भारतीय मानक

इस्पात नलिकाएँ संरचनात्मक उपयोगों के लिये — विशिष्टि

(चौथा पुनरीक्षण)

Indian Standard

STEEL TUBES FOR STRUCTURAL PURPOSES — SPECIFICATION

(*Fourth Revision*)

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ICS 77.140.75 ; 91.220

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

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Price Group 3

FOREWORD

This Indian Standard (Fourth 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 1958 and its first, second and third revisions were issued in 1963, 1968 and 1979 respectively. While reviewing the standard, the Committee has felt it necessary to revise this Indian Standard with the following modifications:

a) Thickness and mass is aligned with IS 1239 (Part 1) : 1990.

b) All amendments have been incorporated.

In the formulation of this standard, due consideration has been given to the trade practices followed in the country in this field. Due consideration has also been given to international co-ordination among the standards prevailing in different countries. Assistance has been derived from the following publications:

ISO/R 336 : 1976 Plain end steel tubes, welded or seamless; general table of dimensions and masses per unit length. International Organization for Standardization.

BS 6323 : 1982 Steel tubes for mechanical and general engineering purposes. British Standards Institution.

This standard contains clauses **8.1** and **12.1** 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.

Indian Standard

STEEL TUBES FOR STRUCTURAL PURPOSES — SPECIFICATION

(Fourth Revision)

1 SCOPE

This standard covers the requirements for hot finished welded (HFW), hot finished seamless (HFS), and electric resistance welded (ERW) or high frequency induction welded (HRIW) plain carbon steel tubes for structural purposes.

2 REFERENCES

The Indian Standards listed below are the necessary adjuncts to this standard:

IS No.	*Title*
228 : 1983	Method of chemical analysis of steel (in various parts)
1239 (Part 1) : 1990	Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fifth revision*)
1387 : 1993	General requirements for the supply of metallurgical material (*second revision*)
1608 : 1995	Mechanical testing of metals — Tensile testing
2328 : 1983	Method for flattening test on metallic tubes (*first revision*)
2329 : 1985	Method for bend test on metallic tubes (in full section) (*first revision*)
4711 : 1974	Methods for sampling of steel pipes, tubes and fittings (*first revision*)
4736 : 1986	Hot-dip zinc coatings on mild steel tubes (*first revision*)
4740 : 1979	Code of practice for packaging of steel tubes (*first revision*)
10748 : 1995	Hot-rolled steel strip for welded tubes and pipes (*first revision*)

3 DESIGNATION

3.1 Steel tubes covered by this standard shall be designated by their nominal bore and shall be calssified as 'Light', 'Medium' and 'Heavy' depending on the wall thickness (*see* Table 1). They shall be further graded as YSt 210, YSt 240 and YSt 310 depending on the yield stress of the material (*see* Table 2). The designation of the steel tubes shall, therefore, include the nominal bore of the tube, classification on wall thickness and grade of the material.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of the steel tubes for structural purposes shall conform to IS 1387.

5 MATERIAL

5.1 The tubes shall be manufactured from steel as given in Table 3 and shall be supplied in the conditions as shown therein.

6 DIMENSIONS AND WEIGHTS

6.1 The standard sizes and weights of tubes for structural purposes shall be as given in Table 1.

6.1.1 Some geometrical properties of the steel tubes are also given in Table 1 for information.

6.1.2 Tubes of thickness lower than light tubes, specified in Table 1 shall not be permissible.

6.2 Tolerances

The following tolerances shall apply:

a) *Outside Diameter*:

1) Up to and including 48.3 mm	+0.4 mm −0.8 mm
2) Over 48.3 mm	± 1.0 percent

b) *Thickness (for all sizes)*:

1) Welded tubes	+ Not limited − 10 percent
2) Seamless tubes	+ Not limited − 12.5 percent

c) *Weight*:

1) Single tube light	+ 10 percent − 8 percent

Table 1 Sizes and Properties of Steel Tubes for Structural Purposes

(*Clauses* 3.1, 6.1, 6.1.1 *and* 6.1.2)

