

MATERIAL SPECIFICATIONS

Nominal Designation	Material		Chemical Composition %										Tensile Requirements			
	ASTM	JIS	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Other Requirements	Tensile Strength min. ksi	Yield Strength min. ksi	Elongation in 2in., min. %	Reduction of Area, min. %
Carbon Steel	A216-WCB		0.30max	0.60max	1.00max	0.04max	0.045max	0.50max	0.40max	0.25max	0.50max	V 0.03max Cu+Ni+Cr+Mo+V 1.00max	70-95	36	22	35
	SCPH2		0.30max	0.60max	1.00max	0.040max	0.040max	0.50max	0.25max	0.25max	0.50max	Cu+Ni+Cr+Mo 1.00max	70	35.5	19	35
	A352-LCB		0.30max	0.60max	1.00max	0.04max	0.045max						65-90	35	24	35
	SCPL1		0.30max	0.60max	1.00max	0.040max	0.040max	0.50max	0.25max		0.50max	Cu+Ni+Cr 1.00max	65	35.5	21	35
	A105		0.35max	0.35max	0.60-1.05	0.040max	0.050max						70	36	22	30
$C-\frac{1}{2}Mo$	S25C		0.22-0.28	0.15-0.35	0.30-0.60	0.030max	0.035max	0.20max	0.20max		0.30max	Ni+Cr 0.35max	64	38	27	
	A350-LF1		0.30max	0.15-0.30	0.75-1.05	0.035max	0.040max						60-85	30	25	38
	A350-LF2		0.30max	0.15-0.30	1.35max	0.035max	0.040max						70-95	36	22	30
	A217-WC1		0.25max	0.60max	0.50-0.80	0.04max	0.045max	0.50max	0.35max	0.45-0.65	0.50max	W 0.10max Cu+Ni+Cr+W 1.00max	65-90	35	24	35
	SCPH11		0.25max	0.60max	0.50-0.80	0.040max	0.040max	0.50max	0.35max	0.45-0.65	0.50max	W 0.10max Cu+Ni+Cr+W 1.00max	65	35.5	22	35
$2\frac{1}{2}Ni$	SCPL11		0.25max	0.60max	0.50-0.80	0.040max	0.040max			0.45-0.65	0.50max		65	35	24	35
	A182-F1		0.28max	0.15-0.35	0.60-0.90	0.045max	0.045max			0.44-0.65			70	40	20	30
	A352-LC2		0.25max	0.60max	0.50-0.80	0.04max	0.045max	2.00-3.00					70-95	40	24	35
	SCPL21		0.25max	0.60max	0.50-0.80	0.040max	0.040max	2.00-3.00	0.35max		0.50max		70	40	21	35
	A352-LC3		0.15max	0.60max	0.50-0.80	0.04max	0.045max	3.00-4.00					70-95	40	24	35
$3\frac{1}{2}Ni$	SCPL31		0.15max	0.60max	0.50-0.80	0.040max	0.040max	3.00-4.00	0.35max		0.50max		70	40	21	35
	A350-LF3		0.20max	0.20-0.35	0.90max	0.035max	0.040max	3.25-3.75					70-95	37.5	22	35
	A182-F12		0.10-0.20	0.10-0.60	0.30-0.80	0.040max	0.040max		0.80-1.25	0.44-0.65			70	40	20	30
	A217-WC6		0.20max	0.60max	0.50-0.80	0.04max	0.045max	0.50max	1.00-1.50	0.45-0.65	0.50max	W 0.10max Cu+Ni+W 1.00max	70-95	40	20	35
	SCPH21		0.20max	0.60max	0.50-0.80	0.040max	0.040max	0.50max	1.00-1.50	0.45-0.65	0.50max	W 0.10max Cu+Ni+W 1.00max	70	40	17	35
$1\frac{1}{4}Cr-\frac{1}{2}Mo$	A182-F11		0.10-0.20	0.50-1.00	0.30-0.80	0.040max	0.040max		1.00-1.50	0.44-0.65			70	40	20	30
	A217-WC9		0.18max	0.60max	0.40-0.70	0.04max	0.045max	0.50max	2.00-2.75	0.90-1.20	0.50max	W 0.10max Cu+Ni+W 1.00max	70-95	40	20	35
	SCPH32		0.20max	0.60max	0.50-0.80	0.040max	0.040max	0.50max	2.00-2.75	0.90-1.20	0.50max	W 0.10max Cu+Ni+W 1.00max	70	40	17	35
	A182-F22		0.15max	0.50max	0.30-0.60	0.040max	0.040max		2.00-2.50	0.87-1.13			75	45	20	30
	A217-C5		0.20max	0.75max	0.40-0.70	0.04max	0.045max	0.50max	4.00-6.50	0.45-0.65	0.50max	W 0.10max Cu+Ni+W 1.00max	90-115	60	18	35
$5Cr-\frac{1}{2}Mo$	SCPH61		0.20max	0.75max	0.50-0.80	0.040max	0.040max	0.50max	4.00-6.50	0.45-0.65	0.50max	W 0.10max Cu+Ni+W 1.00max	90	60	17	35
	A182-F5 a		0.25max	0.50max	0.60max	0.040max	0.030max	0.50max	4.0-6.0	0.44-0.65			90	65	22	50

