BS 427 : 1990

UDC 620.178.152.341 : 669

Method for Vickers hardness test and for verification of Vickers hardness testing machines

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Méthode d'essai de dureté Vickers et de vérification des machines d'essai de dureté Vickers

Härteprüfung nach Vickers und Prüfung von Vickershärteprüfmaschinen

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Iron and Steel Standards Policy Committee (ISM/-) and Non-ferrous Metals Standards Policy Committee (NFM/-) to Technical Committee ISM/NFM/4 upon which the following bodies were represented:

Aluminium Federation
British Gas plc
British Non-Ferrous Metals Federation
British Railways Board
British Steel Industry
Copper Development Association
Department of Trade and Industry (National Engineering Laboratory)
Department of Trade and Industry (National Physical Laboratory)
ERA Technology Ltd.
GAMBICA (BEAMA Ltd.)
Ministry of Defence
Society of British Aerospace Companies Ltd.
The Welding Institute

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

BCIRA
Institution of Production Engineers
Rhp Bearing Research Centre
Society of Motor Manufacturers and Traders Ltd.
Co-opted members

This British Standard, having been prepared under the direction of the Iron and Steel and the Non-ferrous Metals Standards Policy Committees, was published under the authority of the Board of BSI and comes into effect on 29 June 1990

First published, as BS 427 : Part 1, November 1931 and Part 2, November 1931
Second edition, Part 1, October 1961 and Part 2, December 1962
Third edition, as BS 427, June 1990

The following BSI references relate to the work on this standard:
Committee reference ISM/NFM/4
Draft for comment 88/45497 DC

ISBN 0 580 18166 9

Amendments issued since publication

Amd. No.	Date	Text affected

BSI STANDARDS

Amendment No. 1
published and effective from 30 September 1991
to BS 427 : 1990

Method for Vickers hardness test and for verification of Vickers hardness testing machines

Additional text and corrections

AMD 6756
September 1991

Clause 12. Indenter

After **12.6** insert an additional sub-clause as follows:

'**12.7** All indenters used with a testing machine which is claimed to comply with this British Standard shall have a valid National Measurement Accreditation Service (NAMAS) certification.'

AMD 6756
September 1991

Clause 20.1.3 Indenter

In line 1 delete '**1.2.1**' and substitute '**12.1**'.

In line 2 of item (b) delete '± 0.1°' and substitute '136 ± 0.1°'.

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Contents

Foreword

This British Standard has been prepared under the direction of the Iron and Steel and Non-ferrous Metals Standards Policy Committees. It is published as a single document in order to draw attention to the need for regular verification of hardness testing machines and to the availability of traceability to appropriate national measurement standards. Until 1988 national standard Vickers scales were defined by standardizing machines maintained at the National Physical Laboratory (NPL). Since then traceability has been transferred to standardizing machines maintained at the Instituto di Metrologia G. Collonnetti (IMGC), Turin. It supersedes BS 427 : Part 1 : 1961 and BS 427 : Part 2 : 1962, which are withdrawn.

The Technical Committee has not considered it necessary to make any major changes to the scope of the standard. The relevance of automatic testing machines in production testing is noted but the committee feels that further progress should be made in their development before they are featured in a British Standard. The use of such machines is not prohibited provided that it can be demonstrated that they meet the requirements of this standard.

The full direct verification procedure is carried out by the manufacturer on new machines and on machines returned to them for major overhaul or reconditioning. Further checking that the accuracy of the machine is valid is provided by application of the indirect verification following machine assembly and installation. Regular checks of accuracy of an installed machine, e.g. as part of quality assurance procedures or immediately after servicing, would be carried out by means of the indirect procedure (see section 4). As the extent of usage of machines varies considerably it is not possible to give rules for the frequency of such verifications. Guidance may be obtained on the basis of informed technical judgement from recognized calibrating authorities.

Considerable importance is attached by the committee to routine monitoring and maintenance of a testing machine's performance between verifications. These procedures have been made part of the standard in appendix A but do not impose onerous obligations on users.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Section 1. General

1 Scope

This British Standard describes a method of test for determining the Vickers hardness of metals in the scale ranges HV 1 to HV 100 at room temperature for hardness values between 5 and 3000 HV.

In sections three and four procedures are given for direct and indirect methods of verification respectively of the accuracy of the Vickers testing machine.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1 indirect verifications (of the indenting machine and measuring apparatus)

Performance tests, using a specified number of calibrated test blocks and indentations, which provide traceability.

2.2 direct verification

Traceable tests of the accuracy of the test force and indenter and measuring apparatus, and also includes the performance tests defined under indirect verification.

2.3 repeatability of a testing machine

The range of hardness values obtained on a test block in the indirect verification.

2.4 error of a testing machine

The difference between the mean hardness value obtained on a test block in the indirect verification and the value assigned to the test block by the calibrating authority.

2.5 hardness scale

Range of hardness values given by the specified force.

3 Symbols and designation of hardness

3.1 General

For the purposes of this British Standard the following symbols apply.

Symbol	Term
α	Angle between opposite faces of the vertex of the pyramidal indenter (in degrees)
F	Test force (in N)
f	Load symbol representing the test force (see table 1) NOTE 1. $f = 0.102\ F$
d	Mean of the two diagonals of the indentation, d_1 and d_2 (in mm)
R_a	Arithmetic mean of surface roughness deviation from a straight line (in μm) NOTE 2. See BS 1134 : Part 1
HV	Vickers hardness

3.2 Hardness value

When defining a hardness value, the scale that has been used for the test shall be stated. The symbol HV shall be preceded by the hardness value and supplemented by an index indicating the test conditions in the following order:

(a) a load symbol representing the test force (see table 1);

(b) dwell time of full force in seconds, if different from the standard dwell time of 10 s to 15 s (see clause **8**).

Example. 526 HV 30/20 indicates a Vickers hardness value of 526 obtained using a test force of 294.2 N corresponding to a load symbol of 30 (see table 1) and a non-standard dwell time of 20 s.

Table 1. Correlated values of force and hardness scale

Hardness scale	Load symbol f	Test force F
		N
HV 1	1	9.807
HV 2.5	2.5	24.52
HV 5	5	49.03
HV 10	10	98.07
HV 20	20	196.1
HV 30	30	294.2
HV 50	50	490.3
HV 100	100	980.7

Section 2. Determination of Vickers hardness

4 Principle

An indenter, comprising a diamond in the form of a right pyramid with a square base and a specified angle between opposite faces at the vertex and mounted in a suitable holder, is forced into the material with a test force F (see figure 1).

The two diagonals, d_1 and d_2, of the identation left in the surface of the material after removal of the load, are measured in two directions at right angles and their arithmetic mean d is calculated.

The area of the sloping surface of the indentation is calculated from the mean diagonal, d, the indentation being considered as a right pyramid with a square base of diagonal, d and a vertex angle of 136 °.

The Vickers hardness is a number proportional to the quotient obtained by dividing the test force by the calculated sloping surface area of the indentation (see **9.1**).

5 Apparatus

5.1 *Testing machine,* capable of applying a predeter ˥ined force or forces within the range of 9.807 N ˛o 980.7 N, to the accuracy defined in **11.2**.

5.2 *Indenter,* comprising a diamond pyramid complying with clause **12** and mounted in a suitable holder.

5.3 *Measuring microscope or other measuring device,* capable of measuring the indentation diagonal to the accuracy defined in clause **13**.

6 Conditions of test

6.1 Testing machine

After indirect verification the testing machine shall not be moved. No parts of the machine shall be changed with the exception of the indenter. In particular the same measuring microscope shall be used.

6.2 Test piece surface finish

The test piece shall have such a surface finish as to permit accurate measurement of the diagonal of the indentation (see **B.3**).

6.3 Test piece thickness

No deformation shall be visible at the back of the test piece after the test. The thickness of the test piece shall be not less than 10 times the depth of the indentation (see appendix C).

6.4 Location of indentations

The distance between the centre of any indentation and the edge of the test piece shall be at least 2.5 times the mean diagonal of the indentation in the case of steel, copper and copper alloys and at least three times the mean diagonal of the indentation in the case of light metals, lead and tin and their alloys.

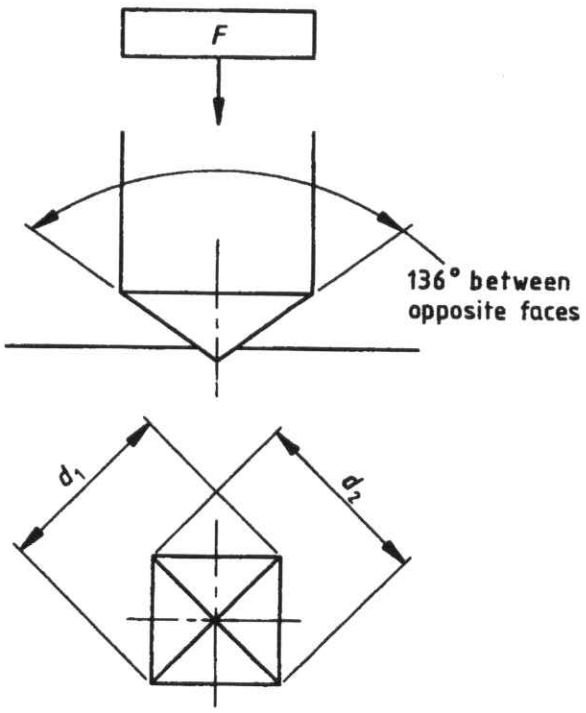


Figure 1. Principle of test and form of indentation

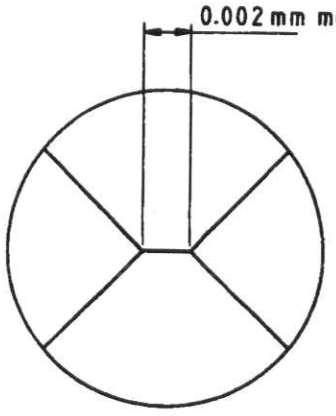


Figure 2. Tip of indenter

The distance between the centres of two adjacent indentations shall be at least three times the mean diagonal of the indentation in the case of steel, copper and copper alloys, and at least six times the mean diagonal in the case of light metals, lead and tin and their alloys. If two adjacent indentations differ in size, the spacing shall be based on the mean diagonal of the larger indentation.

NOTE 1. Tests which do not comply with clause **6** are of comparative value only.

NOTE 2. *Effect of metallurgical structure.* For materials of coarse metallurgical structure, the indentation should be large enough to ensure that the average hardness of the material is obtained. Where possible, when the structure is known to be non-uniform, several indentations should be made and an average value taken.

7 Choice of hardness scale

A Vickers hardness scale is defined by the specified force. The scales normally used are listed in table 1 with load symbol representing the test force.

The choice of a scale to be used for a particular test is determined by the size of the indentation that will provide optimum information and accuracy. To achieve maximum accuracy, the force shall be reasonably large having regard to the composition, treatment and dimensions of the test piece.

NOTE. Although a maximum force of 294.2 N is generally recommended, i.e. HV 30, larger forces may be desirable to yield average hardness values when testing materials having a coarse structure, but it should be noted that the use of large forces on hard metals tends to reduce the life of the diamond indenter.

8 Test procedure

Locate the test piece rigidly in relation to the indenter (see **B.4**). Apply the force along the axis of the indenter and normal to the surface of the test piece, in such a manner that the indenter is forced into the test piece without shock or vibration.

NOTE 1. Misalignments of the test piece of 10 ° or more may cause unacceptable errors.

Maintain the full force for the standard dwell time of 10 s to 15 s.

NOTE 2. In special cases where defined by the material specification other dwell times may be used but the hardness values obtained are not traceable and are of comparative value only.

After removal of the force determine the mean diagonal of the indentation from the average of measurements taken in two directions at right angles.

NOTE 3. Attention is drawn to the fact that measurement of the diagonals of the indentation is subjective and consideration should be given to the need for the calculation of individual correction factors as described in appendix F.

9 Calculation of Vickers hardness values

9.1 When the indentations are made on flat surfaces calculate the Vickers hardness using the following equation.

NOTE. For convenience computed values are given in tables 4 to 11 for each of the hardness scales given in table 1.

$$\text{HV} = \text{Constant}^{1)} \times \frac{\text{Test force}}{\text{Calculated surface area of indentation}}$$

$$\text{HV} = 0.102 \times \frac{2F \sin \frac{136°}{2}}{d^2} = \frac{2f \sin \frac{136°}{2}}{d^2}$$

The hardness value shall be expressed as designated in accordance with **3.2**.

9.2 When the indentations are made on spherical or cylindrical surfaces, calculate the Vickers hardness as described in **9.1** and apply the appropriate correction factor obtained from the tables in appendix E.

