

भारतीय मानक
पानी, गैस और मल-जल के लिए विद्युत वेल्डित इस्पात
पाइप (168.3 से 2 032 मि.मी. सांकेतिक साइज) — विशिष्ट
(दूसरा पुनरीक्षण)

Indian Standard

SEAMLESS OR ELECTRICALLY WELDED
STEEL PIPES FOR WATER, GAS AND
SEWAGE (168.3 TO 2 032 mm OUTSIDE
DIAMETER) — SPECIFICATION

(Second Revision)

UDC 621.643.2 [669.14 - 462.3] : 628.1/3

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

June 1991

Price Group 3

Deputy Director

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Tubes, Pipes and Fittings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1966 and has been revised in 1981. While reviewing this Indian Standard in the light of the experience gained during these years, the committee has felt to revise the same, taking note of the present practices being followed in the country and also overseas standards existing on the subject. In the revision of this Indian Standard the following main modifications have been made:

- a) Requirements for seamless tubes have been included;
- b) Nominal size has been deleted and only outside diameter has been retained;
- c) One more grade has been added and grade designation have been modified along with requirements for chemical composition and mechanical properties;
- d) Product analysis requirements have been added; and
- e) Requirements for condition of supply and flattening test have been modified.

In the formulation of this standard due weightage has been given to international coordination among the standard prevailing in different countries in addition to the practices in the country. This has been met by deriving assistance from the following publications:

ISO 559 : 1977	Welded or seamless steel tubes for water, sewage and gas. International Organization for Standardization.
BS 534 : 1981	Steel pipes, and specials for water, and sewage. British Standards Institution.
BS 3601 : 1974	Steel pipes and tubes for pressure purposes : carbon steel : with specified room temperature properties. British Standards Institution.
API Specification 5 L — 1988	Specification for line pipe. American Petroleum Institute.

This standard contains clauses 3.3, 4.1, 6.1, 8.3, 9.1.1, 12.3 and 16.2 which call for agreement between the purchaser and the manufacturer.

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.

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Indian Standard

SEAMLESS OR ELECTRICALLY WELDED STEEL PIPES FOR WATER, GAS AND SEWAGE (168.3 TO 2 032 mm OUTSIDE DIAMETER) — SPECIFICATION

(Second Revision)

1 SCOPE

This standard applies to seamless or electric fusion welded, electric resistance welded and induction welded carbon steel pipes for water, gas and sewage of outside diameter from 168.3 to 2 032 mm and having joints with plain or bevelled ends for butt welding or sleeve welded joints (swelled and plain end).

1.1 This standard does not cover steel pipes with screwed joints and requirements for specials, such as collars, tees and bends, etc.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	Title
228 :	Methods of chemical analysis of steels (issued in various parts)
1894 : 1972	Methods for tensile testing of steel tubes (<i>first revision</i>)
2328 : 1985	Method for flattening test on metallic tubes (<i>first revision</i>)
3803 : 1974	Method for elongation conversions for steel (<i>first revision</i>)
4711 : 1974	Method for sampling of steel pipes, tubes and fittings (<i>first revision</i>)
4736 : 1986	Hot-dip zinc coatings on mild steel tubes (<i>first revision</i>)
9595 : 1980	Recommendations for metal arc welding of carbon and carbon manganese steels

3 TERMINOLOGY

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

3.1 Effective Length

The term 'effective length' denotes the actual length that a pipe contributes when assembled in a run of piping.

3.2 Exact Length

The term 'exact length' denotes pipes cut to specific length on which only a small tolerance is allowed.

3.3 Random Length

The term 'random length' denotes the normal manufacturing lengths falling within a range agreed to between the purchaser and the manufacturer.

3.4 Tube (Pipe)

A long hollow, open-ended object of circular or other cross section. The term 'tube' is synonymous with the term pipe.

4 DESIGNATION

4.1 The pipes shall be designated by the method of manufacture followed by the number corresponding to the minimum specified tensile strength in MPa.

