

DATA SECTION

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SAE Bar Compositions

Reference ASTM A29 & SAE J403
Nonresulfurized Carbon Steels

SAE No.	C	Mn	P Max.	S Max.
1005	0.06 max	0.35 max	.040	.050
1006	0.08 max	0.25-0.40	.040	.050
1008	0.10 max	0.30-0.50	.040	.050
1010	0.08-0.13	0.30-0.60	.040	.050
1011	0.08-0.13	0.60-0.90	.040	.050
1012	0.10-0.15	0.30-0.60	.040	.050
1013	0.11-0.16	0.50-0.80	.040	.050
1015	0.13-0.18	0.30-0.60	.040	.050
1016	0.13-0.18	0.60-0.90	.040	.050
1017	0.15-0.20	0.30-0.60	.040	.050
1018	0.15-0.20	0.60-0.90	.040	.050
1019	0.15-0.20	0.70-1.00	.040	.050
1020	0.18-0.23	0.30-0.60	.040	.050
M1020	0.17-0.24	0.25-0.60	.040	.050
1021	0.18-0.23	0.60-0.90	.040	.050
1022	0.18-0.23	0.70-1.00	.040	.050
1023	0.20-0.25	0.30-0.60	.040	.050
1025	0.22-0.28	0.30-0.60	.040	.050
1026	0.22-0.28	0.60-0.90	.040	.050
1029	0.25-0.31	0.60-0.90	.040	.050
1030	0.28-0.34	0.60-0.90	.040	.050
1034	0.32-0.38	0.50-0.80	.040	.050
1035	0.32-0.38	0.60-0.90	.040	.050
1037	0.32-0.38	0.70-1.00	.040	.050
1038	0.35-0.42	0.60-0.90	.040	.050
1039	0.37-0.44	0.70-1.00	.040	.050
1040	0.37-0.44	0.60-0.90	.040	.050
1042	0.40-0.47	0.60-0.90	.040	.050
1043	0.40-0.47	0.70-1.00	.040	.050
1044	0.43-0.50	0.30-0.60	.040	.050
M1044	0.40-0.50	0.25-0.60	.040	.050
1045	0.43-0.50	0.60-0.90	.040	.050
1046	0.43-0.50	0.70-1.00	.040	.050
1049	0.46-0.53	0.60-0.90	.040	.050
1050	0.48-0.55	0.60-0.90	.040	.050
1053	0.48-0.55	0.70-1.00	.040	.050
1055	0.50-0.60	0.60-0.90	.040	.050
1059	0.55-0.65	0.50-0.80	.040	.050
1060	0.55-0.65	0.60-0.90	.040	.050
1064	0.60-0.70	0.50-0.80	.040	.050
1065	0.60-0.70	0.60-0.90	.040	.050
1069	0.65-0.75	0.40-0.70	.040	.050
1070	0.65-0.75	0.60-0.90	.040	.050
1071	0.65-0.75	0.75-1.05	.040	.050
1074	0.70-0.80	0.50-0.80	.040	.050
1075	0.70-0.80	0.40-0.70	.040	.050
1078	0.72-0.85	0.30-0.60	.040	.050
1080	0.75-0.88	0.60-0.90	.040	.050
1084	0.80-0.93	0.60-0.90	.040	.050
1086	0.80-0.93	0.30-0.50	.040	.050
1090	0.85-0.93	0.60-0.90	.040	.050
1095	0.90-1.03	0.30-0.50	.040	.050

Continued

SAE No.	C	Mn	P Max.	S Max.
1513	0.10-0.16	1.10-1.40	.040	.050
1518	0.15-0.21	1.10-1.40	.040	.050
1522	0.18-0.24	1.10-1.40	.040	.050
1524	0.19-0.25	1.35-1.65	.040	.050
1525	0.23-0.29	0.80-1.10	.040	.050
1526	0.22-0.29	1.10-1.40	.040	.050
1527	0.22-0.29	1.20-1.50	.040	.050
1536	0.30-0.37	1.20-1.50	.040	.050
1541	0.36-0.44	1.35-1.65	.040	.050
1547	0.43-0.51	1.35-1.65	.040	.050
1548	0.44-0.52	1.10-1.40	.040	.050
1551	0.45-0.56	0.85-1.15	.040	.050
1552	0.47-0.55	1.20-1.50	.040	.050
1561	0.55-0.65	0.75-1.05	.040	.050
1566	0.60-0.71	0.85-1.15	.040	.050
1572	0.65-0.76	1.00-1.30	.040	.050

SAE Bar Compositions

Resulfurized Carbon Steels

SAE No.	C	Mn	P Max.	S Max.
1108	0.08-0.13	0.60-0.80	.040	.08-.13
1110	0.08-0.13	0.30-0.60	.040	.08-.13
1117	0.14-0.20	1.00-1.30	.040	.08-.13
1116	0.14-0.20	1.10-1.40	.040	.16-.23
1118	0.14-0.20	1.30-1.60	.040	.08-.13
1119	0.14-0.20	1.00-1.30	.040	.24-.33
1137	0.32-0.39	1.35-1.65	.040	.08-.13
1139	0.35-.430	1.35-1.65	.040	.13-.20
1140	0.37-.440	0.70-1.00	.040	.08-.13
1141	0.37-.450	1.35-1.65	.040	.08-.13
1144	0.40-.480	1.35-1.65	.040	.24-.33
1145	0.42-.490	0.70-1.00	.040	.04-.07
1146	0.42-.490	0.70-1.00	.040	.08-.13
1151	0.48-.550	0.70-1.00	.040	.08-.13

SAE Bar Compositions

Rephosphorized and Resulfurized Carbon Steels

SAE No.	C	Mn	P	S	Pb
1211	0.13 max.	0.60-0.90	.07-.12	.10-.15	-
1212	0.13 max.	0.70-1.00	.07-.12	.16-.23	-
1213	0.13 max.	0.70-1.00	.07-.12	.24-.33	-
12L13	0.13 max.	0.70-1.00	.07-.12	.24-.33	.15-.35
1215	0.09 max.	0.75-1.05	.04-.09	.26-.35	-
12L14	0.15 max.	0.85-.1.15	.04-.09	.26-.35	.15-.35
12L15	0.09 max.	0.75-1.05	.04-.09	.26-.35	.15-.35

SAE Bar Compositions

Standard Alloy Steel

SAE No.	C	Mn	Ni	Cr	Mo
MOLYBDENUM STEELS					
4012	.09-0.14	0.75-1.00	—	—	.15-.25
4023	.20-0.25	0.70-0.90	—	—	.20-.30
4024	.20-0.25	0.70-0.90	—	—	.20-.30
4027	.25-0.30	0.70-0.90	—	—	.20-.30
4028	.25-0.30	0.70-0.90	—	—	.20-.30
4032	.30-0.35	0.70-0.90	—	—	.20-.30
4037	.35-0.40	0.70-0.90	—	—	.20-.30
4042	.40-0.45	0.70-0.90	—	—	.20-.30
4047	.45-0.50	0.70-0.90	—	—	.20-.30
CHROMIUM-MOLYBDENUM STEELS					
4118	.18-0.23	0.70-0.90	—	0.40-0.60	.08-.15
4130	.28-0.33	0.40-0.60	—	0.80-1.10	.15-.25
4135	.33-0.38	0.70-0.90	—	0.80-1.10	.15-.25
4137	.35-0.40	0.70-0.90	—	0.80-1.10	.15-.25
4140	.38-0.43	0.75-1.00	—	0.80-1.10	.15-.25
4142	.40-0.45	0.75-1.00	—	0.80-1.10	.15-.25
4145	.43-0.48	0.75-1.00	—	0.80-1.10	.15-.25
4147	.45-0.50	0.75-1.00	—	0.80-1.10	.15-.25
4150	.48-0.53	0.75-1.00	—	0.80-1.10	.15-.25
4161	.56-0.64	0.75-1.00	—	0.70-0.90	.25-.35
NICKEL—CHROMIUM—MOLYBDENUM STEELS					
4320	.17-0.22	0.45-0.65	1.65-2.00	0.40-0.60	.20-.30
4340	.38-0.43	0.60-0.80	1.65-2.00	0.70-0.90	.20-.30
E4340	.38-0.43	0.65-0.85	1.65-2.00	0.70-0.90	.20-.30
NICKEL 1.75%—MOLYBDENUM 0.25% STEEL					
4615	.13-0.18	0.45-0.65	1.65-2.00	—	.20-.30
4620	.17-0.22	0.45-0.65	1.65-2.00	—	.20-.30
4621	.18-0.23	0.70-0.90	1.65-2.00	—	.20-.30
4626	.24-0.29	0.45-0.65	0.70-1.00	—	.15-.25
NICKEL 1.05%—CHROMIUM 0.45% MOLYBDENUM 0.20%					
4718	.16-0.21	0.70-0.90	0.90-1.20	0.35-0.55	.30-.40
4720	.17-0.22	0.50-0.70	0.90-1.20	0.35-0.55	.15-.25
NICKEL 3.50%—MOLYBDENUM 0.25%					
4815	.13-0.18	0.40-0.60	3.25-3.75	—	.20-.30
4817	.15-0.20	0.40-0.60	3.25-3.75	—	.20-.30
4820	.18-0.23	0.50-0.70	3.25-3.75	—	.20-.30
CHROMIUM STEEL					
5017	.12-0.17	0.30-0.50	—	0.30-0.50	—
5046	.43-0.48	0.75-1.00	—	0.20-0.35	—
5115	.13-0.18	0.70-0.90	—	0.70-0.90	—
5117	.15-0.20	0.70-0.90	—	0.70-0.90	—
5120	.17-0.22	0.70-0.90	—	0.70-0.90	—
5130	.28-0.33	0.70-0.90	—	0.80-1.10	—
5132	.30-0.35	0.60-0.80	—	0.75-1.00	—
5135	.33-0.38	0.60-0.80	—	0.80-1.05	—
5140	.38-0.43	0.70-0.90	—	0.70-0.90	—
5145	.43-0.48	0.70-0.90	—	0.70-0.90	—
5147	.46-0.51	0.70-0.95	—	0.85-1.15	—
5150	.48-0.53	0.70-0.90	—	0.70-0.90	—
5155	.51-0.59	0.70-0.90	—	0.70-0.90	—
5160	.56-0.64	0.75-1.00	—	0.70-0.90	—
E50100	.98-1.10	0.25-0.45	—	0.40-0.60	—
E51100	.98-1.10	0.25-0.45	—	0.90-1.15	—
E52100	.98-1.10	0.25-0.45	—	1.30-1.60	—

