

Hardness Comparisons for Steel

Approximate Equivalent Hardness Numbers for Brinell Hardness Numbers for Steel(s)

Brinell indentation dia., mm	10mm Standard ball	Brinell hardness ball, 3000-kg Hultgren ball	No. (b) Tungsten carbide ball	Diamond pyramid hardness No.	Rockwell hardness No. [a]				Rockwell superficial hardness No. superficial brale penetrator			Shore scleroscope hardness No.	Tensile strength (approx.), 1000 psi	Brinell indentation dia., mm
					A-scale, 60-kg load, brale penetrator	B scale, 100-kg load, 1/8 in. dia. ball	C-scale, 150-kg load, brale penetrator	D-scale, 100-kg load, brale penetrator	15-N scale, 15-kg load	30N scale, 30-kg load	45-N scale, 45-kg load			
...	...	...	...	640	85.6	...	66.0	75.9	93.2	84.4	75.4	97	...	...
...	...	...	...	920	85.3	...	67.5	75.5	93.0	84.0	74.9	95	...	...
...	...	...	...	900	85.3	...	67.0	76.1	92.9	83.6	74.2	95	...	...
...	...	...	787	840	84.7	...	66.4	75.7	92.7	83.1	73.6	93	...	...
...	...	...	...	860	84.4	...	65.6	75.3	92.5	82.7	73.1	92	...	...
2.25	...	...	745	840	84.1	...	66.3	74.8	92.3	82.2	72.2	91	...	2.25
...	...	...	733	830	83.8	...	64.7	74.3	92.1	81.7	71.8	90	...	...
...	...	...	722	800	83.4	...	64.0	73.8	91.8	81.1	71.0	88	...	...
2.30	...	...	712	...	...	...	...	...	...	...	...	...	...	2.30
...	...	...	710	780	83.0	...	63.3	73.3	91.5	80.4	70.2	87	...	...
...	...	...	898	788	82.8	...	62.5	72.8	91.2	79.7	69.4	86	...	...
...	...	...	884	740	82.2	...	61.8	72.1	91.0	79.1	68.8	...	...	...
2.35	...	...	882	737	82.2	...	61.7	72.0	91.0	79.0	68.5	84	...	...
...	...	...	870	720	81.8	...	61.0	71.5	90.7	78.4	67.7	83	...	...
...	...	...	858	700	81.3	...	60.1	70.8	90.3	77.6	66.7	...	...	...
2.40	...	...	853	697	81.2	...	60.0	70.7	90.2	77.5	66.5	61	...	2.40
...	...	...	847	680	81.1	...	59.7	70.5	90.1	77.2	66.2	...	...	...
...	...	...	838	680	80.8	...	59.2	70.1	89.8	76.8	65.7	83	329	...
...	...	...	830	670	80.8	...	58.6	69.8	89.7	76.4	65.3	...	324	...
2.45	...	...	827	667	80.5	...	58.7	69.7	89.6	76.3	65.1	79	323	2.45
...	...	...	...	677	80.7	...	58.1	70.0	89.8	76.8	65.7	...	328	...
2.50	...	801	601	640	79.8	...	57.3	69.7	89.0	75.1	63.5	77	309	...
...	...	...	...	640	79.8	...	57.3	69.7	89.0	75.1	63.5	...	309	2.60
2.55	...	578	...	640	79.8	...	57.3	69.7	89.0	75.1	63.5	...	309	...
...	...	...	578	...	675	...	56.0	67.7	88.4	73.8	62.1	75	297	2.55
...	...	556	...	607	78.8	...	55.6	67.4	88.1	73.5	61.6	...	293	...
2.60	...	...	555	591	78.4	...	54.7	66.7	87.3	72.7	60.6	73	288	2.60
...	...	334	...	578	78.0	...	54.0	66.1	87.5	72.0	59.8	...	279	...
2.65	...	...	534	569	77.8	...	53.5	65.8	87.2	71.6	59.2	71	274	2.65
...	...	514	...	553	77.1	...	52.5	65.0	87.2	70.7	58.0	...	266	...
2.70	...	...	514	547	76.9	...	52.1	64.7	86.7	70.3	57.6	70	263	2.70
...	...	495	...	539	76.7	...	51.8	64.3	86.5	69.9	56.9	...	259	...
2.75	...	496	...	530	76.4	...	51.1	63.9	86.3	69.6	56.2	...	254	2.75
...	...	...	495	528	76.3	...	51.0	63.8	86.0	69.4	56.1	88	253	...
...	...	...	...	516	75.9	...	50.3	63.2	85.9	68.7	55.2	...	247	...
2.80	...	477	...	508	75.6	...	49.8	62.7	85.6	68.2	54.5	66	243	2.80
...	...	481	...	496	75.1	...	48.8	61.9	85.3	67.4	53.5	...	237	...
2.85	...	461	...	491	74.9	...	48.5	61.7	84.9	67.2	53.2	65	235	2.85
...	...	444	...	474	74.3	...	47.2	61.0	84.7	66.0	51.7	...	225	...
2.90	...	444	...	472	74.2	...	47.1	60.8	84.1	65.8	51.5	63	225	2.90
2.95	429	429	429	465	73.4	...	46.7	59.7	84.0	64.6	49.8	81	217	2.95
3.00	415	415	415	440	72.8	...	44.5	58.8	83.4	63.6	48.4	69	210	3.00
3.05	401	401	401	425	72.0	...	43.1	57.8	82.6	62.3	46.9	59	202	3.05
3.10	388	388	388	410	71.4	...	41.8	56.8	82.0	61.1	45.3	56	195	3.10