Example:

EFW — Fe 410 indicates electric fusion (arc) welded steel pipe having a minimum tensile strength of 410 MPa

5 QUALITY OF STEEL

5.1 Pipes shall be manufactured from steel produced by the open hearth or electric or one of the basic oxygen processes. Other processes may be used by agreement between the purchaser and the manufacturer.

6 MANUFACTURE OF THE PRODUCT

6.1 Seamless

It is manufactured by hot working steel or if necessary by subsequently cold finishing to produce the desired shape, dimensions and properties.

6.2 Electrically Welded Tube

Pipe shall be made from steel plates or strips by butt welding longitudinally or spirally. The weld shall be continuous. Prior to welding, edges of plates or strips may be prepared suitably where required by the process of manufacture.

6.2.1 For outside diameter of 813 mm or above maximum of 2 longitudinal welds is permissible in the case of EFW pipes.

6.2.2 Whenever agreed to between the manufacturer and the purchaser, a maximum of two circumferential welds is permissible for tubes outside diameter 406.4 mm and above to make a random length provided all other requirements of the specification are complied with. This is valid for welded tube.

6.3 Any of the following processes shall be employed for manufacture of pipes.

<i>Seamless</i>	<i>Method of Manufacture</i>	<i>Reference</i>
Hot Finished		H.F.S.
<i>Welded</i>		
a)	Electric Resistance Welded and Induction welded	ERW
b)	Electric Fusion (Arc) welded	EFW
i)	Automatic submerged arc welded	
ii)	Automatic metal arc welded with covered electrodes	
iii)	Automatic metal arc welded with bare electrode and CO ₂ .	
iv)	Manual metal arc welding (This method shall be permissible only by agreement between the purchaser and the manufacturer, provided all other requirements of this specification are met). Where the manual arc welding is adopted. The method shall be in accordance with IS 9595 : 1980.	

7 CHEMICAL COMPOSITION

7.1 Ladle Analysis

The ladle analysis of steel shall be as given in Table 1. The analysis of steel shall be carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical method. In case of dispute the procedure given in IS 228 and its relevant parts, shall be the referee method. However, where the method is not given in IS 228 and its relevant parts, the referee method shall be agreed to between the purchaser and the manufacturer.

Table 1 Chemical Composition
(Clause 7.1)

Steel Grade	Chemical Composition (Ladle Analysis)		
	C	P	S
	Max	Max	Max
Fe 330	0.17	0.055	0.055
Fe 410	0.25	0.055	0.055
Fe 450	0.30	0.050	0.050

In case of non-availability of ladle analysis, the finished product may be checked to verify the chemical composition, if so agreed to by the producer.

7.2 Product Analysis

The product analysis shall be carried out on the finished products. The permissible variation in the case of such product analysis from the limits specified shall be as given below:

<i>Element</i>	<i>Permissible Deviation on Products Analysis, Percent</i>
Carbon	+ 0.02
Sulphur	+ 0.005
Phosphorous	+ 0.005

8 TENSILE STRENGTH

8.1 The tensile properties of strip cut longitudinally (excluding the weld) from selected pipes, shall show the following properties (see Table 2).

Table 2 Mechanical Properties

Steel Grade	Tensile Strength MPa, Min	Percentage Elongation $5.65\sqrt{S_0}$ Min
Fe 330	330	20
Fe 410	410	18
Fe 450	450	12

S₀ — Original cross sectional area of the specimen.

9 LENGTH

9.1 Random Length

Steel tubes shall be supplied in single random lengths from 4 to 7 metres or double random lengths of 7 to 14 metres. For orders over 200 metres, of any one size of tube, it shall be permissible to supply short random lengths from 2 to 4 metres provided the total of such lengths does not exceed 7.5 percent of the total lengths.

9.2 Where length is specified as 'exact' or 'cut lengths' the permissible variation shall be ± 10 mm for length up to and including 6 m. For every 3 m increase in length above 6 m, the plus tolerances shall be increased, by 2 mm with maximum of 20 mm.