NOTE. Hardness measurements made on test pieces with non-uniform curvature should be regarded as being of comparative value only.

[1)] Constant $= \frac{1}{g_n} = \frac{1}{9.80665}$ = approximately 0.102.

Section 3. Direct verification of accuracy of the testing machine

10 Principle

Direct verification of the accuracy of a Vickers hardness testing machine involves verification of the accuracy of the applied forces, the physical characteristics of the diamond indenter and the accuracy of the indentation measurement apparatus.

The calibration of all measurement equipment used in the verification shall be traceable to the national reference standards.

The direct verification shall also include a performance test (indirect verification) in accordance with section four.

11 Force

11.1 The steady forces applied by the machine (see table 1) shall be verified in accordance with BS 1610 : Part 1 by means of either:

(a) elastic proving devices previously calibrated to grade 0.5 of BS 1610 : Part 2; or

(b) proving levers and masses that have been calibrated in accordance with BS 1610 : Part 2.

11.2 Regardless of the position of the indenter carrier within its working range each steady force shall be correct within ± 0.5 % of its nominal value. For each force, readings shall be taken at three or more positions of the carrier and each reading of the measured force shall be within 0.5 % of the nominal force.

11.3 The force shall be applied without shock or vibration. The magnitude of any additional impact force shall be less than 0.5 % of the nominal force.

NOTE. When necessary the impact force should be reduced by means of a dash pot or other device.

11.4 If the machine is designed to provide an automatic time cycle, it shall be verified that the time for which full force is maintained is 10 s to 15 s. If, as may be required for tests on some materials, a machine provides a time cycle that maintains the full force for a duration other than 10 s to 15 s, this duration shall be verified and shall be within a tolerance of ± 2 s.

12 Indenter

12.1 The indenter shall be a diamond in the form of a right pyramid with a square base rigidly mounted in a suitable holder.

12.2 The four faces of the diamond pyramid shall be polished and free from surface defects.

12.3 The angle between opposite faces of the vertex of the diamond pyramid shall be 136 ± 0.3 °.

12.4 Each of the four angles in a section normal to the axis of the diamond pyramid shall be 90 ± 0.5 °.

12.5 The inclination of the axis of the diamond pyramid to the axis of the indenter (normal to the seating surface) shall be less than 0.3 °.

12.6 All four faces of the diamond pyramid shall meet in a point. This requirement is satisfied if the line of junction between opposite faces (see figure 2) is not greater than 0.002 mm.

13 Measuring apparatus

13.1 The measuring microscope or other measuring device used for measuring the diagonals of the indentation shall be graduated to read directly to 0.001 mm or less.

13.2 The measuring device shall be verified by measurements made on a stage micrometer at a minimum of five intervals. The maximum error shall not exceed the following:

± 0.001 mm; for intervals up to and including 0.2 mm

± 0.5 %; for intervals exceeding 0.2 mm.

13.3 Intervals of the stage micrometer shall be known to within ± 0.0002 mm.

14 Performance test

When tested in accordance with the indirect verification procedure in clause **16**, the testing machine shall be accurate to the limits specified in clause **17**.

NOTE. The indirect verification confirms that the sum of the individual errors assessed in the direct verification does not exceed the allowable error given in **17.2** (b).

Section 4. Indirect verification of accuracy of the testing machine

15 Principle

Indirect verification of the accuracy of a Vickers hardness testing machine requires the use of hardness test blocks which have been calibrated on a standardizing machine. The verification procedure then involves checking that the testing machine measures with sufficient accuracy the known hardness of the calibrated blocks.

Calibrated test blocks may be obtained from appropriate manufacturers. They shall be manufactured and calibrated in accordance with clauses **18** and **19** and their hardness shall be certified in accordance with **19.5**.

In addition, hardness testing machines shall be checked regularly in accordance with appendix A, to confirm that they have not become maladjusted in the intervals between the periodic indirect verifications.

In the UK these measurements shall be traceable to appropriate national measurement standards.

NOTE. Until 1988, national standard Vickers scales were defined by standardizing machines maintained at the National Physical Laboratory, Teddington. Since then, traceability has been transferred to standardizing machines maintained at the Instituto di Metrologia G. Collonnetti, Turin.

Traceability can be assured by employing hardness test blocks calibrated by a laboratory that is accredited by the National Measurement Accreditation Service (NAMAS) for the measurements concerned. Such measurements shall be covered by official NAMAS calibration certificates. NAMAS will also provide guidance, where necessary, on accredited laboratories in other countries, which provide equivalent assurance of traceability. The indirect verification procedure shall be carried out by a laboratory accredited by NAMAS.

16 Indirect verification procedure

16.1 Before carrying out the procedure, ascertain in a preliminary inspection that the machine is correctly set up on a rigid support free from significant vibration, and that the indenter is securely fixed to the carrier.

16.2 Adjust the illuminating system of the measuring microscope or other measuring device to give uniform intensity over the field of view and maximum contrast between the indentation and the undisturbed surface of the block.

16.3 Make the preliminary verification of the measuring device by measurements of the reference indentation in each of three test blocks in accordance with **16.4**. Alternatively, employ a reading block which contains three different sized indentations, e.g. 0.2, 0.3 and 0.4 mm, previously calibrated using either the NPL or IMGC standardizing Vickers microscope.

Carry out the indirect verification of the testing machine including the measuring apparatus in accordance with section two using hardness blocks calibrated in accordance with clause **19**.

16.4 Verify the testing machine using two of the hardness scales given in table 1 in accordance with the following.

For each scale chosen, select standardized blocks from two different hardness ranges specified as follows; the forces and blocks shall be chosen so that at least one standardized block in each hardness range is used for the verification:

120 HV to 200 HV;

250 HV to 600 HV;

650 HV to 900 HV.

NOTE 1. For general purposes, the hardness scales preferred for the indirect verification are HV 10 and HV 30.

NOTE 2. Only one Vickers scale should be selected in the range HV 1 to HV 5.

NOTE 3. For accurate verification the diagonals of the indentations should, where possible, be greater than 0.150 mm.

16.5 When verifying testing machines using only one test force, select three standardized blocks one in each of the ranges specified.

16.6 On each hardness block, make no less than five indentations in accordance with clause **8** spaced over the surface of the test block in accordance with **19.2**, then measure both diagonals of each indentation.

17 Assessment of accuracy of measuring apparatus and testing machine

17.1 Accuracy of measuring apparatus

The accuracy of the measuring apparatus shall be deemed satisfactory if the mean measured diagonal of each reference indentation is within ± 1 % of the assigned mean diagonal value.

17.2 Accuracy of the testing machine

The accuracy of the machine shall be deemed satisfactory if the hardness values obtained in each test of five indentations meet the following requirements for repeatability and error.

(a) *Repeatability.* The range of the five hardness values, i.e. the difference between the largest and the smallest value, shall not exceed 4 % of the assigned hardness value of the test block.

(b) *Error.* The mean hardness value determined for the five indentations shall not differ from the assigned hardness value of the test block by more than the maximum permissible error values given in table 2.

18 Manufacture of hardness test blocks

18.1 Each metal block to be standardized shall be manufactured to give homogeneity and stability of structure. The block, if of steel, shall be demagnetized.

18.2 The minimum thickness of the block, the flatness and surface texture of the test surface and the underside, and the maximum verification in thickness shall be as given in table 3.

18.3 The finish of the test surface shall provide a suitable reflectivity and be free from scratches which would interfere with measurements of the indentations.

18.4 No material shall be removed from the block after it has been calibrated.

19 Calibration of hardness test blocks

19.1 General

The calibration of the block shall establish its uniformity of hardness and its hardness value.

The calibration of the block shall be carried out using a standardizing machine complying with clause **20**.

Each hardness value assigned to a block shall, where appropriate, be traceable to the national standard hardness scale either directly or indirectly through a hierarchical chain such as that provided by NAMAS.

19.2 Location of indentations

The distance between the centre of any indentation and the edge of the test block shall be at least three times the mean diagonal of the indentation ($3d$).

The distance between the centres of two adjacent indentations shall be at least five times the mean diagonal of the indentations ($5d$).

19.3 Calibration procedure

Carry out the test in accordance with clause **8** under the following conditions.

(a) *Application of load.* The load shall be applied gradually and the full force shall be maintained for 10 s to 15 s.

(b) *Measurement of indentation.* Each indentation shall be measured independently by at least two observers and the hardness value assigned to the block shall be the mean of the hardness values so obtained.

19.4 Uniformity of hardness

Not less than 10 indentations distributed over the test surface shall be made on the block for a selected Vickers scale.

The block shall be regarded as sufficiently uniform for standardization purposes if the range of hardness values obtained from the indentations does not exceed 2 % of the mean hardness value for hardness values $\geq$ 200 or 3 % for hardness values $<$ 200.

Table 2. Maximum permissible error, expressed as a plus or minus percentage of the specified hardness HV of the standardized block used

Hardness scale	Hardness value										
	100	200	300	400	500	600	700	800	900	1000	1500
HV 1	3	4	4	4	5	5	5	6	6	6	8
HV 2.5	3	3	3	3	4	4	4	4	4	5	5
HV 5	3	3	3	3	3	3	3	3	3	4	4
HV 10	3	3	3	3	3	3	3	3	3	3	3
HV 20	3	3	3	3	3	3	3	3	3	3	3
HV 30	2	2	2	2	2	2	2	2	2	2	2
HV 50	2	2	2	2	2	2	2	2	2	2	2
HV 100	2	2	2	2	2	2	2	2	2	2	2

Table 3. Dimensions of hardness test blocks

Minimum thickness	Maximum variation in flatness	Maximum variation in thickness	Maximum surface texture R_a	
			Test surface	Bottom surface
mm	mm	mm/50 mm	μm	μm
6	0.005	0.015	0.1	0.4

19.5 Hardness value

The hardness value assigned to the block for the selected Vickers scale shall be the mean hardness value obtained when examining the block for uniformity. This value shall be rounded to the nearest unit for values of 500 HV and over, to the nearest half unit for hardness values in the range 200 to 500 HV and to the nearest 0.2 for lower hardness values.

19.6 Reference indentation

One of the indentations shall be selected as a reference indentation for the indirect verification of the measuring apparatus. It shall be identified with a permanent mark.

The size assigned to the indentation shall be the mean of the two diagonals measured when examining the block for uniformity. The value shall be rounded to the nearest 0.1 μm.

19.7 Marking

Each block shall be marked by the manufacturer with his name or mark and a serial number. The marking should preferably be on the side of the block, in which case it shall be upright when the test surface is uppermost, or alternatively the marking may be on the test surface.

19.8 Documentation

The standardizing authority shall issue a document stating;

(a) a reference to BS 427 : 1990 for traceability purposes;

(b) the serial number of the block;

(c) the hardness value assigned to the block and the hardness scale used, e.g. 255 HV 30;

(d) the maximum and minimum hardness values obtained in the calibration;

(e) the mean diagonal of the reference indentation and its indentification;

(f) the manufacturer's name and date of calibration;

(g) the thickness of the block where marking is only on a side face of the block.

20 Standardizing machine

20.1 Direct verification

20.1.1 *General*

The standardizing machines used for calibrating the blocks (comprising the indenting machine, the indenter and the measuring microscope) shall satisfy the following requirements.

20.1.2 *Force*

Regardless of the position of the indenter carrier within its working range, each steady force shall be correct within ± 0.1 % of its nominal value.

20.1.3 *Indenter*

The indenter shall comply with **1.2.1** and also with the following.

(a) The four faces of the diamond pyramid indenter shall be highly polished, free from flaws and flat within 0.0003 mm.

(b) The angle between opposite faces at the vertex of the diamond pyramid shall be ± 0.1 °.

(c) Each of the four angles in a section normal to the axis of the diamond pyramid shall be 90 ± 0.3 °.

(d) The inclination of the axis of the diamond pyramid to the axis of the indenter (normal to the seating surface) shall be less than 0.2 °.

(e) All four faces of the diamond pyramid shall meet in a point. This requirement is satisfied if the line of junction between opposite faces (see figure 2) is not greater than 0.0005 mm.

20.1.4 *Measuring microscope*

The scale of the measuring microscope shall be graduated to read in intervals of 0.0005 mm or less and the intervals shall be readily sub-divisible by estimation to 0.0001 mm.

The measuring microscope shall be calibrated so as to ensure that any interval within the working range can be measured correctly to ± 0.0005 mm.

20.2 Indirect verification of measuring microscope

The performance of the measuring microscope shall be verified by measurements of appropriately sized sets of 10 standardized indentations, previously calibrated by either the NPL or IMGC.

NOTE. Such a reading block usually contains three sets of different sized indentations, e.g. 0.2, 0.3 and 0.4 mm.