SAE No.	C	Mn	Ni	Cr	Mo	
CHROMIUM—VANADIUM STEELS						
6118	.16-0.21	0.50-0.70	—	0.50-0.70	.10-.15V	
6150	.48-0.53	0.70-0.90	—	0.80-1.10	.15min.V	
NICKEL 0.55%—CHROMIUM 0.50% MOLYBDENUM 0.20%—0.30%						
8615	.13-0.18	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8617	.15-0.20	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8620	.18-0.23	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8622	.20-0.25	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8625	.23-0.28	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8627	.25-0.30	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8630	.28-0.33	0.70-0.90	0.40-0.70	0.40-0.60	.15-.25	
8637	.35-0.40	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8640	.38-0.43	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8642	.40-0.45	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8645	.48-0.48	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8650	.48-0.53	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8655	.51-0.59	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8660	.56-0.64	0.75-1.00	0.40-0.70	0.40-0.60	.15-.25	
8720	.18-0.23	0.70-0.90	0.40-0.70	0.40-0.60	.20-.30	
8740	.38-0.43	0.75-1.00	0.40-0.70	0.40-0.60	.20-.30	
8822	.20-0.25	0.75-1.00	0.40-0.70	0.40-0.60	.30-.40	
9260	.56-0.64	0.75-1.00	—	—	—	
STANDARD BORON STEELS Boron content of 0.0005% to 0.003%						
SAE No.	C	Mn	Si	Ni	Cr	Mo
50B40	.38-0.43	0.75-1.00	.15-.35	—	.40-.60	—
50B44	.43-0.48	0.75-1.00	.15-.35	—	.40-.60	—
50B46	.44-0.49	0.75-1.00	.15-.35	—	.20-.35	—
50B50	.48-0.53	0.75-1.00	.15-.35	—	.40-.60	—
50B60	.56-0.64	0.75-1.00	.15-.35	—	.40-.60	—
51B60	.56-0.64	0.75-1.00	.15-.35	—	.70-.90	—
81B45	.43-0.48	0.75-1.00	.15-.35	.20-.40	.35-.55	.08-.15
86B45	.43-0.48	0.75-1.00	.15-.35	.40-.70	.40-.60	.15-.25
94B15	.13-0.18	0.75-1.00	.15-.35	.30-.60	.30-.50	.08-.15
94B17	.15-0.20	0.75-1.00	.15-.35	.30-.60	.30-.50	.08-.15
94B30	.28-0.33	0.75-1.00	.15-.35	.30-.60	.30-.60	.08-.15

NOTE: Phosphorous is 0.35% max., sulfur, 0.040% max.

SAE Plate Compositions

Standard Alloy Steels

SAE No.	C	Mn	Ni	Cr	Mo
4130	.27-0.34	.35-0.60	—	.80-1.15	.15-0.25
4140	.36-0.44	.70-1.00	—	.80-1.15	.15-0.25
E4150	.46-0.54	.75-1.10	—	.80-1.15	.15-0.25
4340	.36-0.44	.55-0.80	1.65-2.00	.60-0.90	.20-0.30
6150	.46-0.54	.60-0.90	—	.80-1.15	—
8615	.12-0.18	.60-0.90	.40-0.70	.35-0.60	.15-0.25
8617	.15-0.21	.60-0.90	.40-0.70	.35-0.60	.15-0.25
8620	.17-0.23	.60-0.90	.40-0.70	.35-0.60	.15-0.25

Mechanical Properties of Steel

The mechanical properties shown below are for general information purposes and are for steels in the as-rolled condition.

Case Hardening or Low Carbon Bars (as rolled)

SAE	Cond. of Steel	Tensile Str. KSI	Yield Str. KSI	% Elong in 2"	% Red. of Area	Hardness Br. R		Machinability Rating (C1212 =100)
M1020	Hot R'd.	55	30	25	50	111	B62	50
1018	Hot R'd.	58	32	25	50	116	B65	52
	Cold Dr.	64	54	15	40	126	B70	70
Core Props: carburized at 1700°F., cooled, reheated to 1425°, 350° Q&T.								
		92.00	56	27	48	195	B92	—
10L18	Cold Dr.	64	54	15	40	126	B70	80
1020	Hot R'd.	55	30	25	50	111	B62	52
12L14	Cold Dr.	78	60	10	35	165	B85	180
12L14+Te	Cold Dr.	78	60	10	35	165	B85	250
1215	Cold Dr.	78	60	10	35	165	B85	136
	Hot R'd.	62	34	23	47	121	B68	90
1117	Cold Dr.	69	58	15	40	137	B75	90
	Core Props: carburized at 1700°F., cooled, reheated to 1450°, 350° Q&T.							
		96.5	59	23	53	195	B92	—
11L17	Hot R'd.	62	34	23	47	121	B68	100
	Cold Dr.	69	58	15	40	137	B75	125
Core Props: carburized at 1700°F., cooled, reheated to 1450°, 350° Q&T.								
		97	60	23	52	197	B92	—
86L20	Hot R'd.	91	66	25	64	185	B90	88
	Cold Dr.	103	86	23	58	210	B95	92
Core Props: carburized at 1700°F., cooled, reheated to 1550°, 300° Q&T.								
		135	105	21	54	262	C26	—
E4320	Hot R'd.	84	61	29	58	165	B85	55
	Cold Dr.	98	81	18	54	205	B94	60
Core Props: carburized at 1700°F., cooled, reheated to 1500°, 300° oil Q&T.								
		218	178	14	48	429	—	—
4615-17	Hot R'd.	82	62	28	65	185	B90	58
	Cold Dr.	99	84.6	19	61	210	B95	64
Core Props: carburized at 1700°F., cooled, reheated to 1550°, 300° oil Q&T.								
		110	80	25	61	229	C20	—
4620	Hot R'd.	85	63	28	64	185	B90	58
E4620	Cold Dr.	101	85	22	60	207	B94	64
Core Props: carburized at 1700°F., cooled, reheated to 1550°, 300° oil Q&T.								
		120	89	22	55	2448	C24	—
8620	Hot R'd.	89	65	25	63	190	B91	60
	Cold Dr.	102	85	22	58	210	B95	63
Core Props: carburized at 1700°F., cooled, reheated to 1550°, 300° oil Q&T.								
		129	99	21	52	255	C25	—

Medium Carbon or Direct Hardening Bars

SAE	Cond. of Steel	Tensile Str. KSI	Yield Str. KSI	% Elong in 2"	% Red. of Area	Hardness Br. R		Machinability Rating (C1212 =100)
1035	Hot R'd.	72	39.5	18	40	143	B90	65
	Water Quenched, 1550°F.—Tempered 1000°F.							
		103	72	23	59	201	B94	—
M1044	Hot R'd.	80	44	16	40	166	B86	65
1045	Hot R'd.	82	45	16	40	162	B84	56
	Cold Dr.	91	77	12	35	180	B89	65
Water Quenched, 1550°F.—Tempered 1000°F.								
		120	90	18	52	240	C22	—
1045	TG&P	82	45	16	40	162	B84	56
1137	Cold Dr.	88	48	15	35	180	B89	70
	Oil Quenched, 1550°F.—Tempered 1000°F.							
		112	88	21	56	255	C25	—
1141	Hot R'd.	94	51.5	15	35	190	B91	65
	Cold Dr.	105	88	10	30	210	B95	70
Oil Quenched, 1550°F.—Tempered 1000°F.								
		126	100	19	54	277	C29	—
1141	TG&P	94	51.5	15	35	190	B91	65
1141	Drawn, G&P	105	88	10	30	205	B94	70
11L41	Hot R'd.	94	51.5	15	35	185	B90	95
	Cold Dr.	105	88	10	30	205	B94	100
Oil Quenched, 1550°F.—Tempered 1000°F.								
		126	101	20	54	277	C29	—
1144	Hot R'd.	97	53	15	35	210	B95	64
	Cold Dr.	108	90	10	30	217	C22	80
Oil Quenched, 1550°F.—Tempered 1000°F.								
		129	100.5	18	53	278	C30	—
E4130	Hot R'd.	86	56	29	57	185	B90	65
	Cold Dr.	98	87	21	52	200	B93	70
Water Quenched, 1575°F.—Tempered 1000°F.								
		146	133	17	50	293	C31	—
4140	Hot R'd.	89	62	26	58	190	B91	57
	Cold Dr.	102	90	18	50	228	B98	66
Oil Quenched, 1550°F.—Tempered 1000°F.								
		153	131	16	45	302	C32	—
4147-50	Hot R'd.	100	66	21	51	195	B92	54
	Oil Quenched, 1550°F.—Tempered 1000°F.							
		158	134	14	42	311	C33	—
41L40-42	Hot R'd.	91	63	27	58	185	B90	87
	Cold Dr.	103	93	19	51	228	B98	90
Oil Quenched, 1550°F.—Tempered 1000°F.								
		156	133	16	44	311	C33	—

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Mechanical Properties of Steel

Medium Carbon or Direct Hardening Bars (Cont.)

SAE	Cond. of Steel	Tensile Str. KSI	Yield Str. KSI	% Elong in 2"	% Red. of Area	Hardness Br.	Hardness R	Machinability Rating (C1212 =100)
41L47/50	Hot R'd.	103	69	23	51	205	B94	80
Rounds	Cold Dr.	112	95	16	43	228	B98	85
	Oil Quenched, 1550°F.—Tempered 1000°F.	162	138	14	40	311	C33	—
4150 Mod. RS	Hot R'd.	103	69	23	51	205	B94	73
Flats, Sqs.	Oil Quenched, 1550°F.—Tempered 1000°F.	160	135	14	41	311	C33	—
4340 C4340	Hot R'd.	101	69	21	45	210	B95	45
	Cold Dr.	111	99	16	42	228	B98	55
	Oil Quenched, 1550°F.—Tempered 1000°F.	182	162	15	40	363	C39	—
E6150	Hot R'd.	91	58	22	53	185	B90	50
	Oil Quenched, 1550°F.—Tempered 1000°F.	155	132	15	44	302	C32	—
E8740	Cold Dr.	107	96	17	48	228	B98	66
	Oil Quenched, 1550°F.—Tempered 1000°F.	152	129	15	44	302	C32	—

High Carbon or Direct Hardening Bars

SAE	Cond. of Steel	Tensile Str. KSI	Yield Str. KSI	% Elong in 2"	% Red. of Area	Hardness Br.	Hardness R	Machinability Rating (C1212 =100)
1095	Hot R'd.	120	66	10	25	271	C28	—
	Water Quenched, 1450°F.—Tempered 800°F.	200	138	12	37	390	C42	—
52100	Hot R'd.	100	81	25	57	192	—	39
	Cold Dr.	107	87.5	17	54	229	—	41
	SP. Ann							

Mechanical Properties of Steel

Heat Treated Bars/Minimum Mechanical Properties

Properties area at center of bars up to 1 1/2", and at mid-radius of bars over 1 1/2".
Yield Strength – 0.2% or .02% offset as indicated per ASTM E8.

