

**HARDNESS CONVERSION TABLE  
FOR CARBON AND ALLOY STEELS  
NON-AUSTENITIC STAINLESS STEEL  
MOST NON-FERROUS ALLOYS-EXCEPT ALUMINUM  
ALL VALUES ARE APPROXIMATE**

C Scale	Rockwell Hardness Numbers				Brinell Hardness Number (Carbide Ball)	Tensile Strength	
	A Scale	15N Scale Superficial	B Scale	30T Scale Superficial		ksi	MPa
60	81.2	90.2	—	—	(654)*	—	—
58	80.1	89.3	—	—	615	—	—
56	79.0	88.3	—	—	577	313	2160
54	78.0	87.4	—	—	543	292	2010
52	76.8	86.4	—	—	512	273	1880
50	75.9	85.5	—	—	481	255	1760
48	74.7	84.5	—	—	455	238	1640
47	74.1	83.9	—	—	443	229	1580
46	73.6	83.5	—	—	432	221	1520
45	73.1	83.0	—	—	421	215	1480
44	72.5	82.5	—	—	409	208	1430
43	72.0	82.0	—	—	400	201	1390
42	71.5	81.5	—	—	390	194	1340
41	70.9	80.9	—	—	381	188	1300
40	70.4	80.4	—	—	371	182	1250
39	69.9	79.9	—	—	362	177	1220
38	69.4	79.4	—	—	353	171	1180
37	68.9	78.8	—	—	344	166	1140
36	68.4	78.3	—	—	336	161	1110
35	67.9	77.7	—	—	327	156	1080
34	67.4	77.2	—	—	319	152	1050
33	66.8	76.6	—	—	311	149	1030
32	66.3	76.1	—	—	301	146	1010
31	65.8	75.6	—	—	294	141	970
30	65.3	75.0	—	—	286	138	950
29	64.6	74.5	—	—	279	135	930
28	64.3	73.9	—	—	271	131	900
27	63.8	73.3	—	—	264	128	880
26	63.3	72.8	—	—	258	125	860
25	62.8	72.2	—	—	253	123	850
24	62.4	71.6	—	—	247	119	820
23	62.0	71.0	—	—	243	117	810
—	—	—	100	83.1	240	116	800
—	—	—	98	81.8	228	111	766
—	—	—	96	80.4	216	104	717
—	—	—	94	79.1	205	98	676
—	—	—	92	77.8	195	92	635
—	—	—	90	76.4	185	89	615
—	—	—	88	75.1	176	86	590
—	—	—	86	73.8	169	83	570
—	—	—	84	72.4	162	81	560
—	—	—	82	71.1	156	77	530
—	—	—	80	69.7	150	72	495
—	—	—	78	68.4	144	69	475
—	—	—	76	67.1	139	67	460
—	—	—	74	65.7	135	65	450
—	—	—	72	64.4	130	63	435
—	—	—	70	63.1	125	61	420
—	—	—	68	61.7	121	59	405
—	—	—	66	60.4	117	57	395
—	—	—	64	59.0	114	—	—
—	—	—	62	57.7	110	—	—
—	—	—	60	56.4	107	—	—

\*Outside recommended Brinell hardness testing range (ASTM E 10)

**STEEL PLATES (Over 24" Wide) – CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES**

Description	Size Range Inches	COMPOSITION % (Maximum unless otherwise specified)						TYPICAL MECHANICAL*			
		C	Mn	P (Max)	S (Max)	Si	Other	Tensile Strength ksi ††	Yield Strength ksi ††	Elongation in 2" %	Rockwell Hardness
<b>COMMERCIAL QUALITY</b>											
Carbon Steel (Typical Composition) (ASTM A 830)	3/4 & Under:	.05/.13**	.30/.60	.035	.040	.10 Max.	—	50	35	25	B65
	Over 3/4 – 2	.05/.21	.30/.60	.035	.040	.15/.40	—	60	35	25	B72
<b>1045</b> (ASTM A 830)	All	.43/.50	.60/.90	.035	.040	.15/.40	—	90	50	20	B90
<b>FREE MACHINING</b>											
FM 45 (Typical Composition)	All	.40/.50	1.00/1.35	.040	.20/.30	.10 Max	—	92	50	20	B90
<b>ALLOY STEEL</b>											
4140	All	.36/.44	.75/1.00	.035	.040	.15/.35	Cr .80/1.10, Mo .15/.25	95	54	25	B92
8620	All	.17/.23	.70/.90	.035	.040	.15/.35	Cr .40/.60, Ni .40/.70, Mo .15/.25	78	52	25	B89
ASTM A 829 (Both Grades)											
<b>ABRASION RESISTING</b>											
AR Medium (Typical Composition)	1 & Under	.32/.45	1.15/1.90	.035	.035	.15/.40	—	Brinell 200/250 Typical			
AR 400 Formable (Typical Composition)	All	.12/.19	1.25/1.65	.025	.005	.15/.70	Mo .55 Max, V.08 Max, B .0005/.003	360/444 (Reported) See Page 257 For Forming Data			