Notes: C; Carbon, Si; Silicon, Mn; Manganese, P; Phosphorus, S; Sulfur, Ni; Nickel, Cr; Chromium, Mo; Molybdenum, Cu; Copper, V; Vanadium, W; Tungsten

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Continued

Nominal Designation	Material		Chemical Composition %										Tensile Requirements				
	ASTM	JIS	C	Si	Mn	P	S	Ni	Cr	Mo	Other Requirements	Tensile Strength min. ksi	Yield Strength min. ksi	Elongation in 2in., min.%	Reduction of Area, min. %		
18Cr (12Cr)	A217—CA15		0.15max	1.50max	1.00max	0.040max	0.040max	1.00max	11.5—14.0	0.50max		90—115	65	18	30		
		SCS 1	0.15max	1.50max	1.00max	0.040max	0.040max	1.00max	11.50—14.00	0.05max		78	50	20	40		
	A182—F 6 a		0.15max	1.00max	1.00max	0.040max	0.030max	0.50max	11.5—13.5			85 (Class 2)	55 (Class 2)	18 (Class 2)	35 (Class 2)		
	A479—403		0.15max	0.50max	1.00max	0.040max	0.030max		11.50—13.00			70 (Condition 1)	40 (Condition 1)	20 (Condition 1)	45 (Condition 1)		
		SUS403	0.15max	0.50max	1.00max	0.040max	0.030max	0.60max	11.50—13.00			85	57	25	55		
18Cr—8 Ni		SUS410	0.15max	1.00max	1.00max	0.040max	0.030max	0.60max	11.50—13.50			78	50	25	55		
		SUS420J 1	0.16—0.25	1.00max	1.00max	0.040max	0.030max	0.60max	12.00—14.00			92	64	20	50		
		SUS420J 2	0.26—0.40	1.00max	1.00max	0.040max	0.030max	0.60max	12.00—14.00			106.5	78	12	40		
	A351—CF 8		0.08max	2.00max	1.50max	0.040max	0.040max	8.0—11.0	13.0—21.0			70	30	35			
		SCS13	0.08max	2.00max	2.00max	0.040max	0.040max	8.0—11.0	18.00—21.00			64	27	30			
18Cr—8 Ni low carbon	A182—F304		0.08max	1.00max	2.00max	0.040max	0.030max	8.0—11.0	18.00—20.00			75	30	30	50		
		SUSF304	0.08max	1.00max	2.00max	0.040max	0.030max	8.0—11.0	18.00—20.00		N 0.10max	75 (Annealed)	30 (Annealed)	45	50		
	A479—304		0.08max	1.00max	2.00max	0.045max	0.030max	8.0—10.50	18.00—20.00			75 (Annealed)	30 (Annealed)	40 (Annealed)	60		
		SUS304	0.08max	1.00max	2.00max	0.040max	0.030max	8.0—10.50	18.00—20.00			70	30	35			
	A351—CF 3		0.03max	2.00max	1.50max	0.040max	0.040max	8.0—12.0	17.0—21.0			57	27	35			
18Cr—8 Ni low carbon		SCS19	0.03max	2.00max	2.00max	0.040max	0.040max	8.00—12.00	17.00—21.00			70	25	30	50		
	A182—F304L		0.035max	1.00max	2.00max	0.040max	0.030max	8.00—13.00	18.00—20.00			65	26	30	50		
		SUSF304L	0.030max	1.00max	2.00max	0.040max	0.030max	9.00—13.00	18.00—20.00			70	26	30	50		
	A479—304L		0.030max	1.00max	2.00max	0.045max	0.030max	8.00—12.00	18.00—20.00		N 0.10max	70	25	30	40		
