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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 409

TABLES OF VICKERS HARDNESS VALUES (HV) FOR METALLIC MATERIALS

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BRIEF HISTORY

The ISO Recommendation R 409, *Tables of Vickers Hardness Values (HV) for Metallic Materials*, was drawn up by 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 May 1962, this document was circulated, as Draft ISO Recommendation (No. 515) to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications, by the following Member Bodies:

Australia	France	Poland
Austria	Germany	Romania
Belgium	Hungary	Sweden
Canada	India	Turkey
Chile	Israel	United Kingdom
Czechoslovakia	Italy	U.S.S.R.
Colombia	Mexico	Yugoslavia
Denmark	Netherlands	
Finland	New Zealand	

No Member Body opposed the approval of the Draft.

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 17, *Steel*.
ISO/TC 25, *Cast iron*.

and was disapproved by the Secretariats of the following Technical Committees:

ISO/TC 2, *Bolts, nuts and accessories*.
ISO/TC 26, *Copper and copper alloys*.
ISO/TC 79, *Light Metals and their Alloys*.
ISO/TC 82, *Mining*.

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

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TABLES OF VICKERS HARDNESS VALUES (HV)
FOR METALLIC MATERIALS

This ISO Recommendation contains

1. TABLES OF VICKERS HARDNESS VALUES (HV)
FOR USE IN TESTS MADE ON FLAT SURFACES

The following tables, for loads of 1, 2.5, 3, 5, 10, 20, 30, 50 and 100 kgf have been calculated from the formula below:

$$\text{Vickers hardness (HV)} = \frac{2F \sin \dfrac{136°}{2}}{d^2}$$

where F = applied load,

d = mean diagonal,

$136°$ = angle of the vertex, between two opposite faces of the indenter,

without regard to the limitations imposed by practical conditions.

In industrial tests carried out in accordance with this ISO Recommendation, using testing machines in good order, the principal limitation will arise in the measurement of the diagonals of the indentation, and it is unlikely that the accuracy of determination of the mean diagonal will be better than $\pm$ 0.001 mm. The corresponding accuracy in the resulting hardness value may be obtained from the graph reproduced at the end of the tables (Figure, page 31) which shows the change of hardness value equivalent to a change of 0.001 mm in the length of the mean diagonal for various loads at different levels of hardness.

NOTES

1. The tables are calculated on the basis of k = 1.8543678 where k = 2 sin 68°.

2. For workshop conditions, it is recommended that Vickers hardness values above 100 HV should be rounded off to round numbers and that all values below 100 HV should be taken to the first decimal place. The accurate values shown in these tables are essential for testing the hardness of blocks for calibrating Vickers hardness testing machines.

