

Hardness vs Minimum Thickness Chart 55

Any greater thickness and hardness can be safely tested on indicated scale	Rockwell Superficial Hardness Scales			Rockwell Regular Hardness Scales		
	15N	30N	45N	A	D	C
	15 kgf	30 kgf	45 kgf	60 kgf	100 kgf	150 kgf
Thickness inches (mm)	N Brale Indenter			Brale Indenter		
.006 (0.15)	92	-	-	-	-	-
.008 (0.20)	90	-	-	-	-	-
.010 (0.25)	88	-	-	-	-	-
.012 (0.30)	83	82	77	-	-	-
.014 (0.36)	76	78.5	74	-	-	-
.016 (0.41)	68	74	72	86	-	-
.018 (0.46)	x	66	68	84	-	-
.020 (0.51)	x	57	63	82	77	-
.022 (0.56)	x	47	58	79	75	69
.024 (0.61)	x	x	51	76	72	67
.026 (0.66)	x	x	37	71	68	65
.028 (0.71)	x	x	20	67	63	62
.030 (0.76)	x	x	x	60	58	57
.032 (0.81)	x	x	x	x	51	52
.034 (0.86)	x	x	x	x	43	45
.036 (0.91)	x	x	x	x	x	37
.038 (0.96)	x	x	x	x	x	28
.040 (1.02)	x	x	x	x	x	20
Any greater thickness and hardness can be safely tested on indicated scale	Rockwell Superficial Hardness Scales			Rockwell Regular Hardness Scales		
	15-T	30-T	45-T	F	B	G
	15 kgf	30 kgf	45 kgf	60 kgf	100 kgf	150 kgf
Thickness inches (mm)	1/16-in Ball Indenter			1/16-in Ball Indenter		
.010 (0.25)	91	-	-	-	-	-
.012 (0.30)	86	-	-	-	-	-
.014 (0.36)	81	80	-	-	-	-
.016 (0.41)	75	72	71	-	-	-
.018 (0.46)	68	64	62	-	-	-
.020 (0.51)	x	55	53	-	-	-
.022 (0.56)	x	45	43	-	-	-
.024 (0.61)	x	34	31	98	94	94
.026 (0.66)	x	x	18	91	87	87
.028 (0.71)	x	x	4	85	80	76
.030 (0.76)	x	x	x	77	71	68
.032 (0.81)	x	x	x	69	62	59
.034 (0.86)	x	x	x	x	52	50
.036 (0.91)	x	x	x	x	40	42
.038 (0.96)	x	x	x	x	28	31
.040 (1.02)	x	x	x	x	x	22

X = No minimum hardness. These are approximate numbers only.

Conversions

All values, except WMN, are consistent with ASTM E140 Tables 1 and 2, and ASTM A370 Tables 3A and 3B, where applicable. WMN or Wilson Microficial Numbers were developed by Wilson Instruments in the Wilson Standards laboratory and are not derived from ASTM.

Cylindrical Corrections Values are consistent with ASTM E18 Table 6,7,13, and 14
Hardness vs. Minimum Thickness Values are consistent with ASTM E18 Tables 4, 5, 11, and 12 except for D and G scale values, which are obtained from indentation hardness testing by Vincent E. Lysaght.

Cylindrical Correction Chart 53

Cylindrical work corrections to be added to observed Rockwell number for scales indicated

