Table 1 — (*Concluded*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	193.7	4.8	22.36	28.49	26.619	6.085	5.784	1271.39	131.27	6.68	44.63
	193.7	5.4	25.08	31.94	26.273	6.085	5.746	1416.97	146.31	6.66	44.36
	193.7	5.9	27.33	34.81	25.987	6.085	5.715	1536.13	158.61	6.64	44.13
175	193.7	6.3	29.12	37.09	25.759	6.085	5.689	1630.05	168.31	6.63	43.95
	193.7	8	36.64	46.67	24.801	6.085	5.583	2015.54	208.11	6.57	43.19
	193.7	10	45.30	57.71	23.697	6.085	5.457	2441.59	252.10	6.50	42.31
	193.7	12	53.77	68.50	22.618	6.085	5.331	2839.20	293.15	6.44	41.45
	219.1	4.8	25.37	32.32	34.471	6.883	6.582	1856.03	169.42	7.58	57.43
	219.1	5.6	29.49	37.56	33.947	6.883	6531	2141.61	195.49	7.55	57.02
	219.1	5.9	31.02	39.52	33.751	6.883	6.513	2247.01	205.11	7.54	56.86
200	219.1	6.3	33.06	42.12	33.491	6.883	6.487	2386.14	217.81	7.53	56.65
	219.1	8	41.65	53.06	32.397	6.883	6.381	2959.63	270.16	7.47	55.78
	219.1	10	51.57	65.69	31.134	6.883	6.255	3598.44	328.47	7.40	54.78
	219.1	12	61.29	78.07	29.895	6.883	6.129	4199.88	383.38	7.33	53.79
	244.5	5.9	34.72	44.23	42.529	7.681	7.310	3149.12	257.60	8.44	71.21
225	244.5	6.3	37.01	47.14	42.237	7.681	7.285	3346.03	273.70	8.42	70.97
	244.5	8	46.66	59.44	41.007	7.681	7.179	4160.45	340.32	8.37	70.00
	244.5	10	57.83	73.67	39.584	7.681	7.053	5073.15	414.98	8.30	68.86
	273	5.9	38.86	49.51	53.584	8.577	8.206	4417.18	323.60	9.45	89.22
	273	6.3	41.44	52.79	53.256	8.577	8.181	4695.82	344.02	9.43	88.96
250	273	8	52.28	66.60	51.875	8.577	8.074	5851.71	428.70	9.37	87.86
	273	10	64.86	82.62	50.273	8.577	7.948	7154.09	524.11	9.31	86.59
	273	12	77.24	98.39	48.695	8.577	7.823	8396.14	615.10	9.24	85.33
	323.9	6.3	49.34	62.86	76.111	10.176	9.780	7928.90	489.59	11.23	126.14
	323.9	8	62.32	79.39	74.458	10.176	9.673	9910.08	611.92	11.17	124.82
300	323.9	10	77.41	98.61	72.536	10.176	9.547	12158.34	750.75	11.10	123.29
	323.9	12	92.30	117.58	70.639	10.176	9.422	14319.56	884.20	11.04	121.78
	355.6	8	68.58	87.36	90.579	11.172	10.669	13201.37	742.48	12.29	151.11
350	355.6	10	85.23	108.57	88.457	11.172	10.543	16223.50	912.46	12.22	149.42
	355.6	12	101.68	129.53	86.361	11.172	10.418	19139.47	1076.46	12.16	147.76

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 : ± 10 percent

2) Seamless tubes : + Not limited, – 12.5 percent

c) *Weight*:

1) Single tube : ± 10 percent

2) 10 tonne lots : ± 7.5 percent

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

7 WORKMANSHIP

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

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

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

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 mechanical tests shall be carried out on the selected tube. 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) 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)

Sl No.	Grade	Tensile Strength *Min*	Yield Strength *Min*	Elongation on Gauge Length $5.65\sqrt{S_o}$, *Min*
		MPa	MPa	Percent
(1)	(2)	(3)	(4)	(5)
i)	YSt 210	330	210	20
ii)	YSt 240	410	240	17
iii)	YSt 310	450	310	14
iv)	YSt 355	490	355	10

NOTES

1 1 MPa = 1N/mm² = 0 102 kgf/mm²

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

11.3 Ductility Test

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

Table 3 Steel and Supply Conditions
(*Clause* 5.1)

Sl No.	Manufacturing Process	Steel	Supply Conditions
(1)	(2)	(3)	(4)
i)	HFW	IS 10748	Only YSt 210 or YSt 240
ii)	HFS/CDS	Bars/ingots with suitable Chemical composition as per IS 10748 to achieve mechanical for respective grades	YSt 210, YSt 240, YSt 310 or YSt 355
iii)	ERW/HFIW	IS 10748	YSt 210, YSt 240, YSt 310 or YSt 355 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.

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.

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)
(1)	(2)	(3)	(4)	(5)
i)	HFS/CDS/ERW/HFIW	YSt 210	75 percent of OD[1]	60 percent of OD
ii)	HFS/CDS/ERW/HFIW	YSt 240	85 percent of OD	75 percent of OD
iii)	HFS/CDS/ERW/HFIW	YSt 310	85 percent of OD	75 percent of OD
iv)	HFS/CDS/ERW/HFIW	YSt 355	85 percent of OD	75 percent of OD

[1] OD = Outside diameter