Grade	Thermal Condition	Tensile Strength (KSI) Range or Min.		Min. Yield Strength (KSI)	Min. % Elong in 2"	Min. % Red. of Area	Surface Hardness		Machinability Rating (C1212 =100)	
							Brinell	HRC		
4140/42	HR	Over	7-9 1/2"	105	80	15	40	269/321	28/34	55
ASTM A434	QTSR	Over	9 1/2"	–	–	–	–	–	–	–
CL. BC	CF DGP	Thru	1"	110	130	16	50	269/321	28/34	55
4340 ASTM A434	QTSR	Thru	1 1/2"	155	130	14	35	302/363	32/39	52
CL. BD	TGP	Over	1 1/2-2 1/2"	150	120	14	35	302/363	32/39	52
		Over	2 1/2-4"	140	110	14	35	302/363	32/39	52
		Over	4-7"	135	105	14	35	302/363	32/39	52
		Over	7-9 1/2"	130	100	14	35	302/363	32/39	52
		Over	9 1/2"	130	100	14	35	302/363	32/39	52
Stressproof	CD	Thru	2"	115	100	8	25	–	–	83
ASTM A311	As Drawn	Over	2-3"	115	100	8	20	–	–	83
CL.B	Heavy	Over	3-4 1/2"	115	100	8	20	–	–	83
SAE 1144	Draft									
Fatigue-Proof SAE 1144	Elevated Temp Drawn		140		125	5	15	280 Min.	30 Min.	80
e.t.d. 150	Elevated Temp Drawn		150		130	10 (Mean)	37 (Mean)	302 Min.	32 Min.	–
41L40/42/47	HR & CF QTSR		125		100	15	45	269/321	27/34	70
4150 Mod. RS HR Square	Norm & SR Thru 6"		–		–	–	–	241/302	23/32	62
4150 Mod. RS HR Rounds	QTSR	Thru	1 1/2"	130	110	16	50	262/311	27/33	62
		Over	1 1/2-2 1/2"	125	110	16	50	262/311	27/33	62
		Over	2 1/2-4"	115	95	16	45	262/311	27/33	62
		Over	4-7"	110	85	16	45	262/311	27/33	62
		Over	7-9 1/2"	105	80	15	40	262/321	27/34	62
		Over	9 1/2"	–	–	–	–	–	–	–

Mechanical Properties of Steel

Plates

Grade	Condition of Steel	Tensile Strength KSI	Yield Strength KSI	% Elong. in 2"	% Elong. in 8"	Approx. Brinell Hardness
Structural Quality ALLOY						
ASTM A36, ASME SA36	As Rolled	58 to 80	36 Min.	23	20	137
EX-TEN 50						
ASTM A572(50)	As Rolled	65 Min.	50 Min.	21	18	143
Cor-Ten A						
ASTM A242	As Rolled	70 Min.	50 Min.	–	16	156
Cor-Ten B						
ASTM A588(A)	As Rolled	70 Min.	50 Min.	19	16	156
ASTM A656 Gr. 50	As Rolled	60 Min.	50 Min.	–	20	123/159
ASTM A656 Gr. 80	As Rolled	95 Min.	80 Min.	18	12	212/255
T-1 Type A ASTM A514 Gr. B	Q&T	110 to 130	100 Min.	16	–	235/293
T-1 Type B ASTM A514 Gr. H	Q&T	110 to 130	100 Min.	16	–	235/293
T-1 ASTM A514 Gr. F	Q&T	110 to 130	100 Min.	16	–	235/293
T-1 Type C ASTM A514 Gr. Q	Q&T	110 to 130	90 Min.	14	–	235/293
Pressure Vessel Quality Carbon						
ASTM A285, ASME SA285						
Grade C	As Rolled	55 to 75	30 Min.	27	23	137
ASTM A516, ASME SA516						
Grade 70	As Rolled	70 to 90	38 Min.	21	17	163
Norm--						
ASTM A387, ASME SA387						
Grade II	Ann.	60 to 85	35 Min.	22	19	135/174
ASTM A387, ASME SA387						
Grade 22	N&T	75 to 100	45 Min.	18	–	149/207
Intermediate Carbon						
AISI 1045	As Rolled	90	50	–	–	187
Improved Machining Carbon						
C1119	As Rolled	68 to 78	37 to 40	20/40%	15/35%	140/150
Abrasion Resisting						
AR Carbon	As Rolled	–	–	–	–	212/255
T-1 Type A						
321 Min. BHN	Q&T	–	–	–	–	321 Min
Through Hardening						
4130	As Rolled	90	52	28	–	179
4140	Annealed	95	54	25	–	197
4340 MTS	Annealed	100	58	21	–	229
E6150	Annealed	97	55	23	–	197
E4150	Norm & Temp.	145	115	14	–	262/321

Stainless Steel

Austenitic/Chrome-Nickle (Non-Hardening)

	303	304	304L	309	310	316	316L	321
Chemical Comp. (%)								
Chromium.....	17.-19.	18.-20.	18.-20.	22.-24.	24.-26.	16.-18.	16.-18.	17.-19.
Nickel.....	8.-10.	8.-11.	8.-11.	12.-15.	19.-22.	10.-14.	10.-14.	9.-12.
Other elements (a).....	5.15-4.0	—	—	—	—	Mo.2.-3.	Mo 2.-3.	T15XCmm
Carbon.....	.15 max	.08 max	.03 max	.20 max	.25 max	.25max	.03 max	.08 max
Manganese.....	2. max	2.max	2.max	2.max	2.max	2.max	2.max	2.max
Silicon.....	1.max	1.max	1.max	1.max	1.5max	1.max	1.max	1.max
Machinability rating.....	70	48	48	—	—	45	45	50
Physical Data								
Melting—°F.....	2550	2550	2550	2550	2550	2550	2550	2550
Density—lb./in.3.....	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Specific heat—								
Blu °F/lb(32-212F).....	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Thermal Conductivity—								
BTU/ft ² /hr/°F/ft:.....								
212 F.....	9.4	9.4	9.4	9.0	8.0	9.4	9.4	9.3
932 F.....	12.4	12.4	12.4	10.8	10.8	12.4	12.4	12.8
Mean Coeff. of exp.—								
In/in/°F X 106.....								
68.212F.....	9.2	9.2	9.2	8.7	8.0	9.2	9.2	8.3
68 lo indicated—F.....	11.0	11.0	11.0	10.9	10.9	10.7	10.7	10.6
(1600).....	(1600)	(1600)	(2100)	(2100)	(1600)	(1600)	(1700)	
Electrical Prop.								
Magnetic Perm.....	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Electrical resistivity—								
68F.....	72.0	72.0	72.0	78.0	78.0	74.0	72.0	72.0
1200 F.....	116.0	116.0	116.0	114.8	—	116.0	116.0	—
Heat Resist.								
Max. operating °F:								
Intermittent.....	1400	1600	1600	1800	1900	1600	1600	1600
Continuous.....	1700	1700	1700	2000	2100	1700	1700	1700
Temperatures—°F								
Forging—start.....	2250	2200	2200	2150	2150	2200	2200	2200
Forging—finish.....	1700	1700	1700	1800	1800	1700	1700	1700
Annealing—Ranges.....	1800-2000	1800-1950	1800-1950	2050-2150	2050-2150	1975-2150	1800-2000	1800-2000
Annealing—cooling (b).....	WQ	WQ(AC)	AC	WQ(AC)	WQ(AC)	WQ(AC)	AC	WQ(AC)
Hardening—ranges.....				Hardenable only by cold working				
Quenching (O) Oil, (A) Air								
Tempering—for hardness								
Drawing—for stress relieving								
Mech. Prop (nominal) anld.								
Structure annealed(C).....	A	A	A	A	A	A	A	A
Yield strength-KSI-min.....	35	35	30	40	30	35	30	35
Ultimate strength								
KSI—min.....	90	85	80	95	75	85	75	85
Elong--%.....								
In 2 inches—min.....	50	55	55	45	40	60	60	55
Red. In area--% min.....	55	70	70	65	50	70	70	65
Mod. Of elast. —								
Lb/in.2 X 106.....	29	29	29	29	30	29	29	29
Hardness—Brinell(max).....	160mm	180	180	200	180	200	180	200
Hardness-Rockwell(max).....	B80mm	B90	B90	895	B90	B95	890	B95
Impact values—Izod								
-ft.lb (min).....	60	85	80	80	80	70	80	80

Stainless Steel

	Martensitic/ Chrome (Hardenable)		Ferritic (Non- Hardenable)	
	410	416	440C	430
Mech. Prop. –anld.				
Structure annealed	FC	FC	FC	FC
Yield strength				
KSI-min	40	40	65	45
Ultimate strength				
KSI-min	75	75	110	75
Elongation—				
% in 2 inches—min	35.0	30.0	14.0	30.0
Red. In area % min	70.0	65.0	25.0	65.0
Mod of elast.				
Lb.in.2 X 103	29.0	29.0	30.0	29.0
Hardness—Brinell				
(max)	200	180	260	200
Hardness-Rockwell				
(max)	B95	B90	B105	B95
Impact values—Izod				
–ft.lb (min)	85	–	Low	3-85
Mech. Prop. –HT:				
Yield Strength –KSI	38-180	500-115	60-275	–
Ultimate Strength –KSI	60-200	900-1400	100-285	–
Elongation—				
% in 2 inches	25-2	25-15	8-1	–
Hardness—Brinell	120-400	180-280	200-600	–
Hardness—Rockwell	B70-C45	B90-C30	B95-C58	–
Creep strength				
KSI at 1000 F:				
1 % Flow on 10,000 hr	12	–	–	8.5
1 % Flow on 100,000 hr	11	–	–	6.5

- (a) Phosphorus and Sulfur are present
- (b) Thin sections of the 300 Series, marked WQ(AC) are usually air cooled; heavy sections, water quenched, AC=Air Cool. FC= Furnace Cool. SFC = Slow Furnace Cool. WQ = Water Quench. C=Carbide, A=Austenite.

Stainless Steel

Precipitation Hardening

	17-4 Ann (Aisi 630)	17-4 H1150
Mech. Prop. –anld.		
Yield strength		
KSI – min	–	105
Ultimate strength		
KSI-min	–	135
Elongation—		
% in 2 inches –min	–	16
Reduction of area		
% min	–	50
Hardness	363 BHN	28 MIN
.	MAX	HRC
Machinability Rating	45	50

Plate Tolerances

Carbon & Alloy Plate

Permissible Variations in Thickness for Rectangular Carbon, High-Strength, Low Alloy, and Alloy- Steel Plates, When Ordered to Thickness

NOTE 1 - Permissible variation under Specified thickness, 0.01 in.
 NOTE 2 - Thickness to be measured at 3/8 to 3/4 in. From the longitudinal edge.
 NOTE 3 - For Thickness measured at any location other than that specified in Note 2, the permissible maximum over tolerance shall be increased by 75%, rounded to the nearest 0.01 in.

