Maruti Metal Industries

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Maruti Metal Industries

ABOUT US:

Maruti Metal Industries is an ISO 9001 2000 certified company. We take the pleasure to introduce overselves as one the largest IMPORTERS, STOCK HOLDERS & SUPPLIERS of NON-FERROUS METALS AND STAINLESS STEEL, SHEET, PLATES, COILS, TUBES,
PIPES, RODS, WIRES, FLATS, STRUCTURAL, FITTINGS, FLANGES, Alloy Steel, Mild Steel Products.

Confirming to TP-202, 304, 304L, 309, 310, 310S, 316, 316S, 316TI, 321, 410, 430, 904L, NICKLE, MONEL, INCONEL, TITANIUM & ALL HIGH NICKLE GRADES.

ALL ITEMS IN BRASS, COPPER, ALUMINUM, CARBON STEEL, MILD STEEL & BOILER QUALITY (BQ) ITEMS.

Being all leading stockiests, we are in a position to cater all your requirements of the above mentioned items. We are regularly supplying these items to many leading industrial Units consisting of CHEMICALS/ FERTILIZERS/PETROCHEMICAL PLANTS, PAPER MILLS, CEMENT PLANTS/ SUGAR MILL/ FABRICATION UNITS etc.

We also supply these items especially Stainless Steel Sheets/ Plates/ Coils/ Pipes to Engi

.:: QUALITY POLICY

QUALITY POLIC

Strict quality assurance system is being followed in all our departments and Total Qulaity Management is applied to streamline and all the procedures and practices in operation to achieve high standard of efficiency Contionious efforts are being made for improvement of materials technology and equipments to give best quality products at the most affordable prices.

The quality assurance dept oversees all important quality functions and performs the following activities :

1) The system controls the quality of all incoming materials as per the raw material test certificate of the material. Randomly checking in each size for chemical and physical properties at Government approved laboratory.

2) During forming pressing forging and heat treatment process control system outlines inprocess checks and controls to be followed during heat treatment and testing.

3) Suitables fixtures and templates are used to maintain dimensional accuracy necessary guages and callipers are calibrated periodically to maintain their acuuracy.

4) Fittings are supplied with with test certificate as per approved QAP. Test certificates incorporate chemical composition, mechanical properties hardness detail of heat treatment Ultrasonic test Radiography test and stamping details.

QUALITY OBJECTIVES:

We consider three elements to be essential for the overall quality of the company services :

INDEPENDENCE & OBJECTIVITY
TECHNICAL & SCIENTIFIC QUALITY
PRACTICAL BENEFITS TO CLIENTS.

QUALITY ACTVITIES:

The quality assurance dept oversees all important quality functions and performs the following activities :

1) The system controls the quality of all incoming materials as per the raw material test certificate of the material. Randomly checking in each size for chemical and physical properties at Government approved laboratory.

2) During forming, pressing, forging and heat treatment process control system outlines inprocess checks and controls to be followed during heat treatment and testing.

3) Suitables fixtures and templates are used to maintain dimensional accuracy; necessary gauges and callipers are calibrated periodically to maintain their accuracy.

4) Materials are supplied with test certificate as per approved QAP. Test certificates incorporate chemical composition, mechanical properties, hardness detail of heat treatment, Ultrasonic test, Radiography test and stamping details.

(NICKEL BASE ALLOYS) GUIDE TO APPLICATIONS

NICKEL 200	Commercial pure wrought Nickel for the construction of chemical plant
NICKEL 201	A law-carbon grade of nickel free from the stress- corrosion cracking associated with graphitisation in chemical plant operating at temperatures above 300^0 C, e.g. castic soda plant.
NICKEL 205	A high-purity nickel for anodes, plants and grids of electronic valves and for megnetostrictive transducers.
NICKEL 212	Slightly stiffer than pure nickel, used for electrode support wires in radio valves and tungsten filament lamps.
NICKEL 222	A cathode nickel for the sleeves of indirectly heated, oxide-coated cathodes in radio valves.
NICKEL 270	A high-purity nickel with a minimum temperature - coefficient of resistant of 0.006^{0}c over the range 0.100^{0}C. Made by the powder metallurgy process. Used for components of special valves., such as hydrogen thyratons and for electric resistance thermometers and controls.
MONEL alloy 400	A general engineering alloy with good resistance to corrosion by sea water, sulphuric, hydrochloric and phosphoric acids, pharmaceutial products, ammonium sulphate, fatty acids, etc. It retains its strength and toughness up to about 4500^{0}c and is used for chemical, steam and petroleum plant, marine and pickling equipment,
MONEL alloysK-500	An alloy with similar corrosion-resistance to MONEL alloy 400 but amenable to precipitation hardening to give high strength. Used for propeller and pump shafts, bolts, doctor blades and valve spindles.
CAST MONEL alloys	Cast alloy pig supplied for foundry addition to silicon. For corrosion-resistance castings.
INCONEL alloy 600	This alloy has excellent mechanical properties and oxidation-resistance at high temperatures. It is used for furnace parts, heat-treatment equipment, heating element sheating in nuclear engineering and in the construction of chemical plant.
INCONEL alloy 625	An alloy with high strength and toughness from cryogenic temperatures to 100^{0}C in addition to good oxidation-resistance. It resist attack by other media and is virtually immune to chlo ride-stress corrotion cracking. It is used in aerospace and is being evaluated for chemical and marine engineering.
INCOLOY alloy 800	This alloy resist hydrogen/hydrogen sulphide corrosion and chlorides stress corrosion cracking. It is based for pigtails and headers and hydrocarbon “cracker” tubes for other high-temperature processing equipment.
INCOLOY alloy 825	This product resist corrosion by acids and alkalies in either reducing or oxidising conditions. It is resistant to stress-corrosion cracking and pitting and used for chemical plant and pickling plant. A nickel iron cobalt alloy combining a low coefficient of expansion and higher inflexion temperature with higher strength than is usual in this composition range. It is being evaluated for such applications as diesel engine piston crowns compensating members in gas turbine engines and controlled clearance rotating machinery parts.
INCOLOY alloy Ds	A general purpose heat resisting alloy with particular resistance to carburisation and alternating carburisation and oxdition. It is used for furnace parts, heat treatment and vitreous enamelling equipment.

NICKEL BASE ALLOYS

NOMINAL CHEMICAL COMPOSITION, % (not for specification purposes)

Nickel	NI	C	Mn	Fe	S	Si	Cu	Cr	Co	Mo	Al	TI	Other
Nickel	99.5	0.08	0.018	0.2	0.005	0.18	0.13	-	-	-	-	-	-
Nickel201	99.5	0.01	0.018	0.2	0.005	0.18	0.13	-	-	-	-	-	-
Nickel205	99.5	0.08	0.018	0.010	0.004	0.08	0.08	-	-	-	-	0.03 Mg	0.05
Nickel212	97.7	0.010	2.0	0.05	0.005	0.05	0.03	-	-	-	-	-	-
Nickel222	99.5	0.01	0.02	0.04	0.0025	0.01	0.01	0.01	0.06	0.01	0.01	Mg0.08	
Nickel270	99.98	0.01	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	<0.001	Mg<0.001	
	Ni	C	Mn	Fe	S	SI	Cu	Cr	Co	Mo	Ai	Ti	Other
MONEL alloy 400	63.0 min	0.15	1.0	25max	0.024max	0.05max	31.0	-	-	-	-	-	-
MONEL alloy 500	63.0 min	0.015	1.5 max	2.0max	0.010max	0.5	30.0	-	-	-	2.9	0.6	-
Cast MONEL alloy	63.0 min	0.07	0.75	2.5max	0.02 max	0.04max	30.0	0.10max	-	0.20max	0.05max	0.01max	-
Cast MONEL alloy	63.0 min	0.03max	0.020max	2.5max	0.02max	0.04max	30.0	0.10	-	0.20max	0.05max	0.01max	-
INCONEL alloy 600	72.0MIN	0.15MAX	1.0MAX	8.0	0.015 max	0.05max	0.05 max	15.5	-	-	-	-	Nb + Ta
INCONEL alloy 625	60.5	0.10max	0.25	5.0max	0.015max	0.5 max	-	21.5	-	9.0	0.25	0.25	3.65
INCOLOY alloy 800	32.5	0.10max	1.5max	Bal.	0.015max	1.0max	0.75 max	21.0	-	-	0.38	0.38	-
INCOLOY alloy 825	42.0	0.05max	1.0max	Bal.	0.03 max	0.5max	2.25	21.5	-	3.0	0.20max	0.9	-
INCOLOY alloy 904	32.5	0.025	0.025	Bal.	0.015	0.25	0.25	-	14.5	-	0.1	1.6	-
INCOLOY alloy DS	37.0	1.2	1.2	Bal.	-	2.3 max	2.3 max	18.0	-	-	-	0.20	
Hastalloy B	Rest/Bal	0.10	0.80	5.58	0.7		0.6	1.25	28	-	-	-	-
Hastalloy C	Rest/Bal	0.07	0.80	5.75	0.7		16.0	1.25	17 -	-	-	-	
Hastalloy G Alloy	Rest/Bal	0.05	1.0-2.0	18.0-21.0	0.7		1.5 21-23.5	1.25	5.575	-	-	-	-

PHYSICAL AND MECHANICAL PROPERTIES

Nickel	Density Kg/mm² C	Melting range at 20⁰C	Specific heat Conductivity J/Kg C	Thermal expansion at 20⁰C W/m C	Thermal resistivity 10-c/C 20-95⁰C	Electrical Strength at 20⁰C Mocrohm cm	Tensile HV N/mm²	Hardness
Nickel 200	8.89	1435-1445	456	74.9	13.3	9.5	380-550	90-120
Nickel 201	8.89	1435-1445	456	79.2	13.3	7.6	340-420	75-100
Nickel 205	8.89	1435-1445	456	74.9	13.3	9.5	340	77
Nickel 212	8.89	1435-1445	430	44.1	-	10.9	476	144
Nickel 222	8.89	1435-1445	456	74.9	13.3	8.8	340	77
Nickel 270	8.89	1435-1445	460	85.7	13.3	7.5	340	80
MONEL alloy 400	8.83	1300-1350	419	21.7	14.1	51.0	480-620	111-151
MONEL alloy K-500	8.46	1315-1350	419	17.4	13.7	61.4	620-760	141-189
INCONEL alloy 600	8.42	1370-1425	461	14.8	13.3	103	550-690	121-173
INCONEL alloy 625 8.	8.44	1290-1350	410	9.8	12.8	129	830-1040	146-247
INCOLOY alloy 800	7.95	1355-1385	502	11.7	14.2	99	520-700	121-188
INCOLOY alloy 825	8.14	1370-1400	441	10.9	14.0	113	590-730	121-183
INCOLOY alloy 904	8.12	-	442	14.9	4.6	72	923	-
INCOLOY alloy DS	7.92	1330-1400	452	12.0	14.1	108	680	208

STAINLESS STEEL PIPE, SCHEDULE, DIMENSION,

DESIGNATION		O/D	NOMINAL WALL THICKNESS														
OF DIAMETER		DIA	SCH.5S		SCH.5		SCH.10S		SCH.10		SCH.20S.		SCH.30		SCH.40S		SCH. 40
(A)	(B)	METER MM	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK
6	1/8	10.3	1.0	0.23			1.2	0.27			1.5	.33			1.73	0.37	
8	1/4	13.7	1.2	0.37			1.65	0.49			2.00	.58			2.24	0.64	
10	3/8	17.2	1.2	0.47			1.65	0.63			2.00	.74			2.31	0.87	
15	1/2	21.3	1.65	0.81	1.65	0.81	2.11	1.02	2.11	1.02	2.5	1.15			2.77	1.29	
20	3/4	26.7	1.65	1.03	1.65	1.03	2.11	1.30	2.11	1.30	2.5	1.49			2.87	1.71	
25	1	33.4	1.65	1.31	1.65	1.31	2.77	2.13	2.77	2.13	3.00	2.24			3.38	2.54	
32	11/4	24.2	1.65	1.67	1.65	1.67	2.77	2.73	2.77	2.73	3.00	2.90			3.56	3.44	
40	11/2	48.3	1.65	1.93	1.65	1.93	2.77	3.16	2.77	3.16	3.00	3.35			3.68	4.11	
50	2	60.3	1.65	2.42	1.65	2.42	2.77	3.99	2.77	3.99	3.5	4.90			3.91	5.52	
65	21/2	73.0	2.11	3.75	2.11	3.75	3.05	5.34	3.05	5.34	3.5	6.00			5.16	8.77	
80	3	88.9	2.11	4.59	2.11	4.59	3.05	6.56	3.05	6.56	4.00	8.37			5.49	11.47	
90	31/2	101.6	2.11	5.25	2/11	5.25	3.05	7.53	3.05	7.53	4.00	9.62			5.74	13.78	
100	4	114.3	2.11	5.93	2.11	5.93	3.05	8.50	3.05	8.50	4.5	12.18			6.02	6.32	
125	5	141.3	2.77	9.61	2.77	9.61	3.40	11.74	3.40	11.74	5.00	16.80			6.55	22.10	
150	6	168.3	2.77	11.47	2.77	11.47	3.40	14.04	3.40	14.04	5.5	22.08			7.11	28.69	
200	8	219.1	2.77	15.00	2.77	15.00	3.76	20.77	3.76	20.27	6.35	33.82	7.04	37.38	8.18	43.20	
250	10	273.1	3.40	22.95	3.40	22.95	4.19	28.20	4.19	28.20	6.35	42.41	7.80	51.81	9.27	61.22	
300	12	323.9	3.96	31.72	4.19	33.60	4.57	36.54	4.57	36.54	6.35	50.48	8.38	66.20	9.53	75.01	10.31
350	14	355.6	3.96	34.86			4.78	41.99	6.35	55.53	7.92	68.95	9.53	82.58	9.53	82.58	11.13
400	16	406.4	4.19	42.20			4.78	48.07	6.35	63.61	7.92	79.03	9.53	94.70	9.53	94.70	12.70
450	18	457.2	4.19	47.46			4.78	54.15	6.35	71.69	7.92	89.10	11.13	124.32	9.53	106.83	14.27
500	20	508.0	4.78	60.23			5.54	69.70	6.35	79.76	9.53	118.93	12.70	157.51	9.53	118.9	15.06
550	22	558.8	4.78	65.95			5.54	76.75	6.35	87.84	9.53	131.07	12.70	173.66	9.53	131.07	15.88
600	24	609.6	5.54	83.80			6.35	95.92	6.35	95.92	9.53	143.20	14.27	212.72	9.53	143.20	17.45
650	26	660.4							7.92	129.40	12.70	205.97			9.53	155.32	
700	28	711.2							7.92	139.47	12.70	222.13	15.88	276.48	9.53	167.44	
750	30	762.0	6.35	120.15			7.92	149.55	7.92	149.55	12.70	238.28	15.88	296.68	9.53	179.56	
800	32	812.8							7.92	159.62	12.70	254.44	15.88	316.88	9.53	191.69	17.48
850	34	863.6							7.92	169.64	12.70	270.50	15.88	336.96	9.53	203.74	17.48
900	36	914.4							7.92	179.77	12.70	286.75	15.88	357.28	9.53	215.93	19.05

WALL THICKNESS, WEIGHT/METER

NOMINAL WALL THICKNESS																
	SCH 60		SCH 80 S		SCH.80		SCH.100		SCH.120		SCH.140		SCH.160		SCH.XXS	
WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR	WALL THK	WEIGHT KG/MTR
			2.41	0.47												
			3.02	0.82												
			3.20	1.12												
			3.73	1.64									4.75	1.97	7.47	2.59
			3.91	2.93									5.54	2.93	7.82	3.69
			4.55	3.29									6.35	4.30	9.09	5.53
			4.85	4.53									6.35	5.69	9.70	7.88
			5.08	5.49									7.14	7.35	10.16	9.69
			5.54	7.60									8.71	11.26	11.07	13.65
			7.01	11.59									9.53	15.15	14.02	20.72
			7.62	15.51									11.13	21.67	15.24	28.11
			8.08	18.92											16.15	34.56
			8.56	22.66					11.13	28.75			13.49	34.05	17.12	41.66
			9.53	31.44					12.70	40.90			15.88	49.87	19.05	58.31
			10.97	43.21					14.27	55.03			18.24	68.53	21.95	79.1
	10.81	53.90	12.70	65.63			15.06	76.93	18.24	91.73	20.62	102.47	23.01	112.97	22.23	108.00
	12.20	82.80	12.70	82.80	15.06	97.27	18.24	116.38	21.41	134.90	25.40	157.51	28.58	174.95	25.40	155.5
80.94	14.27	110.62	12.70	98.95	17.45	133.88	21.41	162.14	25.40	189.82	28.58	211.31	33.32	242.40	25.40	189.82
96.00	15.06	128.42	12.70	109.04	19.05	160.54	23.80	197.74	27.76	227.88	31.75	257.47	35.71	286.04		
125.20	16.66	162.59	12.70	125.20	21.41	206.40	26.19	249.34	30.94	290.88	36.53	338.32	40.46	370.74		
158.27	19.05	209.00	12.70	141.35	23.80	258.29	29.36	314.54	34.93	369.34	39.67	414.74	45.24	466.67		
185.89	20.62	251.65	12.70	157.51	26.19	315.97	32.54	387.41	38.10	448.30	44.45	515.94	49.99	573.31		
216.04	22.23	298.55	12.70	173.66	28.57	379.70	34.92	457.83	41.27	535.17	47.62	609.30	53.97	682.57		
258.74	24.59	360.21	12.70	189.82	30.94	448.30	38.89	555.76	46.02	649.44	52.37	730.72	59.51	819.70		
			12.70	205.97	24.66D-t) t											
			12.70	222.13	1000											
			1270	238.28	Wt/pam + formula											
348.11			12.70	254.44	Weight stainless steel pipe											
370.22			12.70	270.50	OD (mm) - W.T. (mm) XW.T. (mm) X 0.02466 = Kg. per mtr.											
427.09			12.70	286.75												

STAINLESS STEEL PIPE & TUBE KG/MTRS

N.B	O.D	Schedule		Schedule		Schedule		Schedule		Schedule		Schedule	
		5 S		10 S		40 S		80 S		160		XX-Strong	
		Wall											
Inch	mm	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m	mm	kg/m
1/8”	10.29			1.24	0.281	1.73	0.371	2.41	0.476				
1/4”	13.72			1.65	0.498	2.24	0.643	3.02	0.809				
3/8”	17.15			1.65	0.640	2.31	0.858	3.20	1.12				
1/2”	21.34	1.65	0.814	2.11	1.01	2.77	1.29	3.73	1.65	4.78	1.98	7.47	2.59
3/4”	26.67	1.65	1.033	2.11	1.30	2.87	1.71	3.91	2.23	5.56	2.94	7.82	3.69
1”	33.40	1.65	1.31	2.77	2.12	3.38	2.54	4.55	3.29	6.35	4.30	9.10	5.53
11/4”	42.16	1.65	1.67	2.77	2.73	3.56	3.44	4.85	4.53	6.35	5.59	9.70	7.88
11/12”	48.26	1.65	1.925	2.77	3.15	3.68	4.11	5.08	5.49	7.14	7.35	10.16	9.69
2”	60.33	1.65	2.424	2.77	3.99	3.91	5.52	5.54	7.60	8.74	11.29	11.07	13.65
2 1/2”	73.03	2.11	3.75	3.05	5.34	5.16	8.77	7.01	11.6	9.53	15.15	14.02	20.71
3”	88.90	2.11	4.58	3.05	6.56	5.49	11.5	4.62	15.5	11.13	21.67	15.24	28.11
3 1/2”	101.60	2.11	5.26	3.05	7.53	5.74	13.8	8.08	18.9				
4”	114.30	2.11	5.93	3.05	8.50	6.02	16.3	8.56	22.7	13.49	34.05	17.12	41.66
5”	141.30	2.77	9.61	3.40	11.74	6.55	22.1	9.53	31.4	15.88	49.87	19.05	58.31
6”	168.28	2.77	11.48	3.40	14.0	7.11	28.7	10.97	43.2	18.26	68.59	21.95	80.43
8”	219.08	2.77	15.00	3.76	20.27	8.18	43.2	12.70	65.5	23.01	113.01	22.22	109.57
10”	273.05	3.40	22.96	4.19	28.21	9.27	61.23	12.70	82.79	28.58	174.90	25.40	157.51
12”	323.85	3.96	31.72	4.57	36.54	9.53	74.93	12.70	98.95	33.32	242.53	25.40	189.81
14”	355.60	3.96	34.9	4.78	41.9								
16”	406.40	4.19	49.2	4.78	48.1								
18”	457	4.19	47.5	4.78	54.2								
20”	508	4.78	60.2	5.54	69.9								
24”	610	5.54	83.9	6.35	96.0								

N.B	O.D	Schedule 20[1)]		Schedule 120[1)]	
		Wall			
Inch	mm	mm	kg/mm	mm	kg/m
4”	114.30			11.13	28.8
5”	141.30			12.70	40.9
6”	168.28			14.27	55.0
8”	219.08	6.35	33.8	18.26	91.8
10”	273.08	6.35	42.4	21.44	135.1
12”	323.85	6.35	50.4	25.40	189.8
14”	355.60	7.92	68.9	27.79	228.1
16	406.40	7.92	79.0		
18”	457.20	7.92	89.1		
20.”	508	9.53	118.9		
24”	610	9.53	143.3		

ANSI B 36.10

Gauge	BWG Birmingham/Stubs Iron Wire and Sheets		SWG Imperial / Legal Standards Wire Gauge	
	inch	mm	inch	mm
14	0.0830	2.108	0.0800	2.032
16	0.0650	1.651	0.0640	1.626
18	0.0490	1.245	0.0480	1.219
20	0.0350	0.889	0.0360	0.914

DN	DIN 2440, O.D mm	for threading Wall mm	Din 2633, Welding neck flanges Tube O.D Group 1,mm	Tube O.D Group2, mm
6	10.2	2.0		
8	13.5	2.35		
10	17.2	2.35	17.2	14
15	21.3	2.65	21.3	20
20	26.9	2.65	26.9	25
25	33.7	3.25	33.7	30
32	42.4	3.25	42.4	38
40	48.3	3.25	48.3	44.5
50	60.3	3.65	60.3	57
65	76.1	3.65	76.1	
80	88.9	4.05	88.9	
100	114.3	4.5	114.3	108
125	139.7	4.85	139.7	133
150	165.1	4.85	168.3	159
175			193.7	
200			219.1	
250			273	267
300			323.9	
350			355.6	368
400			406.4	419

Here is a digest of two German specification showing DN. These tables are given for guidance only. The fitting catalogue S-1131-ENG gives futher information about DIN 2633.

Alternations in the programme may be made without further notice

TOLERANCE: ASTM SPECIFICATION FOR TUBING & PIPING

Specification	Allowable Outside Diameter Variation in mm			Allowable Wall Thickness Variation		Exact Length Testing Tolerance in mm		
	Nominal Diameter	Over	Under	%Over	%Under	Over	Under	
ASTM-A213 Seamless Boiler Superheater and Heat Exchanger Tubes	Under 25.4 25.4-38.1 incl 38.1-50.8 excl 50.8-63.5 excl 63.5-76.2 excl 76.2-101.6 incl	.1016 .1524 .2032 .254 .3048 .381	.1016 .1524 .2032 .254 .3048 .381	+20 +22 +22 +2 +22 +22	-0 -0 -0 -0 -0 -0	3.175 3.175 3.176 4.46 4.76 4.76	0 0 0 0 0 0	Tension Test Flattening Test Flare Test Hardness Test 100% Hydrostatic test Refer to ASTM A-450
ASTM-A249 Welded Boiler Superheater, Heat Exchanger And Condenser Tubes	Under 25.4 25.4-38.1 incl 38.1-50.8 Excl 50.0-63.5 excl 63.5-76.2 excl 76.2-101.6 incl	.1016 .1524 .2032 .254 .3848 .381	.1016 .1524 .2032 .254 .3048 .381	+10 +10 +10 +10 +10 +10 Minimum Wall tubes + 18% 0 available On request	-10 -10 -10 -10 -10 -10	3.175 3.175 3.175 4.76 4.76 4.76	0 0 0 0 0 0	Tension Test Flattening Test Flare Test Reverse Bend Test Hardness Test 100% Hydrostastic Test *Reverse flattening Test Refer to ASTM A-450 *Wherever applicable
ASTM-A269 Seamless & Welded Tubing for General Service	Untp 12.7 12.7-38.1 excl 38.1-88.9 excl 88.9-139.7 excl 139.7-203.2 excl	.13 .13 .25 .38 .76	.13 .13 .25 .38 .76	+15 +10 +10 +10 +10	-15 -10 -10 -10 -10	3.2 3.2 4.8 4.8 4.8	0 0 0 0 0	Flare Test Flance Test (Welded Only) Hardness Test Reverse Flattening Test (Welded only) 100% Hydrostatic Test Refer to ASTM-A269
ASTM-A270 Semless & Welded Sanitary Tubing	25.4 38.1 50.8 60.5 76.2 101.6	.05 .05 .05 .05 .08 .08	.20 .20 .28 .28 .30 .38	+12.5 +12.5 +12.5 +12.5 +12.5 +12.5	-12.5 -12.5 -12.5 -12.5 -12.5 -12.5	3.2 3.2 3.2 3.2 3.2 3.2	0 0 0 0 0 0	Reverse flattening Test 100% Hydrostastic Test Externa' polish on all tubes Refer to ASTM A-270
ASTM-A312 Semless & Welded pipe	3.175-38.1 incl 38.1-1016 incl 101.6-203.2 imcl	.4 .79 1.59	.79 .79 .79	Minimum Wall 12.5% under nominal wall Specified		6.4 6.4 6.4 (Normally Random Lengths ordered	0 0 0	Tension Test Flattening Test 100% Hydrostatic Test Refer to ASTM A-530
ASTM A-358 Welded pipe	219.08-750mm or 0.01 inch	+0.5%		-0.3		6.0		Refer to ASTM A-530

CHEMICAL COMPOSITION OF S. S. PIPES & TUBES

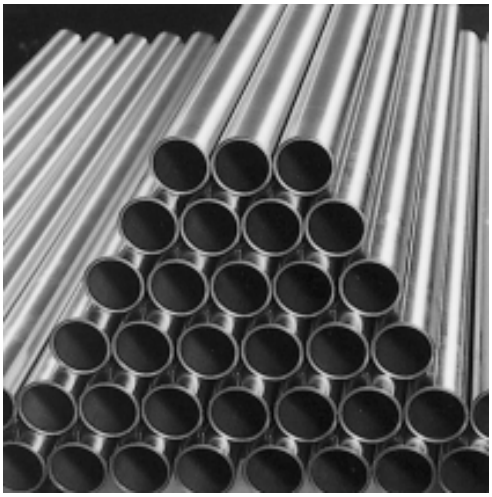
Grade	UNS Design-ation	Composition %															
		Carbon max	Manga-nese max	Sulfur max	Phos-phorus max	Silicon	Nickel	Chromium	Molyb-denum	Tita-nium	Colum-blum plus Tantalum	Tanta-lum max	Nitrogen[C]	Vana-dium	Copper	Cerlum	Bom
TP304	S30400	0.08	2.00	0.040	0.030	0.75 max	8.00-11.0	18.0-20.0	--	--	--	--	--	--	--	--	--
TP304H	S30409	0.04-0.10	2.00	0.040	0.030	0.75 max	8.00-11.0	18.0-20.0	---	---	---	---	---	---	---	---	
TP304L	S30403	0.035	2.00	0.040	0.030	0.75 max	8.00-13.0	18.0-20.0	---	---	---	---	---	---	---	---	
TP304N	S30451	0.08	2.00	0.040	0.030	0.75 max	8.00-11.0	18.0-20.0	---	---	---	---	0.10-0.16	---	---	---	
TP304LN	S30453	0.035	2.00	0.040	0.030	0.75 max	8.00-11.0	18.0-20.0	---	---	---	---	0.10-0.18	---	---	---	
TP309Cb	S30940	0.08	2.00	0.045	0.030	0.75 max	12.0-16.0	22.0-24.0	0.75 max	---	10 x C min 1.10 max	---	---	---	---	---	
TP309H	S30909	0.04-0.10	2.00	0.040	0.030	0.75 max	12.0-15.0	22.0-24.0	---	---	---	---	---	---	---	---	
TP309HCb	S3041	0.04-0.10	2.00	0.045	0.030	0.75 max	12.0-16.0	22.0-24.0	0.75 max	---	10 x C min 1.10 max	---	---	---	---	---	
TP309S	S30908	0.08	2.00	0.045	0.030	0.75 max	12.0-15.0	22.0-24.0	0.75 max	---	---	---	---	---	---	---	
TP310Cb	S31040	0.08	2.00	0.045	0.030	0.75 max	19.0-22.0	24.0-26.0	0.75 max	---	10 x C min 1.10 max	---	---	---	---	---	
TP310H	S31009	0.04-0.10	2.00	0.040	0.030	0.75 max	19.0-22.0	24.0-26.0	---	---	---	---	---	---	---	---	
TP310HCb	S31041	0.04-0.10	2.00	0.045	0.030	0.75 max	19.0-22.0	24.0-26.0	0.75 max	---	10 x C min 1.10 max	---	---	---			
TP310S	S31008	0.08	2.00	0.045	0.030	0.75 max	19.0-22.0	24.0-26.0	0.75 max	---	---	---	---	---		---	
	S31272	0.08-0.12	1.5 2.00	0.030	0.015	0.3-0.7	14.0-16.0	14.0-16.0	1.0-1.4	0.3-0.6							0.04 0.00
TP316	S31600	0.08	2.00	0.040	0.030	0.75 max	11.0-14.0	16.0-18.0	2.00-3.00	---	---	---	---	---	---	---	
TP316H	S31609	0.04-0.10	2.00	0.040	0.030	0.75 max	11.0-14.0	16.0-18.0	2.00-3.00	---	---	---	---	---	---	---	
TP316L	S31603	0.035	2.00	0.040	0.030	0.75 max	10.0-15.0	16.0-18.0	2.00-3.00	---	---	---	---	---	---	---	
TP316N	S31651	0.08	2.00	0.040	0.030	0.75 max	11.0-14.0	16.0-18.0	2.00-3.00				0.10-0.16	--	---	---	
TP316LN	S31653	0.035	2.00	0.040	0.030	0.75 max	11.0-14.0	16.0-18.0	2.00-3.00	---	---	---	0.10-0.18	---	----	---	
TP317	S31700	0.08	2.00	0.040	0.030	0.75 max	11.0-14.0	18.0-20.0	3.00-4.00	---	---	---	---	---	---	---	
TP317L	S31703	0.035	2.00	0.040	0.030	0.75 max	11.0-15.0	18.0-20.0	3.00-4.00	---	---	---	---	---	---	---	
TP321	S32100	0.08	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	---	[F]	---	---	---	---	---	---	
TP321H	S32109	0.04-0.10	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	---	[G]	---	---	---	---	---	---	
TP347	S34700	0.08	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	--	---	[H]	---	---	---	---	---	
TP347H	S34709	0.04-0.10	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	--	---	[I]	---	---	---	---	---	---
TP347LN	S34751	0.005-0.020	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	---	---	0.2-0.5[H]	---	0.06-0.10	---	---	---	
TP348	S34800	0.08	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	---	---	[H]	0.10	---	--	---	---	
TP348H	S34809	0.04-0.10	2.00	0.040	0.030	0.75 max	9.00-13.0	17.0-20.0	---	---	[I]	0.10	---	--	---	---	
TPXM 10	S21900	0.08-1000	8.00-10.00	0.040	0.030	1.00 max	5.50-7.50	19.0-21.5	---	---	---	---	0.15-0.40	---	---	---	
TPXM 11	S21904	0.04-10.00	8.00-10.00	0.040	0.030	1.00 max	5.50-7.50	19.0-21.5	---	---	---	---	0.15-0.40	---	---	---	
TPXM-15	S38100	0.08	2.00	0.030	0.030	1.50-2.50	17.5-18-5	17.0-19.0	---	---	---	---	---	---	---	---	
TPXM-19	S20910	0.060	4.00-6.00	0.040	0.030	1.00 max	11.5-13.5	20.5-3.00	1.50-3.00	---	0.10-0.30	---	0.20-0.40	0.10-0.30	---	---	
TPXM-29	S24000	0.080	11.5-14.5	0.060	0.030	1.00 max	2.25-3.75	17.0-19.0	---	---	--	---	0.20-0.40	---	---	---	
---	S31254	0.020	1.00	0.030	0.010	0.80 max	17.5-18.5	19.5-20.5	6.00-6.50	---	---	---	0.18-0.22	---	0.50-1.00		
---	S30615	0.16-0.24	2.00	0.030	0.030	3.2-4.0	13.5-16.0	17.0-19.5	---	---	---	---	---	---	---	---	
---	S30815	0.05-0.10	0.80	0.040	0.030	1.40-2.00	10.0-12.0	20.0-22.0	---	---	---	---	0.14-0.20	---	---	0.03-0.08	
---	S31050	0.025	2.00	0.020	0.015	0.4	20.5-23.5	24.0-26.0	1.6-2.6	---	---	---	0.09-0.15	---	---	---	
---	S30600	0.018	2.00	0.020	0.020	3.7-4.3	14.0-15.5	17.0-18.5	0.20 max	---	---	---	---	---	0.50 max	---	
---	S31725	0.03	2.00	0.040[J]	0.030	0.75	13.5-17.5	18.0-20.0	4.0-5.0	---	---	---	0.10 max	---	0.75 max	---	
---	S31726	0.03	2.00	0.040[J]	0.030	0.75	13.5-17.5	17.0-20.0	4.0-5.0	---	---	---	0.10-0.20	---	0.75 max	---	
---	S32615	0.07	2.00	0.045	0.030	4.8-6.0	19.0-22.0	16.5-19.5	0.3-1.5	---	---	---	---	---	1.5-2.5	---	
---	S33228	0.04-0.08	1.00	0.020	0.015	0.30 max	31.0-33.0	26.0-28.0	---	---	0.6-1.0	---	---	---	---	0.05-0.10	---
---	S24565	0.03	5.0-7.0	0.030	0.010	1.00max	16.0-18.0	23.0-25.0	4.0-5.0	---	0.1 max		0.04-0.6	---	---	---	---
---	S30415	0.4-0.06	0.80	0.045	0.030	1.00-2.00	9.00-10.0	18.0-19.0	---	---	---	---	0.12-0.16	---	---	0.03-0.08	
---	S32654	0.020	2.00-4.00	0.030	0.005	0.50 max	21.0-23.0	24.0-25.0	7.00-8.00	---	---	---	0.45-0.55	---	0.030-0.60	---	
---	S35315	0.04-0.08	2.00	0.045	0.030	0.75	34.0-36.0	24.0-26.0	---	---	---	---	0.12-0.18	---	---	0.03-0.08	
---	N08367	0.030	2.00	0.030	0.030	1.00 max	23.50-25.50	20.00-22.00	6.00-7.00	---	---	---	0.18-0.25	---	0.75 max	---	---
---	N08904	0.020	2.00	0.045	0.035	1.00	23.0-28.0	19.0-23.0	4.0-5.0	---	---	---	0.10 max	---	1.0-2.0	---	---

New designation established in accordance with Practice E 527 and SAE J 1086.
Maximum, unless otherwise indicated.The method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.
For welded TP316, TP316N, TP316LN, and TP316H pipe, the nickel range shall be 10.0-14.0 %. For small diameter or thin walls or both, where many drawing passes are required, a carbon maximum of 0.040 % is necessary in grades TP304L and TP316L. Small diameter tubes are defined as those less 0.500 in (12.7mm) in outside diameter and light wall tubes as those less than 0.049 in (1.20 mm) in average wall thickness (1.10 mm) in minimum wall thickness
The titanium content shall be not less than five times the carbon content and not more than 0.70 %. The titanium content shall be not be less than four times the carbon content and not more than 0.60 %. The Columblum plus titanium content shall be not less than ten times carbon content and not more than 1.00 %.
The Columblum plus titanium content shall be not less than eight times carbon content and not more than 1.00 %.
For welded pipe, the phosphorus maximum shall be 0.045 %. Grade S34751 shall have a columblum (Nioblum) plus tantalum content of not less than 15 times the carbon content.

