
सामान्य सेवाओं के लिए स्टेनलेस इस्पात
वेल्डेड पाइप और ट्यूब — विशिष्टि

**Stainless Steel Welded Pipes and
Tubes for General Services —
Specification**

ICS 77.140.75, 23.040.10

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

Steel Tubes, Pipes and Fittings Sectional Committee, MTD 19

FOREWORD

This Indian Standard 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.

A large quantity of stainless steel welded pipes and tubes are manufactured in India for various applications. Given the diverse applications of stainless steel seamless pipes and tubes, coupled with corrosion resistance and desired mechanical properties at low as well as high temperatures, the committee decided to formulate a standard on seamless stainless steel pipes and tubes for general applications. Due to its unique combination of ductility, elasticity and hardness it finds application in various industries. Because the welded pipes and tubes can be produced easily as compared to seamless pipes and tubes and are less expensive, these pipes and tubes have wider applications. Apart from wide applications in oil and gas industry, it is used in various mechanical and engineering industries also.

There are many grades of Stainless Steel and corrosion and mechanical properties varies vastly from grade to grade and hence proper selection of the grade for a particular application is of utmost importance. Proper care should be taken while production, handling storage and fabrication of final product to retain the important properties of stainless steel pipes and tubes.

In the formulation of this standard, due weightage has been given to international co-ordination among the standards prevailing in different countries in addition to relating it to the practices in the field in this country. Assistance has been derived from the following:

ASTM A 268	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A 632	Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A 789	Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A 790	Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
ISO 1127	Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length
ISO 9330-6	Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Longitudinally welded austenitic stainless steel tubes

This standard contains clauses **8.1, 9.2, 11.1, 18.1** and **19** which call for an agreement between the manufacturer and the purchaser.

The Composition of the Committee and the Panel responsible for the formulation of this standard is given at Annex C.

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 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. 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

STAINLESS STEEL WELDED PIPES AND TUBES FOR GENERAL SERVICES — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements for welded stainless steel pipes and tubes for general services.

1.2 This standard does not specify requirements of welded stainless steel pipes and tubes intended for distinct purposes, which are covered by separate Indian Standards.

2 REFERENCES

The following 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

IS No.	Title
228 (various parts)	Methods of chemical analysis of steels
1387 : 1993	General requirements for the supply of metallurgical materials (<i>second revision</i>)
1500 (Part 1) : 2019/ ISO 6506-1 : 2014	Metallic materials — Brinell hardness test: Part 1 Test method (<i>fifth revision</i>)
1586 (Part 1) : 2018/ ISO 6508-1 : 2016	Metallic Materials — Rockwell hardness test: Part 1 Test method (<i>fifth revision</i>)
1608 (Part 1) : 2018/ ISO 6892-1 : 2016	Metallic Materials — Tensile Testing: Part 1 Method of Test at room temperature (<i>fourth revision</i>)
1956 (Part 8) : 1976	Glossary of terms related to iron and steel: Part 8 Steel tubes and pipes (<i>first revision</i>)
2328 : 2018/ ISO 8492 : 2013	Metallic materials — Tube — Flattening test (<i>third revision</i>)
2330 : 2018/ ISO 8494 : 2013	Metallic materials — Tube — Flanging test (<i>third revision</i>)

IS No.

Title

4748 : 2021/ ISO 643 : 2019	Steel — Micrographic determination of the apparent grain size (<i>third revision</i>)
8910 : 2010/ ISO 404 : 1992	General technical delivery requirements for steel and steel products (<i>first revision</i>)

3 TERMINOLOGY

Unless otherwise provided herein, the definitions as mentioned in IS 1956 (Part 8) shall apply.

3.1 Pipe — A long hollow cylinder of round cross section, ordered by specifying nominal bore and wall thickness.

3.2 Tube — A long hollow cylinder of round cross section ordered by specifying outside diameter (OD) and wall thickness.

4 TYPES AND GRADES

4.1 Types of the welded stainless steel pipes/tubes for general services are primarily classified on the basis of crystalline structure as austenitic, ferritic, martensitic, and duplex.

4.2 Stainless steel pipes/tubes are designated by the symbol WLD to indicate the process of manufacture as welded. In case of heavily cold worked pipes a symbol HCW is used.

5 SUPPLY OF MATERIAL

General requirements relating to the supply of the steel pipes/tubes shall conform to IS 8910.

6 ORDERING INFORMATION

Orders for pipes/tubes under this specification shall include the following to describe the desired material adequately:

- Pipe/tubes;
- Process {welded (WLD) or in case of pipe-heavily cold worked welded (HCW)};
- Quantity (mass or number);

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- d) Grade;
- e) Size (nominal bore and thickness or outside diameter and thickness);
- f) Length;
- g) Optional requirements; and
- h) No. of seams (for sizes above 355.6 mm OD).

7 MANUFACTURE

7.1 The pipes and tubes shall be manufactured by automated welding process without addition of filler metal during the welding process.

7.2 Austenitic stainless steel pipes can also be supplied in heavily cold-worked (HCW) condition by cold working to at least 35 percent reduction in thickness of both wall and weld prior to the final anneal.

7.3 Austenitic stainless steel welded pipe and HCW pipe larger than 355.6 mm OD can have either one longitudinal weld or shall be produced by forming and welding two longitudinal sections of flat stock when approved by the purchaser. All weld test, inspection, treatment shall be performed on each weld seam.

8 CHEMICAL COMPOSITION

8.1 Ladle Analysis

The ladle analysis of stainless steels 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. Incaseof dispute the procedure given in IS 228 and its relevant parts, shall be the referee method. However, in case the method isnot given in IS 228 and its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.

8.2 Product Analysis

Permissible variations in the case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

9 HEAT TREATMENT

9.1 All pipes/tubes shall be furnished in heat treated condition.

9.2 Accordingly, ferritic and martensitic stainless steels shall be supplied in heat treated condition, where the pipes/tubes are reheated to a temperature of 650 °C (temperature for grade 410S2 is 700 to 760 °C) and cooled as appropriate to meet the requirements of this specification.

9.3 Austenitic stainless steel pipes/tubes are to be supplied in solution annealed condition. The heat treatment procedure shall consist of reheating the material to the minimum temperature mentioned in Table 3, followed by quenching in water or rapidly cooled by other means as appropriate to meet the requirements of this specification.

9.3.1 In addition, pipes/tubes of certain grades of Austenitic Stainless Steels, such as 309H, 310H, 321, 321H, 347, 347H, 348 may be subjected to Stabilizing heat treatment subsequent to the solution annealing at a temperature as agreed to between the purchaser and the manufacturer, which is generally lower than the solution annealing temperature.