9.3 Supply in any length and the tolerances other than the above specified shall be mutually agreed to between the manufacturer and the purchaser.

10 OUTSIDE DIAMETERS

10.1 Outside diameters of the finished pipes shall be as given below:

Outside Diameter (mm)	Outside Diameter (mm)
168.3	864.0
193.7	914.0
219.1	965.0
244.5	1 016.0
273.1	1 067.0
323.9	1 118.0
355.6	1 168.0
406.4	1 219.0
457.0	1 321.0
508.0	1 422.0
559.0	1 524.0
610.0	1 626.0
660.0	1 727.0
711.0	1 829.0
762.0	2 032.0
813.0	

10.1.1 Pipes of outside diameter other than those covered in 10.1 shall be permissible as agreed to between the manufacturer and the purchaser.

11 TOLERANCES

11.1 Outside Diameter

Pipe Body — The tolerance on the pipe body shall be as shown below:

Outside Diameter mm	Tolerance	
	Welded Pipe	Seamless Pipe
Up to 508	± 0.75 percent	± 1 Percent
Over 508	± 1 percent	± 1.5 percent

11.2 Wall Thickness

The tolerance on specified wall thickness shall be as follows:

ERW Pipe	± 10 percent
EFW Pipe and	+ 20 percent
Seamless Pipe	— 12.5 percent

11.3 Straightness

Finished pipe shall not deviate from straightness by more than 0.2 percent of the total length.

11.3.1 Checking shall be carried out using a taut string or wire from end to end, along the side of the pipe to measure, the greatest deviation.

12 WALL THICKNESS

12.1 The specified wall thickness of the pipes shall be agreed to between the manufacturer and the purchaser but shall not be less than the values given in Table 3.

Table 3 Minimum Specified Thickness of Pipes

Minimum Specified Thickness of Pipes Outside Dia	Minimum Specified Thickness of Pipes
168.3 to 406.6 mm	4 mm
Above 406.6 to 559.0 mm	5 mm
Above 559.0 to 914.0 mm	6 mm
Above 914.0 to 1 219.0 mm	7 mm
Above 1 219.0 to 1 620.0 mm	8 mm
Above 1 620.0 to 2 032.0 mm	10 mm

13 HYDRAULIC PRESSURE TEST

Each tube shall be hydraulically tested at the manufacturer's works, before the pipe is coated, wrapped or lined at the manufacturer's works.

13.1 The hydraulic test pressure shall be the pressure calculated from the following formula, except that the maximum test pressure shall not exceed 5 MPa:

$$P = \frac{2 St}{D}$$

where

P = test pressure in MPa,

S = stress in MPa which shall be taken as 40 percent of the specified minimum tensile strength,

t = specified thickness in mm,

D = specified outside diameter in mm.

13.2 Test pressure shall be applied and maintained for sufficiently long time for proof and inspection.

NOTE — Normally 5 seconds are sufficient for the purpose of the test.

13.3 NDT test may be carried out in place of hydraulic pressure test. Method of NDT and the acceptance level shall be as agreed to between the manufacturer and the purchaser.

14 CONDITION OF SUPPLY

14.1 Any type of protective coating may be applied as agreed to between the manufacturer and the purchaser.

14.2 Where tubes are required to be galvanized the zinc coating on the tubes shall be in accordance with IS 4736 : 1986.

14.3 Unless otherwise agreed to between the purchaser and the supplier, the pipe shall be supplied without any protective coating.

15 JOINTS AND ENDS

The type of joints and ends of pipes shall be specified by the purchaser. The types of joints and ends recognized under this standard are:

- Plain ends or bevelled ends for butt welding (see Fig. 1A and 1B) unless otherwise agreed, bevelled ends shall be bevelled to an angle of $30^{\circ} \pm 5^{\circ}$ measured from a line drawn perpendicular to the axis of the pipe. The root face shall be 1.6 ± 0.8 mm.
- Joints with sleeve joint or swelled and plain ends for welding (see Fig. 2).