MECHANICAL PROPERTIES OF S.S.PIPES

Table-2 Annealing Requirements — A 312/A 312M — Table-3 Tensile Requirements

Grade or UNS Designation	Solution Treating Temperature	Cooling Requirements
All Grades not individually listed below	1900ºF(1040ºC)	rapid[c]
TP321H, TP347H, TP348H		
Cold Rolled	2000ºF (1100ºC)	
Hot Rolled only	1925ºF (1050ºC)	
TP304H, TP316H		
Cold Rolled	1900ºF (1040ºC)	
Hot rolled only	1900ºF (1040ºC)	
TP309H, TP309HCb, TP310H	1900ºF (1040ºC)	
TP310HCb		
S30815	1920ºF (1050ºC)	rapid
S31272	1920ºF (1050ºC)	rapid
S31254	2100ºF (1150ºC)	rapid
S24565	2050-2140ºF (1120-1170ºC)	rapid
S35315	2010ºF (1100ºC)	rapid
N08367	2010ºF (1100ºC)	rapid
N08904	2010ºF (1100ºC)	rapid



Grade	UNS Designation	Tensile Strength, min Ksi (MPa)	Yield Strength, Min Ksi (MPa)
TP304L	S30403	70 (485)	25 (170)
TP316L	S31603	70 (485)	25 (170)
TP304	S30400	75 (515)	30 (205)
TP304H	S30409	75 (515)	30 (205)
TP309Cb	S30940	75 (515)	30 (205)
TP309H	S30909	75 (515)	30 (205)
TP309HCb	S30941	75 (515)	30 (205)
TP309S	S30908	75 (515)	30 (205)
TP310Cb	S31040	75 (515)	30 (205)
TP310H	S31009	75 (515)	30 (205)
TP310HCb	S31041	75 (515)	30 (205)
TP310S	S31008	75 (515)	30 (205)
	S31272	65 (450)	29 (200)
TP316	S31600	75 (515)	30 (2050
TP316H	S31609	75 (515)	30 (205)
TP317	S31700	75 (515)	30 (205)
TP317L	S31703	75 (515)	30 (205)
TP321	S32100		
Welded		75 (515)	30 (205)
Seamless			
≤ 3/8 in.		75 (515)	30 (205)
> 3/8 in.		70 (485)	25 (170)
TP321H	S32109		
Welded		75 (515)	30 (205)
Seamless			
< 3/8 in.		75 (515)	30 (205)
> 3/8 in.		70 (485)	25 (170)
TP347	s34700	75 (515)	30 (205)
TP347H	S3470	75 (515)	30 (205)
TP347LN	S34751	75 (515)	30 (205)
TP348	S34800	75 (515)	30 (205)
TP348H	S34809	75 (515)	30 (205)
TPXM-10	S21900	90 (620)	50 (345)
TPXM-11	S21904	90 (620)	50 (345)
TPXM-15	S38100	75 (515)	30 (205)
TPXM-29	S24000	100 (690)	55 (380)
TPXM-19	S20910	100 (690)	55 (380)
TP304N	S30451	80 (550)	35(240)
TP316N	S31651	80 (550)	35 (240)
TP304LN	S31653	75 (515)	30 (205)
---	S31254	94 (650)	44 (300)
---	S30615	90 (620)	40 (275)
---	S30815	87 (600)	45 (310)
---	S30600	78 (540)	35 (240)
---	S31725	75 (515)	30 (205)
---	S31726	80 (550)	35 (240)
---	S31050		
T<0.25 IN.		84 (580)	39 (270)
T>0.25 in.		78 (540)	37 (255)
---	S32615	80 (550)	32 (220)
---	S33228	73 (500)	27 (185)
---	S24565	115 (795)	60 (415)
---	S30415	87 (600)	42 (290)
---	S32654	109 (750)	62 (430)
---	S35315	94 (650)	39 (270)
---	N08367:		
t<0.187		100 (690)	45 (310)
t>0.187		95 (655	45 (310)
---	N08904	71(490)	31(215)

Elongation in 2 in or 50 mm (or 4D), min,% Longitudinal Transverse
All Grades except S 31050 and S 32615 35 25 S32615, S31050 25 --NO8367
Prior to the inssuance of A 312/A 312 M- 88a, the tensile and yield strength values were 76 (515) and 30 (205) respectively, for nominal wall greater than 3/8 in. (9.5 mm).

STAINLESS STEEL PIPES & TUBES- CHEMICAL COMPOSITION & MECHANICAL PROPERTIES

					Chemical Composition %									Tensile Test			
			Production Process.														
ASTM Specifications	Grade	Scope	Steel	Tube	C	Mn	P	S	Si	Ni	Cr	Mo	Others	psi min	Kg/mm²	psi	Kg/mm²
A 268-62 T Seamless and Welded Ferritic Stainless Steel tubing for General Service	TP 405	General Corrosion resisting and high temperature service	Electric furnace	Seam-less or welded	0.08 max	1.00 max	0.040 max	0.030 max	0.75 max	0.50 max	11.5~ 13.5	- -	AIO.10 0.30	60000	42 min	30000 min	21 min
	TP 410				0.15	1.00 max	0.040 max	0.030 max	0.75 max	0.50 max	11.5~ 13.5	- -	-	60000 min			
	TP 430				0.12 max	1.00 max	0.040 max	0.030 max	0.75 max	0.50 max	16.0~ 18.0~	- -	- -	60000		35000 min	25 min
	TP 443				0.20 max	1.00 max	0.040 max	0.030 max	0.75 max	0.50 max	18.0~ 23.0~	-	Cu 0.90-1.25	70000 min 70000	47 min	40000 min	26 min
	TP 446				0.20 max	1.50 max	0.040 max	0.030 max	0.75 max	0.50 max	23.0~ 30.0~	- -	No 10-0.25				
	TP 329				0.20 max	1.00 max	0.040 max	0.030 max	0.76 max	2.50 5.00	23.0~ 28.0	1.0-2.0	-	75000 min	53 min	45000 min	32 min
A 269-62 T Seamless and Welded Austenitic Stainless Steel tubing for General Service	TP 304	General Corrosion resisting and high temperature service	Electric furnace	Seam-less or welded	0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	8.0-11.0	18.0 20.0	-	-				
	TP 304L				0.035 max	2.00 max	0.040 max	0.030 max	0.75 max	8.00~ 13.00	18.00~ 20.00	-	-				
	TP 316				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	11.0~ 14.0~	16.0~ 18.0	2.0-3.00	- -				
	TP 316L				0.035 max	2.00 max	0.040 max	0.030 max	0.75 max	10.00 15.00	16.00~ 18.00	2.00 3.00	-				
	TP 317				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	11.0~ 14.0	18.0~ 20.0	3.0~ 4.00	-				
	TP 321				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0~ 20.0	-	Ti 5 x C-0.60				
	TP 347				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0~ 20.0	-	(Co+To)10 xC-1.0				
	TP 348				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0~ 20.00	-					
	TP 304				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	8.0~ 11.0	18-0~ 20.2		(Co+To) 10 Ta 0.10 max				
A 269-62 T Seamless and Austenitic Chromium-Nickel Steel Tubes for Refinery Service	TP 304H	General Corrosion resisting and high temperature service	Electric furnace	Seam-less or welded	0.04-0.10	2.00 max	0.040 max	0.030 max	0.75 max	8.0~ 11.0	18.0~ 20.0	-	-	75000 min	53 min	30000 min	21 min
	TP 321				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0 20.0	-	Ti 5xC-0.60				
	TP 321H				0.04-0.10	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0~ 20.0	-	Ti 4 x C 0.60				
	TP 347				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0~ 20.0	- -	(Co+To) 8 XC-1.0				
	TP 347H				0.04-0.10	2.00 max	0.040 max	0.030 max	0.75 max	9.0~ 13.0	17.0~ 20.0	-	(Co+To) 10 XC-1.0				
A 334-62 T Seamless hand Welded Carbon and Alloy-Steel I Tubes for low Tempera-ture Service (1)	0	Carbon and alloy steel tubes for low temperature service	Open hearth or Electric furnace	Seamless or automatic welding process with no addition of filler metal in the welding operation	0.25 max	0.64-1.06	0.050 max	0.060 max	-	-	-	-	-	55000 min	39 min	30000 min	21 min
	3				0.19 max	0.31-0.64	0.050 max	0.050 max	0.18~ 0.37	3.18~ 3.82	-	-	-	55000 min	39 min	30000 min	21 min
	5				0.19 max	0.20-0.64	0.050 max	0.050 max	0.18~ 0.37	4.68~ 5.32	-	-	-	65000 min	46 min	35000 min	25 min

STAINLESS STEEL PIPES & TUBES- CHEMICAL COMPOSITION & MECHANICAL PROPERTIES

Elongation (in 2 in %)		Flattening Test	Flaring Test		Hardness Test		Hydrostatic Test	Impact Test			
								Impact Temp.	Impact Requirement		
5/16 in & over in wall thickness	Standard round 2 in gauge length test specimen		d/D	d1 (min)	Brinel T T>0.200 (5.0mm)	Rockwell 0.200 in (15.0 mm)> t > 0.65 (1.7 mm)	Test Pressure psi (kg/cm²)	Min. impact test temp. deg-faht	Size of specimen mm	Min. average notched bar impact value of each set of three specimen ft-1b	Min. notched bar impact value of one specimen only of a set ft - 1b
20 min				1.10d	207 max	B 95 max	1000 (70) min 30000 (2110) x 1/D max	-	-	-	-
					207 max	B 95 max					
					190 max	B 90 max					
					207 max	B 95 max					
					207 max	B 95 max					
18 min	-				241 max	B 100max					
10 min	-										
			0.9	1.21 d							
			0.8	1.22 d							
			0.7	1.25 d							
			0.6	1.30 d	200 max	B 90 max	1000 (70) min 30000(2110) x 1/D max	-	-	-	-
			0.5	1.39 d							
			0.4	1.51 d							
			0.3	1.68 d							
			0.9	1.21 d							
			0.8	1.22 d							
			0.7	1.25 d	200 max		30000(2110) x 1/D d 3 IN (76.2 MM) 2500 (176) d 3 IN (76.2 MM) 4500 (316) MAX				
35 min			0.6	1.30 d							
			0.5	1.39 d							
			0.4	1.51 d							
			0.3	1.68 d							
35 min	28 min	Medium carbon steel $H=\frac{1.07\,t}{0.07+f/D}$ Ferritic alloy steel $H=\frac{1.08\,t}{0.08+t/D}$ Austenitic steel and 10W carbon steel $H=\frac{1.09f}{0.09+f/D}$	0.9	Carbon moly bodenum and austenitic steel: 1.21 d Other ferritic alloy steel: 1.15 d	163 max	B 85 max		- 50			
			0.8	Carbon moly bodenum and austenitic steel: 1.22 d Other ferritic alloy steel: 1.17 d							
			0.7	Carbon moly bodenum and austenitic steel: 1.25 d Other ferritic alloy steel: 1.19 d							
			0.6	Carbon moly bodenum and austenitic steel: 1.30 d Other ferritic alloy steel: 1.23 d	190 max	B 90 max	13200 (2250) x 1/D D 1 in (25.4 mm) 1000 (70) D 1 1/2 in (38.1 mm) 1500 (105) S 2 in (50.8) 2000 (141) D 3 in (76.2 mm) 2500 (176) D 5 in (127.0mm) 3500 (246) D 5 in (127.0 mm) 4500 (316) MAX	- 150	10 by 10	15	10
			0.5	Carbon moly bodenum and austenitic steel: 1.39 d Other ferritic alloy steel: 1.28 d	207 max	B 95 max			10 by 7.5	12.5	9.5
			0.4	Carbon moly bodenum and austenitic steel: 1.51 d Other ferritic alloy steel: 1.38 d					10 by 5	10	7.0
30 min	22 min		0.3	Carbon moly bodenum and austenitic steel: 1.68 d Other ferritic alloy steel: 1.50 d				- 150	10 by 2.5	5	3.5

STAINLESS STEEL PIPES & TUBES- CHEMICAL COMPOSITION & MECHANICAL PROPERTIES

ASTM Specification	Grade		Scope	Production Process		Chemical Composition %								
				Steel	Tube	C	Mn	P	S	Si	Cr	Mo	Ni	Others
A 209-62T Seamless Molybdenum Alloy Steel Boiler and Superheater Tubes	T 1		Boiler and supertheater tubes.	Open-hearth or electric furnace	Seamless (Hot-finished or cold drawn, as specified)	0.10~ 0.20	0.30~ 0.80	0.025~ max	0.025 max	0.10~ 0.50	-	0.44~ 0.65	- -	- -
	T 1a					0.15~ 0.25	0.30~ 0.80	0.025 max	0.025 max	0.10~ 0.50	- -	0.44~ 0.65	-	-
	T 1b		Supertheater tubes.			0.14 max	0.30~ 0.80	0.025 max	0.025 max	0.10~ 0.50	-	0.44~ 0.65	- -	- -
A 210-62T Seamless Medium Carbon Steel Boiler and Superheater Tubes			Boiler tubes and boiler flues (safe ends, arch and stay tubes and superheater tubes.	Open-hearth or electric furnace	Seamless (Hot-finished or cold drawn, as specified)	0.27 max	0.93 max	0.035 max	0.035 max	0.10 min	-	-	-	-
A 213-62T Seamless Medium And Austenitic Alloy steel Boiler, Superheater and Heat-Exchanger Tubes (1)	Ferritic steel.	T 2				0.10~ 0.20	0.30~ 0.61	0.025 max	0.025 max	0.10~ 0.30	0.50~ 0.81	0.44~ 0.65	-	-
		T 3b				0.15 max	0.30~ 0.60	0.030 max	0.030 max	0.50 max	1.65~ 6.00	0.44 0.65	-	-
		T 5				0.15 max	0.30~ 0.60	0.025 max	0.025 max	0.50 max	4.00~ 6.00	0.45~ 0.65	-	-
		T 5b				0.15 max	0.30~ 0.60	0.025 max	0.025 max	1.00~ 2.00	4.00~ 6.00	0.45~ 0.65	-	-
		T 5c				0.12 max	0.30~ 0.60	0.025 max	0.025 max	0.50 max	4.00~ 6.00	0.45~ 0.65	-	Ti 4 x C -0.78
		T 7				0.15 max	0.30~ 0.60	0.03 max	0.03 max	0.50~ 1.00	6.00~ 8.00	0.45~ 0.65	-	-
		T 9				0.15 max	0.30~ 0.60	0.025 max	0.025 max	0.25~ 1.00	8.00~ 10.00	0.90 1.10	-	-
		T 11				0.15 max	0.30~ 0.60	0.025 max	0.025 max	0.50~ 1.00	1.00~ 1.50	0.44~ 0.65	-	-
		T 12				0.15 max	0.30~ 0.61	0.025 max	0.025 max	0.50 nax	0.80~ 1.25	0.44~ 0.65	-	-
		T 17				0.15~ 0.25	0.30~ 0.61	0.025 max	0.025 max	0.15~ 0.35	0.80~ 1.25	-	-	Ve 0.15-min
		T 21	Boiler and Superheater tubes and heat exchanger tubes	Electric-furnace or other processes approved by the purchaser, except that Grades. T12 and T 17 may be made by the open-hearth process	Seamless (Hot-finished or cold drawn, as specified)	0.15 max	0.30~ 0.60	0.025 max	0.025 max	0.50 max	2.65~ 3.35	0.80~ 1.06	-	-
		TP 22				0.15 max	0.30~ 0.60	0.025 max	0.025 max	0.50 max	1.90~ 2.60	0.87~ 1.13	-	-
	Auste-nitic Steel	TP 304				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	18.0~ 20.0	-	8.00~ 11.0	
		TP 304H				0.04 0.10	2.00 max	0.040 max	0.030 max	0.75 max	18.0~ 20.0	-	8.00~ 11.0	-
		TP 304L				0.035 max	2.00 max	0.040 max	0.030 max	0.75 max	18.0~ 20.0	-	8.00~ 13.0	-
		TP 310				0.15 max	2.00 max	0.040 max	0.030 max	0.75 max	24.0~ 26.0	-	19.0~ 22.0	
		TP 316				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	16.0~ 18.0	2.00~ 3.00	11.0~ 14.0	-
		TP 316H				0.04~ 0.10	2.00 max	0.040 max	0.030 max	0.75 max	16.0~ 18.0	2.00~ 3.00	11.0~ 14.0	-
		TP 316L				0.035 max	2.00 max	0.040 max	0.030 max	0.75 max	16.0~ 18.0	2.00~ 3.00	10.0~ 15.0	-
		TP 321				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	17.0~ 20.0	-	9.0~ 13.0	Ti 5 x C -0.60
		TP 321H				0.04~ 0.10	2.00 max	0.040 max	0.030 max	0.75 max	17.0~ 20.0	-	9.0~ 13.0	Ti 5 x C -0.60
		TP 347				0.08 max	2.00 max	0.040 max	0.030 max	0.75 max	17.0 20.0	-	9.0~ 13.0	(Co+Ta) 10 XC-1.00
		TP 347H				0.04~ 0.10	2.00 max	0.040 max	0.030 max	0.75 max	17.0~ 20.0	-	9.0~ 13.0	(Co +Ta) 8 XC-1.00
		TP 348				0.08 max	2.00 max	0.40 max	0.030 max	0.75 max	17.0~ 20.0	-	9.0~ 13.0	(Co+Ta)10 XC-1.00 TA0.10max
		TP 348H				0.04 0.10	2.00 max	0.040 max	0.030 max	0.75 max	17.0~ 20.0	-	9.0~ 13.0	(Co+Ta)8 XC-1.00 Ta0.10max

STAINLESS STEEL PIPES & TUBES- CHEMICAL COMPOSITION & MECHANICAL PROPERTIES

Tension Test						Flattening Test	Elongation Test				Flaring Test		Hardness Test		Hydrostatic Test
Tensile Strengh		Yield Point		Elongation (in 2)%									Brinell t>0.200 in (5.0 mm)	Rockwell 0.200 in (0.0mm) ≥ t≤0.065(1.7mm)	Test Pressure psi (Kg/cm²)
Psi	Kg/ mm2	Psi	Kg/ mm2	5/6 in and over in wall thickness	Standard round 2 in gauge length test speciman		D ≤3/4 in(19.0 mm)	D ≤2 1/2 in(63.5 mm)	D≤3 3/4 in(95.2 mm)	D≥3 3 3/4 in(95.2 mm)	d/D	d¹ (min)	Hot rolled tubes / Cold drawn tubes	Hot rolled tubes / Cold drawn tubes	
55000 min 53000 min 60000 min	39 min 42 min 37 min	30000 min 28000 min 32000 min	21 min 22 min 20 min	30 min 30 min 30 min	-	$H=\frac{1.081}{0.08+1/D}$					0.9 0.8 0.7 0.6 0.5 0.4 0.3	1.21 d 1.22 d 1.25 d 1.30 d 1.39 d 1.51 d 1.68 d	137 max 143 max 137 max	B 77max B 79 max B 77 max	32000 (2250)xt/D D< t in (25.4 mm) 1000 (70) D< 11/2 in (25.4 mm) 1500 (105) D< 2 in (50.8 mm) 2000 (141) D< 3 in (76.2 mm) 2500 (176) D< 5 in (127.0 mm) 3500 (246) D< 5 in (127.0 mm) 4500 (316)
60000 min	42 min	37000 min	26 min	25 min	-	$H=\frac{1.071}{0.07+1/D}$					0.9 0.8 0.7 0.6 0.5 0.4 0.3	1.21 d 1.22 d 1.25 d 1.30 d 1.39 d 1.51 d 1.68 d	143 max	B77 max	32000 (2250)xt/D D< t in (25.4 mm) 1000 (70) D< 11/2 in (38.1 mm) 1500 (105) D< 2 in (50.8 mm) 2000 (141) D< 3 in (76.2 mm) 2500 (176) D< 5 in (127.0 mm) 3500 (246) D< 5 in (127.0 mm) 4500 (316)
						$H=\frac{1.081}{0.08+1/D}$					0.9 0.8 0.7 0.6 0.5 0.4 0.3	1.15d 1.17d 1.19d 1.23d 1.28d 1.38d 1.50d	163 max 163 max 163 max 163 max 179 max 163 max 179 max 179 max 163 max 163 max 163 max 163 max 163 max 163 max	8.79 max B 85 max B 85 max B 85 max B 89 max B 85 max B 89 max B 89 max B 85 max B 85 max B 85 max B 85 max B 85 max B 85 max	
60000 min	42 min	30000 min	21 min	30 min	-										
75000 min 70000 min	53 min 49 min	30000 min 25000 min	21 min 18 min			$H=\frac{1.091}{0.09=1D}$					0.9 0.8 0.7 0.6 0.5 0.4 0.3	1.21d 1.22d 1.25d 1.30d 1.39d 1.51d 1.68d	190 max	B 90 max	
75000 min 70000 min	53 min 49 min	30000 min 25000 min	21 min 18 min	35 min											
75000 min	53 min	30000 min	21 min												

STEEL GRADES

STAINLESS STEEL EQUIVALENT SPECIFICATIONS FOR CHEMICAL

Designation Sandvik	Chemical composition (nominal), % C	Cr	Ni	Mo	Others	Standards* UNS	ASTM TP AISI
5R 10	<0.05	18.5	9	-	-	S30400/S30409	304/304H
SANMAC 304L	<0.030	18.5	10.5	-	-	S30400/S30403	304/304L
3 R12	<0.030	18.5	10	-	-	S30403	304L
3 R 19	<0.03	18.5	9.5	-	N	S30453	304LN
5R60	<0.05	17	12	2.6	-	S31600/S31609	316H/316H
SANMAC 316 L	<0.030	17	13	2.6	-	S31600/S31603	316/316L
3R60	<0.030	17.5	13	2.6	-	S31603	316L
3R64	<0.03	18.5	14.5	3.1	-	S31703	317L
3R65	<0.030	17	11.5	2.1	-	S31603	316L
6R35	<0.06	17.9	10.3	-	Ti	S32100/ S32109	321/ 321H
8R30	<0.08	17.5	10	-	Ti	S32100/ S32109	321/ 321H
8R40	<0.06	17.5	11	-	Nb	S34700/ S34709	347/ 347H
8R41	0.06	16.5	13	-	Nb	-	-
5R75	<0.05	17	12	2.1	Ti	(S31635)	(316Ti)
8R70	<0.08	17	13	2.1	Ti	(S31335)	(316Ti)
3R60 U.G	<0.020	17.5	14	2.6	-	S31603	316L (U.G)
3R69	<0.030	17.5	13.5	2.6	N	(S31653)	(316LN)
2RE10	<0.020	24.5	20.5	-	-	-	(310L)
2RE69	<0.020	25	22	2.1	N	S31050	310 mod.
2RE69	<0.020	25	22	2.1	N	-	(310 mod.)
3RE60	<0.030	18.5	4.9	2.7	Si, N	S31500	-
SAF2304	<0.030	23	4.5	-	N	S32304	-
SAF2205	<0.030	22	5.5	3.2	N	S31803	-
SAF2507	<0.030	25	7	4	N	S32750	-
2RK65	<0.02	20	25	4.5	Cu	N08904	-
254 SMO	<0.020	20	18	6.1	N Cu	S31254	-
Sanicro 28	<0.020	27	31	3.5	Cu	N08028	-
4C54	<0.20	26.5	-	-	N	S44600	446-1
8RE10	0.07	24.5	20.5	-	-	S31008	310S
253 MA	0.08	21	11	-	Si, N, Ce	S30815	-
Sanicro 31HT	0.07	21	31	-	Ti, Al	N08811/ N08810	-
Sanicro 30	<0.030	20	32	-	Ti, Al	N08800	Alloy 800
Sanicro 41	<0.030	21.5	40	3	Cu, Ti	N08825	Alloy 825
Sanicro 69	<0.05	30.0	60.0	-	Fe	N06690	Alloy 690
Sanicro 70	<0.08	16	72.5	-	Fe	N06600	Alloy 600
10 RE51	0.04	26	5	1.4	-	S32900	--
5RA50	<0.050	18	9.5	0.5	S	S30300	303

1) Valid for SEW 470
2) DIN 17459
3) Sanicro 31 H
4) Valid for SEW 400
5) NFA 49-317 with min 45% can be fulfilled
6) Is replacing 8R30 in our stock standard programme
7) Is replacing 8R70 in our stock standard programme

Designation of Grades according to EN is pending
In brackets, nearest equivalent steel grade.
Other steel grades may be produced on request.
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253 MA and 254 SMO are trademarks owned by Avesta Sheffield AB.

STAINLESS STEEL EQUIVALENT SPECIFICATIONS FOR MECHANICAL

BS	SS	Werkstoff-Nr.	AFNOR	Mechanical strength Proof strength $Rp_{0.2}$ MPa, min	Tensile strength, R_m MPa	Elongation A %, min
304S31/51	2333	1.4301	Z6CN 18-09	210	515-690	45
304S11/304S31	2352/2333	1.4306/1.4301	Z2CN 18-10/Z6CN18-09	210	515-680	40[5]
304S11	2352	1.4306	Z2CN18-10	210	515-680	45
-	2371	1.4311	Z2CN18-10AZ	275	550-750	40
316S33	2343	1.4436/(1.4401)	Z6CND17-12	220	515-690	40
316S13/16S33	2353/2343	1.4435/1.4436	Z2CND17-13/Z6CND17-12	220	515-690	40[5]
316S13	2353	1.4435/(1.4404)	Z2CND17-13	220	515-690	45
-	2367	(1.4438)	Z2CND19-15	220	515-690	40
316S11	2348	1.4404/1.4401	Z2CND17-12/ (Z6CND17-11)	220	515-690	45
321S31/51	2337	1.4541/1.4878[1]	-	210	515-690	35
321S31/51	2337	1.4541/1.4878[1]	-	210	515-690	35
347S31/51	2338	1.4550	(Z6CNNb18-10)	210	515-690	35
-	-	1.4961	-	210	510-690	35
-	2350	1.4571	(Z6CNDT17-12)	210(190)	500-730	35
-	2350	1.4571	(Z6CNDT17-12)	210(190)	500-730	35
316S13	2353	1.4435	(Z2CND17-12)	190	490-690	40
-	(2375)	1.4429	Z2CNS17-12AZ	300	590-780	40
-	-	1.4335	Z2CN25-20	210	500-670	35
-	-	1.4466	Z1CND25-22AZ	270	580-780	30
-	-	1.4465	-	255	540-740	40
-	2376	1.4417	Z2CND18-05-03	450	700-880	30
-	2327	1.4362	Z2CN23-04AZ	400	600-820	25
-	2377	1.4462	Z2CND22-05.03	450	680-880	25
-	2328	-	-	550	800-1000	25
-	2562	1.4539	Z1NCDU25-20-04	220	520-720	35
-	2378	(1.4529)	Z1CNDU20-18-06AZ	300	≥650	35
-	2584	1.4563	Z1NCDU31-27-03	215	550-750	40
-	2322	1.4749	-	275	500-700	20
-	2361	1.4845	Z12CN25-20	210	515-750	35
-	2368	1.4893	-	310	600-850	40
NA15	-	1.4959[2]/1.4876[1] 1.4958[3]	-	170	450-700	35
NA15	-	1.4558	-	205	520-690	30
-	-	2.4858	-	240	590-750	30
-	-	-	-	240	≥585	30
NA14	-	2.4816	-	245	550-750	30
-	2324	1.4460[4]	-	485	620-800	20
-	2346	1.4305	Z10CNF18-09	215	500-700	45

Maruti Metal Industries

ASA PIPE SCHEDULES
WALL = WALL THICKNESS IN MILLI METER

CARBON STEEL SEAMLESS PIPE DIMENSIONS & WEIGHT

WT = WEIGHT IN KG PER METER

Nominal Pipe size	O D mm	Schedule 10		Schedule 20		Schedule 30		Standard		Schedule 40		Schedule 60		Extra Strong		Schedule 80		Schedule 100		Schedule 120		Schedule 140		Schedule 160		Schedule Extra Strong	
Inches		Wall	Wt.	Wall	Wt	Wall	Wt.	Wall	Wt.	Wall	Wt	Wall	Wt.	Wall	Wt	Wall	Wt..	Wall	Wt.	Wall	Wt.	Wall	Wt.	Wall	Wt.	Wall	Wt.
1/8	10.3							1.7	0.357	1.7	0.357			2.4	0.470	2.4	0.470										
1/4	13.7							2.2	0.625	2.2	0.625			3.0	0.804	3.0	0.804										
3/8	17.1							2.3	0.848	2.3	0.804			3.2	1.10	3.2	1.10										
1/2	21.3							2.8	1.26	2.8	1.26			3.7	1.62	3.7	1.62							4.6	1.96	7.5	2.54
3/4	26.7							2.9	1.68	2.9	1.68			3.9	2.19	3.9	5.5							4.8	2.89	7.5	3.63
1	33.4							3.4	2.50	3.4	2.50			4.5	3.23	4.5	3.23							6.4	4.23	9.1	5.45
11/4	42.2							3.6	3.38	3.6	3.38			4.9	4.46	4.9	4.46							6.4	5.60	9.7	7.75
11/2	48.3							3.7	4.05	3.7	4.05			5.1	5.40									7.1	7.23	10.2	9.54
2	60.3							3.9	5.43	3.9	5.43			5.5	7.47	5.5	7.47							8.7	11.1	11.1	13.4
21/2	73.0							5.2	8.62	5.2	8.62			7.0	11.4	7.0	11.4							9.5	14.9	14.0	20.4
3	88.9							5.5	11.3	5.5	11.3			7.6	15.3	7.6	15.3							11.3	21.3	15.2	27.2
31/2	101.6							5.7	13.6	5.7	13.6			8.1	18.6	8.1	18.6									16.2	34.0
4	114.3							6.0	16.1	6.0	16.1			8.6	22.3	8.6	22.3			11.1	28.3			13.5	33.5	17.1	41.1
5	141.3							6.6	21.8	6.6	21.8			9.5	30.9	9.5	30.9			12.7	40.2			15.9	49.0	19.0	57.4
6	168.3							7.1	28.2	7.1	28.2			11.0	42.5	11.0	42.5			14.3	54.2			18.3	67.5	21.9	79.1
8	219			6.4	33.3	7.0	36.7	8.2	42.5	8.2	42.5	10.3	53.1	12.7	64.6	12.7	64.6	15.1	75.8	18.3	90.7	20.6	101	23.0	112.0	22.2	108.0
10	273.0			6.4	41.7	7.8	50.9	9.3	60.2	12.7	81.5	12.7	81.5	12.7	81.5	15.1	95.8	18.3	115.0	21.4	133.0	25.4	155	28.6	172.0	25.4	155.0
12	323.9			6.4	49.7	8.4	65.1	9.5	73.8	10.3	79.7	14.3	109.0	12.7	97.4	17.4	132.0	21.4	160.0	25.4	187.0	28.6	208	33.3	239.0	25.4	187.0
14	355.6	6.4	54.6	7.9	68.1	9.5	81.2	9.5	81.2	11.1	94.3	15.1	126.0	12.7	107.0	19.0	158.0	23.8	195.0	27.8	224	31.8	253	35.7	281.0		
16	406.4	6.4	62.6	7.9	77.9	9.5	93.1	9.5	81.2	11.1	94.3	15.1	126.0	12.7	123.0	21.4	203.0	26.2	245.0	30.9	286.0	36.5	333	40.5	365.0		
18	457.2	6.4	70.5	7.9	87.8	11.1	122.0	9.5	105.0	14.3	156.0	19.0	206.0	12.7	139.0	23.8	254.0	29.4	310.0	34.9	363.0	39.7	408	15.2	459.0		
20	508.0	6.4	78.5	9.5	117.0	12.7	155.0	9.5	117.0	15.1	183.0	20.6	248.0	12.7	155.0	26.2	311.0	32.5	381.0	38.1	441.0	44.4	508	50.0	564.0		
22	558.8	6.4	86.4	9.5	129.0	12.7	171.0	9.5	129.0			22.2	294.0	12.7	171.0	28.6	373.0	34.9	451.0	41.3	526.0	47.6	6000	54.0	671.0		
24	609.6	6.4	94.7	9.5	141.0	14.3	210.0	9.5	141.0	17.4	255.0	24.6	355.0	12.7	187.0	30.9	441.0	38.9	547.0	45.00	639.0	52.4	719.0	59.5	807.0		
26	660.4	7.9	128.0	12.7	203.0			9.5	153.0					12.7	203.0												
28	711.2	7.9	138.0	12.7	219.0	15.9	272.0	9.5	165.0					12.7	219.0												
30	762.0	7.9	147.0	12.7	234.0	15.9	292.0	9.5	176.0					12.7	234.0												
32	812.8	7.9	157.0	12.7	250.0	15.9	312	9.5	188.0					12.7	250.0												
34	863.6	7.9	167.0	12.7	266.0	15.9	332.0	9.5	200.0					12.7	266.0												
36	914.4	7.9	177.0	12.7	282.0	15.9	351.0	9.5	212.0					12.7	281.0												

CARBON STEEL, ALLOY STEEL LOW TEM, PIPE AND TUBE SPECIFICATION

CHEMICAL									MECHANICAL PROPERTIES			SPECIFIC REQUIREMENT
									TENSILE STRENGTH	YIELD STRESS	ELONGATION	
SPECIFICATION	WT	C%	Mn %	P % MAX	S% MAX	Si%	Cr%	Mo%	Mpa	Mpa	50mm MIN Longitudinal	
ASTM A53/A	AW	0.25MAX	0.95MAX	0.050	0.045	-	-	-	330MIN	205MIN	36	
ASTM A53/B	AW	0.30MAX	1.20MAX	0.050	0.045	-	-	-	415MIN	240MIIN	29/5	Cr Mo Cu Ni Va
ASTM /A 106/A	AW	0.25MAX	0.27-0.93	0.035	0.025	0.10MIN	0.40MAX	0.15MAX	330MIN	205MIN	35/2	40 15 40 40 08
ASTM A 106/B	AW	0.35MAX	0.29-1.06	0.035	0.035	0.10MIN	0.40MAX	0.15MAX	415 MIN	240MIN	30/22	Five elements not to exceed 1%
ASTM A 106/C	AW	0.35MAX	0.29-1.06	0.035	0.035	0.10MIN	0.40MAX	0.15MAX	485MIN	275MIN	30/22	
ASTM A179	MW	0.06~018	0.27-0.63	0.035	0.035	-	-	-	325MIN	180MIN	35.0	Hardness 72 HRB Max
ASTMA214	MW	0.18MAX	0.27-0.63	0.035	0.035	-	-	-	385MIN	180MIN	35.0	Hardness 72 HRB Max
ASTM A192	MW	0.06-0.18	0.27-0.63	0.035	0.035	0.25MAX	-	-	325MIN	180MIN	35.0	Hardness 77 HRB Max
ASTM a209/T1	MW	0.10-0.20	0.30-0.80	0.025	0.025	0.10-0.50	-	0.44-0.65	380MIN	205MIN	30/22	Hardness 80 HRB Max
ASTM A209/T1a	MW	0.15-0.25	0.30-0.80	0.025	0.025	0.10-0.50	-	0.44-0.65	365MIN	195MIN	30/22	Hardness 81 HRB Max
ASTM A209/T1b	MW	0.14MAX	0.30-0.80	0.025	0.025	0.10MIN	-	0.44-0.65	415MIN	220MIN	30/22	Hardness 77 HRB Max
ASTM A210/A-1	MW	0.27max	0.93max	0.035	0.035	0.10min	-	-	415MIN	255MIN	30/22	Hardness 79 HRB Max
ASTMA210/C	MW	0.35MAX	0.23-1.06	0.035	0.035	0.10MIN	-	-	485MIN	275MIN	30/22	Hardness 89 HRB Max
ASTM A213/T2	MW	0.10/0.20	0.30-0.61	0.025	0.025	0.10-0.30	0.50-0.81	0.44-0.65	415MIN	205MIN	30/22	Hardness 85 HRB Max
ASTM A213/T5	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50MAX	4.00-6.00	0.44-0.65	415MIN	205MIN	30/22	Hardness 85 HRB Max
ASTM A213/T11	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50MAX	1.00-1.50	0.44-0.65	415MIN	205MIN	30/22	Hardness 85 HRB Max
ASTM A213/T12	0.05	0.15MAX	0.30-0.61	0.025	0.025	0.50MAX	0.80-1.25	0.44-0.65	415MIN	220MIN	30/22	Hardness 85 HRB Max
ASTM A213/T22	0.05	0.15MAX	0.30-0.60	0.025	0.025	0.50MAX	1.90-2.60	0.87-1.13	415MIN	205MIN	30/22	Hardness 85 HRB Max
ASTM A333/3	AW	0.19MAX	0.31-0.64	0.025	0.025	0.18-0.37	Ni	3.18-3.82	380MIN	205MIN	35/25	
ASTM A333/6	AW	0.30MAX	0.29-1.06	0.025	0.025	0.10MIN	--	-	415MIN	240MIN	30/22	IMPACT AS -50f
ASTM A334/3	AW	0.19MAX	0.31-0.64	0.025	0.025	0.18-0.37	Ni	3.18-3.82	380MIN	205MIN	35/28	FOR 40X10/18/1490 HRB MAX
ASTM A334/6	MW	0.30MAX	0.9-1.06	0.025	0.025	0.10MIN	-	-	415MIN	240MIN	30/22	50 f 40X10/18/14
ASTM A335/P1	AW	0.10-0.20	0.30-0.80	0.025	0.025	0.10-0.50-	-	0.40-0.65	380MIN	205MIN	30/22	
ASTM A335/P2	AW	0.10-0.20	0.30-0.61	0.025	0.025	0.10-0.30	0.50-0.81	0.40-0.65	380MIN	205MIN	30/22	
ASTM A335/P5	AW	0.15MAX	0.30-0.60	0.025	0.025	0.50-1.00	4.00-6.00	0.40-0.65	415MIN	205MIN	30/22	
ASTM A335/P11	0.05	0.15MAX	0.30-0.60	0.025	0.025	0.50-1.00	1.00-1.50	0.400-65	415MIN	205MIN	30/22	
ASTM A335/P12	0.05	0.15MAX	0.30-0.61	0.025	0.025	0.50MAX	0.80-1.25	0.40-0.65	415MIN	205MIN	50/22	
ASTM A335/P22	0.05	0.15MAX	0.30-0.60	0.025	0.025	0.50MAX	1.90-2.60	0.87.1.13	415MIN	205MIN	30/22	
BS/3059/1/33		0.15Max	0.30-0.70	0.050	0.050	-	-	-	324-441	186MIN	25	
BS/3059/2/33		0.15MAX	0.400.70	0.050	0.050	0.10-0.35	-	-	324-441	186MIN	21	
BS/3059/245		0.120.18	0.90-1.20	0.035	0.035	0.10-0.35	-	-	441-560	245MIN	22	
BS/3059/2/620		0.10-0.15	0.40-0.70	0.040	0.040	0.10-0.35	0.70-1.10	0.45-0.65	441-618	235MIN	22	
DIN/17175/ST35.8		0.17MAX	0.40MIN	0.040	0.040	0.35MAX	-	-	340-441	235MIN	25	
DIN/17175/ST45.8		0.22MAX	0.45MIN	0.040	0.040	0.10-0.35	-	-	441-540	255 MIN	25	
DIN/17175/15MO3		0.12-0.20	0.50-0.80	0.040	0.040	0.10-0.35	-	0.250-0.35	441-540	284MIN	21	
DIN/17175/13CrMo44		0.10-0.18	0.40-0.60	0.040	0.040	0.15-0.35	0.70-1.60	0.40-0.50	441-570	294MIN	22	
DIN/17175/10CrM910		0.15MAX	0.40-0.60	0.040	0.040	0.15-0.50	2.0-2.5	0.9-1.10	441-570	249MIN	22	
ASTM A199/T5	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50MAX	4.00-6.00	0.45-0.65	415MIN	170MIN	30/22	
ASTM A199/T11	MW	0.05-0.15	0.30-0.60	0.025	0.025	0.50-1.00	1.00-1.50	0.44-0.65	415MIN	170MIN	30/22	
ASTM A199/T22	MW	0.05-0.15	0.30-0.60	0.025	0.025	0.50MAX	1.90-2.60	0.87-1.13	415MIN	170MIN	30/22	
ASTM A199/T4	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50-1.00	2.15-2.85	0.44-0.65	415MIN	170MIN	30/22	
ASTM A199/T7	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50-1.00	6.00-8.00	0.45-0.65	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T5	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50MAX	4.00-6.00	0.45-0.65	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T11	MW	0.05-0.15	0.30-0.60	0.025	0.025	0.50-1.00	1.00-1.50	0.44-0.65	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTMA199/T22	MW	0.05-0.15	0.30-0.60	0.025	0.025	0.50MAX	1.90-2.60	0.87-1.13	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T4	MW	0.05-0.15	0.30-0.60	0.025	0.025	0.50-1.00	2.15-2.852	0.44-0.85	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T7	MW	0.15MAX	0.30-0.60	0.025	0.025	0.50-1.00	6.00-8.00	0.45-0.65	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T9	MW	0.15MAX	0.30-0.60	0.025	0.025	0.25-1.00	8.00-10.00	0.90-1.10	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T9	MW	0.15MAX	0.30-0.60	0.025	0.025	0.25-1.00	8.00-10.00	0.90-1.10	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A199/T9	MW	0.15MAX	0.30-0.60	0.025	0.025	0.25-1.00	8.00-10.00	0.90-1.10	415MIN	170MIN	30/22	HARDNESS 85 HRB MAX
ASTM A335/P9	MW	0.15MAX	0.30-0.60	0.025	0.025	0.25-1.00	8.00-10.00	0.09-1.10	415MIN	172MIN	30/22	HARDNESS 85 HRB MAX
ASTM A178A	MW	0.06-0.18	0.30-0.60	0.035	0.035	-	-	-	325MIN	180MIN	35	HARDNESS 89 HRB MAX
ASTM A178C	MW	0.35 MAX	0.27-0.63	0.035	0.035	-	-	-	415MIN	170MIN	30	HARDNESS 89 HRB MAX
ASTM A178B	MW	0.27MAX	0.80 MAX	0.030	0.015	0.10MIN	-	-	485MIN	275MIN	30	HARDNESS 89 HRB MAX