9.4 Duplex stainless steel pipes/tubes shall be supplied in the heat treatment condition as mentioned in Table 3.

10 MECHANICAL PROPERTIES

10.1 Tensile Requirements

Pipes and tubes shall confirm to the tensile properties prescribed in Table 4.

11 TRANSVERSE TENSION TEST

It is an optional test and shall be conductedIf required by the purchaser. For pipes of OD 219 mm and above transverse test may be done for 10 percent of the lengths supplied for all austenitic grades other than 310MoLN and 326. In such case the elongation shall be 25 percent minimum.

12 HARDNESS TEST

12.1 Pipes

Pipes of ferritic and duplex stainless steel shall conform to the requirements of hardness values on one of the scales (Rockwell or Brinell) prescribed in Table 5. The hardness test shall be carried out by IS 1500 (Part 1) or IS 1586 (Part 1), as applicable.

Table 1 Chemical Composition, Percent
(*Clauses 8.1 and 8.2*)

Sl No.	Grade Designation Letter Symbol [see IS 1762 (Part 1)]	Numerical Symbol ISS	C Max	Si Max	Mn Max	Ni Max	Cr	Mo	S Max	P Max	N Max	Cu Max	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
i)	Ferritic steels:												
1	X 04Cr12Al	405	0.08	1.00	1.00	0.60	11.5-14.5	—	0.030	0.040	—		Al 0.10-0.30
2	X 02Cr12	409 M	0.030	1.00	0.50-1.50	1.50	10.5-12.5	—	0.030	0.040	—		—
3	X02Cr12Ni1	410S2	0.04	1.00	1.00	0.60-1.10	10.5-12.5	—	0.030	0.045	0.100	—	—
4	X10Cr15	429	0.12	1.00	1.00	—	14.0-16.0	—	0.030	0.040	—	—	—
5	X 07Cr17	430	0.12	1.00	1.00	0.75	16.0-18.0	—	0.030	0.040	—		—
6	X02Cr17TiNb	430Ti	0.030	0.75	1.00	—	16.00-19.00	—	0.030	0.040	—	—	Ti or Nb 0.10-1.00
7	X 02Cr18Ti	439	0.030	1.00	1.00	0.50	17.0-19.0	—	0.030	0.040	0.030	—	Ti [0.2 + 4 (C + N)] Min —1.1 Max; Al 0.15 Max
8	X02Cr18TiNb	439Ti2	0.030	1.00	1.00	—	17.5-18.5	—	0.015	0.040	—	—	Ti (0.1-0.6) Nb [(0.3 + (3 x C)] Min
9	X10Cr20	442	0.200	1.00	1.00	0.60	18.0-23.0	—	0.040	0.040	—	—	—
10	X02Cr18Mo2TiNb	444	0.025	1.00	1.00	1	17.5-19.5	1.75-2.50	0.030	0.040	0.035	—	(Ti + Nb) [0.20 + 4 (C + N)] Min, 0.80 Max
11	X10Cr25	446S1	0.200	1.00	1.50	0.75	23.0-27.0	—	0.030	0.040	0.250	—	—
12	X03Cr26Mo1Ti	446S2	0.06	0.75	0.75	0.50	25.0-27.0	0.75-1.50	0.020	0.040	0.040	0.20	Ti 0.20-1.00; Ti 7 (C + N) Min
13	X01Cr26Mo1Nb	446S3	0.010	0.40	0.40	0.50	25.0-27.5	0.75-1.50	0.020	0.020	0.015 ^N	0.20	Nb0.05-0.20, (Ni + Cu) 0.50
ii)	Martensitic steels:												
1	X 12Cr12	410	0.08-0.15	1.00	1.00	0.75	11.5-13.5	—	0.030	0.040	—	—	—
iii)	Austenitic steels:												
1	X 10Cr17Mn6Ni4N20	201	0.15	1.00	5.5-7.5	3.5-5.5	16.0-18.0	—	0.030	0.060	0.250	—	—
2	X02Cr17Mn7Ni4N	201LN	0.030	0.75	6.40-7.50	4.0-5.0	16.0-17.5	—	0.015	0.045	0.10-0.25	1.00	—
3	X02Cr16Mn8Ni2N	204	0.030	1.00	7.00-9.00	1.50-3.00	15.0-17.0	—	0.030	0.040	0.15-0.30	—	—
4	X04Cr19Ni9	304	0.07	0.75	2.00	8.0-10.5	17.5-19.5	—	0.030	0.045	0.100	—	—
5	X 02Cr19Ni10	304 L	0.030	0.75	2.00	8.0-12.0	17.5-19.5	—	0.030	0.045	0.100	—	—

Table 1 (Continued)