TABLE 1

Load = 1 kgf

Mean diagonal of indentation mm	Change in length of mean diagonal									
	0.000	+ 0.001 mm	+ 0.002 mm	+ 0.003 mm	+ 0.004 mm	+ 0.005 mm	+ 0.006 mm	+ 0.007 mm	+ 0.008 mm	+ 0.009 mm
0.03	2060	1930	1811	1703	1604	1514	1431	1355	1284	1219
0.04	1159	1103	1051	1003	958	916	876	839	805	772
0.05	742	713	686	660	636	613	591	571	551	533
0.06	515	498	482	467	453	439	426	413	401	389
0.07	378	368	358	348	339	330	321	313	305	297
0.08	290	283	276	269	263	257	251	245	239	234
0.09	229	224	219	214	210	205	201	197	193	189
0.10	185	182	178	175	171	168	165	162	159	156
0.11	153	151	148	145	143	140	138	135	133	131
0.12	129	127	125	123	121	119	117	115	113	111
0.13	110	108	106	105	103	102	100	98.8	97.4	96.0
0.14	94.6	93.3	92.0	90.7	89.4	88.2	87.0	85.8	84.7	83.5
0.15	82.4	81.3	80.3	79.2	78.2	77.2	76.2	75.2	74.3	73.4
0.16	72.4	71.5	70.7	69.8	68.9	68.1	67.3	66.5	65.7	64.9
0.17	64.2	63.4	62.7	62.0	61.2	60.6	59.9	59.2	58.5	57.9
0.18	57.2	56.6	56.0	55.4	54.8	54.2	53.6	53.0	52.5	51.9
0.19	51.4	50.8	50.3	49.8	49.3	48.8	48.3	47.8	47.3	46.8
0.20	46.4	45.9	45.4	45.0	44.6	44.1	43.7	43.3	42.9	42.5
0.21	42.0	41.7	41.3	40.9	40.5	40.1	39.7	39.4	39.0	38.7
0.22	38.3	38.0	37.6	37.3	37.0	36.6	36.3	36.0	35.7	35.4
0.23	35.1	34.8	34.5	34.2	33.9	33.6	33.3	33.0	32.7	32.5
0.24	32.2	31.9	31.7	31.4	31.1	30.9	30.6	30.4	30.2	29.9
0.25	29.7	29.4	29.2	29.0	28.7	28.5	28.3	28.1	27.9	27.6
0.26	27.4	27.2	27.0	26.8	26.6	26.4	26.2	26.0	25.8	25.6
0.27	25.4	25.2	25.1	24.9	24.7	24.5	24.3	24.2	24.0	23.8
0.28	23.7	23.5	23.3	23.2	23.0	22.8	22.7	22.5	22.4	22.2
0.29	22.0	21.9	21.7	21.6	21.5	21.3	21.2	21.0	20.9	20.7
0.30	20.6	20.5	20.3	20.2	20.1	19.9	19.8	19.7	19.5	19.4
0.31	19.3	19.2	19.0	18.9	18.8	18.7	18.6	18.5	18.3	18.2
0.32	18.1	18.0	17.9	17.8	17.7	17.6	17.4	17.3	17.2	17.1
0.33	17.0	16.9	16.8	16.7	16.6	16.5	16.4	16.3	16.2	16.1
0.34	16.04	15.95	15.85	15.76	15.67	15.58	15.49	15.40	15.31	15.22
0.35	15.14	15.05	14.97	14.88	14.80	14.71	14.63	14.55	14.47	14.39
0.36	14.31	14.23	14.15	14.07	14.00	13.92	13.84	13.77	13.69	13.62
0.37	13.55	13.47	13.40	13.33	13.26	13.19	13.12	13.05	12.98	12.91
0.38	12.84	12.77	12.71	12.64	12.58	12.51	12.45	12.38	12.32	12.25
0.39	12.19	12.13	12.07	12.01	11.95	11.89	11.83	11.77	11.71	11.65
0.40	11.59	11.53	11.47	11.42	11.36	11.31	11.25	11.19	11.14	11.09
0.41	11.03	10.98	10.92	10.87	10.82	10.77	10.72	10.66	10.61	10.56
0.42	10.51	10.46	10.41	10.36	10.31	10.27	10.22	10.17	10.12	10.08
0.43	10.03	9.98	9.94	9.89	9.85	9.80	9.75	9.71	9.67	9.62
0.44	9.58	9.53	9.49	9.45	9.41	9.36	9.32	9.28	9.24	9.20
0.45	9.16	9.12	9.08	9.04	9.00	8.96	8.92	8.88	8.84	8.80
0.46	8.76	8.73	8.69	8.65	8.61	8.58	8.54	8.50	8.47	8.43
0.47	8.39	8.36	8.32	8.29	8.25	8.22	8.18	8.15	8.12	8.08
0.48	8.05	8.02	7.98	7.95	7.92	7.88	7.85	7.82	7.79	7.75
0.49	7.72	7.69	7.66	7.63	7.60	7.57	7.54	7.51	7.48	7.45
0.50	7.42	7.39	7.36	7.33	7.30	7.27	7.24	7.21	7.19	7.16
0.51	7.13	7.10	7.07	7.05	7.02	6.99	6.96	6.94	6.91	6.88
0.52	6.86	6.83	6.81	6.78	6.75	6.73	6.70	6.68	6.65	6.63
0.53	6.60	6.58	6.55	6.53	6.50	6.48	6.45	6.43	6.41	6.38
0.54	6.36	6.34	6.31	6.29	6.27	6.24	6.22	6.20	6.17	6.15
0.55	6.13	6.11	6.09	6.06	6.04	6.02	6.00	5.98	5.96	5.93
0.56	5.91	5.89	5.87	5.85	5.83	5.81	5.79	5.77	5.75	5.73
0.57	5.71	5.69	5.67	5.65	5.63	5.61	5.59	5.57	5.55	5.53
0.58	5.51	5.49	5.47	5.46	5.44	5.42	5.40	5.38	5.36	5.35
0.59	5.33	5.31	5.29	5.27	5.26	5.24	5.22	5.20	5.19	5.17
0.60	5.15	5.13	5.12	5.10	5.08	5.07	5.05	5.03	5.02	5.00