TABLE 1 STAINLESS STEEL PLATES - CHEMICAL COMPOSITION

UNS Designation [B]	Type[c]	Carbon [D]	Manganese	Phos-phorus	Sulphur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements[E,F]
			Austenitic (Chromium-Nickel)(Chromium-Manganese-Nickel)									
N08020	...	0.07	2.00	0.045	0.035	1.00	19.0-21.0	32.0-38.0	2.00-3.00	...	3.0-4.0	Cb 8xc min, 1.00 max
N08367	...	0.030	2.00	0.040	0.030	1.00	20.0-22.0	23.5-25.5	6.0-7.0	0.18-0.25	0.75	...
N08800	800[G]	0.010	1.50	0.0045	0.015	1.00	19.0-23.0	30.0-35.0	...	...	0.75	Fe[H] 39.5 min Al 0.15-0.60 Ti 0.15-0.60
N08810	800H[G]	0.05-0.10	1.50	0.045	0.015	1.00	19.0-23.0	30.0-35.0	...	...	0.75	Fe [H]39.5 min Al 0.15-0.60 Ti 0.15-0.60
N08811	...	0.06-0.10	1.50	0.040	0.015	1.00	19.0-23.0	30.0-35.0	...	...	0.75	Fe [H]39.5 min Ti 0.15-0.60 Ai 0.15-0.60
N08904	904L[G]	0.020	2.00	0.045	0.030	1.00	19.0-23.0	23.0-28.0	4.0-5.0	0.10	1.0-2.0	...
N08926	...	0.020	2.00	0.030	0.010	0.50	19.0-21.0	24.0-26.0	6.0-7.0	0.15-0.25	0.5-1.5	...
S20100	201	0.15	5.5-7.5	0.060	0.030	1.00	16.0-18.0	3.5-5.5	...	0.25	...	...
S20103	...	0.03	5.5-7.5	0.045	0.030	0.75	16.0-18.0	3.5-5.5	...	0.25	...	...
S20153	...	0.03	6.4-7.5	0.045	0.015	0.75	16.0-17.5	4.0-5.0	...	0.10-0.25	1.00	...
S20161	...	0.15	4.0-6.0	0.040	0.040	3.0-4.0	15.0-18.0	4.0-6.0	...	0.08-0.20	...	...
S20200	202	0.15	7.5-10.0	0.060	0.030	1.00	17.0-19.0	4.0-6.0	...	0.25	...	...
S20400	...	0.030	7.0-9.0	0.040	0.030	1.00	15.0-17.0	1.50-3.00	...	0.15.030	...	...
S20910	XM-19[J]	0.06	4.0-6.0	0.040	0.030	0.75	20.5-23.5	11.5-13.5	1.50-3.00	0.20-0.40	...	Cb 0.10-0.30 V 0.10-0.30
S21400	XM-31[J]	0.12	14.0-16.0	0.045	0.030	0.30-1.00	17.0-18.5	1.00	...	0.35 MIN	...	...
S21600	XM-17[J]	0.08	7.5-9.0	0.045	0.030	0.75	17.5-22.0	5.0-7.0	2.00-3.00	0.25-0.50	...	...
S21603	XM-18[J]	0.03	7.5-9.0	0.045	0.030	0.75	17.5-22.0	5.0-7.0	2.00-3.00	0.25-0.50	...	...
S21800	...	0.10	7.0-9.0	0.060	0.030	3.5-4.5	16.0-18.0	8.0-9.0	...	0.08-0.18	...	...
S24000	XM-29[J]	0.08	11.5-14.5	0.060	0.030	0.75	17.0-19.0	2.3-3.7	...	0.20-0.40	...	...
S30100	301	0.15	2.00	0.045	0.030	1.00	16.0-18.0	6.0-8.0	---	0.10	...	...
S30103	301L[G]	0.03	2.00	0.045	0.030	1.00	16.0-18.0	6.0-8.0	...	0.20	...	...
S30153	301LN[G]	0.03	2.00	0.045	0.030	1.00	16.0-18.0	6.0-8.0	...	0.07-0.20	...	...
S30200	302	0.15	2.00	0.045	0.030	0.75	17.0-19.0	8.0-10.0	...	0.10	...	...
S30400	304	0.08	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	0.10	...	..
S30403	304L	0.030	2.00	0.045	0.030	0.75	18.0-20.	8.0-12.0	...	0.10	...	...
S30409	304H	0.04-0.10	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	...	...	...
S30415	...	0.04-0.06	0.80	0.045	0.030	1.00-2.00	18.0-19.0	9.0-10.0	...	0.12-0.18	...	Ce 0.03-0.08
S30451	304N	0.08	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	0.10-0.16	...	...
S30452	XM-21[J]	0.08	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	0.16-0.30	...	...
S30453	304LN	0.030	2.00	0.045	0.030	0.75	18.0-20.0	8.0-12.0	...	0.10-0.16	...	...
S30500	305	0.12	2.00	0.045	0.030	0.75	17.0-19.0	10.5-13.0	...	...	...	...
S30600	...	0.018	2.00	0.020	0.020	3.7-4.3	17.0-18.5	14.0-15.5	0.20	...	0.50	...
S30601	...	0.015	0.50-0.80	0.030	0.013	5.0-5.6	17.0-18.0	17.0-18.0	0.05	0.35	...	
S30615	...	0.16-0.24	2.00	0.030	0.030	3.2-4.0	17.0-19.5	13.5-16.0	...	...	...	Al 0.80-1.50
S30815	...	0.05-0.10	0.80	0.040	0.030	1.40-2.00	20.0-22.0	10.0-12.0	...	0.14-0.20	...	Ce 0.03-0.08
S30908	309S	0.08	2.00	0.045	0.030	0.75	22.0-24.0	12.0-15.0	...	...	...	...
S30909	309H[G]	0.04-0.10	2.00	0.045	0.030	0.75	22.0-24.0	12.0-15.0	...	...	...	...
S30940 XCMIN	309Cb[G]	0.08	2.00	0.045	0.030	0.75	22.0-24.0	12.16.0	...	...	...	Cb 10 1.10 MAX
S30941	309HCb[G]	0.04-0.10	2.00	0.045	0.030	0.75	22.0-24.0	12.0-16.0	...	...	...	Cb 10XC min 1.10 max
S31008	310S	0.08	2.00	0.045	0.030	1.50	24.0-26.0	19.0-22.0	...	...	...	...
S31009	310H[G]	0.04-0.10	2.00	0.045	0.030	0.75	24.0-26.0	19.0-22.0	...	...	...	...
S31040	310Cb[G]	0.08	2.00	0.045	0.030	1.50	24.0-26.0	19.0-22.0	...	...	...	Cb 10xC min 1.10 max

STAINLESS STEEL PLATES - CHEMICAL COMPOSITION

UNS Designation [B]	Type[C]	Carbon [D]	Manganese	Phos-phorus	Sulphur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements[E,F]
S31041	310HCb[G]	0.04-0.10	2.00	0.045	0.030	0.75	24.0-26.0	19.0-22.0	...	...	...	Cb 10xc min, 1.10 max
S31050	310MoLN[G]	0.020	2.00	0.030	0.010	0.50	24.0-26.0	20.5-23.5	1.60-2.60	0.09-0.15	...	...
S31254	...	0.020	1.00	0.030	0.010	0.80	19.5-20.5	17.5-18.5	6.0-6.5	0.18.022	0.50-1.00	...
S31266	...	0.030	2.0-4.0	0.035	0.020	1.00	23.0-25.0	21.0-24.0	5.2-6.2	0.35-0.60	1.00-2.50	W 1.50-2.50
S31600	316	0.08	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	0.10	...	...
S31603	316L	0.030	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	0.10	...	...
S31609	316H	0.04-0.10	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	...	...	...
S31635	316Ti	0.08	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	0.10	...	Ti 5xc (C+N) min 0.70 max
S31640	316Cb	0.08	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	0.10		Cb 10xc min, 1.10 max
S31651	316N	0.08	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	0.10-0.16	...	...
S31653	316LN	0.030	2.00	0.045	0.030	0.75	16.0-18.0	10.0-14.0	2.00-3.00	0.10-0.16	...	...
S31700	317	0.08	2.00	0.045	0.030	0.75	18.0-20.0	11.0-15.0	3.0-4.0	0.10	...	...
S31703	317L	0.030	2.00	0.045	0.030	0.75	18.0-20.0	11.0-15.0	3.0-4.0	0.10	...	...
S31725	317LM[G]	0.030	2.00	0.045	0.030	0.75	18.0-20.0	13.5-17.5	4.0-5.0	0.20	...	...
S31726	317LMN[G]	0.030	2.00	0.045	0.030	0.75	17.0-20.0	13.5-17.5	4.0-5.0	0.10-0.20	...	...
S31753	317LN	0.030	2.00	0.045	0.030	0.75	18.0-20.0	11.0-15.0	3.0-4.0	0.10-0.22	...	...
S32050	...	0.030	1.50	0.035	0.020	1.00	22.0-24.0	20.0-23.0	6.0-6.8	0.21-0.32	0.40	...
S32100	321	0.08	2.00	0.045	0.030	0.75	17.0-19.0	9.0-12.0	....	0.10	...	Ti 5 x (C+N) min 0.70 max
S32109	321H	0.04-0.10	2.00	0.045	0.030	0.75	17.0-19.0	9.0-12.0	9.0-12.0	...	...	Ti 4 x (C+N) min 0.70 max
S32615	...	0.07	2.00	0.045	0.030	4.8-6.0	16.5-19.5	19.0-22.0	0.30-150	...	1.50-2.50	...
S32654	...	0.020	2.0-4.0	0.030	0.005	0.50	24.0-25.0	21.0-23.0	7.0-8.0	0.45-0.55	0.30-0.60	...
S33228	...	0.04-0.08	1.00	0.020	0.015	0.30	26.0-28.0	31.0-33.0	...	...	...	Ce0.05-0.10 Cb 0.6-1.0 Al 0.025
S33400	334[G]	0.08	1.00	0.030	0.015	1.00	18.0-20.0	19.0-21.0	...	...	...	AL 0.15-0.60 Ti 0.15-0.60
S34565	...	0.030	5.0-7.0	0.030	0.010	1.00	23.0-25.0	16.0-18.0	4.0-5.0	0.40-0.60	...	Cb 0.10
S34700	347	0.08	2.00	0.045	0.030	0.75	17.0-19.0	9.0-13.0	....	...	...	Cb 10 x c min 1.00 max
S34709	347H	0.04-0.10	2.00	0.045	0.030	0.75	17.0-19.0	9.0-13.0	...	...	..	Cb 8 x c min 1.00 max
S34800	348	0.08	2.00	0.045	0.030	0.75	17.0-19.0	9.0-13.0	...	...	...	(Cb+Ta) 10 x c min 1.00 max Ta0.10 Co 0.20
S34809	348H	0.04-0.10	2.00	0.045	0.030	0.75	17.0-19.0	9.0-13.0	...	...	...	(Cb+Ta) 8 x c min 1.00 max Ta0.10 Co 0.20
S35045	...	0.06-0.10	1.50	0.045	0.015	1.00	25.0-29.0	32.0-37.0	...	...	0.75	Al 0.15-0.60 Ti 0.15-0.60
S35135	...	0.08	1.00	0.045	0.015	0.60-1.00	20.0-25.0	30.0-38.0	4.0-4.8	...	0.75	Ti 0.40-1.00
S35315	...	0.04-0.08	2.00	0.040	0.030	1.20-2.00	24.0-26.0	34.0-36.0	...	0.12-0.18	...	Ce 0.03-0.10
S38100	XM-15	0.08	2.00	0.030	0.030	1.50-2.50	17.0-19.0	17.0-18.0	...	....	...	...
Duplex (Austenitic Ferritic)												
S31200	...	0.030	2.00	0.045	0.030	1.00	24.0-26.0	5.5-6.5	1.20-2.00	0.14-0.20	...	...
S31260	...	0.03	1.00	0.030	0.030	0.75	24.0-26.0	5.5-7.5	2.5-3.5	0.10-0.30	0.20-0.80	W0.10-0.50
S31803	...	0.03	2.00	0.030	0.020	1.00	21.0-23.0	4.5-6.5	2.5-3.5	0.08-0.20	...	...
S32001	...	0.030	4.0-6.0	0.040	0.030	1.00	19.5-21.5	1.00-3.00	0.60	0.05-0.17	1.00	...
S32205	2205[G]	0.030	2.00	0.030	0.020	1.00	22.0-23.0	4.5-6.5	3.0-3.5	0.14-0.20	...	...

UNS Designation [B]	Type[C]	Carbon [D]	Manganese	Phos-phorus	Sulphur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper Elements[E,F]	Other
S32304	2304[G]	0.030	2.50	0.040	0.030	1.00	21.5-24.5	3.0-5.5	0.05-0.60	0.05-0.60	0.05-0.60	...
S32520	...	0.030	1.50	0.035	0.020	0.80	24.0-26.0	5.5-8.0	3.0-4.0	0.20-0.35	0.50-2.00	...
S32550	255[G]	0.040	1.50	0.040	0.030	1.00	24.0-27.0	4.5-6.5	2.9-3.9	0.10-0.25	1.50-2.50	...
S32750	2507[G]	0.030	1.20	0.035	0.020	0.80	24.0-26.0	6.0-8.0	3.0-5.0	0.24-0.32	0.50	...
S32760	...	0.030	1.00	0.030	0.010	1.00	24.0-26.0	6.0-8.0	3.0-4.0	0.20-0.30	0.50-1.00	w 0.50-1.00
S32900	329	0.080	1.00	0.040	0.030	0.75	23.0-28.0	2.0-5.00	1.00-2.00	...	...	...
S32950	...	0.030	2.00	0.035	0.010	0.60	26.0-29.0	3.5-5.2	1.00-2.50	0.15-0.35	...	...
Ferritic or Martensitic (Chromium)												
S32803	...	0.015	0.50	0.020	0.035	0.55	28.0-29.0	3.0-4.0	1.80-2.50 (C+N)0.030	0.020	min, 0.15-0.50	Cb 12x(C+N)
S40500	405	0.08	1.00	0.040	0.030	1.00	11.5-14.5	0.60	...	...	...	Al 0.10-0.30
S40900[L]	409											
S40910	...	0.030	1.00	0.040	0.020	1.00	10.5-11.7	0.50	...	0.030	... 0.50 max, Cb 0.17	Ti 6x(C+N) min,
S40920	...	0.030	1.00	0.040	0.020	1.00	10.5-11.7	0.50	...	0.030	... Ti 0.15-0.50 Cb 0.10	Ti 8x(C+N) min,
S40930	...	0.030	1.00	0.040	0.020	1.00	10.5-11.7	0.50	...	0.030	... x(C+N)] min 0.75 max Ti 0.05 min	(Ti+Cb)[0.08+8
S40945	...	0.030	1.00	0.040	0.030	1.00	10.5-11.7	0.50	...	0.030	... Ti 0.05-0.20	Cb 0.18-0.40
S40975	...	0.030	1.00	0.040	0.030	1.00	10.5-11.7	0.50-1.00	...	0.030	... min, 0.75 max	Ti 6x (C+N)
S40977	...	0.030	1.50	0.040	0.015	1.00	10.5-12.5	0.30-1.00	...	0.030	...	...
S41000	410	0.08-0.15	1.00	0.040	0.030	1.00	11.5-13.5	0.75	...	...	...	...
S41003	...	0.030	1.50	0.040	0.030	1.00	10.5-12.5	1.50	...	0.030	...	...
S41008	410S	0.08	1.00	0.040	0.030	1.00	11.5-13.5	0.60	...	...	...	...
S41045	...	0.030	1.00	0.040	0.030	1.00	12.0-13.0	0.50	..	0.030	.. min, 0.60 max	Cb 9x (C+N)
S41050	...	0.04	1.00	0.045	0.030	1.00	10.5-12.5	0.60-1.10	...	0.10	...	...
S41500[M]	...	0.05	.50-1.00	0.030	0.030	0.60	11.5-14.0	3.5-5.5	0.50-1.00	...	...	...
S42035	...	0.08	1.00	0.045	0.030	1.00	13.5-15.5	1.0-2.5	0.2-1.2	...	...	Ti 0.30-0.50
S42900	429[G]	0.12	1.00	0.040	0.030	1.00	14.0-16.0	...	...	..	...	...
S43000	430	0.12	1.00	0.040	0.030	1.00	16.0-18.0	0.75	...	...	...	...
S43035	439	0.07	1.00	0.040	0.030	1.00	17.0-19.0	0.50	...	0.04	... [0.20+4(C+N)] min, 1.10 max Al 0.15	Ti
S43400	434	0.12	1.00	0.040	0.030	1.00	16.0-18.0	...	0.75-1.25	...	...	...
S43600	436	0.12	1.00	0.040	0.030	1.00	16.0-18.0	...	0.75-1.25	...	... min,0.80 max	Cb 5xc
S43932	...	0.030	1.00	0.040	0.030	1.00	17.0-19.0	0.50	...	0.030	... [0.20+4(C+N)] min, 0.75 max Al 0.15	(Ti+Cb)
S43940	...	0.030	1.00	0.040	0.015	1.00	17.5-18.5	...	...	..	... [0.30+(3xC)] min	Ti 0.10-0.60Cb
S44400	444	0.025	1.00	0.040	0.030	1.00	17.5-19.5	1.00	1.75-2.50	0.035	... 0.20+4 (C+N)] min, 0.80 max	(Ti+Cb) [

STAINLESS STEEL PLATES - CHEMICAL COMPOSITION

UNS Designation [B]	Type[c]	Carbon [D]	Manganese	Phos-phorus	Sulphur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements[E,F]
S44500	...	0.020	1.00	0.040	0.012	1.00	19.0-21.0	0.60	....	0.03	0.30-0.60	Cb 10x)(C+N) min, 0.80 max
S44626	XM-33[J]	0.06	0.75	0.040	0.020	0.75	25.0-27.0	0.50	0.75-1.50	0.04	0.20	Ti 0.20-1.00 Ti 7 (C+N) min
S44627	XM-27[J]	0.010[N]	0.40	0.020	0.020	0.40	25.0-27.5	0.50	0.75-1.50	0.015[N]	0.20	Cb 0.05-0.20 (Ni+Cu) 0.50
S44635	...	0.025	1.00	0.040	0.030	0.75	24.5-26.0	3.5-4.5	3.5-4.5	0.035	...	(Ti+Cb) [0.20+4 (C+N)] min 0.80 max
S44660	...	0.030	1.00	0.040	0.030	1.00	25.0-28.0	1.0-3.5	3.0-4.0	0.040	...	(Ti+Cb) 0.20 - 1.00, Ti + Cb 6 x (C+N) min
S44700	...	0.010	0.30	0.025	0.020	0.20	28.0-30.0	0.15	3.5-4.2	0.020	0.15	(C+N) 0.025
S44735	...	0.030	1.00	0.040	0.030	1.00	28.0-30.0	1.00	3.6-4.2	0.045	...	(Ti+Cb) 0.20-1.00 (Ti+Cb) 6 x (C+N) min
S44800 S46800	... ...	0.010 0.030	0.30 1.00	0.025 0.040	0.020 0.030	0.20 1.00	28.0-30.0 18.0-20.0	2.00-2.50 0.50	3.5-4.2 ...	0.020 0.030	0.15	(C+N) 0.025 Ti 0.07-0.30 Cb 0.10-0.60 (Ti+Cb) [0.20+4 (C+N)] min 0.80 max

A) Maximum unless range or minimum is indicated.

B) Designation established in accordance with practice E 527 and SAE J 1086.

C) Unless otherwise indicated, a grade designation originally assigned by the American Iron and Steel Institute (AISI)

D) Carbon analysis shall be reported to nearest 0.01% except for the low-carbon type, which shall be reported to nearest 0.001 %

E) The terms Columbium (Cb) and Niobium (Nb) both related to the same element.

F) When two minimums or two maximums are listed for a single type, as in the case of both a value from a formula and an absolute value, the higher minimum or lower maximum shall apply.

G) Common name, not a trademark, widely used, not associated with any one producer.

H) Iron shall be determined arithmatically by difference of 100 minus the sum of the other specified elements.

I) (Al + Ti) 0.85- 1.20

J) Naming system developed and applied by ASTM.

K) Cr + 3.3 Mo + 16 N = 40 min

L) S40900 (Type 409) has been replaced by S40910, S40920, and S40930, Unless otherwise specified in the ordering information, an other specifying S40900 or Type 409 shall be satisfied by any one of S40910, S 40920 or S40930 at the option of the seller, Material meeting the requirements of S40910, S40920 or S40930, may at the option the manufacturer by certified as S40900.

M) Plate version of CA-6NM

N) Product (Check or verification) analysis tolerance over the maximum limit for C and N in XM-27 shall be 0.002 %.

STAINLESS STEEL PLATES - MECHANICAL PROPERTIES

UNS Designation	Type	Tensile Strength, min		Yield Strength, min		Elongation in 2 in. or 50 mm, min,%	Hardness, max[c]		Cold Bend[OD]
		Ksi	MPa	Ksi	MPa		Brinell	Rockwell B	
		Austenitic (Chromium-Nickel) (Chromium- Manganese-Nickel)							
N08020	...	80	550	35	240	30.0	217	95	not required
N08367									
Sheet and Strip		100	690	45	310	30.0	...	100	not required
Plate		95	655	45	310	30.0	241	...	not required
N08800	800[F]	75	520	30	205	30.0	...	...	not required
N08810	800H[F]	65	450	25	170	30.0	...	...	not required
N08811	...	65	450	25	170	30.0	...	...	not required
N08904	904L[F]	71	490	31	220	35.0	...	90	not required
N08926	...	94	650	43	295	35.0	...	...	not required
S20100	201-1[I]	75	515	38	260	40.0	...	95	...
S20100	201-2[I]	95	655	45	310	40.0	217	100	...
S20103	201L[F]	95	655	38	260	40.0	217	95	not required
S20153	201LN[F]	95	655	45	310	45.0	241	100	not required
S20161	...	125	860	50	345	40.0	255	25	not required
S20200	202	90	620	38	260	40.0	241	...	...
S20400	...	95	655	48	330	35.0	241	100	not required
S30100	301	75	515	30	205	40.0	217	95	not required
S30103	301L[F]	80	550	32	220	45.0	241	100	not required
S30153	30LN[F]	80	550	35	240	45.0	241	100	not required
S30200	302	75	515	30	205	40.0	201	92	not required
S30400	304	75	515	30	205	40.0	201	92	not required
S30403	304L	70	485	25	170	40.0	201	92	not required
S30409	304H	75	515	30	205	40.0	201	92	not required
S30415	...	87	600	42	290	40.0	217	95	not required
S30451	304N	80	550	35	240	30.0	201	92	not required
S30453	304LN	75	515	30	205	40.0	201	92	not required
S30500	305	70	485	25	170	40.0	183	88	not required
S30600	...	78	540	35	240	40.0	..	..	...
S30601	..	78	540	37	255	30.0	..	...	not required
S30615	...	90	620	40	275	35.0	217	95	not required
S30815	...	87	600	45	310	40.0	217	95	...
S30908	309S	75	515	30	205	40.0	217	95	not required
S30909	309H[F]	75	515	30	205	40.0	217	95	not required
S30940	309Cb[F]	75	515	30	205	40.0	217	95	not required
S30941	309HCb[F]	75	515	30	205	40.0	217	95	not required
S31008	310S	75	515	30	205	40.0	217	95	not required
S31009	310H[F]	75	515	30	205	40.0	217	95	not required
S31040	310Cb[F]	75	515	30	205	40.0	217	95	not required
S31.41	310HCb[F]	75	515	30	205	40.0	217	95	not required
S31254									
Sheet and Strip		100	690	45	310	35.0	223	96	not required
Plate		95	655	45	310	35.0	223	96	not required
S31266		109	750	61	420	35.0	...	...	not required
S31600	316	75	515	30	205	40.0	217	95	not required
S31603	316L	70	485	25	170	40.0	217	95	not required
S31653	316LN	75	515	30	205	40.0	217	95	not required
S31609	316H	75	515	30	205	40.0	217	95	not required
S31635	316Ti[F]	75	515	30	205	30.0	217	95	not required
S31640	316Cb[F]	75	515	30	205	30.0	217	95	not required
S31651	316N	80	550	35	240	35.0	217	95	not required
S31700	317	75	515	30	205	35.0	217	95	not required

Mechanical Test Requirements

UNS Designation [B]	Type	Tensile Strength, min		Yield Strength,[B] min		Elongation in 2 in. or 50 mm, min,%	Hardness, max[c]		Cold Bend[OD]
		Ksi	MPa	Ksi	MPa		Brinell	Rockwell B	
S31725	317Lm[F]	75	515	30	205	40.0	217	95	not required
S31726	317LMN[F]	80	550	35	240	40.0	223	96	not required
S31703	317L	75	515	30	205	40.0	217	95	not required
S31753	317LN	80	550	35	240	40.0	217.	95	not required
S32050	...	98	675	48	330	40.0	250	...	not required
S32100	321	75	515	30	205	40.0	217	95	not required
S32109	321H	75	515	30	205	40.0	217	95	not required
S32615	...	80	550	32	220	25.0	...	...	not required
S32654	...	109	750	62	430	40.0	250	...	not required
S33228	...	73	500	27	185	30.0	217	95	not required
S33400	334	70	485	25	170	30.0	...	92	not required
S34565	...	115	765	60	415	35.0	241	100	not required
S34700	347	75	515	30	205	40.0	201	92	not required
S34709	347H	75	515	30	205	40.0	201	92	not required
S34800	348	75	515	30	205	40.0	201	92	not required
S34809	348H	75	515	30	205	40.0	201	92	not required
S35045	...	70	485	25	170	35.0	...	...	not required
S35135									
Sheet and strip	...	80	550	30	205	30.0	...	..	not required
Plate	...	75	515	30	205	30.0	...	...	not required
S35315	...	94	650	39	270	40.0	217	95	not required
S38100	XM-15	75	515	30	205	40.0	217	95	not required
S30452	XM-21								
Sheet and Strip		90	620	50	345	30.0	241	100	not required
Plate		85	585	40	275	30.0	241	100	not required
S31050	310MoLN[F]								
	t ≤ 0.25 in	84	580	39	270	25.0	217	95	not required
	t > 0.25 in.	78	540	37	255	25.0	217	95	not required
S21600	XM-17[L]								
Sheet and Strip		100	690	60	415	40.0	241	100	not required
Plate		90	620	50	345	40.0	241	100	not required
S21603	XM-18[L]								
Sheet and Strip		100	690	60	415	40.0	241	100	not required
Plate		90	620	50	345	40.0	241	100	not required
S20910	XM-19[L]								
Sheet and Strip	...	105	725	60	415	30.0	241	100	not required
Plate		100	690	55	380	35.0	241	100	not required
S24000	XM-29[L]								
Sheet and Strip		100	690	60	415	40.0	241	100	not required
Plate		100	690	55	380	40.0	241	100	not required
S21400	XM-31[L]								
Sheet		125	860	70	485	40.0	...	...	not required
Strip		105	725	55	380	40.0	...	...	not required
S21800	...	95	655	50	345	35.0	241	100	not required
Duplex (Austenitic Ferritic)									
S31200	...	100	690	65	450	25.0	293	31[J]	not required
S31260	...	100	690	70	485	20.0	290	...	...
S31803	...	90	620	65	450	25.0	293	31[J]	not required
S32001	...	90	620	65	450	25.0	...	25[G]	not required
S32205	2205[F]	90	620	65	450	25.0	293	31[J]	not required
S32304	2304[F]	87	600	58	400	25.0	290	32[J]	not required
S32520	...	112	760	80	550	25.0	310	...	not required
S32550	255[F]	110	760	80	550	15.0	302	32[J]	not required
S32750	2507[F]	116	795	80	550	15.0	310	32[J]	not required

Mechanical Test Requirements

UNS Designation [B]	Type[A]	Tensile Strength, min		Yield Strength,[B] min		Elongation in 2 in. or 50 mm, min,%	Hardness, max[c]		Cold Bend[0D]
		Ksi	MPa	Ksi	MPa		Brinell	Rockwell B	
S32760	...	108	750	80	550	25.0	270	...	not required
S32900	329	90	620	70	485	15.0	269	28	not required
S32950[M]	...	100	690	70	485	15.0	293	32	not required
Ferritic or Martensitic (chromium)									
S32803	...	87	600	72	500	16.0	241	100	not required
S40500	405	60	415	25	170	20.0	179	88	180
S40900[N]	409[N]								
S40910	...	55	380	25	170	20.0	179	88	180
S40920	...	55	380	25	170	20.0	179	88	180
S40930	...	55	380	25	170	20.0	179	88	180
S40945	...	55	380	30	205	22.0	...	80	180
S40975	...	60	415	40	275	20.0	197	92	180
S40977	...	65	450	41	280	18.0	180	88	not required
S41000	410	65	450	30	205	20.0	217	96	180
S41003	...	66	455	40	275	18.0	223	20	not required
S41008	410S	60	415	30	205	22.0	183	89	180
S41045	...	55	380	30	205	22.0	...	80	180
S41050	...	60	415	30	205	22.0	183	89	180
S41500	...	115	795	90	620	15.0	302	32	not required
S42035	...	80	550	55	380	16.0	180	88	not required
S42900	429[F]	65	450	30	205	22.0	183	89	180
S43000	430	65	450	30	205	22.0	183	89	180
S43035	439	60	415	30	205	22.0	183	89	180
S43400	434	65	450	35	240	22.0	...	89	180
S43600	436	65	450	35	240	22.0	...	89	180
S43932	...	60	415	30	205	22.0	183	89	180
S43940	...	62	430	36	250	18.0	180	88	not required

Mechanical Test Requirements

UNS Designation [B]	Type[A]	Tensile Strength, min		Yield Strength,[B] min		Elongation in 2 in. or 50 mm, min,%	Hardness, max[c]		Cold Bend[0D]
		Ksi	MPa	Ksi	MPa		Brinell	Rockwell B	
S44400	..	60	415	40	275	20.0	217	96	180
S44500	..	62	427	30	205	22	..	83	180
S44626	xm-33[L]	68	470	45	310	20.0	217	96	180
S44627	xm-27[L]	65	450	40	275	22.0	187	90	180
S44635	...	90	620	75	515	20.0	269	28[F]	180
S44660	...	85	585	65	450	18.0	241	100	180
S44700	...	80	550	60	415	20.0	223	20[F]	180
S44735.	...	80	550	60	415	18.0	255	25[F]	180
S44800	...	80	550	60	415	20.0	223	20[F]	180
S46800	...	60	415	30	205	22	...	90	180

A) Unless otherwise indicated, a grade designation originally assigned by the American iron and Steel Institute (AISI).

B) Yield strength shall be determined by the offset method at 0.2% in accordance with Test Methods with Test Definitions A 370. Unless otherwise specified (see specification A 480/A, 480, paragraph 4.1.11, Ordering information), an alternative method of determining yield strength may be based on total extension under load 0.5%.

C) Either Brinell or Rockwell B Hardness is permissible.

D) Bend test are required to chromium steels (ferritic or martensitic) thicker than 1 in. (25 mm) or for any austenitic or duplex (austenitic-ferritic) stainless steels regardless of thickness.

E) Elongation for thickness, less than 0.015 in. (0.38 mm) shall be 20% minimum, in 1 in (25.4 mm)

F) Common name, not a trademark, widely used, not associated with any one producer.

G) Yield strength requirements shall not apply to material under 0.020 in (0.50 mm) in thickness.

H) Not applicable for thickness under 0.010 in. (0.25 mm)

I) Type 201 is generally produced with CHEMICAL COMPOSITION BALANCED FOR RICH SIDE (type 201-1) OR LEAN SIDE (Type 201-2) AUSTE NITE STABILITY DEPENDING ON THE PROPERTIES REQUIRED FOR SPECIFIC APPLICATION.

J) Rockwell C scale.

K) For S32615, the grain size a determined in accordance with the Test Methods E 112, Comparison Method, Plate II, shall be No. 3 or liner.

L) Naming system developed and applied by ASTM

M) Prior to Specication A 240-89b, the tensile value for S32950 was 90 ksi.

N) S40900 (Type 409) has been replaced by S40910, S40920, and S40930. Unless otherwise specified in the ordering information, an order specifying S40900 or Type 409 shall be satisfied by any one of S40910 S40920, S40930 at the option of the seller, Material meeting the requirements of S40910, S40920, or S40930, may at the option of the manufacturer be certified as S40900.

O) Material 0.050 in (1.27 mm) and under in thickness shall have a minimum elongation of 20 %.