\*NOT GUARANTEED or REPORTED by producing mill

\*\*For various widths and thicknesses, 0.05/0.21 Carbon may be available. Unless otherwise specified, either carbon range may be furnished.

†† 1 ksi = 1000 psi

Continued on following page

## STEEL PLATES (Over 24" Wide) – SPECIFIED CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Continued from preceding page

Description	Size Range Inches	COMPOSITION % (Maximum unless otherwise specified)						MECHANICAL				
		C	Mn	P	S	Si	Other	Tensile Strength ksi †	Yield Strength ksi †	Elongation* % in 8" in 2"		Typical** Rockwell Hardness
								min	min	min	min	
<b>HIGH STRENGTH LOW ALLOY</b>												
ASTM A 588 † † (Cor-Ten)	Plate 4 & Under	.20	.75/1.35	.04	.05	.15/.65	Ni .50 max, Cr .40/.70, Cu .20/.40, V .01/.10	70	50	16	19	B83
	Shapes	"	"	"	"	"	"	70	50	18	21	B83
ASTM A 572 Gr 50 (Ex-Ten 50)	3/8 & Under	.23	.50/1.35	.04	.05	.40	V .01/.15 or Cb .005/.05	65	50	16	19	B79
	Over 3/8 – 1-1/2	.23	.80/1.35	.04	.05	.40	V .01/.15 or Cb .005/.05	"	"	"	"	"
	Over 1-1/2 – 2-1/2	.23	.80/1.35	.04	.05	.15/.40	V .01/.15 or Cb .005/.05	"	"	"	"	"
ASTM A 656 Gr 80	3/4 & Under	.18	1.65	.025	.035	.60	N.02, V .008/.15 or Cb .008/.10	90	80	9	12	B96
CleanForm® 100 (Typical Composition)		.08	1.70	.020	.005	.13	Al .02/.08, Mo.23 B-Cb-V-Ti***	110	100	11	15	C25 (Charpy V-notch Impact Tested)
Domex® 100XF		.12	2.0	.025	.010	.15	Al .015 min, Cb .09 max, Ti .15 max	110	100	–	15	C25 (Charpy V-Notch 20 ft/lbs min at -40°F)§
<b>PRESSURE VESSEL QUALITY</b>												
ASME SA-516 Gr 70	1/2 & Under	.27	85/1.20	.035	.035	.15/.40	Ni .40, Cr .30, Mo .12, Cu .40, V .03, Cb .02,	70/90	38	17	21	B85
	Over 1/2 – 2	.28	"	"	"	"	Cu + Ni + Cr + Mo = 1.00, Cr + Mo = .32	"	"	"	"	"
	Over 2 – 4	.30	"	"	"	"		"	"	"	"	"
	Over 4 – 8	.31	"	"	"	"		"	"	"	"	"

\*Adjustments required for thicknesses under 5/16" and over 3-1/2"

\*\*NOT GUARANTEED or REPORTED by producing mill

\*\*\*May be added, either singly or in combination at the discretion of the steel producer, to achieve the required mechanical properties.