Specified Thickness, in.	Tolerance Over Specified Thickness for Widths Given, in.							
	48 & Under	48-60, excl	60-72, excl	72-84, excl	84-96, excl	96-108, excl	108-120, excl	120-120, excl
To 1/4, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
1/4 to 15/16, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
15/16 to 3/8, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
3/8 to 7/16, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
7/16 to 1/2, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
1/2 to 5/8, excl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
5/8 to 3/4, excl	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
3/4 to 1, excl	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05
1 to 2, excl	0.06	0.06	0.06	0.06	0.06	0.07	0.08	0.10
2 to 3, excl	0.09	0.09	0.09	0.10	0.10	0.11	0.12	0.13
3 to 4, excl	0.11	0.11	0.11	0.11	0.11	0.13	0.14	0.15
4 to 6, excl	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6 to 10, excl	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24
10 to 12, excl	0.29	0.29	0.33	0.33	0.33	0.33	0.33	0.33
12 to 15, incl	0.29	0.29	0.35	0.35	0.35	0.35	0.35	0.35

Permissible Variations in Width & Length for Sheared Plates 1 1/2 in. and Under in Thickness Variations over Specified Width & Length* for Specified Dimensions, in., & Equivalent Weights, lb/ft², Given

Length	Width	To 3/8, excl		3/8-5/8, excl		5/8-1, excl		1-2, excl	
		W	L	W	L	W	L	W	L
To 120, excl	To 60, excl	3/8	1/2	7/16	5/8	1/2	3/4	5/8	1
	60 to 84, excl	7/16	5/8	1/2	11/16	5/8	7/8	3/4	1
	84 to 108, excl	1/2	3/4	5/8	7/8	3/4	1	1	1 7/8
	108 and over	5/8	7/8	3/4	1	7/8	1 1/8	1 1/8	1 1/4
120 to 240, excl	To 60, excl	3/8	3/4	1/2	7/8	5/8	1	3/4	1 1/8
	60 to 84, excl	1/2	3/4	5/8	7/8	3/4	1	7/8	1 1/4
	84 to 108, excl	9/16	7/8	1 1/16	5/16	13/16	1 1/8	1	1 3/8
	108 and over	5/8	1	3/4	1 1/8	7/8	1 1/4	1 1/8	1 3/8
240 to 360, excl	To 60, excl	3/8	1	1/2	1 1/8	5/8	1 1/4	3/4	1 1/2
	60 to 84, excl	1/2	1	5/8	1 1/8	3/8	1 1/4	7/8	1 1/2
	84 to 108, excl	9/16	1	1 1/16	1 1/8	7/8	1 3/8	1	1 1/2
	108 and over	1 1/16	1 7/8	7/8	1 1/4	1	1 3/8	1 1/4	1 3/4
360 to 480, excl	To 60, excl	7/16	1 7/8	1/2	1 1/4	5/8	1 3/8	3/4	1 5/8
	60 to 84, excl	1/2	1 1/4	5/8	1 3/8	3/4	1 1/2	7/8	1 5/8
	84 to 108, excl	9/16	1 1/4	3/4	1 3/8	7/8	1 1/2	1	1 7/8
	108 and over	3/4	1 3/8	7/8	1 1/2	1	1 5/8	1 1/4	1 7/8

* Permissible variation under specified width and length, 1/4 in.

Permissible Variations in Width & Length for Rectangular Plates When Gas Cutting is Specified or Required

NOTE 1 - These variations may be taken all under or divided over and under, if so specified

Specified Thickness, in.	ALLOY	CARBON
	Variations Over for All Specified Widths or Lengths, In.	Variations Over for All Specified Widths or Lengths, In.
To 2, excl	3/4	1/2
2 to 4, excl	1	5/8
4 to 6, excl	1 1/8	3/4
6 to 8, excl	1 5/16	7/8
8 to 15, incl	1 1/2	1

Sheet Thickness Tolerances

Hot Rolled HR P & O Cold Rolled Galvanized

Gage No.	Hot Rolled, HR P & O, Cold Rolled			Galvanized			
	Dec. Equiv.	Toler. Range		Lbs. Per Sq. Ft.	Dec. Equiv.	Toler. Range	
4	.2242	.2332		9.375			
		.2152					
5	.2092	.2182		8.750			
		.2002					
6	.1943	.2033		8.125			
		.1853					
7	.1793	.1873	.1873	7.500			
		.1713	.1713				
8	.1644	.1724	.1724	6.875	.1681	.1771	7.031
		.1564	.1564			.1591	
9	.1495	.1575	.1575	6.250	.1532	.1622	6.406
		.1415	.1415			.1442	
10	.1345	.1425	.1405	5.625	.1382	.1472	5.781
		.1265	.1285			.1292	
11	.1196	.1276	.1256	5.000	.1233	.1323	5.156
		.1116	.1136			.1143	
12	.1046	.1126	.1106	4.375	.1084	.1174	4.531
		.0966	.0986			.0994	
13	.0897	.0967	.0947	3.750	.0934	.1014	3.906
		.0827	.0847			.0854	
14	.0747	.0817	.0797	3.125	.0785	.0865	3.281
		.0677	.0697			.0705	
15	.0673	.0733	.0723	2.813	.0710	.0770	2.969
		.0613	.0623			.0650	
16	.0598	.0658	.0648	2.500	0.635	.0695	2.656
		.0538	.0548			.0575	
17	.0538	.0598	.0578	2.250	.0575	.0625	2.406
		.0478	.0498			.0525	
18	.0478	.0528	.0518	2.000	.0516	.0566	2.156
		.0428	.0438			.0466	
19	.0418	.0458	1.750	1.750	.0456	.0506	1.906
		.0378				.0406	
20	.0359	.0389	1.500	1.500	.0396	.0436	1.656
		.0329				.0356	
21	.0329	.0359	1.375	1.375	.0366	.0406	1.531
		.0299				.0326	
22	.0299	.0329	1.250	1.250	.0336	.0376	1.406
		.0269				.0296	
23	.0269	.0299	1.125	1.125	.0306	.0346	1.281
		.0239				.0266	
24	.0239	.0269	1.000	1.000	.0276	.0316	1.156
		.0209				.0236	
25	.0209	.0239	.875	.875	.0247	.0287	1.031
		.0179				.0207	
26	.0179	.0199	.750	.750	.0217	.0247	.906
		.0159				.0187	
27	.0164	.0184	.688	.688	.0202	.0232	.844
		.0144				.0172	
28	.0149	.0169	.625	.625	.0187	.0217	.781
		.0129				.0157	
29					.0172	.0202	.719
						.0142	
30					.0157	.0187	.656
						.0127	

Bar Tolerances

HR Carbon & Alloy Bars

Specified Width, in.	Permitted Variations Over or Under Specified Thickness, for Thicknesses Given in inches, in.						Permitted Variations From Specified Widths, in		
	0.203 to 0.230, excl	0.230 to 1/4, excl	1/4 to 1/2, incl..	Over 1/2 to 1, incl..	Over 1 to 2, incl..	Over 2 to 3, incl..	Over 3	Over	Under
To 1, incl..	0.007	0.007	0.008	0.010	—	—	—	1/64	1/64
Over 1 to 2, incl..	0.007	0.007	0.012	0.015	1/32	—	—	1/32	1/32
Over 2 to 4, incl..	0.008	0.008	0.015	0.020	1/32	3/64	3/64	1/16	1/32
Over 4 to 6, incl..	0.009	0.009	0.015	0.020	1/32	3/64	3/64	3/32	1/16
Over 6 to 8, incl..	^A	0.015	0.016	0.025	1/32	3/64	1/16	1/8	3/32 ^B

^A Flats over 6 to 8 in, incl., in width are not available as hot-rolled carbon steel bars in thickness under 0.230 in.

^B For flats over 6 to 8 in, in width, and to 3 in. incl in thickness.

Bar Tolerances

Permitted Variations in Sectional Dimensions
for Round and Square Bars and Round-
Cornered Squares

Specified Size, in.	Permitted Variations from Specified Size, in.		Permitted Out-of-Round or out-of-Square, in. ^A
	Over	Under	
To 5/16	0.005	0.005	0.008
Over 5/16 to 7/16, incl..	0.006	0.006	0.009
Over 7/16 to 5/8, incl..	0.007	0.007	0.010
Over 5/8 to 7/8, incl..	0.008	0.008	0.012
Over 7/8 to 1, incl..	0.009	0.009	0.013
Over 1 to 1 1/8, incl..	0.010	0.010	0.015
Over 1 1/8 to 1 1/4, incl..	0.011	0.011	0.016
Over 1 1/4 to 1 3/8, incl..	0.012	0.012	0.018
Over 1 3/8 to 1 1/2, incl..	0.014	0.014	0.021
Over 1 1/2 to 2, incl..	1/64	1/64	0.023
Over 2 to 2 1/2, incl..	1/32	0	0.023
Over 2 1/2 to 3 1/2, incl..	3/64	0	0.035
Over 3 1/2 to 4 1/2, incl..	1/16	0	0.046
Over 4 1/2 to 5 1/2, incl..	5/64	0	0.058
Over 5 1/2 to 6 1/2, incl..	1/8	0	0.070
Over 6 1/2 to 8 1/4, incl..	5/32	0	0.085
Over 8 1/2 to 9 1/2, incl..	3/16	0	0.100
Over 9 1/2 to 10, incl..	1/4	0	0.120

^A Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the same transverse cross section. Out-of-square section is the difference is perpendicular distance between opposite faces, measured at the same transverse cross section.

Bar Tolerances

Permitted Variations in Sectional Dimensions
for Hexagons

Specified Size Between Opposite Sides, in.	Permitted Variations from Specified Size, in.		Permitted Out-of-Hexagon section, Three Measurements in. ^A
	Over	Under	
1/2 and under	0.007	0.007	0.011
Over 1/2 to 1, incl..	0.010	0.010	0.015
Over 1 to 1 1/2 incl..	0.021	0.013	0.025
Over 1 1/2 to 2, incl..	1/32	1/64	1/32
Over 2 to 2 1/2 incl..	3/64	1/64	3/64
Over 2 1/2 to 3 1/2, incl..	1/16	1/64	1/16

^A Out-of-hexagon section is the greatest difference in distance between any two opposite faces measured at the same transverse cross section.

Bar Tolerances

CF Carbon Bars
Cold Drawn or Tuned & Polished

Size Range In Inches	Undersize Variations in Inches			
	Max. Carbon Range .28% or less	Max. Carbon Range .28% to .55% incl.	Max. Carbon Range to 0.55% Incl. Stress Relieved or Annealed After Cold Finishing	Max. Carbon Range Over 55% or all all Grades Quenched & Tempered or Normalized And Tempered Before Cold Finishing
1 1/2 or Under	.002	.003	.004	.005
Over 1 1/2 to 2 1/2, incl.	.003	.004	.005	.006
Over 2 1/2 to 4, incl.	.004	.005	.006	.007
Over 4 to 6, incl.	.005	.006	.007	.008
Over 6 to 8, incl.	.006	.007	.008	.009
Over 8 to 9, incl.	.007	.008	.009	.010
Over 9	.008	.009	.010	.011
Cold Drawn Hexagons				
3/4 or under	.002	.003	.004	.006
Over 3/4 to 1 1/2, incl.	.003	.004	.005	.007
Over 1 1/2 to 2 1/2, incl.	.004	.005	.006	.008
Over 2 1/2 to 3 1/8, incl.	.005	.006	.007	.009
Over 3 1/8 to 4, incl.	.005	.006	-	-
Cold Drawn Squares				
3/4 or under	.002	.004	.005	.007
Over 3/4 to 1 1/2, incl.	.003	.005	.006	.008
Over 1 1/2 to 2 1/2, incl.	.004	.006	.007	.009
Over 2 1/2 to 4, incl.	.006	.008	.009	.011
Over 4 to 5, incl.	.010	-	-	-
Over 5 to 6, incl.	.014	-	-	-
Cold Drawn Flats				
Tolerances for flats apply to thickness as well as width				
Width in Inches				
To 3/4, incl.	.003	.004	.006	.008
Over 4 to 1 1/2, incl.	.004	.005	.008	.010
Over 1 1/2 to 3 incl.	.005	.006	.010	.012
Over 3 to 4 incl.	.006	.008	.011	.016
Over 4 to 6, incl.,	.008	.010	.012	.020
Over 6	.013	.015	-	-
Turned, Ground and Polished Rounds Cold Drawn, Ground and Polished Rounds				
Size Range In Inches	Undersize Variations in Inches			
	Turned, Ground and Polished Rounds		Cold Drawn, Ground and Polished Rounds	
1 1/2 and Under	-.0005 to -.0015		.001	
Over 1 1/2 to less than 2 1/2	-.0005 to -.0020		.0015	
2 1/2 to 3, incl.	-.0005 to -.0025		.002	
Over 3 to 4, incl.	-.0005 to -.0035		.003	
Over 4 to 6, incl.	-.0005 to -.0045		.004	
Over 6	-.0005 to -.0055		.005	

* All tolerances are on the minus side +.000.