CARBON STEEL PLATES - IS 8500 / SAILMA

CHEMICAL COMPOSITION

Grade IS 8500	Ladle Analysis C% Max	Mn% Max	S% Max	P% Max	Si% Max	C.E% Max
Fe 440	.20	1.30	.050 .040	.050 .040	45	40
Fe 440B	.20	1.30	.050 .040	.050 .040	45	40
Fe 490	.20	1.50	.050 .040	.050 .040	45	42
Fe 490B	.20	1.50	.050 .040	.050 .040	45	44
Fe 540	.20	1.60	.045 .040	.045 .040	45	44
Fe 540B	.20	1.60	.045 .040	.045 .040	45	44
Fe 570	.22	1.60	.045 .040	.045 .040	45	46
Fe 570B	.22	1.60	.045 .040	.045 .040	45	46
Fe 590	.22	1.60	.045 .040	.045 .040	45	48
Fe 590B	.22	1.80	.045 .040	.045 .040	45	48

MECHANICAL PROPERTIES

Grade IS 8500	Tensile Strength (Min) MPa	Yield Strength (Min) <16 mm MPa	16-40 mm MPa	41-63 mm MPa	>63 mm MPa	Elongation Percent (Min) $5.65.\sqrt{So}$	Bend (Internal diameter) Min <12 mm	12-25 mm	Charpy V-notch Impact toughness, Joules, Min (Average of 3 Values) Room Temp^0 - 20^{0}C	
Fe 440	440	300	290	280	By agreement	22	2t	3t	-	-
Fe 440B	440	300	290	280	-	22	2t	3t	50	30
Fe 490	490	350	330	320	-	22	2t	3t	-	-
Fe 490B	490	350	330	320	-	22	2t	3t	50	25
Fe 540	540	410	390	380	-	20	2t	3t	-	-
Fe 540B	540	410	390	380	-	20	2t	3t	50	25
Fe 570	570	450	430	420	-	20	2t	3t	-	-
Fe 570B	570	450	430	420	-	20	2t	3t	45	20
Fe 590	590	450	430	420	-	20	2t	3t	-	-
Fe 590B	590	450	430	420	-	20	2t	3t	45	20

SAILMA High Strength Micro Alloy Structural steel (Semi Killed)

CHEMICAL COMPOSITION

Grade	C% Max	Mn% Max	S% Max	P% Max	Nb+V+Ti% Max
SAILMA 300	0.25	1.50	0.055	0.055	0.20
SAILMA 300HI	0.20	1.50	0.040	0.040	0.20
SAILMA 350	0.25	1.50	0.040	0.040	0.20
SAILMA 350 HI	0.20	1.50	0.040	0.040	0.20
SAILMA 410	0.25	1.50	0.040	0.040	0.20
SAILMA 410HI	0.20	1.50	0.040	0.040	0.20
SAILMA 450	0.25	1.50	0.040	0.040	0.20
SAILMA 450HI	0.20	1.50	0.040	0.040	0.20

MECHANICAL PROPERTIES

Grade	UTS (MPa)	YS (MPa) Min	El.% Min $5.65\sqrt{So}$	IMPACT CHARPYV		Bend Test
SAILMA300	440-560	300	20	0^{0}C-20^{0}C Joules (Min)		3T
SAILMA300HI	440-560	300	21	40		3T
SAILMA350	490-610	350	20	-		3T
SAILMA350HI	490-610	350	21	40	30	3T
SAILMA410	510-660	410	19	-		3T
SAILMA 410HI	540-660	410	20	35	25	3T
SAILMA450	570-720	450	18	-		3T
SAILMA450 HI	570-720	450	19	30	20	3T

IS - 2002 - 62 STEEL PLATES FOR BOILERS

Designation			Chemical Composition			Tensile test			Elongation	
	C max	mn	si max	P max	S max	Tensile Strength Kf/mm²	Yield Strength Kf/mm²min		Test	% min piece
IS 2002-1	0.18	0.5 1.2	0.15-0.35	0.035	0.040	36.7-49	24	23	5.65/Sc	24
IS 2002-2	0.20	0.5 1.2	0.15-0.35	0.035	0.40	41.7-54	27	26	5.65/Sc	22
IS 2002-3	0.22	0.5 1.2	0.15-0.35	0.035	0.040	46.8-59	29.5	29	5.65/Sc	21

IS - 2062 -92 STEEL FOR GENERAL STRUCTURAL PURPOSE

Grade	Designation	%Chemical Composition						Supply Tensile	Tensile Strength (min) Kg/mm²	Yield Strength (min) kg/mm²			% El in gauge length 5.56/so	Bend Test	Std. Test Piece charpy V Notch Impact Energy joule min	Remark
		C max	Mn max	S max	P max	Si max	CE max			<20 mm	20-40 min	>40 min				
A	Fe 410 WA	0.23	1.5	0.050	0.050	-	0.42	As rolled	41.8	25.50	24.48	23.45	23	31	-	
B	FE410WB	0.22	1.5	0.045	0.045	0.40	0.41	As Rolled Plates above 12mm may be normalised if agreed to between manufacturer & purchaser	41.8	25.50	24.48	23.45	21 for t< 25 mm 3t for > 25 mm	23	27	min Charpy impact energy to be guaranteed at O-C agreed betn. mfgrs. purchaser
C	FE410WC	0.20	1.5	0.040	0.040	0.40	0.39	As Rolled Plates above 12mm shall be normalise	41.8	25.50	24.48	23.45	23	21	27	impact properties to be guaranteed at any one of two temp.- 20c or 40 c as specified by purchaser

ASTM A 537 - 35 PRESSURE VESSEL PLATES, HEAT TREATED, CARBON MANGANESES-SILICON STEEL

Designation	%Chemical Composition										Heat Treat-ment	Tensile Strength			Elongation % min	
	C Max		Min. thickness in mm		P max	S max	Cu max	Ni max	Cr max	Mo max		Thickness in mm	Tensile Strength Ksi (MPa)	Yield Strength Ksi (MPa) min	GL= 8 in or 200 mm	GL = 2 in or 50 mm
			t<1-1/2(38)	t>-1-1/2												
A 537 -1	0.24	0.15-0.50	0.70-1.35	1.0-1.60	0.035	0.040	0.035	0.25	0.25	0.08	Normalised	t<2-1 (64) 2-1/2<t <4 (100)	70-90 (485-620) 65-85 (450-585)	50 (345) 45 (310)	18	22
A 537 -2	0.24	0.15-0.50	0.70-1.35	1.0-1.60	0.035	0.040	0.035	0.25	0.25	0.08	Quenched & Tempered	T<2-1/2(64) 2-1/2<t (4(100)	80-100 (550-690) 75-95 (515-655)	60 (415) 55 (380)	-	22

ASTM A 285 - 80 PRESSURE VESSEL PLATES, CARBON STEEL LOW AND INTERMEDIATE TENSILE

Designation	Chemical Composition				Chemical Composition			
	C max	Mn max	P max	S max	Tensile Strength Ksi(MPa)	Yield Strength Ksi (Mpa)	Elongation % mm Gl + 8 in	Gl = 2 in
A 285	0.7	0.90	0.035	0.035	45-65 (310-450))	24-(165)	27	30
A 285 B	0.22	0.90	0.035	0.035	50-70 (385-485)	27(185)	25	28
A 285 C	0.28	0.90	0.035	0.035	55-75 (380-515)	30(205)	23	27

ASTM A515-78 PRESSURE VESSEL PLATES, CARBON STEEL, FOR INTERMEDIATE & HIGHER TEMP. SERVICE

Designation	Chemical Composition, %						Tensile Test			
	Thickness in (mm)	C max	Si	Mn max	P max	S max	Tensile Strength Ksi (MPa)	Yield Strength Ksi (Mpa), min	Elongation,% min	
									GI=8 in. *2	GI=2 in
A 515-55	1<1(25) 1<t<2 (50) 2<t<4(100) 4<t<8 (200) t<1	0.20 0.22 0.24 0.26 0.28	0.15-0.30	0.90	0.035	0.04	55-75 (380-515)	30(205)	23	27
A 515-60	t<1 (25) 1<t<2 (50) 2<t<4 (100) 4<t<8 (200) t<8	0.24 0.27 0.29 0.31 0.31	0.15-0.30	0.90	0.035	0.04	60-80 (415-550)	32(220)	21	25
A 515-65	t<1 (25) 1<t<2 (50) 2<t<4 (100) 4<t<8(200) t<8	0.28 0.31 0.33 0.33 0.33	0.15-0.30	0.90	0.035	0.04	65-85 (450-585)	35(240)	19	23
A 515-70	t<1 (25) 1<t<2 (50) 2<t<4< (100) 4<t<8 (200) t<8	0.31 0.33 0.35 0.35 0.35	0.15-0.30	0.90	0.035	0.04	70-90 (485-620)	38(260)	17	21

ASTM A515-78 PRESSURE VESSEL PLATES, CARBON STEEL, FOR INTERMEDIATE AND LOWER TEMP. SERVICE

Designation	Chemical Composition, %						Tensile Test			
	Thickness in (mm)	C max	Si	Mn max	P max	S max	Tensile Strength Ksi (MPa)	Yield Strength Ksi (MPa), min or 200 mm	Elongation,% min	
									GI=8 in. *2 or 50 mm	GI=2 in
A 516-55	T<1/2 (13)	0.18	0.15~0.30	0.60~0.90	0.035	0.04	55-75 (380-515)	30(205)	23	27
	1<t<2(50) 2<t<4(100) 4<t<8 (200) t>8	0.20 0.22 0.24 0.26	0.15-0.30	0.60~1.20	0.035	0.04				
A 516-60	T<1/2 (13)	0.21	0.15~0.30	0.60~0.90	0.035	0.04	60-80 (415-550)	32(220)	21	25
	1<t<2 (50) 2<t<4 (100) 4<t<8 (200) t<8	0.23 0.25 0.27 0.27	0.15-0.30	0.85~1.20	0.035	0.04				
A 516-65	t<1/2(13) 1<t<2 (50) 2<t<4 (100) 4<t<8(200) t<8	0.24 0.26 0.28 0.29 0.29	0.15-0.30	0.85~1.20	0.035	0.04	65-85 (450-585)	35(240)	19	23
A 516-70	t<1/2 (13) 1<t<2 (50) 2<t<4< (100) 4<t8 (200) t>8	0.27 0.28 0.30 0.31 0.31	0.15-0.30	0.85~1.20	0.035	0.04	70-90 (485-620)	38(260)	17	21

*1.Refer to Note *1 ASTM A.455.

*2.(1) Refer to Note *2 for ASTM A.455

(2) For plates over 3.5 in. (88.9 mm) in thickness, a deduction of 0.5% from the specified percentage of elongation in 2 in. (50 mm) shall be made for each increase of 0.5 in. of the specified thickness over 3.5 in. This deduction shall not exceed 3%.

Heat Treatment	
Fine grain practice. 1. plate 1.50 in (38 mm) and under in thickness are normally supplied in the as-rolled condition. 2. plate over 1.50 in. in thickness shall be normalized.	*1. Grade 60 plate 0.50 in (13.mm) and under in thickness may be specified to have 0.85-1.20% managese on heat analysis. *2. Refer to Note *1 for ASTM A. 455. *3. Refer to Note *2 for ASTM A. 455.

CHEMICAL COMPOSITION

ASTM A353-78 PRESSURE VESSEL PLATES, ALLOY STEEL, 9 PERCENT NICKEL, DOUBLE - NORMALIZED & TEMPERED									
Chemical Composition, %							Tensile Test		
Designation max	C	Si max	Mn max	P max	S	Ni	Tensile Strength Ksi (MPa)	Yield Strength Ksi (MPa) min	Elongation, % min, GL = 2 in or 50 mm
A 353	0.13	0.15~0.30	0.90	0.035	0.040	8.50~9.50	100~120 (690~825)	75(515)	20

ASTM A387-78 PRESSURE VESSEL PLATES, ALLOY STEEL, CHROMIUM - MOLYBDENUM										
CHEMICAL COMPOSITION, %										
Designation	Specification	C max	Si	Mn	P max	S max	Cr	Mo	Tensile Strength Ksi (MPa)	Yield Strentgh (0.2% offset) Ksi (MPa) min
A 387	Grade 2	0.21	0.15~0.30	0.55~0.80	0.035	0.040	0.50~0.80	0.45~0.60	55-80 (380-550)	33 (230)
	Grade 12	0.17	0.15~0.30	0.40~0.65	0.035	0.040	0.80~1.15	0.45~0.60	55-80 (380-550)	33 (230)
	Grade 11	0.17	0.50~0.80	0.40~0.65	0.035	0.040	1.00~1.50	0.45~0.65	60-85 (415-585)	35 (240)
	Grade 22	0.15*1	0.50 max	0.30~0.60	0.035	0.035	2.00~2.50	0.90~1.10	60-85 (415-585)	30 (205)
	Grade 21	0.15*1	0.50 max	0.30~0.60	0.035	0.035	2.75~3.25	0.90~1.10	60-85 (415~585)	30 (205)
	Grade 5	0.15	0.50 max	0.30~0.60	0.040	0.030	4.00~6.00	0.45~0.65	60-85 (415~585)	30 (205)
	Grade 7	0.15	1.00 max	0.30~0.60	0.030	0.030	6.00~8.00	0.45~0.65	60-85 (415~585)	30 (205)
	Grade 9	0.15	1.00 max	0.30~0.60	0.030	0.030	8.00~10.00	0.90~1.10	60-85 (415~585)	30 (205)

1). The carbon content for plates over 5 inch (127 mm) in thickness is 0.17% max. on product analysis.

*2). a) For plates under 0.312 inch (7.92 mm) in thickness, a deduction of 1.25% from the specified percentage of elongation shall be made for each decrease of 0.031 inch (0.79 mm) of the specified thickness under 0.312 inch.

b) For plates over 3.5 inch (88.9 mm) in thickness, a deduction of 0.5% from the specified percentage of elongation in 2 inch (50 mm) shall be made for each increase of 0.05 inch of the specified thickness over 3.5 in this deduction shall not exceed 3%

c) For plates upto the including 3/4 inch thickness, if the percentage of elongation of an 8 inch or 200 mm gauge length test specimen falls not more than 3 % below tyhe amount prescribed, the elongation shall be considered satisfactory provided the percentage of elongation in 2 inch (50 mm) across the break is not less than 25 %.

*3). Measured on round test specimen.

*4). Measured on flat test specimen

*5). Applicable to annealed and normalised-tempered materials

*6). Not applicable to annealed material

MECHANICAL PROPERTIES

ALLOY STEEL PLATES - MECHANICAL PROPERTIES ASTMA -387 GRADE 2, 5, 7, 9, 11, 12, 22 CLASS 1 & 2								
Tensile Test								
Class 1*5			Class 2*6					
Elongation %min		Reduction	Tensile	Yield Strength	Elongation %, min		Reduction	Heat Treatment
GL=8 in.*2 or 200 mm	GL= 2in. or 50 m	of area % min.	Strength Ksi(MPa)	(0.02%Offset) Ksi(MPa)	GL=8 in. *2 or 200mm	GL=2 in. or 50 mm	of Area %, min	Tempering Tempeature
18	22	--	70-90 (485-620)	45 (310)	18	22	--	
18	22	--	65-85 (450-585)	40 (275)	19	22	--	1,150^{0}F(620^{0}C)and over
19	22	--	75-100 (515-690)	45 (310)	18	22	--	
--	18	45*3 40*4	75-100 (515-690)	45 (310)		18	45*3 40*4	
--	18	45*3 40*4	75-100 (515-690)	45 (310)		18	45*3 40*4	1.250^{0}F(675^{0}C) and over
--	18	45*3 40*4	75~100 (515-690)	45 (310)	--	18	45*3 40.4	1,300^{0}F(705^{0}C) and over
--	18	45*3 40*4	75~100 (515-690)	45 (310)	--	18	45*3 40.4	1,250^{0}F(675^{0}C) and over
--	18	45*3 40*4	75~100 (515-690)	45 (310)	--	18	45*3 40.4	1,250^{0}F(675^{0}C) and over

CHEMICAL COMPOSITION OF STAINLESS STEEL

Grade Designation				Chemical Composition	
AISI	C Max	Mn Max	P Max	S Max	Si Max
201	0.15	5.50/7.50	0.06	0.030	1.0
202	0.15	7.50/10.0	0.06	0.030	1.0
301	0.15	2.0 Max	0.045	0.040	1.0
302	0.15	2.00	0.045	0.030	1.0
303	0.15	2.00	0.045	-	1.0
304	0.08	2.00	0.045	0.030	1.0
304L	0.030	2.00	0.045	0.030	1.0
308	0.08	2.00	0.040	0.030	1.0
309	0.20	2.0 Max	0.045	0.030	1.0
309S	0.08	2.00	0.045	0.030	1.0
310	0.25	2.00	0.045	0.030	1.50
310S	0.08	2.00	0.040	0.030	1.50
314	0.25	2.00	0.045	0.030	1.5 to 3
316	0.08	2.00	0.045	0.030	1.0
316L	0.030	2.00	0.045	0.030	1.0
317	0.08	2.00	0.045	0.030	1.0
317L	0.030	2.00	0.045	0.030	1.0
316TI	0.080	2.00	0.045	0.030	1.0
321	0.08	2.00	0.045	0.030	1.0
347	0.08	2.00	0.045	0.030	1.0
430	0.12	1.00	0.040	0.030	0.75
446	0.20	1.50 Max	0.040	0.030	1.0
403	0.15	1.00	0.040	0.030	.50
410	0.15	1.00	0.040	0.030	1.00
410 S	0.08	1.00	0.040	0.030	1.0
414	0.15	1.00 Max	0.040	0.030	1.0
420	Over.15	1.00	0.040	0.030	1.00
431	0.20	1.00 Max	0.040	0.030	1.0
440A	0.60/0.70	1.00	0.040	0.030	1.0
440B	0.75	1.00	0.040	0.030	1.0
	0.95				
440C	0.95	1.00	0.040	0030	1.0
	1.2				
446	0.20	1.50	0.040	0.030	1.0

CHEMICAL COMPOSITION OF STAINLESS STEEL

Percent				Nearest Equivalent Specification	
Cr.	Ni	Mo	Other element	I.S.	En
16.0/18.0	3.5/5.5	-	N-25 max	10Cr 17Mn6Ni4	-
17.0/19.0	4.0/6.0	-	N-25 max	-	-
16.0/18.0	6.0/8.0	-	-	10Cr17Ni7	-
17.0/19.0	8.0/10.0	-	-	07Cr18Ni9	En-58A
17.0/19.0	8.0/10.0	-	-	15Cr18Ni9	En-58M
18.0/20.0	8.0/10.0	-	-	04Cr18Ni10	En-58E
18.0/20.0	8.0/10.0	-	-	02Cr18Ni11	-
10.0/21.0	10.0/12.0	-	-	-	-
22.0/24.0	12.0/15.0	-	-	20Cr24Ni12	-
22.0/24.0	12.0/15.0	-	-	-	-
24.0/26.0	19.0/22.0	-	-	10Cr25Ni12	-
24.0/26.0	19.0/22.0	-	-	-	-
25.0/26.0	19.0/22.0	-	-	-	-
16.0/18.0	10.0/14.0	2.0/3.0	-	04Cr17Ni12MO2	En 58H
16.0/18.0	10.0/14.0	2.0/3.0	-	03Cr17Ni12MO2	-
18.0/20.0	11.0/15.0	3.0/4.0	-	-	-
18.0/20.0	11.0/15.0	3.0/4.0	-	TIy5 c min	-
16.0/18.0	10.0/14.0	2.0/3.0	Ti5xC min	-	-
17.0/19.0	9.0/12.0	-	Ti5xC min	04Cr18Ni10Ti20	En-58C
17.0/19.0	9.0/12.0	-	Nb/Ta 10xC min	04Cr18NiNb-40	En-58G
14.0/18.0	0.60	-	-	07Cr17	En-60
23.0/27.0	0.60 Max	-	N-25 Max	-	-
11.5/13.0	0.60	-	-	-	-
11.5/13.5	0.60	-	-	12Cr13	En-58A
11.5/13.5	0.60 Max	-	-	-	-
11.5/13.5	1.25/2.50	-	-	-	-
12.0/14.0	0.60	-	-	22Cr13	En-56C&D
15.0/17.0	1.25/2.50	0.75 max	-	15Cr16 Ni2	En-57
16.0/18.0	-	-	-	-	-
16.0/18.0	-	0.75 max	-	-	-
16.0/18.0	-	0.75 max	-	-	-
23.0/27.0	-	-	-	NO.25 max	-

CHEMICAL COMPOSITION

Materials	Corresponding standards	Product symbol	Cu	Sn	Zn	Pb	Ni	Fe	AS	P
COPPER TUBES	ASTM B-68	C 12200	99.00							0.015-0.040
	BS 2871 Part 3	C 106	99.85			0.01		0.03	0.05	0.013-0.050
	DIN 1785	StCuF 25	99.90							0.015-0.040
	IS 2501	ETP Copper	99.90			0.005				
COPPER NICKEL TUBES 90/10	BS 2871 Part 3	CN 102			---	0.01	9-11	1.0-2.0		
	ASTM B - 111	C 70600	Remainder		1.0	0.05	9-11	1.0-1.8		
	DIN 1785	Cu Ni 10 Fe 1 Mn			0.5	0.03	9-11	1.0-2.0		
	NFA 51 102	Cu Ni 10 Fe 1 Mn			0.5	0.05	9-11	1.0-2.0		
	JIS H 3300	C 7060			0.5	0.05	9-11	1.0-1.8		
	IS 1545	Cu Ni 10 Fe 1			0.5	0.05	9-1	1.0-1.8		
CUPRO NICKEL TUBES 70/30	BS 2871 Part 3	Cn 107			---	0.01	29-32	0.4-1		
	ASTM B 111	C 71500	Remainder		1.0	0.05	29-33	0.4-1		
	DIN 1785	Cu Ni 30 Mn 1 Fe			0.5	0.03	29.-32	0.4-1		
	NFA51 102	Cu Ni 30 Mn 1 Fe			0.5	0.05	29-33	0.4-0.7		
	JIS H 3300	C 7150			0.5	0.05	29-33	0.0-0.7		
	IS 1545	Cu Ni 30 Mn 1 Fe			0.5	0.05	29-33	0.4-1		
ADMIRALTY BRASS TUBES	BS 2871 Part 3	CZ-III	70-73	1-1.5		0.07	---	0.06	.02-.06	---
	ASTM B - 111	C 44300	70-73	.9-1.2	Remainder	0.07	---	0.06	.02-.06	---
	DIN 1785	Cu Zn 28 Sn 1	70-73	.9-1.3		0.07	0.1	0.07	.02-.06	0.01
	NFA 51 102	Cu Zn 29 Sn 1	70-73	.9-1.2		0.07	---	0.06	.02-.06	---
	JIS H 3300	C 4430	70-33	.9-1.2		0.07	---	0.06	.02-.06	---
	IS 1545	Cu Zn 29 Sn 1 As	70-73	1-1.5		0.07	---	0.06	.02-.06	---
ALUMINIUM BRASS TUBES	BS 2871 Part 3	CZ 110	76-78			0.07	---	0.06	.02-.06	---
	ASTM B - 111	C 68700	76-79		Remainder	0.07	---	0.06	.02-.06	---
	DIN 1785	Cu Zn 20 Ai 2	76-79			0.07	0.1	0.07	.02-.035	0.01
	NFA 51 102	Cu Zn 22 Ai 2	76-79			0.07	---	0.06	.02-.06	---
	JIS H 3300	C 6870	76-79			0.07	---	0.06	.02-.06	---
	IS 1545	Cu Zn 21 Ai 2 AS	76-78			0.07	---	0.06	.02-.06	---
BRASS TUBES 70/30	BS 2871 Part 3	CZ 126	69-71	---		0.07	---	0.06	.02-.06	
	ASTM B - 135	C 26000	68.5-71.5	---	Remainder	0.07	---	`0.05	---	
	IS 407	Cu Zn 30 As	68.5-71.5	---		0.07	---	0.06	.02-.06	
	DIN 17671	Cu Zn 30 2.0265	69-71	0.05		0.05	0.2	0.05	---	
	IS 1545	Cu Zn 30 As	69-71	---		0.07	---	006	.02-.06	
BRASS TUBES 63/37	ASTM B - 135	C 27200	62-65	---		0.07	---	0.07	---	
	DIN 17671	Cu Zn37	62-64	0.10	Remainder	0.10	0.30	0.10	---	
	IS 407	Cu Zn 37	62.95	---		0.30	---	0.010	0.06	
	JIS H3300	*C 2800	60			-				
	JIS H3300	*C 2700	63		37	-				

MECHANICAL PROPERTIES

Mn	S	C	Al	Total Impurities max.	Condition	Yield Strength N/mm²	Tensile N/mm²	Elongation (%)	Hardness HV 5	Grain Size mm (75X)
					050 060					0.015-0.040 0.040 min
				0.06	M,1/2H,0				105 min 80-100 60 max	0.05 max
					F25	150-240	250 min	30 min	---	---
				0.03	O D		201 min 265 min	40 min	---	---
0.5-1.0	0.05	0.05		0.30	M O	---	---	---	150 80-110	0.05 max
0.0	---	---		---	0.61 H 55	105 min 240 min	275 min 310 min	---	---	---
0.5-1.0	0.05	0.05		0.30	F29	90-180	290 min	30 min	---	---
0.3-1.0	0.02	0.05		0.10	---	---	---	---	70-100	0.040-0.045
0.2-1.0	---	---		0.50	0	---	275 min	30 min	---	0.010-0.045
0.05-1.0	---	---		0.30	O D		295 min 285 min		110 max 130 min	
0.5-1	0.08	0.06		0.30	M O		---	---	150 90-120	0.05 max
1.0	---	---		---	0.61 HR 50	125 min 345 min	360 min 495 min	35 min 30 min	---	---
0.5-1.5	0.05	0.05		0.30	F 37 F 42	120-220 150-260	370 min 420 min	35 min 30 min	---	---
0.05-1.5	0.02	0.06		0.10	---	---	---	---	90-130	0.010-0.045
0.2-1	---	---		0.50	0	---	363 min	30 min	---	0.010-0.045
0.5-1	---	---		0.30	O D	---	360 480	---	115 max 140 max	---
				0.30	M TA O	---	---	---	150 min 80-105 75 max	0.05 max
				---	0.61	105	310	---	---	0.01-0.045
				0.10	F 36 F 32	140-220 100-170	360 min 320 min	45 min 55 min	---	---
				0.30	---	---	---	---	80-120	0.01-0.045
				---	0	---	314 min	30 min	---	0.01-0.045
				0.3	M TA O	---	375 mpa mijn 340 mpa min 385 mpa min	---	80 min 80-105 130 min	0.01-0.045
			1.8-2.3	0.3	M TA O	---	---	--	150 min 85-110 75 max	0.05 max
			1.8-2.5	---	0.61	125	345	---	---	0.01-0.045
			1.8-2.3	0.1	F 39 F 34	150 - 230 120 - 180	390 min 340 min	44 min 55 min	---	---
			1.8-2.5	0.3	---	---	---	---	80-130	0.010-0.45
			1.8-2.5	---	0	---	375	40	---	0.010-0.045
			1.8-2.3	0.3	O TA HD	400 mpa max 355 mpa min 415 mpa min	---	85 max 80-110 130 min	---	0.010-0.045
			---	0.3	M TA O	---	---	---	150 min 80-105 75 max	0.05 max
			---	---	H 58 H 80	--	370 min 455 min	---	---	---
			---	0.3	O TA HD	---	285 mpa min 300 mpa min 400 mpa min	---	75 max 80-110 135 min	---
			0.02	0.1	F 28 F 35 F 42	180 mps max 200 mpa max 320 mpa max	280-350 350-420 420 min	---	---	---
			---	0.3	O TA HD	---	375 max 340 min 385 min	55 min	80 max 80-105 130 min	---
			---	---	H 58 H 80	---	370 min 455 min	---	---	---
			0.03	0.10	F 29 F 37	180 max 200 min	290-370 370-440	50 min 27 min	---	---
			---	0.06	O TA HD	---	285 min 320 min 400 min	---	80 max 80-110 130 min	---

SPECIFICATIONS FOR BRASS RODS, SECTIONS AND FORGINGS

Material Descriptions	Indian Standard specification	British Standard specification	Composition Limits								Physical Properties				
			Copper %	Lead %	Tin %	Iron %	Manganese %	Aluminium %	Other Element %	Zinc %	Tensile strength Kg/mm²		2% proof stress Kg/mm² min	Elongation 0% on 5.6 /A	
Free cutting Brass type 1	319	249	56 to 59	2 to 3.5	-	0.35 max	-	-	0.7 Max	Remainder	Annea-fed 1/2 Hard Hard	35 to 29 41-33 56 to 50	-	Annea-led 1/2 Hard	12 to 22 4 to 17 -to 4
Type II	319	-	60 to 63	2.5 to 3.7	-	0.35 Max	-	-	0.5 Max	Remainder	Annea-led 1/2 hard Hard	34 to 28 40 to 32 56 to 49	13-16.5	Annea-led 1/2 Hard - Hard	15 to 25 7 to 20 to 4
Forging Brass	3488	218	56.5 to 60	1.0 to 2.5	-	-	-	-	0.25 Max	Remainder	35 Min	-	-	25% Min	-
High Tensile Brass Rods Alloy I	320	-	56 to 59	0.5Max	0.75 to 1.75	1.25 Max	2.0 Max	0.2 Max	0.5 Max	Remainder	53	-	24-28	15%	-
Alloy II	320	-	56 to 59	1.0 Max	0.5 Max	0.7 to 1.2	0.5 to 1.2	0.2 to 1.2	0.5 Max	Remainder	47	-	24	20%	-
Alloy III	320	-	57 to 61	0.75 to 1.0	1.0 Max	0.25 to 1.0	0.25 to 1.0	0.5 to 2.0	0.5 Max	Remainder	53	-	28-	15 %	-

Alloy Desi-gnation	Chemical composition %					Condi tion	Thickness		Mechanical properties		Elongation on gauge length of 50 mm Persent	Vickers Hardness		Bend Test
									Tensile Strength					
	Cu	Pb Max	Fe	Total imputies including Iron max	Zn		Over	Upto & including	N/mm2 upto & including 450 mm Wide	(Kgf/mm2 over 450 mm wide)		Upto & including 450 mm	Over 450 mm wide	Trasvers Bend Angle Radius deg
(1) CuZn 30	(2) 68.5 to 71.5	(3) 0.05	(4) 0.05	(5) 0.3	(6)	(7) 0 HA HB HO HS	mm (8) - - -	mm (9) 10 10 35 10 10	min (10) 275 (28.0) 320 (32.5) 345 (35.0) 405 (41.5) 560	min (11) 275 (28.0) 320 (32.5) 345 (34.0) 380 (39.0) -	min (12) 50 - 35 - 20 - - 5 -	min (13) max (14) 80 75 100 125 180	min (15) max (16) 80 75 95 120	(17) (18) 180cls 180 CLS 180 CLS 180 t 90.21
CUzN 37	61.5 64.5	0.30	0.075	0.6		O HA HB HD HE HS	- - - 35 - - -	10 10 35 10 10 10 5	275 (28.0) 335 (34.0) 380 (38.5) 450 (46.0) 515 660	275 (28.0) 320 (32.5) 345 (35.0) 405 (41.5)	40 30 15 5	80 75 110 135 165 185	80 75 100 125	180CLS 180CLS 180 CLS 180 t 90.21
Cu Zn 40	58.5 to 61.5	0.30	0.10	0.75		0 HB HD	- - -	10 10 10	(67.5) 275 (28.0) 420 (43.0) 490 (50.0)	275 (28.0) 420 (43.0) 490 (50.0)	30 12 5	85 100 125	85 100 125 125	180CLS 180 t 90 21

Grade	Cu	Pb	Fe	As	Impu.	Z	Temper	Tensile	Hardness
CuZn 30As	68.5-75.5	0.07	0.06	0.02-0.06	0.30		Annealed (0) Temper annealed (TA) Hard (HD)	285 min 300 min 400 min	75 max 80-110 135 min
Cu Zn 37	62.0-65.0	0.30	0.1	0.06	0.06		Annealed (O) Temper annealed (TA) Hard (HD)	285 min 320 min 400 min	80 max 80-100 130 min
CuZn 21	76.0-78.0	0.07	0.06	0.02-0.06	-		Annealed 31.5-40.9 Drawn 58.3-70.9	-	5-110 HV 75 max 150 min
CuZn29	70.0-73.0	0.07	0.06	0.02-0.06			Annealed 28.3-37.8 Drawn 50.4-61.4	-	80-105HV 75 HV max 150 min

SPECIFICATION FOR COPPER RODS & SECTIONS

Material Description	Specification			Composition Limits			Tensile Strength	Physical properities	
	IIS	BSS %	Copper %	Phosphorous %	Arsenic %	Other impurities	Kg/mm2 min mm%	Elongation %	Electrical conductivity
Phosphorous Deoxidised non arsenical copper	4171	2874C106	99.85 min (including silver)	0.015 to 0.05		0.06Max	Anne 21 23	33 13 Min	
Arsenical copper	288		99.20		3 to5		22	40 Min	
High Conductivity ElectrolyticTough Pitch	613	2874C101	99.9 Min (including Silver)			0.03 Max	23.5/29.5	40 Min	99.25% IACS at 20°C
Cadmium Copper (High Conductivity wear resistance)		2874C108	Remainder		Cadmium 0.5 to 1.2 %	0.1 Min	30 Min	5% Min	80.97% 1 LACS
High conductivity Tellurium Copper		2874C109	Remainder		0.3 to 0.7%	Tellurium 0.2Max	26.5	12%	
Leaded Copper			Remainder		lead 0.6-1%	0.2 max	22.30	10%	94.98% LACS
Aluminium		2874 CA 104	Remainder	Nickel Iron 4-6 4-6	Manganese 0.5 Max	Alminium 8-5-11	71.5	12	
Bronze Rods		CA 103	Remainder	4% Max	0.5% Max	8.8-10	53	22	

Material Descriptions	I SS ISS	BSS BSS	Copper %	Arsenic %	Phosphorous %	Lead %	Iron %	Nickel	Other Elements	Tensile Strength Kgmm²	Elongation 4/A	Electrical Conductivity	Hardness
Phosphorous Deoxidised non Arsenical copper	2501 DHPI DHP II	2871 C106	99.85 Min		0.013 to 0.05	0.01	0.03		0.06	Anne 22 Drawn 28	Anne 40% Drawn HH		60 Max 105 Min 80-100
Phosphorous Deoxidised Arsenical copper	250 DPA	2871 C 107	99.20 Min	0.3 to 0.5	0.013 to 0.5	0.01	0.03		0.7	Anne 22 Drawn 28	Anne 40% Drawn		
High Conductivity copper tubes	2501 EP	1977 (2871) C 101	99.9 Min			0.005			0.03	Anne 20.5 to 25.2 Drawn 26.8	Anne 40% Drawn	99.25 LACS	
Cupro nickel tubes	1845 Cuni 10Fe 1	BS 2871 Part 2 CN 102	Remdr-Remdr	Manga nese 0.5-1.5		0.01	1.2	10-11	0.3	Anne 30.5 to 38.5 Drawn 44 Min	30		80-110HV 150 Mn
Cupro nickel tubes	Cuni 30	CN 107	Remdr	0.5-1.5		0.01	0.4/1	30/32	0.3	Anne 37-46 Drawn 51	30		90-120 HV

INDIAN STANDARD SPECIFICATION FOR PHOSPHOR BRONZE RODS AND BARS

Chemical Composition %		Cross Sectional Thk.		Condition	0.2% Proof Stress Min N/mm² (Kgf/mm²)	Tensile Strength Min N/mm (Kgf/mm²)	Elongation on Gauge Length of 5.65 A min %
Constituent	%	Over mm	Upto & Incl. mm				
Tin Phosphrous	4.6-5.5	10	18	As Manufactured	410(42.0)	495 (50.0)	10
Lead max	0.02-0.040	18	38	As Manufactured	380 (39.0)	460 (47.0)	10
Total Impu. max	0.02	38	75	As Manufactured	315 (32.0)	385 (39.5)	15
Copper	0.2	75	110	As Manufactured	235 (24.0)	315 (32.0)	20

IS- 10773 : 95 WROUGHT COPPER TUBES FOR REFERIGERATION & AIR - CONDITIONING PURPOSE

Grade	Chemical Composition %								Condition	0.2% prof Stress MP a Min	Tensile Strength MPa		5 Elong on 50 mm Min
	Copper	Lead	Tin	Iron	Arsenica	Nickel	Phosphorus	Tot-Impu.			Min	Max	
1	99.90 Min	0.01	0.01	0.03	0.05	0.1	0.04-0.015	-	Soft annealed Light annealed Light	- -	205 205 250	- - -	40 25

IS-733-83 CHEMICAL COMP. & PHYSICAL PROP. OF WROUGHT ALUMINIUM & ALUMINIUM ALLOY BARS, RODS & SECTIONS

Designation	Chemical composition %											Tensile strength		
	Ai	Cu	Mg	Si	Fe	Mn	Zn	Ti	Cr..	Other	Condition	Mpa Min	Mpa Max	%Elongation Min On 50 mm
19000	99.0 min	0.1	-	0.5	0.6	0.1	-	-	-	T+V=0.07	M O	65	110	18 25
19500	99.5 min	0.05	-	0.3	0.4	0.05	-	-	-	T+V=0.07	M O	65	100	23 25
24345	Remainder	3.8 5.0	0.2- 0.8	0.5- 1.2	0.7	0.3- 1.2	0.2	0.3	0.3	T+V=0.05	M O	150	240	12 12
53000	Remainder	0.1 4.0	2.8	0.6	0.5	0.5	0.2	0.2	0.25	Cr+MN=0.05	M O	215	260	14 16
63400	Remainder	0.1	0.4 0.7	0.3- 0.7	0.6	0.3	0.2	0.2	-	-	M O	110	130	12 18
64430	Remainder	0.1	0.4 1.2	0.6 1.3	0.6	0.4 1.0	0.1	0.2	0.25	-	M O	110	150	12 16

IS-737-86 CHEMICAL COM & PHYSICAL PROP. OF WROUGHT ALUMINIUM & ALUMINIUM ALLOY SHEET & STRIP

Designation	Chemical composition %											Tensile strength		Elongation on 50 mm%	
	Ai	Cu	Mg	Si	Fe	Mn	Zn	Ti	Cr..	Other	Condition	Mpa Min	Mpa Max	MPa Max	MPa Max
19990	99.9 Min		-							Cu+Sr.Fe =0.01	0 H2 H4	180 180	65 100 100		
19800	99.8 Min	0.03	-	0.18	0.15	0.06	0.06			Cu+S+Fe+ Min=0.2	0 H2 H4				
19600	99.6 Min	0.05	-	0.025	0.35	0.06	0.06			Cu+Si+Fe Min +Mn+Zn=1.0	0 H2 H4				
19000	99.0 Min	0.1	0.2	0.6		0.1	0.1			FE+Mn+Zn=1.0	0 Cu+Mg+Fe H4	H2			
24345		3.8 5.0	0.2 0.8	0.5 1.2		1.2	0.2	0.9	0.9		0 W WP				
51300		0.3	0.2 0.9	0.6		0.4	0.4	0.2	0.2		0 H2 H4				
64430		0.1	0.4 1.2	0.6 1.3		0.1	0.1	0.2	0.25		0 W WP				