† 1 ksi = 1000 psi

† † Composite of Grades A and B

§ Adjustments in minimum ft/lbs required for sub-size specimens per ASTM A 673

Continued on following page

**STEEL PLATES (Over 24" Wide) – SPECIFIED CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES**

Continued from preceding page

Description	Size Range Inches	COMPOSITION %						MECHANICAL					
		(Maximum unless otherwise specified)						Tensile Strength ksi \$	Yield Strength ksi \$	Elongation*		Typical** Rockwell Hardness	
		C	Mn	P	S	Si	Other			in 8"	in 2"		
<b>STRUCTURAL</b>													
ASTM A 36	3/4 & Under	.25	—	.04	.05	.40	—	58/80	36	18	21	B76	
	Over 3/4 – 1-1/2	.25	.80/1.20	.04	.05	.40	—	"	"	"	"	"	
(Refer to page 263 for A36 bars & shapes)	Over 1-1/2 – 2-1/2	.26	.80/1.20	.04	.05	.15/.40	—	"	"	"	"	"	
	Over 2-1/2 – 4	.27	.85/1.20	.04	.05	.15/.40	—	"	"	"	"	"	
	Over 4 – 8	.29	.85/1.20	.04	.05	.15/.40	—	"	"	"	"	"	
	Over 8 – 10	.29	.85/1.20	.04	.05	.15/.40	—	58/80	32	18	21	B76	
ASTM A 514 Gr B (T-1 Type A)	3/16 – 1-1/4	.12/.21	.70/1.00	.035	.035	.20/.35	Cr .40/.65, Mo .15/.25, V .03/.08, Ti .01/.03, B .0005/.005	110/130	100	Elong* in 2" % min 16	Reduction in Area % min 35†	C25	
ASTM A 514 Gr H (T-1 Type B)	1-3/8 – 2	.12/.21	.95/1.30	.035	.035	.20/.35	Ni .30/.70, Cr .40/.65, Mo .20/.30, V .03/.08, B .0005/.005	110/130	100	16	35†	C25	
ASTM A 514 Gr F (T-1)	2-1/4 – 2-1/2	.10/.20	.60/1.00	.035	.035	.15/.35	Ni .70/1.00, Cr .40/.65, Mo .40/.60, V .03/.08, Cu .15/.50, B .0005/.006	110/130	100	16	35†	C25	
ASTM A 514 Gr Q (T-1 Type C)	3 – 6	.14/.21	.95/1.30	.035	.035	.15/.35	Ni 1.20/1.50, Cr 1.00/1.50, Mo .40/.60, V .03/.08	100/130	90	14	45	C25	

\*Adjustments required for thicknesses under 5/16" and over 3-1/2"

\*\*NOT GUARANTEED or REPORTED by producing mill

†Adjustments required depending on test specimen size

\$1 ksi = 1000 psi

## STEEL PLATES TECHNICAL DATA

Nominal Chemical Composition and Mechanical Properties—See page 252

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### FREE MACHINING PLATES

#### FM 45 Medium Carbon Free Machining

A medium carbon, high manganese plate which is produced from killed steel to promote uniformity. The chemical content is balanced to permit high surface hardness by flame or induction hardening and better response to standard quench and temper heat treatments than is possible with SAE 1045 steel. The free machining characteristics of this plate allow the user to employ speeds and feeds up to 85% of those recommended for 1212 and obtain a superior finish. Free machining analyses are inherently less sound than non-free machining grades. Where soundness is the first consideration, free machining analyses are not recommended.

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### ABRASION RESISTING STEELS

Not Recommended for Structural Applications

#### AR Medium Hard

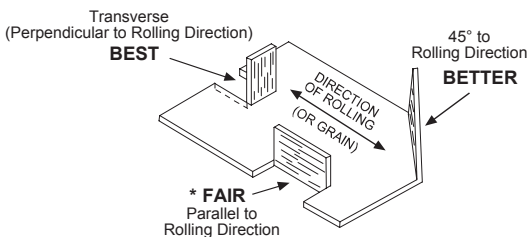
As rolled. Typical hardness of 200/250 BHN is not guaranteed.

#### AR 400 Formable

This premium performance abrasion resisting plate is a low carbon, extra-low sulfur, quenched and tempered alloy plate that exhibits outstanding forming and welding capabilities in addition to providing the wear and durability associated with a hardness level of BHN 360-444. See page 257 for recommended bending parameters.

