

Chemical Requirements

Carbon, Alloy Steel and Stainless Steel Bolting Materials for High Temperature Services

ASTM Designation A 193

Type	Grade Symbol	Material	Carbon %	Manganese %	Phosphorus %	Sulfur %	Silicon %	Chromium %	Nickel %	Molybdenum %	Titanium %	Columbium & Tantalum %	Vanadium %	Copper %	Nitrogen %
Ferritic Steel	B5	AISI 501	0.10 min.	1.00 max.	0.040 max.	0.030 max.	1.00 max.	4.00-6.00		0.40-0.65					
	B6 & B6X	AISI 410	0.15 max.	1.00 max.	0.040 max.	0.030 max.	1.00 max.	11.50-13.50							
	B7 & B7M	AISI 4140, 4142, 4145, 4140H, 4142H & 4145H	0.37-0.49	0.65-1.10	0.035 max.	0.040 max.	0.15-0.35	0.75-1.20		0.15-0.25					
	B16	EN40CrMoV4.6	0.36-0.47	0.45-0.70	0.035 max.	0.040 max.	0.15-0.35	0.80-1.15		0.50-0.65			0.25-0.35		
Austenitic Steels	B8 & B8A	AISI 304	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	18.00-20.00	8.00-10.50						
	B8C & B8CA	AISI 347	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	17.00-19.00	9.00-13.00			10 x carbon content min.			
	B8M, B8MA, B8M2 & B8M3	AISI 316	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	16.00-18.00	10.00-14.00	2.00-3.00					
	B8N & B8NA	AISI 304N	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	18.00-20.00	8.00-10.50						0.10-0.16
	B8P & B8PA	AISI 305 + restricted carbon	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	17.00-19.00	10.50-13.00						
	B8R & B8RA	XM19	0.06 max.	4.00-6.00	0.040 max.	0.030 max.	1.00 max.	20.50-23.50	11.50-13.50	1.50-3.00		0.10-0.30	0.10-0.30		0.20-0.40
	B8S & B8SA	S21900 + restricted phosphorus	0.10 max.	7.00-9.00	0.040 max.	0.040 max.	3.50-4.50	16.00-18.00	8.00-9.00						0.08-0.18
	B8T & B8TA	AISI 321	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	17.00-19.00	9.00-12.00			5 x carbon content min.			
	B8LN & B8LNA	AISI 304N + restricted carbon	0.030 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	18.00-20.00	8.00-10.50						0.10-0.16
	B8MN & B8MNA	AISI 316N	0.08 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	16.00-18.00	10.00-14.00	2.00-3.00					0.10-0.16
	B8MLN & B8MLNA	AISI 316N + restricted carbon	0.030 max.	2.00 max.	0.045 max.	0.030 max.	1.00 max.	16.00-18.00	10.00-14.00	2.00-3.00					0.10-0.16
	B8MLCuN & B8MLCuNA	S31254	0.020 max.	1.00 max.	0.030 max.	0.010 max.	0.80 max.	19.50-20.50	17.50-18.50	6.00-6.50				0.50-1.00	0.18-0.22

Mechanical Requirements

Carbon, Alloy Steel and Stainless Steel Bolting Materials for High Temperature Services