Bar Tolerances

CF Alloy Bars
Cold Drawn or Tuned & Polished

Specified Size In Inches	Undersize Variations in Inches			
	Max. Carbon Range .28% or less	Max. Carbon Range over .28 to .55% incl.	Annld. or Stress Relieved after C.F. Max. carb. tp .55%	Max. Carbon Range Over 0.55% with or without stress relieving or annealing after cold finishing. Also all carbons heat Tr. or Norm. & Temp, before cold Finishing
To 1 incl. (in coils)	.002	.003	.004	.005
To 1 1/2 incl.	.003	.004	.005	.006
Over 1 1/2 to 2 1/2	.004	.005	.006	.007
Over 2 1/2 to 4	.005	.006	.007	.008
Over 4 to 6	.006	.007	.008	.009
Over 6 to 8	.007	.008	.009	.010
Over 8 to 9	.008	.009	.010	.011
Over 9	.009	.010	.011	.012
Cold Drawn Hexagons				
To 3/4, incl.	.003	.004	.005	.007
Over 3/4 to 1 1/2	.004	.005	.006	.008
Over 1 1/2 to 2 1/2	.005	.006	.007	.009
Over 2 1/2 to 3 1/8	.006	.007	.008	.010
Cold Drawn Squares				
To 3/4, Incl.	.003	.005	.006	.008
Over 3/4 to 1 1/2	.004	.006	.007	.009
Over 1 1/2 to 2 1/2	.005	.007	.008	.010
Over 2 1/2 to 4	.007	.009	.010	.012
Over 4 to 5	.011	-	-	-
Cold Drawn Flats				
Tolerances for flats apply to thickness as well as width				
Width in Inches				
To 3/4, incl.	.004	.005	.007	.009
Over 3/4 to 1 1/2	.005	.006	.009	.011
Over 1 1/2 to 3	.006	.007	.011	.013
Over 3 to 4	.007	.009	.012	.017
Over 4 to 6	.009	.011	.013	.021
Over 6	.014	-	-	-
Cold Drawn Ground and Polished Rounds Turned, Ground and Polished Rounds				
Diameter In Inches	Cold Drawn, Ground & Polished		Turned, Ground & Polished	
	All Carbons with or without thermal treatment before Cold Drawing		Not Heat Treated All Carb.	Heat* Treated All Carb.
To 1 1/2 incl.	.001	.0005	.0015	.0015
Over 1 1/2 to 2 1/2, excl.	.0015	.0005	.0020	.0020
2 1/2 to 3, incl.	.002	.0005	.0025	.0025
Over 3 to 4, incl.	.003	.0005	.0035	.0035
Over 4 to 6, incl.	-	.0005	.0045	.0045
Over 6	-	.0005	.0055	.0055

* All tolerances are on the minus side +.000.

Structural Tolerances

Shape	Section Nominal Sizes In.	Depth, In.		Flange Width, In.		Flanges Out-of-Square max.In. * †
		Over Theoretical	Under Theoretical	Over Theoretical	Under Theoretical	
W and HP	Up to 12, incl.	1/8	1/8	1/4	3/16	1/4
	Over 12	1/8	1/8	1/4	3/16	5/16
S and M	3 to 7, incl.	3/32	1/16	1/8	1/8	1/32
	Over 7 to 14, incl.	1/8	3/32	5/32	5/32	1/32
	Over 14 to 24, incl.	3/16	1/8	3/16	3/16	1/32
C and MC	1 1/2 and Under	1/32	1/32	1/32	1/32	1/32
	Over 1 1/2 to 3, excl	1/16	1/16	1/16	1/16	1/32
	3 to 7, incl.	3/32	1/16	1/8	1/8	1/32
	Over 7 to 14, incl.	1/8	3/32	1/8	5/32	1/32
	Over 14	3/16	1/8	1/8	3/16	1/32

*Applies when flanges of channels are toed in or out. For channels 5/8 in. and under in depth, the permissible out-of-square is 3/64 in./in. of depth.
 †Tolerance is per inch of flange width for S, M, C, and MC shapes.

Permissible Variations in Cross Section for Angles (L Shapes) and Zees

Section	Nominal Size, in.	Depth, In.		Flange Width or Length of Leg, in.		Out of Sq. per in.	Variations from Thickness Given, Over and Under, in.		
		Over Theoretical	Under Theoretical	Over Theoretical	Under Theoretical		3/16 and under	Over 3/16 to 3/8 incl. Over 3/8	
Angles* (L Shapes)	1 and under	-	-	1/32	1/32	3/128 [†]	0.008	0.010	--
	Over 1 to 2, incl.	-	-	3/64	3/64	3/128 [†]	0.010	0.010	0.012
	Over 2 to 3, excl	-	-	1/16	1/16	3/128 [†]	0.012	0.015	0.015
	3 to 4, incl.	-	-	1/8	3/32	3/128 [†]	--	--	--
	Over 4 to 6, incl.	-	-	1/8	1/8	3/128 [†]	--	--	--
Zees	Over 6	-	-	3/16	1/8	3/128 [†]	--	--	--
	3 to 4, incl.	1/8	1/16	1/8	3/32	3/128 [†]	--	--	--
	Over 4 to 6, incl.	1/8	1/16	1/8	1/8	3/128 [†]	--	--	--

* For unequal leg angles, longer leg determines classification.

† 3/128 in./in. = 1 1/2 deg.

Permissible Variations in Straightness for S, M, C, MC, L, T, Z, Shapes

Variable	Nominal Size, in.	Permissible Variation, In.
Camber	Under 3	1/4 in. in any 5 ft, or 1/4 X (number of feet of total length/5)
	3 and over	1/8 X (number of feet of total length/5)
Sweep	all	Due to the extreme variations in flexibility of these shapes, straightness tolerances for sweep are subject to negotiations between the manufacturer and the purchaser for the individual sections involved.
Permissible Variations in Straightness for W Shapes		
Permissible Variation, In.		
Camber and sweep		1/8 in. X (number of feet of total length*/10)

* Sections with a flange width less than 6 in. tolerance for sweep = 1/8 in. X (number of feet of total length/5).

Stainless Tolerances

Stainless Cold Finished Rounds
 Drawn, Ground or Ground & Polished

Size, Inches	Over, Inches	Under, Inches
.044 to 5/16 excl.	.001	.001
5/16 to 1/2 excl.	.0015	.0015
1/2 to 1 excl.	.002	.002
1 to 1 1/2 excl.	.0025	.0025
1 1/2 to 4 incl.	.003	.003
Stainless Hexagons & Squares		
.125 to .3125 excl.	.000	-.002
.3125 to .500 excl.	.000	-.003
.500 to 1.000 incl.	.000	-.004
Over 1 to 2 incl.	.000	-.006
Over 2 to 3 incl.	.000	-.008
Over 3	.000	-.010

Stainless Hot Finished Flats

Width, Inches	Thickness, Inches, Over & Under			Width, Inches	
	Thru 1/2"	Over 1/2" thru 1"	Over 1 thru 2"	Over	Under
To 1 incl.	.008	.010	--	1/64	1/64
Over 1 to 2 incl.	.012	.015	1/32	1/32	1/32
Over 2 to 4 incl.	.015	.020	1/32	1/16	1/32
Over 4 to 6 incl.	.015	.020	1/32	3/32	1/16
Over 6 to 8 incl.	.016	.025	1/32	1/8	5/32
Over 8 to 10 incl.	.021	.031	1/32	5/32	3/16

Stainless Bar Straightness

Measurement is taken on the concave side of the bar with a straight edge.

Hot Finished no. of feet in length
 1/8 inch in any 5 feet; but may not exceed 1/8 X $\frac{\text{no. of feet in length}}{5}$ inches.

Cold Finished no. of feet in length
 1/16 inch in any 5 feet; but may not exceed 1/16 X $\frac{\text{no. of feet in length}}{5}$ inches.

Stainless Sheet/Gauge

Thickness, In.	Sheet Width, Inches			
	Under, Incl.	Ga.	48 max.	Handmill 48-60 Over 60
.1875 to .146	8&9	.007	.0105	.014
.146 to .131	10	.006	.009	.012
.131 to .115	11	.005	.0075	.010
.115 to .099	12	.005	.007	.009
.099 to .084	13	.004	.006	.008
.084 to .073	14	.004	.0055	.007
.073 to .059	15 & 16	.003	.0045	.006
.059 to .041	17 & 19	.003	.004	--
.041 to .030	20 to 22	.002	.003	--
.030 to .017	23 to 27	.0015	--	--
.017 to .008	28 to 34	.0015	--	--
.008 to .006	35 to 38	.0015	--	--
.006	39	.001	--	--

WIDTH & LENGTH/Nothing under size

Widths through 48" — 1/16" over. Widths over 48" — 1/8" over.
 Lengths through 120" — 1/4" over. Lengths over 120" — 1/2" over.

CAMBER/Roller leveled, not required

Widths through 36": 1/8" every 8 Ft. Widths over 36": 3/32" every 8 Ft.

Stainless Tolerances

Stainless Sheet/Flatness

Thickness in Inches	Width in Inches	Flatness Tolerance (maximum deviation from a horizontal flat surface), Inches
.062 & over	To 60 incl.	1/2
	Over 60 to 72 incl.	3/4
	Over 72	1
Under .062	To 36 incl.	1/2
	Over 36 to 60 incl.	3/4
	Over 60	1

Stainless Plate Thickness

Thickness In Inches	Thickness Tolerance Over Variation* in Inches			
	Widths to 84" Incl.	Widths Over 84" to 120" Incl.	Widths Over 120" to 144" Incl.	Widths Over 144" Incl.
3/16 to 3/8 excl.	.045	.050	—	—
3/8 to 3/4 excl.	.055	.060	.075	.090
3/4 to 1 excl.	.060	.065	.085	.100
1 to 2 incl.	.070	.075	.095	.115
Over 2	OA	OA	OA	OA

* No plate shall vary more than .01 inch under the thickness ordered.

OA = On application.

Spot grinding not to exceed .01 inch under the specified thickness is permitted to remove surface imperfections.