For each observer (see **19.3** (b)), the average diagonal obtained from measurements of a set of 10 indentations shall be within 0.5 % of the assigned mean diagonal value.

20.3 Monitoring of standardizing machine

The accuracy and stability of the Vickers hardness scales defined by standardizing machines shall be monitored in accordance with the following.

(a) A minimum of two scales shall be monitored.

NOTE. The preferred scales are HV 10 and HV 30.

(b) A set of at least three test blocks covering the range of the first scale and three test blocks covering the range of the second scale, which comply with the uniformity of hardness requirement given in **19.4**, shall be provided.

(c) Periodic monitoring values shall be obtained from the mean of five indentations on each block and the periodic monitoring tests shall be made at regular intervals.

(d) An assessment of the performance of the machine shall be made from the recorded monitoring values over a period of time and shall show that a monitoring value is reproducible within ± 0.5 % HV of the average of the monitoring values obtained for the block.

(e) The test blocks shall be calibrated at least twice (initially and after at least six calibrations have been made in accordance with **20.3** (c)) by the standarizing machine that defines the national standard scale. Both NPL and IMGC calibration values shall be valid throughout the life of the block.

NOTE. The frequency of subsequent calibrations will be defined by NAMAS.

The monitoring values shall be reproducible within ± 1.0 % HV of the mean standard hardness value for the block.

(f) Monitoring shall continue on the same set of blocks in accordance with **20.3** (c) and (e) until the softest block is full.

Appendices

Appendix A. Monitoring the accuracy of the test machine by the users

A.1 The procedure of monitoring the accuracy of a testing machine involves making regular tests in a given hardness scale on the same hardness test block and recording the results for assessment.

A.2 Monitoring the accuracy of the testing machine should be carried out in accordance with clause **8** and **19.2** using hardness test blocks calibrated under the conditions specified in clause **19**.

NOTE. In special cases, when it is desirable in place of test blocks to use test specimens of the same material or form as the components to be tested, the test specimens should be calibrated in accordance with the requirements in clause **19** using a testing machine monitored in accordance with **19.1** and **20.3**.

A.3 The testing machine should be in its usual condition and the indenter currently being used should be in the machine.

A.4 Before making a hardness test the measuring apparatus should be indirectly verified on the reference indentation on the test block selected in **A.5** in accordance with **16.2** and **17.1**.

A.5 A test block should be provided of a similar hardness and calibrated in the same Vickers scale as that being used by the testing machine. On each monitoring occasion a single hardness test should be made on the block. When necessary a second test should be made and the results of both tests should be recorded. Tests should be repeated at regular intervals, e.g. on each day that the machine is in use.

NOTE. For machines using more than one hardness scale the procedure should be repeated with a different Vickers hardness scale, e.g. HV 30 and HV 5.

A.6 An assessment of the accuracy of the machine should be made from the recorded monitoring values over a period of time and the machine should be deemed satisfactory if the hardness value is reproducible within the following percentage of the assigned value for the block:

(a) ± 5 % for HV 1;

(b) ± 4 % for HV 2.5;

(c) ± 3 % for HV 5, HV 10 and HV 20;

(d) ± 2 % for HV 30, HV 50 and HV 100.

Appendix B. Advisory comment upon Vickers hardness testing procedure

B.1 The testing machine should not be sited in gritty or unduly dusty conditions, nor in a position subject to significant vibration or excessive temperature changes.

The performance of the testing machine and measuring apparatus should be frequently checked by means of calibrated hardness test blocks (see appendix A).

B.2 The indenter should be examined regularly for signs of damage and replaced whenever these are found. The results of any test inadvertently made with a damaged or worn indenter could be incorrect and should be discarded.

B.3 The surfaces of the indenter and of the test piece should be completely free from any trace of lubricant unless the product standard specifies otherwise. Texture such as grinding marks on the test piece may be removed by localized polishing.

B.4 It is important that the test piece lies firmly on the support so that displacement cannot occur during the test.

B.5 Although the Vickers formula will, in principle, give the same hardness values for different loads, there will be in general be discrepancies between hardness values obtained with different hardness scales. Hardness values should therefore be quoted in conjunction with the appropriate hardness scale used for the test, e.g. 226 HV 30.

B.6 For some materials the requirement that the thickness of the test piece shall be not less than 10 times the depth of the indentation may be unduly restrictive. If, in particular circumstances, it becomes necessary to accept a lower ratio of thickness to depth, the hardness value may be influenced by the size and hardness of the anvil, and a special investigation may be needed to establish what influence these factors exert on the true hardness as obtained from thicker test pieces. Test parameters should therefore be chosen where possible to avoid such difficulties.

B.7 As there is no general procedure for accurately converting Vickers hardness into other scales of hardness, it is recommended that such conversions should be avoided, except for special cases where a reliable basis for the conversion has been established beforehand by direct test on the material concerned (see BS 860).

Appendix C. Minimum thickness of test piece

For convenience when carrying out tests in accordance with this standard, figure 3 shows the recommended minimum thickness of the test piece, or of the layer under test, for various applied loads over a range of hardness values.

The curves are calculated from the requirement that the thickness of the test piece shall be equal to at least 10 times the indentation depth (which corresponds to 1.5 times the diagonal length of the indentation).

Appendix D. Tables of Vickers hardness values (HV) for use in tests made on flat surfaces

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

$$HV = \frac{0.102 \times 2F \sin \frac{136°}{2}}{d^2}$$

without regard to the limitations imposed by practical conditions.

In industrial tests carried out in accordance with this standard, 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 ± 0.001 mm. The corresponding accuracy in the resulting hardness value may be obtained from figure 4 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.

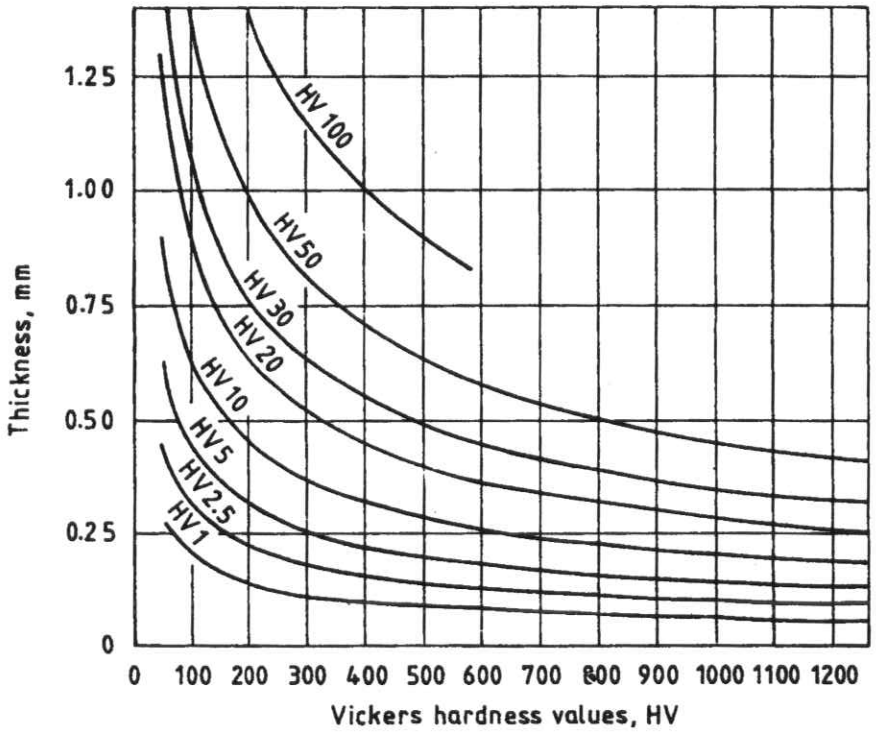


Figure 3. Graph showing recommended minimum thickness of test piece

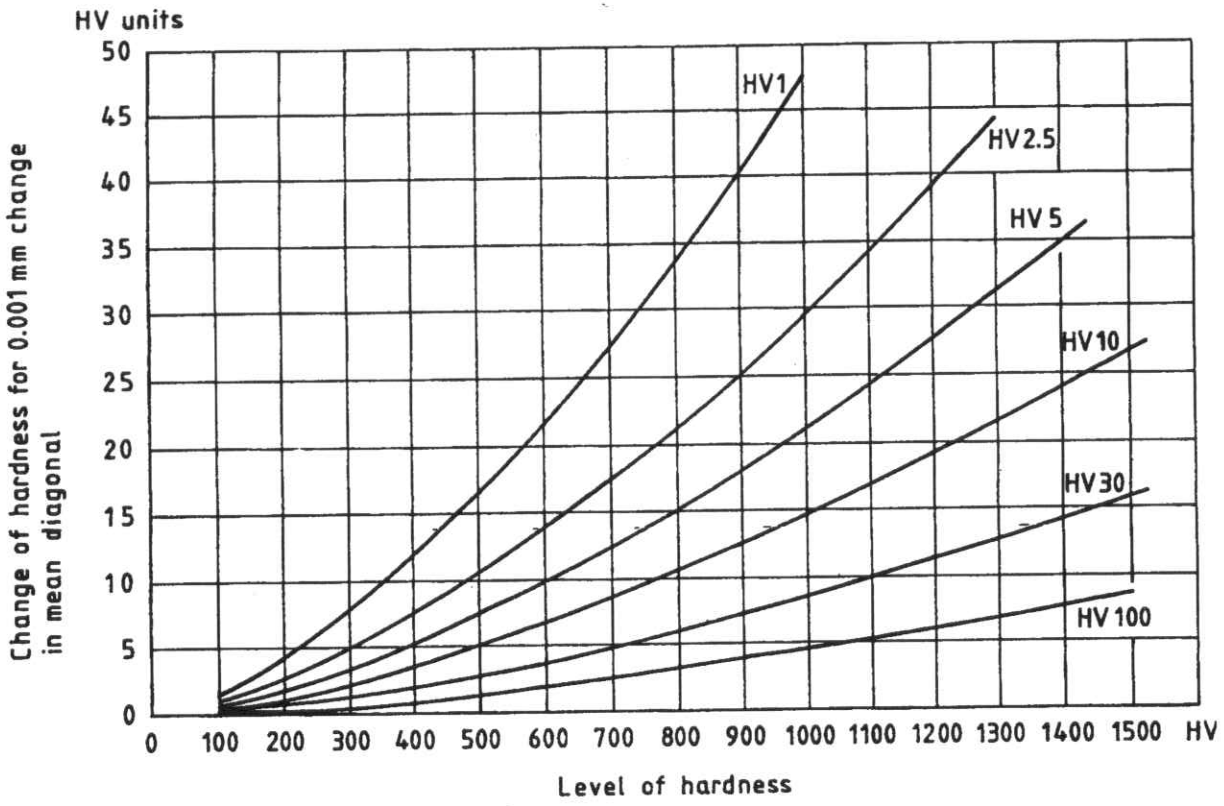


Figure 4. Graph showing change of hardness for 0.001 mm change in mean diagonal for different loads at different levels of hardness

