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कंकरीट आस्तर और लेपन वाले इस्पात सिलिन्डर—
विशिष्ट

(पहला पुनरीक्षण)

Indian Standard

STEEL CYLINDER PIPES WITH CONCRETE
LINING AND COATING — SPECIFICATION

(*First Revision*)

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on 24 November 1989, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

Ordinary reinforced concrete pipes being unsuitable for use in situations where relatively high water pressures are met with, other types of pipes, such as prestressed concrete pipes, steel pipes, cast iron pipes and asbestos cement pressure pipes, etc, are often used in such situations. One such type is the steel cylinder pipe with concrete lining and coating and these pipes have the advantage that they provide the required rigidity even when thin shells are used to form the steel cylinder.

Steel cylinder pipes with concrete lining and coating are used in water mains and, to a limited extent, in the pressure sewer lines and irrigation works. When used for carrying highly acidic sewage or industrial waste, necessary precautions should be taken to prevent exposure of steel cylinder to the action of the sewage or industrial waste. When the pipes are likely to be in contact with corrosive soil, proper precautions should be taken, such as coating with bitumen on the outside, using richer mix and/or using sulphate resistant mixes.

This standard covers the technical provisions relating to steel cylinder pipes with concrete lining and coating. Specials for steel cylinder pipes with concrete lining and coating are covered in IS 7322 : 1985.

This standard was first published in 1963 with the title 'Steel cylinder reinforced concrete pipes'. The present revision has been done with a view to modifying some of the requirements in the light of experience gained in the use of this standard. This revision incorporates a number of technical changes, the most important of them are as follows:

- a) Inclusion of pipes of internal diameter 800, 1 000, 1 300, 1 500 and 1 700 mm and extending the internal diameter of pipes up to 3 000 mm;
- b) Modification in recommendations regarding reinforcement cage;
- c) Modification of ends of pipes for jointing;
- d) Modification in the thickness of lining, coating and barrel thickness;
- e) Deletion of pressure steam curing; and
- f) Splitting of the standard into three distinct sections as follows:

Section 1 General

Section 2 Steel cylinder

Section 3 Lining and coating

In this revision the title of the standard has been modified since such pipes are basically steel cylinder pipes on which lining and coating of concrete is done for better performance and rigidity.

The composition of the committee responsible for the formulation of this standard is given in Annex B.

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.

Indian Standard

STEEL CYLINDER PIPES WITH CONCRETE LINING AND COATING — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard lays down the requirements for steel cylinder pipes with concrete lining and coating having nominal internal diameter from 200 mm to 3 000 mm for use in water mains, sewers, irrigation works and similar situations.

NOTES

1 Such pipes shall generally be provided with:

- a) plain ends
 - 1) for butt welded joints with collar upto 700 mm dia, and
 - 2) for simple butt welded jointing above 800 mm dia.
- b) flanged ends; and
- c) Spigot and socket ends (conforming to relevant Indian Standard) for joints with rubber rings.

2 Pipes having other type of ends may be used, where specifically required.

2 REFERENCES

2.1 The Indian Standards listed in Annex A are necessary adjuncts to this standard.

SECTION 1 GENERAL

3 CLASSIFICATION

3.1 For the purpose of this standard, steel cylinder pipes with concrete lining and coating shall be classified as under:

Class	Test Pressure
Class 1	0.5 Mpa (or 50 m head)
Class 2	1.0 Mpa (or 100 m head)
Class 3	1.5 Mpa (or 150 m head)
Class 4	2.0 Mpa (or 200 m head)
Class 5	2.5 Mpa (or 250 m head)
Special class	Above 2.5 Mpa (or above 250 m head), the exact test pressure being specified by the purchaser

NOTE — As a general guide the corresponding working pressure for these pipes may be taken as 50 percent and 67 percent of the above values for pumping mains and gravity mains, respectively.

4 DIMENSIONS

4.1 Diameter

The internal diameter of finished pipes shall be 200, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 300, 1 400, 1 500, 1 600, 1 700, 1 800, 1 900, 2 000, 2 100, 2 200, 2 300, 2 400, 2 500, 2 600, 2 700, 2 800, 2 900 and 3 000 mm.

4.1.1 Tolerance on internal diameter shall be ± 3 mm for pipes of diameter 300 mm and under, and ± 6 mm or $\pm 1\frac{1}{2}$ percent of internal diameter, whichever is less, for pipes of diameter exceeding 300 mm.

4.2 Length

The length in which the pipes are to be supplied shall be mutually agreed to between the purchaser and manufacturer. However, the recommended length is 6 m. The overall length of the pipe shall not vary by more than ± 1 percent of the agreed length, unless otherwise agreed to between the purchaser and the manufacturer.

5 WORKMANSHIP AND FINISH

5.1 The pipes with lining and coating shall be straight and free from cracks, except craze cracks. 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.

5.1.1 The lining and coating of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between the purchaser and the manufacturer. The lining and coating shall be free from excessive laitance and surface irregularities. Projections exceeding 3 mm measured from the general surface of the lining shall be removed either by trowelling before the lining has set, or by grinding after curing of the lining.