Sl No.	Grade Designation Letter Symbol [see IS 1762 (Part 1)]	Numerical Symbol ISS	C Max	Si Max	Mn Max	Ni Max	Cr	Mo	S Max	P Max	N Max	Cu Max	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
6	X 07Cr19Ni9	304H	0.04-0.10	0.75	2.00	8.0-10.5	18.0-20.0	—	0.030	0.045	—	—	—
7	X 02Cr19Ni10N	304LN	0.030	0.75	2.00	8.0-12.0	18.00-20.00	—	0.030	0.045	0.10-0.16	—	—
8	X 04Cr19Ni9N	304N	0.08	0.75	2.00	8.0-10.5	18.0-20.0	—	0.030	0.045	0.10-0.16	—	—
9	X05Cr18Ni9Si1CeN	304Ce	0.04-0.06	1.00-2.00	0.80	9.0-10.0	18.0-19.0	—	0.030	0.045	0.12-0.18	—	Ce 0.03-0.08
10	X07Cr21Ni11Ce	308Ce	0.05-0.10	1.40-2.00	0.80	10.0-12.00	20.0-22.0	—	0.030	0.040	0.14-0.20	—	Ce 0.03-0.08
11	X 04Cr23Ni14	309 S	0.08	0.75	2.00	12.0-15.0	22.0-24.0	—	0.030	0.045	—	—	—
12	X05Cr23Ni13	309H	0.04-0.10	0.75	2.00	12.0-15.0	22.0-24.0	—	0.030	0.045	—	—	—
13	X05Cr23Ni13Nb	309Nb	0.08	0.75	2.00	12.0-16.0	22.0-24.0	—	0.030	0.045	—	—	Nb 10 × C Min, 1.10 Max
14	X07Cr23Ni13Nb	309HNb	0.04-0.10	0.75	2.00	12.0-16.0	22.0-24.0	—	0.030	0.045	—	—	Nb 10 × C Min, 1.10 Max
15	X 04Cr25Ni20	310 S	0.08	1.50	2.00	19.0-22.0	24.0-26.0	—	0.030	0.045	—	—	—
16	X07Cr25Ni20	310H	0.04-0.10	0.75	2.00	19.0-22.0	24.0-26.0	—	0.030	0.045	—	—	—
17	X05Cr25Ni20Nb	310Nb	0.08	1.50	2.00	19.0-22.0	24.0-26.0	—	0.030	0.045	—	—	Nb 10 × C Min, 1.10 Max
18	X07Cr25Ni20Nb	310HNb	0.04-0.10	0.75	2.00	19.0-22.0	24.0-26.0	—	0.030	0.045	—	—	Nb 10 × C Min, 1.10 Max
19	X01Cr25Ni21Mo2N	310MoLN	0.020	0.50	2.00	20.5-23.5	24.0-26.0	1.60-2.60	0.010	0.030	0.09-0.1	—	—
20	X02Cr20Ni18Mo6CuN	312	0.020	0.80	1.00	17.5-18.5	19.5-20.5	6.0-6.5	0.010	0.030	0.18-0.25	0.50-1.00	—
21	X 04Cr17Ni12Mo2	316	0.08	0.75	2.00	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	0.100	—	—
22	X 02Cr17Ni12Mo2	316 L	0.030	0.75	2.00	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	0.100	—	—
23	X 07Cr17Ni12Mo2	316 H	0.04-0.10	0.75	2.00	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	—	—	—
24	X 02Cr17Ni12Mo2N	316 LN	0.030	0.75	2.00	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	0.10-0.16	—	—
25	X 04Cr17Ni12Mo2Ti	316 Ti	0.08	0.75	2.00	10.0-14.0	16.0-18.0	2.0-3.0	0.030	0.045	0.100	—	Ti 5 × (C + N) Min — 0.70 Max
26	X05Cr17Ni12Mo2N	316N1	0.08	0.75	2.00	10.0-14.0	16.0-18.0	2.00-3.00	0.030	0.045	0.10-0.16	—	—
27	X02Cr20Ni9Mo1N	316N2	0.030	1.00	2.00	8.0-9.5	19.5-21.5	0.50-1.50	0.015	0.045	0.14-0.25	1	—
28	X 04Cr19Ni13Mo3	317	0.08	0.75	2.00	11.0-15.0	18.0-20.0	3.0-4.0	0.030	0.045	0.100	—	—
29	X 02Cr19Ni13Mo3	317L	0.030	0.75	2.00	11.0-15.0	18.0-20.0	3.0-4.0	0.030	0.045	0.100	—	—
30	X02Cr18Ni15Mo4Cu3N	317LCu	0.030	1.00	1.00	14.5-16.5	17.5-19.0	3.8-4.5	0.030	0.030	0.15-0.21	2.8-4.0	-

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Table 1 (Concluded)

Sl No.	Grade Designation Letter Symbol [see IS 1762 (Part 1)]	Numerical Symbol ISS	C Max	Si Max	Mn Max	Ni Max	Cr	Mo	S Max	P Max	N Max	Cu Max	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
31	X02Cr19Ni12Mo3N	317LN	0.030	0.75	2.00	11.0-15.0	18.0-20.0	3.0-4.0	0.030	0.045	0.10-0.22	-	-
32	X02Cr19Ni14Mo4	317LM	0.030	1.00	2.00	13.5-17.5	18.0-20.0	4.0-5.0	0.030	0.045	0.20	0.75	
33	X02Cr18Ni14Mo4N	317LMN	0.030	1.00	2.00	13.5-17.5	17.0-20.0	4.0-5.0	0.030	0.045	0.100-0.20	0.75	
34	X 04Cr18Ni10Ti	321	0.08	0.75	2.00	9.0-12.0	17.0-19.0	—	0.030	0.045	0.100		Ti $5 \times (C + N)$ Min — 0.70 Max
35	X07Cr18Ni10Ti	321H	0.04-0.10	0.75	2.00	9.0-12.0	17.0-19.0	—	0.030	0.045	—	—	Ti $4 \times (C + N)$ Min, 0.70 Max
36	X02Cr24Ni22Mo7N	326	0.020	0.50	2.00-4.00	21.0-23.0	24.0-25.0	7.0-8.0	0.005	0.030	0.45-0.55	0.30-0.60	-
37	X02Cr24Ni17Mo4Mn6N	345	0.030	1.00	5.00-7.00	16.0-18.0	23.0-25.0	4.0-5.0	0.010	0.030	0.40-0.60	—	Nb 0.10
38	X 04Cr18Ni10Nb	347	0.08	0.75	2.00	9.0-13.0	17.0-19.0	—	0.030	0.045	—		Nb $10 \times C - 1.00$ Max
39	X07Cr18Ni10Nb	347H	0.04-0.10	0.75	2.00	9.0-13.0	17.0-19.0	—	0.030	0.045	—	—	Nb $8 \times C$ Min, 1.00 Max
40	X01Cr18Ni10NbN	347LN	0.005-0.020	1.00	2.00	9.0-13.0	17.0-19.0	—	0.030	0.045	0.06-0.10	—	Nb 0.20-0.50' 15 × C Min
41	X05Cr18Ni10NbTa	348	0.08	0.75	2.00	9.0-13.0	17.0-19.0	—	0.030	0.045	—	—	(Nb + Ta) $10 \times C$ min, 1.00 Max, Ta 0.10, Co 0.20
42	X07Cr18Ni10NbTa	348H	0.04-0.10	0.75	2.00	9.0-13.0	17.0-19.0	—	0.030	0.045	—	—	(Nb + Ta) $8 \times C$ Min, 1.00 Max, Ta 0.10, Co 0.20
43	X02Cr21Ni25Cu	904L	0.020	1.00	2.00	23.0-28.0	19.0-23.0	4.00-5.00	0.035	0.045	0.100	1.00-2.00	-
44	X01Cr20Ni25Mo6Cu	904LN	0.020	0.50	2.00	24.0-26.0	19.0-21.0	6.00-7.00	0.010	0.030	0.15-0.25	0.50-1.50	-
iv) Duplex:													
1	X02Cr22Ni5Mo3N	1803	0.030	1.00	2.00	4.5-6.5	21.0-23.0	2.5-3.5	0.020	0.030	0.08-0.20	—	-
2	X02Cr21Mn5Ni2N	2101	0.040	1.00	4.00-6.00	1.35-1.70	21.0-22.0	0.10-0.80	0.030	0.040	0.20-0.25	0.10-0.80	-
3	X 02Cr22Ni6Mo3N	2205	0.030	1.00	2.00	4.5-6.5	22.0-23.0	3.0-3.5	0.020	0.030	0.14-0.20	—	-
4	X 02Cr23Ni4CuN	2304	0.030	1.00	2.50	3.0-5.5	21.5-24.5	0.05-0.60	0.030	0.040	0.05-0.20	0.05-0.60	-
5	X 02Cr25Ni7Mo4CuN	2507	0.030	0.80	1.20	6.0-8.0	24.0-26.0	3.0-5.0	0.020	0.035	0.24-0.32	0.50	-
6	X02Cr25Ni7Mo3CuWN	2760	0.030	1.00	1.00	6.0-8.0	24.0-26.0	3.0-4.0	0.010	0.030	0.20-0.30	0.50-1.00	W 0.50-1.00