Table 4. Vickers hardness scale HV 1 (load 1 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.03	2060.00	1930.00	1811.00	1703.00	1604.00	1514.00	1431.00	1355.00	1284.00	1219.00
0.04	1159.00	1103.00	1051.00	1003.00	958.00	916.00	876.00	839.00	805.00	772.00
0.05	742.00	713.00	686.00	660.00	636.00	613.00	591.00	571.00	551.00	533.00
0.06	515.00	498.00	482.00	467.00	453.00	439.00	426.00	413.00	401.00	389.00
0.07	378.00	368.00	358.00	348.00	339.00	330.00	321.00	313.00	305.00	297.00
0.08	290.00	283.00	276.00	269.00	263.00	257.00	251.00	245.00	239.00	234.00
0.09	229.00	224.00	219.00	214.00	210.00	205.00	201.00	197.00	193.00	189.00
0.10	185.00	182.00	178.00	175.00	171.00	168.00	165.00	162.00	159.00	156.00
0.11	153.00	151.00	148.00	145.00	143.00	140.00	138.00	135.00	133.00	131.00
0.12	129.00	127.00	125.00	123.00	121.00	119.00	117.00	115.00	113.00	111.00
0.13	110.00	108.00	106.00	105.00	103.00	102.00	100.00	98.80	97.40	96.00
0.14	94.60	93.30	92.00	90.70	89.40	88.20	87.00	85.80	84.70	83.50
0.15	82.40	81.30	80.30	79.20	78.20	77.20	76.20	75.20	74.30	73.40
0.16	72.40	71.50	70.70	69.80	68.90	68.10	67.30	66.50	65.70	64.90
0.17	64.20	63.40	62.70	62.00	61.20	60.60	59.90	59.20	58.50	57.90
0.18	57.20	56.60	56.00	55.40	54.80	54.20	53.60	53.00	52.50	51.90
0.19	51.40	50.80	50.30	49.80	49.30	48.80	48.30	47.80	47.30	46.80
0.20	46.40	45.90	45.40	45.00	44.60	44.10	43.70	43.30	42.90	42.50
0.21	42.00	41.70	41.30	40.90	40.50	40.10	39.70	39.40	39.00	38.70
0.22	38.30	38.00	37.60	37.30	37.00	36.60	36.30	36.00	35.70	35.40
0.23	35.10	34.80	34.50	34.20	33.90	33.60	33.30	33.00	32.70	32.50
0.24	32.20	31.90	31.70	31.40	31.10	30.90	30.60	30.40	30.20	29.90
0.25	29.70	29.40	29.20	29.00	28.70	28.50	28.30	28.10	27.90	27.60
0.26	27.40	27.20	27.00	26.80	26.60	26.40	26.20	26.00	25.80	25.60
0.27	25.40	25.20	25.10	24.90	24.70	24.50	24.30	24.20	24.00	23.80
0.28	23.70	23.50	23.30	23.20	23.00	22.80	22.70	22.50	22.40	22.20
0.29	22.00	21.90	21.70	21.60	21.50	21.30	21.20	21.00	20.90	20.70
0.30	20.60	20.50	20.30	20.20	20.10	19.90	19.80	19.70	19.50	19.40
0.31	19.30	19.20	19.00	18.90	18.80	18.70	18.60	18.50	18.30	18.20
0.32	18.10	18.00	17.90	17.80	17.70	17.60	17.40	17.30	17.20	17.10
0.33	17.00	16.90	16.80	16.70	16.60	16.50	16.40	16.30	16.20	16.10
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

Table 4. Vickers hardness scale HV 1 (load 1 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
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 5. Vickers hardness scale HV 2.5 (load 2.5 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.04	2897.00	2758.00	2628.00	2507.00	2395.00	2289.00	2191.00	2099.00	2012.00	1931.00
0.05	1854.00	1782.00	1714.00	1650.00	1590.00	1533.00	1478.00	1427.00	1378.00	1332.00
0.06	1288.00	1246.00	1206.00	1168.00	1132.00	1097.00	1064.00	1033.00	1003.00	974.00
0.07	946.00	920.00	894.00	870.00	847.00	824.00	803.00	782.00	762.00	743.00
0.08	724.00	707.00	689.00	673.00	657.00	642.00	627.00	612.00	599.00	585.00
0.09	572.00	560.00	548.00	536.00	525.00	514.00	503.00	493.00	483.00	473.00
0.10	464.00	454.00	446.00	437.00	429.00	420.00	413.00	405.00	397.00	390.00
0.11	383.00	376.00	370.00	363.00	357.00	351.00	345.00	339.00	333.00	327.00
0.12	322.00	317.00	311.00	306.00	302.00	297.00	292.00	287.00	283.00	279.00
0.13	274.00	270.00	266.00	262.00	258.00	254.00	251.00	247.00	243.00	240.00
0.14	237.00	233.00	230.00	227.00	224.00	220.00	217.00	215.00	212.00	209.00
0.15	206.00	203.00	201.00	198.00	195.00	193.00	190.00	188.00	186.00	183.00
0.16	181.00	179.00	177.00	174.00	172.00	170.00	168.00	166.00	164.00	162.00
0.17	160.00	159.00	157.00	155.00	153.00	151.00	150.00	148.00	146.00	145.00
0.18	143.00	142.00	140.00	138.00	137.00	135.00	134.00	133.00	131.00	130.00
0.19	128.00	127.00	126.00	124.00	123.00	122.00	121.00	119.00	118.00	117.00
0.20	116.00	115.00	114.00	112.00	111.00	110.00	109.00	108.00	107.00	106.00
0.21	105.00	104.00	103.00	102.00	101.00	100.00	99.40	98.50	97.50	96.70
0.22	95.80	94.90	94.10	93.20	92.40	91.60	90.80	90.00	89.20	88.40
0.23	87.60	86.90	86.10	85.40	84.70	83.90	83.20	82.50	81.80	81.20
0.24	80.50	79.80	79.20	78.50	77.90	77.20	76.60	76.00	75.40	74.80
0.25	74.20	73.60	73.00	72.40	71.90	71.30	70.70	70.20	69.60	69.10
0.26	68.60	68.10	67.50	67.00	66.50	66.00	65.50	65.00	64.50	64.10
0.27	63.60	63.10	62.70	62.20	61.70	61.30	60.90	60.40	60.00	59.60
0.28	59.10	58.70	58.30	57.90	57.50	57.10	56.70	56.30	55.90	55.50
0.29	55.10	54.70	54.40	54.00	53.60	53.30	52.90	52.60	52.20	51.90
0.30	51.50	51.20	50.80	50.50	50.20	49.80	49.50	49.20	48.90	48.60
0.31	48.20	47.90	47.60	47.30	47.00	46.70	46.40	46.10	45.80	45.60
0.32	45.30	45.00	44.70	44.40	44.20	43.90	43.60	43.40	43.10	42.80
0.33	42.60	42.30	42.10	41.80	41.60	41.30	41.10	40.80	40.60	40.30
0.34	40.10	39.90	39.60	39.40	39.20	38.90	38.70	38.50	38.30	38.10
0.35	37.80	37.60	37.40	37.20	37.00	36.80	36.60	36.40	36.20	36.00
0.36	35.80	35.60	35.40	35.20	35.00	34.80	34.60	34.40	34.20	34.00
0.37	33.90	33.70	33.50	33.30	33.10	33.00	32.80	32.60	32.40	32.30
0.38	32.10	31.90	31.80	31.60	31.40	31.30	31.10	31.00	30.80	30.60
0.39	30.50	30.30	30.20	30.00	29.90	29.70	29.60	29.40	29.30	29.10
0.40	29.00	28.80	28.70	28.50	28.40	28.30	28.10	28.00	27.80	27.70
0.41	27.60	27.40	27.30	27.20	27.00	26.90	26.80	26.70	26.50	26.40
0.42	26.30	26.20	26.00	25.90	25.80	25.70	25.50	25.40	25.30	25.20
0.43	25.10	25.00	24.80	24.70	24.60	24.50	24.40	24.30	24.20	24.10
0.44	23.90	23.80	23.70	23.60	23.50	23.40	23.30	23.20	23.10	23.00
0.45	22.90	22.80	22.70	22.60	22.50	22.40	22.30	22.20	22.10	22.00
0.46	21.90	21.80	21.70	21.60	21.50	21.40	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	21.21
0.48	20.12	20.04	19.95	19.87	19.79	19.71	19.63	19.55	19.47	19.39

Table 5. Vickers hardness scale HV 2.5 (load 2.5 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
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
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

Table 5. Vickers hardness scale HV 2.5 (load 2.5 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
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 6. Vickers hardness scale HV 5 (load 5 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.06	2576.00	2492.00	2412.00	2336.00	2264.00	2195.00	2129.00	2065.00	2005.11	1947.00
0.07	1892.00	1839.00	1789.00	1740.00	1693.00	1648.00	1605.00	1564.00	1524.00	1486.00
0.08	1449.00	1413.00	1379.00	1346.00	1314.00	1283.00	1254.00	1225.00	1197.00	1171.00
0.09	1145.00	1120.00	1095.00	1072.00	1049.00	1027.00	1006.00	985.00	965.00	946.00
0.10	927.00	909.00	891.00	874.00	857.00	841.00	825.00	810.00	795.00	780.00
0.11	766.00	753.00	739.00	726.00	713.00	701.00	689.00	677.00	666.00	655.00
0.12	644.00	633.00	623.00	613.00	603.00	593.00	584.00	575.00	566.00	557.00
0.13	549.00	540.00	532.00	524.00	516.00	509.00	501.00	494.00	487.00	480.00
0.14	473.00	466.00	460.00	453.00	447.00	441.00	435.00	429.00	423.00	418.00
0.15	412.00	407.00	401.00	396.00	391.00	386.00	381.00	376.00	371.00	367.00
0.16	362.00	358.00	353.00	349.00	345.00	341.00	336.00	332.00	329.00	325.00
0.17	321.00	317.00	313.00	310.00	306.00	303.00	299.00	296.00	293.00	289.00
0.18	286.00	283.00	280.00	277.00	274.00	271.00	268.00	265.00	262.00	260.00
0.19	257.00	254.00	252.00	249.00	246.00	244.00	241.00	239.00	237.00	234.00
0.20	232.00	229.00	227.00	225.00	223.00	221.00	218.00	216.00	214.00	212.00
0.21	210.00	208.00	206.00	204.00	202.00	201.00	199.00	197.00	195.00	193.00
0.22	192.00	190.00	188.00	186.00	185.00	183.00	182.00	180.00	178.00	177.00
0.23	175.00	174.00	172.00	171.00	169.00	168.00	166.00	165.00	164.00	162.00
0.24	161.00	160.00	158.00	157.00	156.00	154.00	153.00	152.00	151.00	150.00
0.25	148.00	147.00	146.00	145.00	144.00	143.00	141.00	140.00	139.00	138.00
0.26	137.00	136.00	135.00	134.00	133.00	132.00	131.00	130.00	129.00	128.00
0.27	127.00	126.00	125.00	124.00	123.50	122.60	121.70	120.80	120.00	119.10
0.28	118.30	117.40	116.60	115.80	115.00	114.20	113.40	112.60	111.80	111.00
0.29	110.20	109.50	108.70	108.00	107.30	106.50	105.80	105.10	104.40	103.70
0.30	103.00	102.30	101.70	101.00	100.30	99.70	99.00	98.40	97.70	97.10
0.31	96.50	95.90	95.20	94.60	94.00	93.40	92.90	92.30	91.70	91.10
0.32	90.50	90.00	89.40	88.90	88.30	87.80	87.20	86.70	86.20	85.70
0.33	85.10	84.60	84.10	83.60	83.10	82.60	82.10	81.60	81.20	80.70
0.34	80.20	79.70	79.30	78.80	78.40	77.90	77.40	77.00	76.60	76.10
0.35	75.70	75.30	74.80	74.40	74.00	73.60	73.20	72.70	72.30	71.90
0.36	71.50	71.10	70.80	70.40	70.00	69.60	69.20	68.80	68.50	68.10
0.37	67.70	67.40	67.00	66.60	66.30	65.90	65.60	65.20	64.90	64.50
0.38	64.20	63.90	63.50	63.20	62.90	62.60	62.20	61.90	61.60	61.30
0.39	61.00	60.60	60.30	60.00	59.70	59.40	59.10	58.80	58.50	58.20
0.40	57.90	57.70	57.40	57.10	56.80	56.50	56.20	56.00	55.70	55.40
0.41	55.20	54.90	54.60	54.40	54.10	53.80	53.60	53.30	53.10	52.80
0.42	52.60	52.30	52.10	51.80	51.60	51.30	51.10	50.90	50.60	50.40
0.43	50.10	49.90	49.70	49.50	49.20	49.00	48.80	48.60	48.30	48.10
0.44	47.90	47.70	47.50	47.20	47.00	46.80	46.60	46.40	46.20	46.00
0.45	45.80	45.60	45.40	45.20	45.00	44.80	44.60	44.40	44.20	44.00
0.46	43.80	43.60	43.40	43.30	43.10	42.90	42.70	42.50	42.30	42.20
0.47	42.00	41.80	41.60	41.40	41.30	41.10	40.90	40.80	40.60	40.40
0.48	40.20	40.10	39.90	39.70	39.60	39.40	39.30	39.10	38.90	38.80
0.49	38.60	38.50	38.30	38.10	38.00	37.80	37.70	37.50	37.40	37.20
0.50	37.10	36.90	36.80	36.60	36.50	36.40	36.20	36.10	35.90	35.80

Table 6. Vickers hardness scale HV 5 (load 5 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.51	35.60	35.50	35.40	35.20	35.10	35.00	34.80	34.70	34.60	34.40
0.52	34.30	34.20	34.00	33.90	33.80	33.60	33.50	33.40	33.30	33.10
0.53	33.00	32.90	32.80	32.60	32.50	32.40	32.30	32.20	32.00	31.90
0.54	31.80	31.70	31.60	31.40	31.30	31.20	31.10	31.00	30.90	30.80
0.55	30.70	30.50	30.40	30.30	30.20	30.10	30.00	29.90	29.80	29.70
0.56	29.60	29.50	29.40	29.30	29.10	29.00	28.90	28.80	28.70	28.60
0.57	28.50	28.40	28.30	28.20	28.10	28.00	27.90	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
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	12.17	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

