Draft Indian Standard

STAINLESS STEEL WELDED TUBES FOR DECORATIVE PURPOSES — SPECIFICATION

1 SCOPE

This standard covers the requirements for austenitic, ferritic and duplex stainless steel welded tubes intended for structural applications also including tubes used in construction for decorative purposes.

Tubes shall be manufactured in round, square, rectangular or shapes and sections specified by the purchaser with wall thickness above 0.5 mm and up to 9.53 mm and Outside dimensions up to 406.4 mm.

2 REFERENCES

The following standards containw 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*
IS 228(various parts)	Methods of chemical analysis of steels
IS 1500 (Part 1): 2019 / ISO 6506-1: 2014	Metallic materials — Brinell hardness test: Part 1 Test method (*fifth revision*)
IS 1586 (Part 1) : 2018 / ISO 6508-1 : 2016	Metallic materials — Rockwell hardness test: Part 1 Test method (*fifth revision*)
IS 1608 (Part 1) : 2022 / ISO 6892-1 : 2019	Metallic materials — Tensile testing: Part 1 Method of test at room temperature (*fifth revision*)
IS 1762 (Part 1) : 1974	Code for designation of steels: Part 1 Based on letter symbols (*first revision*)
IS 1956 (Part 8) : 1976	Glossary of terms relating to iron and steel: Part 8 Steel tubes and pipes (*first revision*)
IS 3073 : 1967	Assessment of surface roughness
IS 8910 : 2022 / ISO 404 : 2013	Steel and steel products — General technical delivery requirements (*second revision*)

3 TERMINOLOGY

The definitions as mentioned in IS 1956 (Part 8) shall apply.

4 SUPPLY OF MATERIAL

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

5 ORDERING INFORMATION

The purchaser should clearly specify the requirement while ordering to describe the desired material adequately and may include, but not limited to the followings in the order:

a) Quantity (meters, mass, or number of pieces);
b) Form (round, square, rectangular, other shapes, if any);
c) Dimensions;
d) Round-outside diameter and wall thickness for all conditions;
e) Square and rectangular- outside dimensions and wall thickness;
f) Any other shape (to be specified);
g) Length (mill lengths, cut lengths, or multiple lengths);
h) Grade;
j) Condition;
k) Inside diameter bead condition;
m) Surface finish;
n) Report of chemical analysis, if required;
o) Individual optional requirements, if required; and
p) Any special marking required by the purchaser.

6 MANUFACTURE

Steel shall be made by any process. The tubes shall be manufactured by automated welding process without the addition of filler metal.

7 CONDITION OF SUPPLY

7.1 The tubes shall be furnished in any of the following conditions as specified:

a) As welded,
b) Welded and annealed,
c) Cold reduced,
d) Cold reduced and annealed.

7.2 The inside diameter bead shall be furnished in any of the following conditions as specified:

a) Bead not removed,
b) Bead controlled to 0.13 mm or 15 percent of the specified wall thickness, whichever is greater, and
c) Bead removed.

8 CHEMICAL COMPOSITION

8.1 Ladle Analysis

The tubes shall be manufactured from the Stainless steel grades mentioned in Table 1. The chemical composition of the steel as determined on the ladle analysis shall conform to the requirement as mentioned Table 1.

The analysis of steel shall be carried out either by the method specified in IS228 and its relevant parts or any other established instrumental/chemical methods. 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 as agreed to between the purchaser and the manufacturer.

8.2 Product Analysis

In case of product analysis permissible variations over the maximum limits specified in Table 1 shall be as per Table 2.