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Table 2 Permissible Variation Between Specified Analysis and Product Analysis
(Clause 8.2)

Sl No.	Element	Limits of Ladle Analysis as Shown in Table 1, Percent		Permissible Deviation ¹⁾ , Percent, Max ± unless specified as +
		Over (3)	Upto and Including (4)	
(1)	(2)			(5)
i)	C	—	0.03	+ 0.005
		0.03	0.2	0.01
		0.2	0.6	0.02
		0.6	1.2	0.03
ii)	Si	—	1	0.05
		1	2.5	0.1
iii)	Mn	—	1	0.03
		1	3	0.04
		3	6	0.05
		6	10	0.06
iv)	Al	—	0.3	0.05
		10	15	+ 0.15
v)	Cr	15	20	0.2
		20	30	0.25
vi)	Mo	—	0.6	+ 0.03
		0.6	1.75	0.05
vii)	Ni	1.75	3	0.1
		—	1	+ 0.03
		1	5	0.07
		5	10	0.1
viii)	N	10	20	0.15
		20	30	0.2
ix)	Ti	—	0.02	0.005
		0.02	0.15	0.01
		0.15	0.35	0.02
x)	Nb	—	1	+ 0.05
xii)	P	—	1.2	+ 0.05
xiiii)	Ta	—	0.04	+ 0.005
Xiv	Cu	—	0.2	+ 0.03
xv)	V	0.04	0.2	0.01
		0.2	0.5	0.02
		—	0.04	+ 0.005
xvi)	W	—	0.1	0.01
		1	3	0.15
		3	4	0.15
xvii)	Nb	—	0.5	+ 0.03
		0.5	1.5	0.05
xviii)	P	—	0.5	+ 0.03
		0.5	1.5	0.05
xix)	Sn	—	1	+ 0.03
		1	2	0.05

NOTE — Tolerance shall be mutually as agreed to between the purchaser and the supplier for other alloying elements.

1) The use of '+' means that in one cast the deviation may occur over the upper value or under the lower value of the specified range in the table but not both at the same time.

Table 3 Recommended Heat Treatment
(*Clauses 9.3 and 9.4*)

Type	Grades	Heat treatment temp, °C
Duplex	1803,2205,	1020-1100
	2101	1020 Min.
	2304,	925-1050
	2507,	1025-1125
	2760	1100-1150
Austenitic	201, 201LN, 204, 304, 304L, 304H, 304Ce, 304N, 304LN, 309S, 309H, 309Nb, 309HNB, 310S, 310H, 310Nb, 310HNB, 310MoLN 316, 316L, 316H, 316Ti, 316N1, 316LN, 316N2, 317, 317L, 317LN, 321,347, 347LN, 348	1040 Min.
	317LCu	1060-1180
	308Ce	1050 Min.
	321H, 347H	1050-1150
	348H	1050-1100
	904L, 904LN	1100 Min.
	312, 326	1150 Min.
	345	1120-1170

Table 4 Tensile Requirements
(*Clause 10.1*)

Grade	Tensile Strength, Mpa, Min	Yield Strength, Mpa, Min	Percent Elongation, Min on a Gauge length of 50 mm
(1)	(2)	(3)	(4)
Ferritic and martensitic			
405	415	205	20
409	380	170	20
409M	450	280	18
410	415	205	20
410S2	485	350	18
415	795	620	15
429	415	240	20
430	415	240	20
430Ti	415	240	20
439	415	205	20
439Ti2	430	250	18
442	485	275	20
444	415	275	20
446S1	485	275	18
446S2	470	310	20
446S3	450	275	20
Duplex			
1803	620	450	25
2101 t > 5mm	650	450	30
2101 t ≤ 5mm	700	530	30

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Table 4 (Continued)

Grade	Tensile Strength, Mpa, Min	Yield Strength, Mpa, Min	Percent Elongation, Min on a Gauge length of 50 mm
(1)	(2)	(3)	(4)
2205	655	450	25
2304 OD <= 25 mm	690	450	25
2304 OD > 25 mm	600	400	25
2507	800	550	15
2760	750	550	25
<hr/>			
Austenitic			
204	635	330	35
304	515	205	35
304L	485	170	35
304H	515	205	35
304Ce	600	290	35
304N	550	240	35
304LN	515	205	35
308Ce	600	310	35
309S	515	205	35
309H	515	205	35
309Nb	515	205	35
309HNb	515	205	35
310S	515	205	35
310H	515	205	35
310Nb	515	205	35
310HNb	515	205	35
310MoLN, t ≤ 6.35 mm	580	270	25
310MoLN, t > 6.35 mm	540	255	25
312 t ≤ 5.00 mm	675	310	35
312 t > 5.00 mm	655	310	35
316	515	205	35
316L	485	170	35
316H	515	205	35
316Ti	515	205	35
316N1	550	240	35
316LN	515	205	35
317L	515	205	35
317LM	515	205	35
317LMN	550	240	35
321 - t ≤ 9.5mm	515	205	35
321 - t > 9.5mm	485	170	35
321H - t ≤ 4.8mm	515	205	35
321H - t > 4.8mm	480	170	35
326	750	430	25
345	795	415	35

Table 4 (Concluded)

Grade	Tensile Strength, Mpa, Min	Yield Strength, Mpa, Min	Percent Elongation, Min on a Gauge length of 50 mm
(1)	(2)	(3)	(4)
347	515	205	35
347H	515	205	35
347LN	515	205	35
348	515	205	35
348H	515	205	35
904L	490	215	35
904LN	650	295	35

Small Diameter tubes of austenitic grades of outside diameter from 3.2 mm to 12.7 mm and wall thickness from 0.4 mm to 1.65 mm

304	515	205	35
304L	485	170	35
310	515	205	35
316	515	205	35
316L	485	170	35
317	515	205	35
321	515	205	35
347	515	205	35
348	515	205	35

NOTES

1 For pipes of ferritic and martensitic stainless steel smaller than 12.7 mm in outside diameter, the elongation values applicable for strip specimen shall apply. For longitudinal strip tests, a deduction of 1 percent shall be made from the above-mentioned minimum elongation for each 0.8 mm decrease in wall thickness below 8 mm.