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Type	Grade Symbol	Diameter Inch (mm.)	Minimum Tempering Temperature °F (°C)	Tensile Strength, min., ksi (Mpa)	Yield Strength, min., 0.2 % offset, ksi (Mpa)	Elongation in 4 D, min., %	Reduction of Area, min., %	Hardness, max.
Ferritic Steel	B5	up to 4 (100), included	1,100 (593)	100 (690)	80 (550)	16	50	
	B6	up to 4 (100), included	1,100 (593)	110 (760)	85 (585)	15	50	
	B6X	up to 4 (100), included	1,100 (593)	90 (620)	70 (485)	16	50	26 HRC
	B7	2½ (65) and under	1,100 (593)	125 (860)	105 (720)	16	50	35 HRC or 321 HB
		over 2½ to 4 (65 to 100)	1,100 (593)	115 (795)	95 (655)	16	50	33 HRC or 302 HB
		over 4 to 7 (100 to 180)	1,100 (593)	100 (690)	75 (515)	18	50	29 HRC or 277 HB
	B7M	2½ (65) and under	1,150 (620)	100 (690)	80 (550)	18	50	235 HB or 99 HRB
		over 2½ to 4 (65 to 100)	1,150 (620)	100 (690)	80 (550)	18	50	235 HB or 99 HRB
		over 4 to 7 (100 to 180)	1,150 (620)	100 (690)	75 (515)	18	50	235 HB or 99 HRB
	B16	2½ (65) and under	1,200 (650)	125 (860)	105 (725)	18	50	35 HRC or 321 HB
over 2½ to 4 (65 to 100)		1,200 (650)	110 (760)	95 (655)	17	45	33 HRC or 302 HB	
over 4 to 7 (100 to 180)		1,200 (650)	100 (690)	85 (585)	16	45	29 HRC or 277 HB	
Austenitic Steels	B8, B8C, B8M, B8P, B8T, B8LN & B8MLN	Classes 1 and 1D, all diameters	carbide solution treated	75 (515)	30 (205)	30	50	223 HB or 96 HRB
	B8A, B8CA, B8MA, B8PA, B8TA, B8LNA, B8MLNA, B8NA & B8MNA	Classes 1A, all diameters	carbide solution treated in the finished condition	75 (515)	30 (205)	30	50	192 HB or 90 HRB
	B8N, B8MN & B8MLCuN	Classes 1B and 1D, all diameters	carbide solution treated	80 (550)	35 (240)	30	40	223 HB or 96 HRB
	B8R	Classes 1C and 1D, all diameters	carbide solution treated	100 (690)	55 (380)	35	55	271 HB 28 HRC
	B8RA	all diameters	carbide solution treated in the finished condition	100 (690)	55 (380)	35	55	271 HB 28 HRC
	B8S	all diameters	carbide solution treated	95 (655)	50 (345)	35	35	271 HB 28 HRC
	B8SA	all diameters	carbide solution treated in the finished condition	95 (655)	50 (345)	35	35	271 HB 28 HRC
	B8, B8C, B8P, B8T, B8N & B8MLCuN	Classes 2, ¾ (20) and under	carbide solution treated in the finished condition	125 (860)	100 (690)	12	35	321 HB 35 HRC
		over ¾ to 1 (20 to 25) included		115 (795)	80 (550)	15	35	321 HB 35 HRC
		over 1 to 1¼ (25.4 to 31.6) included		105 (725)	65 (450)	20	35	321 HB 35 HRC
		over 1¼ to 1½ (32 to 40) included		100 (690)	50 (345)	28	45	321 HB 35 HRC
	B8M, B8MN & B8MLCuN	Classes 2, ¾ (20) and under	carbide solution treated in the finished condition	110 (760)	95 (665)	15	45	321 HB 35 HRC
		over ¾ to 1 (20 to 25) included		100 (690)	80 (550)	20	45	321 HB 35 HRC
		over 1 to 1¼ (25.4 to 31.6) included		95 (655)	65 (450)	25	45	321 HB 35 HRC
		over 1¼ to 1½ (32 to 40) included		90 (620)	50 (345)	30	45	321 HB 35 HRC
	B8M2	Classes 2B, 2 (50.8) and under	carbide solution treated in the finished condition	95 (655)	75 (515)	25	40	35 HRC or 321 HB
		over 2 to 2½ (50.8 to 63.2) included		90 (620)	65 (450)	30	40	35 HRC or 321 HB
		over 2½ to (63.2 to 76.2) included		80 (550)	55 (380)	30	40	35 HRC or 321 HB
B8M3	Classes 2C, 2 (50.8) and under	carbide solution treated in the finished condition	85 (585)	65 (45)	30	60	35 HRC or 321 HB	
	over 2 to (50.8)		85 (585)	60 (415)	30	60	35 HRC or 321 HB	