Table 1 Chemical Composition, Percent

(*Clause* 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:***												
	X 02Cr12Ti	409	0.030	1.00	1.00	0.50	10.5 to 11.7	—	0.020	0.040	0.030		Ti 6x (C + N) *Min* 0.50 *Max*; Nb 0.17 *Max*
	X 02Cr12	409 M	0.030	1.00	0.50 to 1.50	1.50	10.5 to 12.5	—	0.030	0.040	—		—
	X02Cr12Ti	409Ti1	0.030	1.00	1.00	0.50	10.5 to 11.7	—	0.020	0.040	0.030	—	Ti 8x (C + N) *Min*, Ti 0.15 to 0.50; Nb 0.10
	X02Cr12TiNb	409Ti2	0.030	1.00	1.00	0.50	10.5 to 11.7	—	0.020	0.040	0.030	—	(Ti + Nb) [0.08 + 8x (C + N)] min, 0.75 *Max*; Ti 0.05 *Min*
	X 04Cr12	410 S	0.08	1.00	1.00	0.60	11.5–13.5	—	0.030	0.040	—		
	X10Cr15	429	0.12	1.00	1.00	—	14.0 to 16.0	—	0.030	0.040	—	—	—
	X1Cr15Nb	429Nb	0.020	1.00	1.00	—	14.0 to 16.0	—	0.015	0.025	0.020	—	Nb 0.20 to 0.6
	X 07Cr17	430	0.12	1.00	1.00	0.75	16.0 to 18.0	—	0.030	0.040	—		—
	X02Cr17TiNb	430Ti	0.030	0.75	1.00	—	16.0 to 19.0	—	0.030	0.040	—	—	Ti or Nb 0.10 to 1.00
	X08Cr17Mo1	434	0.12	1.00	1.00	—	16.0 to 18.0	0.75 to 1.25	0.030	0.040	—	—	—
	X02Cr17Mo1Nb	436	0.12	1.00	1.00	—	16.0 to 18.0	0.75 to 1.25	0.030	0.040	—	—	Nb 5x C *Min*, 0.80 *Max*
	X 02Cr18Ti	439	0.030	1.00	1.00	0.50	17.0 to 19.0	—	0.030	0.040	0.030	—	Ti [0.2 + 4 (C + N)] *Min* to 1.1 *Max*; Al 0.15 *Max*
	X02Cr19TiNb	441	0.030	1.00	1.00	1	17.5 to 19.5	—	0.030	0.040	0.030	—	Ti (0.1 to 0.5) Nb [0.3 + (9x C) *Min*, 0.90 *Max*
	X02Cr18Mo2TiNb	444	0.025	1.00	1.00	1	17.5 to 19.5	1.75 to 2.50	0.030	0.040	0.035	—	(Ti + Nb)[0.20 + 4 (C + N)] *Min*, 0.80 *Max*
ii)	***Austenitic steels:***												—
	X 10Cr17Ni7	301	0.15	1.00	2.00	6.0 to 8.0	16.0 to 18.0	—	0.030	0.045	0.100	—	—
	X 07Cr18Ni9	302	0.15	0.75	2.00	8.0 to 10.0	17.0 to 19.0	—	0.030	0.045	0.100	—	—
	X04Cr19Ni9	304	0.07	0.75	2.00	8.0 to 10.5	17.5 to 19.5	—	0.030	0.045	0.100	—	—
	X 02Cr19Ni10	304 L	0.030	0.75	2.00	8.0.12.0	17.5 to 19.5	—	0.030	0.045	0.100	—	—
	X05Cr18Ni11	305	0.12	0.75	2.00	10.5 to 13.0	17.0 to 19.0	—	0.030	0.045	—	—	—
	X 04Cr23Ni14	309 S	0.08	0.75	2.00	12.0 to 15.0	22.0 to 24.0	—	0.030	0.045	—	—	—
	X05Cr23Ni13Nb	309Nb	0.08	0.75	2.00	12.0 to 16.0	22.0 to 24.0	—	0.030	0.045	—	—	Nb 10x C *Min*, 1.10 *Max*
	X 04Cr25Ni20	310 S	0.08	1.50	2.00	19.0–22.0	24.0 to 26.0	—	0.030	0.045	—	—	—
	X 04Cr17Ni12Mo2	316	0.08	0.75	2.00	10.0 to 14.0	16.0 to 18.0	2.0 to 3.0	0.030	0.045	0.100	—	—
	X 02Cr17Ni12Mo2	316 L	0.030	0.75	2.00	10.0 to 14.0	16.0 to 18.0	2.0 to 3.0	0.030	0.045	0.100	—	—
	X02Cr20Ni9Mo1N	316N2	0.030	1.00	2.00	8.0 to 9.5	19.5 to 21.5	0.50 to 1.50	0.015	0.045	0.14 to 0.25	1.00	—
	X 04Cr19Ni13Mo3	317	0.08	0.75	2.00	11.0 to 15.0	18.0 to 20.0	3.0–4.0	0.030	0.045	0.100	—	—
	X 04Cr18Ni10Ti	321	0.08	0.75	2.00	9.0 to 12.0	17.0 to 19.0	—	0.030	0.045	0.100		Ti 5x (C + N) *Min* — 0.70 *Max*