Nominal Bore	Outside Diameter	Class	Thickness	Weight	Area of Cross Section	Internal Volume	Surface		Moment of Inertia	Modulus of Section	Radius of Gyration	Square of Radius of Gyration
							External	Internal				
mm	mm		mm	kg/m	cm^2	cm^3/m	cm^3/m	cm^3/m	cm^4	cm^3	cm	cm^2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
15	21.3	Light	2.0	0.947	1.21	235		543	0.57	0.54	0.69	0.47
		Medium	2.6	1.21	1.53	203	669	506	0.69	0.64	0.66	0.44
		Heavy	3.2	1.44	1.82	174		468	0.75	0.70	0.55	0.42
20	26.9	Light	2.3	1.38	1.78	390		700	1.36	1.01	0.87	0.76
		Medium	2.6	1.56	1.98	370	845	681	1.48	1.10	0.86	0.74
		Heavy	3.2	1.87	2.38	330		644	1.70	1.26	0.84	0.71
25	33.7	Light	2.6	1.98	2.54	638		895	3.09	1.83	1.10	1.21
		Medium	3.2	2.41	3.06	585	1 059	857	3.61	2.14	1.08	1.17
		Heavy	4.0	2.93	3.73	518		807	4.19	2.48	1.05	1.11
32	42.4	Light	2.6	2.54	3.25	1 086		1 168	6.47	3.05	1.41	1.98
		Medium	3.2	3.10	3.94	1 017	1 332	1 130	7.62	3.59	1.39	1.93
		Heavy	4.0	3.79	4.82	929		1 080	8.99	4.24	1.36	1.86
40	48.3	Light	2.9	3.23	4.13	1 418		1 335	10.70	4.43	1.61	2.59
		Medium	3.2	3.56	4.53	1 378	1 517	1 316	11.59	4.80	1.59	2.54
		Heavy	4.0	4.37	5.56	1 275		1 265	13.77	5.70	1.57	2.47
50	60.3	Light	2.9	4.08	5.23	2 332		1 711	21.59	7.16	2.03	4.13
		Medium	3.6	5.03	6.41	2 213		1 667	25.88	8.58	2.00	4.02
		Heavy	4.5	6.19	7.88	2 066		1 611	30.90	10.2	1.98	3.92
65	76.1	Light	3.2	5.71	7.32	3 814		2 189	48.79	12.82	2.58	6.66
		Medium	3.6	6.42	8.20	3 727	2 391	2 163	54.02	14.20	2.57	6.60
		Heavy	4.5	7.93	10.1	3 534		2 107	65.12	17.1	2.54	6.43
80	88.9	Light	3.2	6.72	8.61	5 343		2 591	79.23	17.82	3.03	9.19
		Medium	4.0	8.36	10.7	5 138	2 793	2 540	96.36	21.68	3.00	9.00
		Heavy	4.8	9.90	12.7	4 936		2 490	112.52	25.31	2.98	8.88
90	101.6	Light	3.6	8.70	11.1	6 995		2 964	133.27	26.23	3.47	12.03
		Medium	4.0	9.63	12.3	6 877	3 192	2 939	146.32	28.80	3.45	11.91
		Heavy	4.8	11.5	14.6	6 644		2 889	171.44	33.75	3.43	11.76