NOTE — The root face of the bevel may be prepared by hand fitting, if required.

Depth of Sleeve, X (for Welded Tubes)

Dimension	Outside Diameter of Pipe	Tolerance
mm	mm	mm
50	168.3 up to 406.4	± 6
60	457.0 up to 1 219.0	± 6
75	1 321 up to 2 032.0	± 6
Clearance Y, between the plain ends, Max	168.3 up to 1 219.0	4
	1 321.0 up to 2 032.0	6

15.1 Pipes with sleeve welded joints shall be supplied with the plain and parallel end and sleeve end tapered to approximately 3 mm per 100 mm. The ends shall be sized and gauged so as to ensure that the plain end will freely enter the sleeve and thereafter be capable of being forced home.

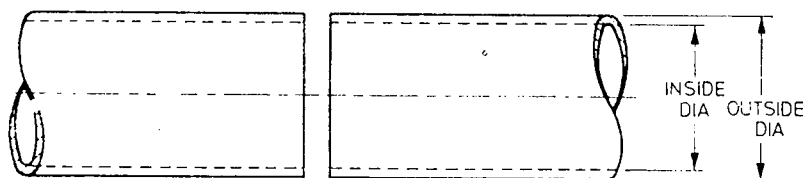
15.2 All sleeves shall be made so that the plain end shall enter the specified minimum depth given in 14(b). The manufacturer shall make available for inspection at the works metal gauges of suitable dimensions to enable the purchaser or his representative to ascertain that the sleeve and plain end comply with the requirements of the specification.

16 MECHANICAL TEST

16.1 Tensile Test

Tensile test shall be carried out as in IS 1894 : 1972. The tensile strength and percentage elongation of pipes shall not be less than the values specified in Table 2. The percentage elongation shall be determined on a gauge length of $5.65\sqrt{S_0}$. If other gauge lengths are used, conversion shall be made as in IS 3803 : 1974.

NOTE — For welded tubes the strip tensile test specimen shall not contain the weld.



1A Plain Ends for Butt Welding



1B Bevelled Ends for Butt Welded Joints

FIG. 1 TYPES OF ENDS

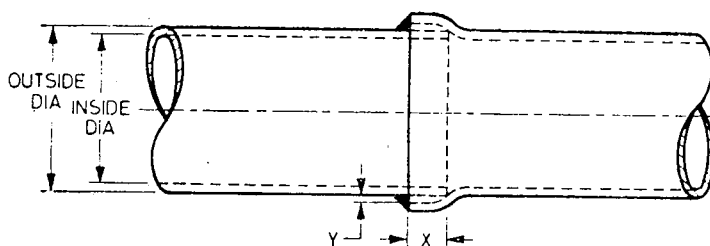


FIG. 2 SLEEVE JOINT OR SWELLED AND PLAIN END FOR WELDING

Deputy Director

16.2 Flattening Test

16.2.1 For ERW Pipes

A ring less than 40 mm in length taken from the end of each selected tube shall be flattened between parallel plates as follows:

The test shall be made keeping the weld at 90° to the direction of the force. No opening shall occur by fracture in the weld until the distance between the plates is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks on the metal elsewhere than in the weld shall occur until the distance between the plates is less than 60 percent of the original outside diameter.

16.2.2 For Seamless Pipes

This test shall be carried out in accordance with IS 2328 : 1985. A ring, not less than 40 mm long, cut from one end of each selected pipe shall when cold be flattened between two parallel flat surfaces without showing either crack or flaw, until when the pressure is released, the interior surfaces of the test piece remain at the middle of a distance apart not greater than 10 t , in the case of Fe 450 and 8 t in the case of Fe 330 and Fe 410.

NOTES

1 If any flaw appears during flattening test, it may be removed by grinding or filing. In such cases if the remaining wall thickness is not less than the minimum permitted thickness as per clause 10.2 the sample shall be accepted.