	X 04Cr18Ni10Nb	347	0.08	0.75	2.00	9.0 to 13.0	17.0 to 19.0	—	0.030	0.045	—		Nb 10x C — 1.00 *Max*
iii)	***Duplex:***												
	X02Cr22Ni5Mo3N	1803	0.030	1.00	2.00	4.5 to 6.5	21.0 to 23.0	2.5 to 3.5	0.020	0.030	0.08 to 0.20	—	—
	X02Cr21Mn3Ni2N	2011	0.030	1.00	2.00 to 3.00	1.0 to 2.0	20.5 to 23.5	0.10 to 1.00	0.020	0.040	0.15 to 0.27	0.50	—
	X02Cr21Mn5Ni2N	2101	0.040	1.00	4.00 to 6.00	1.35 to 1.70	21.0 to 22.0	0.10 to 0.80	0.030	0.040	0.20 to 0.25	0.10 to 0.80	—
	X 02Cr22Ni6Mo3N	2205	0.030	1.00	2.00	4.5 to 6.5	22.0 to 23.0	3.0 to 3.5	0.020	0.030	0.14 to 0.20	—	—
	X 02Cr23Ni4CuN	2304	0.030	1.00	2.50	3.0 to 5.5	21.5 to 24.5	0.05 to 0.60	0.030	0.040	0.05 to 0.20	0.05 to 0.60	—
	X02Cr23Ni4MoCu	2441	0.030	0.70	2.50 to 4.00	3.0 to 4.5	23.0 to 25.0	1.00 to 2.00	0.005	0.035	0.20 to 0.30	0.10 to 0.80	—
	X 02Cr25Ni7Mo4CuN	2507	0.030	0.80	1.20	6.0 to 8.0	24.0 to 26.0	3.0 to 5.0	0.020	0.035	0.24 to 0.32	0.50	—
	X02Cr25Ni7Mo3CuWN	2760	0.030	1.00	1.00	6.0 to 8.0	24.0 to 26.0	3.0 to 4.0	0.010	0.030	0.20 to 0.30	0.50 to 1.00	W 0.50 to 1.00

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
		Over	Upto and Including	± unless specified as +
(1)	(2)	(3)	(4)	(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
		10	14	0.1
iv)	Cr	10	15	+ 0.15
		15	20	0.2
		20	30	0.25
v)	Mo	—	0.6	+ 0.03
		0.6	1.75	0.05
		1.75	3	0.1
vi)	Ni	—	1	+ 0.03
		1	5	0.07
		5	10	0.1
		10	20	0.15
		20	30	0.2
vii)	N	—	0.02	0.005
		0.02	0.15	0.01
		0.15	0.35	0.02
viii)	Ti	—	1	+ 0.05
ix)	Nb	—	1.2	+ 0.05
x)	S	—	0.04	+ 0.005
		0.04	0.2	0.01
		0.2	0.5	0.02
xi)	P	—	0.04	+ 0.005
		0.04	0.1	0.01
xii)	Cu	—	0.5	+ 0.03
		0.5	1	0.05
		1	3	0.1
		3	4	0.15
xiii)	W	—	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.

9 DIMENSIONS AND TOLERANCES FOR ROUND TUBES

9.1 For all conditions except tubing with bead removed, Table 3 shall apply.

9.2 For Tubing with bear removed, Table 4 will apply.

9.3 Lengths — Tubing is normally furnished in mill lengths 1.5 meters and over. In case a definite length is required the length tolerance as specified in the Table 5 shall apply.