5.1.2 In case of coating applied under pressure by rotary brushes or by guniting the surface may not have smooth finish.

5.2 Defects

Defects shall be deemed to include voids, sand and clay pockets, blisters, areas that are thin or drummy or excessively cracked or not in contact with the surface of the pipe and cracks into which a flat metal filler gauge 0.8 mm thick can be inserted to a depth of half the thickness of lining and coating at intervals along the crack not exceeding 75 mm. Superficial cracks shall be deemed not to be defects.

5.2.1 Repair of Defects

Defects shall be repaired as soon as practicable. Unless otherwise specified, defects shall be repaired to the full thickness by hand trowelling.

NOTE — Other methods of repair are subject to agreement between the purchaser and the manufacturer.

6 MARKING

6.1 The following information shall be clearly marked on the each pipe:

- a) Size of pipe,
- b) Class of pipe,
- c) Date of manufacture, and
- d) Indication of the source of manufacture.

SECTION 2 STEEL CYLINDER

7 MATERIALS

7.1 The steel cylinder shall be manufactured from steel plates conforming either to IS 226 : 1975 or to IS 2062 : 1984. Stiffening bands and flats, where used, shall also conform either to IS 226 : 1975 or to IS 2062 : 1984. Where the thickness of the steel plate, the stiffening band or flat exceeds 20 mm, only steel conforming to IS 2062 : 1984 shall be used.

7.2 Electrodes for Welding

The electrodes used for welding of steel plates shall conform to IS 814 (Part 2) : 1974.

8 DESIGN

8.1 General

Steel cylinder shall be designed such that the maximum tensile stress in steel under the specified hydrostatic test pressure does not exceed 200 Mpa, assuming that no tension is taken up by the concrete.

8.2 The thickness of the plate used for steel cylinder shall be not less than the thickness specified in Table 1.

Table 1 Minimum Thickness of Plates for Steel Cylinders

(Clause 8.2)

Internal Diameter of Finished Pipe (see also 4.1) mm	Minimum Thickness of Plate mm
200 to 450	3.0
500 to 900	5.0
1 000 to 1 100	6.0
1 200 to 1 500	8.0
1 600 to 1 800	10.0
1 900 to 2 200	12.0
2 300 to 2 600	14.0
2 700 to 3 000	16.0

9 MANUFACTURE

9.1 The steel cylinder shall be formed by shaping and welding together steel plates of specified thickness. Either lap welding or butt welding shall be adopted for all longitudinal and circumferential welds. All welds shall be made down-hand by the manual welding or automatic shielded arc welding process. Welding shall be done so that there shall be thorough fusion and complete penetration. Prior to welding, the plates shall be fitted closely and during welding they shall be held firmly. For guidance on metal arc welding, reference may be made to IS 816 : 1969.

9.2 The ends of the steel cylinder shall be square with its longitudinal axis.

10 HYDROSTATIC TEST

10.1 Each steel cylinder shall be subjected, before concreting, to hydrostatic test under a water pressure equivalent to the test pressure given in 3.1. The steel cylinder shall be kept under pressure by pumping water for a period of not less than one minute, and while under pressure, the cylinder shall be moderately hammered with a 1 kg hammer throughout its length. The steel cylinder shall withstand the pressure test without showing any leakage. Cylinders which show leakage may be rewelded at the points of leakage and subjected to a repeat hydrostatic test and may be accepted if it does not show any leakage.

SECTION 3 LINING AND COATING

11 MATERIALS

11.1 Reinforcement

All cage reinforcement used in the pipe shall conform to IS 432 (Part 1) : 1982 or IS 432 (Part 2) : 1982.

11.2 Cement

The cement for concrete or mortar used in the lining and coating of steel cylinder pipes shall conform to IS 269 : 1989 or IS 455 : 1989 or IS 1489 : 1976 or IS 8041 : 1990 or IS 8043 : 1978 or IS 8112 : 1989 or IS 6909 : 1990 or IS 6452 : 1989 or IS 12269 : 1987 or IS 12330 : 1988.

11.3 Aggregates

The aggregates used shall conform to IS 383 : 1970. The maximum size of aggregate shall be one-third the thickness of concrete covering the steel cylinder either outside or inside.

11.4 Concrete and Mortar

The concrete mix shall have a minimum cement content of 450 kg/m³ and a characteristic compressive strength of 25 N/mm² at 28 days. If mortar is used, it shall have a minimum cement content of 600 kg/m³ and a characteristic compressive strength of 25 N/mm² at 28 days.

NOTES

1 Compressive strength test of concrete shall be conducted on 150 mm cubes in accordance with IS 516 : 1959 and compressive strength test of mortar shall be conducted on 70.6 mm cubes in accordance with IS 4031 (Part 5) : 1988.

2 The water-cement ratio shall be the least that will produce a workable mix. No limit has been set for the water-cement ratio because the optimum ratio depends on the mix proportions, the diameter of the pipe to be lined and coated, and the method of applying concrete or mortar to the pipe.

12 THICKNESS AND COVER

12.1 Lining and Coating Thickness

The minimum thickness of lining and coating shall be as given in Table 2.