TABLE 2

Load   2.5 kgf

Mean diagonal of indentation mm	0.000 mm	+ 0.001 mm	+ 0.002 mm	+ 0.003 mm	+ 0.004 mm	+ 0.005 mm	+ 0.006 mm	+ 0.007 mm	+ 0.008 mm	+ 0.009 mm
					Change in length of mean diagonal					
0.04	2897	2758	2628	2507	2395	2289	2191	2099	2012	1931
0.05	1854	1782	1714	1650	1590	1533	1478	1427	1378	1332
0.06	1288	1246	1206	1168	1132	1097	1064	1033	1003	974
0.07	946	920	894	870	847	824	803	782	762	743
0.08	724	707	689	673	657	642	627	612	599	585
0.09	572	560	548	536	525	514	503	493	483	473
0.10	464	454	446	437	429	420	413	405	397	390
0.11	383	376	370	363	357	351	345	339	333	327
0.12	322	317	311	306	302	297	292	287	283	279
0.13	274	270	266	262	258	254	251	247	243	240
0.14	237	233	230	227	224	220	217	215	212	209
0.15	206	203	201	198	195	193	190	188	186	183
0.16	181	179	177	174	172	170	168	166	164	162
0.17	160	159	157	155	153	151	150	148	146	145
0.18	143	142	140	138	137	135	134	133	131	130
0.19	128	127	126	124	123	122	121	119	118	117
0.20	116	115	114	112	111	110	109	108	107	106
0.21	105	104	103	102	101	100	99.4	98.5	97.5	96.7
0.22	95.8	94.9	94.1	93.2	92.4	91.6	90.8	90.0	89.2	88.4
0.23	87.6	86.9	86.1	85.4	84.7	83.9	83.2	82.5	81.8	81.2
0.24	80.5	79.8	79.2	78.5	77.9	77.2	76.6	76.0	75.4	74.8
0.25	74.2	73.6	73.0	72.4	71.9	71.3	70.7	70.2	69.6	69.1
0.26	68.6	68.1	67.5	67.0	66.5	66.0	65.5	65.0	64.5	64.1
0.27	63.6	63.1	62.7	62.2	61.7	61.3	60.9	60.4	60.0	59.6
0.28	59.1	58.7	58.3	57.9	57.5	57.1	56.7	56.3	55.9	55.5
0.29	55.1	54.7	54.4	54.0	53.7	53.3	52.9	52.6	52.2	51.9
0.30	51.5	51.2	50.8	50.5	50.2	49.8	49.5	49.2	48.9	48.6
0.31	48.2	47.9	47.6	47.3	47.0	46.7	46.4	46.1	45.8	45.6
0.32	45.3	45.0	44.7	44.4	44.2	43.9	43.6	43.4	43.1	42.8
0.33	42.6	42.3	42.1	41.8	41.6	41.3	41.1	40.8	40.6	40.3
0.34	40.1	39.9	39.6	39.4	39.2	38.9	38.7	38.5	38.3	38.1
0.35	37.8	37.6	37.4	37.2	37.0	36.8	36.6	36.4	36.2	36.0
0.36	35.8	35.6	35.4	35.2	35.0	34.8	34.6	34.4	34.2	34.0
0.37	33.9	33.7	33.5	33.3	33.1	33.0	32.8	32.6	32.4	32.3
0.38	32.1	31.9	31.8	31.6	31.4	31.3	31.1	31.0	30.8	30.6
0.39	30.5	30.3	30.2	30.0	29.9	29.7	29.6	29.4	29.3	29.1
0.40	29.0	28.8	28.7	28.5	28.4	28.3	28.1	28.0	27.8	27.7
0.41	27.6	27.4	27.3	27.2	27.0	26.9	26.8	26.7	26.5	26.4
0.42	26.3	26.2	26.0	25.9	25.8	25.7	25.5	25.4	25.3	25.2
0.43	25.1	25.0	24.8	24.7	24.6	24.5	24.4	24.3	24.2	24.1
0.44	23.9	23.8	23.7	23.6	23.5	23.4	23.3	23.2	23.1	23.0
0.45	22.9	22.8	22.7	22.6	22.5	22.4	22.3	22.2	22.1	22.0
0.46	21.9	21.8	21.7	21.6	21.5	21.4	21.35	21.26	21.17	21.08
0.47	20.99	20.90	20.81	20.72	20.63	20.55	20.46	20.38	20.29	20.21
0.48	20.12	20.04	19.95	19.87	19.79	19.71	19.63	19.55	19.47	19.39
0.49	19.31	19.23	19.15	19.07	19.00	18.92	18.84	18.77	18.69	18.62
0.50	18.54	18.47	18.40	18.32	18.25	18.18	18.11	18.04	17.96	17.89
0.51	17.82	17.75	17.68	17.62	17.55	17.48	17.41	17.34	17.28	17.21
0.52	17.14	17.08	17.01	16.95	16.88	16.82	16.76	16.69	16.63	16.57
0.53	16.50	16.44	16.38	16.32	16.26	16.20	16.14	16.08	16.02	15.96
0.54	15.90	15.84	15.78	15.72	15.67	15.61	15.55	15.49	15.44	15.38
0.55	15.33	15.27	15.21	15.16	15.10	15.05	15.00	14.94	14.89	14.84
0.56	14.78	14.73	14.68	14.63	14.57	14.52	14.47	14.42	14.37	14.32
0.57	14.27	14.22	14.17	14.12	14.07	14.02	13.97	13.92	13.88	13.83