Observed Reading	Scales C, D, A Brale Diamond Indenter Diameter of Specimen - inches (mm)									
	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
	90	NA	0.5	0	0	0	0	0	0	0
85		0.5	0.5	0.5	0	0	0	0	0	0
80		0.5	0.5	0.5	0.5	0.5	0	0	0	0
75		1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
70		1.0	1.0	0.5	0.5	0.5	0.5	0.5	0	0
65		1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
60		1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
55		2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0
50		2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5
45		3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
40		3.5	2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5
35		4.0	3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
30		5.0	3.5	2.5	2.0	1.5	1.5	1.0	1.0	0.5
25		5.5	4.0	3.0	2.5	2.0	1.5	1.0	1.0	1.0
20		6.0	4.5	3.5	2.5	2.0	1.5	1.5	1.0	1.0
Observed Reading	Scales B, F, G 1/16-in Ball Indenter Diameter of Specimen - inches (mm)									
	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
	100	NA	3.5	2.5	1.5	1.5	1.0	1.0	0.5	NA
90		4.0	3.0	2.0	1.5	1.5	1.5	1.0		
80		5.0	3.5	2.5	2.0	1.5	1.5	1.5		
70		6.0	4.0	3.0	2.5	2.0	2.0	1.5		
60		7.0	5.0	3.5	3.0	2.5	2.0	2.0		
50		8.0	5.5	4.0	3.5	3.0	2.5	2.0		
40		9.0	6.0	4.5	4.0	3.0	2.5	2.5		
30		10.0	6.5	5.0	4.5	3.5	3.0	2.5		
20		11.0	7.5	5.5	4.5	4.0	3.5	3.0		
10		12.0	8.0	6.0	5.0	4.0	3.5	3.0		
0		12.5	8.5	6.5	5.5	4.5	3.5	3.0		
Observed Reading	Scales 15-N, 30-N, 45-N N Brale Diamond Indenter Diameter of Specimen - inches (mm)									
	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
	90	0	0	0	0	0	0	0	0	NA
85	0.5	0.5	0.5	0.5	0	0	0	0		
80	1.0	0.5	0.5	0.5	0.5	0	0	0		
75	1.5	1.0	0.5	0.5	0.5	0.5	0	0		
70	2.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5		
65	2.5	1.5	1.0	0.5	0.5	0.5	0.5	0.5		
60	3.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5		
55	3.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5		
50	3.5	2.0	1.5	1.0	1.0	1.0	1.0	0.5		
45	4.0	2.0	1.5	1.0	1.0	1.0	1.0	1.0		
40	4.5	2.5	1.5	1.5	1.0	1.0	1.0	1.0		
35	5.0	2.5	2.0	1.5	1.0	1.0	1.0	1.0		
30	5.5	3.0	2.0	1.5	1.5	1.0	1.0	1.0		
25	5.5	3.0	2.0	1.5	1.5	1.5	1.5	1.0		
20	6.0	3.0	2.0	1.5	1.5	1.5	1.5	1.5		
Observed Reading	Scales 15-T, 30-T, 45-T 1/16-in Ball Indenter Diameter of Specimen - inches (mm)									
	1/8 (3.2)	1/4 (6.4)	3/8 (10)	1/2 (13)	5/8 (16)	3/4 (19)	7/8 (22)	1 (25)	1-1/4 (32)	1-1/2 (38)
	90	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0.5	NA
80	3.0	2.0	1.5	1.5	1.0	1.0	1.0	0.5		
70	5.0	3.5	2.5	2.0	1.5	1.0	1.0	1.0		
60	6.5	4.5	3.0	2.5	2.0	1.5	1.5	1.5		
50	8.5	5.5	4.0	3.0	2.5	2.0	2.0	1.5		
40	10.0	6.5	4.5	3.5	3.0	2.5	2.0	2.0		
30	11.5	7.5	5.0	3.5	3.5	2.5	2.0	2.0		
20	13.0	9.0	6.0	4.5	4.5	3.0	2.0	2.0		

These corrections are approximate only and represent the averages to the nearest 1/2 Rockwell number.