		SUS304L	0.030max	1.00max	2.00max	0.040max	0.030max	9.00—13.00	18.00—20.00			70	26	40	60		
16Cr—12Ni—2 Mo (18Cr—8 Ni—Mo)	A182—F316		0.08max	1.00max	2.00max	0.040max	0.030max	10.00—14.00	16.00—18.00	2.00—3.00		75	30	30	50		
		SUSF316	0.08max	1.00max	2.00max	0.040max	0.030max	10.00—14.00	16.00—18.00	2.00—3.00		75 (Annealed)	30 (Annealed)	45	50		
	A479—316		0.08max	1.00max	2.00max	0.045max	0.030max	10.00—14.00	16.00—18.00	2.00—3.00	N 0.10max	75 (Annealed)	30 (Annealed)	40 (Annealed)	60		
		SUS316	0.08max	1.00max	2.00max	0.040max	0.030max	10.00—14.00	16.00—18.00	2.00—3.00		75	30	40	60		
	A182—F316L		0.035max	1.00max	2.00max	0.040max	0.030max	10.00—15.00	16.00—18.00	2.00—3.00		70	25	30	50		
18Cr—9 Ni—2 Mo low carbon		SUSF316L	0.030max	1.00max	2.00max	0.040max	0.030max	12.00—15.00	16.00—18.00	2.00—3.00		65	26	30	50		
	A479—316L		0.030max	1.00max	2.00max	0.045max	0.030max	10.00—14.00	16.00—18.00	2.00—3.00		70	25	30	40		
		SUS316L	0.030max	1.00max	2.00max	0.040max	0.030max	12.00—15.00	16.00—18.00	2.00—3.00	N 0.10max	70	26	40	60		
	A351—CF8M		0.08max	1.50max	1.50max	0.040max	0.040max	9.0—12.0	18.0—21.0	2.0—3.0		70	30	30			
		SCS14	0.08max	1.50max	2.00max	0.040max	0.040max	10.00—14.00	17.00—20.00	2.00—3.00		64	27	30			
18Cr—9 Ni—2 Mo low carbon	A351—CF3M		0.03max	1.50max	1.50max	0.040max	0.040max	9.0—13.0	17.0—21.0	2.0—3.0		70	30	30			
		SCS16	0.03max	1.50max	2.00max	0.040max	0.040max	12.00—16.00	17.00—20.00	2.00—3.00		57	36	35			
	A182—F321		0.08max	1.00max	2.00max	0.030max	0.030max	9.00—12.00	17.00min		Ti stimes the C% to 0.60%	75	30	30	50		
		SUSF321	0.08max	1.00max	2.00max	0.040max	0.030max	9.00—13.00	17.00—20.00		Ti stimes the C% min	75	30	45	50		
	A351—CF8C		0.08max	2.00max	1.50max	0.040max	0.040max	9.0—12.0	18.0—21.0		Cb stimes the C% to 1.00%	70	30	30			
18Cr—10Ni—Cb (18Cr—8 Ni—Cb)		SCS21	0.08max	2.00max	2.00max	0.040max	0.040max	9.00—12.00	18.00—21.00		Nb+Ti 10times the C% to 1.35%	64	30	30			
	A182—F347		0.08max	1.00max	2.00max	0.030max	0.030max	9.00—13.00	17.00—20.00		Cb+Ti 10times the C% to 1.00%	75	30	30	50		
		SUSF347	0.08max	1.00max	2.00max	0.040max	0.030max	9.00—13.00	17.00—20.00		Cb+Ti 10times the C% min	75	30	45	50		
	A351—CN7M		0.07max	1.50max	1.50max	0.040max	0.040max	27.5—30.5	19.0—22.0	2.0—3.0	Cu 3.00—4.00	62	25	35			
	B473		0.07max	1.00max	2.00max	0.045max	0.035max	32.0—38.0	19.00—21.00	2.00—3.00	Cb+Ti 3.00—4.00 stimes the C% to 1.00%	80	35	30	50		