Table 6. Vickers hardness scale HV 5 (load 5 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
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
1.14	7.13	7.12	7.11	7.10	7.08	7.07	7.06	7.05	7.04	7.02
1.15	7.01	7.00	6.99	6.97	6.96	6.95	6.94	6.93	6.91	6.90
1.16	6.89	6.88	6.87	6.85	6.84	6.83	6.82	6.81	6.80	6.78
1.17	6.77	6.76	6.75	6.74	6.73	6.72	6.70	6.69	6.68	6.67
1.18	6.66	6.65	6.64	6.63	6.61	6.60	6.59	6.58	6.57	6.56
1.19	6.55	6.54	6.53	6.51	6.50	6.49	6.48	6.47	6.46	6.45
1.20	6.44	6.43	6.42	6.41	6.40	6.39	6.37	6.36	6.35	6.34
1.21	6.33	6.32	6.31	6.30	6.29	6.28	6.27	6.26	6.25	6.24
1.22	6.23	6.22	6.21	6.20	6.19	6.18	6.17	6.16	6.15	6.14
1.23	6.13	6.12	6.11	6.10	6.09	6.08	6.07	6.06	6.05	6.04
1.24	6.03	6.02	6.01	6.00	5.99	5.98	5.97	5.96	5.95	5.94
1.25	5.93	5.92	5.92	5.91	5.90	5.89	5.88	5.87	5.86	5.85
1.26	5.84	5.83	5.82	5.81	5.80	5.79	5.78	5.78	5.77	5.76
1.27	5.75	5.74	5.73	5.72	5.71	5.70	5.69	5.69	5.68	5.67
1.28	5.66	5.65	5.64	5.63	5.62	5.62	5.61	5.60	5.59	5.58
1.29	5.57	5.56	5.55	5.55	5.54	5.53	5.52	5.51	5.50	5.49
1.30	5.49	5.48	5.47	5.46	5.45	5.44	5.44	5.43	5.42	5.41
1.31	5.40	5.39	5.39	5.38	5.37	5.36	5.35	5.35	5.34	5.33
1.32	5.32	5.31	5.31	5.30	5.29	5.28	5.27	5.27	5.26	5.25
1.33	5.24	5.23	5.23	5.22	5.21	5.20	5.19	5.19	5.18	5.17
1.34	5.16	5.16	5.15	5.14	5.13	5.13	5.12	5.11	5.10	5.09
1.35	5.09	5.08	5.07	5.06	5.06	5.05	5.04	5.04	5.03	5.02
1.36	5.01	5.01	5.00	4.99	4.98	4.98	4.97	4.96	4.95	4.95

Table 7. Vickers hardness scale HV 10 (load 10 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.09	2289.00	2239.00	2191.00	2144.00	2099.00	2055.00	2012.00	1971.00	1931.00	1892.00
0.10	1854.00	1818.00	1782.00	1748.00	1714.00	1682.00	1650.00	1620.00	1590.00	1561.00
0.11	1533.00	1505.00	1478.00	1452.00	1427.00	1402.00	1378.00	1355.00	1332.00	1309.00
0.12	1288.00	1267.00	1246.00	1226.00	1206.00	1187.00	1168.00	1150.00	1132.00	1114.00
0.13	1097.00	1081.00	1064.00	1048.00	1033.00	1017.00	1003.00	988.00	974.00	960.00
0.14	946.00	933.00	920.00	907.00	894.00	882.00	870.00	858.00	847.00	835.00
0.15	824.00	813.00	803.00	792.00	782.00	772.00	762.00	752.00	743.00	734.00
0.16	724.00	715.00	707.00	698.00	689.00	681.00	673.00	665.00	657.00	649.00
0.17	642.00	634.00	627.00	620.00	612.00	606.00	599.00	592.00	585.00	579.00
0.18	572.00	566.00	560.00	554.00	548.00	542.00	536.00	530.00	525.00	519.00
0.19	514.00	508.00	503.00	498.00	493.00	488.00	483.00	478.00	473.00	468.00
0.20	464.00	459.00	454.00	450.00	446.00	441.00	437.00	433.00	429.00	425.00
0.21	420.00	417.00	413.00	409.00	405.00	401.00	397.00	394.00	390.00	387.00
0.22	383.00	380.00	376.00	373.00	370.00	366.00	363.00	360.00	357.00	354.00
0.23	351.00	348.00	345.00	342.00	339.00	336.00	333.00	330.00	327.00	325.00
0.24	322.00	319.00	317.00	314.00	311.00	309.00	306.00	304.00	302.00	299.00
0.25	297.00	294.00	292.00	290.00	287.00	285.00	283.00	281.00	279.00	276.00
0.26	274.00	272.00	270.00	268.00	266.00	264.00	262.00	260.00	258.00	256.00
0.27	254.00	252.00	251.00	249.00	247.00	245.00	243.00	242.00	240.00	238.00
0.28	237.00	235.00	233.00	232.00	230.00	228.00	227.00	225.00	224.00	222.00
0.29	220.00	219.00	217.00	216.00	215.00	213.00	212.00	210.00	209.00	207.00
0.30	206.00	205.00	203.00	202.00	201.00	199.00	198.00	197.00	195.00	194.00
0.31	193.00	192.00	190.00	189.00	188.00	187.00	186.00	185.00	183.00	182.00
0.32	181.00	180.00	179.00	178.00	177.00	176.00	174.00	173.00	172.00	171.00
0.33	170.00	169.00	168.00	167.00	166.00	165.00	164.00	163.00	162.00	161.00
0.34	160.40	159.50	158.50	157.60	156.70	155.80	154.90	154.00	153.10	152.20
0.35	151.40	150.50	149.70	148.80	148.00	147.10	146.30	145.50	144.70	143.90
0.36	143.10	142.30	141.50	140.70	140.00	139.20	138.40	137.70	136.90	136.20
0.37	135.50	134.70	134.00	133.30	132.60	131.90	131.20	130.50	129.80	129.10
0.38	128.40	127.70	127.10	126.40	125.80	125.10	124.50	123.80	123.20	122.50
0.39	121.90	121.30	120.70	120.10	119.50	118.90	118.30	117.70	117.10	116.50
0.40	115.90	115.30	114.70	114.20	113.60	113.10	112.50	111.90	111.40	110.90
0.41	110.30	109.80	109.20	108.70	108.20	107.70	107.20	106.60	106.10	105.60
0.42	105.10	104.60	104.10	103.60	103.10	102.70	102.20	101.70	101.20	100.80
0.43	100.30	99.80	99.40	98.90	98.50	98.00	97.50	97.10	96.70	96.20
0.44	95.80	95.30	94.90	94.50	94.10	93.60	93.20	92.80	92.40	92.00
0.45	91.60	91.20	90.80	90.40	90.00	89.60	89.20	88.80	88.40	88.00
0.46	87.60	87.30	86.90	86.50	86.10	85.80	85.40	85.00	84.70	84.30
0.47	83.90	83.60	83.20	82.90	82.50	82.20	81.80	81.50	81.20	80.80
0.48	80.50	80.20	79.80	79.50	79.20	78.80	78.50	78.20	77.90	77.50
0.49	77.20	76.90	76.60	76.30	76.00	75.70	75.40	75.10	74.80	74.50
0.50	74.20	73.90	73.60	73.30	73.00	72.70	72.40	72.10	71.90	71.60
0.51	71.30	71.00	70.70	70.50	70.20	69.90	69.60	69.40	69.10	68.80
0.52	68.60	68.30	68.10	67.80	67.50	67.30	67.00	66.80	66.50	66.30
0.53	66.00	65.80	65.50	65.30	65.00	64.80	64.50	64.30	64.10	63.80

Table 7. Vickers hardness scale HV 10 (load 10 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.44	8.94	8.93	8.92	8.91	8.89	8.88	8.87	8.86	8.84	8.83
1.45	8.82	8.81	8.80	8.78	8.77	8.76	8.75	8.74	8.72	8.71
1.46	8.70	8.69	8.68	8.66	8.65	8.64	8.63	8.62	8.60	8.59
1.47	8.58	8.57	8.56	8.55	8.53	8.52	8.51	8.50	8.49	8.48
1.48	8.47	8.45	8.44	8.43	8.42	8.41	8.40	8.39	8.38	8.36
1.49	8.35	8.34	8.33	8.32	8.31	8.30	8.29	8.27	8.26	8.25
1.50	8.24	8.23	8.22	8.21	8.20	8.19	8.18	8.17	8.15	8.14
1.51	8.13	8.12	8.11	8.10	8.09	8.08	8.07	8.06	8.05	8.04
1.52	8.03	8.02	8.01	7.99	7.98	7.97	7.96	7.95	7.94	7.93
1.53	7.92	7.91	7.90	7.89	7.88	7.87	7.86	7.85	7.84	7.83
1.54	7.82	7.81	7.80	7.79	7.78	7.77	7.76	7.75	7.74	7.73
1.55	7.72	7.71	7.70	7.69	7.68	7.67	7.66	7.65	7.64	7.63
1.56	7.62	7.61	7.60	7.59	7.58	7.57	7.56	7.55	7.54	7.53
1.57	7.52	7.51	7.50	7.49	7.48	7.48	7.47	7.46	7.45	7.44
1.58	7.43	7.42	7.41	7.40	7.39	7.38	7.37	7.36	7.35	7.34
1.59	7.34	7.33	7.32	7.31	7.30	7.29	7.28	7.27	7.26	7.25
1.60	7.24	7.23	7.23	7.22	7.21	7.20	7.19	7.18	7.17	7.16
1.61	7.15	7.15	7.14	7.13	7.12	7.11	7.10	7.09	7.08	7.07
1.62	7.07	7.06	7.05	7.04	7.03	7.02	7.01	7.01	7.00	6.99
1.63	6.98	6.97	6.96	6.95	6.95	6.94	6.93	6.92	6.91	6.90
1.64	6.89	6.89	6.88	6.87	6.86	6.85	6.84	6.84	6.83	6.82
1.65	6.81	6.80	6.79	6.79	6.78	6.77	6.76	6.75	6.75	6.74
1.66	6.73	6.72	6.71	6.71	6.70	6.69	6.68	6.67	6.67	6.66
1.67	6.65	6.64	6.63	6.63	6.62	6.61	6.60	6.59	6.59	6.58
1.68	6.57	6.56	6.55	6.55	6.54	6.53	6.52	6.52	6.51	6.50
1.69	6.49	6.48	6.48	6.47	6.46	6.45	6.45	6.44	6.43	6.42
1.70	6.42	6.41	6.40	6.39	6.39	6.38	6.37	6.36	6.36	6.35
1.71	6.34	6.33	6.33	6.32	6.31	6.30	6.30	6.29	6.28	6.28
1.72	6.27	6.26	6.25	6.25	6.24	6.23	6.22	6.22	6.21	6.20
1.73	6.20	6.19	6.18	6.17	6.17	6.16	6.15	6.15	6.14	6.13
1.74	6.12	6.12	6.11	6.10	6.10	6.09	6.08	6.08	6.07	6.06
1.75	6.06	6.05	6.04	6.03	6.03	6.02	6.01	6.01	6.00	5.99
1.76	5.99	5.98	5.97	5.97	5.96	5.95	5.95	5.94	5.93	5.93
1.77	5.92	5.91	5.91	5.90	5.89	5.89	5.88	5.87	5.87	5.86
1.78	5.85	5.85	5.84	5.83	5.83	5.82	5.81	5.81	5.80	5.79
1.79	5.79	5.78	5.77	5.77	5.76	5.76	5.75	5.74	5.74	5.73
1.80	5.72	5.72	5.71	5.70	5.70	5.69	5.69	5.68	5.67	5.67
1.81	5.66	5.65	5.65	5.64	5.64	5.63	5.62	5.62	5.61	5.60
1.82	5.60	5.59	5.59	5.58	5.57	5.57	5.56	5.56	5.55	5.54
1.83	5.54	5.53	5.53	5.52	5.51	5.51	5.50	5.50	5.49	5.48
1.84	5.48	5.47	5.47	5.46	5.45	5.45	5.44	5.44	5.43	5.42
1.85	5.42	5.41	5.41	5.40	5.39	5.39	5.38	5.38	5.37	5.37
1.86	5.36	5.36	5.35	5.34	5.34	5.33	5.33	5.32	5.31	5.31
1.87	5.30	5.30	5.29	5.29	5.28	5.27	5.27	5.26	5.26	5.25
1.88	5.25	5.24	5.24	5.23	5.22	5.22	5.21	5.21	5.20	5.20