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Hardened Steel and Hardened Alloys

Rockwell			Superficial			Vickers	Knoop	Brinell	Tensile Strength	Micro-ficial	
C	A	D	G	15-N	30-N	45-N	HV	HK	HB	KSI	WMN
150 kg Brale	60 kg Brale	100 kg Brale	150 kg 1/16" ball	15 kg N Brale	30 kg N Brale	45 kg N Brale	10 kg	500 gm and over	3000 kg 10 mm ball	1000 lbs/sq in	1000 gm
80	92.0	86.5	↑	96.5	92.0	87.0	1865	-	↑	↑	-
79	91.5	85.5	↑	96.3	91.5	86.5	1787	-	↑	↑	-
78	91.0	84.5	↑	96.0	91.0	85.5	1710	-	↑	↑	-
77	90.5	84.0	↑	95.8	90.5	84.5	1633	-	↑	↑	-
76	90.0	83.0	↑	95.5	90.0	83.5	1556	-	↑	↑	-
75	89.5	82.5	↑	95.3	89.0	82.5	1478	-	↑	↑	-
74	89.0	81.5	↑	95.0	88.5	81.5	1400	-	↑	↑	-
73	88.5	81.0	↑	94.8	88.0	80.5	1323	-	↑	↑	-
72	88.0	80.0	↑	94.5	87.0	79.5	1245	-	↑	↑	-
71	87.0	79.5	↑	94.3	86.5	78.5	1160	-	↑	↑	-
70	86.5	78.5	↑	94.0	86.0	77.5	1076	972	NOTE 1	NOTE 2	953
69	86.0	78.0	↑	93.5	85.0	76.5	1004	946	↑	↑	949
68	85.6	76.9	↑	93.2	84.4	75.4	940	920	↑	↑	945
67	85.0	76.1	↑	92.9	83.6	74.2	900	895	↑	↑	942
66	84.5	75.4	↑	92.5	82.8	73.3	865	870	NA	↑	938
65	83.9	74.5	↑	92.2	81.9	72.0	832	846	739	↑	934
64	83.4	73.8	↑	91.8	81.1	71.0	800	822	722	↑	930
63	82.8	73.0	↑	91.4	80.1	69.9	772	799	706	↑	926
62	82.3	72.2	↑	91.1	79.3	68.8	746	776	688	↑	922
61	81.8	71.5	↑	90.7	78.4	67.7	720	754	670	↑	917
60	81.2	70.7	↑	90.2	77.5	66.6	697	732	654	NA	913
59	80.7	69.9	↑	89.8	76.6	65.5	674	710	634	↑	909
58	80.1	69.2	↑	89.3	75.7	64.3	653	690	615	↑	904
57	79.6	68.5	↑	88.9	74.8	63.2	633	670	595	↑	900
56	79.0	67.7	↑	88.3	73.9	62.0	613	650	577	↑	896
55	78.5	66.9	↑	87.9	73.0	60.9	595	630	560	↑	891
54	78.0	66.1	↑	87.4	72.0	59.8	577	612	543	↑	887