Table 2 Minimum Thickness of Lining and Coating

Internal Diameter of Finished Pipe mm	Minimum Thickness of Lining mm	Minimum Thickness of Coating mm
200 to 300	15	25
350 to 400	20	25
450 to 3 000	25	25

12.2 Cover

The clear cover to the reinforcement whether steel cylinder or cage shall not be less than 9 mm for lining and 12 mm for coating.

13 MANUFACTURE

13.1 Cage Reinforcement

Minimum reinforcement in the coating shall be three percent of the quantity of steel cylinder of minimum plate thickness given in Table 1. The reinforcement shall be wire, wound spirally or wire fabric. The coating shall be applied before any rusting occurs to the reinforcement. Longitudinal reinforcement is required in case coating is done by vibration.

13.1.1 Wire

Anchoring of ends and splices in the wire shall be by welding or by other suitable means. The wire reinforcement may be given a tension of 50 to 75 Mpa while wrapping on the shell before the coating is applied.

13.1.2 Wire Fabric

Splices shall be made by welding or other suitable means. The fabric shall be wrapped on the shell by tack welding.

13.2 Mixing of Concrete or Mortar

The concrete or mortar for lining and coating shall be mixed in mechanical mixers. Mixing shall be continued until there is a uniform 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 two minutes.

13.3 Lining and Coating

Lining shall always be done at the manufacturer's works. Whilst coating shall be done later either at the manufacturer's works or at site.

13.3.1 Lining shall be done by spinning or spinning combined with vibrations or vibrations.

13.3.2 Preparation of Steel Surface

At the time of application of the concrete or mortar, the surface of the pipe shall be clean. Loose rust, loose millscale, dirt, debris, oil, grease and other detrimental materials shall be removed by manual, mechanical or chemical means. If chemicals deleterious to steel or cement are used to clean the steel surface, such chemicals shall be removed at the completion of cleaning process.

13.3.3 Coating shall not commence before the expiry of three days after the completion of the lining unless otherwise it is established that the lining has attained a works cube strength of not less than 10 Mpa earlier than this period. During this entire period the lining shall be under curing. The coating shall be either vibrated or

applied under pressure by rotary brushes or guniting.

13.3.4 In case any portion of the pipe is to be left exposed without lining and coating, the same shall be mutually agreed to between the purchaser and the manufacturer.

NOTE— After field welding of the joint, the exposed portions of adjacent pipes shall be protected by placing wire fabric with tack welds and applying cement mortar by hand.

3.4 Curing

After completion of concreting, the concrete or mortar shall be kept wet by any suitable means

such as immersion in water, covering by wet gunny bags or by mechanical sprinklers for a period of not less than 14 days when cement conforming to IS 269 : 1989, IS 455 : 1989, IS 1489 : 1976, IS 8043 : 1978 and IS 6909 : 1990 is used; not less than 7 days when cement conforming to IS 8041 : 1990 and IS 8112 : 1989 is used; not less than 3 days when cement conforming to IS 6452 : 1989 and IS 12269 : 1989 is used and not less than 21 days when cement conforming to IS 12330 : 1988 is used.

13.4.1 Steam Curing

Non-pressure steam curing may be permitted provided the requirements of non-pressure steam curing are fulfilled.

ANNEX A
(Clause 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
226 : 1975	Specification for structural steel (standard quality) (<i>fifth revision</i>)	816 : 1969	Code of practice for use of metal arc welding for general construction in mild steel (<i>first revision</i>)
269 : 1989	Specification for 33 grade ordinary Portland cement (<i>fourth revision</i>)	1489 : 1976	Specification for Portland Pozzolana cement (<i>second revision</i>)
383 : 1970	Specification for coarse and fine aggregates from natural sources for concrete (<i>second revision</i>)	2062 : 1984	Specification for weldable structural steel (<i>third revision</i>)
432 (Part 1) : 1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement : Part 1 Mild steel and medium tensile steel bars (<i>third revision</i>)	4031 (Part 6) : 1988	Methods of physical tests for hydraulic cement : Part 6 Determination of compressive strength of hydraulic cement (other than masonry cement) (<i>first revision</i>)
432 (Part 2) : 1982	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement : Part 2 Hard-drawn steel wire (<i>third revision</i>)	6452 : 1989	Specification for high alumina cement for structural use (<i>first revision</i>)
455 : 1989	Specification for Portland slag cement (<i>fourth revision</i>)	6909 : 1990	Specification for supersulphated cement (<i>first revision</i>)
516 : 1959	Method of test for strength of concrete	8041 : 1990	Specification for rapid hardening Portland cement (<i>second revision</i>)
814 (Part 2) : 1974	Specification for covered electrodes for metal arc welding of structural steels: Part 2 Welding sheets (<i>fourth revision</i>)	8043 : 1978	Specification for hydrophobic Portland cement (<i>first revision</i>)
		8112 : 1989	Specification for 43 grade ordinary Portland cement (<i>first revision</i>)
		12269 : 1987	Specification for 53 grade ordinary Portland cement
		12330 : 1988	Specification for sulphate resisting Portland cement

ANNEX B

(Foreword)

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