Table 7. Vickers hardness scale HV 10 (load 10 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.89	5.19	5.19	5.18	5.17	5.17	5.16	5.16	5.15	5.15	5.14
1.90	5.14	5.13	5.13	5.12	5.12	5.11	5.10	5.10	5.09	5.09
1.91	5.08	5.08	5.07	5.07	5.06	5.06	5.05	5.05	5.04	5.04
1.92	5.03	5.03	5.02	5.01	5.01	5.00	5.00	4.99	4.99	4.98

Table 8. Vickers hardness scale HV 20 (load 20 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.13	2195.00	2161.00	2129.00	2097.00	2065.00	2035.00	2005.00	1976.00	1947.00	1920.00
0.14	1892.00	1865.00	1839.00	1814.00	1789.00	1764.00	1740.00	1716.00	1693.00	1671.00
0.15	1648.00	1627.00	1605.00	1584.00	1564.00	1544.00	1524.00	1505.00	1486.00	1467.00
0.16	1449.00	1431.00	1413.00	1396.00	1379.00	1362.00	1346.00	1330.00	1314.00	1299.00
0.17	1283.00	1268.00	1254.00	1239.00	1225.00	1211.00	1197.00	1184.00	1171.00	1157.00
0.18	1145.00	1132.00	1120.00	1107.00	1095.00	1084.00	1072.00	1061.00	1049.00	1038.00
0.19	1027.00	1017.00	1006.00	996.00	985.00	975.00	965.00	956.00	946.00	937.00
0.20	927.00	918.00	909.00	900.00	891.00	883.00	874.00	866.00	857.00	849.00
0.21	841.00	833.00	825.00	814.00	810.00	802.00	795.00	788.00	780.00	773.00
0.22	766.00	759.00	753.00	746.00	739.00	733.00	726.00	720.00	713.00	707.00
0.23	701.00	695.00	689.00	683.00	677.00	672.00	666.00	660.00	655.00	649.00
0.24	644.00	639.00	633.00	628.00	623.00	618.00	613.00	608.00	603.00	598.00
0.25	593.00	589.00	584.00	579.00	575.00	570.00	566.00	562.00	557.00	553.00
0.26	549.00	544.00	540.00	536.00	532.00	528.00	524.00	520.00	516.00	513.00
0.27	509.00	505.00	501.00	498.00	494.00	490.00	487.00	483.00	480.00	476.00
0.28	473.00	470.00	466.00	463.00	460.00	457.00	453.00	450.00	447.00	444.00
0.29	441.00	438.00	435.00	432.00	429.00	426.00	423.00	420.00	418.00	415.00
0.30	412.00	409.00	407.00	404.00	401.00	399.00	396.00	394.00	391.00	388.00
0.31	386.00	383.00	381.00	379.00	376.00	374.00	371.00	369.00	367.00	364.00
0.32	362.00	360.00	358.00	355.00	353.00	351.00	349.00	347.00	345.00	343.00
0.33	341.00	339.00	336.00	334.00	332.00	330.00	329.00	327.00	325.00	323.00
0.34	321.00	319.00	317.00	315.00	313.00	312.00	310.00	308.00	306.00	304.00
0.35	303.00	301.00	299.00	298.00	296.00	294.00	293.00	291.00	289.00	288.00
0.36	286.00	285.00	283.00	281.00	280.00	278.00	277.00	275.00	274.00	272.00
0.37	271.00	269.00	268.00	267.00	265.00	264.00	262.00	261.00	260.00	258.00
0.38	257.00	255.00	254.00	253.00	252.00	250.00	249.00	248.00	246.00	245.00
0.39	244.00	243.00	241.00	240.00	239.00	238.00	237.00	235.00	234.00	233.00
0.40	232.00	231.00	229.00	228.00	227.00	226.00	225.00	224.00	223.00	222.00
0.41	221.00	220.00	218.00	217.00	216.00	215.00	214.00	213.00	212.00	211.00
0.42	210.00	209.00	208.00	207.00	206.00	205.00	204.00	203.00	202.50	201.50
0.43	200.60	199.70	198.70	197.80	196.90	196.00	195.10	194.20	193.30	192.40
0.44	191.60	190.70	189.80	189.00	188.10	187.30	186.40	185.60	184.80	184.00
0.45	183.10	182.30	181.50	180.70	179.90	179.10	178.40	177.60	176.80	176.00
0.46	175.30	174.50	173.80	173.00	172.30	171.50	170.80	170.10	169.30	168.60
0.47	167.90	167.20	166.50	165.80	165.10	164.40	163.70	163.00	162.30	161.60
0.48	161.00	160.30	159.60	159.00	158.30	157.70	157.00	156.40	155.70	155.10
0.49	154.50	153.80	153.20	152.60	152.00	151.40	150.80	150.10	149.50	148.90
0.50	148.30	147.80	147.20	146.60	146.00	145.40	144.90	144.30	143.70	143.10
0.51	142.60	142.00	141.50	140.90	140.40	139.80	139.30	138.80	138.20	137.70
0.52	137.20	136.60	136.10	135.60	135.10	134.60	134.00	133.50	133.00	132.50
0.53	132.00	131.50	131.00	130.50	130.10	129.60	129.10	128.60	128.10	127.70
0.54	127.20	126.70	126.20	125.80	125.30	124.90	124.40	124.00	123.50	123.00
0.55	122.60	122.20	121.70	121.30	120.80	120.40	120.00	119.50	119.10	118.70
0.56	118.30	117.80	117.40	117.00	116.60	116.20	115.80	115.40	115.00	114.60
0.57	114.20	113.80	113.40	113.00	112.60	112.20	111.80	111.40	111.00	110.60

Table 8. Vickers hardness scale HV 20 (load 20 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.58	110.20	109.90	109.50	109.10	108.70	108.40	108.00	107.60	107.30	106.90
0.59	106.50	106.20	105.80	105.50	105.10	104.80	104.40	104.10	103.70	103.40
0.60	103.00	102.70	102.30	102.00	101.70	101.30	101.00	100.70	100.30	100.00
0.61	99.70	99.30	99.00	98.70	98.40	98.10	97.70	97.40	97.10	96.80
0.62	96.50	96.20	95.90	96.60	95.20	94.90	94.60	94.30	94.00	93.70
0.63	93.40	93.10	92.90	92.60	92.30	92.00	91.70	91.40	91.10	90.80
0.64	90.50	90.30	90.00	89.70	89.40	89.10	88.90	88.60	88.30	88.10
0.65	87.80	87.50	87.20	87.00	86.70	86.40	86.20	85.90	85.70	85.40
0.66	85.10	84.90	84.60	84.40	84.10	83.90	83.60	83.40	83.10	82.90
0.67	82.60	82.40	82.10	81.90	81.60	81.40	81.20	80.90	80.70	80.40
0.68	80.20	80.00	79.70	79.50	79.30	79.00	78.80	78.60	78.40	78.10
0.69	77.90	77.70	77.40	77.20	77.00	76.80	76.60	76.30	76.10	75.90
0.70	75.70	75.50	75.30	75.00	74.80	74.60	74.40	74.20	74.00	73.80
0.71	73.60	73.40	73.20	73.00	72.70	72.50	72.30	72.10	71.90	71.70
0.72	71.50	71.30	71.10	70.90	70.80	70.60	70.40	70.20	70.00	69.80
0.73	69.60	69.40	69.20	69.00	68.80	68.70	68.50	68.30	68.10	67.90
0.74	67.70	67.50	67.40	67.20	67.00	66.80	66.60	66.50	66.30	66.10
0.75	65.90	65.80	65.60	65.40	65.20	65.10	64.90	64.70	64.50	64.40
0.76	64.20	64.00	63.90	63.70	63.50	63.40	63.20	63.00	62.90	62.70
0.77	62.60	62.40	62.20	62.10	61.90	61.70	61.60	61.40	61.30	61.10
0.78	61.00	60.80	60.60	60.50	60.30	60.20	60.00	59.90	59.70	59.60
0.79	59.40	59.30	59.10	59.00	58.80	58.70	58.50	58.40	58.20	58.10
0.80	57.90	57.80	57.70	57.50	57.40	57.20	57.10	56.90	56.80	56.70
0.81	56.50	56.40	56.20	56.10	56.00	55.80	55.70	55.60	55.40	55.30
0.82	55.20	55.00	54.90	54.80	54.60	54.50	54.40	54.20	54.10	54.00
0.83	53.80	53.70	53.60	53.40	53.30	53.20	53.10	52.90	52.80	52.70
0.84	52.60	52.40	52.30	52.20	52.10	51.90	51.80	51.70	51.60	51.50
0.85	51.30	51.20	51.10	51.00	50.90	50.70	50.60	50.50	50.40	50.30
0.86	50.10	50.00	49.90	49.80	49.70	49.60	49.50	49.30	49.20	49.10
0.87	49.00	48.90	48.80	48.70	48.60	48.40	48.30	48.20	48.10	48.00
0.88	47.90	47.80	47.70	47.60	47.50	47.40	47.20	47.10	47.00	46.90
0.89	46.80	46.70	46.60	46.50	46.40	46.30	46.20	46.10	46.00	45.90
0.90	45.80	45.70	45.60	45.50	45.40	45.30	45.20	45.10	45.00	44.90
0.91	44.80	44.70	44.60	44.50	44.40	44.30	44.20	44.10	44.00	43.90
0.92	43.80	43.70	43.60	43.50	43.40	43.35	43.25	43.16	43.07	42.97
0.93	42.88	42.79	42.70	42.61	42.51	42.42	42.33	42.24	42.15	42.06
0.94	41.97	41.88	41.79	41.71	41.62	41.53	41.44	41.35	41.27	41.18
0.95	41.09	41.01	40.92	40.84	40.75	40.66	40.58	40.50	40.41	40.33
0.96	40.24	40.16	40.08	39.99	39.91	39.83	39.74	39.66	39.58	39.50
0.97	39.42	39.34	39.25	39.17	39.09	39.01	38.93	38.85	38.77	38.70
0.98	38.62	38.54	38.46	38.38	38.30	38.23	38.15	38.07	37.99	37.92
0.99	37.84	37.76	37.69	37.61	37.54	37.46	37.39	37.31	37.24	37.16
1.00	37.09	37.01	36.94	36.87	36.79	36.72	36.65	36.57	36.50	36.43
1.01	36.36	36.28	36.21	36.14	36.07	36.00	35.93	35.86	35.79	35.72
1.02	35.65	35.58	35.51	35.44	35.37	35.30	35.23	35.16	35.09	35.03