2 Tensile requirements do not apply to pipes of ferritic and martensitic stainless steel smaller than 3.2 mm in outside diameter or with walls thinner than 0.4 mm.

Table 5 Hardness Requirement for Pipes
(Clause 12.1)

Grade	Brinell Hardness, Max	Rockwell Hardness Max	HRC
(1)	(2)	(3)	
410S2	360		
1803	290	30	
2101	290	30	
2507	300	32	
2205	290	30	
2304	290	30	
2760	270	—	

12.2 Tubes

12.2.1 Tubes shall conform to the requirements of hardness values on one of the scales (Rockwell or Brinell) prescribed in Table 6. The hardness test shall be carried out by IS 1500 (Part 1) or IS 1586 (Part 1), as applicable.

12.2.2 Hardness test is not required for tubes smaller than 6.4 mm in outside diameter or having a wall thickness less than 0.51 mm. Such tubes shall be subjected to tensile test only.

Table 6 Hardness Requirement for Tubes
(Clause 12.2.1)

Grade	Brinell Hardness, Max	Rockwell Hardness, HRB, Max
(1)	(2)	(3)
405	207	95
409	207	95
409M	180	88
410	207	95
415	295	32 HRC
429	190	90
430	190	90
430Ti	190	90
439	190	90
439Ti2	180	88
443	207	95
444	217	95
446S1	207	95
446S2	241	100
446S3	241	100
1803	290	30 HRC
2205	290	30 HRC
2304	290	30 HRC
2507	310	32 HRC
2760	300	32 HRC

Grade	Brinell Hardness, Max	Rockwell Hardness, HRB, Max
(1)	(2)	(3)
201	220	96
201LN	250	100
304	192	90
304L	192	90
304LN	192	90
312	220	96
316	192	90
316L	192	90
316LN	192	90
316N2	192	90
317	192	90
317LM	192	90
317LMN	192	90
317LCu	192	90
321	192	90
326	250	100
345	265	100
347	192	90
348	192	90
904L	192	90
904LN	265	100

13 FLANGE TEST (FOR TUBES)

13.1 One test shall be carried out in accordance with IS 2330 on specimens from one end of one pipe/tube from each lot of finished pipe/tubes for sizes upto 150 mm in outside diameter. For tubes over 150 mm in outside diameter, or tubes with wall thickness 9.52 mm and over, the flattening test may be performed.

13.2 A section of tube shall be capable of having a flange turned over at 90 degree to the body of the tube without cracking. The width of flange shall not be less than the percentage specified in Table 7. For tubes of austenitic grades, the width for all sizes mentioned in Table 7 shall be not less than 15 percent.

Table 7 Flange Requirement

(Clause 13.2)

Outside Diameter mm	Width of Flange
Upto and including 63.4mm	15 percent of the specified OD
Over 63.4 and up to and including 96.2	12 percent of the specified OD
Over 96.2 and up to and including 203.2	10 percent of the specified OD

Small diameter tubes (tubes of outside diameter from 1.27 mm to 12.7 mm and wall thickness from 0.13 to 1.65 mm) need not undergo this test.

14 REVERSE FLATTENING TEST (FOR TUBES)

One reverse flattening test shall be made on a specimen from each 450 meters of finished tubing.

A section of 100 mm in length of finished welded tubing of outside diameter equal to or above 12.7 mm shall be split longitudinally 90 degree and each side of the weld and the sample opened and flattened with the weld at the point of maximum bend. There shall be no cracks or lack of penetration or overlap resulting from flash removal in the weld. There shall be no evidence of cracks or lack of penetration or overlaps resulting from flash removal in the weld.

15 FLATTENING TEST (FOR PIPES AND LARGE SIZE TUBES ONLY)

15.1 Flattening test shall be carried out in accordance with IS 2328 for sizes upto 600 mm and a thickness no greater than 15 percent of the outside diameter. A section of pipe/tube not less than 100 mm in length for welded pipes/tubes shall be flattened cold between parallel plates. The weld shall be placed 90 degree from the direction of the applied force. The pipes shall be capable of not showing crack or flaw during flattening, till the distance between the parallel plates H is less than specified, which is calculated as follows:

$$H = (1 + e)t/(e + t/D)$$

where

H = distance between flattening plates, in. [mm];

t = specified wall thickness, in. [mm];

D = specified outside diameter; and

e = deformation per unit length (constant for a given grade of steel, 0.09 for austenitic and duplex steel, 0.08 for ferritic and martensitic).

15.2 For the purpose of flattening test, tubes over 203 mm in outside diameter, or tubes with wall thickness 9.52 mm and over are termed as large size tubes.

16 GRAIN SIZE

The grain size shall be determined as per IS 4748 for grades of austenitic steels mentioned in Table 8.

Table 8 Grain size

(Clause 16)

Grade	Grain Size
309H, 309HCb	No 6 or Coarser
310H, 310HCb	
304H, 316H, 321H	No 7 or Coarser
347H, 348H	

17 SAMPLING

17.1 One pipe/tube shall be tested for product analysis from pipes/tubes of each heat of steel.

17.2 For determination of mechanical properties and grain size, one pipe/tube from each lot shall be tested. The term lot applies to all pipes/tubes prior to cutting, of the same nominal diameter and wall thickness that are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those pipes/tubes of the same size and the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace a lot shall include all pipes/tubes of the same size and heat, heat treated in the same furnace at the same temperature, time at heat, and furnace speed, in the same production run.

18 LEAK TIGHTNESS TEST

18.1 All pipes/tubes shall be tested for leak tightness by hydrostatic test.

18.2 Hydrostatic test shall be carried out for pipes and tubes as per respective clauses given below:

18.2.1 If any pipe/tube shows leakage in hydrostatic test, it shall be rejected.

18.2.2 The test pressure shall be held for a minimum of 5 s. The test pressure shall be held for a time sufficient to permit the entire length of the pipe/tube to be inspected.