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TABLE 2 *(concluded)*

Load   2.5 kgf

Mean diagonal of indentation	Change in length of mean diagonal									
mm	0.000	+ 0.001 mm	+ 0.002 mm	+ 0.003 mm	+ 0.004 mm	+ 0.005 mm	+ 0.006 mm	+ 0.007 mm	+ 0.008 mm	+ 0.009 mm
0.58	13.78	13.73	13.69	13.64	13.59	13.55	13.50	13.45	13.41	13.36
0.59	13.32	13.27	13.23	13.18	13.14	13.09	13.05	13.01	12.96	12.92
0.60	12.88	12.83	12.79	12.75	12.71	12.67	12.62	12.58	12.54	12.50
0.61	12.46	12.42	12.38	12.34	12.30	12.26	12.22	12.18	12.14	12.10
0.62	12.06	12.02	11.98	11.94	11.91	11.87	11.83	11.79	11.75	11.72
0.63	11.68	11.64	11.61	11.57	11.53	11.50	11.46	11.43	11.39	11.35
0.64	11.32	11.28	11.25	11.21	11.18	11.14	11.11	11.07	11.04	11.01
0.65	10.97	10.94	10.91	10.87	10.84	10.81	10.77	10.74	10.71	10.67
0.66	10.64	10.61	10.58	10.55	10.51	10.48	10.45	10.42	10.39	10.36
0.67	10.33	10.30	10.27	10.24	10.21	10.17	10.14	10.11	10.09	10.06
0.68	10.03	10.00	9.97	9.94	9.91	9.88	9.85	9.82	9.79	9.77
0.69	9.74	9.71	9.68	9.65	9.63	9.60	9.57	9.54	9.52	9.49
0.70	9.46	9.43	9.41	9.38	9.35	9.33	9.30	9.27	9.25	9.22
0.71	9.20	9.17	9.14	9.12	9.09	9.07	9.04	9.02	8.99	8.97
0.72	8.94	8.92	8.89	8.87	8.84	8.82	8.80	8.77	8.75	8.72
0.73	8.70	8.68	8.65	8.63	8.60	8.58	8.56	8.53	8.51	8.49
0.74	8.47	8.44	8.42	8.40	8.38	8.35	8.33	8.31	8.29	8.26
0.75	8.24	8.22	8.20	8.18	8.15	8.13	8.11	8.09	8.07	8.05
0.76	8.03	8.01	7.98	7.96	7.94	7.92	7.90	7.88	7.86	7.84
0.77	7.82	7.80	7.78	7.76	7.74	7.72	7.70	7.68	7.66	7.64
0.78	7.62	7.60	7.58	7.56	7.54	7.52	7.50	7.48	7.47	7.45
0.79	7.43	7.41	7.39	7.37	7.35	7.34	7.32	7.30	7.28	7.26
0.80	7.24	7.23	7.21	7.19	7.17	7.15	7.14	7.12	7.10	7.08
0.81	7.07	7.05	7.03	7.01	7.00	6.98	6.96	6.95	6.93	6.91
0.82	6.89	6.88	6.86	6.84	6.83	6.81	6.79	6.78	6.76	6.75
0.83	6.73	6.71	6.70	6.68	6.67	6.65	6.63	6.62	6.60	6.59
0.84	6.57	6.55	6.54	6.52	6.51	6.49	6.48	6.46	6.45	6.43
0.85	6.42	6.40	6.39	6.37	6.36	6.34	6.33	6.31	6.30	6.28
0.86	6.27	6.25	6.24	6.22	6.21	6.20	6.18	6.17	6.15	6.14
0.87	6.12	6.11	6.10	6.08	6.07	6.06	6.04	6.03	6.01	6.00
0.88	5.99	5.97	5.96	5.95	5.93	5.92	5.91	5.89	5.88	5.87
0.89	5.85	5.84	5.83	5.81	5.80	5.79	5.77	5.76	5.75	5.74
0.90	5.72	5.71	5.70	5.69	5.67	5.66	5.65	5.64	5.62	5.61
0.91	5.60	5.59	5.57	5.56	5.55	5.54	5.53	5.51	5.50	5.49
0.92	5.48	5.47	5.45	5.44	5.43	5.42	5.41	5.39	5.38	5.37
0.93	5.36	5.35	5.34	5.33	5.31	5.30	5.29	5.28	5.27	5.26
0.94	5.25	5.24	5.22	5.21	5.20	5.19	5.18	5.17	5.16	5.15
0.95	5.14	5.13	5.12	5.10	5.09	5.08	5.07	5.06	5.05	5.04
0.96	5.03	5.02	5.01	5.00	4.99	4.98	4.97	4.96	4.95	4.94