CHEMICAL & PHYSICAL PROP. OF CARBON STEEL STAINLESS STEEL AND ALLOY STEEL FORGED FITTINGS

ASTM Grade	C	Mn	Si	S	P	Cr	Ni	Mo	Other	Tensile PSI(Kg/mm²)	Yield PSI(Kg/mm²)	Elongation %	Hardness BHN	Redn. in Area
A105	0.35 max	0.60 1.05	0.35 max	0.050 max	0.040 max	-	-	-	-	70000 49.46	36000 (25.50)	30Strip 22Round	187	30% Round
A 181 Cl 60 & 70	0.35 max	1.10 max	0.32 max	0.35 min	0.05 max	-	-	-	-	Cl.70-70000(49.46) Cl.60-60000(42.32)	30000 (20.90) 36000 (25.25)	22	-	35%
A 182 F 304	0.08 max	2.00 max	1.00 max	0.03 max	0.04 max	18.0 20.0	8.0 11.0	-	-	75000 (52.52)	30000 (20.90)	30	-	50%
A 182 F 304 L	0.085 max	2.00 max	1.00 max	0.03 max	0.04 max	18.0 20.0	8.0 13.0	-	-	70000 (49.46)	25000 (17.34)	30	-	50%
A 182 F 304 N	0.08 max	2.00 max	0.75 max	0.03 max	0.04 max	18.4 20.0	8.0 10.50	- -	- -	80000 (56.09)	35000 (24.47)	30(long) 25(trans)	-	50% (long) 45(trans)
A 182 F316	0.08 max	2.00 max	1.00 max	0.03 max	0.04 max	16 18.6	10.0 14.0	2.0 3.0	M=0.1-0.16	75000 (52.52)	30000 (20.90)	30	-	50%
A 182 F316L	0.35 max	2.00 max	1.00 max	0.03 max	0.04 max	16 18.0	10.0 15.0	2.0 3.0	-	70000 (49.46)	25000 (17.34)	30	-	50%
A 182 F316H	0.04 0.10	2.00 max	1.00 max	0.03 max	0.04 max	16 18.0	10. 14.0	2.0 3.0	-	75000 (52.52)	3000 (20.90)	30	-	50%
A 182 F 321	0.08 max	2.00 max	1.00 max	0.03	0.04	17 min	9 12.0	2.0 3.0	Ti=Cx5 0.70 max	75000 (52.52)	30000 (20.90)	30	-	50%
A 182 F 310	0.15 max	2.00 max	1.00 max	0.03	0.04	24.0 26.0	19.0 22.0	-	-	75000 (52.52)	3000 (20.90)	30	-	50%
A 182 F317L	0.03 max	2.00 max	1.00 max	0.03	0.045	18.0 20.0	11.0 15.0	3.0 4.0	- -	70000 (49.46)	25000 (17.34)	30	-	50%
A 182 F 347H	0.04 max	2.00 max	1.00 max	0.03 max	0.04 max	17.0 20.0	9.0 13.0		Cb+Ta + -8C-1.0	75000 (52.52)	30000 (20.90)	30	-	50%
A 182 F1	0.28 max	0.60 0.90	0.15 0.35	0.045 max	0.045 max	-	-	0.44 0.65	-	70000 (49.46)	40000 (28.05)	20	143-192	30
A 182 F 12 class2	0.10 0.20	0.30 0.80	0.10 0.60	0.04 max	0.04 max	0.8 1.25	-	0.44 0.65		70000 (49.46)	40000 (28.05)	20	143-207	30
A 182 F 11 class 2	0.10 0.20	0.30 0.80	0.50 1.0	0.04 max	0.04 max	1.0 1.50	-	0.44 0.65	-	70000 (49.46)	40000 (28.05)	20	143-207	30
A 182 F 22 class 3	0.05 0.15	0.30 0.60	0.5 max	0.04 max	0.04 max	2.0 2.50	-	0.87 1.13	-	75000 (52.52)	45000 (31.7)	20	156-207	30
A 182 F5	0.15 max	0.30 0.60	0.5 max	0.03 max	0.03 max	4.0 6.0	0.5 max	0.44 0.65	- -	70000 (49.46)	40000 (28.05)	20	143-217	35
A 182 F9	0.15 max	0.30 0.60	0.5 1.0	0.03 max	0.03 max	8.0 10.0	-	0.90 1.10	-	85000 (56.65)	55000 (38.75	20	179-217	40

LOW TEMP. FITTING CHEMICAL & PHYSICAL PROP

ASTM Grade	C	Min	Si	S	P	Cr	Ni	Mo	Other	Tensile Ksi(MPa)	Yield Ksi(Mpa)	Elongation % Strip/Round	Impact Jules. Av. min	Redn. in Area
A350LF1	0.30 MAX	0.60 1.35	0.15 0.30	0.040 MAX	0.035 MAX	0.30 MAX	0.40 MAX	0.12 MAX	Cu-0.4 max Cb - 0.4 max Cb - 0.02 max	60.85 (415.585)	0(205)	28/35	18/14	38
LF2	0.30 MAX	0.90 MAX	0.15 0.30	0.040 MAX	0.035 MAX	0.30 MAX	0.40 MAX	0.12 MAX	Cb-0.02 max Va-0.3	0.95 (485.655)	36(250)	30/22	20/16	36
LF3	0.20 MAX	0.6 1.35	0.20 0.35	0.040 MAX	0035 MAX	0.30 MAX	3.25 3.75	0.12 MAX	Cu-0.4 max Cb -0.02max Va-0.3 max	0.95 (485.655)	37.5(250)	30/22	20/16	35
LF5	0.30 MAX	0.60 1.35	0.20 0.35	0.040 MAX	0.035 MAX	0.30 MAX	1.0 2.0	0.12 MAX	Cu-0.4max cb-0.02max Va-0.3max	Ci.1.60.85(415.585) CI. 2.70.95(485.655)	CI.1 30(205) CI.2 37.5(260)	CI. 1 28/25 CI.2 30/22	20/16	CI.1.38 CI.135
LF6	0.22 1.50	1.15 1.50	0.15 0.30	0.025 MAX	0.025 MAX	0.30 MAX	0.40 MAX	0.12 MAX	Cu-0.4 max Cb-0.02 max Va-0.04-0.11	CI1.66-91(455-495) CI.275-100(515-690)	52(360) 60(415)	CI.1 30/22 CI.2 28/20	2016	40
LF9	0.20 MAX	0.40 1.06	-	0.040 MAX	0.035 MAX	0.30 MAX	1.60 2.24	-	Cb-0.02 max Cu-0.75-1.25 vA-0.03	63-88 (435-605)	46(315)	28/25	18/14	38
A 420WPL-6	0.30 MAX	0.39 1.06	0.10 MIN	0.030 MAX	0.030 MAX	-	-	-	-	60-85 (415-585)	35(240)	30/22 Long 16.5/12 Trans	17.6/13.6 17.6-13.6	
WPL - 9	0.20 MAX	0.40 1.06	-	0.030	0.030	-	1.60 2.24	-	Cu-0.75-1.25	63-88 (435-610)	46(315)	28/20 Long. 18/- Trans.	17.6/13.6 17.6/11.6	
WPL 3	0.20 MAX	0.31 0.64	0.13 0.37	0.050	0.050	-	3.18 3.82	-	-	65-90 (450-620)	35(240)	30/22Long 20/14 Trans	17.6/13.6 17.6/13.6.	
WPL 8	0.13 MAX	0.90 MAX	0.13 0.37	0.030	0.030	-	8.40 9.60	-	-	100-125 (690-865)	75(515)	22/16	33.9/27.1	

S. S. ROUND BAR CHEMICAL & PHYSICAL PROP

ASTM Grade	C	Mn	Si	S	P	Cr	Ni	Mo	Other	Tensile Ksi(MPa)	Yield Ksi(Mpa)	Elongation % Strip/Round	Impact Jules. Av. min	Redn. in Area
A479 TP 304	0.08 MAX	2.00 MAX	1.00 MAX	0.030 MAX	0.045 MAX	18.0 20.0	8.0 11.0	-	N2-0.10 MAX	75000 (515)	3000 (205)	30	-	40
A479 TP 316	0.08 MAX	2.00 MAX	1.00 MAX	0.030 MAX	0.045 MAX	16.0 18.0	10.0 14.0	2.0 3.0	N20.10 MAX	75000 (515	30000 (250))	30	-	40
A479 TP 317 L	0.035 MAX	2.00 MAX	1.00 MAX	0.030 MAX	0.045 MAX	18.0 20.0	11.0 15.0	3.0 4.0	N2-0.10 MAX	75000 (515)	30000 (250)	30	-	40
A479 TP 310S	0.08 MAX	2.00 MAX	1.00 MAX	0.030 MAX	0.045 MAX	24.0 26.0	19.0 22.0	-	-	75000 (515)	3000 (205)	30	-	40
A479 TP 316 H	0.04 0.10	2.00 MAX	1.00 MAX	0.030 MAX	0.040 MAX	16.0 18.0	10.0 14.0	2.0 3.0		75000 (515)	30000 (205)	30	-	40
A479 TP 347 H	0.04 0.10	2.00 MAX	1.00 MAX	0.030 MAX	0.040 MAX	17.0 19.0	9.0 13.0	-	Cb=Bxc -13.0	75000 (515)	30000 (205)	30	-	40

WEIGHT OF ALUMINIUM SHEETS

S.W.G	Inch	Millmeters	Lb Sq/foot	Kg Sq/Foot	Kg 8' x 4'	Kg 8' x 3'	Kg 6' x 3'
3/8"	.375	9.53	5.29	2.399	76.740	57.540	43.170
3/0	.372	9.45	5.24	2.376	75.890	57.080	42.810
2/0	.348	8.84	4.91	2.227	71.210	53.430	40.050
1/0	.324	8.03	4.57	2.072	66.300	49.720	37.270
5/16"	.312	7.93	4.40	1.995	63.860	47.900	35.910
1	.300	7.62	4.23	1.918	61.370	46.630	34.490
2	.276	7.01	3.89	1.764	56.410	42.350	31.750
3	.252	6.40	3.55	1.610	51.560	38.690	29.020
1/4"	.250	6.35	3.52	1.596	51.166	38.380	28.740
4	.232	5.89	3.27	1.483	47.480	35.600	26.390
5	.212	5.48	2.99	1.356	43.370	32.510	24.400
6	.192	4.88	2.71	1.229	39.280	29.480	22.080
3/16"	.187	4.75	2.64	1.197	38.270	28.710	21.530
7	.176	4.47	2.48	1.126	36.600	27.040	20.260
8	.160	4.06	2.26	1.025	32.730	24.520	18.420
9	.144	3.66	2.03	0.921	29.480	22.080	16.610
10	.128	3.25	1.80	0.816	26.170	19.650	14.730
1/8"	.125	3.18	1.76	0.798	25.570	19.190	14.370
11	.116	2.95	1.64	0.744	23.720	17.830	13.320
12	.104	2.64	1.47	0.667	21.250	15.950	11.960
13	.092	2.34	1.30	0.590	18.810	14.090	10.600
14	.080	2.03	1.13	0.512	16.320	12.240	9.210
15	.072	1.83	1.02	0.462	14.730	11.050	8.380
16	.064	1.63	0.902	0.409	13.090	9.830	7.130
17	.056	1.42	0.792	0.359	11.480	8.610	5.430
18	.048	1.22	0.677	0.307	9.830	7.330	5.520
19	.040	1.02	0.564	0.255	8.160	6.116	4.610
20	.036	0.914	0.508	0.230	7.330	5.520	4.110
21	.032	0.813	0.451	0.205	6.520	4.409	3.650
22	.028	0.711	0.395	0.179	5.720	4.300	3.190
23	.024	0.610	0.388	0.153	4.810	3.640	2.720
24	.022	0.559	0.310	0.141	4.470	3.340	2.480
25	.020	0.508	0.232	0.128	4.060	3.080	2.280
26	.018	0.457	0.254	0.115	3.650	2.740	2.030
27	0.0164	0.417	0.231	0.105			
28	0.0148	0.376	0.203	0.095			
29	0.0136	0.346	0.192	0.0871			
30	0.0124	0.315	0.175	0.0794			
31	0.0116	0.294	0.164	0.0744			
32	0.0108	0.274	0.152	0.0689			
33	0.0105	0.267	0.148	0.0671			
34	0.0092	0.233	0.130	0.0590			
35	0.0084	0.213	0.118	0.0535			
36	0.0076	0.193	0.107	0.0485			
37	0.0068	0.172	0.0959	0.0435			
38	0.0060	0.152	0.0846	0.0384			
39	0.0052	0.132	0.0733	0.0332			
40	0.0048	0.122	0.0677	0.0307			
41	0.0044	0.112	0.0620	0.0281			
42	0.0040	0.102	0.0564	0.0256			
43	0.0036	0.0915	0.0508	0.0230			
44	0.0032	0.0831	0.0452	0.0205			
45	0.0028	0.0711	0.0395	0.0179			
46	0.0024	0.0610	0.0338	0.0153			
47	0.0020	0.0508	0.0282	0.0128			
48	0.0016	0.0406	0.0226	0.0102			
49	0.0012	0.0305	0.0169	0.0077			
50	0.0010	0.0154	0.0141	0.0064			

IS : 1239 (PART 1) - 1979 MILD STEEL TUBES
MAXIMUM PERMISSIBLE PRESSURE AND TEMPERATURE
FOR TUBES FOR CONVEYING STEAM

The maximum permissible pressure and temperature for tubes with screwed and socketed joints shall be as follows.

MAXIMUM PERMISSIBLE PRESSURE AND TEMPERATURE FOR TUBES WITH STEEL COUPLINGS OR SCREWED AND SOCKETED JOINTS

Nominal Bore mm	Maximum Permissible Pressure N/mm^2	Kg/cm^2	Maximum Permissible Temperature ^0C
Up to and including 25 mm1.20	1.20	12.24	260
Over 25 mm up to and including 40 mm	1.03	10.50	260
Over 40 mm up to and including 80 mm	0.86	8.77	260
Over 80 mm up to and including 100 mm	0.69	7.04	260
Over 100 mm up to and including 125 mm	0.69	7.04	171
Over 125 mm up to and including 150 mm	0.50	5.10	160

For tubes fitted with appropriate flanges or suitably butt welded together, the maximum permissible pressure shall be 21.00 Kg/cm^2 and the maximum permissible temperature 260^0C.

BEND TEST FLATTENING TEST

Bend Test on tubes up to and including 50 mm Nominal Bore - When tested in accordance with IS: 1239-1963, the finished tubes shall be capable of withstanding the bend test without showing any signs of fracture or failure. Welded tubes shall be bent with the weld at 90^0 to the plane of bending. The tubes shall not filled for this test.

Ungalvanized tubes shall be capable of being bent cold, without cracking, through 180^0 round a former having a radius at the bottom of groove, in the plane of bending, equal to six times the outside diameter of the tube.

Galvanized tubes shall be capable of being bent cold, without cracking, the steel thorugh 90^0 round a former having a radius at the bottom of the groove, equal to eight times the outside diameter of the tube.

Flattening Test on Tubes above 50 mm Nominal Bore - Rings, not less than 40 mm in length, cut from the ends of selected tubes, shall be flattened between parallel plates with the weld if any at 90^0 (Point of maximum bending) in accordance with IS: 1239-1963. No opening shall occur by fracture in the weld until the distance the plates is less than 75 percent of original outside diameter of the pipe and no cracks or breaks in the metal elsewhere than in the weld shall occur until the distance between the plates is less than 60 percent of the orginal outside diameter.

Maruti Metal Industries

DIMENSIONS AND NOMINAL WEIGHTS OF BLACK STEEL TUBES IN ACCORDANCE WITH IS: 1239 (PART 1) - 1979

	Outside daimeter				Thickness						Weight of black tube						Dimention of sockets	
Nominal	Light		Medium & heavy		Light		Medium		Heavy		Light		Medium		Heavy		Outside	
											Plain	Screwed	Plain	Screwed	Plain	Screwed	Diameter	length
Bore mm	Max mm	Min mm	Max mm	Min mm	mm	swg	mm	swg	mm	swg	End kg/m	Socketed kg/m	End kg/m	Socketed kg/m	End kg/m	Socketed kg/m	Min mm	Min mm
6	10.1	9.7	10.6	9.8	1.8	15	2.0	14	2.65	12	0.361	0.364	0.407	0.410	0.496	0.496	15	19
8	13.6	13.2	14.0	13.2	1.8	15	2.35	13	2.9	11	0.517	0.521	0.650	0.654	0.769	0.773	18.5	27
10	17.1	16.7	17.5	16.7	1.8	15	2.35	13	2.9	11	0.674	0.680	0.852	0.858	1.02	1.03	22	28
15	21.4	21.0	21.8	21.0	2.0	14	2.65	12	3.25	10	0.952	0.951	1.22	1.23	1.45	1.46	27	37
20	26.9	26.4	27.3	26.5	2.35	13	2.65	12	3.25	10	1.41	1.42	1.58	1.59	1.90	1.91	32.5	39
25	33.8	33.2	34.2	33.3	2.65	12	3.25	10	4.05	8	2.01	2.03	2.44	2.46	2.97	2.99	39.5	46
32	42.5	41.9	42.9	42.0	2.65	12	3.25	10	4.05	8	2.58	2.61	3.14	3.17	3.84	3.87	49	51
40	48.4	47.8	48.8	47.9	2.9	11	3.25	10	4.05	8	3.25	3.29	3.61	3.65	4.43	4.47	56	51
50	60.2	59.6	60.8	59.7	2.9	11	3.65	9	4.5	7	4.11	4.18	5.10	5.17	6.17	6.24	68	60
65	76.0	75.2	76.6	75.3	3.25	10	3.65	9	4.5	7	5.80	5.92	6.51	6.63	7.90	8.02	84	69
80	88.7	87.9	89.5	88.0	3.25	10	4.05	8	4.85	6	6.81	6.98	8.47	8.64	10.1	10.3	98	75
100	113.9	113.0	115.0	113.1	3.65	9	4.5	7	5.4	5	9.89	10.2	12.1	12.4	14.4	14.7	124	87
125	-	-	140.8	138.5	-	-	4.85	6	5.4	5	-	-	16.2	16.7	17.8	18.3	151	96
150	-	-	166.5	163.9	-	-	4.85	6	5.4	5	-	-	19.2	19.8	21.2	21.8	178	96

Tolerances on Thickness and weight :

The following manufacturing shall be permitted on the tubes and sockets.

(a) Thickness :

(1) Butt welded Light tubes	+Not limited -8 percent
Medium and Heavy tubes	+Not limited -10 percent
(2) Seamless tube	-12.5 percent

(b) Weight:

(1) Single tube (light series)	+ 10percent -8 percent
(2) single tube (medium and heavy series)	± 10 percent

ROUND BAR - METRIC

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
.5	.0004	.0015
1.0	.0018	.0062
1.5	.0042	.014
2.0	.0076	.039
2.5	.012	.039
3.0	.017	.055
3.5	.023	.076
4.0	.030	.099
4.5	.038	.125
5.0	.047	.154
5.5	.057	.187
6.0	.068	222
6.5	.079	.260
7.0	.092	.302
7.5	.106	.347
8.0	.120	.395
8.5	.136	.445
9.0	.152	.499
9.5	.169	.556
10	.188	.617
11	.227	.746
12	.271	.888
13	.317	1.04
14	.369	1.21
15	.424	1.39
16	.482	1.58
17	.543	1.78
18	.610	2.00
19	.680	2.23
20	.753	2.47

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
21	.829	2.72
22	.908	2.98
23	.994	3.26
24	1.08	3.55
25	1.17	3.85
26	1.27	4.17
27	1.37	4.50
28	1.47	4.83
30	1.69	5.55
32	1.92	6.31
33	2.05	6.71
35	2.30	7.55
36	2.44	7.99
38	2.71	8.90
39	2.86	9.38
40	3.01	9.86
42	3.32	10.88
45	3.80	12.48
48	4.33	14.21
50	4.70	15.41
52	5.08	16.67
55	5.69	18.65
56	5.89	19.33
58	6.32	20.74
60	6.77	22.20
62	7.22	23.70
64	7.70	25.25
65	7.94	26.05
68	8.69	28.51
70	9.21	30.21

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
72	9.74	31.96
75	10.57	34.68
80	12.03	39.46
90	15.22	49.94
100	18.79	61.65
110	22.74	74.6
120	27.07	88.8
130	31.70	104
140	36.88	121
150	42.37	139
160	48.16	158
170	54.26	178
180	60.96	200
190	67.97	223
200	75.3	247
220	90.8	298
240	108	355
250	117	385
260	127	417
280	147	483
300	169	555
320	192	631
340	217	713
350	230	755
360	244	799
380	271	890
400	301	986
500	469	1540

STAINLESS , ALLOY STEELS, ROUND BAR

WEIGHT OF S. S. ROUND

DIA (MM) X DIA (MM) X 0.0019 KG. (PER FEET)

HEXAGONAL BAR - METRIC

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
..5	.0518	.170
5.5	0628	.206
7	.102	.333
8	.133	.435
10	.207	.680
11	.251	.823
12	.298	.979
13	.351	1.15
14	.405	1.33
15	.466	1.53

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
16	.530	1.74
17	.597	1.96
18	.671	2.20
19	.747	2.45
20	.829	2.72
22	1.00	3.29
24	1.20	3.92
25	1.30	4.25
27	1.51	4.96
30	1.87	6.12

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
32	2.12	6.56
35	2.54	8.33
36	2.69	8.81
38	2.99	9.82
40	3.32	10.9
41	3.48	11.4
46	4.39	14.4
48	4.79	15.7
50	5.18	17.0

SQUARE BAR - METRIC

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
5	.0597	.196
5.5	.0722	.237
6	.0862	.283
7	.117	.385
8	.153	.502
9	.194	.636
10	.239	.785
11	.290	.950
12	.344	1.13
13	.405	1.33
14	.469	1.54
15	.540	1.77

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
16	.613	2.01
17	.692	2.27
18	.774	2.54
19	.863	2.83
20	.957	3.14
21	1.06	3.46
22	1.16	3.80
23	1.27	4.15
24	1.38	4.52
25	1.50	4.91
26	1.62	5.31
27	1.74	5.72

Size	Weights in kg.	
	mm Wt. per ft.	Wt. per. Mt
28	1.88	6.15
30	2.15	7.06
32	2.45	8.04
35	2.93	9.62
36	3.11	10.2
38	3.44	11.3
40	3.84	12.6
42	4.21	13.8
45	4.85	15.9
46	5.06	16.6
48	5.52	18.1
50	5.97	19.6

STAINLESS, ALLOY STEELS, HEXAGON, AND SQUARE BAR

WEIGHT OF S. S. HEXAGONAL ROD.

DIA (MM)X DIA (MM) X 0.002072 KG. (PER FEET)

ANGLES (Equal Sides) Angles (Equal and unequal Sides)

Sides in	Thickness						Weight in Kg per meter				
mm	3	4	5	6	8	10	12	15	16	18	20
Equivalent 20 x 20mm	0.9	1.1									
25 x 25 mm	1.1	1.4	1.8								
30 x 30mm	1.4	1.8	2.2								
35 x 35 mm	1.6	2.1	2.6	3.0							
40 x 40 mm	1.8	2.4	3.0	3.5							
45 x 45 mm	2.1	2.7	3.4	4.0							
50 x 50 mm	2.3	3.0	3.8	4.5							
55 x 55 mm			4.1	4.9	6.4	7.9					
60 x 60 mm			4.5	5.4	7.0	8.6					
65 x 65 mm			4.9	5.8	7.7	9.4					
70 x 70 mm			5.3	6.3	8.3	10.2					
75 x 75 mm			5.7	6.8	8.9	11.0					
45 x 30 mm	1.7	2.2	2.8	3.3							
75 x 50 mm			4.7	5.6	7.4	9.0					
90 x 60 mm				6.8	8.9	11.0	13.0				
100 x 75 mm				8.0	10.5	13.0	15.4				
125 x 75 mm				9.2	12.1	14.9					
125 x 95 mm				10.1	13.3	16.5	19.6				
150 x 75 mm					13.7	16.9	20.1				
150 x 115 mm					16.2	20.0	23.8	29.5			

Size in mm	Weight kg/M	Mill
ANGLES (equal)		
50x50x6	4.5	BMM
65x65x6	5.8	BMM
65x65x8	7.7	BMM
65x65x10	9.4	BMM
75x75x6	6.8	BMM
75x75x8	8.9	BMM
75x75x10	11.0	BMM
80x80x6	7.3	BMM
80x80x8	9.6	BMM
80x80x10	11.8	BMM
90x90x6	8.2	BMM
90x90x8	10.8	BMM
90x90x10	13.4	BMM
100x100x8	12.1	DSM
100x100x10	14.9	DSM
100x100x12	17.7	DSM
110x110x10	16.6	DSM
110x110x12	19.7	DSM
130x130x10	19.7	DSM
130x130x12	23.4	DSM
150x150x16	35.8	BRSM
150x150x20	44.1	BRSM
200x200x16	48.5	BRSM
200x200x20	60.0	BRSM

ANGLES (Equal)

Desig-nation	Size	Thickness		Weight		Desig-nation	Size	Thickness		Weight	
		Web	Flange	Meter	Foot			Web	Flange	Meter	Foot
INST	mmxmm	mm	mm	kg (Normal tee)	ib	ISDT	mmxmm	mm	mm (Deep Legged Tee)	kg	lb
20	20x20	3	3	0.9	0.60	100	100x50	5.8	10	8.7	
						150	150x75	8.0	11.6	15.7	
20	20x20	4	4	1.1							
30	30x30	3	3	1.4	0.9	ISLT					
30	30X30	4	4	1.8		200	200X163	8.0	12.5	28.4	
						250	250X180	9.2	14.1	37.5	
40	40x 40	6	6	3.5	2.35						
50	50 x 50	6	6	5.4	3.63	ISHT		(Slit Tee From H Section)			
75	75x75	9	9	10.0		75	75x150	8.4	9.0	15.3	10.28
75	75x75	10	10	10.95		100	100x200	7.0	9.0	20.0	13.48
						125	125x250	8.8	9.7	27.4	18.41
80	80x80	8	8	9.6	6.45	150	150x250	7.9	10.6	29.4	19.76
100	100x100	10	10	14.9							
150	150x150	10	10	22.7							

Common Grades IS : 2060 SAILMA

Tolerance as per IS : 1852

Abbreviations used : DSM (Durgapur Section Mill)
BMM (Bhilai Merchant Mill)
BRSM (Bhilai Rail & structural Mill)

CHANNELS MILD STEEL CHANNEL, BEAMS, ANGLES STEEL SIZE WEIGHT/KG/M

Size mm	Weight Kg/m
75x40x48	6.8
100x50x5	9.2
125x65x5.3	12.8
125x66x6	13.7
150x75x5.7	16.4
150x75x6.5	17.7
175x75x6	19.2
200x75x6.2	22.2
200x76x7.5	24.3
250x82x9	34.2
300x90x7.8	35.9
400x100x8.8	49.5

Designation	Size	Weight
	mm x mm	Kg x m
	Telegraph channel	
41T	41 x 32	4.79
1 Mtr.	Gate Channel	6.25

BEAMS

Size mm	Weight Kg/m
116x100	23.0
125x70x5	13.2
150x75x5	15.0
175x85x5.8	19.5
200x100x5.7	25.4
250x125x16.9	37.3
300x140x7.7	44.2
450x150x9.4	72.4
500x180x10.2	86.92
600x210x12.00	122.6
INP - 14 (140x66)	14.3
INP -16 (160x74)	17.9
INP -18 (180x82)	21.9
350 x 140 x 8.1	52.4
400 x 140 x 8.9	61.6

EN SERIES STEEL

E.N. No.	Type and Application	Chemical composition & max						Physical Properties min			Limiting Size (diameter or width) Across Plats)	Condition	Brinell No.
		C	Mn	Ni	Cr.	Mo.	Others	T.I t/sq	El %	Izod ft.lbs			
IA	Free cutting machining Steel for low duty bolts, nuts, studs etc	.07/.15	.80/1.20	-	-	-	s. .2/.3 P. .07 Si. .10	32 28 25 23 23	10 14 14 14 26	- - - - -	17/32" and less Over 17/32" to 1-1/2" Over 1-1/2" to 2 1/2" Over 2 1/2" to 4" 4" Other finishes	Cold rolled or Cold drawn	-
3	20 CARBON STEEL for nicraft sockets Plug ends, lightly stres-sed levers, bolts nuts	.25	1.0				S & P .06 Si .05/.35	25/35	25		6"	As rolled	
3B	20 CARBON STEEL Cold drawn	.25	1.0	-	-	-	S & P .06 Si. .35	28	25	-	-	Normalised	-
8	40CARBON STEEL without grain size con trol. For mothor connect-ing rods, crankshafts, bolts and machine details in general.	.35/.45	.6/10				Si 06/.36 S & P .06	35 Q 40 H 45 35 Q 40 R 45	20 20 20 17 17 17	 10 10 - - -	6' 2 1/2" 7/8" 6" 2 1/2 7/8"	Normalized H & T H & T N & CD H & T & CD H & T & CD	152/207 179/229 201/255 152/207 169/229 201/255
8M	40 Carbon Steel. Free cutting	.35/45	.9/1.30	-	-	-	S. .12/.20 P. .06 Si. .25	35 Q 40 R 45 38	20 22 20 12	- 25 40 -	6" 2" 1/2" 1 1/2" max	Normalised H & T H & T Cold drawn	152/207 179/229 201/255 229/ max
16	Manganese-Molybde-num steel. suitable for tensile ranges of 45/75 tons according to the ruling section.	.30/.40	1.3/1.8	-	-	.20/.35	S & P. .05	R. 45 S. 50 T. 55 U. 60 V. 65	22 20 18 17 16	40 40 40 35 35	6" 4" 2.1/2" 1.1/8" 7/8"	H & T H & T H & T H & T H & T	201-255 223-277 248-302 269-321 293-341
18	1 percent Chromium Steel. suitable for ten-sile ranges of 45/65 tons according to the ruling section	.35/.45	.60/.95	-	.85/ 1.15	-	S. & P. .05	R. 45 S. 50 T. 55	22 20 18	40 40 40	4" PS 32 2 1/2" " 36 1.1/8" " 4.1	H & T H & T H & T	201/255 223/277 248/302

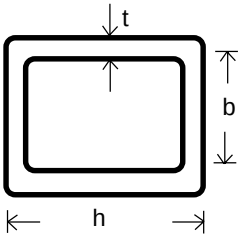
EN SERIES STEEL

E.N. No.	Type and Application	Chemical composition & max						Physical Properties min			Limiting Size (diameter or width) Across Plates)	Condition	Brinell No.
		C	Mn	Ni	Cr.	Mo.	Others	T.I t/sq	El %	Izod ft.lbs			
19	1 percent chromium Molybdenum steel Suitable for tensile ranges of 45/80 tons according to the ruling section of the part	.35/.45	.50/.80	-	.90 1.50	.2/4	S & P .05 Si 0.10/.35	R. 45 S. 50 T. 55 U. 60 V. 65 W. 70 Y. 80	22 20 18 17 16 15 10	40 40 40 35 35 30 10	6" PS 32 4" - 36 2 1/2 - 41 2 1/2" - 46 1.1/8" - 50 1. 1/8 - 55 1" - 64	H & T H & T H & T H & T H & T H & T H & T	201/255 223/177 248/302 269/321 293/341 311/375 363/415
24	1 1/2 percent Nickel-Chromium Molybdenum steel. Suitable for tensile ranges of 50/ 100 tons according to the ruling section of the part.	.35/45	.45/.7	1.3/ 1.8	.9/1.4	.2/35	Si. 10/35 S. P 0.05	S. 50 T. 55 U. 60 V. 65 W. 70 X. 75 Y. 80 Z.100	20 18 17 16 15 14 14 8	40 40 35 35 30 25 25 8	6" PS 36 6" - 41 4" - 46 2 1/2 - 50 1.1/8" - 55 1.1/8" - 59 1.1/8" - 64 1.1/8" - 80	H & T H & T H & T H & T H & T H & T H & T H & T	223/277 248/302 269/321 293/341 311/375 341/388 363/415 444 Min
31	1 percent Carbon Chrominum steel For parts of maximum hardness such as ball races.	.9/1.2	.3/.75	-	1/1.6	-	S.& P. .05 Si. .10/.35	-	-	-	-	-	-
36A	3 percent Nickel- Chromium	.15	.3/.6	3/3.75	.6/1.1	-	Si .10/.35	55	15	35	-	-	-
36B	Case- hardening steel	.12/.18	.3/.6	3/3.75	.6/1.1	-	-	65	13	30	-	-	-
36C	3 percent Nickel Chro mium. Molybdenum Case Hardening steel	.12/.18	.3/.6	3/3.75	.6/1.1	.1/.25	Si .10/.35	65	13	30	-	-	-
41A	1-1/2 percent Chromium aluminium Molybdenum Nitriding steel	.25/.35	.65	.40	1.4/ 1.8	.1/.25	Si .1/.45 AL .9/1.3 S. & P. .05	R 45 S 50 T 55	20 19 17	40 40 35	6" 4" 2 1/2"	H & T H & T H & T	201/255 223/277 248/302
41B	As above (EN_1 41 A)	.35/.45	.65	.40	1.4/ 1.8	.1/.25	Si. .1/.45 S. & P. .05 AL .9/1.3	R. 45 S. 50 T. 55	20 19 17	40 40 35	-	H & T H & T H & T	201/255 223/277 248/302
42	Carbon spring steel for oil Hardening and tempering. Suitable for laminated and coil springs.	.7/.85	.55/.75	-	-	-	Si. .1/.40 S. & P. .05	-	-	-	-	-	-
47	1 percent Chromium-Vanadium spring steel for oil hardening and tempering.	.45/.55	.5/.8	-	.8/1.2	-	Va. .15 min Si. .50 S. & P. .05	-	-	-	-	-	-
353	1.1/4 percent, Nickel Chromium Case Hardening steel	.20	.50/1.0	1.0/ 1.5	.75/ 1.25	.08/ .15	Si. .35 S. & P. .05	65	12	20	-	-	-
354	1-3/4 percent Nickel-Chromium Molybdenum Case-Hardening steel.	20	.50/1.0	1.5/ 2.0	.75/ 1.25	.10/ .20	Si. .35 S. & P. .05	75	12	20	-	-	-

SIGNS AND ABBREVIATIONS

H & T	Hardened and Tempered	CD Cold drawn.
CR	Cold Rolled.	PS Proof Stress.
N.	Normalised	<Maximum