Stainless Sheared Mill Plates

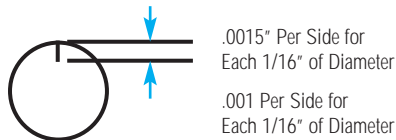
Width In Inches	Length in inches	Tolerances, in Inches over specified width & length for given width, length and thickness					
		Under 3/8" Thick		3/8" to 1/2"		Over 1/2" to 1"	
		Width	Length	Width	Length	Width	Length
48 and Under	Over	1/4	1/2	5/16	5/8	3/8	3/4
Over 48 to 60 incl.	240	5/16	5/8	3/8	3/4	1/2	3/4
Over 60 to 84 incl.	to 7/16	11/16	1/2	3/4	5/8	7/8	
Over 84 to 108 incl.	360	9/16	3/4	5/8	7/8	3/4	1
Over 108		5/8	7/8	11/16	1	7/8	1
60 and Under	Over	7/16	11/8	1/2	11/4	5/8	13/8
Over 60 to 84 incl.	360	1/2	11/4	5/8	11/4	3/4	11/2
Over 84 to 108 incl.	to 9/16	11/4	3/4	13/8	7/8	11/2	
Over 108	480	3/4	13/8	7/8	11/2	1	15/8
60 and Under	Over	7/16	11/4	1/2	11/2	5/8	15/8
Over 60 to 84 incl.	480	1/2	13/8	5/8	11/2	3/4	15/8
Over 84 to 108 incl.	to 5/8	13/8	3/4	11/2	7/8	15/8	
Over 108	600	3/4	11/2	7/8	15/8	1	13/4
60 and Under		1/2	13/4	5/8	17/8	3/4	7/8
Over 60 to 84 incl.	Over	5/8	13/4	3/4	17/8	7/8	17/8
Over 84 to 108 incl.	600	5/8	13/4	3/4	17/8	7/8	17/8
Over 108		7/8	13/4	1	2	11/8	21/4

The tolerance under specified width and length is 1/4 incl.

Cold Finish Bar Machining Allowance

Resulfurized: 1100 and 1200 Series
 Straight Carbon: Series 1000,
 Stressproof and Fatigue-Proof

Formula for Calculating Allowable Seam Depth



This is the generally accepted industry allowance for seam depth in carbon and alloy steels. The removal of the indicated amounts of stock should minimize seams.

Size	Non-Resulfurized	Resulfurized	Size	Non-Resulfurized	Resulfurized	Size	Non-Resulfurized	Resulfurized
5/8 & under	.015	.010	1 1/2	.036	.024	2 1/16	.064	.043
2 1/32	.016	.010	1 9/16	.037	.025	2 3/4	.066	.044
1 1/16	.016	.011	1 5/8	.039	.026	2 3/16	.067	.045
2 3/32	.017	.011	1 11/16	.040	.027	2 7/8	.069	.046
3/4	.018	.012	1 3/4	.042	.028	2 5/16	.070	.047
2 5/32	.019	.012	1 25/32	.043	.028	2 63/64	.072	.048
1 3/16	.019	.013	1 11/16	.043	.029	3	.072	.048
2 7/32	.020	.013	1 27/32	.044	.029	3 1/16	.073	.049
5 5/64	.021	.014	1 55/64	.045	.030	3 1/8	.075	.050
7/8	.021	.014	1 7/8	.045	.030	3 3/16	.076	.051
2 9/32	.022	.014	1 115/16	.046	.031	3 1/4	.078	.052
1 5/16	.022	.015	1 131/32	.047	.031	3 5/16	.079	.053
3 1/32	.023	.015	1 163/64	.048	.032	3 3/8	.081	.054
1	.024	.016	2	.048	.032	3 7/16	.082	.055
1 1/32	.025	.016	2 1/32	.049	.032	3 1/2	.084	.056
1 3/64	.025	.017	2 1/16	.049	.033	3 9/16	.085	.057
1 1/16	.025	.017	2 1/8	.051	.034	3 5/8	.087	.058
1 5/64	.026	.017	2 3/16	.052	.035	3 11/16	.088	.059
1 3/32	.026	.017	2 7/32	.053	.035	3 3/4	.090	.060
1 7/64	.027	.017	2 1/4	.054	.036	3 13/16	.091	.061
1 1/8	.027	.018	2 9/32	.055	.036	3 7/8	.093	.062
1 5/32	.028	.018	2 5/16	.055	.037	3 15/16	.094	.063
1 3/16	.028	.018	2 11/32	.056	.037	4	.096	.064
1 7/32	.029	.019	2 3/8	.057	.038	4 1/8	.099	.066
1 15/64	.030	.020	2 13/32	.058	.038	4 1/4	.102	.068
1 1/4	.030	.020	2 7/16	.058	.039	4 3/8	.105	.070
1 17/64	.030	.020	2 15/32	.059	.039	4 1/2	.108	.072
1 9/32	.031	.020	2 1/2	.060	.040	4 5/8	.111	.074
1 19/64	.031	.021	2 17/32	.061	.040	4 3/4	.114	.076
1 5/16	.031	.021	2 9/16	.061	.041	4 7/8	.117	.078
1 23/64	.033	.022	2 19/32	.062	.041	5	.120	.080
1 3/8	.033	.022	2 5/8	.063	.042			
1 7/16	.034	.022	2 21/32	.064	.042			

Machinability Ratings for Cold Drawn Steel Bar

Based on 1018 & 1212 as 100%

Grade Designation	Average Mach. Rating		Condition of Product	Grade Designation	Average Mach. Rating		Condition of Product
	1018	1212			1018	1212	
1008	71	66	Cold Drawn	1212	149	100	Cold Drawn
1010	73	68	Cold Drawn	1213	235	136	Cold Drawn
1012	73	68	Cold Drawn	12L14	334	180	Cold Drawn
1015	86	72	Cold Drawn	12L14 + Te	422	250	Cold Drawn
1016	100	78	Cold Drawn	Incut 100	334	185	Cold Drawn
1017	86	72	Cold Drawn	Incut 200	422	250	Cold Drawn
1018	100	70	Cold Drawn	Ledloy AX	422	250	Cold Drawn
10L18	126	92	Cold Drawn	1215	235	136	Cold Drawn
1020	86	72	Cold Drawn	1330	61	60	Annealed & CD
1021	100	78	Cold Drawn	1335	61	60	Annealed & CD
1022	100	78	Cold Drawn	1340	53	65	Annealed & CD
1023	95	76	Cold Drawn	4047	71	65	Annealed & CD
1025	86	72	Cold Drawn	4118	100	70	Cold Drawn
1030	80	70	Cold Drawn	4130	86	70	Annealed & CD
1035	80	70	Cold Drawn	4137	80	70	Annealed & CD
1038	66	64	Cold Drawn	4140	91	66	Annealed & CD
1040	66	64	Cold Drawn	4142	71	65	Annealed & CD
1042	66	64	Cold Drawn	4145	66	64	Annealed & CD
1043	53	65	Cold Drawn	4147	66	64	Annealed & CD
1044	53	65	Cold Drawn	4150	61	62	Annealed & CD
1045	53	65	Cold Drawn	4320	61	60	Annealed & CD
1045	86	72	Annealed & CD	4340	53	55	Annealed & CD
10L45	91	84	Annealed & CD	4620	71	64	Cold Drawn
1050	50	54	Cold Drawn	52100	28	41	Annealed & CD
1055	46	85	Annealed & CD	6150	61	60	Annealed & CD
1060	46	85	Annealed & CD	8615	80	70	Cold Drawn
1065	40	80	Annealed & CD	8617	71	63	Cold Drawn
1070	40	80	Annealed & CD	8620	71	63	Cold Drawn
1074	40	75	Annealed & CD	8622	71	63	Cold Drawn
1078	40	75	Annealed & CD				
1080	32	70	Annealed & CD				
1090	32	70	Annealed & CD				
1095	32	70	Annealed & CD				
1541	53	65	Cold Drawn				
1110	109	81	Cold Drawn				
1117	122	91	Cold Drawn				
11L17	152	125					
1118	122	90	Cold Drawn				
1137	86	72	Cold Drawn				
1140	86	72	Cold Drawn				
1141	80	70	Cold Drawn				
1141	109	81	Annealed & CD				
11L41	133	94	Annealed & CD				
1144	95	80	Cold Drawn				
1144	114	85	Annealed & CD				
11L44	119	87	Cold Drawn				
11L44	142	98	Annealed & CD				
1146	80	70	Cold Drawn				
1151	80	70	Cold Drawn				

Approximate Hardness Conversion Numbers for Steel

Based on Brinell Hardness Numbers

Brinell Indentation Diam. mm	Brinell Hardness No. 10-mm Tungstone Carbide Ball, 3,000 Kg Load	ROCKWELL HARDNESS NO.			Diamond Pyramid Hardness No. Vickers	Shore Sciro-scope Hardness No.	Tensile Strength (approximate) in 1,000 psi
		C-	B-	A-			
		Scale, 150-Kg Load, Brale Penetrator	Scale, 100-Kg Load, 1/16-in. Diam. Ball	Scale, 60-Kg Load, Brale Penetrator			
2.25	745	65.3	-	84.1	840	91	-
2.30	712	-	-	-	-	-	-
2.35	682	61.7	-	82.2	737	84	-
2.40	653	60.0	-	81.2	697	81	-
2.45	627	58.7	-	80.5	667	79	-
2.50	601	57.3	-	79.8	640	77	-
2.55	578	56.0	-	79.1	615	75	-
2.60	555	54.7	-	78.4	591	73	298
2.65	534	53.5	-	77.8	569	71	288
2.70	514	52.1	-	76.9	547	70	274
2.75	495	51.0	-	76.3	528	68	264
2.80	477	49.6	-	75.6	508	66	252
2.85	461	48.5	-	74.9	491	65	242
2.90	444	47.1	-	74.2	472	63	230
2.95	429	45.7	-	73.4	455	61	219
3.00	415	44.5	-	72.8	440	59	212
3.05	401	43.1	-	72.0	425	58	202
3.10	388	41.8	-	71.4	410	56	193
3.15	375	40.4	-	70.6	396	54	184
3.20	363	39.1	-	70.0	383	52	177
3.25	352	37.9	(110.0)	69.3	372	51	171
3.30	341	36.6	(109.0)	68.7	360	50	164
3.35	331	35.5	(108.5)	68.1	350	48	159
3.40	321	34.3	(108.0)	67.5	339	47	154
3.45	311	33.1	(107.5)	66.9	328	46	149
3.50	302	32.1	(107.0)	66.3	319	45	146
3.55	293	30.9	(106.0)	65.7	309	43	141
3.60	285	29.9	(105.5)	65.3	301	-	138
3.65	277	28.8	(104.5)	64.6	292	41	134
3.70	269	27.6	(104.0)	64.1	284	40	130
3.75	262	26.6	(103.0)	63.6	276	39	127
3.80	255	25.4	(102.0)	63.0	269	38	123
3.85	248	24.2	(101.0)	62.5	261	37	120
3.90	241	22.8	100.0	61.8	253	36	116
3.95	235	21.7	99.0	61.4	247	35	114
4.00	229	20.5	98.2	60.8	241	34	111
4.05	223	(18.8)	97.3	-	234	-	-
4.10	217	(17.5)	96.4	-	228	33	105
4.15	212	(16.0)	95.5	-	222	-	102
4.20	207	(15.2)	94.6	-	218	32	100
4.25	201	(13.8)	93.8	-	212	31	98
4.30	197	(12.7)	92.8	-	207	30	95
4.35	192	(11.5)	91.9	-	202	29	93
4.40	187	(10.0)	90.7	-	196	-	90
4.45	183	(9.0)	90.0	-	192	28	89
4.50	79	(8.0)	89.0	-	188	27	87
4.55	174	(6.4)	87.8	-	182	-	85
4.60	170	(5.4)	86.8	-	178	26	83
4.65	167	(4.4)	86.0	-	175	-	81
4.70	163	(3.3)	85.0	-	171	25	79
4.80	156	(0.9)	82.9	-	163	-	76
4.90	149	-	80.8	-	156	23	73
5.00	143	-	78.7	-	150	22	71
5.10	137	-	76.4	-	143	21	67
5.20	131	-	74.0	-	137	-	65