53	77.4	65.4	↑	86.9	71.2	58.6	560	594	525	↑	883
52	76.8	64.6	↑	86.4	70.2	57.4	544	576	512	↑	879
51	76.3	63.8	↑	85.9	69.4	56.1	528	558	496	↑	874
50	75.9	63.1	↑	85.5	68.5	55.0	513	542	481	↑	870
49	75.2	62.1	↑	85.0	67.6	53.8	498	526	469	↑	865
48	74.7	61.4	↑	84.5	66.7	52.5	484	510	455	↑	861
47	74.1	60.8	↑	83.9	65.8	51.4	471	495	443	↑	856
46	73.6	60.0	↑	83.5	64.8	50.3	458	480	432	↑	851
45	73.1	59.2	↑	83.0	64.0	49.0	446	466	421	↑	847
44	72.5	58.5	↑	82.5	63.1	47.8	434	452	409	↑	842
43	72.0	57.7	↑	82.0	62.2	46.7	423	438	400	↑	837
42	71.5	56.9	↑	81.5	61.3	45.5	412	426	390	↑	832
41	70.9	56.2	↑	80.9	60.4	44.3	402	414	381	↑	827
40	70.4	55.4	↑	80.4	59.5	43.1	392	402	371	↑	822
39	69.9	54.6	↑	79.9	58.6	41.9	382	391	362	↑	817
38	69.4	53.8	↑	79.4	57.7	40.8	372	380	353	↑	812
37	68.9	53.1	↑	78.8	56.8	39.6	363	370	344	↑	807
36	68.4	52.3	↑	78.3	55.9	38.4	354	360	336	↑	802
35	67.9	51.5	↑	77.7	55.0	37.2	345	351	327	↑	798
34	67.4	50.8	↑	77.2	54.2	36.1	336	342	319	↑	793
33	66.8	50.0	↑	76.6	53.3	34.9	327	334	311	↑	788
32	66.3	49.2	↑	76.1	52.1	33.7	318	326	301	↑	783
31	65.8	48.4	NA	75.6	51.3	32.5	310	318	294	↑	778
30	65.3	47.7	92.0	75.0	50.4	31.3	302	311	286	↑	773
29	64.6	47.0	91.0	74.5	49.5	30.1	294	304	279	↑	768
28	64.3	46.1	90.0	73.9	48.6	28.9	286	297	271	↑	762
27	63.8	45.2	89.0	73.3	47.7	27.8	279	290	264	↑	757
26	63.3	44.6	88.0	72.8	46.8	26.7	272	284	258	↑	751
25	62.8	43.8	87.0	72.2	45.9	25.5	266	278	253	↑	746
24	62.4	43.1	86.0	71.6	45.0	24.3	260	272	247	↑	741
23	62.0	42.1	84.5	71.0	44.0	23.1	254	266	243	↑	736
22	61.5	41.6	83.5	70.5	43.2	22.0	248	261	237	↑	730
21	61.0	40.9	82.5	69.9	42.3	20.7	243	256	231	↑	725
20	60.5	40.1	81.0	69.4	41.5	19.6	238	251	226	↑	720

