

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 410

TABLES OF BRINELL HARDNESS VALUES (HB)
FOR USE IN TESTS MADE ON FLAT SURFACES

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BRIEF HISTORY

The ISO Recommendation R 410, *Tables of Brinell Hardness Values (HB) for Use in Tests Made on Flat Surfaces*, was drawn up by the Co-ordinating Committee on the Mechanical Testing of Metals (METESCO), the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question began in 1960 and led, in 1962, to the adoption of a document which the METESCO Secretariat turned over to the General Secretariat, with the request that it be subjected to the procedures that Draft ISO Recommendations customarily follow.

In August 1962, this document was circulated, as Draft ISO Recommendation (No. 531) to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications, by the following Member Bodies:

Australia	Germany	Portugal
Austria	India	Republic of South Africa
Belgium	Ireland	Romania
Burma	Italy	Sweden
Canada	Japan	Turkey
Chile	Netherlands	U.A.R.
Czechoslovakia	New Zealand	United Kingdom
Denmark	Norway	U.S.S.R.
Finland	Poland	Yugoslavia

One Member Body opposed the approval of the Draft: France.

The Draft was submitted simultaneously to the Secretariats of all the ISO Technical Committees. It was approved by the Secretariats of the following Technical Committees concerned with the question of mechanical tests:

ISO/TC 2, *Bolts, nuts and accessories.*
ISO/TC 17, *Steel.*
ISO/TC 25, *Cast iron.*
ISO/TC 26, *Copper and copper alloys.*

and was not disapproved by any Secretariat.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in December 1964, to accept it as an ISO RECOMMENDATION.

TABLES OF BRINELL HARDNESS VALUES (HB)
FOR USE IN TESTS MADE ON FLAT SURFACES

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1. TABLES OF BRINELL HARDNESS VALUES (HB)

Without regard to the limitations imposed by practical conditions, the following tables have been calculated from the formula

$$HB = \frac{2F}{\pi D (D - \sqrt{D^2 - d^2})}$$

where

- F* = Test load, in kilogrammes-force,
- D* = Diameter of the ball, in millimetres,
- d* = Diameter of indentation, in millimetres.

The tables cover a range of indentation diameters *d* between 0.25 *D* and 0.6 *D*.

In industrial tests carried out in accordance with ISO Recommendation R 79, *Brinell hardness test for steel*, and with corresponding ISO Recommendations for other metals*, and using testing machines in good order, the main cause of error is the measurement of the diameter of the indentation, and it is unlikely that the accuracy of determination of the mean diameter will be better than ± 1 per cent. This will lead to an error of approximately ± 2 per cent in the hardness value obtained.

NOTE. — The values above 450 HB appear in italic type so as to emphasize that the use of the Brinell test with a steel ball on products having a hardness greater than this value should be avoided. This limitation is not valid for the Modified Brinell test with a tungsten carbide ball, but the hardness obtained refers to a different scale.

* To date, two ISO Recommendations:
ISO Recommendation R 191, *Brinell hardness test for light metals and their alloys*, and
ISO Recommendation R 403, *Brinell hardness test for copper and copper alloys*.