Table 8. Vickers hardness scale HV 20 (load 20 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.03	34.96	34.89	34.82	34.76	34.69	34.62	34.55	34.49	34.42	34.36
1.04	34.29	34.22	34.16	34.09	34.03	33.96	33.90	33.83	33.77	33.70
1.05	33.64	33.58	33.51	33.45	33.38	33.32	33.26	33.20	33.13	33.07
1.06	33.01	32.95	32.88	32.82	32.76	32.70	32.64	32.58	32.51	32.45
1.07	32.39	32.33	32.27	32.21	32.15	32.09	32.03	31.97	31.91	31.86
1.08	31.80	31.74	31.68	31.62	31.56	31.50	31.45	31.39	31.33	31.27
1.09	31.22	31.16	31.10	31.04	30.99	30.93	30.87	30.82	30.76	30.71
1.10	30.65	30.60	30.54	30.48	30.43	30.37	30.32	30.26	30.21	30.16
1.11	30.10	30.05	29.99	29.94	29.89	29.83	29.78	29.72	29.67	29.62
1.12	29.57	29.51	29.46	29.41	29.36	29.30	29.25	29.20	29.15	29.10
1.13	29.04	28.99	28.94	28.89	28.84	28.79	28.74	28.69	28.64	28.59
1.14	28.54	28.49	28.44	28.39	28.34	28.29	28.24	28.19	28.14	28.09
1.15	28.04	27.99	27.95	27.90	27.85	27.80	27.75	27.71	27.66	27.61
1.16	27.56	27.51	27.47	27.42	27.37	27.33	27.28	27.23	27.19	27.14
1.17	27.09	27.05	27.00	26.95	26.91	26.86	26.82	26.77	26.73	26.68
1.18	26.64	26.59	26.55	26.50	26.46	26.41	26.37	26.32	26.28	26.23
1.19	26.19	26.15	26.10	26.06	26.01	25.97	25.93	25.88	25.84	25.80
1.20	25.76	25.71	25.67	25.63	25.58	25.54	25.50	25.46	25.42	25.37
1.21	25.33	25.29	25.25	25.21	25.16	25.12	25.08	25.04	25.00	24.95
1.22	24.92	24.88	24.84	24.80	24.75	24.71	24.67	24.63	24.59	24.55
1.23	24.51	24.47	24.43	24.39	24.36	24.32	24.28	24.24	24.20	24.16
1.24	24.12	24.08	24.04	24.00	23.97	23.93	23.89	23.85	23.81	23.77
1.25	23.74	23.70	23.66	23.62	23.58	23.55	23.51	23.47	23.43	23.40
1.26	23.36	23.32	23.29	23.25	23.21	23.18	23.14	23.10	23.07	23.03
1.27	22.99	22.96	22.92	22.89	22.85	22.81	22.78	22.74	22.71	22.67
1.28	22.64	22.60	22.57	22.53	22.50	22.46	22.43	22.39	22.36	22.32
1.29	22.29	22.25	22.22	22.18	22.15	22.11	22.08	22.05	22.01	21.98
1.30	21.95	21.91	21.88	21.84	21.81	21.78	21.74	21.71	21.68	21.64
1.31	21.61	21.58	21.55	21.51	21.48	21.45	21.41	21.38	21.35	21.32
1.32	21.29	21.25	21.22	21.19	21.16	21.12	21.09	21.06	21.03	21.00
1.33	20.97	20.93	20.90	20.87	20.84	20.81	20.78	20.75	20.72	20.69
1.34	20.65	20.62	20.59	20.56	20.53	20.50	20.47	20.44	20.41	20.38
1.35	20.35	20.32	20.29	20.26	20.23	20.20	20.17	20.14	20.11	20.08
1.36	20.05	20.02	19.99	19.96	19.93	19.90	19.88	19.85	19.82	19.79
1.37	19.76	19.73	19.70	19.67	19.65	19.62	19.59	19.56	19.53	19.50
1.38	19.47	19.45	19.42	19.39	19.36	19.33	19.31	19.28	19.25	19.22
1.39	19.20	19.17	19.14	19.11	19.09	19.06	19.03	19.00	18.98	18.95
1.40	18.92	18.90	18.87	18.84	18.81	18.79	18.76	18.73	18.71	18.68
1.41	18.65	18.63	18.60	18.58	18.55	18.52	18.50	18.47	18.44	18.42
1.42	18.39	18.37	18.34	18.32	18.29	18.26	18.24	18.21	18.19	18.16
1.43	18.14	18.11	18.09	18.06	18.04	18.01	17.99	17.96	17.94	17.91
1.44	17.89	17.86	17.84	17.81	17.79	17.76	17.74	17.71	17.69	17.66
1.45	17.64	17.62	17.59	17.57	17.54	17.52	17.49	17.47	17.45	17.42
1.46	17.40	17.38	17.35	17.33	17.30	17.28	17.26	17.23	17.21	17.19
1.47	17.16	17.14	17.12	17.09	17.07	17.05	17.02	17.00	16.98	16.95

Table 8. Vickers hardness scale HV 20 (load 20 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.48	16.93	16.91	16.89	16.86	16.84	16.82	16.80	16.77	16.75	16.73
1.49	16.71	16.68	16.66	16.64	16.62	16.59	16.57	16.55	16.53	16.51
1.50	16.48	16.46	16.44	16.42	16.40	16.37	16.35	16.33	16.31	16.29
1.51	16.27	16.24	16.22	16.20	16.18	16.16	16.14	16.12	16.09	16.07
1.52	16.05	16.03	16.01	15.99	15.97	15.95	15.93	15.91	15.88	15.86
1.53	15.84	15.82	15.80	15.78	15.76	15.74	15.72	15.70	15.68	15.66
1.54	15.64	15.62	15.60	15.58	15.56	15.54	15.52	15.50	15.48	15.46
1.55	15.44	15.42	15.40	15.38	15.36	15.34	15.32	15.30	15.28	15.26
1.56	15.24	15.22	15.20	15.18	15.16	15.14	15.12	15.10	15.08	15.07
1.57	15.05	15.03	15.01	14.99	14.97	14.95	14.93	14.91	14.89	14.88
1.58	14.86	14.84	14.82	14.80	14.78	14.76	14.74	14.73	14.71	14.69
1.59	14.67	14.65	14.63	14.61	14.60	14.58	14.56	14.54	14.52	14.51
1.60	14.49	14.47	14.45	14.43	14.42	14.40	14.38	14.36	14.34	14.33
1.61	14.31	14.29	14.27	14.25	14.24	14.22	14.20	14.18	14.17	14.15
1.62	14.13	14.11	14.10	14.08	14.06	14.04	14.03	14.01	13.99	13.98
1.63	13.96	13.94	13.92	13.91	13.89	13.87	13.86	13.84	13.82	13.81
1.64	13.79	13.77	13.76	13.74	13.72	13.71	13.69	13.67	13.66	13.64
1.65	13.62	13.61	13.59	13.57	13.56	13.54	13.52	13.51	13.49	13.48
1.66	13.46	13.44	13.43	13.41	13.39	13.38	13.36	13.35	13.33	13.31
1.67	13.30	13.28	13.27	13.25	13.23	13.22	13.20	13.19	13.17	13.16
1.68	13.14	13.12	13.11	13.09	13.08	13.06	13.05	13.03	13.02	13.00
1.69	12.99	12.97	12.95	12.94	12.92	12.91	12.89	12.88	12.86	12.85
1.70	12.83	12.82	12.80	12.79	12.77	12.76	12.74	12.73	12.71	12.70
1.71	12.68	12.67	12.65	12.64	12.62	12.61	12.59	12.58	12.57	12.55
1.72	12.54	12.52	12.51	12.49	12.48	12.46	12.45	12.43	12.42	12.41
1.73	12.39	12.38	12.36	12.35	12.33	12.32	12.31	12.29	12.28	12.26
1.74	12.25	12.24	12.22	12.21	12.19	12.18	12.17	12.15	12.14	12.12
1.75	12.11	12.10	12.08	12.07	12.05	12.04	12.03	12.01	12.00	11.99
1.76	11.97	11.96	11.95	11.93	11.92	11.91	11.89	11.88	11.86	11.85
1.77	11.84	11.82	11.81	11.80	11.78	11.77	11.76	11.74	11.73	11.72
1.78	11.71	11.69	11.68	11.67	11.65	11.64	11.63	11.61	11.60	11.59
1.79	11.57	11.56	11.55	11.54	11.52	11.51	11.50	11.48	11.47	11.46
1.80	11.45	11.43	11.42	11.41	11.40	11.38	11.37	11.36	11.35	11.33
1.81	11.32	11.31	11.30	11.28	11.27	11.26	11.25	11.23	11.22	11.21
1.82	11.20	11.18	11.17	11.16	11.15	11.14	11.12	11.11	11.10	11.09
1.83	11.07	11.06	11.05	11.04	11.03	11.01	11.00	10.99	10.98	10.97
1.84	10.95	10.94	10.93	10.92	10.91	10.90	10.88	10.87	10.86	10.85
1.85	10.84	10.82	10.81	10.80	10.79	10.78	10.77	10.75	10.74	10.73
1.86	10.72	10.71	10.70	10.69	10.67	10.66	10.65	10.64	10.63	10.62
1.87	10.61	10.59	10.58	10.57	10.56	10.55	10.54	10.53	10.52	10.50
1.88	10.49	10.48	10.47	10.46	10.45	10.44	10.43	10.42	10.40	10.39
1.89	10.38	10.37	10.36	10.35	10.34	10.33	10.32	10.31	10.30	10.28
1.90	10.27	10.26	10.25	10.24	10.23	10.22	10.21	10.20	10.19	10.18
1.91	10.17	10.16	10.14	10.13	10.12	10.11	10.10	10.09	10.08	10.07
1.92	10.06	10.05	10.04	10.03	10.02	10.01	10.00	9.99	9.98	9.97

Table 8. Vickers hardness scale HV 20 (load 20 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.93	9.96	9.95	9.94	9.93	9.92	9.91	9.89	9.88	9.87	9.86
1.94	9.85	9.84	9.83	9.82	9.81	9.80	9.79	9.78	9.77	9.76
1.95	9.75	9.74	9.73	9.72	9.71	9.70	9.69	9.68	9.67	9.66
1.96	9.65	9.64	9.63	9.62	9.61	9.61	9.60	9.59	9.58	9.57
1.97	9.56	9.55	9.54	9.53	9.52	9.51	9.50	9.49	9.48	9.47
1.98	9.46	9.45	9.44	9.43	9.42	9.41	9.40	9.39	9.38	9.37
1.99	9.37	9.36	9.35	9.34	9.33	9.32	9.31	9.30	9.29	9.28

Table 9. Vickers hardness scale HV 30 (load 30 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.16	2173.00	2146.00	2120.00	2094.00	2068.00	2043.00	2019.00	1995.00	1971.00	1948.00
0.17	1925.00	1903.00	1880.00	1859.00	1837.00	1817.00	1796.00	1776.00	1756.00	1736.00
0.18	1717.00	1698.00	1679.00	1661.00	1643.00	1625.00	1608.00	1591.00	1574.00	1557.00
0.19	1541.00	1525.00	1509.00	1493.00	1478.00	1463.00	1448.00	1433.00	1419.00	1405.00
0.20	1391.00	1377.00	1363.00	1350.00	1337.00	1324.00	1311.00	1298.00	1286.00	1274.00
0.21	1261.00	1250.00	1238.00	1226.00	1215.00	1203.00	1192.00	1181.00	1171.00	1160.00
0.22	1149.00	1139.00	1129.00	1119.00	1109.00	1099.00	1089.00	1080.00	1070.00	1061.00
0.23	1052.00	1043.00	1034.00	1025.00	1016.00	1007.00	999.00	990.00	982.00	974.00
0.24	966.00	958.00	950.00	942.00	934.00	927.00	919.00	912.00	905.00	897.00
0.25	890.00	883.00	876.00	869.00	862.00	856.00	849.00	842.00	836.00	829.00
0.26	823.00	817.00	810.00	804.00	798.00	792.00	786.00	780.00	775.00	769.00
0.27	763.00	757.00	752.00	746.00	741.00	736.00	730.00	725.00	720.00	715.00
0.28	710.00	705.00	700.00	695.00	690.00	685.00	680.00	675.00	671.00	666.00
0.29	661.00	657.00	652.00	648.00	644.00	639.00	635.00	631.00	626.00	622.00
0.30	618.00	614.00	610.00	606.00	602.00	598.00	594.00	590.00	586.00	583.00
0.31	579.00	575.00	571.00	568.00	564.00	561.00	557.00	554.00	550.00	547.00
0.32	543.00	540.00	537.00	533.00	530.00	527.00	523.00	520.00	517.00	514.00
0.33	511.00	508.00	505.00	502.00	499.00	496.00	493.00	490.00	487.00	484.00
0.34	481.00	478.00	476.00	473.00	470.00	467.00	465.00	462.00	459.00	457.00
0.35	454.00	452.00	449.00	446.00	444.00	441.00	439.00	436.00	434.00	432.00
0.36	429.00	427.00	425.00	422.00	420.00	418.00	415.00	413.00	411.00	409.00
0.37	406.00	404.00	402.00	400.00	398.00	396.00	393.00	391.00	389.00	387.00
0.38	385.00	383.00	381.00	379.00	377.00	375.00	373.00	371.00	370.00	368.00
0.39	366.00	364.00	362.00	360.00	358.00	357.00	355.00	353.00	351.00	349.00
0.40	348.00	346.00	344.00	343.00	341.00	339.00	337.00	336.00	334.00	333.00
0.41	331.00	329.00	328.00	326.00	325.00	323.00	321.00	320.00	318.00	317.00
0.42	315.00	314.00	312.00	311.00	309.00	308.00	307.00	305.00	304.00	302.00
0.43	301.00	299.00	298.00	297.00	295.00	294.00	293.00	291.00	290.00	289.00
0.44	287.00	286.00	285.00	283.00	282.00	281.00	280.00	278.00	277.00	276.00
0.45	275.00	274.00	272.00	271.00	270.00	269.00	268.00	266.00	265.00	264.00
0.46	263.00	262.00	261.00	260.00	258.00	257.00	256.00	255.00	254.00	253.00
0.47	252.00	251.00	250.00	249.00	248.00	247.00	246.00	245.00	243.00	242.00
0.48	241.00	240.00	239.00	238.00	237.50	236.50	235.50	234.60	233.60	232.60
0.49	231.70	230.80	229.80	228.90	228.00	227.00	226.10	225.20	224.30	223.40
0.50	222.50	221.60	220.80	219.90	219.00	218.10	217.30	216.40	215.60	214.70
0.51	213.90	213.00	212.20	211.40	210.60	209.80	208.90	208.10	207.30	206.50
0.52	205.70	204.90	204.20	203.40	202.60	201.80	201.10	200.30	199.50	198.80
0.53	198.00	197.30	196.60	195.80	195.10	194.40	193.60	192.90	192.20	191.50
0.54	190.80	190.10	189.40	188.70	188.00	187.30	186.60	185.90	185.20	184.60
0.55	183.90	183.20	182.60	181.90	181.30	180.60	180.00	179.30	178.70	178.00
0.56	177.40	176.80	176.10	175.50	174.90	174.30	173.70	173.00	172.40	171.80
0.57	171.20	170.60	170.00	169.40	168.80	168.30	167.70	167.10	166.50	165.90
0.58	165.40	164.80	164.20	163.70	163.10	162.60	162.00	161.50	160.90	160.40
0.59	159.80	159.30	158.70	158.20	157.70	157.10	156.60	156.10	155.60	155.00
0.60	154.50	154.00	153.50	153.00	152.50	152.00	151.50	151.00	150.50	150.00