18.2.3 The hydrostatic test may not be capable of testing the end portion of the pipe/tube. The length of pipe/tube that cannot be tested shall be determined by the manufacturer and, if specified in the purchase order, reported to the purchaser.

18.3 For Pipes

18.3.1 Hydraulic test shall be carried out against each length of pipe by subjecting pipe to a hydrostatic pressure that will produce in the pipe wall a stress not less 50 percent of the specified minimum yield strength for austenitic stainless steel pipes and 60 percent of the specified minimum yield strength for other stainless steel pipes. The test pressure or stress shall be determined using the following equation:

$$P = 2St/D \text{ or } S = PD/2t$$

where

P = hydrostatic test pressure in psi [MPa];

S = pipe wall stress, in psi or [MPa];

t = specified wall thickness, nominal wall thickness; and

D = specified outside diameter, outside diameter.

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The hydrostatic test pressure determined by the above equation shall be rounded to the nearest 0.5 MPa for pressure below 7 MPa, and to the nearest 1.0 MPa for pressure of 7 MPa and above. The hydrostatic test may be performed prior to cutting to final length, or prior to upsetting, swaging, expanding, bending or other forming operation or both.

18.3.2 Regardless of pipe-wall stress-level determined by equation, the minimum hydrostatic test pressure required to satisfy these requirements need not exceed 17.0 MPa for outside diameters of 88.9 mm or less, or 19.0 MPa for outside diameters over 88.9 mm. This does not prohibit testing at higher pressures at the option of the manufacturer.

18.4 For Tubes

18.4.1 Each tube made from ferritic, martensitic and austenitic steel shall be tested by the manufacturer at hydrostatic pressure not less than the pressure derived from the following equation:

$$P = 220.6 t/D$$

In case of tube made from duplex steel, the following equation to be used to derive minimum hydrostatic pressure

$$P = 441.2t/D$$

where

P = hydrostatic test pressure, in psi [MPa];

t = wall thickness, all thickness; and

D = outside diameter.

18.4.2 The hydrostatic test pressure determined by the above equation shall be rounded to the nearest 0.3 MPa for pressure below 7 MPa, and to the nearest 0.7 MPa for pressure of 7 MPa and above. The hydrostatic test may be performed prior to cutting to final length, or prior to upsetting, swaging, expanding, bending or other forming operation or both.

18.4.3 Regardless of the determination made by the above equation, the minimum hydrostatic test pressure required to satisfy these requirements need not exceed 7 MPa. This does not prohibit testing at higher pressures at manufacturer's option or as provided in **18.4.4**.

18.4.4 With concurrence of the manufacturer, a minimum hydrostatic test pressure in excess of the requirements prescribed may be stated on the order. The tube wall stress shall be determined by the following equation:

$$S = PD/2t$$

where

S = pipe/tube wall stress, in MPa, and all other symbols as defined in **18.4.1**.

19 CORROSION TEST

If required by the purchaser, the material shall be tested for corrosion resistance as specified in IS 10461 (Part 1) or IS 10461 (Part 2) for austenitic steels and test method may be agreed upon between purchaser and manufacturer for duplex and ferritic stainless steels.

20 OTHER TESTS

In addition to tests specified in **10** to **19**, as applicable, additional tests such as eddy current test, air under water test, radiographic tests and other tests can be carried out for requirements and corresponding method of test as agreed to between manufacturer and purchaser.

21 RETESTS

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 lot 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 lot represented by the test samples shall be deemed as not complying with the standard.

22 WORKMANSHIP, FINISH, AND APPEARANCE

22.1 The pipes and tubes shall be clean and free from such defects as can be established by visual inspection. The pipes and tubes shall have a finish and surface condition, which permits surface imperfections or marks requiring dressing to be identified.

22.2 The finished pipes and tubes shall be reasonably straight and shall be free from burr. For tubes over 50 mm in diameter, deviation from straightness over the entire length shall not exceed 0.2 percent of the length. Deviation from straightness over any length of 1 M shall not exceed 3 mm.

23 REPAIR BY WELDING OR GRINDING

23.1 It shall be permissible to dress the base metal by grinding or machining surface marks and imperfections, such as scabs, seams, tears, laps, slivers or gouges, provided that the thickness of the pipe/tube after dressing does not fall below the nominal thickness by more than the tolerance specified.

23.2 If approved by the purchaser, repair welding of base metal defects in pipes of OD equal to or above 168.3 mm with a specified wall thickness of 4.8 mm or more, may be done. Such pipes shall be marked 'WR'. The composition of the deposited filler metal shall be suitable for the composition being welded. Defects shall be thoroughly chipped or ground out before

welding and each repaired length shall be reheat-treated or stress relieved as required by the specification. Each length of repaired pipe shall be tested hydrostatically as required by the product specification.

23.3 Repair of base metal of tubes by welding is not permitted.

24 DIMENSIONS AND TOLERANCES

24.1 For Pipes

24.1.1 Preferred dimensions for pipes shall be as given in Annex A.

24.1.2 Permissible variations on the outside diameter and wall thickness for pipes shall be as given in Table 9 and 10 respectively.

Table 9 Permissible Variations on Outside Diameter for Pipes

All dimensions in millimetres.
(*Clauses 24.1.2 and 24.1.4*)

Outside Diameter mm (1)	Tolerance on Outside Diameter mm (2)
10.3 to 48.3, incl.	+ 0.4/- 0.8
Over 48.26 to 114.3, incl.	± 0.8
Over 114.3 to 168.3, incl.	+ 1.6/- 0.8
Over 168.3 to 457, incl.	+ 2.4/- 0.8
Over 457 to 660, incl.	+ 3.2/- 0.8
Over 660 to 864, incl.	+ 4.0/- 0.8

24.1.3 The tolerances on outside diameter include ovality. Except for thin walled pipes, defined as pipe having a wall thickness of 3 percent or less of the specified OD. Ovality for such pipes shall be within 1.5 percent of the specified OD. Tolerance OD of such pipes also shall be applicable only to the mean of the extreme OD reading in any one cross-section.

Tolerances on exact lengths of pipes

For lengths up to and including 6 m: +10 mm/- 0 mm.

For lengths above 6 m upto and including 12 m : + 15 mm /- 0 mm.

For lengths greater than 12 m, the applicable tolerances shall be agreed between the purchaser and manufacturer. No circumferential joints are permitted unless specified.