Table 3 Diameter, Wall, and Ovality Tolerances (All Conditions Except Tubing with Bead Removed)

(*Clause* 9.1)

Sl No.	OD Size, mm	Wall Thickness, mm	OD, mm +/ to
(1)	(2)	(3)	(4)
i)	Under 12.7	0.51 to 1.24	0.10
ii)	12.7 to 25.4	0.51 to 1.65	0.13
iii)	12.7 to 25.4	over 1.65 to 3.40	0.25
iv)	over 25.4 to 38.1, incl	0.64 to 1.65	0.20
v)	over 25.4 to 38.1, incl	over 1.65 to 3.40	0.25
vi)	over 38.1 to 50.8, incl	0.64 to 1.24	0.25
vii)	over 38.1 to 50.8, incl	over 1.24 to 2.11	0.28
viii)	over 38.1 to 50.8, incl	over 2.11 to 3.78	0.30
ix)	over 50.8 to 63.5, incl	0.81 to 1.65	0.30
x)	over 50.8 to 63.5, incl	over 1.65 to 2.77	0.33
xi)	over 50.8 to 63.5, incl	over 2.77 to 4.19	0.36
xii)	over 63.5 to 88.9, incl	0.81 to 4.19	0.36
xiii)	over 63.5 to 88.9, incl	over 4.19	0.51
xiv)	over 88.9 to 127.0, incl	0.89 to 4.19	0.51
xv)	over 88.9 to 127.0, incl	over 4.19	0.64
xvi)	over 127.0 to 190.5, incl	1.24 to 6.35	0.64
xvii)	over 127.0 to 190.5, incl	over 6.35	0.76
xviii)	over 190.5 to 406.4, incl	all	0.001 25 mm/mm of circumference

NOTES

1 Ovality is the difference between maximum and minimum outside diameters measured at any one cross section. There is no additional tolerance for ovality on tubes having a specified wall thickness of more than 3 percent of the outside diameter.

2 For sizes up to and including 5 to in. (127.0 to mm) outside diameter, an ovality tolerance of twice the tabular outside diameter tolerance spread shown is applied one half plus and one half minus to tubes having a specified wall thickness of 3 percent or less of the specified outside diameter. The average of the maximum and minimum outside diameter readings should fall within the outside diameter tolerances as shown in this table.

3 For sizes over 5 to in. (127.0 to mm) to and including 16 to in. (406.4 to mm) outside diameter, when the specified wall thickness is 3 percent or less of the outside diameter, the ovality shall not exceed 1.5 percent of the specified outside diameter.

4 Wall tolerance ±10 percent of specified wall thickness.

Table 4 Diameter, Wall, and Ovality Tolerances for Tubing with Bead Removed

(*Clause* 9.2)

Sl No.	OD Size, mm	OD, mm +/ to	ID, mm +/ to
(1)	(2)	(3)	(4)
i)	Under 2.4	0.03	0.03
ii)	2.4 to 4.8, excl	0.038	0.038
iii)	4.8 to 12.7, excl	0.08	0.13
iv)	12.7 to 25.4, excl	0.10	0.15
v)	25.4 to 38.1, excl	0.13	0.18
vi)	38.1 to 50.8, excl	0.15	0.20
vii)	50.8 to 63.5, excl	0.18	0.25
viii)	63.5 to 88.9, excl	0.25	0.36
ix)	88.9 to 127.0, incl	0.38	0.51
x)	Over 127.0 to 406.4, incl	0.001 25 mm/mm of circumference	0.001 3 mm/mm of circumference

NOTES

1 Ovality is the difference between maximum and minimum outside diameters measured at any one cross to section. There is no additional tolerance for ovality on tubes having a specified wall thickness of more than 3 percent of the outside diameter.

2 An ovality allowance of twice the outside diameter tolerance, shown in this table, is applied one half plus and one half minus to the outside diameter, for tubes having a specified wall thickness of 3 percent or less of the specified outside diameter. The average of the maximum and minimum outside diameter readings should fall within the outside diameter tolerances of this table.

3 Tubing may be specified to only two of the three following dimensions—outside diameter, inside diameter, or wall.

4 Wall tolerance is ± 10 percent of the specified wall thickness.

Table 5 Length Tolerances — Cut Length Tubes

(*Clause* 9.3 *and* 10.6)

Sl No.	Length, m	Outside Diameter, mm	Permissible Variation in length, mm	
			Over*	Under
(1)	(2)	(3)	(4)	(5)
i)	1.2 and under	up to 50.8, incl	1.6	0
ii)	1.2 and under	over 50.8 to 101.6, incl	2.4	0
iii)	1.2 and under	over 101.6	3.2	0
iv)	Over 1.2 to 3.0, incl	up to 50.8, incl	2.4	0
v)	Over 1.2 to 3.0, incl	over 50.8	3.2	0
vi)	over 3.0 to 7.3, incl	all sizes	4.8	0

NOTE — For all diameters in lengths over 7.3 m, an additional over tolerance of 3.2 mm for each 3.0 m or fraction thereof shall be permissible, up to a tolerance of 12.7 mm, max.