TABLE 1

Diameter of ball 10 mm Load = 3000 kgf F/D² = 30

Diameter of indentation	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
mm										
2.50	601	597	592	587	582	578	573	569	564	560
2.60	555	551	547	543	538	534	530	526	522	518
2.70	514	510	507	503	499	495	492	488	485	481
2.80	477	474	471	467	464	461	457	454	451	448
2.90	444	441	438	435	432	429	426	423	420	417
3.00	415	412	409	406	404	401	398	395	393	390
3.10	388	385	383	380	378	375	373	370	368	366
3.20	363	361	359	356	354	352	350	347	345	343
3.30	341	339	337	335	333	331	329	326	325	323
3.40	321	319	317	315	313	311	309	307	306	304
3.50	302	300	298	297	295	293	292	290	288	286
3.60	285	283	282	280	278	277	275	274	272	271
3.70	269	268	266	265	263	262	260	259	257	256
3.80	255	253	252	250	249	248	246	245	244	242
3.90	241	240	239	237	236	235	234	232	231	230
4.00	229	228	226	225	224	223	222	221	219	218
4.10	217	216	215	214	213	212	211	210	209	208
4.20	207	205	204	203	202	201	200	199	198	198
4.30	197	196	195	194	193	192	191	190	189	188
4.40	187	186	185	185	184	183	182	181	180	179
4.50	179	178	177	176	175	174	174	173	172	171
4.60	170	170	169	168	167	167	166	165	164	164
4.70	163	162	161	161	160	159	158	158	157	156
4.80	156	155	154	154	153	152	152	151	150	150
4.90	149	148	148	147	146	146	145	144	144	143
5.00	143	142	141	141	140	140	139	138	138	137
5.10	137	136	135	135	134	134	133	133	132	132
5.20	131	130	130	129	129	128	128	127	127	126
5.30	126	125	125	124	124	123	123	122	122	121
5.40	121	120	120	119	119	118	118	117	117	116
5.50	116	115	115	114	114	114	113	113	112	112
5.60	111	111	110	110	110	109	109	108	108	107
5.70	107	107	106	106	105	105	105	104	104	103
5.80	103	103	102	102	101	101	101	100	99.9	99.5
5.90	99.2	98.8	98.4	98.0	97.7	97.3	96.9	96.6	96.2	95.9
6.00	95.5	—	—	—	—	—	—	—	—	—

TABLE 2

Diameter of ball = 10 mm Load : 1000 kgf F/D² = 10

Diameter of indentation	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
mm										
2.50	200	199	197	196	194	193	191	190	188	187
2.60	185	184	182	181	179	178	177	175	174	173
2.70	171	170	169	168	166	165	164	163	162	160
2.80	159	158	157	156	155	154	152	151	150	149
2.90	148	147	146	145	144	143	142	141	140	139
3.00	138	137	136	135	135	134	133	132	131	130
3.10	129	128	128	127	126	125	124	123	123	122
3.20	121	120	120	119	118	117	117	116	115	114
3.30	114	113	112	112	111	110	110	109	108	108
3.40	107	106	106	105	104	104	103	102	102	101
3.50	101	100	99.5	98.9	98.3	97.7	97.2	96.6	96.1	95.5
3.60	95.0	94.4	93.9	93.3	92.8	92.3	91.8	91.2	90.7	90.2
3.70	89.7	89.2	88.7	88.2	87.7	87.2	86.8	86.3	85.8	85.3
3.80	84.9	84.4	83.9	83.5	83.0	82.6	82.1	81.7	81.3	80.8
3.90	80.4	80.0	79.5	79.1	78.7	78.3	77.9	77.5	77.1	76.7
4.00	76.3	75.9	75.5	75.1	74.7	74.3	73.9	73.5	73.2	72.8
4.10	72.4	72.0	71.7	71.3	71.0	70.6	70.2	69.9	69.5	69.2
4.20	68.8	68.5	68.2	67.8	67.5	67.1	66.8	66.5	66.2	65.8
4.30	65.5	65.2	64.9	64.6	64.2	63.9	63.6	63.3	63.0	62.7
4.40	62.4	62.1	61.8	61.5	61.2	60.9	60.6	60.4	60.1	59.8
4.50	59.5	59.2	59.0	58.7	58.4	58.1	57.9	57.6	57.3	57.1
4.60	56.8	56.5	56.3	56.0	55.8	55.5	55.3	55.0	54.8	54.5
4.70	54.3	54.0	53.8	53.5	53.3	53.0	52.8	52.6	52.3	52.1
4.80	51.9	51.6	51.4	51.2	51.0	50.7	50.5	50.3	50.1	49.8
4.90	49.6	49.4	49.2	49.0	48.8	48.6	48.3	48.1	47.9	47.7
5.00	47.5	47.3	47.1	46.9	46.7	46.5	46.3	46.1	45.9	45.7
5.10	45.5	45.3	45.1	45.0	44.8	44.6	44.4	44.2	44.0	43.8
5.20	43.7	43.5	43.3	43.1	42.9	42.8	42.6	42.4	42.2	42.1
5.30	41.9	41.7	41.5	41.4	41.2	41.0	40.9	40.7	40.5	40.4
5.40	40.2	40.0	39.9	39.7	39.6	39.4	39.2	39.1	38.9	38.8
5.50	38.6	38.5	38.3	38.2	38.0	37.9	37.7	37.6	37.4	37.3
5.60	37.1	37.0	36.8	36.7	36.5	36.4	36.3	36.1	36.0	35.8
5.70	35.7	35.6	35.4	35.3	35.1	35.0	34.9	34.7	34.6	34.5
5.80	34.3	34.2	34.1	33.9	33.8	33.7	33.6	33.4	33.3	33.2
5.90	33.1	32.9	32.8	32.7	32.6	32.4	32.3	32.2	32.1	32.0
6.00	31.8	---	---	---	---	---	---	---	---	---