Circumference & Area of Circles/Inches

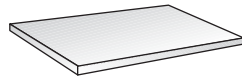
Diameter				Diam. Circ. Area			Diam. Circ. Area		
Frac.	Decimal	Circ.	Area	Diam.	Circ.	Area	Diam.	Circ.	Area
1/64	.015625	.04909	.00019	1	3.1416	.7854	64	201.06	3216.99
1/32	.03125	.09818	.00077	2	6.2832	3.1416	65	204.20	3318.31
3/64	.046875	.14726	.00173	3	9.4248	7.0686	66	207.34	3421.19
1/16	.0625	.19635	.00307	4	12.5664	12.5664	67	210.49	3525.65
5/64	.078125	.24545	.00479	5	15.7080	19.635	68	213.63	3631.68
3/32	.09375	.29452	.00690	6	18.850	28.274	69	216.77	3739.28
7/64	.109375	.34363	.00939	7	21.991	38.485	70	219.91	3848.45
1/8	.125	.39270	.01227	8	25.133	50.266	71	223.05	3959.19
9/64	.140625	.44181	.01553	9	28.274	63.617	72	226.19	4071.50
5/32	.15625	.49087	.01917	10	31.416	78.540	73	229.34	4185.39
11/64	.171875	.53999	.02320	11	34.558	95.033	74	232.48	4300.84
3/16	.1875	.58905	.02761	12	37.699	113.10	75	235.62	4417.86
13/64	.203125	.63817	.03241	13	40.841	132.73	76	238.76	4536.46
7/32	.21875	.68722	.03758	14	43.982	153.94	77	241.90	4656.63
15/64	.234375	.73635	.04314	15	47.124	176.72	78	245.04	4778.36
1/4	.25	.78540	.04909	16	50.265	201.06	79	248.19	4901.67
17/64	.265625	.83453	.05542	17	53.407	226.98	80	251.33	5026.55
9/32	.28125	.88357	.06213	18	56.549	254.47	81	254.47	5153.00
19/64	.296875	.93271	.06922	19	59.690	283.53	82	257.61	5281.02
5/16	.3125	.98175	.07670	20	62.832	314.16	83	260.75	5410.61
21/64	.328125	1.0309	.08456	21	65.973	346.36	84	263.89	5541.77
11/32	.34375	1.0799	.09281	22	69.115	380.13	85	267.04	5674.50
23/64	.359375	1.1291	.10144	23	72.257	415.48	86	270.18	5808.80
3/8	.375	1.1781	.11045	24	75.398	452.39	87	273.32	5944.68
25/64	.390625	1.2273	.11984	25	78.540	490.87	88	276.46	6082.12
13/32	.40625	1.2763	.12962	26	81.681	530.93	89	279.60	6221.14
27/64	.421875	1.3254	.13979	27	84.823	572.56	90	282.74	6361.73
7/16	.4375	1.3744	.15033	28	87.965	615.75	91	285.88	6503.88
29/64	.453125	1.4236	.16126	29	91.106	660.52	92	289.03	6647.61
15/32	.46875	1.4726	.17257	30	94.248	706.86	93	292.17	6792.91
31/64	.484375	1.5218	.18427	31	97.389	754.77	94	295.31	6939.78
1/2	.5	1.5708	.19635	32	100.53	804.25	95	298.45	7088.22
33/64	.515625	1.6199	.20880	33	103.67	855.30	96	301.59	7238.23
17/32	.53125	1.6690	.22166	34	106.81	907.92	97	304.73	7389.81
35/64	.546875	1.7181	.23489	35	109.96	962.11	98	307.88	7542.96
9/16	.5625	1.7671	.24850	36	113.10	1017.88	99	311.02	7697.69
37/64	.578125	1.8163	.26248	37	116.24	1075.21	100	314.16	7853.98
19/32	.59375	1.8653	.27688	38	119.38	1134.11	101	317.30	8011.85
39/64	.609375	1.9145	.29164	39	122.52	1194.59	102	320.44	8171.28
5/8	.625	1.9635	.30680	40	125.66	1256.64	103	323.58	8332.29
41/64	.640625	2.0127	.32232	41	128.81	1320.25	104	326.73	8494.87
21/32	.65625	2.0617	.33824	42	131.95	1385.44	105	329.87	8659.01
43/64	.671875	2.1108	.35453	43	135.09	1452.20	106	333.01	8824.73
11/16	.6875	2.1598	.37122	44	138.23	1520.53	107	336.15	8992.02
45/64	.703125	2.2090	.38828	45	141.37	1590.43	108	339.29	9160.88
23/32	.71875	2.2580	.40574	46	144.51	1661.90	109	342.43	9331.32
47/64	.734375	2.3072	.42356	47	147.65	1734.94	110	345.58	9503.32
3/4	.75	2.3562	.44179	48	150.80	1809.56	111	348.72	9676.89
49/64	.765625	2.4054	.45253	49	153.94	1885.74	112	351.86	9852.03
25/32	.78125	2.4544	.47937	50	157.08	1963.50	113	355.00	10028.75
51/64	.796875	2.5036	.49872	51	160.22	2042.82	114	358.14	10207.03
13/16	.8125	2.5525	.51849	52	163.36	2123.72	115	361.28	10386.89
53/64	.828125	2.6017	.53862	53	166.50	2206.18	116	364.42	10568.32
27/32	.84375	2.6507	.55914	54	169.65	2290.22	117	367.57	10751.32
55/64	.859375	2.6999	.58003	55	172.79	2375.83	118	370.71	10935.88
7/8	.875	2.7489	.60132	56	175.93	2463.01	119	373.85	11122.02
57/64	.890625	2.7981	.62298	57	179.07	2551.76	120	376.99	11309.73
29/32	.90625	2.8471	.64504	58	182.21	2642.08	121	380.13	11499.01
59/64	.921875	2.8963	.66746	59	185.35	2733.97	122	383.27	11689.87
15/16	.9375	2.9452	.69029	60	188.50	2827.43	123	386.42	11882.29
61/64	.953125	2.9945	.71349	61	191.64	2922.07	124	389.56	12076.28
31/32	.96875	3.0434	.73708	62	194.78	3019.07	125	392.70	12271.85
63/64	.984375	3.0928	.76097	63	197.92	3117.25	126	395.84	12468.98

Cold Rolled Steel Strip

Tempers

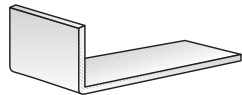
No. 1 – Hard

Carbon 0.25% max.
Thickness: 0.070" and thicker – RB 84 min.
Under 0.070" – RB 90 min.



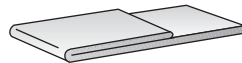
No. 2 – Half Hard

Carbon 0.25% max.
Thickness: 0.040" and thicker – RB 70 min.



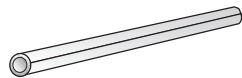
No. 3 – Quarter Hard

Carbon 0.25% max.
Thickness: 0.040" and thicker – RB 60 min.
to RB 75 approx. max.



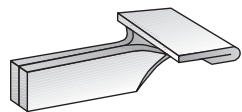
No. 4 – Pinch Pass or Skin Rolled

Carbon 0.25% max.
Thickness: 0.040" and thicker – RB 65 max.



No. 5 – Dead Soft

Carbon 0.15% max.
Thickness: 0.040" and thicker – RB 55 max.



NOTE: For these tempers, it's customary not to exceed 0.60% manganese by ladle analysis. If manganese is specified above 0.60% by ladle analysis or in the case of temper Nos. 4 and 5, the carbon is specified above 0.15% by ladle analysis, these Rockwell Hardness values don't apply.

Cold Rolled Steel Strip

Edges

No.1

Perfect square or round edge.



No. 2

Natural mill edge.



No. 3

Approx. square edge by slitting, not filed.



No. 4

Round edge produced by edge rolling.



No. 5

Approx. sq. edge by rolling or filling after slitting.



No. 6

Square edge produced by edge rolling



Metric System of Measurement

In the metric system of measurements, the principal unit for length is the meter; the principal unit for capacity, the liter; and the principal unit for weight, the gram. The following prefixes are used for sub-divisions and multiples: milli = 1/1000; centi = 1/100; deci = 1/10; deca = 10; hecto = 100; kilo = 1000. In abbreviations, the sub-divisions are frequently used with a small letter and the multiples with a capital letter, although this practice is not universally followed everywhere where the metric system is used.

All the multiples and sub-divisions are not used commercially. Those ordinarily used for length are kilometer, meter, centimeter and millimeter; for capacity, square meter, square centimeter and square millimeter; for cubic measures, cubic meter, cubic decimeter (liter), cubic centimeter, and cubic millimeter. The most commonly used weights are the kilogram and gram. The metric system was legalized in the United States by an Act of Congress in 1866.

Measures of Length

10 millimeters (mm.)	=	1 centimeter (cm.)
10 centimeters	=	1 decimeter (dm.)
10 decimeters	=	1 meter (m.)
1000 meters	=	1 kilometer (km.)

Square Measure

100 square millimeters (mm. ²)	=	1 square centimeter (cm. ²).
100 square centimeters	=	1 square decimeter (dm. ²).
100 square decimeters	=	1 square meter (m. ²).

Surveyor's Square Measure

100 square meters (m. ²)	=	1 are (ar.).
100 ares	=	1 hectare (har.).
100 hectares	=	1 square kilometer (km. ²).

Cubic Measure

1000 cubic millimeters (mm. ³)	=	1 cubic centimeter (cm. ³).
1000 cubic centimeters	=	1 cubic decimeter (dm. ³).
1000 cubic decimeters	=	1 cubic meter (m. ³).

Dry and Liquid Measure

10 milliliters (ml.)	=	1 centiliter (cl.).
10 centiliters	=	1 deciliter (dl.).
10 deciliters	=	1 liter (l.).
100 liters	=	1 hectoliter (hl.).

1 liter = 1 cubic decimeter = the volume of 1 kilogram of pure water at a temperature of 39.2 degrees F.

Measures of Weight

10 milligrams (mg.)	=	1 centigram (cg.).
10 centigrams	=	1 decigram (dg.).
10 decigrams	=	1 gram (g.).
10 grams	=	1 decagram (Dg.).
10 decagrams	=	1 hectogram (Hg.).
10 hectograms	=	1 kilogram (Kg.).
1000 kilograms	=	1 (metric) ton (T.).

Metric and English Conversion Table

Linear Measure

1 kilometer =	0.6214 mile.	1 mile =	1.609 kilometer.	
1 meter {	=	39.37 inches.	1 yard =	0.9144 meter.
	=	3.2808 feet.	1 foot =	0.3048 meter.
	=	1.0936 yard.	1 foot =	304.8 millimeters.
1 centimeter =	0.3937 inch.	1 inch =	2.542 centimeters.	
1 millimeter =	0.03937	1 inch =	25.4 millimeters.	