9.4 Straightness Tolerance — The straightness tolerance shall be 0.76 mm maximum in any 0.9 m length of tubing. The straightness tolerance on shorter lengths and on special requirements shall be agreed upon between the purchaser and producer.

10 DIMENSIONS AND TOLERANCES FOR SQUARE AND RECTANGULAR TUBES

10.1 Outside Dimensions of the Sides — The variation in the outside dimension of the sides shall not exceed the amount prescribed in Table 6.

10.2 Wall Thickness — The wall thickness shall be within +/ to 10 percent of specified wall thickness.

10.3 Maximum Radii of Corners — For the purpose of the standard, the corner radius is defined as the effective corner radius (ECR), which is equal to half of the difference between the profile width and the width of the flat. The maximum radii of corners shall be as given in Table 6.

Table 6 Maximum Radii of Corners

(*Clause* 10.1 *and* 10.3)

Sl No. (1)	**Wall Thickness,** in (mm) (2)	**Radii of Corners,** *Max*, in (mm) (3)
i)	Over 0.51 to 1.24, incl	2.4
ii)	Over 1.24 to 1.65), incl	3.2
iii)	Over 1.65 to 2.11, incl	3.6
iv)	Over 2.11 to 2.42, incl	4.8
v)	Over 2.42 to 2.77, incl	5.2
vi)	Over 2.77 to 3.40, incl	5.6
vii)	Over 3.40 to 3.96, incl	6.4
viii)	Over 5.08 to 6.35, incl	9.5
ix)	Over 5.08 to 6.35, incl	12.7
x)	Over 6.35 to 9.53, incl	19.1

Maximum radii of corners (Table 5)
For the purpose of this standard, the corner radius is defined as the Effective Corner Radius (ECR), which is equal to half the difference between the 'profile width' and the 'width of the flat'.

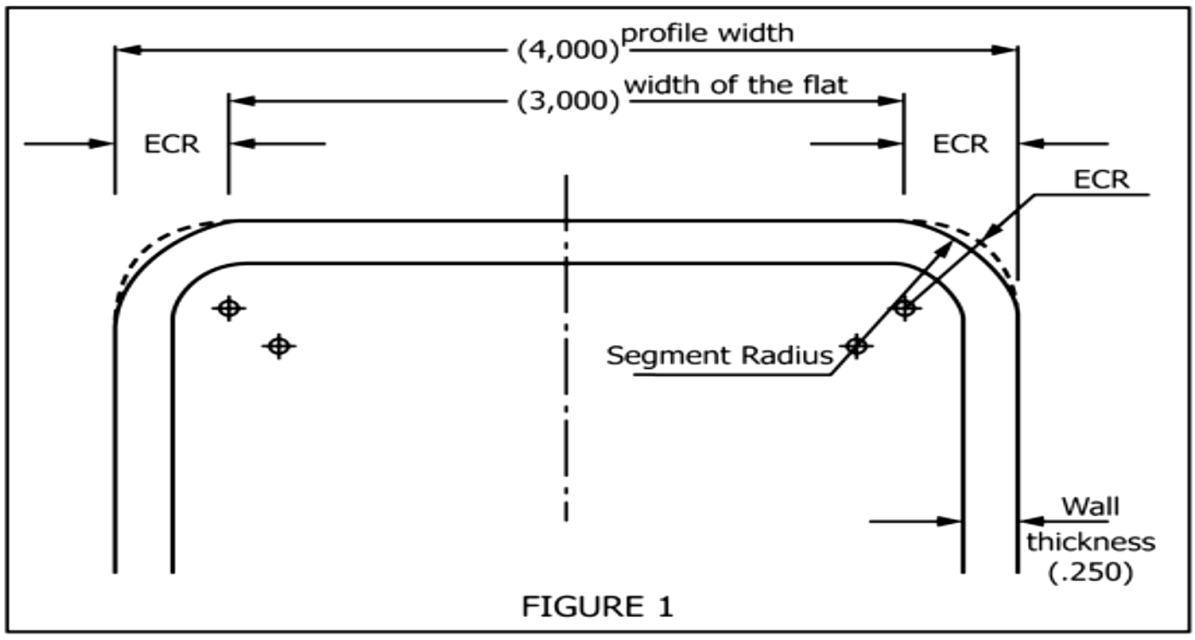

FIGURE 1

$$ECR = \frac{(\text{Tube Width}) - (\text{Width of Flat})}{2}$$

For this 4' wide shape with a wall thickness of .25' the Effective Corner Radius = ECR
ECR = (4' – 3') / 2 = .5'