2 Superficial ruptures resulting from surface imperfections shall not be a cause of rejection.

16.3 Guided Bend Test (For EFW Pipes)

Strips 40 mm wide, cut circumferentially from pipes or from coupon plates attached to and welded with the pipes, with the weld near the middle of the sample shall, without fracture, be doubled over a round bar the diameter of which

shall be calculated as given below. The weld reinforcement shall be removed from the faces.

16.3.1 One face bend and one root bend specimen, both conforming to Fig. 3 shall be bent approximately 180° in a jig substantially in accordance with Fig. 4 for any combination of diameter, wall thickness and grade. The maximum value for jig dimensions A may be calculated by the formula given below. The manufacturer shall use a jig based on this dimension or a smaller dimension at his option.

$$A = \frac{1.15 (D - 2t)}{\frac{eD}{t} - 2e - 1}$$

where

1.15 = peaking factor,

D = specified OD in mm,

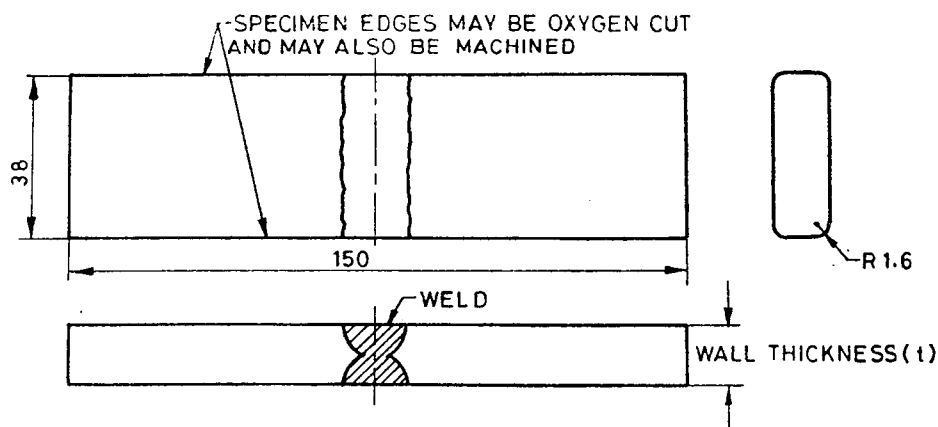
t = specified wall thickness in mm, and

e = strain in mm

= 0.132 5 for Grade 320

= 0.127 5 for Grade 410.

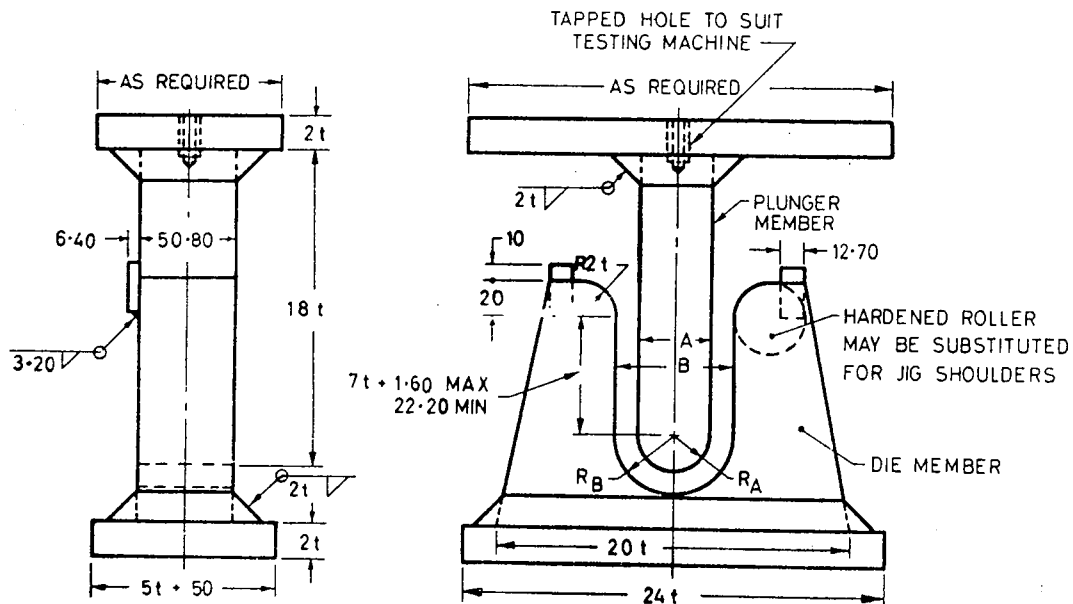
16.3.2 The specimens shall not fracture completely. Cracks 6.35 mm or less in length at the edge of the specimen or 3.18 mm or less in length in the centre of the specimen shall be disregarded. Any crack greater than 3.18 mm in length and regardless of depth located within the weld metal is a cause for rejection. Any pop-out greater than 3.18 mm in length (6.35 mm at the edge) and 12.5 percent or less of the specified wall thickness in depth and located in the parent metal, the heat affected zone, or the fusion line, shall not be the cause for rejection. If the fracture or crack in the specimen is caused by a defect or flaw, that specimen may be discarded and a new specimen substituted from the same pipe.