STAINLESS STEEL HOLLOW SECTION, SQUARE & RECTANGULAR TUBE WT. / MTR

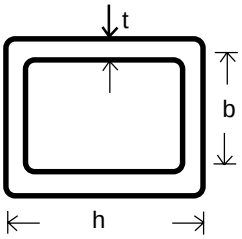


h mm	b mm	t mm	Weight kg/m	A mm^2	I_y 10^4 mm^4	W_y 10^3 mm^3	i_y mm	I_z 10^4 mm^4	W_z 10^3 mm^3	i_z mm	I_v 10^4 mm^4	W_v 10^3 mm^3
30	20	1,00	0776	94	1,15	0,77	11,06	0,6135	0,61	8,08	1,29	1,01
30	20	1,20	0,925	110	1,33	0,89	11,00	0,7052	0,71	8,01	1,52	1,18
30	20	1,50	1,146	135	1,58	1,05	10,82	0,837	0,84	7,87	1,83	1,40
30	20	2,00	1,495	173	1.93	1,28	10,55	1,011	1.01	7.64	2,29	1,71
40	10	1,50	1,146	135	2,15	1,07	12,61	0,213	0,42	3,97	0,70	0,81
40	10	2,00	1,495	173	2,59	1,29	12,23	0,245	0,49	3,76	0,83	0,94
40	20	1,00	0,950	113	2,33	1,16	14,37	0,794	0.79	8,38	1,93	1,38
40	20	1,20	1,106	134	2,72	1,36	14,25	0,921	0,92	8,29	2,27	1,60
40	20	1,50	1,371	165	3,26	1,63	14,05	1,094	1,09	8,14	2,74	1,91
40	20	2,00	1,840	213	4,03	2,01	13,76	1,337	1,33	7,92	3,45	2,36
40	30	1,20	1,310	158	3,63	1,81	15,15	2,328	1,55	12,14	4,52	250
40	30	1,50	1,620	195	4,37	2,18	14,97	2,801	1,86	11,99	5,52	3,02
40	30	2,00	2,150	253	5,48	2,74	14,72	3,497	2,33	11,76	7,07	3,79
40	30	3,00	3,280	347	7,03	3,51	14,23	4,455	2,97	11,33	9,41	4,89
40	20	2,00	1,903	233	5,48	2,43	15,33	1,499	2,49	8,02	4,05	2,68
50	10	1,50	1,371	165	4,00	1,60	15,56	0,268	0,54	4,03	0,92	1,03
50	10	2,00	1,840	215	4.91	1,96	15,10	0,31	0,62	3,80	1,09	1,20
50	20	1,20	1,310	158	4,78	1,91	17,40	1,133	1,13	8,47	3,05	2,03
50	20	1,50	1,620	195	5,76	2,30	17,19	1,351	1,35	8,32	3,69	2,42
50	20	2,00	2,150	253	7,21	2,88	16,88	1,662	1,66	8,11	4,66	3,00
50	25	1,20	1,415	170	5,50	2,20	17,98	1,873	1,50	10,50	4,54	2,59
50	25	1,50	1,758	210	6,64	2,66	17,79	2,249	1,80	10,35	5,54	3,13
50	25	2,00	2,319	273	8,36	3,35	17,50	2,801	2,22	10,13	7,06	3,92
50	25	3,00	3,456	376	10,81	4,32	16,95	3,552	2,84	9,72	9,34	5,04
50	30	1,20	1,496	182	6,21	2,48	18,47	2,826	1,88	12,46	6,22	3,17
50	30	2,00	2,454	293	9,52	3,81	18,02	4,282	2,86	12,09	9,77	4,84
50	30	3,00	3,756	405	12,40	4,96	17,50	5,52	3,68	11,67	13,08	6,30
50	30	4,00	4,808	515	14,76	5,91	16,93	6,49	4,32	11,23	16,07	7,53
50	40	1,50	2,122	255	9,29	3,72	19,09	6,595	3,30	16,08	12,26	5,24
50	40	2,00	2,804	333	11,82	4,73	18,84	8,37	4,19	15,85	15,86	6,67
50	40	3,00	4,131	462	15,59	6,24	18,37	10,994	5,50	15,43	21,55	8,83
60	10	1,50	1,620	195	6,67	2,22	18,50	0,323	0,65	4,07	1,13	1,25
60	10	2,00	2,150	253	8,29	2,76	18,10	0,375	0,75	3,85	1,35	1,46
60	20	1,20	1,496	182	7,64	2,55	20,48	1,346	1,35	8,60	3,85	2,45
60	20	1,50	1,859	225	9,24	3,08	20,26	1,609	1,61	8,46	4,66	2,94
60	20	2,00	2,454	293	11,66	3,89	19,94	1,087	1,99	8,24	5,89	3,65
60	30	1,50	2,122	255	11,81	3,94	21,25	4,02	2,68	12,56	9,77	4,64
60	30	2,00	2,804	333	15,02	5,01	21,24	5,067	3,38	12,34	12,57	5,88
60	30	3,00	4,131	462	19,80	6,60	20,70	6,58	4,38	11,93	16,89	7,71
60	40	1,50	2,329	285	14,37	4,79	22,46	7,71	3,85	16,44	15,97	6,35
60	40	2,00	3,080	373	18,39	6,13	22,20	9,82	4,91	16,22	20,70	8,12
60	40	3,00	4,650	520	24,49	8,16	21,70	12,98	6,49	15,80	28,24	10,81
60	40	4,00	5,960	668	29,92	9,98	21,17	15,74	7,87	15,35	35,50	13,27
80	10	1,50	2,122	255	15,10	3,78	24,34	0,43	0,87	4,12	1,57	1,69
80	10	2,00	2,804	333	19,06	4,77	23,92	0,51	1,01	3,90	1,87	1,99
80	20	2,00	3,080	373	25,15	6,29	25,97	2,64	2,64	8,41	8,40	4,96
80	40	1,50	2,802	345	28,97	7,24	28,98	9,93	4,97	16,97	23,77	8,57
80	40	2,00	3,711	453	37,32	9,33	28,70	12,71	6,35	16,75	30,88	11,00
80	40	3,00	5,491	634	50,35	12,59	28,18	16,94	8,47	16,35	42,28	14,77
80	40	4,00	7,222	820	62,49	15,62	27,61	20,76	10,38	15,91	53,43	18,29
80	40	5,00	8,902	996	72,64	18,16	27,01	23,83	11,91	15,47	62,97	21,16
80	50	2,00	4,060	493	43,40	10,85	29,67	21,04	8,42	20,66	45,31	14,04
80	50	3,00	5,928	691	58,89	14,72	29,19	28,36	11,34	20,26	62,55	19,02
80	60	2,00	4,380	533	49,49	12,37	30,47	31,85	10,62	24,44	61,22	17,08
80	60	3,00	6,530	749	67,43	16,86	30,00	43,24	14,41	24,03	84,95	23,28
80	60	4,00	8,450	973	84,68	21,17	29,50	54,08	18,03	23,58	109,08	29,33
80	60	5,00	10,629	1188	99,73	24,93	28,57	63,44	21,15	23,11	130,81	34,56
100	20	2,00	3,711	453	46,11	9,22	31,90	3,29	3,29	8,52	10,94	6,26
100	40	2,00	4,380	533	65,32	13,06	35,01	15,60	7,80	17,11	41,47	13,89
100	40	3,00	6,530	749	88,91	17,78	34,45	20,91	10,45	16,71	56,88	18,73
100	40	4,00	8,450	973	111,46	22,29	33,85	25,78	12,89	16,28	72,04	23,31

STAINLESS STEEL HOLLOW SECTION, SQUARE & RECTANGULAR TUBE WT. / MTR

h mm	b mm	t mm	Weight kg/m	A mm^2	I_y 10^4 mm^4	W_y 10^3 mm^3	i_y mm	I_z 10^4 mm^4	W_z 10^3 mm^3	i_z mm	I_v 10^4 mm^4	W_v 10^3 mm^3
100	40	500	10,629	1187	131,00	26,20	33,22	20,79	14,89	15,84	85,15	27,11
100	50	2.00	4,680	573	74,93	14,99	36,16	25,65	10,26	21,16	61,59	17,73
100	50	3,00	6,950	807	102,45	20,49	35,63	34,74	13,90	20,75	85,20	24,12
100	50	4,00	9,9090	1050	129,14	25,83	35,07	43,34	17,34	20,32	109,02	30,34
100	50	500	11,240	1283	152.69	30,54	34,500	50,72	20,29	19,88	130,28	35,68
100	50	6,00	13,490	1504	172,90	34,58	33,900	56,85	22,74	19,44	149,42	40,31
100	60	2,00	4,988	613	84,53	16,91	37,13	38,58	12,86	25,09	84,08	21,56
100	60	3,00	7,530	864	115,98	23,20	36,64	52,61	17,54	24,68	116,95	29,52
100	60	4,00	9,816	1126	146,82	29,36	36,11	66,16	22,05	24,24	150,60	37,38
100	60	5,00	12,395	1379	174,37	34,87	35,56	78,05	26,02	23,79	181,17	44,28
100	60	6,00	14,600	1619	198,43	36,69	35,01	88,25	29,42	23,35	209,30	50,40
100	80	2,00	5,625	693	103,74	20,75	38,69	73,83	18,46	32,64	134,59	29,24
100	80	3,00	8,388	978	143,07	28,61	38,25	101,60	25,40	32,23	188,34	40,33
100	80	4,00	11,050	1281	182,57	36,51	37,75	129,33	32,33	31,77	244,29	51,51
100	80	5,00	13,750	1569	217,75	43,55	37,25	153,89	38,47	31,32	296,06	61,54
100	80	6,00	16,220	1848	249,90	49,90	36,74	175,92	43,98	30,85	344,80	70,67
120	40	2,00	4,988	613	104,00	17,33	41,19	18,49	9,24	17,37	52,32	16,78
120	40	3,00	7,530	864	142,44	23,74	40,60	24,87	12,44	16,97	71,82	22,69
120	40	4,00	9,816	1128	180,27	30,05	39,98	30,85	15,43	16,54	91,07	28,33
120	60	2,00	5,624	693	131,85	21,97	43,62	45,31	15,10	25,57	107,88	26,05
120	60	3,00	8,388	979	181,83	30,30	43,10	61,99	20,66	25,16	150,24	35,76
120	60	4,00	11,050	1279	231,48	38,58	42,54	78,23	26,08	24,73	193,77	45,44
120	60	5,00	13,750	1570	276,60	46,10	41,97	92,67	30,89	24,30	233,50	54,00
120	60	6,00	16,220	1849	316,78	52,79	41,39	105,21	35,07	23,85	270,29	61,68
120	80	2,00	6,400	773	159,70	26,62	45,45	86,00	21,50	33,35	175,00	35,32
120	80	3,00	9,530	1094	221,21	36,87	44,97	118,68	29,67	32,94	245,28	48,87
120	80	4,00	12,400	1432	283,06	47,18	44,46	151,24	37,81	32,50	318,69	62,62
120	80	5,00	15,380	1761	340,09	56,68	43,95	180,97	45,24	32,06	387,05	75,05
120	80	6,00	17,500	2078	391,77	65,29	43,42	207,63	51,91	31,61	451,77	86,49
140	80	3,00	10,080	1208	321,22	45,89	51,57	135,76	33,94	33,52	304,37	57,40
140	80	4,00	13,312	1588	413,51	59,07	51,03	173,81	43,45	33,06	395,92	73,73
140	80	5,00	16,320	1952	497,66	71,09	50,49	208,06	52,01	32,65	481,43	88,57
150	50	3,00	9,530	1093	286,94	32,26	51,24	50,70	20,28	21,54	144,47	36,88
150	50	4,00	12,400	1435	367,37	48,98	50,60	63,88	25,55	21,10	185,30	46,69
150	50	5,00	15,580	1761	439,58	58,61	49,96	75,24	50,10	20,67	222,05	55,27
150	100	3,00	11,664	1381	442,28	58,97	56,59	237,87	47,57	41,50	486,59	78,22
150	100	4,00	15,424	1814	570,68	76,09	56,09	305,92	61,18	41,07	635,89	101,06
150	100	5,00	18,800	2239	691,68	92,22	55,58	369,57	73,91	40,63	776,96	122,14
150	100	6.00	22,560	2652	804,08	107,21	55,06	428,21	85,64	40,18	912,74	141,96
160	80	3,00	11,800	1323	445,39	55,67	58,02	152,84	38,21	33,99	365,07	65,94
160	80	4,00	15,030	1741	575,10	71,89	57,47	196,05	49,01	33,56	475,22	84,84
160	80	5,00	18,660	2143	694,27	86,78	56,92	235,14	58,78	33,12	578,31	102,10
160	80	6,00	21,200	2537	805,62	100,70	56,35	271,06	67,77	32,69	676,50	118,15
200	100	3,00	14,064	1667	886,97	88,70	72,94	305,58	61,12	42,81	723,49	105,29
200	100	4,00	18,624	2201	1153,24	115,32	72,39	395,22	79,04	42,37	946,81	136,48
200	100	5,00	22,400	2717	1402,13	140,21	71,84	478,01	95,60	41,94	1158,57	165,48
200	100	6,00	27,360	3226	1639,16	163,92	71,28	555,87	11,17	41,51	1363,22	192,96

Dimension	Tolerance	
External dimensions	<100mm	+1%
	100 mm < 200 mm	+0,8%
Thickness	t < 5mm	+10%
	t>5mm	0.5 mm
Squareness	90=1	
Side convexity x 1		max. 0.8%
Side convexity x 2		min. 0,5 mm
External corner radius R		(1,8 x 2,1)t
Straightness	max 0,15%	
Twist V		2 mm+0,5 mm/m
Lenght l	< 5000 mm	+5mm/ - 0mm
Lenght l	< 5000 mm	+15mm/ - 0mm



Grade:

- EN 1,4301 / AISI 304
- EN 1,4571 / AISI 316 Ti
- EN 1,4404 / AISI 316L

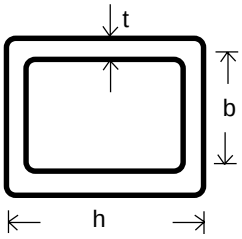
(also available as STALA 350 grade)
Duplex steel and high-alloy austenitic steel grades available to order

Surface finish grades

- hot or cold-rolled (lightly brushed)
- standrad ground finish Grit 220 or 320
- to special order, Grit 80 -500 ground finish
- pickled finish
- other surface finishes to order

Dimensions of hollow sections

- wall thickness 1,2 to 6mm
- square hollow sections 25 x 25 mm to 150 x 150mm
- rectangular hollow sections 30 x 20 mm to 200 x 100 mm
- thick wall small-dimension sections such as 50 x 50 x 6.0 mm available to special order.



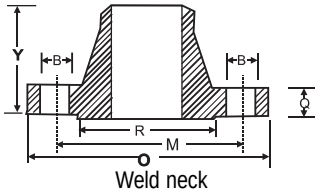
HOLLOW SECTION,

h = b mm	t mm	Weight kg/m	A mm^2	I_y 10^4 mm^4	W_y 10^3 mm^3	i_y mm	I_z 10^4 mm^4	W_z 10^3 mm^3
25	1,00	0,776	93	0,88	0,71	9,74	1,41	1,06
25	1,20	0,925	110	1,02	0,82	9,64	1,66	1,24
25	1,50	1,146	135	1,21	0,97	9,48	2,01	1,47
25	2,00	1.495	173	1,48	1,18	9,23	2,53	1,80
25	3,00	2,216	233	1,79	1,43	8,76	3,24	2,23
30	1,00	0,950	113	1,57	1,41	11,78	2,49	1,57
30	1,20	1,106	134	1,83	1,22	11,69	2,93	1,84
30	1,50	1,371	165	2,19	1,46	11,52	3,57	2,21
30	2,00	1,840	233	2,71	1,43	10,79	4,54	2,75
30	3,00	2,720	290	3,39	2,26	10,81	5,97	3,49
32	1,20	1,200	144	2,25	1,40	12,49	3,58	2,11
32	1,50	1,472	177	2,70	1,69	12,34	4,37	2,54
34	1,20	1,310	153	2,72	1,60	13,33	4,32	2,41
34	1,50	1,620	189	3,27	1,93	13,16	5,28	2,90
35	1,20	1,310	158	2,98	1,70	13,73	4,73	2,56
35	1,50	1,620	195	3,59	2,05	13,57	5,78	3,09
35	2,00	2,150	253	4,50	2,57	13,33	7,41	3,89
35	3,00	3,280	347	5,75	3,29	12,87	9,89	5,03
38	1,20	1,415	172	3,86	2,03	14,97	6,09	3,05
38	1,50	1,758	213	4,66	2,45	14,79	7,46	3,70
38	2,00	2,319	277	5,87	3,09	14,56	9,60	4,67
40	1,20	1,496	182	4,53	2,26	15,77	7,13	3,40
40	1,50	1,859	225	5,48	2,74	15,61	8,75	4,13
40	2,00	2,454	293	6,93	3,46	15,37	11,28	5,23
40	3,00	3,756	405	9,01	4,50	14,92	15,22	6,86
40	4,00	4,808	515	10,38	5,36	14,19	18,87	8,27
50	1,50	2,329	285	10,72	5,36	19,39	17,42	6,65
50	2,00	3,080	373	11,05	4,42	17,21	22,63	8,51
50	3,00	4,650	520	18,78	7,51	19,00	30,97	11,38
50	4,00	5,960	668	22,93	9,17	18,53	39,10	14,02
50	5,00	7,410	805	26,19	10,48	18,04	46,02	16,14
50	6,00	8,832	930	28,58	11,43	17,53	46,02	16,14
60	1,50	2,802	345	19,51	6,50	23,78	30,48	9,77
60	2,00	3,711	453	25,12	8,37	23,55	39,79	12,59
60	3,00	5,491	634	33,86	11,29	23,11	54,94	17,04
60	4,00	7,222	820	42,01	14,00	22,63	70,12	21,29
60	5,00	8,902	996	48.83	16,28	22,14	83,55	24,87
70	2,00	4,380	533	40,69	11,63	27,63	63,96	17,48
70	3,00	6,530	749	55,39	15,83	27,19	88,86	23,85
70	4,00	8,450	973	69,48	19,85	26,72	114.25	30,09
70	5,00	10,629	1188	81,73	23,35	26,23	137,21	35,50
80	2,00	4,988	613	61,66	15,41	31,72	96,34	23,16
80	3,00	7,530	864	84,51	21,13	31,27	134,44	31,80
80	4,00	9,816	1126	106,87	26,72	30,81	173,77	40,41
80	5,00	12,395	1379	126,81	31,72	30,32	209,87	48,04
80	6,00	14,600	1619	144,20	36,05	29,84	209,87	48,04
100	2,00	6,400	773	122,95	24,59	39,88	190,54	36,92
100	3,00	9,530	1094	170,16	34,02	39,44	267,49	51,15
100	4,00	12,400	1432	217,53	43,52	38,98	348,18	65,66
100	5,00	15,380	1761	261,13	52,23	38,51	423,66	78,83
100	6,00	17,500	2078	300,56	60,11	38,03	495,48	91,01
120	3,00	11,800	1323	299,97	50,00	47,62	467,87	75,09
120	4,00	15,030	1737	386,22	64,37	47,15	611,76	97,03
120	5,00	18,660	2144	467,08	77,85	46,67	747,87	117,27
120	6,00	21,200	2538	541,77	90,30	46,20	879,04	136,30
150	3,00	14,064	1668	597,61	79,68	59,86	924,81	119,61
150	4,00	18,624	2196	774,80	103,31	59,40	12115,26	1551,99
150	5,00	22,400	2717	943,78	125,80	58,94	14913,96	1892,47
150	6,00	27,360	3226	1102,87	147,00	58,47	17613,05	2214,37

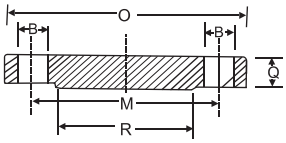
ANSI FLANGES WEIGHTS (KGS)

N. B.	150 lbs		300 lbs		600 lbs		900 lbs	
Size	WN	SO	WN	SO	WN	SO	WIN	SO
1/2”	0.7	0.4	0.8	0.7	0.9	0.8	1.9	1.8
3/4”	0.9	0.7	1.4	1.2	1.6	1.4	2.7	2.5
1”	1.1	0.8	1.7	1.4	1.9	1.7	3.9	3.6
1 1/4”	1.5	1.2	2.2	1.8	2.6	2.1	4.5	4.1
1 1/2”	1.8	1.4	3.2	2.7	3.5	3.1	6.2	5.6
2”	2.7	2.2	3.6	3.2	4.7	3.8	11.3	10.3
2 1/2”	4.4	3.5	5.5	4.5	6.7	5.5	15.5	14.3
3”	5.1	4.1	7.3	6.1	8.7	7.3	15	12.3
3 1/2”	6.4	5.2	9	7.5	11.2	8.9	--	--
4”	7.5	5.6	11.9	10	18.3	15.8	24	20.5
5”	9	6.3	16	12.5	30.5	25	37.5	33.5
6”	11	7.8	20	16.2	37	29.5	50	43
8”	18.5	12.6	31	25	55	44	85	74
10”	25	18	44.3	35	91	71	125	105
12”	38	27.5	64	50	108	85	165	136
14”	51	37	88	72	150	96	198	158
16”	63	46	112	90	180	145	224	184
18”	71	50	138	115	240	175	320	258
20”	88	64	171	137	295	220	375	316
24”	120	90	240	210	363	315	680	608

FORGED FLANGES DIMENSIONS



Weld neck



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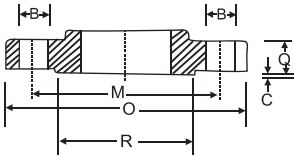


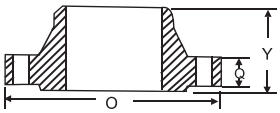
Slip-on

150 lbs

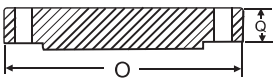
Normal pipe size (in mm)	Outside dia of flange	Minimum thickness of flange	Overall Length			bolt circle	No. and size of holes		O D of Raised face
			Welding neck	slip-on & socket welding	Lap joint				
	O	Q	Y			Dia.m	No.	B	R
15	89	11.2	47.6	15.9	15.9	60.5	4	15	35
20	98	12.7	52.4	15.9	15.9	70.0	4	15	43
25	108	14.3	55.6	17.5	17.5	79.5	4	15	51
32	117	15.9	57.2	20.6	20.6	89.0	4	15	64
40	127	17.5	61.9	22.2	22.2	98.5	4	15	73
50	152	19.1	63.5	25.4	25.4	120.5	4	19	92
65	178	22.3	69.8	28.6	28.6	139.5	4	19	105
80	190	23.9	69.8	30.2	30.2	152.5	4	19	127
90	216	23.9	71.4	31.8	31.8	178.0	8	19	140
100	229	23.9	76.2	33.3	33.3	190.5	8	19	157
125	254	23.9	88.9	36.5	36.5	216.0	8	22	186
150	279	25.4	88.9	39.7	39.7	241.5	8	22	216
200	343	28.6	101.6	44.4	44.4	298.5	8	22	270
250	406	30.2	101.6	49.2	49.2	362.0	12	25	324
300	483	31.8	114.3	55.6	55.6	432.0	12	25	381
350	533	35.0	127.0	57.2	79.4	476.0	12	29	413
400	597	36.6	127.0	63.5	87.3	539.5	16	29	470
450	635	39.7	139.7	68.3	96.8	578.0	16	32	533
500	698	42.9	144.5	73.0	103.2	635.0	20	32	584
600	813	47.7	152.4	82.6	111.1	749.5	20	35	692

300 lbs

Normal pipe size (in mm)	Outside dia of flange	Minimum thickness of flange	Overall Length			bolt circle	No. and size of holes		O D of Raised face
			Welding neck	slip-on & socket welding	Lap joint				
	O	Q	Y			Dia.m	No.	B	R
15	95	14.3	52.4	22.2	22.2	66.5	4	15	35
20	117	15.9	57.2	25.4	25.4	82.5	4	19	43
25	124	17.5	61.9	27.0	27.0	89.5	4	19	51
32	133	19.1	65.1	27.0	27.0	98.5	4	19	64
40	156	20.7	68.3	30.2	30.2	114.5	4	22	73
50	165	22.3	69.8	33.3	33.3	127.0	8	19	92
65	190	25.4	76.2	38.1	38.1	149.0	8	22	105
80	210	28.6	79.4	42.9	42.9	168.0	8	22	127
90	229	30.2	81.0	44.5	44.5	184.0	8	22	140
100	254	31.8	85.7	47.6	47.6	200.0	8	22	157
125	279	35.0	98.4	50.8	50.8	235.0	8	22	186
150	313	36.6	98.4	52.4	52.4	270.0	12	22	216
200	381	41.3	111.1	61.9	61.9	330.0	12	25	270
250	444	47.7	117..5	66.7	95.3	387.5	16	29	324
300	521	50.8	130.2	73.0	101.6	451.0	16	32	381
350	584	54.0	142.9	76.2	111.1	514.5	20	32	413
400	648	57.2	146.0	82.6	120.7	571.5	20	35	470
450	711	60.4	158.8	88.9	130.2	628.5	24	35	584
500	775	63.5	161.9	95.2	139.7	686.0	24	35	692
600	914	69.9	168.3	106.4	152.4	813.0	24	41	692



Weld neck



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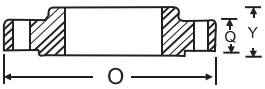


Slip-on

600 lbs

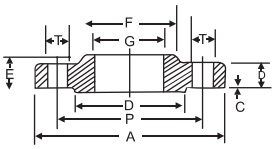
Normal pipe size (in mm)	Outside dia of flange	Minimum thickness of flange	Overall Length			bolt circle	No. and size of holes		O D of Raised face
			Welding neck	slip-on & socket welding	Lap joint				
	O	Q	Y			Dia.m	No.	B	R
15	95	14.3	52.4	22.2	22.2	66.5	4	15	35
20	117	15.9	57.2	25.4	25.4	82.5	4	19	43
25	124	17.5	61.9	27.0	27.0	89.5	4	19	51
32	133	20.7	66.7	28.6	28.5	98.5	4	19	64
40	156	22.3	69.8	31.8	31.8	114.5	4	22	73
50	165	25.4	73.0	36.5	36.5	127.0	8	19	92
65	190	28.6	79.4	41.3	41.3	149.0	8	22	105
80	210	31.8	82.6	46.0	46.0	168.0	8	22	127
90	229	35.0	85.7	49.2	49.2	184	8	25	140
100	273	38.1	101.6	54.0	54.0	216.0	8	25	157
125	330	44.5	114.3	60.3	60.3	266.5	8	29	186
150	356	47.7	117.5	66.7	66.7	292.0	12	29	216
200	419	55.6	133.4	76.2	76.2	349.0	12	32	270
250	508	63.5	152.4	85.7	115.1	432.0	16	35	324
300	559	66.7	155.6	92.1	111.1	489.0	20	35	381
350	603	69.9	165.1	93.7	117.5	527.0	20	38	413
400	686	76.2	177.8	106.4	127.0	603.0	20	41	470
450	743	82.6	184.2	117.6	139.7	654.0	20	45	533
500	813	88.9	190.5	127.0	165.1	724.0	24	45	584
600	940	101.6	203.2	139.7	184.2	838.0	24	51	692

900 lbs

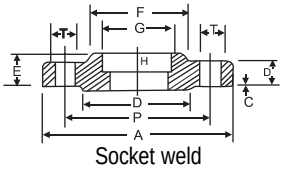
Normal pipe size (in mm)	Outside dia of flange	Minimum thickness of flange	Overall Length			bolt circle	No. and size of holes		O D of Raised face
			Welding neck	slip-on & socket welding	Lap joint				
	O	Q	Y			Dia.m	No.	B	R
15	121	22.3	60.3	31.8	31.8	82.5	4	22	35
20	130	25.4	69.8	34.9	34.9	89.0	4	22	43
25	149	28.6	73.0	41.3	41.3	101.5	4	25	51
32	159	28.6	73.0	41.3	41.3	111.0	4	25	64
40	178	31.8	82.6	44.4	44.4	124.0	4	29	73
50	216	38.1	101.6	57.2	57.2	165.0	8	25	92
65	244	41.3	104.8	63.5	63.5	190.5	8	29	105
80	241	38.1	101.6	54.0	54.0	190.5	8	25	127
100	292	44.5	114.3	69.8	69.8	235.0	8	32	157
125	349	50.8	127.0	79.4	79.4	279.5	8	35	186
150	381	55.6	139.7	85.7	85.7	317.5	12	32	216
200	470	68.5	161.5	101.8	114.3	393.5	12	38	270
250	546	69.9	184.2	108.0	127.0	470.0	16	38	324
300	610	79.4	200.0	117.5	142.9	533.5	20	38	381
350	641	85.8	212.7	130.2	155.6	559.0	20	41	413
400	705	88.9	215.8	133.4	165.1	616.0	20	45	470
450	787	101.6	228.6	152.4	190.5	686.0	20	51	533
500	857	108.0	247.6	158.8	209.6	749.5	20	54	584
600	1041	139.7	292.1	203.2	266.7	901.5	20	67	692

CLASS 1500 FLANGES - METRIC

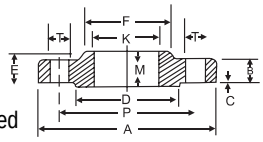
N.B.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	T	No.of Holes
15	121	22.2	6.4	35	32	38	22.4	9.5	21.3	23.5	60	22	32	23.0	82.6	3.0	22.2	4
20	130	25.4	6.4	43	35	44	27.7	11.0	26.7	29.0	70	25	35	28.0	88.9	3.0	22.2	4
25	149	28.6	6.4	51	41	52	34.5	12.5	33.4	36.0	73	29	41	35.0	101.6	3.0	25.4	4
32	159	28.6	6.4	64	41	64	43.2	14.5	42.2	44.5	73	30	41	43.5	111.1	5.0	25.4	4
40	178	31.8	6.4	73	44	70	49.5	16.0	48.3	50.5	83	32	44	50.0	123.8	6.5	28.6	4
50	216	38.1	6.4	92	57	105	62.0	17.5	60.3	63.5	102	38	57	62.5	165.1	8.0	25.4	8
65	244	41.3	6.4	105	64	124	74.7	19.0	73.0	76.0	105	48	64	75.0	190.5	8.0	28.6	8
80	267	47.6	6.4	127	73	133	--	--	88.9	92.0	117	51	73	91.5	203.2	9.5	31.8	8
100	311	54.0	6.4	157	91	162	--	--	114.3	118.0	124	57	91	17.0	241.3	11.0	34.9	8
125	375	73.0	6.4	186	105	197	--	--	141.3	145.0	156	64	105	145.0	292.1	11.0	41.3	8
150	394	82.6	6.4	216	119	229	--	--	168.3	171.0	171	70	119	171.0	317.5	12.5	38.1	12
200	483	92.1	6.4	270	143	292	--	--	219.1	222.0	213	76	143	222.0	393.7	12.5	44.4	12
250	584	108.0	6.4	324	159	368	--	--	273.0	276.0	254	84	178	277.0	482.6	12.5	50.8	12
300	673	123.8	6.4	381	181	451	--	-	323.9	329.0	283	92	219	328.0	571.5	12.5	54.0	16
350	749	133.4	6.4	413	--	495	--	--	356.6	--	298	--	241	360.0	635.0	12.5	60.3	16
400	826	146.1	6.4	470	--	552	--	--	406.4	--	311	--	260	411.0	704.8	12.5	6.7	16
450	914	161.9	6.4	533	--	597	--	--	457.2	--	327	--	276	462.0	774.7	12.5	73.0	16
500	984	178.0	6.4	584	--	641	--	--	508.0	--	356	--	292	514.0	831.8	12.5	79.4	16
600	1168	203.0	6.4	692	--	762	--	--	609.6	--	406	--	330	616.0	990.6	12.5	92.0	16



Slip-on



Socket weld



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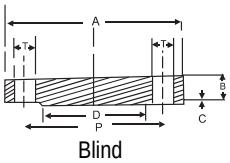

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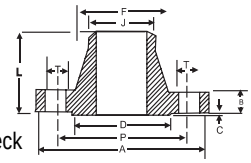
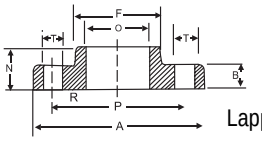


Weld-neck



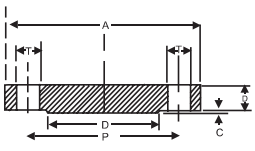
Lapped

CLASS 2500 FLANGES - METRIC

N.B.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	T	No of Holes
15	133	30.2	6.4	35	40	43	--	--	21.3	23.5	73	29	40	23.0	88.9	3.0	22.2	4
20	140	31.7	6.4	43	43	51	--	--	26.7	29.0	79	32	43	28.0	95.2	3.0	22.2	4
25	159	34.9	6.4	51	48	57	--	--	33.4	35.0	89	35	48	35.0	107.9	3.0	25.4	4
32	184	38.1	6.4	64	52	73	--	--	42.2	44.5	95	38	52	43.5	130.2	5.0	28.6	4
40	203	44.4	6.4	73	60	79	--	--	48.3	50.5	111	44	60	50.0	146.0	6.5	31.8	4
50	235	50.8	6.4	92	70	95	--	--	60.3	63.5	127	51	70	62.5	171.4	8.0	28.6	8
65	267	57.1	6.4	105	79	114	--	--	73.0	76.0	143	57	79	75.5	196.8	8.0	31.8	8
80	305	66.7	6.4	127	92	133	--	--	88.9	92.0	168	64	92	91.5	228.6	9.5	34.9	8
100	356	76.2	6.4	157	108	165	--	--	114.3	118.0	190	70	108	117.0	273.0	11.0	41.3	8
125	419	92.1	6.4	186	130	203	--	--	141.3	145.0	229	76	130	145.0	323.8	11.0	47.6	8
150	483	108.0	6.4	216	152	235	--	--	168.3	171.0	273	83	152	171.0	368.3	12.5	54.0	8
200	552	127.0	6.4	270	178	305	--	--	219.1	222.0	318	95	178	222.0	438.1	12.5	54.0	12
250	673	165.1	6.4	324	229	375	--	--	273.0	276.0	419	108	229	277.0	539.7	12.5	66.7	12
300	762	184.1	6.4	381	254	441	--	--	323.9	329.9	464	121	254	328.0	619.1	12.5	73.0	12

*Minimum length.

Blind



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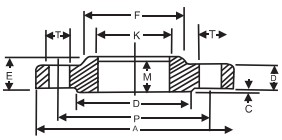
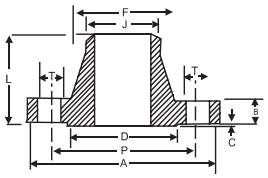
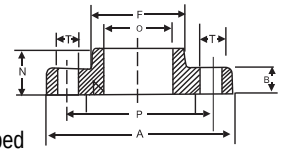




Weld-neck

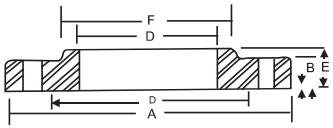


Lapped

Maruti Metal Industries

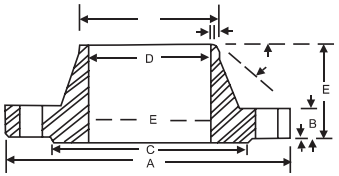
DIMENSIONAL TOLERANCES FOR FORGED STEEL FLANGES

Threaded, lap joint, slip-on and Blind Flanges
ANSI B 16.5



Outside Diameter (A)	When O.D. is 24" or less	±1/16**	Outside Dia. of Hub (F)	12" and smaller	+3/32"*-1/16**
	When 0. D is over 24"	± 1/8**		Over 12"	± 1/8**
Inside Diameter (D)	Threaded	Within limits on Boring gauge	Drilling	Bolt Circle	± 1/16*
				Bolt hole spacing	±1/32*
	Slip on and Lap Joint	10" and smaller + 1/32", -0" 12" and larger + 1/16"-0"		Eccentricity between 2 ½" and smaller bolt circle diameter and machined facing Diameter	1/32" Max. 3" and larger 1/16" Max.
Diameter of Contact Face (C)	1/16 Raised Face	±1/32"	Overall Height (E)	On flanges 18" and smaller	+1/8"*-1/32"*
				On flanges larger than 13"	+3/15"*-1/16"*
	1/4 Raised Face, Tongue and Groove of male and Female	± 1/64"	Thickness (E)	13" and smaller	41/8"-0"
				Over 18"	+ 3/16"-0"
Diameter of Counter bore	Same as for inside diameter			Where allowance has been left On face for finish: All sizes + 1/8"*-1/16"*	

Welding neck flanges
ANSI B 16.5



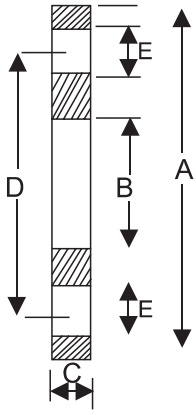
This tolerance not covered by ANSI B 16.5

Outside Diameter (A)	When O. D. is 24: or less	± 1/16"*	Drilling	Bolt Circle	± 1/16"
	When O. D. is over 24"	± 1/8"*		Bolt hole spacing	± 1/32"
smaller inside Diameter (D)	10" and smaller	± 1/32"		Eccentricity between ½" and smaller2½" and bolt circle diameter and machined facing diameter	1/32" max 3" and larger 1/16" max
	12" to 18"	± 1/16			
	Over 18"	+ 1/8-1/16"	Width of Land	All sizes	± 1/32"
Diameter of Contact Face (C)	1/16" Raised Face	± 1/32"	Angle of Hub Bevel	All Sizes	± 2½"
	1/4" Raised face, Tongue and Groove, or Male and Female	± 1/64"		18" and smaller	± 1/16
Diameter of Hub at Point of Welding (G)	5" and smaller	+3/32"-1/32"	Overall Height (E)	12" and larger ±	± 1/8"
				10" and smaller	+ 1/8"-0"
	5" and larger	+5/32"-1/32	Thickness (E)	Over 18"	+ 3/16"-0"
Diameter of Hub at Base (F)	When "F" is 24" and smaller	± 1/8"*		Where allowance has been left on face for Finish, All size	+1/8"*-1/16"*
	When "F" is over 24"	± 1/8			

BS 10 PIPE FLANGES

N.B. Size	Table	Dia of Flange A	Bore of Slip-on B	Thickness of Flange C	Pitch circle Dia D	Dia of Bilt Holes E	No. of Bolts
½”	D	3 ¾	0.88	3/16	2 5/8	9/16	4
	E	3 ¾	0.88	1/4	2 5/8	9/16	4
	F	3 ¾	0.88	3/8	2 5/8	9/16	4
	H	4 ½	0.88	1/2	3 1/4	11/16	4
¾”	D	4	1.09	3/16	2 7/8	9/16	4
	E	4	1.09	1/4	2 7/8	9/16	4
	F	4	1.09	3/8	2 7/8	9/16	4
	H	4 1/2	1.09	1/2	3 1/4	11/16	4
1”	D	4 1/2	1.36	3/16	3 1/4	9/16	4
	E	4 1/2	1.36	9/32	3 1/4	9/16	4
	F	4 3/4	1.36	3/8	3 7/16	11/16	4
	H	4 3/4	1.36	9/16	3 7/16	11/16	4
1.1/4”	D	4 3/4	1.70	1/4	3 7/16	9/16	4
	E	4 3/4	1.70	5/16	3 7/16	9/16	4
	F	5 1/4	1.70	1/2	3 7/8	11/16	4
	H	5 1/4	1.70	11/16	3 7/8	11/16	4
1.1/2”	D	5 1/4	1.95	1/4	3 7/8	9/16	4
	E	5 1/4	1.95	11/32	3 7/8	9/16	4
	F	5 1/2	1.95	1/2	4 1/8	11/16	4
	H	5 1/2	1.95	11/16	4 1/8	11/16	4
2”	D	6	2.44	5/16	4 1/2	11/16	4
	E	6	2.44	3/8	4 1/2	11/16	4
	F	6 1/2	2.44	5/8	5	11/16	4
	H	6 1/2	2.44	3/4	5	11/16	4
2.1/2”	D	6 1/2	2.94	5/18	5	11/16	4
	E	6 1/2	2.94	13/32	5	11/16	4
	F	7 1/4	2.94	5/8	5 3/4	11/16	8
	H	7 1/4	2.94	3/4	5 3/4	11/16	8
3”	D	7 1/4	3.57	3/8	5 3/4	11/16	4
	E	7 1/4	3.57	7/16	5 3/4	11/18	4
	F	8	3.57	5/8	6 1/2	11/16	8
	H	8	3.57	7/8	6 1/2	11/16	8
3.1/2”	D	8	4.07	3/8	6 1/2	11/16	4
	E	8	4.07	15/32	6 1/2	11/16	8
	F	8 1/2	4.07	3/4	7	11/16	8
	H	8 1/2	4.07	7/8	7	11/16	8
4”	D	8 1/2	4.57	3/8	7	11/16	4
	E	8 1/2	4.57	1/2	7	11/16	8
	F	9	4.57	3/4	7 1/2	11/16	8
	H	9	4.57	1	7 1/2	11/16	8
5”	D	10	5.56	1/2	8 1/4	11/16	8
	E	10	5.66	9/16	8 1/4	11/16	8
	F	11	5.66	7/8	9 1/4	11/16	8
	H	11	5.66	1 1/2	9 1/4	11/16	8