FIG. 1 MEASUREMENT OF CORNER RADII

10.4 Twist Tolerance — The tolerance on the twist in case of square and rectangular sections is given in Table 7.

Table 7 Twist Tolerances

(*Clause* 10.4)

Sl No. (1)	Largest Size, mm (2)	Twist max (mm/m) (3)
i)	Under 12.7	1.4
ii)	Over 12.7 to 38.1, incl	2.1
iii)	Over 38.1 to 63.5, incl	2.6
iv)	Over 63.5 to 101.6, incl	3.5
v)	Over 101.6 to 152.4 incl	6.9
vi)	Over 152.4	10.4

10.5 Out of Squareness — The out of squareness in the case of square and rectangular sections shall be as follows ± 0.6percent of the size of the longest side.

10.6 Length — Tubing is normally furnished in mill lengths 1.5 meters and over. In case a definite length is required the length tolerance as specified in Table 5 shall apply.

11 WORKMANSHIP, FINISH, AND APPEARANCE

11.1 The tubes/pipes shall be clean and free from such defects as can be established by visual inspection. If Special finish is required, it shall be stated in the order. The tubes/pipes shall have a finish and surface condition which permits surface imperfections or marks requiring dressing to be identified.

11.2 Removal of imperfections by grinding is permitted, provided the wall thicknesses are not decreased to less than that permitted in the permissible variations in wall thickness.

12 Surface Finishes

12.1 The tubes shall be free from scale.

12.2 If special surface conditioning is required, they shall be specified in the order. The following surface finishes may be specified.

12.3 Type of Surface Finish

12.3.1 *Mill Finish* — A finish without additional polishing or operations intended to smooth the surface.

12.3.2 *Mechanically Polished Surface Finish* — The purchaser may specify one of the following finish numbers for a mechanically polished surface:

12.3.2.1 *Finish no.* 80 — A ground finish produced by polishing a tube with an abrasive media impregnated with No. 80 grit.

12.3.2.2 *Finish no.* 120 — A ground finish produced by polishing a tube with an abrasive media impregnated with No. 120 grit.

12.3.2.3 *Finish no.* 180 — A ground finish produced by polishing a tube with an abrasive media impregnated with No. 180 grit.

12.3.2.4 *Finish no.* 240 — A ground finish produced by polishing a tube with an abrasive

media impregnated with No. 240 grit.

12.3.2.5 Other mechanically polished finishes may be agreed upon between the purchaser and manufacturer.

12.3.3 *Electropolished Finish* — A bright reflective finish produced by electropolishing. The manufacturer may use other polishing operations prior to electropolishing.

12.3.4 *Maximum Roughness Average* (R_a) *Surface Finish* — The customer may specify a maximum Ra on the inside surface, outside surface, or both. The measurement of surface roughness shall be in accordance with IS 3073.

12.3.4.1 When no agreement is made regarding Ra measurement of longitudinally polished tube, disputes shall be resolved using measurements made in accordance with IS 3073.

12.4 The manufacturer shall select a manufacturing method to produce the specified finish. The operations may or may not include polishing.

12.4.1 The purchaser may specify the polishing type for either the inside surface, outside surface or both for the final desired effect.

12.4.1.1 *Longitudinally polished finish* — It is usually performed on the inside surface only.

12.4.1.2 *Circumferential (rotary) polished finish* — This can be performed on either the inside surface, outside surface, or both.

12.4.1.3 When the surface is finished by circumferential mechanical polishing, the R_a measurement shall be measured in the longitudinal direction. Roughness measurement of a longitudinal mechanical polished surface shall be a matter of agreement between the manufacturer and the purchaser.

12.5 Acceptance criteria for minor surface imperfections shall be a matter for agreement by the manufacturer and the purchaser.

