.0	2.0	4.3	4.8
900	1.0	1.0	3.1	3.5	1.5	1.5	3.7	4.2	2.0	2.0	4.2	4.7
1 000	1.0	1.0	3.0	3.4	1.5	1.5	3.6	4.1	2.0	2.0	4.1	4.6
1 100	2.9	2.9	2.9	3.2	3.5	3.5	3.5	3.8	4.0	4.0	4.0	4.3
1 200	2.8	2.8	2.8	3.2	3.4	3.4	3.4	3.8	3.9	3.9	3.9	4.3
1 400	2.8	2.8	2.8	3.1	3.3	3.3	3.3	3.7	3.8	3.8	3.8	4.2
1 600	2.7	2.7	2.7	3.0	3.2	3.2	3.2	3.6	3.7	3.7	3.7	4.1
1 800	2.6	2.6	2.6	3.0	3.1	3.1	3.1	3.6	3.6	3.6	3.6	4.1
2 000	2.6	2.6	2.6	2.9	3.1	3.1	3.1	3.5	3.6	3.6	3.6	4.0

(MTD 6)

**AMENDMENT NO. 2 NOVEMBER 2012  
TO  
IS 8329 : 2000 CENTRIFUGALLY CAST (SPUN)  
DUCTILE IRON PRESSURE PIPES FOR WATER,  
GAS AND SEWAGE — SPECIFICATION**

*( Third Revision )*

*(Page 8, Table 3, Nominal Diameter DN 1100, Number of holes) —  
Substitute '32' for '28'.*

(MTD 6)

---

Reprography Unit, BIS, New Delhi, India