24.1.4 Pipes with Stricter limits for the tolerances mentioned in Table 9 and 10 may also be supplied subject to agreement between manufacturer and purchaser.

24.1.5 Information on NPS Designation against Nominal Bore for pipes for guidance only is given at Annex B

24.2 For Tubes

The tolerance on OD, wall thickness and cut lengths for tubes is as given in Table 11.

25 MARKING

25.1 Each tube shall be marked with the following details:

- Name and trade-mark of the manufacturer;
- Nominal bore and thickness for pipes or OD and thickness for tubes;
- Grade;
- Heat No.;
- Lot number; and
- Process (WLD or HCW, as applicable).

25.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

26 PACKING

The methods of preparation for dispatch shall be subject to agreement between the purchaser and the manufacturer.

Table 10 Permissible Variations on Thickness for Pipes

(*Clauses 24.1.2 and 24.1.4*)

Outside Diameter mm (1)	Tolerance on Wall Thickness Percent from nominal size (2)
10.3 to 73, incl. for all t/D ratios	+ 20/- 12.5
Over 73 to 457, incl., t/D up to 5% incl	+ 22.5/- 12.5
Over 73 to 457, incl., t/D > 5%	+ 15/- 12.5
Over 457 all t/D ratios	+ 17.5/- 12.5

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Table 11 Tolerance on Sizes of Tubes
(Clause 24.2)

Outside Diameter (OD) mm (1)	Tolerance on OD mm (2)	Tolerance on Wall Thickness ¹ , % (3)	Tolerance on Cut Lengths ² mm (4)	Thin Walled Tubes ³ (5)
Up to 13, excl.	± 0.13	± 15	+ 3/-0	
13 to 38, excl.	± 0.13	± 10	+ 3/-0	Less than 1.6 mm nominal
38 to 89, excl.	± 0.25	± 10	+ 5/-0	Less than 2.4 mm nominal
89 to 140, excl.	± 0.38	± 10	+ 5/-0	Less than 3.8 mm nominal
140 to 203, excl.	± 0.76	± 10	+ 5/-0	Less than 3.8 mm nominal
203 to 305, excl.	± 1.01	± 10	+ 5/-0	Less than 5.1 mm nominal
305 to 356, excl.	± 1.26	± 10	+ 5/-0	Less than 5.6 mm nominal

NOTES

1 For tubes of wall thickness 19 mm or above, or ID 60 percent or less of the OD, tolerance on wall thickness shall be ± 12.5 percent.

For tubes less than 13 mm ID, the tolerance on wall thickness shall be ± 15 percent.

2 These tolerances apply to cut lengths of ≤ 7 meter. For > 7 meter, tolerances shall be mutually agreed upon.

3 Ovality for thin walled tubes, the maximum and minimum diameter at a cross section shall not deviate more than twice of tolerance as above, however the mean diameter at that cross section must be within the tolerance.

ANNEX A

(Clause 24.1.1)

PREFERRED SIZES FOR PIPES

Nominal Bore	Outside Diameter	Nominal Wall Thickness	Nominal Bore	Outside Diameter	Nominal Wall Thickness
	mm	mm		mm	mm
(1)	(2)	(3)	(1)	(2)	(3)
3	10.3	1.2 1.7 2.4	65	73.0	2.1 3.1 5.2 7
6	13.7	1.6 2.2 3	75	88.9	2.1 3 5.5 7.6
10	17.1	1.6 2.3 3.2	90	101.6	2.1 3 5.7 8.1
15	21.3	1.6 2.1 2.8 3.7	100	114.3	2.1 3 6 8.6
20	26.7	1.6 2.1 2.9 3.9	125	141.3	2.8 3.4 6.5 9.5
25	33.4	1.6 2.8 3.4 4.5	150	168.3	2.8 3.4 7.1 11
32	42.2	1.6 2.8 3.6 4.8	200	219.1	2.8 3.8 8.2 12.7
40	48.3	1.6 2.8 3.7 5.1	250	273.0	3.4 4.2 9.3 12.7
50	60.3	1.6 2.8 3.9 5.5			

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Nominal Bore	Outside Diameter mm	Nominal Wall Thickness mm	Nominal Bore	Outside Diameter mm	Nominal Wall Thickness mm	
(1)	(2)	(3)	(1)	(2)	(3)	
300	323.8	4	600	609.6	5.5	
		4.6			6.3	
		9.5			9.5	
		12.7			6.3	
350	355.6	4	750	762.0	7.9	
		4.8			(Thickness): 6.35 ~ 30 mm Nominal diameter and wall thickness subject to the approval of manufacturer and purchaser	
		9.5				
400	406.4	4.2	800	812.8		
		4.8				
		9.5				
450	457.2	4.2	850	864.0		
		4.8				
		9.5				
500	508.0	4.8	900	914.0		
		5.5				
		9.5				
550	558.8	4.8	950	965.0		
		5.5				
		9.5				

ANNEX B

(Clause 24.1.5)

INFORMATION ON NPS DESIGNATION AGAINST NOMINAL BORE FOR PIPES – FOR GUIDANCE ONLY

Nominal Bore	Outside Diameter mm	Nominal Wall Thickness mm	Equivalent NPS Designation-Schedule
(1)	(2)	(3)	(4)
3	10.3	1.2	1/8-10S
		1.7	1/8-40S
		2.4	1/8-80S
6	13.7	1.6	1/4-10S
		2.2	1/4-40S
		3	1/4-80S
10	17.1	1.6	3/8-10S
		2.3	3/8-40S
		3.2	3/8-80S
15	21.3	1.6	1/2-5S
		2.1	1/2-10S
		2.8	1/2-40S
		3.7	1/2-80S
20	26.7	1.6	3/4-5S
		2.1	3/4-10S
		2.9	3/4-40S
		3.9	3/4-80S
25	33.4	1.6	1-5S
		2.8	1-10S
		3.4	1-40S
		4.5	1-80S
32	42.2	1.6	1½-5S
		2.8	1½-10S
		3.6	1½-40S
		4.8	1½-80S
40	48.3	1.6	1½-5S
		2.8	1½-10S
		3.7	1½-40S
		5.1	1½-80S
50	60.3	1.6	2-5S
		2.8	2-10S
		3.9	2-40S
		5.5	2-80S