12.6 Combinations of the above finishes for internal and external surfaces may be specified. When tubes / pipes are polished on one surface only, the other surface may be the regular mill finish.

12.7 Any other finish as agreed between purchaser and producer may also be supplied and if no finish is specified, it would be left at the discretion of the producer

13 TENSILE TEST

13.1 Tensile test shall be carried out as per IS 1608 (Part 1) whenever specified by the purchaser. One test shall be performed on a specimen from one tube of each lot of 800 m or a fraction thereof from each heat of steel, prior to cutting to length.

13.2 The yield strength corresponding to a permanent offset of 0.2 percent of the gauge length of the specimen or to a total extension of 0.5 percent of the gauge length under load shall be determined. The requirements in round annealed condition are given in Table 8. For other conditions of supply and for other shapes the tensile requirements may be mutually agreed between purchaser and manufacturer

Table 8 Tensile Requirements (Round Annealed Condition)

(*Clause* 13.2)

Sl No.	**Grade**	**Tensile Strength,** *Min* MPa	**Yield Strength,** *Min* MPa	**Elongation[A] in 50 mm,** *Min*, percent
(1)	(2)	(3)	(4)	(5)
i)	429 and 430	414	241	20
ii)	430Ti	414	207	20
iii)	304L & 316L	483	172	35
iv)	316N2	635	310	35
v)	All other austenitic steels	517	207	35
vi)	409	379	207	20
vii)	All other ferritic steels	414	241	20
viii)	1803	620	450	25
ix)	2101 thickness≤ 5.00 mm	700	530	30
x)	thickness > 5.00 mm	650	450	30
xi)	2205	655	450	25
xii)	2304	600	400	25
xiii)	2507	795	550	15
xiv)	2760	750	550	25
xv)	2011 thickness < 5.00 mm	700	515	30
xvi)	thickness ≥ 5.00 mm	655	450	30
xvii)	2441 thickness < 10 mm	740	540	25
xviii)	thickness ≥ 10 mm	680	480	25

A For longitudinal strip tests, the width of the gauge section shall be 1 inch. (25.4 mm) and a deduction of 1.75 percent point for austenitic grades and 1.0 percent point for MT 429 and MT 430 shall be permitted from the basic minimum elongation for each 1/32 inch. (0.79 mm) decrease in wall thickness below 5/16 inch. (7.94 mm). Below 25 mm dia, pipes shall be directly tested.

14 HARDNESS TEST

It is an optional test and shall be conducted if required by the purchaser. The hardness test shall be performed on a specimen from one tube/pipe from each 800 m or fraction thereof from each heat of steel as per IS 1586 (Part 1)/IS 1500 (Part 1) and the hardness values shall be as given in Table 9.

Table 9 Hardness Requirement (Round Annealed Condition)

(*Clause* 14)

Sl No.	**Grade**	**Hardness**		
		Brinell, *Max*	**Rockwell B,** *Max*	**Rockwell C,** *Max*
(1)	(2)	(3)	(4)	(5)
i)	All austenitic unless shown below	192	90	—
ii)	All ferritic steel	190	90	—
iii)	429 and 430	190	90	—
iv)	430Ti	190	90	—
v)	316N2	256	100	—
vi)	1803	290	—	30
vii)	2101	290	—	30
viii)	2205	290	—	30
ix)	2304	290	—	30
x)	2507	300	—	32
xi)	2760	310	—	32
xii)	2011	293	—	31
xiii)	2441	290	—	31

15 ANNEALED WELDS

This is an optional requirement and if required by the purchaser, mechanical tubing manufactured from duplex stainless steel may be supplied with post weld heat treatment (PWHT).

16 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 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

17 MARKING

17.1 Each tube (applicable for tubes ≥ 19 mm in outer dimension and having thickness ≥ 0.65 mm), shall be marked with the following details:

a) Name/trade to mark of the manufacturer; and
b) Grade.

17.2 Bundle/Lot Marking

Each Bundle of all sizes should have the following identifications:

a) Name/trade to mark of the manufacturer;
b) Grade;
c) Class of tolerance;
d) Heat no;
e) Outer dimensions & thickness; and

f) Length.

Any other marking pattern can be used for internal traceability as per buyer's confirmation.

17.3 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.