Notes: C: Carbon, Si: Silicon, Mn: Manganese, P: Phosphorus, S: Sulfur, Ni: Nickel, Cr: Chromium, Mo: Molybdenum, N: Nitrogen, Ti: Titanium, Ta: Tantalum, Cb: Columbium = Nb, Niobium, Cu: Copper

MATERIAL SPECIFICATIONS

Continued

Nominal Designation	Material		Chemical Composition %										Tensile Requirements			
	ASTM	JIS	C	Si	Mn	P	S	Ni	Cr	Mo	Fe	Other Requirements	Tensile Strength min. ksi	Yield Strength min. ksi	Elongation in Zn, min. %	Reduction of Area, min. %
Cr—Mo for Bolts	A193Gr.B7		0.38—0.48	0.15—0.35	0.75—1.00	0.04max	0.04max		0.80—1.10	0.15—0.25			125	105	16	50
	A320Gr.L7*		0.38—0.48	0.15—0.35	0.75—1.00	0.040max	0.040max		0.80—1.10	0.15—0.25			125	105	16	50
Cr—Mo—V for Bolts	A193Gr.B16		0.36—0.44	0.15—0.35	0.45—0.70	0.04max	0.04max		0.80—1.15	0.50—0.65		V 0.25—0.35	125	105	18	50
	A193Gr.B8		0.08max	1.00max	2.00max	0.045max	0.030max	8.00—10.50	18.00—20.00				75 (Class 1)	30 (Class 1)	30	50 (Class 1)
Carbon Steel for Nuts	A320Gr.B8*		0.08max	1.00max	2.00max	0.045max	0.030max	8.00—10.50	18.00—20.00				75 (Class 1)	30 (Class 1)	35	50 (Class 1)
	A194Gr.2H		0.40min			0.040max	0.050max									
C—Mo for Nuts	A194Gr.4		0.40—0.50	0.15—0.35	0.70—0.90	0.035max	0.040max			0.20—0.30						
	A194Gr.8		0.08max	1.00max	2.00max	0.045max	0.030max	8.00—10.50	18.00—20.00							
Ni—Mo Alloy (Hastelloy B)	A744—N12M		0.12max	1.00max	1.00max	0.040max	0.030max	remain-der	1.00max	26.0—33.0	6.00max	V 0.60max	72	46	6	
	A744—CW12M2		0.12max	1.50max	1.00max	0.040max	0.030max	remain-der	15.50—20.00	16.00—20.00	7.50max	V 0.40max W 5.25max	72	46	4	
Ni—Cu Alloy (Monel)	A744—M35		0.35max	2.00max	1.50max	0.030max	0.030max	remain-der			3.50max	Cu 26.0—33.0	65	30	25	
	B164classA		0.3max	0.5max	2.0max		0.024max	63.0min			2.5max	Cu 28.0—34.0	70 (Annealed)	25 (Annealed)	35	
Ni—Cr—Fe Alloy (Inconel)	A744—CY40		0.40max	3.00max	1.50max	0.030max	0.030max	remain-der	14.00—17.00		11.00max		70	28	30	

Nominal Designation	Material		Chemical Composition %									Tensile Requirements				
	ASTM	JIS	Cu	Al	Pb	Zn	Fe	Sn	Si	Mn	Other Requirements	Tensile Strength min. ksi	Yield Strength min. ksi	Elongation in 2in., min. %	Reduction of Area, min. %	
Brass rod and bar	B16—C36000		60.0—63.0		2.5—3.7	remain-der	0.35max				Other than Cu, Pb, Zn, Fe 0.30max					
	C3604BD		57.0—61.0		1.8—3.7	remain-der	0.7max				Fe+Sn 1.5max					
Brass plate	B36—C26000		68.5—71.5		0.07max	remain-der	0.05max					49—59 (Quarter hard)				
	C2600P		68.5—71.5		0.07max	remain-der	0.05max					40		40		
Bronze castings	B61—C92200		86.0—90.0		1.0—2.0	3.0—5.0	0.25max	5.5—6.5			Ni 1.0max P 0.05max	34	16	22		
	BC3		86.5—89.5		1.0max	1.0—3.0		9.0—11.0			Other elements total 1.0max	35.5		15		
	BC6		82.0—87.0		4.0—6.0	4.0—7.0		4.0—6.0			Other elements total 2.0max	28		15		
Aluminum—bronze rod and bar	B150—C61900			8.5—10.0	0.02max	0.8max	3.0—4.5	0.6max			Cu+Al+Pb+Zn+Fe+Sn 99.5min	85 (over 1 to 2)	40 (over 1 to 2)	20 (over 1 to 2)		
	C6191BD		81.0—88.0	8.0—11.0			3.0—5.0			0.50—2.0	Ni 0.50—2.0 Cu+Al+Fe+Mn+Ni 99.5min	100		15		
Aluminum—bronze castings	B148—C95500		78.0min	10.0—11.5			3.0—5.0			3.5max	Ni 3.0—5.5 Cu+Al+Fe+Mn+Ni 99.5min	90	40	6		
	A1BC2		78min	8.0—10.5			2.5—5.0			1.5max	Other elements total 0.3max	71		20		
Aluminum plate	B209—No.1060		0.05max	99.60min		0.05max	0.35max		0.25max	0.03max	Mg 0.03max Ti 0.05max V 0.05max each 0.03max	8—14	2.5	22		
	A1050P		0.05max	99.5min		0.05max	0.40max		0.25max	0.05max	Mg 0.05max Ti 0.05max V 0.05max each 0.03max	8.5—14	3	25		

* for low-temperature service.

Notes: C; Carbon, Si; Silicon, Mn; Manganese, P; Phosphorus, S; Sulfur, Ni; Nickel, Cr; Chromium, Mo; Molybdenum, Fe; Iron, V; Vanadium, W; Tungsten, Cu; Copper, Al; Aluminum, Pb; Lead, Zn; Zinc, Sn; Tin, Mg; Magnesium, Ti; Titanium