

## 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	↑	↑	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	↑	↑	938
65	83.9	74.5	↑	92.2	81.9	72.0	832	846	↑	↑	934
64	83.4	73.8	↑	91.8	81.1	71.0	800	822	↑	↑	930
63	82.8	73.0	↑	91.4	80.1	69.9	772	799	↑	↑	926
62	82.3	72.2	↑	91.1	79.3	68.8	746	776	↑	↑	922
61	81.8	71.5	↑	90.7	78.4	67.7	720	754	↑	↑	917
60	81.2	70.7	↑	90.2	77.5	66.6	697	732	↑	↑	913
59	80.7	69.9	↑	89.8	76.6	65.5	674	710	↑	↑	909
58	80.1	69.2	↑	89.3	75.7	64.3	653	690	↑	↑	904
57	79.6	68.5	↑	88.9	74.8	63.2	633	670	↑	↑	900
56	79.0	67.7	↑	88.3	73.9	62.0	613	650	↑	↑	896
55	78.5	66.9	↑	87.9	73.0	60.9	595	630	↑	↑	891
54	78.0	66.1	↑	87.4	72.0	59.8	577	612	↑	↑	887
53	77.4	65.4	↑	86.9	71.2	58.6	560	594	↑	↑	883
52	76.8	64.6	↑	86.4	70.2	57.4	544	576	↑	↑	879
51	76.3	63.8	↑	85.9	69.4	56.1	528	558	↑	↑	874
50	75.9	63.1	↑	85.5	68.5	55.0	513	542	↑	↑	870
49	75.2	62.1	↑	85.0	67.6	53.8	498	526	↑	↑	865
48	74.7	61.4	↑	84.5	66.7	52.5	484	510	↑	↑	861
47	74.1	60.8	↑	83.9	65.8	51.4	471	495	↑	↑	856
46	73.6	60.0	↑	83.5	64.8	50.3	458	480	↑	↑	851
45	73.1	59.2	↑	83.0	64.0	49.0	446	466	↑	↑	847
44	72.5	58.5	↑	82.5	63.1	47.8	434	452	↑	↑	842
43	72.0	57.7	↑	82.0	62.2	46.7	423	438	↑	↑	837
42	71.5	56.9	↑	81.5	61.3	45.5	412	426	↑	↑	832
41	70.9	56.2	↑	80.9	60.4	44.3	402	414	↑	↑	827
40	70.4	55.4	↑	80.4	59.5	43.1	392	402	↑	↑	822
39	69.9	54.6	↑	79.9	58.6	41.9	382	391	↑	↑	817
38	69.4	53.8	↑	79.4	57.7	40.8	372	380	↑	↑	812
37	68.9	53.1	↑	78.8	56.8	39.6	363	370	↑	↑	807
36	68.4	52.3	↑	78.3	55.9	38.4	354	360	↑	↑	802
35	67.9	51.5	↑	77.7	55.0	37.2	345	351	↑	↑	798
34	67.4	50.8	↑	77.2	54.2	36.1	336	342	↑	↑	793
33	66.8	50.0	↑	76.6	53.3	34.9	327	334	↑	↑	788
32	66.3	49.2	↑	76.1	52.1	33.7	318	326	↑	↑	783
31	65.8	48.4	NA	75.6	51.3	32.5	310	318	↑	↑	778
30	65.3	47.7	92.0	75.0	50.4	31.3	302	311	↑	↑	773
29	64.6	47.0	91.0	74.5	49.5	30.1	294	304	↑	↑	768
28	64.3	46.1	90.0	73.9	48.6	28.9	286	297	↑	↑	762
27	63.8	45.2	89.0	73.3	47.7	27.8	279	290	↑	↑	757
26	63.3	44.6	88.0	72.8	46.8	26.7	272	284	↑	↑	751
25	62.8	43.8	87.0	72.2	45.9	25.5	266	278	↑	↑	746
24	62.4	43.1	86.0	71.6	45.0	24.3	260	272	↑	↑	741
23	62.0	42.1	84.5	71.0	44.0	23.1	254	266	↑	↑	736
22	61.5	41.6	83.5	70.5	43.2	22.0	248	261	↑	↑	730
21	61.0	40.9	82.5	69.9	42.3	20.7	243	256	↑	↑	725
20	60.5	40.1	81.0	69.4	41.5	19.6	238	251	↑	↑	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.

## 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 <sub>HV</sub>	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	63.0	42.8	139	110	125	61	566
69	96.2	31.0	43.8	99.0	↑	↑	82.7	62.3	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	NA	532
62	92.2	20.5	40.4	94.5	↑	↑	80.0	57.7	34.7	124	98	110	NA	527
61	91.7	19.0	40.0	94.0	↑	↑	79.6	57.0	33.7	122	96	108	NA	522
60	91.1	17.5	39.5	93.5	↑	↑	79.2	56.4	32.7	120	95	107	NA	517
59	90.5	16.0	39.0	93.0	↑	↑	78.8	55.7	31.7	118	94	106	NA	512
58	90.0	14.5	38.6	92.5	↑	↑	78.4	55.0	30.7</					