SLIP ON



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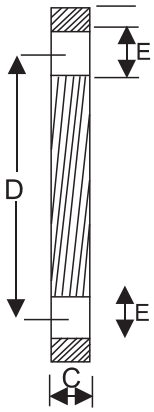

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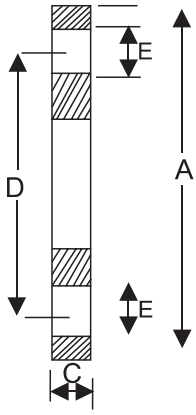
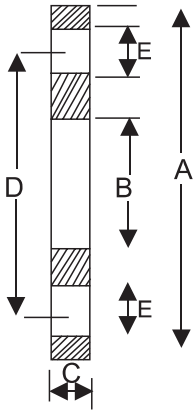


BS 10 PIPE FLANGES

N.B. Size	Table	Dia of Slip-on A	Bore of Flange B	Thickness of Flange C	Pitch circle Dia D	Dia of Bilt Holes E	No. of Bolts
6”	D	11	6.72	1/2	9 1/4	11/16	8
	E	11	6.72	11/16	9 1/4	7/8	8
	F	12	6.72	7/8	10 1/4	7/8	12
	H	12	6.72	1 1/8	10 1/4	7/8	12
8”	D	13 1/4	8.72	1/2	11 1/2	11/16	8
	E	13 1/4	8.72	3/4	11 1/2	7/8	8
	F	14 1/2	8.72	1	12 3/4	7/8	12
	H	14 1/2	8.72	1 1/4	12 3/4	7/8	12
10”	D	16	10.88	5/8	14	7/8	8
	E	16	10.88	7/8	14	7/8	12
	F	17	10.88	11/8	15	1	12
	H	17	10.88	13/8	15	1	12
12”	D	18	12.88	3/4	16	7/8	12
	E	18	12.88	1	16	1	12
	F	19 1/4	12.88	1 1/4	17 1/4	1	16
	H	21 3/4	12.88	1 7/8	19 1/2	1 1/8	16
14”	D	22 3/4	16.16	7/8	20 1/2	1	12
	E	22 3/4	16.16	1 1/4	20 1/2	1	12
	F	24	16.16	1 5/8	21 3/4	1 1/8	16
	H	24	16.16	2 1/8	21 3/4	1 1/4	16
16”	D	25 1/4	16.18	1	23	1	12
	E	22 3/4	16.16	1 1/4	21 3/4	1	12
	F	24	16.16	1 5/8	21 3/4	1 1/8	20
	H	24	16.16	2 1/8	21 3/4	1 1/8	20
18”	D	25 1/4	18.18	1	23	1	12
	E	25 1/4	18.18	1 3/4	23	1	16
	F	26 1/2	18.18	1 3/4	24	1 1/4	20
	H	26 1/2	18.18	2 3/8	24	1 1/4	20
20”	D	27 3/4	20.20	1 1/8	25 1/4	1	16
	E	27 3/4	20.20	1 1/2	25 1/4	1	16
	F	29	20.20	2	26 1/2	1 1/4	24
	H	29	20.20	2 5/8	26 1/2	1 1/4	24
22”	D	30	22.22	1 1/8	27 1/2	1 1/8	16
	E	30	22.22	1 3/4	27 1/2	1 1/8	16
	F	31	22.22	2 1/8	28 1/2	1 1/4	24
	H	31	22.22	2 3/4	28 1/2	1 1/4	24
24”	D	32 1/2	24.25	1 1/4	29 3/4	1 1/8	16
	E	32 1/2	24.25	1 7/8	29 3/4	1 1/4	16
	F	33 1/2	24.25	2 1/4	30 3/4	1 3/8	24
	H	33 1/2	24.25	3	30 3/4	1 3/8	24

SLIP ON



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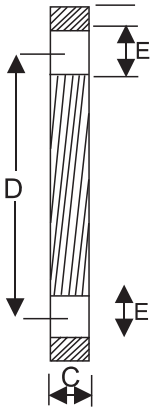

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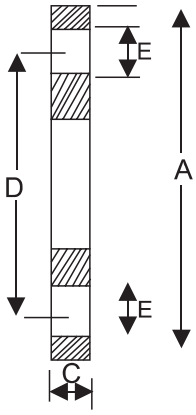


BUTT WELDED PIPE FITTINGS

Nom.	Pipe	Wall thickness				Radius			R						Length				
Bore inch	O.D	5S	10S	40S	80S	1D	1.5D	2D	3D	A	B	C	E	G	L	L	H	D	h
1/2	21.34	1.65	2.11	2.77	3.73	12.7	19.06	25.4	38.1	12.7	15.9	25.4	25.4	34.9	50.8	76.2	50.8	42	8
3/4	26.67	1.65	2.11	2.87	3.91	19.05	28.57	38.10	57.15	19.05	11.1	28.6	25.4	42.8	50.8	76.2	50.8	52	8
1	33.40	1.65	2.77	3.38	4.55	25.4	38.1	50.8	76.2	52.4	22.2	38.1	38.1	50.8	50.8	101.6	50.8	65	10
11/4	42.16	1.65	2.77	3.56	4.85	31.75	47.6	63.5	95.25	31.75	25.0	47.6	38.1	63.1	50.8	101.6	50.8	72	12
11/2	48.26	1.65	2.77	3.68	5.08	38.1	57.15	76.2	114.3	38.10	28.6	57.2	38.1	73.0	50.8	101.6	63.5	82	12
2	60.32	1.65	2.77	3.91	5.54	50.8	76.2	101.6	152.4	50.8	34.0	63.5	38.1	92.0	63.5	152.4	76.2	98	16
21/2	73.02	2.11	3.05	5.16	7.01	63.5	95.25	127.0	190.5	63.5	44.0	76.2	38.1	104.8	63.5	152.4	88.9	118	15
3	88.90	2.11	3.05	5.49	7.62	76.2	114.30	152.4	228.6	76.2	50.8	85.7	50.8	127.0	63.5	152.4	88.9	130	18
31/2	101.60	2.11	3.05	5.74	8.08	88.9	133.35	177.8	266.7	88.9	57.2	95.3	63.5	139.7	76.2	152.4	101.6	140	18
4	114.30	2.11	3.05	6.02	8.56	101.6	152.4	203.2	304.8	101.6	63.5	104.8	63.5	157.2	76.2	152.4	101.6	168	20
5	141.30	2.77	3.40	6.55	9.52	127.0	190.5	254.0	381.0	127.0	82.6	123.8	76.2	185.7	76.2	203.2	127.0	188	25
6	168.27	2.77	3.40	7.11	10.97	152.4	228.6	304.8	457.2	152.4	95.3	142.7	88.9	215.9	88.9	203.2	139.7	215	25
8	219.07	2.77	3.76	8.18	12.7	203.2	304.8	406.4	609.6	203.2	127.0	177.5	101.6	270.0	101.6	203.2	152.4	270	30
10	273.05	3.40	4.19	9.27	12.7	254.0	381.0	508.0	762.0	254.0	158.7	275.9	127.0	324.0	127.0	254.0	177.8	330	35
12	323.85	3.96	4.57	9.52	12.7	304.8	457.2	609.6	914.4	340.8	190.5	254.0	152.4	381.0	152.4	254.0	203.2	400	40
14	355.60	3.96	4.76	9.52	12.7	355.6	533.4	711.2	1066	355.6	222.2	280.0	165.1	412.8	152.4	305.0	330.2	470	40
16	406.40	4.19	4.76	9.52	12.7	406.4	609.6	812.8	1219	406.4	254.0	340.8	177.8	470.0	152.4	305.0	355.6	535	40
18	457.20	4.19	4.76	9.52	12.7	457.2	685.8	914.4	1372	457.2	285.7	343.0	203.2	533.4	152.4	305.0	381.0	535	40
20	508.00	4.76	5.54	9.52	12.7	508.0	762.0	1016	1524	508.0	317.6	381.0	228.6	584.2	152.4	305.0	508.0	642	40
24	609.60	5.54	6.35	9.52	12.7	609.6	914.4	1219	1829	-	881.00	431.8	266.7	698.5	152.4	305.0	508.0	693	40

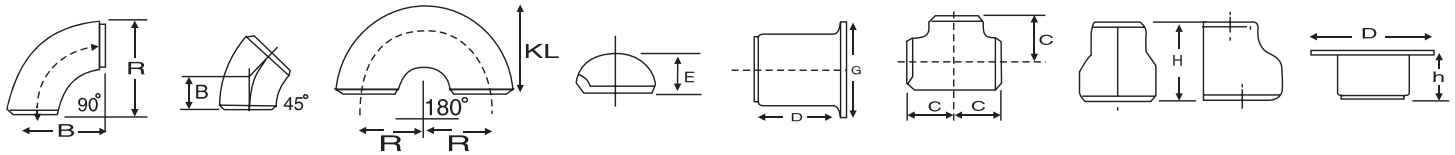


TABLE TOLERANCES (ANSI B 16.9)

All Fittings				90 deg. and 45 deg. elbows and Tees	Reducers & Lap Joints Stub Ends	Caps	180 deg Returns			Lap Joint Stub Ends		
Nominal Pipe size (NPS)	Outside Diameter at Bewel (1), (2) D	Inside diameter at End (1), (2), (3)	Wall Thickness (3)	Center to end Dimension A,B,C,M	Center to Overall Length F,H	Overall Length E	Center to Center Dimension O	Back to Face Dimension K	Alignment of ends U	Outside Diameter of Lap G	Fillet Radius of Lap R	Outside Diameter of Barrel
1/2 to 2/12	1	0.8	Not Less than 87.5% of nominal thickness	2	2	4	7	7	1	+0.1	+0-1	See Table 7 for limiting dimentsions
3 to 3/12	1	1.6		2	2	4	7	7	1	+0-1	+0-1	
4	+2 -1	1.6		2	2	4	7	7	1	+0-1	+0.1	
5 to 6	-3 -1	1.6		2	2	7	7	7	1	+0-1	+0.2	
8	+4 -3	1.6		2	2	7	7	7	1	+0-1	+0-2	
10	+4 -3	3.2		2	2	7	10	7	2	+0.2	+0-2	
12 to 18	+4 -3	3.2		2	2	7	10	7	2	+0-2	+0-2	
20 to 24	+6 -5	4.8		3	3	7	10	7	2	+0-2	+0-2	
26 to 30	+7 -5	4.8		3	3	10	--	--	--	--	--	
32 to 48	+7 -5	4.8		5	5	10	--	--	--	--	--	

Nominal Pipe Size (NPS)	Angularity - Tall	
	Off Angle Q	Off Plane P
1/2 to4	1	2
5to 8	2	4
10 to 12	3	5
14 to 16	3	7
18 to 24	4	10
26 to 30	5	10
32 to 42	5	13
44 to 48	5	20

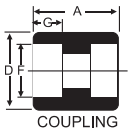
GENERAL NOTE : Dimensions are in millimeters (expect NPS) tolerances are equal plus minus except as noted.

NOTES :

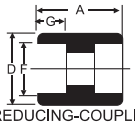
1) Out of round is the sum of absolute values of plus and minus tolerance.
2) This tolerance may be exceed in localized area of formed fittings where increased wall thickness is required to meet design require ments of para 2.2.
3) The inside diameter and the nominal wall thickness at ends are to be specified by the purchaser.
4) Unless otherwise specified by the purchaser, these tolerances apply to the nominal inside diameter, which equals the diffearence between the nominal outside diameter and twice the nominal wall thickness.

SOCKET WELD PIPE FITTINGS - STANDARD DIMENSIONS

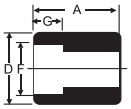
Nominal Pipe Size		inch	1/8	1/4	3/8	1/2	3/4	1	11/4	11/2	2	21/2	3	4
		mm	3.2	6.4	9.5	12.7	19.0	25.4	31.7	38.1	50.8	63.5	76.2	101.6
Length	A	mm	25.4	25.4	28.6	35.0	38.1	44.4	47.6	50.8	63.5	63.5	69.9	76.2
Centre to Face	B	mm	20.6	20.6	24.6	28.6	33.3	38.1	44.4	50.8	60.3	76.2	85.7	106.3
Cap Length	C	mm	17.46	17.46	19.05	22.23	25.4	26.99	30.16	31.75	38.10	38.10	44.45	47.63
Out Side	D	mm	19.0	22.2	25.4	31.7	38.1	44.5	57.2	63.5	76.2	92.1	108.0	139.7
Diameter	E	mm	22.2	22.2	25.4	33.3	38.1	46.0	55.5	62.0	75.4	92.0	109.5	146.0
Socket Bore	F	mm	10.7	14.1	17.5	21.7	27.0	33.8	42.5	48.6	61.1	74.0	89.8	115.4
Depth of Socket	G/H MIN	mm	9.5	9.5	9.5	9.5	12.7	12.7	12.7	12.7	15.9	15.9	15.9	19.0
	G MAX	mm	9.5	9.5	11.1	12.7	14.3	15.9	17.5	19.0	22.2	22.2	25.4	28.6
	H MAX	mm	9.5	9.5	11.1	12.7	14.3	15.9	17.5	19.0	22.2	28.6	35.0	39.7
Centre to Socket	J	mm	11.1	11.1	13.5	15.8	19.0	22.2	27.0	31.7	38.1	41.2	57.1	66.6
Back face	K	mm	8.0	8.0	8.0	11.1	12.7	14.3	17.4	20.6	25.4	28.6	31.7	41.2
Centre to face	L	mm	17.46	19.0	19.0	22.2	25.4	28.6	33.3	35.0	42.8	52.4	63.5	79.3
Wall Thk minimum		mm	3.18	3.30	3.51	4.09	4.27	4.98	5.28	5.54	6.05	7.65	8.31	9.35
Bore		mm	6.45	8.86	12.14	15.42	20.55	26.26	34.67	40.51	52.12	61.95	77.17	101.50



COUPLING

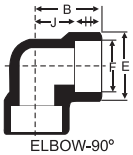


REDUCING-COUPLING

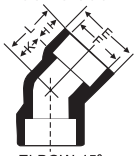


HALF-COUPLING

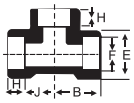
CAP



ELBOW-90°



ELBOW-45°



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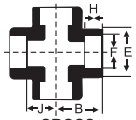
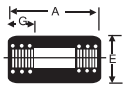
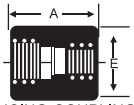


CROSS

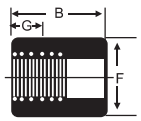
Nominal Pipe Size		inch.	1/8	1/4	3/8	1/2	3/4	1	11/4	11/2	2	21/2	3	4
		mm	3.2	6.4	9.5	12.7	19.0	25.4	31.7	38.1	50.8	63.5	76.2	101.6
Face to Face Length	A	mm	31.7	35.0	38.1	47.6	50.8	60.3	66.7	79.4	85.7	92.1	108.0	120.7
	B	mm	15.9	17.5	19.0	23.8	25.4	30.2	33.3	39.7	42.9	46.0	54.0	60.3
	C	mm	19.0	25.4	25.4	31.7	36.5	41.3	44.5	44.5	47.6	60.3	65.1	68.3
Face to Centre Length	D	mm	20.6	24.6	28.6	33.3	38.1	44.4	50.8	60.3	63.5	82.5	95.2	114.3
	E	mm	15.9	19.0	22.2	28.6	35.0	44.5	57.2	63.5	76.2	92.1	108.0	139.7
Outside Diameter	F	mm	22.2	25.4	33.3	38.1	46.0	55.5	62.0	75.4	84.1	101.6	120.6	152.4
Length of Thread	G	mm	6.35	8.13	9.14	10.92	12.70	14.73	17.02	17.78	19.05	23.67	25.81	27.79
45^0 Elbow Face to Centre	H	mm	17.5	19.0	22.2	25.4	28.6	33.3	35.0	42.8	43.6	52.4	63.5	79.3



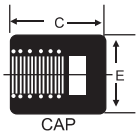
COUPLING



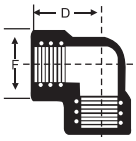
REDUCING-COUPLING



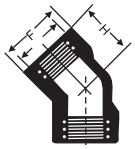
HALF-COUPLING



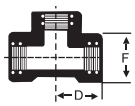
CAP



ELBOW-90°



ELBOW-45 °



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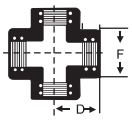


CROSS

FORMULAE

1) WEIGHT OF STAINLESS STEEL PIPES & TUBES
OD (mm) - W.T. (mm) X W.T. (mm) X 0.02466 = Kg. per Mtr.

2) SHEET WIDTH REQUIRED FOR ROLLED AND WELDED PIPES
O.D. (mm) - THK (mm) X 3.14 = Sheet Width

3) WEIGHT OF STAINLESS STEEL SHEETS
Length (mtr.) x Wdth (mrt.) X Thk (mm) X 8 = Kg Per Sheet

4) WEIGHT OF STAINLESS STEEL CIRCLE & BLANKS
O.D. (mm) X O.D.> (mm) X Thk (mm) /160/1000 = Kg Per Pcs.

5) WEIGHT OF STAINLESS STEEL ROUNDS
Dia. (mm) X Dia. (mm) X 0.00623 = Per Mtr.

6) WEIGHT OF STAINLESS STEEL HEXAGONAL RODS
Dia. (mm) X Dia. (mm) X 0.00679 = Per Mtr.

7) WEIGHT OF STAINLESS STEEL SQUARE BARS
Dia. (mm) X Dia. (mm) X 0.00787 = Kg Per Mtr.

8) WEIGHT OF CARBON STEEL PIPES & TUBES
O.D. (mm) - W.T. (mm) X W.T. (mm) X 0.02466 = Kg. Per Mtr.

9) WEIGHT OF CARBON STEEL SHEETS - PLATES
Length (mtr.) X Width (mtr.) X Thk (mm) X 7.85 = Kg. Pert Sheet

10) WEIGHT OF COPPER PIPES
O.D. (mm) - W.T. (mm) X W.T. (mm) X 0.0256 = Kg. Per Mtr.

11) WEIGHT OF LEAD PIPES (appro.)
O.D. (mm) - W.T. (mm) X W.T. (mm) X 0.0345 = Per Mtr.

12) WEIGHT OF LEAD SHEETS (appro.)
Length (mtr.) X Width (mtr.) X Thk (mm) X 11.2 = Kg. Per Sheet

13) WEIGHT OF ALLUMINIUM PIPES (appro.)
O.D. (mm) - W.T. (mm) X W.T. (mm) X 0.0082 = Kg. Per Mtr.

14) WEIGTH OF ALLUMINIUM SHEETS (appro.)
Length (mtr.) X Width (mtr.) X Thk (mm) X 2.66 = Kg Per Sheet

High Conductivity Free Machining Copper Rods

(LEADED COPPER)

CHEMICAL REQUIREMENTS

Copper	Remainder
Lead	0.6 to 1.0
Impurities	0.2% Max

PHYSICAL PROPERTIES

*Tensile strength	23 to 35 k
Elongation	45 to 10%
Electrical conductivity at 20°C	94 to 98%

FABRICATION PROPERTIES

Capacity for bei[illegible]ld worked	Fair
Hot formed	Good
Machineability ratin[illegible] tting brass-100)	80
Suitability for Brazing	Good
Soldering	Good

USES

Threaded-machine components and parts requiring high conductivity, extensive machining and [illegible] resistance; electrical connectors, motor switch components etc.

(TELLURIUM COPPER)

as per BS 2874 C 109)

CHEMICAL REQUIREMENTS

Copper	Remainder
Tellurium	0.3 to 0.7%
Impurities	0.2%-Max.

PHYSICAL PROPERTIES

**Tensile strength	23 to 35 kg
Elongation	45 to 10%
Electrical conductivity at 10°C	94 to 98% IAC

FABRICATION PROPERTIES

Capacity for being cold worked	Fair
Hot formed	Good
Machineability Rating (Eree cutting brass-100)	80
Suitability for Brazing	Good
Soldering	Good

USES

Threaded-machine components and parts requiring high conductivity, extensive machining and [illegible]sion resistance, electrical connectors, motor, switch components, etc. requiring high sof[illegible] temperature.

* Material can be supplied in any temper as required by customers.

** Customers to specify temper required

Copper-Nickel-Alloy Rods

as per ASTM B : 411—64

CHEMICAL REQUIREMENTS

Nickel	1.6 to 2.2%
Silicon	0.4 to 0.8%
Lead	0.1% Max
Iron	0.1% Max
Zinc	0.5% Max
Copper	Balance

PHYSICAL PROPERTIES

Tensile strength	63 kgs/mm²-Mi
Elongation	8%-Min

FABRICATION PROPERTIES

Capable of being precipitation hardened

USES

Compon[illegible] requ[illegible] and wear [illegible]ce qualities.

Copper Rods & Tubes For General Engineering Purposes

(Phosphorus deoxidised non-arsenical)

as per IS 4171 — 1966

BS 2874 — C 106

MICAL REQUIREMENTS

Copper	99.85%-Min. (including silver)
Phosphorus	.013 to .050%
Arsenic	.05%-max.
Nickel	.01%-max.
Other impurities	.06%-max.

PHYSICAL PROPERTIES

Tensile strength	23 to 35 kgs/mm²
Elongation	45 to 8%

FABRICATION PROPERTIES

Capacity for being Cold worked	Excellent
Hot formed	Excellent
Machineability	Poor
Suitability for Brazing	Good
Soldering	Good

USES

Condensers, evaporators and other heat exchanger tubes, brewery tubes, gas lines, oil burner tubes, steam, water, vapour lines etc.

Nickel Silver Alloy Rods

as per BSS 2874—1969 NS 101

CHEMICAL REQUIREMENTS

Copper	44.0 to 47.0%
Lead	1.0 to 2.5%
Iron	0.40% max
Nickel	9.0 to 11.0%
Manganese	0.20 to 0.50%
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strengh	47 kgs/mm²-Min.
Elongation	8%-Min.

FABRICATION PROPERTIES

Capacity for being hot formed	Excellent
Capacity for being cold worked	Fair
Machineability rating (Free cutting brass-100)	80
Suitability for Soldering	Excellent
Brazing	Good

USES

Telecommunications, Flatware and holloware, Architectural and ornamental applications, keys, locks and small machined component where corrosion resistance and decorations are desired.

High Conductivity Wear Resistance

Copper Rods (Cadmium Copper)

CHEMICAL REQUIREMENTS

Copper	Remainder
Cadmium	0.5 to 1.27%
Total impurities	0.05%

PHYSICAL PROPERTIES

Tensile strength	26 to 63 kgs/mm²
Elongation	45 to 2%
Electrical conductivity at 20°C	80 to 97% IACS.
Machineability rating (Free cutting brass-100)	40
Suitability for Brazing	Good
Soldering	Good
Wear resistance	Excellent

Electrode holders for resistance welding machines, arc furnaces, electrodes for spot seam welding and aluminium alloys; commutator bars. springs carrying electric current, switch gear and components for other equipment requiring high conductivity with greater strength and resistance to wear.

Free Cutting Brass Rods

as per BS 2874—CZ 124

CHEMICAL REQUIREMENTS

Copper	60.0 to 63.0%
Lead	2.5 to 3.7%
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strength	28 Kgs./mm²-min.
Elongation	12% min.

FABRICATION PROPERTIES

Capacity for being cold worked	Poor
Capacity for being hot formed	Fair
Machineability Rating (Free cutting Brass-100)	100
Suitability for Soldering	Excellent
Brazing	Good

USES

Hardware, Gears, Pinions, Automatic High Speed Screw Machine Parts.

as per IS: 319, (BS: 249) BS 2874—CZ 121

CHEMICAL REQUIREMENTS

Copper	55.0 to 60.0%
Lead	2.0 to 3.5%
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strength	39 kgs/mm²-min. (25 Tons/Sq. in.)
Elongation	15%-min.

FABRICATION PROPERTIES

Capacity for being cold worked	Poor
Capacity for being hot formed	Fair
Machineability Rating (Free cutting Brass-100)	90
Suitability for Soldering	Excellent
Brazing	Good

USES

Architectural Extrusions, Thresholds, Butts, Hinges, Lock bodies, Screws, Nuts and Bolts.

Naval Brass Rods

(Forging Quality)
as per IS 291 — 1961 Gr. 1
(BS : 2874 / 1969 CZ : 112) BS 251 / 1963

CHEMICAL REQUIREMENTS

Copper	61.0 to 64.0%
Tin	1.0 to 1.5%
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strength	35 kgs /mm2-min. (22-26 Tons/Sq. in.)
Elongation	18% min.

FABRICATION PROPERTIES

Capacity for being cold worked	Fair
Capacity for being hot formed	Good
Hot forgeability Rating (Forging Brass-100)	80
Machineability Rating (Free cutting Brass-100)	30
Suitability for Brazing	Excellent
Soldering	Excellent
Oxy Acetylene Welding	Good

USES

Balls, Bolts, Marine hardware, Nuts, Propeller, Shafts, Rivets, Valve Stems, Welding rods.

(Machining and general purposes other than forging quality)
as per IS 291 — 1961 Gr. 2
(ES 2874 — 1969 CZ 113) BS 252 — 1963

CHEMICAL REQUIREMENTS

Copper	59-62%
Tin	0 5-1%
Lead	0.5.1%
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strength	35 kgs./mm²-min.
Elongation	16%

FABRICATION PROPERTIES

Capacity for being cold worked	Fair
Capacity for being hot formed	Fair
Machineablity rating(Free cutting Brass-100)	70
Suitability for Brazing	Excellent
Soldering	Excellent
Welding	Good

USES

Condenser plates, piston rods, nuts, bolts, rivets and other marine machined hardware not invol forging operation.

Lead Free (Rivetting) Brass Rods

as per BS 2874—CZ 109 (BS 1949)

CHEMICAL REQUIREMENTS

Copper	59-62%
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strength	34 kgs/mm²-Min. (22 Tons/Sq. in.)
Elongation	26% Min.

FABRICATION PROPERTIES

Machineability Rating (Free cutting Brass-100)	55
Bending	Excellent
Rivetting	Excellent
Forging	Excellent

USES

A ductile alloy with good cold working properties suitable for bending and punching Rivets. boltings valve stems, tubing for heat exchangers, brazing rods and hot forgings.

High Tensile Brass Rods

as per BS 2874 1969 CZ 114 (BS 250)

CHEMICAL REQUIREMENTS

Copper	56.0 to 60.0%
Tin	0.2 to 1.0%
Iron	0.25 to 1.2%
Manganese	0.3 to 2.0%
*Lead	0.5 to 1.5%
Aluminium	1.50% Max.
Zinc	Balance

PHYSICAL PROPERTIES

Tensile Strength	47 kgs/mm²-Min. (30 Tons/Sq. in.)
Elongation	18%-Min.

FABRICATION PROPERTIES

Capacity for being cold worked	Fair
Capacity for being hot worked	Good
Machineability Rating (Free cutting brass-100)	30
Wearing Properties	Good
Resistance to Corrosion	Excellent
Suitability for Soldering	Fair

USES

Balls, Clutch discs, pump rods, shafts, valve stems and bodies, welding rods and such other components requiring high strength and excellent resistance to corrosion.

* If the material is required with lower lead Content than that specified. it may be ordered with a maximum lead content of either 0 1% (lead-free grade or 0.5%).

High Tensile Forging Brass Suitable for Soldering

as per BS 2872 1969—CZ 115 (BS 1001)

CHEMICAL REQUIREMENTS

Copper	56.0 to 60.0%
Tin	0.6 to 1.1%
Iron	0.25 to 1.2%
Manganese	0.3 to 2.0%
Lead	0.5 to 1.5%
Aluminium	0 2% Max.
Zinc	Balance

PHYSICAL PROPERTIES

Tensile strength	55 kgs/mm²-Min. (35 Tons/Sq. in.)
Elongation	12% Min.

FABRICATION PROPERTIES

Capacity for being cold worked	Fair
Capacity for being hot worked	Good
Machineability rating (Free cutting brass-100)	30
Wearing properties	Good
Resistance to Corrosion	Excellent
Suitability for Soldering	Excellent

USES

Forgings requiring high tensile strength and soldering properties.

HIGH TENSILE BRASS RODS

as per IS : 320—1962

	Alloy-1 percent	Alloy-2 percent	Alloy-3 percent
CHEMICAL REQUIREMENTS			
Copper	56.0 to 59 0	56.0 to 59.0	5 70 to 61.0
Tin*	*0.75 to 1.75	*0.5 max	*1.0 max
Lead	@0.5 max	@1.0 max	@0.75 to 1.0
Iron	1.25 max	0.7 to 1.2	0.25 to 1.0
Manganese	20.0 max	0 5 to 1.2	0.5 to 1.2
Nickel	—	—	—
Aluminium	0.2 max	0.2 to 1.2	0.5 to 2.0
Other elements	0.5 max	0.5 max	0.5 max
Zinc	Remainder	Remainder	Remainder

PHYSICAL PROPERTIES

	Alloy-1	Alloy-2	Alloy-3
Tensile Strength (Kg/mm^2) min.	53	47	53
Elongation (percent) min.	15	20	15

FABRICATION PROPERTIES

Similar to CZ 115 — Similar to CZ 114

USES

Alloy 1—suitable for soldering.
Alloy 2—less easily soldered.
Alloy 3—suitable for machining.

*Tin is not to be intentionally added

Leaded Brass Rods

(Drilling and Turning Quality)

as per MS 58—DIN 1756

CHEMICAL REQUIREMENTS	
Copper	56.5 to 59.5%
Lead	1 to 3%
Zinc	Remainder
PHYSICAL PROPERTIES	
Tensile strength	39 to 50 kgs/mm^2
Elongation	9 to 15%
FABRICATION PROPERTIES	
Suitability for cold forming	Fair
Suitability for hot forming	Good
Machining, drilling etc.	Very good
Resistance to wear	Poor
Suitability for soldering	Good

USES

For machined components manufactured at high speeds on automatic Capstan Lathes, drilling, shaping or milling machines and which are not subjected to bending.

Forging Brass Rods

as per IS 3488—66, (BS—218—63)

CHEMICAL REQUIREMENTS	
Copper	56.5 to 60.0%
Lead	1.0 to 2.5%
Zinc	Balance
MECHANICAL PROPERTIES	
Tensile strength	35 kgs/mm^2-Min (22 Tons/Sq. in.)
Elongation	25% Min.
FABRICATION PROPERTIES	
Capacity for being cold worked	Poor
Capacity for being hot formed	Excellent
Hot forgeability Rating(Forging Brass-100)	100
Machineability Rating (Free cutting Brass-100)	80
Suitability for Soldering	Excellent
Brazing	Good

USES

Forgings and pressings of all kinds for components requiring free cutting as well as forging quality.

Brass Tubes 63/37

for General Purposes
as per IS 407—1966 (Alloy 2)

CHEMICAL REQUIREMENTS

Copper + incidental nickel	59.63%
Lead	0.80% max.
Iron	0.07% max.
Arsenic	0.06% max.
Other impurities	0.30% max.
Zinc	Remainder

PHYSICAL PROPERTIES

Tensile strength Annealed	29.38 kg/mm²
Half hard	38.kg/mm²-Min.
hard	46 kg/mm²-Min.
Bending, Drifting.	
Flattening properties:	As per IS 407
Hydraulic & Mercurous	
Nitrate test:	As per IS 407

USES

Heat exchangers

Manganese Bronze Rods

as per ASTM B 138—58

CHEMICAL REQUIREMENTS

	Alloy A %	Alloy B %
Copper	57-60	63-68
Tin	0.5-1.5	0.5 max
Iron	0.8-2	2-4
Aluminium	0.25 max	3-6
Manganese	0.05-0.5	2.5-5
Zinc	Remainder	Remainder

PHYSICAL PROPERTIES

Tensile strength	
Alloy A	53 kg/mm²-Min.
Alloy B	80 kgs/mm²-Min.
Elongation	
Alloy A	25%-Min.
Alloy B	10%-Min.

USES

Extra Heavy-duty high strength alloy for large valves, stems, gears bearings, shafting and hydraulic cylinder parts.

Aluminium Bronze Rods

as por BS 2874—CA : 103 (BS 2032)

CHEMICAL REQUIREMENTS

Aluminium	8.8 to 10.0%
Iron + Nickel	4% Max
Manganese	0.5% Max
Copper	Balance

PHYSICAL PROPERTIES

Tensile strength	53 kgs/mm²-Min. (34 Tons/Sq. in.)
Elongation	22%-Min.

FABRICATION PROPERTIES

Capacity for being Cold worked	Fair
Capacity for being hot formed	Excellent
Machineability Rating (Free machining brass-100)	35
Suitability for Brazing	Poor
Soldering	Poor
Welding (Arc)	Good

USES

1. Acid resisting mine pumps, Bearings, Valve seats etc.
2. Corrosion resistant parts, marine hardware, heat-resistant applications, wear and high strength nuts. bolts, stringers and threaded parts.

as per BS 2874—CA : 104 (BS 2033)

CHEMICAL REQUIREMENTS

Aluminium	8.5 to 11.0%
Nickel	4.0 to 6.0%
Iron	4.0 to 6.0%
Manganese	0.5% Max.
Copper	Balance

PHYSICAL PROPERTIES

Tensile strength	71 kgs/mm²-Min. (45 Tons/Sq. in.)
Elongation	12% Min.

FABRICATION PROPERTIES

Capacity for being cold formed	Poor
Capacity for being hot formed	Good
Machineability rating (Free machining brass-100)	35
Suitability for Brazig	Fair
Soldering	Poor
Welding	Good

USES

1. Excellent corrosion resistant alloy, mainly used in propeller hubs, blades and other parts in contact with salt water.
2. Valve guides and seats in air-craft engines.
3. Gear blanks and high pressure Valves, Bearings etc.
4. Heat Exchangers.

Aluminium Silicon Bronze Rods

as per ASTM B 283—56

CHEMICAL REQUIREMENTS

Aluminium	6.5 to 8.0%
Silicon	1.5 to 3 0%
Copper	89% Min.

PHYSICAL PROPERTIES

Tensile Strength	67 kgs/mm²-Min.
Elongation	25%-Min.

FABRICATION PROPERTIES

Machineable Aluminium Bronze with high strength, good corrosion resistance and low co-efficient of frictlon.

Forgeability Rating	75%

USES

Hot forged components, propeller shaft bearings etc.

High Conductivity Electrolytic Copper Rods & Tubes

as per BS 2874 — 1969, C 101
BS 1977—1963 (Tubes)

CHEMICAL REQUIREMENTS

Copper	99.9%-Min. (inclusive of silver)
Lead	0.005%
Total impurities	0.03% (excluding oxygen)

PHYSICAL PROPERTIES

*Tensile strength	23 to 35 kgs/mm²
Elongation	55 to 6%
Electrical conductivity at 20°C	101% IACS (annealed)

FABRICATION PROPERTIES

Capacity for being Cold worked	Excellent
Hot formed	Excellent
Machineability	Poor
Suitability for Silver brazing	Good
Soldering (In an inert or slightly oxidizing condition.)	Good

USES

Electrical conductors switches, terminals, gaskets, radiators, cotter pins, nails, rivets, tubes etc., requiring high electrical/thermal conductivity.

* Material can be supplied in any temper as required by customers.

BRITISH STANDARD SPECIFICATIONS* FOR THE PRINICIPAL NON-FERROUS CASTING ALLOYS—(Contd.)

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Aluminium Bronze	B.S. 1400 : 1961 AB1	Al. 8.5-10.5% Fe. 1.5-3.5% Ni. 1.0% max. Zn. 0.5% max. Mn. 1.0% max. Total other elements 0.3% max. Cu. remainder.	Tensile strength 32 tons per sq. in. Elongation 20% min.	B. 150-46T B. 148-45T-9C D.T.D. 174A B.S. 1031/2 D.I.N. 1714 (G. AlMBz 10) S.T.A. 7-CA3	Alloy used for high grade sand and die-castings such as worm and gear wheels. Also for components to withstand the action of superheated steam.
Aluminium Bronze	B.S. 1400 : 1961 AB2	Al. 8.5-10.5% Fe. 3.5-5.5% Ni. 4.5-6.5% Mn. 1.5% max. Zn. 0.5% max. 0.5% max. Total other elements 0.3% max. Cu. remainder	Tensile strength 41 tons per sq. in. Elongation 15% min.	G. AlMBzB Q.Q.B. 671a.A Q.Q.B. 67a C and D. A.M.S. 4640 B. 148-45-T.9D B.30.45T.9D D.T.D. 412 B.S. 1072/3 S.T.A. 7-CA4	Suitable for high duty sand, die and centrifugal castings.
Brass 60/40	B.S. 1400: 1961 DCB	Cu. 59-63% Al. 0.5% max Pb. 0.1% max. Total other elements 0.75% max. Zn. remainder.	Tensile strength 18 tons per sq. in (min.) Elongation 25% (min.)	B.S. 932 S.T.A. 7-CZ 14 MIL-C-15345 D Grade 2	General purpose, die-casting alloy. Suitable for electrical switchgear and contact parts brush holders.
Brass 60/40	B.S.S. 249	Cu. 55-60% Pb. 2-3.5% Fe. 0.3% max. Other elements 0.75% max. Zn. remainder	Tensile strength 25 tons per sq. in Elongation 20%	Ms. 58	A super high speed machining and screw cutting brass. Also suitable for extrusions.
Naval Brass 60/40	B.S. 1400 : 1961 SCB4	Cu. 60% min. Sn. 1 0 1.5% Pb. 0.1% max Other elements 0.75% max. Zn. remainder.	Tensile strength 16 tons per sq. in. min.	B. 124.45 3 B. 171-42 T.N.B. Q.Q.B. 636 B. A.M.S. 4612 A.M.S. 4611 S.A.E. 73 S.A.E. 76	Suitable for hot and cold rolling. casting. Has better anti-corrosive properties than the usual 60/40 alloy.
Leaded Brass 70/30	B S. 1400 : 1961 SCB2	Cu. 66-73% Pb 2-5% Sn. 1.5% max. Fe. 0.75% max. Ni. 1.0% max. Al. 0.01% max. Total other elements 1.0% max. Zn. remainder.	Tensile strength 11 tons per sq. in. (min.) Elongation 12% (min.)	ASTM. B146-52 (6A) SAE. 41 DIN 1709 GMS 64	Suitable for pressure right castings up to 200 lb./sq. in at normal temperatures. Plumbers' fittings, general hardware ferrules ships', trimmings, etc. Also for battery lugs and other electrical parts.