TABLE 3

Diameter of ball = 10 mm Load = 500 kgf F/D² = 5

Diameter of indentation	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
mm										
2.50	100	99.4	98.6	97.8	97.1	96.3	95.5	94.8	94.0	93.3
2.60	92.6	91.8	91.1	90.4	89.7	89.0	88.4	87.7	87.0	86.4
2.70	85.7	85.1	84.4	83.8	83.2	82.6	81.9	81.3	80.8	80.2
2.80	79.6	79.0	78.4	77.9	77.3	76.8	76.2	75.7	75.1	74.6
2.90	74.1	73.6	73.0	72.5	72.0	71.5	71.0	70.5	70.1	69.6
3.00	69.1	68.6	68.2	67.7	67.3	66.8	66.4	65.9	65.5	65.0
3.10	64.6	64.2	63.8	63.3	62.9	62.5	62.1	61.7	61.3	60.9
3.20	60.5	60.1	59.8	59.4	59.0	58.6	58.3	57.9	57.5	57.2
3.30	56.8	56.5	56.1	55.8	55.4	55.1	54.8	54.4	54.1	53.8
3.40	53.4	53.1	52.8	52.5	52.2	51.8	51.5	51.2	50.9	50.6
3.50	50.3	50.0	49.7	49.4	49.2	48.9	48.6	48.3	48.0	47.7
3.60	47.5	47.2	46.9	46.7	46.4	46.1	45.9	45.6	45.4	45.1
3.70	44.9	44.6	44.4	44.1	43.9	43.6	43.4	43.1	42.9	42.7
3.80	42.4	42.2	42.0	41.7	41.5	41.3	41.1	40.9	40.6	40.4
3.90	40.2	40.0	39.8	39.6	39.4	39.1	38.9	38.7	38.5	38.3
4.00	38.1	37.9	37.7	37.5	37.3	37.1	37.0	36.8	36.6	36.4
4.10	36.2	36.0	35.8	35.7	35.5	35.3	35.1	34.9	34.8	34.6
4.20	34.4	34.2	34.1	33.9	33.7	33.6	33.4	33.2	33.1	32.9
4.30	32.8	32.6	32.4	32.3	32.1	32.0	31.8	31.7	31.5	31.4
4.40	31.2	31.1	30.9	30.8	30.6	30.5	30.3	30.2	30.0	29.9
4.50	29.8	29.6	29.5	29.3	29.2	29.1	28.9	28.8	28.7	28.5
4.60	28.4	28.3	28.1	28.0	27.9	27.8	27.6	27.5	27.4	27.3
4.70	27.1	27.0	26.9	26.8	26.6	26.5	26.4	26.3	26.2	26.1
4.80	25.9	25.8	25.7	25.6	25.5	25.4	25.3	25.1	25.0	24.9
4.90	24.8	24.7	24.6	24.5	24.4	24.3	24.2	24.1	24.0	23.9
5.00	23.8	23.7	23.6	23.5	23.4	23.3	23.2	23.1	23.0	22.9
5.10	22.8	22.7	22.6	22.5	22.4	22.3	22.2	22.1	22.0	21.9
5.20	21.8	21.7	21.6	21.6	21.5	21.4	21.3	21.2	21.1	21.0
5.30	20.9	20.9	20.8	20.7	20.6	20.5	20.4	20.3	20.3	20.2
5.40	20.1	20.0	19.9	19.9	19.8	19.7	19.6	19.5	19.5	19.4
5.50	19.3	19.2	19.2	19.1	19.0	18.9	18.9	18.8	18.7	18.6
5.60	18.6	18.5	18.4	18.3	18.3	18.2	18.1	18.1	18.0	17.9
5.70	17.8	17.8	17.7	17.6	17.6	17.5	17.4	17.4	17.3	17.2
5.80	17.2	17.1	17.0	17.0	16.9	16.8	16.8	16.7	16.7	16.6
5.90	16.5	16.5	16.4	16.3	16.3	16.2	16.2	16.1	16.0	16.0
6.00	15.9	—	—	—	—	—	—	—	—	—