100	114.3	Light	3.6	9.75	12.5	9 004		3 363	192.03	33.60	3.92	15.36
		Medium	4.5	12.2	15.5	8 704	3 591	3 306	234.3	41.0	3.89	15.10
		Heavy	5.4	14.5	18.5	8 409		3 250	274.5	48.0	3.85	14.86
110	127.0	Light	4.5	13.6	17.3	10 930		3 705	325.3	51.2	4.33	18.78
		Medium	4.8	14.5	18.4	10 819	3 990	3 686	344.58	54.27	4.32	18.69
		Heavy	5.4	16.2	20.6	10 599		3 649	382.0	60.2	4.30	18.52
125	139.7	Light	4.5	15.0	19.1	13 410		4 104	437.2	62.6	4.78	22.87
		Medium	4.8	15.9	20.3	13 287	4 389	4 085	463.44	66.35	4.77	22.76
		Heavy	5.4	17.9	22.8	13 043		4 047	514.5	73.7	4.75	22.58
135	152.4	Light	4.5	16.4	20.9	16 142		4 503	572.2	75.1	5.23	27.37
		Medium	4.8	17.5	22.2	16 008	4 788	4 484	606.92	79.65	5.22	27.25
		Heavy	5.4	19.6	25.0	15 740		4 446	674.5	88.5	5.20	27.05
150	165.1	Light	4.5	17.8	22.7	19 128		4 902	732.6	88.7	5.68	32.27
		Medium	4.8	18.9	24.2	18 981	5 187	4 883	777.32	94.16	5.67	32.14
		Heavy	5.4	21.3	27.1	18 690		4 845	864.7	105.0	5.65	31.92
150	168.3	Light	4.5	18.2	23.1	19 921		5 002	777.2	92.4	5.79	33.56
		Medium	4.8	19.4	24.7	19 771	5 287	4 983	824.78	98.01	5.78	33.42
		Heavy 1	5.4	21.7	27.6	19 473		4 946	917.7	109.0	5.76	33.21
		Heavy 2	6.3	25.2	32.0	19 030		4 889	1 053	125.0	5.73	32.85
175	193.7	Light	4.8	22.4	28.5	26 606		5 781	1 271.71	131.31	6.68	44.63
		Medium	5.4	25.1	32.0	26 260	6 085	5 743	1 417	146	6.66	44.36
		Heavy	5.9	27.3	34.8	25 974		5 712	1 535.2	158.65	6.64	41.11
200	219.1	Light	4.8	25.4	32.3	34 454		6 578	1 856.51	169.47	7.58	57.45
		Medium	5.6	29.5	37.5	33 930	6 883	6 528	2 141	195	7.55	57.02
		Heavy	5.9	31.0	39.5	33 734		6 509	2 247	205	7.54	56.86
225	244.5	Heavy	5.9	34.7	44.2	42 507	7 681	7 307	3 149	258	8.44	71.21
250	273.0	Heavy	5.9	38.9	49.5	53 557	8 578	8 202	4 412	323	9.45	89.30
300	323.9	Heavy	6.3	49.3	62.8	76 073	10 177	9 775	7 992	493	11.2	125.44
350	355.6	Heavy	8.0	68.6	87.3	90 533	11 173	10 663	13 111	737	12.3	151.29

Medium, Heavy	± 10 percent
2) 10 tonne lots light	± 5 percent
Medium, Heavy	± 7.5 percent

NOTE — For 10 tonne lots, the weighment may be done in convenient smaller lots and added up at the option of the manufacturer.

7 WORKMANSHIP

7.1 The tubes shall be cleanly finished and reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut cleanly and square with the axis of tube, unless otherwise specified.

Surface imperfections such as handling marks, light die or roll marks, or shallow pits shall not be considered as defects provided the imperfections are removable within minimum wall thickness permitted. Removal of such surface imperfections is not required. Welded tubing shall be free of protruding metal on the outside surface of the weld seam.

8 GALVANIZING

8.1 If the tubes are required in galvanized condition the zinc coating on the tubes shall be conforming to the requirements and tested as per methods, specified in IS 4736.

9 STRAIGHTNESS

9.1 Unless otherwise agreed to between the purchaser and the manufacturer, tubes shall not deviate from straightness by more than 1 mm in any 600 mm length.

10 LENGTHS

10.1 The tubes shall normally be supplied in random lengths at 4 to 7 m. If ordered in exact lengths, the tolerances shall be subject to prior agreement between the manufacturer and the purchaser.

11 MECHANICAL TESTS

11.1 The following tests shall be carried out on the selected tube, strip or plate. For mechanical tests, tubes shall be sampled in accordance with IS 4711.

11.2 Tensile Test

The tensile strength, the yield stress and the percentage elongation shall be determined in accordance with the methods specified in IS 1608 and shall be not less than the values specified for the relevant grades of tubes given in Table 2.

11.2.1 The tensile test shall be made on:

a) a length cut from the end of the selected tube (the ends of the length being plugged for grips, where necessary); or

b) a longitudinal strip cut from the tube, not including the weld, if any, and tested in the curved condition, the choice resting with the manufacturer.