* Relating to sand castings unless otherwise stated.

BRITISH STANDARD SPECIFICATIONS* FOR THE PRINCIPAL NON-FERROUS CASTING ALLOYS—(Contd.)

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Brass 70/30	B.S.S. 267	Cu. 68-72% Sn. 0.015% max. Pb. 0.07% max. Fe. 0.05% max. Ni. 0.10% max. As 0.01% max. Bi. 0.004% max. Zn. remainder,	Tensile strength 19 tons per sq. in.	B. 134.45.6 B. 36.44T.6 B. 134.45.5 B. 36.44T5 B. 129.44T B. 135.46T.2 B. 19.44T Q.Q.B. 611a.E Q.Q W. 321c A.M.S. 4505A S.A.E. 70A S.A.E. 74c S.A.E. 80A	Alpha brass giving good ductility and high strength. Can be used for deep drawing. An addition of tin is made if corrosive conditions have to be withstood:
Gilding Metal 90/10	B.S. 713	Cu. 89.91% Pb. 0.3% max. Total impurities including Pb= 0.6% max. Zn. remainder.	Annealed condition tensile strength 16 tons per sq. in. Elongation 30% Brinell hardness 75 max.	B. 131-46T B. 43-46 (2) B. 36-46T B. 121-46T (1)	Alpha high purity brass for casting. pressings, tubings etc. Will stand much work hardening.
Gilding Metal 85/15 80/20	B.S. 712 B.S. 711	B.S. 712 Cu. 84.86% Pb. 0.3% max. Total impurities including Pb= 0.6% Zn. remainder. B.S. 711 Cu. 79-81% Pb. 0.3% max. Total impurties including Pb= 0.6% Zn. remainder	Annealed condition. B.S. 712 Tensile strength 16 tons per sq. in. Elongation 35% Brinell 75 max. B.S. 711 Tensile strength 17 tons per sq. in. Elongation 40% Brinell 75 max	B. 36-46T (3) S.A.E. 79 Grade A B. 36-46T (4) S.A.E. 79 Grade B	These two alloys posses many of the characteristics of the 90/10 range. The increased zinc content provide scope for the designer and architect but reduces the the thermal and electrical conductivity. Can be brazed and enamelled.
Gunmetal 83/3/9/5	B.S. 1400 : 1961 LG. 1	Sn. 2-4% Zn: 7-10% Pb. 3-6% Ni. 1% max. Total other elements 1.0% max. Cu. remainder.	Tensile strength 11 tons per sq. in. Elongation 12%	B.S. 1158/9 Rg. 3. B. 30.45T.5A B. 145.45T Q.Q.B. 701. a. 11 Q.Q.B. 701 b. 11 S.T.A. 7-CG6	Used where results superior to brass are needed with respect to corrosion strength at elevated temperatures and bearing properties.
Gunmetal 85/5/5/5	B.S. 1400 · 1961 LG 2	Sn. 4-6% Zn. 4-6% Pb. 4-6% Ni. 2% max. Total other elements 0.5% max. Cu. remainder.	Tensile strength 13 tons per sq. in. Elongation 15%	DIN. 1705 (RGS) W.W.P. 461a2 W.W.P. 448a.2 A.S.T.M.B. 62-46T B. 30-45T B. 145-46T A.M.S. 4855 S.A.E. 40 U.S. Air Corps 11306 G Dea B.S. 897/8 S.T.A. 7. CGS.	One of the best gunmetal casting alloys. Recommended for pressure resisting casting. Possesses superior machining properties.

* Relating to sand castings unless otherwise stated.

BRITISH STANDARD SPECIFICATIONS* FOR THE PRINCIPAL NON-FERROUS CASTING ALLOYS—(Contd.)

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Gunmetal 86/7/5/2	B. S. 1400 : 1961 LG. 3	Sn. 6-8% Zn. 3-5% Pb. 1-3% Ni. 2% max. Total other elements 0.5% max. Cu. remainder.	Tensile strength 14 tons per sq. in. Elongation 12%	B. 30.45T.2A B. 61.44 B. 143.44T.2A S.A E. 622 Q.Q.B. 701a. 1 Q.Q.B 691b. 1 DIN. 1705 (RG7) S.T.A. 7-CG4 B.S. 1023/4	Possesses high bearing anti-corrosion properties but not suited for streses such as for unbacked bearings and steam equipment.
Gunmetal Admirality 88/10/2	B. S. 1400 : 1961 G1	Sn. 9.5-10.5% Zn. 1.5-2.5% Pb. 1 5% max. Ni. 1% max. Other elements 0.2% max Cu. remainder.	Tensile strength 17 tons per sq. in Elongation 15%	B.S. 382/3 A.M.S. 4845 S.A.E. 62 B. 30.45.T.1A B. 143 44T-1A S.T.A. 7-CG2.	Standard alloy for marine castings and for resisting pressures yp to 4000 lbs. per sq. in.
Leaded Bronze 76/9/0/15	B. S. 1400 : 1961 LB1	Sn. 8 10% Zn. 1% max. Pb. 13-17% Ni. 2% max. Other elements 0.5% max. Cu. remainder.	Tensile strength 11 tons per sq. in min. Elongation 4% min.	B. 30.45T.3D B. 66.44 11B B. 144.45T-3D B. S. 954/5 Din. 1716 (Pb. Sn. Bz. 13)	Bearing alloy.
Leaded Bronze 80/10/0/10	B. S. 1400 : 1961 LB2	Sn. 9-11% Pb 8.5-11 0% Zn. 0.75% max. Ni. 2.0% max. P. O. 10% max. Cu. remainder Total other elements 0.5% max.	Tensile strength 12.0 tons per sq. in (min.) Elongation 5% (min.)	B.S.962/3 S.A.E. 64 S A.E. 792 A.M.S. 4827B-4842A. ASTM. B144-52-(3A) Castings. DIN. 1716 (G. Sn Pb Bz. 10)	General purpose bearing alloy. Suitable for unlined heavy duty bearings for high shaft speeds.
Leaded Phosphor Bronze 87/7/2/4	B. S. 1400 : 1961 LPB1	Sn. 6-5-8.5% P. 0.3% min. Pb. 2-5% Zn. .2.0% Ni. 1.0 max. Other elements 0.5% max. Cu. remainder.	Tensile strength 12 tons per sq. in min. Elongation 3% min.	B.S. 1061/1 S T.A. 7-CP3	Suitable for the production of high grade castings and chill cast solid and cored sticks. Bearing bushes where lubrication is not perfect.
Manganese Bronze or High Tensile Brass.	B. S. 1400 HTB1	Cu. 55% min Mn. 3.0% max. Al.2.5% max. Fe. 0.5.2.0% Sn. 1.5% max. Ni. 1.0% max. Pb. 0.5% max. Si. 0.1% max Zn. remainder	Tensile strength 30 tons per sq. in. Elongation 20%	A.M.S. 4860 B.S. 207/8 S.T.A.7-CM6 A.S T.M. B147-48 (8a) B147-46T (7a&8a) B132-46T (a). S.A.E. 43	An alloy with good compromise between strength and ductility.

* Relating to sand castings unless otherwise stated.

BRITISH STANDARD SPECIFICATIONS* FOR THE PRINICIPAL NON-FERROUS CASTING ALLOYS.

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Manganese Bronze or High Tensile Brass.	B. S. 1400 HTB2	Cu. 55% min. Mn. 3.0% max. Al.5.0% max. Fe. 0.5-2.5% Ni 2.0% max. Pb. 0.5% max. Sn. 0.5% max. Si. 0.1% max. Zn. remainder.	Tensile strength 38 tons per sq. in. Elongation 15%	B.S. 207/8 S.T.A. 7-CM7A SeMs 58F60	An alloy with high strength.
Manganese Bronze or High Tensile Brass.	B. S. 1400 HTB3	Cu. 55% min. Mn. 4.0% max. Al. 3.0-6.0% Fe. 1.0.2.5% Ni. 1.0%max. Sn. 0.2%max. Pb. 0.2%max. Si. 0.1% max. Zn. remainder.	Tensile strength 48 tons per sq. in. Elongation 12%	B.S. 207/8 S.T.A. 7-CM7	Extra heavy duty high strength alloy.
Phosphor Bronze 90/10	B. S. 1400: 1961 PB1	Sn. 10.0% min. Zn. 0.05% max. P. 0.5% min. Pb. 0.25% max. Total other elements including Pb = 0.3% max. Cu. remainder	Tensile strength 14 tons per sq. in. min. Elongation 3% min.	2B8 G.B.Z. 10 S.A.E. 65 B. 103-44D B. 139.46T.D. B. 159.46T.D. B.S. 1058/59 S.T.A. 7-CP5	For high quality and finish solid and cored chill cast sticks. Casting to withstand heavy loading such as gear blanks, worms, side valves, etc.
Phosphor Bronze 88/12	B. S. 1400 : 1961 PB2	Sn. 11-13% P. O. 15% min. Pb. 0.5% max. Ni. 0.5% max. Zn. 0.3% max. Total other elements 0.2% max. Cu. remainder	Tensile strength 14 tons per sq. in. min. Elongation 5% min.	S.A.E. 65 B.S. 421 S.T.A. 7-CP6	Alloy suitable for centrifugal cast gear blanks, worms and slide valves working under loads.
Silicon Bronze	B. S. 1400-SB1	Si. 1.5-5.0% Zn. 5.0% max. Fe. 2.5% max. Mn. 1.5% max. Total other elements 0.5% max. Cu. remainder.	Tensile strength 20 tons per sq. in. Elongation 15%	D.T.D. 355 B. 96.42c P. 98 45c B. 97.44c B. 99.45c B. S. 1029/30 B. S. 1029/30 S.T.A. 7-CS1	Alloy for withstanding corrosion of mineral, vegetable and organic acids, dyes and fruit juices. Also for strength and certain bearings.

* Relating to sand castings unless otherwise stated.

TABLE 1 CHEMICAL COMPOSITION OF COPPER — IS 191 — 1967.

	GRADE OR SUB-GRADE									
	CATH	ETP	FRHC	FRTP-1	FRTP-2	ATP	DHP-1	DHP-2	DPA	OF
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Copper (any silver present to be counted as copper) percent, *Min*	99.90	99.90	99.90	99.80	99.50	99.20	99.80	99.5	99.20	99.95
Antimony, percent, *Max*	—	—	—	0.01	0.05	0.01	0.005	0.005	0.01	—
Arsenic, percent, *Max*	—	—	—	0.01	0.10	0.20 to 0.50	0.05	0.05	0.20 to 0.50	—
Bismuth, percent, *Max*	0.001	0.001	0.002 5	0.01	0.02	0.005	0.003	0.003	0.003	0.001
Iron, percent, *Max*	—	—	—	0.01	0.03	0.02	0.03	0.03	0.03	—
Lead, percent, *Max*	0.005	0.005	0.005	0.010	0.10	0.02	0.01	0.01	0.010	0.005
Nickel, percent, *Max*	—	—	—	*	*	0.15	0.15	0.15	0.15	—
Selenium and tellurium percent, *Max*	—	—	—	0.05	0.07	0.03	0.02	0.02	0.02	—
Tellurium, percent, *Max*	—	—	—	—	—	—	0.01	0.01	0.01	—
Tin, percent, *Max*	—	—	—	0.010	0.05	0.03	0.01	0.01	0.01	—
Phosphorus	—	—	—	—	—	—	0.02 to 0.10	0.02 to 0.06	0.02 to 0.10	—
Oxygen, percent, *Max*	—	—	—	0.10	0.15	0.10	—	—	—	—
Total of all impurities excluding silver, nickel, arsenic and phosphorus, percent, *Max*	—	—	—	—	—	—	0.06	0.06	0.07	—
Total of metallic impurities excluding silver, percent, *Max*	0.03	—	—	—	—	—	—	—	—	—
Total of all impurities excluding oxygen and silver, percent, *Max*	—	0 03	0.04	—	—	—	—	—	—	—
Total of all impurities excluding silver, percent, *Max*	—	—	—	—	—	—	—	—	—	0.03

*In the case of copper conforming to grades FRTP-1 and FRTP-2 produced in India, any incidental nickel up to a maximum of 0.7 percent shall be counted as copper.

SUMMARY OF SPECIFICATIONS FOR BRASS BARS, RODS AND SECTIONS

Material Designation	SPECIFICATION		COMPOSITION								PROPERTIES	
	Original	Near equivalent	Cu. %	Zn.	Pb.	Sn.	Fe.	Min.	Al	Other elements	U.T.S Min kgs/mm	Elongation Min. %
1. Free Cutting Brass	BS 2874 CZ 124	—	60 to 63	Remainder	2.5 to 3.7	—	—	—	—	—	28	12
2. Free Cutting Brass	BS 2874 CZ 121	IS 319	55 to 60	Remainder	2.0 to 3.5	—	—	—	—	—	30	15
3. Leaded Brass	DIN 1756 MS 58	—	56.5-59.5	Remainder	1.0 to 3	—	—	—	—	—	39-50	9-15
4 Forging Brass	IS 3488-66	BS 218/63	56.5 - 60	Remainder	1.0 to 2.5	—	—		—	—	35	25
5. Lead free Brass	BS 2874 CZ 109	BS 1949	59 to 60	Remainder	—	—	—	—	—	—	34	26
6. High Tensile Brass rods.	BS 2874 CZ 114	BS 250	56 to 60	Remainder	—	.2-1	.25-1.2	3-2	1.5 min	—	47	18
7. High Tensile Brass rods.	BS 2874 CZ 115	BS 1001	56 to 60	Remainder	.5 to 1.5	.6-1.1	.25-1.2	.3-2	.2 min	—	55	12
8. High Tensile Brass rods.	IS 320/1962		56 to 59	Remainder	.5	.25-1.75	—	2.20	.2 min	.5 min	53	15
	Alloy I		56 to 59	Remainder	.5	.05 min	—	0.5-1.2	.2-1.2	.25 min	47	20
	Alloy II		57 to 61	Remainder	.75 to 1	1.0 min	—	0.1-0.2	.5-2	.5 min	53	15
	Alloy III											
9. Naval Brass	IS 291/1961 Grade I	BS 2872 CZ 112 BS 251/63	61 to 64	Remainder	—	1 to 1.5	—	—	—	—	35	18
10. Naval Brass	IS 291/1961 Grade II	BS 2874 CZ 113 BS 252/1963	59 to 62	Remainder	.5 to 1	.5 to	—	—	—	—	35	16
11. Aluminium Bronze	BS 2874 CA 103	BS 2032	Remainder	—	—	—			8.8-10%	Iron + 4% max Nickel	53	34
12. Aluminium Bronze	BS 2874 CA 104	BS 2033	Remainder	—	—	—	4-6%	0.5	8.5-11%	Nickel 4-6%	71 min	12 min
13. Aluminium Silicon Bronze	ASTM B-283/56	—	89%	—	—	—	—	—	6.5-8	Sili 1.5-3%	67 min	25 min
14. Maganese Bronze	ASTM B-138/58 Alloy A		57 - 60	Remainder	—	0.5-1.5	.8-2	.05-.5	0.25 max		53	25
	Alloy B		63 - 68	Remainder	—	0.5 max	2-4	2.5-.5	3-6		80	10
15. Copper Nickel Alloy	ASTM B-411 64	—	Remainder	0.5% max.	1% max		0.1%	—	—	Ni. 1.6-2.2 Sil. 0.4-0.8	63	8
16. Nickel Silver Alloy	BS 2874 NS 101	—	44 - 47	Remainder	1-2.5	—	0.40% max.	.20-.50	—	Ni. 9.0-11.0	47	8 min
17. Electrolytic Tough Pitch Copper	BS 2874 C 101	—	99.9% min	—	0.005%	—	—	—	—	Impurities 0.03%	23-35	5.5-6%

SUMMARY OF SPECIFICATIONS FOR BRASS BARS, RODS AND SECTIONS

	SPECIFICATION		COMPOSITION								PROPERTIES	
Material Designation	Original	Near equivalent	Cu. %	Zn.	Pb.	Sn.	Fe.	Min.	Al	Other elements	U.T.S Min Kgs/mm	Elongation Min. %
18. Leaded Copper	—	—	Remainder	—	.6-1.0	—	—	—	—	Impurities 0.2%	23-35	45-10
19. Tellurium Copper	BS 2874 C 109	—	Remainder	—	—	—	—	—	—	Telli. 3-7% Impu. .2% max	23-35	45-10
20. Phosphorus deoxidised non-arsenical copper.	BS 2874 C 106	—	99.85% min.	—	—	—	—	—	—	Phos. 013-.050 Ni. .01% max Arse. .05% max Impu. .06% max	23-35	45-8
21. Phosphorus deoxidised arsenic copper	BS 2874 C 107	—	99.2% min. (including silver)	—	—	—	—	—	—	Phos. .013-.055 Arse. .3-.5 Ni. .15% max Impu. .07% max.	23-35	45-8
22. Cadmium copper	BS 2874 C 108.	—	Remainder	—	—	—	—	—	—	Cad. .5-1.5% Impu. .05%	26-63	45-2

SUMMARY OF SPECIFICATIONS FOR BRASS AND COPPER TUBES

	SPECIFICATION		COMPOSITION									PROPERTIES	
MATERIAL DESIGNATION	Original	Near equivalent	Cu	As.	Zn.	pb.	Sn	Fe.	Min.	Al.	Other elements.	U.T.S. min. Kgs/mm	Elongation min %
Brass tubes (63/37) for General Purposes.	IS 407-1966 Alloy 2	—	59-63%	.06% max.	Bal.	80% max.	.07% max.	.07% max.	—	—	Impu. 30% max.	Annealed 29 - 38 Half hard 38 Hard 46	—
High Conductivity Electrolytic Copper	BS 2871-1969 C 101	BS 1977/63	99.9% min	—	—	.005%	—	—	—	—	0.03%	23 - 35	55-6%
Copper rods & tubes for General engineering purposes.	BS 2871 C 106	ASTM B-280 1958	99.85% min	.05%	—	—	—	—	—	—	Phos. .013-.050% Nickel .01% Imp. .06%	23 - 35	45.8%
Copper rods & tubes for General engineering purposes.	BS 2871 C 107	BS24 Part 5	99.2% min	.3-.5%	—	—	—	—	—	—	Phos. .013-.050% Nickel .15% Imp. .07%	23 - 35	45-8%
Seamless tubes for Gas installation	—do—	—	99.2 or 99.85	.3-.5 or nil.	—	.15%	—	—	—	—	.070	17 min	
Seamless tubes for Steam Services	—do—	BS 1306	99.2 or 99.85	.3-.5 or nil.	—	.15%	—	—	—	—	.070	14.5	—

SUMMARY OF SPECIFICATIONS FOR COPPER TUBES.

Material Description	SPECIFICATIONS					Scope of Specifications	COMPOSITION LIMITS (as per B.S. Specification)							Ultimate Tensiles stress tons per sq. inch	Use
	BSS	ISS	IRS	ASTM	DIN		Copper	Arsenic	Lead	Nickel	Iron	Tin	Other elements		
							%	%							
Seamless Tubes for General purposes.	BS 2017	..	..	B-280 1958	..	Drawn seamless Tubes as drawn annealed condition.	*99.2 or 99.85	0.3 to 0.5 or nil	0.15	...	..	..	0.070	(14.5 min.)	Refrigeration purposes.
High conducting seamless tubes.	BS 1977	..	..	B-135	..	Solid drawn tubes as drawn or annealed condition.	99.90	nil	..	..	..	..	0.030	(13 min.)	Electrical purposes.
Locomotive fire box (Tubes).	BS 24 part 5	..	W 1-49	B 13-4	..	Annealed & hard tubes.	99.2	0.15 to 0.5	..	..	..	..	..	(14.5 min.)	Locomotive (Railways).
Tubes for screwed connection.	BS 61	..	..	..	..	Free Standards for pressure requirements dia. 1/4" to 4" i.d.	*99.23 or *99.85	0 25 to 0.45 or nil	..	..	..	..	..	..	General Engineers.
Seamless Tubes for Gas installation	BS 140	..	..	B-142	..	Tubes in straight random lengths 15/20 feet.	*99.2 or 99.85	0.3 to 0.5 or nil	0.15	..	..	..	0.070	(17 min.)	Gas installation.
Seamless Tubes for Steam Services	BS 1306	..	..	..	..	Tubes not to exceed 405° temp.	*99.2 or 99.85	0.3 to 0.5 or nil	0.15	..	..	..	0.070	(14.5)	Steam Service Navigation.
Light gauge Tubes (De-oxidised).	BS 659	..	..	B-188 1958	..	One standard for diameters 1/8" to 1" i d.	*99.2 or 99.85	0.3 to 0.5 or nil	..	..	..	..	..	16.5	..

SUMMARY OF SPECIFICATIONS FOR BRASS TUBES.

Material Description	SPECIFICATIONS					Scope of Specifications	COMPOSITION LIMITS (as per B.S. Specification)								Ultimate Tensile stress tons per sq. inch	Use
	BSS	ISS	IRS	ASTM	DIN		Copper	Zinc	Lead	Tin	Iron	Manganese	Aluminium	Other elements		
Tubes for Condensor, Evaporator	BS 2579	..	..	..	..	Seamless Solid drawn Tubes, Comp 70/30 Brass.	70	Remainder	..	..	..	..	..	.3 max.	..	Sugar Industry Evaporat
Cooler Tubes	BS 2579	..	..	B111	1785	Comp 70/29/1 Brass	70	29	..	1	..	..	..	.30 max.	..	Coolers
Brass Tubes for General purpose	BS 885	IS497 of 1953	..	B111	1785	Hard Tubes Annealed	70	Remainder	..	1.5 max.	..	..	..	.4 max.	25 min. to 35 max.	
Condensor and Ferrule Tube.	BS 378	IS1545 of 1960		B111	1785	Seamless drawn Tubes.	70	Remainder	..	..	..	..	..	.4 max.	..	Condensor.
Annealed Brass Tubes for Gas installation.	BS 1402	..	..	B111	1785	Solid drawn annealed Tubes in straight random lengths 15/20 ft.	70	Remainder	..	..	..	..	..	.4 max.	18 min. to 24 max.	

MECHANICAL

Description	Specification	M.P. °C	Elec. Condty. % I. A. C. S.	Elect. Resistivity Micor-ohm.	Thermal Conductivity Cal/Sq.cm. °C	Condition
COPPER :						
High Conductivity Copper	IS : 613 BS : 1036	1083	100	1.724	0.9	Annealed Half Hard Hard
Arsenical Copper	IS : 288 BS : 24 (Part V)	1083	...	...	0.5 to 0.6	Annealed Half Hard
Cadmium Copper	BS : 23	1080	90 to 100	1.820	0.9	Half Hard Hard
Tellurium Copper	C : 109 BS : 2874	1081	95 to 100	1.820	0.9	Soft Hard
HIGH TENSILE BRASS & BRONZE :						
Manganese Bronze	...					Hard
High Tensile Brass	...					Hard
High Tensile Brass	IS : 320 Gr. A BS : 250 BS : CZ-114					Hard
Aluminium Bronze (Al. — 10%)	SAE : 7016 ASTM No. BI50-1 B-124 Alloy 11					Hard

Yield Strength Kg/Sq. mm.	Ultimate Tensile Strength Kg/Sq. mm.	Elongation % in 50 mm. Gauge length:	Hardness on V.P.N.	Shear Strength Kg/Sq. mm.	Remarks
...	20 to 23	45-55	50-70	14-15	Used for general electrical and other purposes where high conductivity is essential.
...	23 to 27	30-40	70-80	17-18	
...	27 to 32	6-15	80-95	27-28	
...	22-23	40-50	50-60	15-16	Used in locomotive industries and for general engineering purposes where superior resistance to scaling and corrosion is essential.
...	26-31	30-40	80-90	27-28	
...	23.5 to 27	8 to 15	100 to 120	16-17	Used for over-head trolly wire and general purposes, where toughness is required along with good electrical conductivity.
...	27-44	3 to 7	120 to 140	28-32	
...	22-23	45-50	50-60	15-16	Can be machined at maximum machining speeds. The electrical conductivity is over 95%.
...	28.5 to 31.5	10-15	100-110	27-28	
20-25	47-52	20-25	160-170	40-42	Good corrosion resistance combined with high strength used, for general engineering purpose and marine applications.
24-26	48-59	20-25	170-180	42-43	Used for superior mechanical properties and corrosion resistance for valve, stem and gears, lever-arms. etc.
30-35	55-65	15-20	175-190	44-45	Good mechanical properties and corrosion resistance and toughness. used in general engineering purposes.
40-50	82-95	10-15	200-220	60-65	High corrosion resistance, good wear resistance, low co-efficient of friction. Used for high pressure steam application and architectural and special engineering applications.

MECHANICAL

Description	Specification	Condition	Yield Strength Kg/Sq. mm.	Ultimate Tensile Strength Kg/Sq. mm.
BRASS :				
Red Brass (85 : 15)	BSS. 712 ASTM. No. B 134 No. 3	Soft.	...	26/28
Cartridge Brass (70 : 30)	IS : 407 BS : 267 ASTM. No. B 134 No. 6	Soft Half Hard Spring Hard	... 30-35 40-45	31.5 to 38 38-46 85-90
Screw Wire Brass (65 : 35)	BS : 266 ASTM. No. B36 No. 8	Half Hard Hard	... ...	40-47 47-52
Muntz Metal (60 : 40)	BS : 264 ASTM. No. B 111	Soft Half Hard	15-16 26-28	31-40 40-50
Hot Stamping Brass	BS : 218	Quarter Hard Half Hard	... ...	31.5-40 40-50
Free Cutting Brass	ASTM. No. B16	Quarter Hard Half Hard	32-33 40-42	37.44-6 44.6-52
Free Cutting Brass	IS : 319 B.S : 249	... ...	... ...	 39-40
Special High Tensile Brass	SOMS-DIN 17661	Hard	60-80	85-100
Naval Brass	IS : 291 GR. A BS : 251	Quarter Hard	20-22	35-45

BRAZING AND

Description	Condition	Ultimate Tensile Strength Kg/Sq. mm.
Silver Solder	Cold Rolled	30-35
Easy Flow Welding Brass	Cold Rolled ...	... ...
Welding Brass	Cold Rolled Strip	...

Elongation % in 50 mm. gauge length	Hardness on V.P.N.	Sheer Strength Kg/Sq. mm	Remarks:
45-55	50-60	20-21	Suitable for fastner, tags, etc. and other architectural components.
55-65 20-35 2-5	50-55 100-130 190-210	25-27 28-30 42-44	Good cold-working brass used in automobile industries, hardware and ammunition components.
20-30 8-12	120-150 150-160	26-28 30-32	Used for architectural grill work, screw, rivetes, stencils, etc.
40-50 10-25	80-85 125-135	25-26 30-32	Used for large nuts and bolts, Hot forging, etc.
30-40 20-30	90-110 130-160	24-25 27-28	Good hot-stamping and machining property.
22-35 10-20	100-120 120-150	... ...	American type of free machining brass has greater impact strength than the British type. Most suitable for extra high speed machinery for automatic machines and general engineering purposes.
15-20	80-150	...	Very high speed for machining and Free cutting quality.
10-20	235-275	...	High hardness and antifriction properties used in automobile industries.
20-30	100-110	...	Better corrosion resistance than muntz metal used in marine engineering.

WELDING RODS

Melting Point °C.	Flow Point °C.	Remarks:
680	725	High class soldering alloy with good conductivity suitable for cable industries.
625	635	High class silver brazing alloy.
880	890	High class welding (filler) alloy used in general oxy-acetyline, welding process.
870	880	Good filler alloy for general welding process.

CORE SECTOR

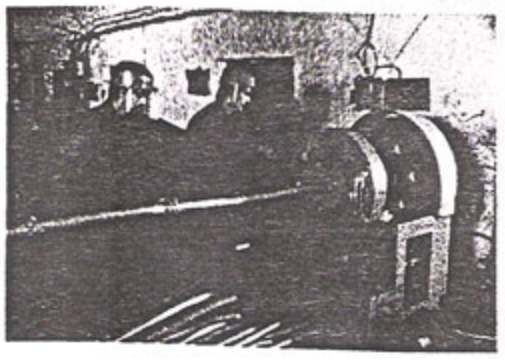
- Chemicals and Fertilizers
- Petrochemicals and Oil Refineries
- Electronics and Telecommunication
- Ship Building and Automotive Transport.
- Power Generation and Energy Distribution
- Machine Building and General Engineering
- Atomic Energy, Space Research and Defence

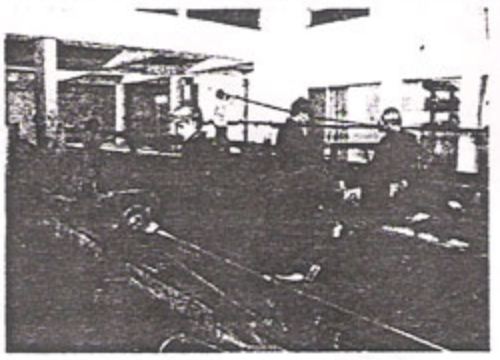
CONSUMER SECTOR

- Air Conditioners and Refrigerators
- Water Coolers and Deep Freezers
- Food Processing and Cold Storage
- Furniture Processing and Cold Storage
- Electrical and Building Hardware
- Domestic Gadgets and Home Appliances
- Writing Instruments and Office Accessories

FORMULAE FOR CALCULATION OF WEIGHT OF TUBES

Product Composition	Kilograms per foot OD & WT in INCHES	Kilograms per meter Length OD & WT in MM
COPPER	(OD - WT) X WT X 5.526	(OD - WT) X WT X 0.0281
CUPRO NICKEL	(OD - WT) X WT X 5.526	(OD - WT) X WT X 0.0281
70/30 BRASS	(OD - WT) X WT X 5.5269	(OD - WT) X WT X 0.0268
ADMIRALTY BRASS	(OD - WT) X WT X 5.269	(OD - WT) X WT X 0.0268
ALUMINIUM BRASS	(OD - WT) X WT X 5.149	(OD - WT) X WT X 0.0262





Every draw reduces diameter & wall thickness of the tube. We use Tungston Carbide dies and plugs, ground & polished to maximum precision in our own tool room. This accounts for the well known Jugal Tubes Pvt. Ltd. quality based on accuracy of size & surface quality.

The tubes hardened by cold working are made tempered in a annealing furnace. The continuous Roller hearth. Annealing furnace is a 225 kw. with 3 heating zones, a 18.3 m. long cooling chamber and loading and unloading table. The annealed tubes are subsequently pickled.

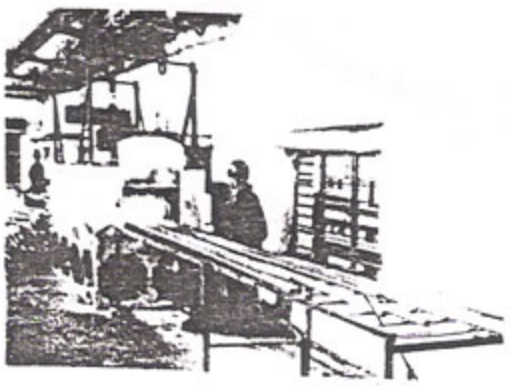
The Jugal, with a 3 Ton pulling Power and a drawing capacity from 6 mm to 15 mm is a

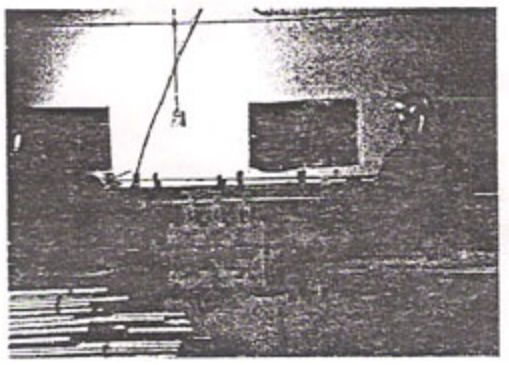
Combined pre-straightening, drawing, straighten-ing, cut-off, and polishing unit is fully automatic, and has all the necessary electrical controls.

With a pull of 15 Tons, the Double Push Bench by JUGAL TUBE, MUMBAI, has 6 speeds, draws two bars/tubes at a time and has a capacity from 15mm to 32mm. It is one of the most modern drawing machine in existence.

In addition we have a number of other draw-benches by reputed manufactures with capacities ranging from 2½ tons to 50 tons pulling power and lengths varying from 7.6 m. To 18.3 m.

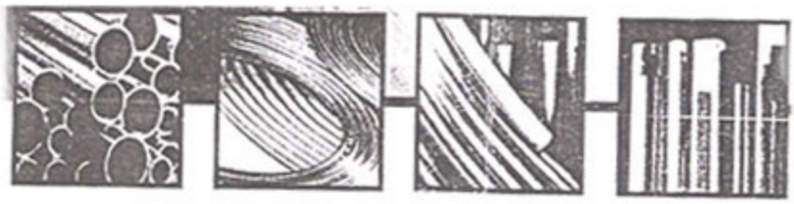
DRAWING





SPECIFICATIONS FOR COPPER TUBES

Material Descriptions	Specifications ISS	BSS	Copper %	Arsenic %	Phos-Phorous %	Lead %	Iron %	Nickel %	Other Ele-ments	Tensile Strength Kg/mm²		Elongation $\sqrt[4]{A}$		Electrical Conductivity ar20°C	Hardness
Phosphorurs De-Oxidised Non Arsenical Copper	2501: DHP I DHP II	2871: C106	99.85 Min.	—	0.013 to 0.05	0.01	0.03	—	0.06	Anne. Drawn	22 28	Anne. Drawn H.H.	40% —		60 Max. 105 Min. 80-100
Phosphorurs De-Oxidised Arsenical Copper	2501: DPA	2871: C107	99.20 Min.	0.3 to 0.5	0.013 to 0.05	0.01	0.03	—	0.07	Anne. Drawn	22 28	Anne. Drawn	40%		
High Conductivity Copper Tubes	2501: ETP	1977 (2871: C 101)	99.9 Min.	—	—	0.005	—	—	0.03	Anne. Drawn.	20.5 to 25.2 26.8 Min.	Ann. Drawn.	40% —	99.25 IACS	
Cupro Nickel Tubes	1545 CuNi10Fe1	BS 2871 Part 2 CN-102	Remdr.	Managa-nese 0.5-1.1		0.01	1-2	10-11	0.3	Anne Drawn	30.5-38.5 44 Min.	30 —			80-110 HV 150 Min.
Cupro Nickel Tubes	CuNi30	CN-107	Remdr.	0.5-1.5		0.01	0.4/1	30/32	0.3	Anne Drawn	37-46 51 Min	30 —			90 120 HV 150 Min.



CHEMICAL COMPOSITION AS PER DOMESTIC & FOREIGN STANDARDS

(A) DHP Grade Copper : Copper UNS No. For DHP Grade is: C 12200

	ASTM B 68	ASTM B 75	ASTM B 280	IS 191: 1980
Copper (Min) %	99.90	99.90	99.90	99.80
Phosphorous %	0.015 – 0.040	0.015 – 0.040	0.015 – 0.040	0.015 – 0.10

(B) DLP Grade Copper: Copper UNS No. For DLP Grade is: C 12000

	ASTM B 68	ASTM B 75	ASTM B 280	IS 191: 1980
Copper (Min) %	99.90	99.90	99.90	---
Phosphorous %	0.004 – 0.012	0.004 – 0.012	0.004 – 0.012	---

(C) DPA Grade Copper : Copper UNS No. For DPA Grade is: C 14200

	ASTM B 68	ASTM B 75	ASTM B 280	IS 191: 1980
Copper (Min) %	--	99.40	--	99.20
Phosphorous %	--	0.015 – 0.040	--	0.015 – 0.10
Arsenic %	--	0.15 – 0.50	--	0.20 – 0.50

(D) ETP GRADE COPPER

	IS 191: 1980
Copper (Min) %	99.90
Bismuth (Max)%	0.001
Lead (Max) %	0.005
Total Imp. %	0.03

SIZES & RANGE

- Copper Pipes & Tubes sizes: 4.76 mm O.D. upto 75 mm O.D.
- Copper Coils sizes: 4.76 mm o.d. upto 22.22 mm O.D.
- Copper Flats sizes: 19 mm width upto 100 mm width.
- Copper Rods (square & round bar) sizes: 9 mm upto 75 mm.
- Copper Finned Tubes sizes: 6 mm O.D. upto 20 mm O.D.