Weld reinforcement shall be removed from both faces.

All dimensions in millimetres.

FIG. 3 GUIDED-BEND TEST SPECIMEN FOR ELECTRIC FUSION WELDED PIPES



$$R_A = \frac{A}{2}, B = 4 + 2t + 3.2 \text{ mm, and } R_B = \frac{B}{2}$$

All dimensions in millimetres.

FIG. 4 JIG FOR GUIDED BEND TEST

16.3.3 On examination of the bent specimen, opening out of a slight defect due to incomplete root penetration or lack of root fusion need not be considered a cause for rejection provided the defect has sound metal at the back and on either side of it. In border line cases, further tests shall be made on specimens from the same weld adjacent to the original test specimen.

17 WORKMANSHIP

17.1 All pipes shall be cleanly finished and when visually inspected, shall be free from defects such as cracks, surface flaws, laminations, etc. The ends shall be cleanly cut and reasonably square with the axis of the pipe.

17.2 The repair of defects shall be permissible in the weld seam of EFW pipes. However, the repair of welded seam of ERW pipes may be carried out by agreement between the manufacturer and the purchaser.

18 MARKING

18.1 Each pipe shall be legibly marked with the following details:

- Manufacturer's name or trade-mark;
- Outside diameter (see 9) and specified wall thickness (see 11.1); and
- Pipe designation (see 4).

Example:

For a pipe manufactured under trade name ABC, having 508 mm outside diameter, 6 mm specified wall thickness conforming to ERW 330 grade shall be legibly marked as follows:

DABC — 508.0 — 6 — ERW 330

18.2 The pipes may also be marked with the Standard Mark. Details are available from the Bureau of Indian Standards.

19 SAMPLING OF PIPES

19.1 Unless otherwise agreed between the manufacturer and the purchaser, the sampling of pipes shall be as in IS 4711 : 1974.

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Director

**AMENDMENT NO. 1 AUGUST 1993
TO
IS 3589 : 1991 SEAMLESS OR ELECTRICALLY
WELDED STEEL PIPES FOR WATER, GAS AND
SEWAGE (168.3 TO 2 032 mm OUTSIDE DIAMETER) —
SPECIFICATION**

(*Second Revision*)

(*Foreword, para 4*) — Substitute the following para for the existing:

‘This standard contains clauses 3.3, 5.1, 6.2.2, 6.3 (iv), 7.1, 10.1.1, 13.3, 14.1, 14.3, 17.2, 19.1 which call for agreement between purchaser and the manufacturers.’

(*Page 2, clause 6.2.1*) — Add a new para after this clause:

‘Subject to mutual agreement between the manufacturer and purchaser, 3 longitudinal welds may be permitted in pipes having O.D 1 600 mm and above.’

(MTD 19)

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