Square Measure

1 square kilometer =	0.3861 square mile =	247.1 acres.
1 hectare =	2.471 acre =	107,640 square feet.
1 are =	0.0247 acre =	1076.4 square feet.
1 square meter =	10.764 square feet =	1/196 square yard.
1 square centimeter =	0.155 square inch.	
1 square millimeter =	0.00155 square inch.	
1 square mile =	2.5899 square kilometers.	
1 acre =	0.4047 hectare =	40.47 ares.
1 square yard =	0.836 square meter.	
1 square foot =	0.0929 square meter =	929 square centimeters.
1 square inch =	6.452 square centimeters =	645.2 square millimeters.

Cubic Measure

1 cubic meter =	25.314 cubic feet =	1.308 cubic yard
1 cubic meter =	264.2 U.S. gallons.	
1 cubic centimeter =	0.061 cubic inch.	
1 liter (cubic decimeter) =	0.0353 cubic foot =	61.023 cubic inches.
1 liter =	0.2642 U.S. gallon =	1.0567 U.S. quart.
1 cubic yard =	0.7645 cubic meter.	
1 cubic foot =	0.02832 cubic meter =	28.317 liters.
1 cubic inch =	16.38716 cubic centimeters.	
1 U.S. gallon =	3.785 liters.	
1 U.S. quart =	0.946 liter.	

Weight

1 metric ton =	0.9842 ton (of 2240 pounds) =	2204.6 pounds.
1 kilogram =	2.2046 pounds =	35.274 ounces avoirdupois.
1 gram =	0.03215 ounce troy =	0.03527 ounce avoirdupois
1 gram =	15.432 grains.	
1 ton (of 2240 pounds) =	1.016 metric ton =	1016 kilograms.
1 pound =	0.4536 kilogram =	453.6 grams.
1 ounce avoirdupois =	28.35 grams.	
1 ounce troy =	31.103 grams.	
1 grain =	0.0648 gram.	
1 kilogram per square millimeter =	1422.32 pounds per square inch.	
1 kilogram per square centimeter =	14.223 pounds per square inch.	
1 kilogram-meter =	7.233 foot-pounds.	
1 pound per square inch =	0.0703 kilogram per square centimeter.	
1 calorie (kilogram calorie) =	3.968 B.T.U. (British thermal unit).	

Inches to Millimeters

Fraction	Inches	M/M	Fraction	Inches	M/M
1/64	0.1563	.397	33/64	.51563	13.097
1/32	.03125	.794	17/32	.53125	13.494
3/64	.04688	1.191	35/64	.54688	13.891
1/16	.06250	1.587	9/16	.56250	14.287
5/64	.07813	1.984	37/64	.57813	14.684
3/32	.09375	2.381	19/32	.59375	15.081
7/64	.10938	2.778	39/64	.60938	15.478
1/8	.12500	3.175	5/8	.62500	15.875
9/64	.14063	3.572	41/64	.64063	16.272
5/32	.15625	3.969	21/32	.65625	16.669
11/64	.17188	4.366	43/64	.67188	17.066
3/16	.18750	4.762	11/16	.68750	17.462
13/64	.20313	5.159	45/64	.70313	17.859
7/32	.21875	5.556	23/32	.71875	18.256
15/64	.23438	5.953	47/64	.73438	18.653
1/4	.25000	6.350	3/4	.75000	19.050
17/64	.26563	6.747	49/64	.76563	19.447
9/32	.28125	7.144	25/32	.78125	19.844
19/64	.29688	7.541	51/64	.79688	20.241
5/16	.31250	7.937	13/16	.81250	20.637
21/64	.32813	8.334	53/64	.82813	21.034
11/32	.34375	8.731	27/32	.84375	21.431
23/64	.35938	9.128	55/64	.85938	21.828
3/8	.37500	9.525	7/8	.87500	22.225
25/64	.39063	9.922	57/64	.89063	22.622
13/32	.40625	10.319	29/32	.90625	23.019
27/64	.42188	10.716	59/64	.92188	23.416
7/16	.43750	11.113	15/16	.93750	23.812
29/64	.45313	11.509	61/64	.95313	24.209
15/32	.46875	11.906	31/32	.96875	24.606
31/64	.48438	12.303	63/64	.98438	25.003
1/2	.50000	12.700		1.00000	25.400

To Convert Inches to Millimeters Multiply By 25.4

- 10' to mm ÷ 3048
- 12' to mm ÷ 3658
- 20' to mm ÷ 6096

Millimeters to Inches

M/M	Inches	M/M	Inches	M/M	Inches
1	.0394	34	1.3396	67	2.6398
2	.0788	35	1.3790	68	2.6792
3	.1182	36	1.4184	69	2.7186
4	.1576	37	1.4578	70	2.7580
5	.1979	38	1.4972	71	2.7974
6	.2364	39	1.5366	72	2.8368
7	.2758	40	1.5760	73	2.8762
8	.3152	41	1.6154	74	2.9156
9	.3546	42	1.6548	75	2.9550
10	.3940	43	1.6942	76	2.9944
11	.4334	44	1.7336	77	3.0338
12	.4728	45	1.7730	78	3.0732
13	.5122	46	1.8124	79	3.1126
14	.5516	47	1.8518	80	3.1520
15	.5910	48	1.8912	81	3.1914
16	.6304	49	1.9306	82	3.2308
17	.6698	50	1.9700	83	3.2702
18	.7092	51	2.0094	84	3.3096
19	.7486	52	2.0488	85	3.3490
20	.7880	53	2.0882	86	3.3884
21	.8274	54	2.1276	87	3.4278
22	.8668	55	2.1670	88	3.4672
23	.9062	56	2.2064	89	3.5066
24	.9456	57	2.2458	90	3.5460
25	.9850	58	2.2852	91	3.5854
26	1.0244	59	2.3246	92	3.6248
27	1.0638	60	2.3640	93	3.6642
28	1.1032	61	2.4034	94	3.7036
29	1.1426	62	2.4428	95	3.7430
30	1.1820	63	2.4822	96	3.7824
31	1.2214	64	2.5216	97	3.8218
32	1.2608	65	2.5610	98	3.8612
33	1.3002	66	2.6004	99	3.9066

To Convert Millimeters to Inches Multiply By 0394 .03937

Useful Information

To find the circumference of a circle:

Multiply the radius by 6.2832, or
 Multiply the diameter by 3.1416, or
 Multiply the square root of the area by 3.3449

To find the radius of a circle:

Multiply the diameter by .5, or
 Multiply the circumference by .15913, or
 Multiply the square root of the area by .56419

To find the diameter of a circle:

Multiply the radius by 2, or
 Multiply the circumference by .31831, or
 Multiply the square root of the area by 1.1284

To find the area of a circle:

Multiply the square of the radius by 3.1416, or
 Multiply the square of the diameter by .7854, or
 Multiply the square of the circumference by .07958

To find the area of a hexagon:

Multiply the square of the distance across by .86603, or
 Multiply the area of the inscribed circle by 1.1027

To find the area of an octagon:

Multiply the square of the distance across by .82843, or
 Multiply the area of the inscribed circle by 1.0348

To find the area of a rectangle:

Multiply the length by the width

To find the area of a triangle:

Multiply the base by one-half the perpendicular height

To find the side of an inscribed square:

Multiply the diameter by .7071, or
 Multiply the circumference by .2251

To find the side of an equal square:

Multiply the diameter by .8862

To find the diameter of the circumscribing circle of a square:

Multiply a side by 1.4142

To find the circumference of the circumscribing circle of a square:

Multiply a side by 4.443

To find the cubic contents of a cone:

Multiply the area of the base by one-third the altitude

To find the area of an ellipse:

Multiply the product of its axes by .7854

To find the area of a parallelogram:

Multiply the base times the perpendicular height

To find the volume of a parallelogram:

Multiply the area of cross section times the length

To find the area of a cylinder:

Multiply the length times the circumference of the body plus the area of both ends.

To find the volume of a cylinder:

Multiply the area of the base by the perpendicular height

To find the area of a sphere:

Multiply the square of the diameter by 3.1416, or
 Multiply the diameter times the circumference

To find the volume of a sphere:

Multiply the cube of the diameter by .5236

To find the capacity of a tank in gallons:

All measurements must be reduced to inches

For cylindrical tanks, multiply the length by the square of the diameter by .0034.

For rectangular tanks, multiply the length by the width by the depth and divide by 231.

For elliptical tanks, multiply the length by the short diameter by the long diameter by .0034

To convert Brinell hardness to tensile strength:

Divide the Brinell Hardness number by two to get the approximate tensile strength in thousands of pounds per square inch.

Example: Assume Brinell Hardness of 248.
 $248 \div 2 = 124,000$ p.s.i. (approx. tensile strength).

Conversely, drop the last three figures of the tensile strength and multiply by two to get the approximate Brinell Hardness number.

Example: Assume tensile strength of 122,000 p.s.i.
 $122 \times 2 = 244$ (approximate Brinell Hardness).

To estimate the weight of a round steel bar:

Multiply the diameter by 4, square the product, and divide by 6. The result is the approximate weight in pounds per foot of length.

To estimate the weight of a square steel bar:

Square the size, add a zero and divide by 3. The result is the approximate weight in pounds per foot of length.

To estimate the weight of a flat steel bar:

Multiply the width by the thickness, add a zero and divide by 3. The result is the approximate weight in pounds per foot of length.

To calculate sheet weight

Sheet Weight = Width x Length x Decimal thickness

Fractions & Decimal Equivalents

Fraction	Decimal	Fraction	Decimal
$1/64$	.01563	$33/64$	.51563
$1/32$	.03125	$17/32$	.53125
$3/64$	.04688	$35/64$	.54688
$1/16$	.06250	$9/16$	.56250
$5/64$	.07813	$37/64$	.57813
$3/32$	.09375	$19/32$	.59375
$7/64$	.10938	$39/64$	.60938
$1/8$	.12500	$5/8$	.62500
$9/64$	.14063	$41/64$	.64063
$5/32$	.15625	$21/32$	.65625
$11/64$	.17188	$43/64$	.67188
$3/16$	.18750	$11/16$	.68750
$13/64$	.20313	$45/64$	.70313
$7/32$	.21875	$23/32$	.71875
$15/64$	.23438	$47/64$	.73438
$1/4$	.25000	$3/4$	.75000
$17/64$	.26563	$49/64$	.76563
$9/32$	.28125	$25/32$	.78125
$19/64$	.29688	$51/64$	.79688
$5/16$	.31250	$13/16$	.81250
$21/64$	.32813	$53/64$	.82813
$11/32$	.34375	$27/32$	.84375
$23/64$	.35938	$55/64$	.85938
$3/8$	.37500	$7/8$	.87500
$25/64$	.39063	$57/64$	.89063
$13/32$	.40625	$29/32$	.90625
$27/64$	.42188	$59/64$	.92188
$7/16$	.43750	$15/16$	.93750
$29/64$.45313	$61/64$.95313
$15/32$.46875	$31/32$.96875
$31/64$.48438	$63/64$.98438
$1/2$.50000	1	1.00000

IMPORTANT

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