TABLE 3

Load   3 kgf

Mean diagonal of indentation	Change in length of mean diagonal									
mm	0.000	+0.001 mm	+0.002 mm	+0.003 mm	+0.004 mm	+0.005 mm	+0.006 mm	+0.007 mm	+0.008 mm	+0.009 mm
0.05	2225	2139	2057	1980	1908	1839	1774	1712	1654	1598
0.06	1545	1495	1447	1402	1358	1317	1277	1239	1203	1168
0.07	1135	1104	1073	1044	1016	989	963	938	914	891
0.08	869	848	827	808	788	770	752	735	718	702
0.09	687	672	657	643	630	616	604	591	579	568
0.10	556	545	535	524	514	505	495	486	477	468
0.11	460	452	443	436	428	421	413	406	400	393
0.12	386	380	374	368	362	356	350	345	340	334
0.13	329	324	319	314	310	305	301	296	292	288
0.14	284	280	276	272	268	265	261	257	254	251
0.15	247	244	241	238	235	232	229	226	223	220
0.16	217	215	212	209	207	204	202	199	197	195
0.17	192	190	188	186	184	182	180	178	176	174
0.18	172	170	168	166	164	163	161	159	157	156
0.19	154	152	151	149	148	146	145	143	142	140
0.20	139	138	136	135	134	132	131	130	129	127
0.21	126	125	124	123	121	120	119	118	117	116
0.22	115	114	113	112	111	110	109	108	107	106
0.23	105	104	103	102	101.6	100.7	99.9	99.0	98.2	97.4
0.24	96.6	95.8	95.0	94.2	93.4	92.7	91.9	91.2	90.5	89.7
0.25	89.0	88.3	87.6	86.9	86.2	85.6	84.9	84.2	83.6	82.9
0.26	82.3	81.7	81.0	80.4	79.8	79.2	78.6	78.0	77.5	76.9
0.27	76.3	75.7	75.2	74.6	74.1	73.6	73.0	72.5	72.0	71.5
0.28	71.0	70.5	70.0	69.5	69.0	68.5	68.0	67.5	67.1	66.6
0.29	66.1	65.7	65.2	64.8	64.4	63.9	63.5	63.1	62.6	62.2
0.30	61.8	61.4	61.0	60.6	60.2	59.8	59.4	59.0	58.6	58.3
0.31	57.9	57.5	57.1	56.8	56.4	56.1	55.7	55.4	55.0	54.7
0.32	54.3	54.0	53.7	53.4	53.0	52.7	52.3	52.0	51.7	51.4
0.33	51.1	50.8	50.5	50.2	49.9	49.6	49.3	49.0	48.7	48.4
0.34	48.1	47.8	47.6	47.3	47.0	46.7	46.5	46.2	45.9	45.7
0.35	45.4	45.2	44.9	44.6	44.4	44.1	43.9	43.6	43.4	43.2
0.36	42.9	42.7	42.5	42.2	42.0	41.8	41.5	41.3	41.1	40.9
0.37	40.6	40.4	40.2	40.0	39.8	39.6	39.3	39.1	38.9	38.7
0.38	38.5	38.3	38.1	37.9	37.7	37.5	37.3	37.1	37.0	36.8
0.39	36.6	36.4	36.2	36.0	35.8	35.7	35.5	35.3	35.1	34.9
0.40	34.8	34.6	34.4	34.3	34.1	33.9	33.7	33.6	33.4	33.3
0.41	33.1	32.9	32.8	32.6	32.5	32.3	32.1	32.0	31.8	31.7
0.42	31.5	31.4	31.2	31.1	30.9	30.8	30.7	30.5	30.4	30.2
0.43	30.1	29.9	29.8	29.7	29.5	29.4	29.3	29.1	29.0	28.9
0.44	28.7	28.6	28.5	28.3	28.2	28.1	28.0	27.8	27.7	27.6
0.45	27.5	27.4	27.2	27.1	27.0	26.9	26.8	26.6	26.5	26.4
0.46	26.3	26.2	26.1	26.0	25.8	25.7	25.6	25.5	25.4	25.3
0.47	25.2	25.1	25.0	24.9	24.8	24.7	24.6	24.5	24.3	24.2
0.48	24.1	24.0	23.9	23.8	23.75	23.65	23.55	23.46	23.36	23.26
0.49	23.17	23.08	22.98	22.89	22.80	22.70	22.61	22.52	22.43	22.34
0.50	22.25	22.16	22.08	21.99	21.90	21.81	21.73	21.64	21.56	21.47
0.51	21.39	21.30	21.22	21.14	21.06	20.98	20.89	20.81	20.73	20.65
0.52	20.57	20.49	20.42	20.34	20.26	20.18	20.11	20.03	19.95	19.88
0.53	19.80	19.73	19.66	19.58	19.51	19.44	19.36	19.29	19.22	19.15
0.54	19.08	19.01	18.94	18.87	18.80	18.73	18.66	18.59	18.52	18.46
0.55	18.39	18.32	18.26	18.19	18.13	18.06	18.00	17.93	17.87	17.80
0.56	17.74	17.68	17.61	17.55	17.49	17.43	17.37	17.30	17.24	17.18
0.57	17.12	17.06	17.00	16.94	16.88	16.83	16.77	16.71	16.65	16.59
0.58	16.54	16.48	16.42	16.37	16.31	16.26	16.20	16.15	16.09	16.04

TABLE 3 (concluded)