Note
 1: A 10 mm steel ball was used for 450 BHN and below. A 10 mm carbide ball was used above 450 BHN.
 2: The tensile strength relation to hardness is not exact, even for steel, unless it is determined for a specific material.

Conversions

All values, except WMN, are consistent with ASTM E140 Tables 1 and 2, and ASTM A370 Tables 3A and 3B, where applicable. WMN or Wilson Microficial Numbers were developed by Wilson Instruments in the Wilson Standards laboratory and are not derived from ASTM.

Cylindrical Corrections Values are consistent with ASTM E18 Table 6,7,13, and 14
 Hardness vs. Minimum Thickness Values are consistent with ASTM E18 Tables 4, 5, 11, and 12 except for D and G scale values, which are obtained from indentation hardness testing by Vincent E. Lysaght.



Soft Steel, Grey and Malleable Cast Iron and Most Non-Ferrous Metals

Rockwell						Superficial			Knoop	Brinell		Tensile Strength	Micro-ficial	
B	F	G	A	E	H	K	15-T	30-T	45-T	HK	HB	HB HV	KSI	WMN
100 kg 1/16" ball	60 kg 1/16" ball	150 kg 1/16" ball	60 kg Brale	100 kg 1/8" ball	60 kg 1/8" ball	150 kg 1/8" ball	15 kg 1/16" ball	30 kg 1/16" ball	45 kg 1/16" ball	500 gm and over	500 kg 10 mm ball	3000 kg 10 kg	1000 lbs/sq in	1000 gm
100	↑	82.5	61.5	↑	↑	↑	93.1	83.1	72.9	251	201	240	116	730
99	↑	81.0	60.9	↑	↑	↑	92.8	82.5	71.9	246	195	234	114	725
98	↑	79.0	60.2	↑	↑	↑	92.5	81.8	70.9	241	189	228	109	719
97	↑	77.5	59.5	↑	↑	↑	92.1	81.1	69.9	236	184	222	104	713
96	↑	76.0	58.9	↑	↑	↑	91.8	80.4	68.9	231	179	216	102	707
95	↑	74.0	58.3	↑	↑	↑	91.5	79.8	67.9	226	175	210	100	701
94	↑	72.5	57.6	↑	↑	↑	91.2	79.1	66.9	221	171	205	98	696
93	↑	71.0	57.0	↑	↑	↑	90.8	78.4	65.9	216	167	200	94	690
92	↑	69.0	56.4	↑	↑	↑	90.5	77.8	64.8	211	163	195	92	684
91	↑	67.5	55.8	↑	↑	↑	90.2	77.1	63.8	206	160	190	90	679
90	↑	66.0	55.2	↑	↑	↑	89.8	76.4	62.8	201	157	185	89	674
89	↑	64.0	54.6	↑	↑	↑	89.5	75.8	61.8	196	154	180	88	668
88	↑	62.5	54.0	↑	↑	↑	89.2	75.1	60.8	192	151	176	86	662
87	↑	61.0	53.4	↑	↑	↑	88.9	74.4	59.8	188	148	172	84	656
86	↑	59.0	52.8	↑	↑	↑	88.6	73.8	58.8	184	145	169	83	651
85	↑	57.5	52.3	↑	↑	↑	88.2	73.1	57.8	180	142	165	82	646
84	↑	56.0	51.7	↑	↑	↑	87.9	72.4	56.8	176	140	162	81	640
83	↑	54.0	51.1	↑	↑	↑	87.6	71.8	55.8	173	137	159	80	634
82	↑	52.5	50.6	↑	↑	↑	87.3	71.1	54.8	170	135	156	77	629
81	↑	51.0	50.0	↑	↑	↑	86.9	70.4	53.8	167	133	153	73	624
80	↑	49.0	49.5	↑	↑	↑	86.6	69.7	52.8	164	130	150	72	618
79	↑	47.5	48.9	↑	↑	↑	86.3	69.1	51.8	161	128	147	70	612
78	↑	46.0	48.4	↑	↑	↑	86.0	68.4	50.8	158	126	144	69	607
77	↑	44.0	47.9	↑	↑	↑	85.6	67.7	49.8	155	124	141	68	602
76	NA	42.5	47.3	↑	↑	↑	85.3	67.1	48.8	152	122	139	67	596
75	99.6	41.0	46.8	↑	↑	↑	85.0	66.4	47.8	150	120	137	66	592
74	99.1	39.0	46.3	↑	↑	↑	84.7	65.7	46.8	147	118	135	65	587
73	98.5	37.5	45.8	↑	↑	↑	84.3	65.1	45.8	145	116	132	64	581
72	98.0	36.0	45.3	NA	↑	↑	83.9	64.4	44.8	143	114	130	63	576
71	97.4	34.5	44.8	100	↑	↑	83.5	63.7	43.8	141	112	127	62	571
70	96.8	32.5	44.3	99.5	↑	↑	83.1	63.1	42.8	139	110	125	61	566
69	96.2	31.0	43.8	99.0	↑	↑	82.7	62.4	41.8	137	109	123	60	561
68	95.6	29.5	43.3	98.0	↑	↑	82.3	61.7	40.8	135	107	121	59	556
67	95.1	28.0	42.8	97.5	↑	↑	81.9	61.0	39.8	133	106	119	58	551
66	94.5	26.5	42.3	97.0	↑	↑	81.5	60.4	38.7	131	104	117	57	546
65	93.9	25.0	41.8	96.0	↑	↑	81.1	59.7	37.7	129	102	116	56	542
64	93.4	23.5	41.4	95.5	↑	↑	80.7	59.0	36.7	127	101	114	NA	537
63	92.8	22.0	40.9	95.0	↑	↑	80.3	58.4	35.7	125	99	112	53	532
62	92.2	20.5	40.4	94.5	↑	↑	80.0	57.7	34.7	124	98	110	52	527
61	91.7	19.0	40.0	93.5	↑	↑	79.6	57.0	33.7	122	96	108	51	522
60	91.1</													