Table 2 Tensile Properties of Steel Tubes for Structural Purposes

(*Clauses* 3.1 *and* 11.2)

Grade	Tensile Strength (*Min*)	Yield Stress (*Min*)	Elongation on Gauge Length $5.65\sqrt{S_o}$, *Min*
	MPa	MPa	Percent
YSt 210	330	210	20
YSt 240	410	240	17
YSt 310	450	310	14

NOTES

1 1 MPa = $1 N/mm^2 = 0.102 kgf/mm^2$.

2 Elongation percent for tubes up to and including 25 mm nominal bore for all grades shall be 12 minimum.

Table 3 Steel and Supply Conditions

(*Clause* 5.1)

Sl No.	Manufacturing Process	Steel	Supply Conditions
i)	HFW	IS 10748	Only YSt 210 or YSt 240
ii)	HFS	Bars/ingots with suitable chemical composition as per IS 10748 to achieve mechanical properties for respective grades	YSt 210, YSt 240 or YSt 310
iii)	ERW/HRIW	IS 10748	YSt 210, YSt 240 or YSt 310 as welded, heat treated or cold drawn and normalized

NOTE — If required the copper bearing steel may be used to impart weather resistant properties in the steel. Copper content shall be between 0.20 to 0.35 percent subject to mutual agreement between the supplier and the purchaser.

11.3 Ductility Test

11.3.1 *Cold Bend Test (Up to and Including 50 mm NB)*

When tested in accordance with IS 2329 an unfilled length of tube shall be capable of being bent cold by tube bending machine around a grooved former (with radius at bottom of the groove equal to 6 × O. D. of the tube) through 180° (with weld at 90° to the plane of bending) without showing any crack at the weld or the metal.

11.3.2 *Flattening Test (Tubes Above 50 mm NB)*

Rings, not less than 40 mm in length cut from the ends of selected tubes with edges rounded shall be flattened between parallel plates with the weld, if any, at 90° (point of maximum bending) in accordance with IS 2328. No opening shall occur by fracture in the weld until the distance between the plates is less than the value specified for each grade in col 4 of Table 4 and no cracks or breaks in the metal elsewhere than in the weld shall occur until the distance between the plates is less than the value specified for each grade in col 5 of Table 4.

11.4 Retest

Should any one of the test pieces first selected fail to pass any of the tests specified, two further samples shall be selected for testing in respect of each failure from the same lot. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test samples shall be deemed as not complying with the standard or the manufacturer may select to test individually the remaining lengths in the lot for the test failed to comply in the preceding tests.

11.5 Sampling

11.5.1 *Sampling of Tubes*

For the purpose of drawing samples all mild steel tubes bearing same designation and manufactured under a single process shall be grouped together to constitute a lot. Each lot shall be sampled separately and assessed for conformity to this specification.

11.5.2 *Sampling and Criterion for Conformity*

Unless otherwise agreed to between the manufacturer and the purchaser the procedure for sampling of tubes for various tests and criteria for conformity shall be as given in IS 4711.

12 MARKING

12.1 Each tube shall be suitably marked with the manufacturer's name or trade-mark, and class of the tube.

12.1.1 The tubes may also be marked with the Standard Mark.

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

13 OILING AND PAINTING

13.1 All tubes shall, unless otherwise specified, be varnished, painted or oiled externally.

14 BUNDLING AND PACKING

14.1 Where tubes are to be bundled for transport, they shall unless otherwise specified, be packed in accordance with IS 4740.

Table 4 Flattening Requirement in Metal

(*Clause* 11.3.2)

Sl No.	Manufacturing Process Metal	Steel Grade	Weld (Distance Between the Plates)	Parent (Distance Between the Plates)
i)	HFW/HFS/ERW/HFIW	YSt 210	75 percent of O.D.[1)]	60 percent of O.D.
ii)	HFW/HFS/ERW/HFIW	YSt 240	85 percent of O.D.	75 percent of O.D.
iii)	FHS/ERW/HFIW	YSt 310	85 percent of O.D.	75 percent of O.D.

[1)] O.D. = Outside diameter.

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.

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 Handbook' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

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TO
IS 1161 : 1998 STEEL TUBES FOR STRUCTURAL PURPOSES — SPECIFICATION

(Fourth Revision)

(*Page* 5, *clause* **12.1**, *line* 2) — Insert 'grade of the steel' after the words 'trade-mark'.

(MTD 19)

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