TABLE 4

Diameter of ball = 10 mm Load = 100 kgf F/D² = 1

Diameter of indentation	0.00		0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
mm										
2.50	20.0	19.9	19.7	19.6	19.4	19.3	19.1	19.0	18.8	18.7
2.60	18.5	18.4	18.2	18.1	17.9	17.8	17.7	17.5	17.4	17.3
2.70	17.1	17.0	16.9	16.8	16.6	16.5	16.4	16.3	16.2	16.0
2.80	15.9	15.8	15.7	15.6	15.5	15.4	15.2	15.1	15.0	14.9
2.90	14.8	14.7	14.6	14.5	14.4	14.3	14.2	14.1	14.0	13.9
3.00	13.8	13.7	13.6	13.5	13.5	13.4	13.3	13.2	13.1	13.0
3.10	12.9	12.8	12.8	12.7	12.6	12.5	12.4	12.3	12.3	12.2
3.20	12.1	12.0	11.9	11.8	11.7	11.7	11.6	11.5	11.5	11.4
3.30	11.4	11.3	11.2	11.2	11.1	11.0	11.0	10.9	10.8	10.8
3.40	10.7	10.6	10.6	10.5	10.4	10.4	10.3	10.2	10.2	10.1
3.50	10.1	10.0	9.95	9.89	9.83	9.77	9.72	9.66	9.61	9.55
3.60	9.50	9.44	9.39	9.33	9.28	9.23	9.18	9.12	9.07	9.02
3.70	8.97	8.92	8.87	8.82	8.77	8.72	8.68	8.63	8.58	8.53
3.80	8.49	8.44	8.39	8.35	8.30	8.26	8.21	8.17	8.13	8.08
3.90	8.04	8.00	7.95	7.91	7.87	7.83	7.79	7.75	7.71	7.67
4.00	7.63	7.59	7.55	7.51	7.47	7.43	7.39	7.35	7.32	7.28
4.10	7.24	7.20	7.17	7.13	7.10	7.06	7.02	6.99	6.95	6.92
4.20	6.88	6.85	6.82	6.78	6.75	6.71	6.68	6.65	6.62	6.58
4.30	6.55	6.52	6.49	6.46	6.42	6.39	6.36	6.33	6.30	6.27
4.40	6.24	6.21	6.18	6.15	6.12	6.09	6.06	6.04	6.01	5.98
4.50	5.95	5.92	5.90	5.87	5.84	5.81	5.79	5.76	5.73	5.71
4.60	5.68	5.65	5.63	5.60	5.58	5.55	5.53	5.50	5.48	5.45
4.70	5.43	5.40	5.38	5.35	5.33	5.30	5.28	5.26	5.23	5.21
4.80	5.19	5.16	5.14	5.12	5.10	5.07	5.05	5.03	5.01	4.98
4.90	4.96	4.94	4.92	4.90	4.88	4.86	4.83	4.81	4.79	4.77
5.00	4.75	4.73	4.71	4.69	4.67	4.65	4.63	4.61	4.59	4.57
5.10	4.55	4.53	4.51	4.50	4.48	4.46	4.44	4.42	4.40	4.38
5.20	4.37	4.35	4.33	4.31	4.29	4.28	4.26	4.24	4.22	4.21
5.30	4.19	4.17	4.15	4.14	4.12	4.10	4.09	4.07	4.05	4.04
5.40	4.02	4.00	3.99	3.97	3.96	3.94	3.92	3.91	3.89	3.88
5.50	3.86	3.85	3.83	3.82	3.80	3.79	3.77	3.76	3.74	3.73
5.60	3.71	3.70	3.68	3.67	3.65	3.64	3.63	3.61	3.60	3.58
5.70	3.57	3.56	3.54	3.53	3.51	3.50	3.49	3.47	3.46	3.45
5.80	3.43	3.42	3.41	3.39	3.38	3.37	3.36	3.34	3.33	3.32
5.90	3.31	3.29	3.28	3.27	3.26	3.24	3.23	3.22	3.21	3.20
6.00	3.18	—	—	—	—	—	—	—	—	—