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Nominal Bore	Outside Diameter mm	Nominal Wall Thickness mm	Equivalent NPS Designation-Schedule
(1)	(2)	(3)	(4)
65	73.0	2.1	2½-5S
		3.1	2½-10S
		5.2	2½-40S
		7	2½-80S
75	88.9	2.1	3-5S
		3	3-10S
		5.5	3-40S
		7.6	13-80S
90	101.6	2.1	3½-5S
		3	3½-10S
		5.7	3½-40S
		8.1	3½-80S
100	114.3	2.1	4-5S
		3	4-10S
		6	4-40S
		8.6	4-80S
125	141.3	2.8	5-5S
		3.4	5-10S
		6.5	5-40S
		9.5	5-80S
150	168.3	2.8	6-5S
		3.4	6-10S
		7.1	6-40S
		11	6-80S
200	219.1	2.8	8-5S
		3.8	8-10S
		8.2	8-40S
		12.7	8-80S
250	273.0	3.4	10-5S
		4.2	10-10S
		9.3	10-40S
		12.7	10-80S
300	323.8	4	12-5S
		4.6	12-10S
		9.5	12-40S
		12.7	12-80S

Nominal Bore	Outside Diameter mm	Nominal Wall Thickness mm	Equivalent NPS Designation-Schedule
(1)	(2)	(3)	(4)
350	355.6	4	14-5S
		4.8	14-10S
		9.5	14-40S
400	406.4	4.2	16-5S
		4.8	16-10S
		9.5	16-40S
450	457.2	4.2	18-5S
		4.8	18-10S
		9.5	18-40S
500	508.0	4.8	20-5S
		5.5	20-10S
		9.5	20-40S
550	558.8	4.8	22-5S
		5.5	22-10S
		9.5	22-40S
600	609.6	5.5	24-5S
		6.3	24-10S
		9.5	24-40S
750	762.0	6.3	30-5S
		7.9	30-10S
800	812.8	(Thickness) : 6.35 ~ 30 mm Nominal diameter and wall thickness subject to the approval of vendor and purchaser	32
850	864.0		34
900	914.0		36
950	965.0		38
1000	1016.0		40
1050	1067.0		42
1100	1118.0		44
1150	1168.0		46
1200	1219.0		48
to	to		to
2000	2032.0		80

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Steel Tubes, Pipes and Fittings Sectional Committee, MTD 19

<i>Organization</i>	<i>Representative(s)</i>
Steel Authority of India Limited (SAIL)-ISP, Burnpur	SHRI ARUNAVA DASGUPTA (Chairperson)
Bharat Heavy Electrical Limited, New Delhi	SHRI K. ATHIMOOLAM SHRI M. KANNAN (<i>Alternate</i>)
Delhi Jal Board, New Delhi	SHRI PRAVEEN BHARGAVA
Department for Promotion of Industry and Internal Trade, New Delhi	SHRI S. K. JAIN
Directorate General Quality Assurance, New Delhi	SHRI BIKAS MONDAL SHRI S. K. ROY (<i>Alternate</i>)
Engineers India Limited, New Delhi	SHRI RAMESHWAR PRASAD SHRI SANJEEV GUPTA (<i>Alternate</i>)
Federation of Industries of India, Maharashtra	SHRI H. L. BHARDWAJ
GAIL (India) Limited, New Delhi	SHRI ANURAG SRIVASTAV SHRI M. I. HAQUE A (<i>Alternate</i>)
Goodluck Steel Tubes Limited, New Delhi	SHRI M. C. GARG SHRI U. D. SHARMA (<i>Alternate</i>)
Gujarat Gas Company Limited, Ahmedabad	SHRI DHARMESH SAILOR SHRI PRAMATH SHAILESH (<i>Alternate</i>)
Gujarat State Petronet Limited, Gandhi Nagar	SHRI N. BOSE BABU SHRI NILESH TANNA (<i>Alternate</i>)
Howrah Pipe Fittings Manufacturers Welfare Association, Kolkata	SHRI MAHANANDA DHARA SHRI P. GHOSH (<i>Alternate</i>)
Indian Oil Corporation Limited-Refineries and Pipelines Division, New Delhi	SHRI PARICHAY DAS
Indian Stainless Steel Development Association, Gurugram	SHRI ROHIT KUMAR
Indus Tubes Limited, Pitampura, New Delhi	SHRI I. P. JAIN SHRI D. K. KAPOOR (<i>Alternate</i>)
Jindal Pipes Limited, Hapur	SHRI D. B. SINGH SHRI K. D. SHARMA (<i>Alternate</i>)
Lalita Infra projects Private Limited, Kolkata	DR BUDDHADEB DUARI SHRI SUBHOJIT BHATTACHARYA (<i>Alternate</i>)
Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade, New Delhi	SHRI T. S. G. NARAYANNEN
RITES Limited, Gurugram	SHRI RAMENDRA KUMAR SHRI AJAY SHARMA (<i>Alternate</i>)
Shri Bajrang Power and Ispat Limited, Raipur	SHRI BANWARI LAL CHOPRA SHRI PRAVEEN KUMAR (<i>Alternate</i>)
Society of Indian Automobile Manufacturers (SIAM), Delhi	SHRI P. K. BANERJEE SHRI AMIT KUMAR (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
Surya Roshni Limited, Delhi	SHRI N. K. SINGLA SHRI NITIN JAIN (<i>Alternate</i>)
Tata Steel Limited, Kolkata	SHRI BRAJ B. PRASAD SHRI UDYAN TYAGI (<i>Alternate</i>)
In Personal Capacity	SHRI C. B. LUNAWAT
BIS Directorate General	SHRI N. SURYANARAYANA, SCIENTIST 'E' AND HEAD (MTD) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary

SHRI ARUN PUCCHAKAYALA
SCIENTIST 'D' (MTD), BIS

Panel for formulation of Standard on Stainless steel pipes and Tubes MTD 19/P 7

<i>Organization</i>	<i>Representative(s)</i>
Indian Stainless Steel Development Association Gurugram	SHRI N. K. VIJAYVARGIA
Ratanamani metals and tubes, Gujarat	SHRI P. H. BHATT
Welspun Steel Ltd (WSL), Gujarat	SHRI PRAKASH TATIA
RDSO, Lucknow	SHRI AHMAD NADEEM
Stainless Steel Pipes and Tubes Manufacturers Association Western Region	SHRI ASHISH SANGHVI
Heavy metals and tubes, Ahmedabad	SHRI HITESH JAIN
IDMA, V V Nagar	SHRI DEVENDRA GUPTA

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This Indian Standard has been developed from Doc No.: MTD 19 (15547).

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 110002
Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

		Telephones
Central	: 601/A, Konnectus Tower-1, 6 th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	{ 2323 7617
Eastern	: 8 th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	{ 2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg Chandigarh 160019	{ 265 9930
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