Load   3 kgf

Mean diagonal of indentation	Change in length of mean diagonal									
mm	0.000	+ 0.001 mm	+ 0.002 mm	+ 0.003 mm	+ 0.004 mm	+ 0.005 mm	+ 0.006 mm	+ 0.007 mm	+ 0.008 mm	+ 0.009 mm
0.59	15.98	15.93	15.87	15.82	15.77	15.71	15.66	15.61	15.56	15.50
0.60	15.45	15.40	15.35	15.30	15.25	15.20	15.15	15.10	15.05	15.00
0.61	14.95	14.90	14.85	14.80	14.76	14.71	14.66	14.61	14.57	14.52
0.62	14.47	14.43	14.38	14.33	14.29	14.24	14.20	14.15	14.11	14.06
0.63	14.02	13.97	13.93	13.88	13.84	13.80	13.75	13.71	13.67	13.62
0.64	13.58	13.54	13.50	13.46	13.41	13.37	13.33	13.29	13.25	13.21
0.65	13.17	13.13	13.09	13.05	13.01	12.97	12.93	12.89	12.85	12.81
0.66	12.77	12.73	12.69	12.66	12.62	12.58	12.54	12.50	12.47	12.43
0.67	12.39	12.36	12.32	12.28	12.25	12.21	12.17	12.14	12.10	12.07
0.68	12.03	12.00	11.96	11.93	11.89	11.86	11.82	11.79	11.75	11.72
0.69	11.68	11.65	11.62	11.58	11.55	11.52	11.48	11.45	11.42	11.39
0.70	11.35	11.32	11.29	11.26	11.22	11.19	11.16	11.13	11.10	11.07
0.71	11.04	11.00	10.97	10.94	10.91	10.88	10.85	10.82	10.79	10.76
0.72	10.73	10.70	10.67	10.64	10.61	10.58	10.55	10.53	10.50	10.47
0.73	10.44	10.41	10.38	10.35	10.33	10.30	10.27	10.24	10.21	10.19
0.74	10.16	10.13	10.10	10.08	10.05	10.02	10.00	9.97	9.94	9.92
0.75	9.89	9.86	9.84	9.81	9.79	9.76	9.73	9.71	9.68	9.66
0.76	9.63	9.61	9.58	9.56	9.53	9.51	9.48	9.46	9.43	9.41
0.77	9.38	9.36	9.33	9.31	9.29	9.26	9.24	9.21	9.19	9.17
0.78	9.14	9.12	9.10	9.07	9.05	9.03	9.00	8.98	8.96	8.94
0.79	8.91	8.89	8.87	8.85	8.82	8.80	8.78	8.76	8.74	8.71
0.80	8.69	8.67	8.65	8.63	8.61	8.58	8.56	8.54	8.52	8.50
0.81	8.48	8.46	8.44	8.42	8.40	8.38	8.35	8.33	8.31	8.29
0.82	8.27	8.25	8.23	8.21	8.19	8.17	8.15	8.13	8.11	8.09
0.83	8.08	8.06	8.04	8.02	8.00	7.98	7.96	7.94	7.92	7.90
0.84	7.88	7.87	7.85	7.83	7.81	7.79	7.77	7.75	7.74	7.72
0.85	7.70	7.68	7.66	7.65	7.63	7.61	7.59	7.57	7.56	7.54
0.86	7.52	7.50	7.49	7.47	7.45	7.44	7.42	7.40	7.38	7.37
0.87	7.35	7.33	7.32	7.30	7.28	7.27	7.25	7.23	7.22	7.20
0.88	7.18	7.17	7.15	7.14	7.12	7.10	7.09	7.07	7.05	7.04
0.89	7.02	7.01	6.99	6.98	6.96	6.94	6.93	6.91	6.90	6.88
0.90	6.87	6.85	6.84	6.82	6.81	6.79	6.78	6.76	6.75	6.73
0.91	6.72	6.70	6.69	6.67	6.66	6.64	6.63	6.62	6.60	6.59
0.92	6.57	6.56	6.54	6.53	6.52	6.50	6.49	6.47	6.46	6.45
0.93	6.43	6.42	6.40	6.39	6.38	6.36	6.35	6.34	6.32	6.31
0.94	6.30	6.28	6.27	6.26	6.24	6.23	6.22	6.20	6.19	6.18
0.95	6.16	6.15	6.14	6.13	6.11	6.10	6.09	6.07	6.06	6.05
0.96	6.04	6.02	6.01	6.00	5.99	5.97	5.96	5.95	5.94	5.92
0.97	5.91	5.90	5.89	5.88	5.86	5.85	5.84	5.83	5.82	5.80
0.98	5.79	5.78	5.77	5.76	5.75	5.73	5.72	5.71	5.70	5.69
0.99	5.68	5.66	5.65	5.64	5.63	5.62	5.61	5.60	5.59	5.57
1.00	5.56	5.55	5.54	5.53	5.52	5.51	5.50	5.49	5.48	5.46
1.01	5.45	5.44	5.43	5.42	5.41	5.40	5.39	5.38	5.37	5.36
1.02	5.35	5.34	5.33	5.32	5.31	5.30	5.28	5.27	5.26	5.25
1.03	5.24	5.23	5.22	5.21	5.20	5.19	5.18	5.17	5.16	5.15
1.04	5.14	5.13	5.12	5.11	5.10	5.09	5.08	5.07	5.07	5.06
1.05	5.05	5.04	5.03	5.02	5.01	5.00	4.99	4.98	4.97	4.96