TABLE 5

Diameter of ball = 5 mm Load = 750 kgf F/D² = 30

Diameter of indentation	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
mm										
1.20	---	---	---	---	---	601	592	582	573	564
1.30	555	547	538	530	522	514	507	499	492	485
1.40	477	471	464	457	451	444	438	432	426	420
1.50	415	409	404	398	393	388	383	378	373	368
1.60	363	359	354	350	345	341	337	333	329	325
1.70	321	317	313	309	306	302	298	295	292	288
1.80	285	282	278	275	272	269	266	263	260	257
1.90	255	252	249	246	244	241	239	236	234	231
2.00	229	226	224	222	219	217	215	213	211	209
2.10	207	204	202	200	198	197	195	193	191	189
2.20	187	185	184	182	180	179	177	175	174	172
2.30	170	169	167	166	164	163	161	160	158	157
2.40	156	154	153	152	150	149	148	146	145	144
2.50	143	141	140	139	138	137	135	134	133	132
2.60	131	130	129	128	127	126	125	124	123	122
2.70	121	120	119	118	117	116	115	114	113	112
2.80	111	110	110	109	108	107	106	105	105	104
2.90	103	102	101	101	99.9	99.2	98.4	97.7	96.9	96.2
3.00	95.5	---	---	---	---	---	---	---	---	---

TABLE 6

Diameter of ball = 5 mm Load = 250 kgf F/D² = 10

Diameter of indentation	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
mm										
1.20	---	---	---	---	---	200	197	194	191	188
1.30	185	182	179	177	174	171	169	166	164	162
1.40	159	157	155	152	150	148	146	144	142	140
1.50	138	136	135	133	131	129	128	126	124	123
1.60	121	120	118	117	115	114	112	111	110	108
1.70	107	106	104	103	102	101	99.5	98.3	97.2	96.1
1.80	95.0	93.9	92.8	91.8	90.7	89.7	88.7	87.7	86.8	85.8
1.90	84.9	83.9	83.0	82.1	81.3	80.4	79.5	78.7	77.9	77.1
2.00	76.3	75.5	74.7	73.9	73.2	72.4	71.7	71.0	70.2	69.5
2.10	68.8	68.2	67.5	66.8	66.2	65.5	64.9	64.2	63.6	63.0
2.20	62.4	61.8	61.2	60.6	60.1	59.5	59.0	58.4	57.9	57.3
2.30	56.8	56.3	55.8	55.3	54.8	54.3	53.8	53.3	52.8	52.3
2.40	51.9	51.4	51.0	50.5	50.1	49.6	49.2	48.8	48.3	47.9
2.50	47.5	47.1	46.7	46.3	45.9	45.5	45.1	44.8	44.4	44.0
2.60	43.7	43.3	42.9	42.6	42.2	41.9	41.5	41.2	40.9	40.5
y.70	40.2	39.9	39.6	39.2	38.9	38.6	38.3	38.0	37.7	37.4
y.80	37.1	36.8	36.5	36.3	36.0	35.7	35.4	35.1	34.9	34.6
2.90	34.3	34.1	33.8	33.6	33.3	33.1	32.8	32.6	32.3	32.1
3.00	31.8	---	---	---	---	---	---	---	---	---