3.15	375	375	375	396	70.8	...	40.4	55.7	81.4	59.9	43.8	54	188	3.15
3.20	363	363	363	383	70.0	...	39.1	54.6	80.0	58.7	42.0	52	182	3.20
3.25	352	352	352	372	69.3	(113.0)	37.9	53.8	79.3	57.6	40.5	51	175	3.25
3.30	341	341	341	360	68.7	(108.0)	36.6	52.8	78.6	56.4	39.1	50	170	3.30
3.35	331	331	331	350	68.1	(108.5)	35.5	51.9	78.0	55.4	37.8	48	168	3.35
3.40	321	321	321	339	67.5	(108.0)	34.3	51.0	77.3	54.3	36.4	47	160	3.40
3.45	311	311	311	328	66.9	(107.5)	33.1	50.0	76.7	53.3	34.4	46	155	3.45
3.50	302	302	302	319	66.3	(107.0)	32.1	49.3	76.1	52.2	33.8	45	150	3.50
3.55	293	293	293	309	65.7	(106.0)	30.9	48.3	75.5	51.2	32.4	43	145	3.55
3.60	285	285	285	301	65.3	(105.5)	29.9	47.5	75.0	50.3	31.2	...	141	3.60
3.65	277	277	277	292	64.6	(104.5)	28.8	46.7	74.4	49.3	29.9	41	137	3.65
3.70	269	269	269	284	64.1	(104.0)	27.8	45.9	73.7	48.3	28.6	40	133	3.70
3.75	262	262	262	280	63.0	(103.0)	26.8	45.0	73.1	47.3	27.3	39	129	3.75
3.80	255	255	255	269	63.0	(102.0)	25.4	44.2	72.5	46.2	26.0	38	125	3.80
3.85	249	249	249	261	62.5	(101.0)	24.2	43.2	71.7	45.1	24.5	37	122	3.85
3.90	241	241	241	253	61.8	(100.0)	22.8	42.0	70.9	43.9	22.8	36	118	3.90
3.95	235	235	235	247	61.4	...	21.7	41.4	70.3	42.9	21.6	35	115	3.95
4.00	229	229	229	241	60.8	...	20.5	40.5	69.7	41.9	20.1	34	111	4.00
4.05	223	223	223	234	...	...	19.3	(118.0)	...	...	...	...	...	4.05
4.10	217	217	217	228	...	...	18.4	(117.5)	...	...	...	33	105	4.10
4.20	207	207	207	218	...	...	16.6	(116.2)	...	...	...	32	100	4.20
4.30	197	197	197	207	...	...	15.0	(112.7)	...	...	...	30	95	4.30
4.40	187	187	187	196	...	...	13.7	(110.0)	...	...	...	...	90	4.40
4.50	179	179	179	188	...	...	12.0	(108.0)	...	...	...	27	87	4.50
4.60	170	170	170	178	...	...	10.8	(104)	...	...	...	26	83	4.60
4.70	163	163	163	171	...	...	10.0	(103.0)	...	...	...	25	79	4.70
4.80	156	156	156	163	...	...	9.2	(103.0)	...	...	...	...	76	4.80
4.90	149	149	149	156	...	...	8.0	(103.0)	...	...	...	23	73	4.90
5.00	143	143	143	150	...	...	7.7	...	...	...	...	22	71	5.00
5.10	137	137	137	143	...	...	7.4	...	...	...	...	21	67	5.10
5.20	131	131	131	137	...	...	7.0	...	...	...	...	...	65	5.20
5.30	126	126	126	132	...	...	7.0	...	...	...	...	20	63	5.30
5.40	121	121	121	127	...	...	6.8	...	...	...	...	19	60	5.40
5.50	116	116	116	122	...	...	6.5	...	...	...	...	18	58	5.50
5.60	111	111	111	117	...	...	6.5	...	...	...	...	15	56	5.60

(a) The values in bold face type correspond to the values in the Joint SAE-ASME-ASTM hardness conversions as printed in ASTM E40, Table 3. (b) Brinell numbers are based on the diameter of impressed indentation. If the ball distorts (flattens) during test, Brinell numbers will vary in accordance with the degree of such distortion when related to hardness determined with a Vickers diamond pyramid, Rockwell brale or other penetrator which does not sensibly distort. At high hardness, therefore, the relationship between Brinell and Vickers or Rockwell scales is affected by the type of ball used. Steel balls (standard or Hultgren) tend to flatten slightly more than carbide balls,

resulting in larger indentation and lower Brinell number than shown by a carbide ball. Thus, on a specimen of 640 Vickers, a Hultgren ball will leave a 2.55 mm impression (578 Bhn) and the carbide ball a 2.50 mm impression (617 Bhn). Conversely, identical impression diameters for both types of ball will correspond to different Vickers or Rockwell values. Thus, if both impressions are 2.55 mm (578 Bhn) material tested with a Hultgren ball has a Vickers hardness of 640, while material tested with a carbide ball has a Vickers hardness of 615 (c) Values in parentheses are beyond normal range.