TABLE 4

Load   5 kgf

Mean diagonal of indentation	Change in length of mean diagonal									
mm	0.000 mm	+ 0.001 mm	+ 0.002 mm	+ 0.003 mm	+ 0.004 mm	+ 0.005 mm	+ 0.006 mm	+ 0.007 mm	+ 0.008 mm	+ 0.009 mm
0.06	2576	2492	2412	2336	2264	2195	2129	2065	2005	1947
0.07	1892	1839	1789	1740	1693	1648	1605	1564	1524	1486
0.08	1449	1413	1379	1346	1314	1283	1254	1225	1197	1171
0.09	1145	1120	1095	1072	1049	1027	1006	985	965	946
0.10	927	909	891	874	857	841	825	810	795	780
0.11	766	753	739	726	713	701	689	677	666	655
0.12	644	633	623	613	603	593	584	575	566	557
0.13	549	540	532	524	516	509	501	494	487	480
0.14	473	466	460	453	447	441	435	429	423	418
0.15	412	407	401	396	391	386	381	376	371	367
0.16	362	358	353	349	345	341	336	332	329	325
0.17	321	317	313	310	306	303	299	296	293	289
0.18	286	283	280	277	274	271	268	265	262	260
0.19	257	254	252	249	246	244	241	239	237	234
0.20	232	229	227	225	223	221	218	216	214	212
0.21	210	208	206	204	202	201	199	197	195	193
0.22	192	190	188	186	185	183	182	180	178	177
0.23	175	174	172	171	169	168	166	165	164	162
0.24	161	160	158	157	156	154	153	152	151	150
0.25	148	147	146	145	144	143	141	140	139	138
0.26	137	136	135	134	133	132	131	130	129	128
0.27	127	126	125	124	123.5	122.6	121.7	120.8	120.0	119.1
0.28	118.3	117.4	116.6	115.8	115.0	114.2	113.4	112.6	111.8	111.0
0.29	110.2	109.5	108.7	108.0	107.3	106.5	105.8	105.1	104.4	103.7
0.30	103.0	102.3	101.7	101.0	100.3	99.7	99.0	98.4	97.7	97.1
0.31	96.5	95.9	95.2	94.6	94.0	93.4	92.9	92.3	91.7	91.1
0.32	90.5	90.0	89.4	88.9	88.3	87.8	87.2	86.7	86.2	85.7
0.33	85.1	84.6	84.1	83.6	83.1	82.6	82.1	81.6	81.2	80.7
0.34	80.2	79.7	79.3	78.8	78.4	77.9	77.4	77.0	76.6	76.1
0.35	75.5	75.3	74.8	74.4	74.0	73.6	73.2	72.7	72.3	71.9
0.36	71.5	71.1	70.8	70.4	70.0	69.6	69.2	68.8	68.5	68.1
0.37	67.7	67.4	67.0	66.6	66.3	65.9	65.6	65.2	64.9	64.5
0.38	64.2	63.9	63.5	63.2	62.9	62.6	62.2	61.9	61.6	61.3
0.39	61.0	60.6	60.3	60.0	59.7	59.4	59.1	58.8	58.5	58.2
0.40	57.9	57.7	57.4	57.1	56.8	56.5	56.2	56.0	55.7	55.4
0.41	55.2	54.9	54.6	54.4	54.1	53.8	53.6	53.3	53.1	52.8
0.42	52.6	52.3	52.1	51.8	51.6	51.3	51.1	50.9	50.6	50.4
0.43	50.1	49.9	49.7	49.5	49.2	49.0	48.8	48.6	48.3	48.1
0.44	47.9	47.7	47.5	47.2	47.0	46.8	46.6	46.4	46.2	46.0
0.45	45.8	45.6	45.4	45.2	45.0	44.8	44.6	44.4	44.2	44.0
0.46	43.8	43.6	43.4	43.3	43.1	42.9	42.7	42.5	42.3	42.2
0.47	42.0	41.8	41.6	41.4	41.3	41.1	40.9	40.8	40.6	40.4
0.48	40.2	40.1	39.9	39.7	39.6	39.4	39.3	39.1	38.9	38.8
0.49	38.6	38.5	38.3	38.1	38.0	37.8	37.7	37.5	37.4	37.2
0.50	37.1	36.9	36.8	36.6	36.5	36.4	36.2	36.1	35.9	35.8
0.51	35.6	35.5	35.4	35.2	35.1	35.0	34.8	34.7	34.6	34.4
0.52	34.3	34.2	34.0	33.9	33.8	33.6	33.5	33.4	33.3	33.1
0.53	33.0	32.9	32.8	32.6	32.5	32.4	32.3	32.2	32.0	31.9
0.54	31.8	31.7	31.6	31.4	31.3	31.2	31.1	31.0	30.9	30.8
0.55	30.7	30.5	30.4	30.3	30.2	30.1	30.0	29.9	29.8	29.7
0.56	29.6	29.5	29.4	29.3	29.1	29.0	28.9	28.8	28.7	28.6
0.57	28.5	28.4	28.3	28.2	28.1	28.0	27.9	27.85	27.75	27.66
0.58	27.56	27.47	27.37	27.28	27.19	27.09	27.00	26.91	26.82	26.73
0.59	26.64	26.55	26.46	26.37	26.28	26.19	26.10	26.01	25.93	25.84