## FABRICATING PRACTICE FOR COLD FORMING (Bend Axis Transverse to Rolling Direction)\* †

Description and Thickness (in.)	Suggested Minimum Inside Radius
<b>Mild Steel (CQ) Plate</b>	
Thru .500" **	1t
<b>ASTM A 36 Plate</b>	
Thru .500" **	1½t
<b>Cor-Ten® or ASTM A 606 Type 4 (Sheet)</b>	
<b>Cor-Ten® or ASTM A 588 (Plate)</b>	
Thru .062"	1t
Over .062" thru .500" **	1½t
<b>Ex-Ten® 50 or ASTM A 572 Gr 50 (Plate)</b>	
<b>Ex-Ten® H50 or ASTM A 1011 HSLAS Gr 50 Class 1 (Sheet)</b>	
Thru .2299" (Sheet)	1½t
Thru .500" (Plate) **	1½t
<b>ASTM A 656 Gr 80</b>	
Thru .250"	2½t
Over .250" thru .750" **	3t
<b>AR 400 Formable (Plate)</b>	
Up to 1"	3t (use 13.5t Bottom V-die)
Over 1" to 1¼"	4t (use 18t Bottom V-die)
Over 1¼" to 1½"	5t (use 18t Bottom V-die)
Hot Forming is not recommended due to loss of abrasion properties.	
<b>100,000 psi Minimum Yield Strength (Plate)</b>	
<b>ASTM A 514 Gr B (T-1 Type A)</b>	
<b>ASTM A 514 Gr H (T-1 Type B)</b>	
Thru ¾"	1¾t
Over ¾" thru 2"	3t
Hot Forming is not recommended due to loss of mechanical properties.	
<b>CleanForm® 100</b>	
Thru .375"	2t
<b>Domex® 100XF</b>	
Thru .250"	1.6t
Over .250" thru .394"	1.8t



\*Larger minimum radii should be used for bending parallel to rolling direction

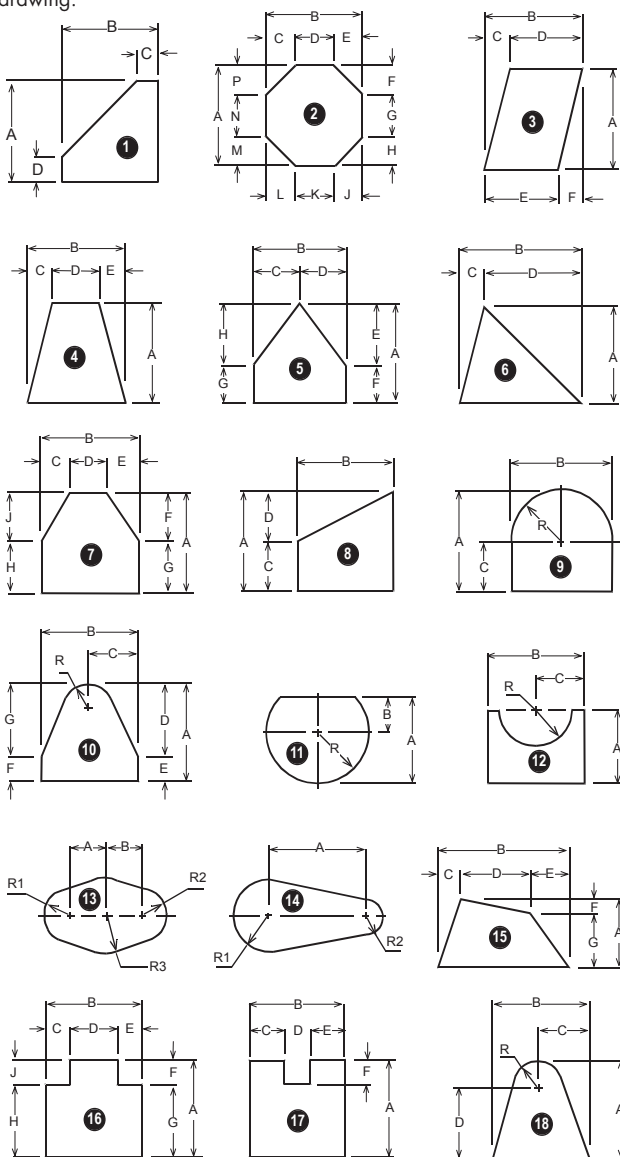
\*\*Hot forming is recommended for thicker sections which may result in lowering of mechanical properties

† All guidelines regarding bending and edge preparation per ASTM A 6 Sect. x4 apply

## SHAPE CUTTING

- ▶ SAW CUT (Straight or Contour)
- ▶ SHEAR (Straight or Contour)
- ▶ NC PUNCH
- ▶ NC OXYGEN-GAS BURN
- ▶ NC PLASMA CUT
- ▶ NC LASER CUT

Sheet and plate can be furnished cut to the shape/sketch you require. Specify the sketch number and the required dimensions or mail/fax your drawing.



### TO ORDER, SPECIFY:

- ▶ Sketch number and dimensions (or furnish drawing)
- ▶ Material type and thickness
- ▶ Quantity required
- ▶ Type of cutting preferred
- ▶ Special requirements (tolerances, machining allowances, etc.)