Table 4 *(continued)*

Load 5 kgf

Mean diagonal of indentation	Change in length of mean diagonal									
mm	0.000	+ 0.001 mm	+ 0.002 mm	+ 0.003 mm	+ 0.004 mm	+ 0.005 mm	+ 0.006 mm	+ 0.007 mm	+ 0.008 mm	+ 0.009 mm
0.60	25.76	25.67	25.58	25.50	25.42	25.33	25.25	25.16	25.08	25.00
0.61	24.92	24.84	24.75	24.67	24.59	24.51	24.43	24.36	24.28	24.20
0.62	24.12	24.04	23.97	23.89	23.81	23.74	23.66	23.58	23.51	23.43
0.63	23.36	23.29	23.21	23.14	23.07	22.99	22.92	22.85	22.78	22.71
0.64	22.64	22.57	22.50	22.43	22.36	22.29	22.22	22.15	22.08	22.01
0.65	21.95	21.88	21.81	21.74	21.68	21.61	21.55	21.48	21.41	21.35
0.66	21.29	21.22	21.16	21.09	21.03	20.97	20.90	20.84	20.78	20.72
0.67	20.65	20.59	20.53	20.47	20.41	20.35	20.29	20.23	20.17	20.11
0.68	20.05	19.99	19.93	19.88	19.82	19.76	19.70	19.65	19.59	19.53
0.69	19.47	19.42	19.36	19.31	19.25	19.20	19.14	19.09	19.03	18.98
0.70	18.92	18.87	18.81	18.76	18.71	18.65	18.60	18.55	18.50	18.44
0.71	18.39	18.34	18.29	18.24	18.19	18.14	18.09	18.04	17.99	17.94
0.72	17.89	17.84	17.79	17.74	17.69	17.64	17.59	17.54	17.49	17.45
0.73	17.40	17.35	17.30	17.26	17.21	17.16	17.12	17.07	17.02	16.98
0.74	16.93	16.89	16.84	16.80	16.75	16.71	16.66	16.62	16.57	16.53
0.75	16.48	16.44	16.40	16.35	16.31	16.27	16.22	16.18	16.14	16.09
0.76	16.05	16.01	15.97	15.93	15.88	15.84	15.80	15.76	15.72	15.68
0.77	15.64	15.60	15.56	15.52	15.48	15.44	15.40	15.36	15.32	15.28
0.78	15.24	15.20	15.16	15.12	15.08	15.05	15.01	14.97	14.93	14.89
0.79	14.86	14.82	14.78	14.74	14.71	14.67	14.63	14.60	14.56	14.52
0.80	14.49	14.45	14.42	14.38	14.34	14.31	14.27	14.24	14.20	14.17
0.81	14.13	14.10	14.06	14.03	13.99	13.96	13.92	13.89	13.86	13.82
0.82	13.79	13.76	13.72	13.69	13.66	13.62	13.59	13.56	13.52	13.49
0.83	13.46	13.43	13.39	13.36	13.33	13.30	13.27	13.23	13.20	13.17
0.84	13.14	13.11	13.08	13.05	13.02	12.99	12.95	12.92	12.89	12.86
0.85	12.83	12.80	12.77	12.74	12.71	12.68	12.65	12.62	12.59	12.57
0.86	12.54	12.51	12.48	12.45	12.42	12.39	12.36	12.33	12.31	12.28
0.87	12.25	12.22	12.19	12.16	12.14	12.11	12.08	12.05	12.03	12.00
0.88	11.97	11.95	11.92	11.89	11.86	11.84	11.81	11.78	11.76	11.73
0.89	11.71	11.68	11.65	11.63	11.60	11.57	11.55	11.52	11.50	11.47
0.90	11.45	11.42	11.40	11.37	11.35	11.32	11.30	11.27	11.25	11.22
0.91	11.20	11.17	11.15	11.12	11.10	11.07	11.05	11.03	11.00	10.98
0.92	10.95	10.93	10.91	10.88	10.86	10.84	10.81	10.79	10.77	10.74
0.93	10.72	10.70	10.67	10.65	10.63	10.61	10.58	10.56	10.54	10.52
0.94	10.49	10.47	10.45	10.43	10.40	10.38	10.36	10.34	10.32	10.30
0.95	10.27	10.25	10.23	10.21	10.19	10.17	10.14	10.12	10.10	10.08
0.96	10.06	10.04	10.02	10.00	9.98	9.96	9.94	9.92	9.89	9.87
0.97	9.85	9.83	9.81	9.79	9.77	9.75	9.73	9.71	9.69	9.67
0.98	9.65	9.63	9.61	9.60	9.58	9.56	9.54	9.52	9.50	9.48
0.99	9.46	9.44	9.42	9.40	9.38	9.37	9.35	9.33	9.31	9.29
1.00	9.27	9.25	9.23	9.22	9.20	9.18	9.16	9.14	9.13	9.11
1.01	9.09	9.07	9.05	9.04	9.02	9.00	8.98	8.96	8.95	8.93
1.02	8.91	8.89	8.88	8.86	8.84	8.83	8.81	8.79	8.77	8.76
1.03	8.74	8.72	8.71	8.69	8.67	8.66	8.64	8.62	8.61	8.59
1.04	8.57	8.56	8.54	8.52	8.51	8.49	8.47	8.46	8.44	8.43
1.05	8.41	8.39	8.38	8.36	8.35	8.33	8.31	8.30	8.28	8.27
1.06	8.25	8.24	8.22	8.21	8.19	8.17	8.16	8.14	8.13	8.11
1.07	8.10	8.08	8.07	8.05	8.04	8.02	8.01	7.99	7.98	7.96
1.08	7.95	7.93	7.92	7.91	7.89	7.88	7.86	7.85	7.83	7.82
1.09	7.80	7.79	7.78	7.76	7.75	7.73	7.72	7.70	7.69	7.68
1.10	7.66	7.65	7.63	7.62	7.61	7.59	7.58	7.57	7.55	7.54
1.11	7.53	7.51	7.50	7.48	7.47	7.46	7.44	7.43	7.42	7.40
1.12	7.39	7.38	7.37	7.35	7.34	7.33	7.31	7.30	7.29	7.27
1.13	7.26	7.25	7.24	7.22	7.21	7.20	7.18	7.17	7.16	7.15