Table 9. Vickers hardness scale HV 30 (load 30 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.61	149.50	149.00	148.50	148.00	147.60	147.10	146.60	146.10	145.70	145.20
0.62	144.70	144.30	143.80	143.30	142.90	142.40	142.00	141.50	141.10	140.60
0.63	140.20	139.70	139.30	138.80	138.40	138.00	137.50	137.10	136.70	136.20
0.64	135.80	135.40	135.00	134.60	134.10	133.70	133.30	132.90	132.50	132.10
0.65	131.70	131.30	130.90	130.50	130.10	129.70	129.30	128.90	128.50	128.10
0.66	127.70	127.30	126.90	126.60	126.20	125.80	125.40	125.00	124.70	124.30
0.67	123.90	123.60	123.20	122.80	122.50	122.10	121.70	121.40	121.00	120.70
0.68	120.30	120.00	119.60	119.30	118.90	118.60	118.20	117.90	117.50	117.20
0.69	116.80	116.50	116.20	115.80	115.50	115.20	114.80	114.50	114.20	113.90
0.70	113.50	113.20	112.90	112.60	112.20	111.90	111.60	111.30	111.00	110.70
0.71	110.40	110.00	109.70	109.40	109.10	108.80	108.50	108.20	107.90	107.60
0.72	107.30	107.00	106.70	106.40	106.10	105.80	105.50	105.30	105.00	104.70
0.73	104.40	104.10	103.80	103.50	103.30	103.00	102.70	102.40	102.10	101.90
0.74	101.60	101.30	101.00	100.80	100.50	100.20	100.00	99.70	99.40	99.20
0.75	98.90	98.60	98.40	98.10	97.90	97.60	97.30	97.10	96.80	96.60
0.76	96.30	96.10	95.80	95.60	95.30	95.10	94.80	94.60	94.30	94.10
0.77	93.80	93.60	93.30	93.10	92.90	92.60	92.40	92.10	91.90	91.70
0.78	91.40	91.20	91.00	90.70	90.50	90.30	90.00	89.80	89.60	89.40
0.79	89.10	88.90	88.70	88.50	88.20	88.00	87.80	87.60	87.40	87.10
0.80	86.90	86.70	86.50	86.30	86.10	85.80	85.60	85.40	85.20	85.00
0.81	84.80	84.60	84.40	84.20	84.00	83.80	83.50	83.30	83.10	82.90
0.82	82.70	82.50	82.30	82.10	81.90	81.70	81.50	81.30	81.10	80.90
0.83	80.80	80.60	80.40	80.20	80.00	79.80	79.60	79.40	79.20	79.00
0.84	78.80	78.70	78.50	78.30	78.10	77.90	77.70	77.50	77.40	77.20
0.85	77.00	76.80	76.60	76.50	76.30	76.10	75.90	75.70	75.60	75.40
0.86	75.20	75.00	74.90	74.70	74.50	74.40	74.20	74.00	73.80	73.70
0.87	73.50	73.30	73.20	73.00	72.80	72.70	72.50	72.30	72.20	72.00
0.88	71.80	71.70	71.50	71.40	71.20	71.00	70.90	70.70	70.50	70.40
0.89	70.20	70.10	69.90	69.80	69.60	69.40	69.30	69.10	69.00	68.80
0.90	68.70	68.50	68.40	68.20	68.10	67.90	67.80	67.60	67.50	67.30
0.91	67.20	67.00	66.90	66.70	66.60	66.40	66.30	66.20	66.00	65.90
0.92	65.70	65.60	65.40	65.30	65.20	65.00	64.90	64.70	64.60	64.50
0.93	64.30	64.20	64.00	63.90	63.80	63.60	63.50	63.40	63.20	63.10
0.94	63.00	62.80	62.70	62.60	62.40	62.30	62.20	62.00	61.90	61.80
0.95	61.60	61.50	61.40	61.30	61.10	61.00	61.90	60.70	60.60	60.50
0.96	60.40	60.20	60.10	60.00	59.90	59.70	59.60	59.50	59.40	59.20
0.97	59.10	59.00	58.90	58.80	58.60	58.50	58.40	58.30	58.20	58.00
0.98	57.90	57.80	57.70	57.60	57.50	57.30	57.20	57.10	57.00	56.90
0.99	56.80	56.60	56.50	56.40	56.30	56.20	56.10	56.00	55.90	55.70
1.00	55.60	55.50	55.40	55.30	55.20	55.10	55.00	54.90	54.80	54.60
1.01	54.50	54.40	54.30	54.20	54.10	54.00	53.90	53.80	53.70	53.60
1.02	53.50	53.40	53.30	53.20	53.10	53.00	52.80	52.70	52.60	52.50
1.03	52.40	52.30	52.20	52.10	52.00	51.90	51.80	51.70	51.60	51.50
1.04	51.40	51.30	51.20	51.10	51.00	50.90	50.80	50.75	50.65	50.56
1.05	50.46	50.36	50.27	50.17	50.08	49.98	49.89	49.79	49.70	49.60

Table 9. Vickers hardness scale HV 30 (load 30 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.06	49.51	49.42	49.33	49.23	49.14	49.05	48.96	48.86	48.77	48.68
1.07	48.59	48.50	48.41	48.32	48.23	48.14	48.05	47.96	47.87	47.78
1.08	47.69	47.61	47.52	47.43	47.34	47.26	47.17	47.08	47.00	46.91
1.09	46.82	46.74	46.65	46.57	46.48	46.40	46.31	46.23	46.14	46.06
1.10	45.98	45.89	45.81	45.73	45.64	45.56	45.48	45.40	45.31	45.23
1.11	45.15	45.07	44.99	44.91	44.83	44.75	44.67	44.59	44.51	44.43
1.12	44.35	44.27	44.19	44.11	44.03	43.96	43.88	43.80	43.72	43.64
1.13	43.57	43.49	43.41	43.34	43.26	43.18	43.11	43.03	42.96	42.88
1.14	42.81	42.73	42.66	42.58	42.51	42.43	42.36	42.29	42.21	42.14
1.15	42.07	41.99	41.92	41.85	41.77	41.70	41.63	41.56	41.49	41.41
1.16	41.34	41.27	41.20	41.13	41.06	40.99	40.92	40.85	40.78	40.71
1.17	40.64	40.57	40.50	40.43	40.36	40.29	40.23	40.16	40.09	40.02
1.18	39.95	39.89	39.82	39.75	39.68	39.62	39.55	39.48	39.42	39.35
1.19	39.28	39.22	39.15	39.09	39.02	38.96	38.89	39.83	38.76	38.70
1.20	38.63	38.57	38.50	38.44	38.38	38.31	38.25	38.19	38.12	38.06
1.21	38.00	37.93	37.87	37.81	37.75	37.68	37.62	37.56	37.50	37.44
1.22	37.38	37.32	37.25	37.19	37.13	37.07	37.01	36.95	36.89	36.83
1.23	36.77	36.71	36.65	36.59	36.53	36.47	36.41	36.36	36.30	36.24
1.24	36.18	36.12	36.06	36.01	35.95	35.89	35.83	35.78	35.72	35.66
1.25	35.60	35.55	35.49	35.43	35.38	35.32	35.26	35.21	35.15	35.10
1.26	35.04	34.99	34.93	34.87	34.82	34.76	34.71	34.65	34.60	34.55
1.27	34.49	34.44	34.38	34.33	34.28	34.22	34.17	34.11	34.06	34.01
1.28	33.95	33.90	33.85	33.80	33.74	33.69	33.64	33.59	33.53	33.48
1.29	33.43	33.38	33.33	33.28	33.22	33.17	33.12	33.07	33.02	32.97
1.30	32.92	32.87	32.82	32.77	32.72	32.67	32.62	32.57	32.52	32.47
1.31	32.42	32.37	32.32	32.27	32.22	32.17	32.12	32.07	32.02	31.98
1.32	31.93	31.88	31.83	31.78	31.74	31.69	31.64	31.59	31.54	31.50
1.33	31.45	31.40	31.36	31.31	31.26	31.21	31.17	31.12	31.07	31.03
1.34	30.98	30.94	30.89	30.84	30.80	30.75	30.71	30.66	30.62	30.57
1.35	30.52	30.48	30.43	30.39	30.34	30.30	30.26	30.21	30.17	30.12
1.36	30.08	30.03	29.99	29.95	29.90	29.86	29.81	29.77	29.73	29.68
1.37	29.64	29.60	29.55	29.51	29.47	29.42	29.38	29.34	29.30	29.25
1.38	29.21	29.17	29.13	29.09	29.04	29.00	28.96	28.92	28.88	28.83
1.39	28.79	28.75	28.71	28.67	28.63	28.59	28.55	28.51	28.46	28.42
1.40	28.38	28.34	28.30	28.26	28.22	28.18	28.14	28.10	28.06	28.02
1.41	27.98	27.94	27.90	27.86	27.82	27.78	27.75	27.71	27.67	27.63
1.42	27.59	27.55	27.51	27.47	27.43	27.40	27.36	27.32	27.28	27.24
1.43	27.20	27.17	27.13	27.09	27.05	27.02	26.98	26.94	26.90	26.87
1.44	26.83	26.79	26.75	26.72	26.68	26.64	26.61	26.57	26.53	26.50
1.45	26.46	26.42	26.39	26.35	26.31	26.28	26.24	26.21	26.17	26.13
1.46	26.10	26.06	26.03	25.99	25.96	25.92	25.89	25.85	25.81	25.78
1.47	25.74	25.71	25.67	25.64	25.60	25.57	25.54	25.50	25.47	25.43
1.48	25.40	25.36	25.33	25.30	25.26	25.23	25.19	25.16	25.13	25.09
1.49	25.06	25.02	24.99	24.96	24.92	24.89	24.86	24.82	24.79	24.76
1.50	24.72	24.69	24.66	24.63	24.59	24.56	24.53	24.50	24.46	24.43

Table 9. Vickers hardness scale HV 30 (load 30 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.51	24.40	24.37	24.33	24.30	24.27	24.24	24.21	24.17	24.14	24.11
1.52	24.08	24.05	24.02	23.98	23.95	23.92	23.89	23.86	23.83	23.80
1.53	23.76	23.73	23.70	23.67	23.64	23.61	23.58	23.55	23.52	23.49
1.54	23.46	23.43	23.40	23.37	23.34	23.31	23.28	23.25	23.22	23.19
1.55	23.16	23.13	23.10	23.07	23.04	23.01	22.98	22.95	22.92	22.89
1.56	22.86	22.83	22.80	22.77	22.74	22.71	22.68	22.66	22.63	22.60
1.57	22.57	22.54	22.51	22.48	22.45	22.43	22.40	22.37	22.34	22.31
1.58	22.28	22.26	22.23	22.20	22.17	22.14	22.12	22.09	22.06	22.03
1.59	22.01	21.98	21.95	21.92	21.89	21.87	21.84	21.81	21.79	21.76
1.60	21.73	21.70	21.68	21.65	21.62	21.60	21.57	21.54	21.52	21.49
1.61	21.46	21.44	21.41	21.38	21.36	21.33	21.30	21.28	21.25	21.22
1.62	21.20	21.17	21.15	21.12	21.09	21.07	21.04	21.02	20.99	20.96
1.63	20.94	20.91	20.89	20.86	20.84	20.81	20.79	20.76	20.73	20.71
1.64	20.68	20.66	20.63	20.61	20.58	20.56	20.53	20.51	20.48	20.46
1.65	20.43	20.41	20.38	20.36	20.34	20.31	20.29	20.26	20.24	20.21
1.66	20.19	20.16	20.14	20.12	20.09	20.07	20.04	20.02	20.00	19.97
1.67	19.95	19.92	19.90	19.88	19.85	19.83	19.80	19.78	19.76	19.73
1.68	19.71	19.69	19.66	19.64	19.62	19.59	19.57	19.55	19.52	19.50
1.69	19.48	19.45	19.43	19.41	19.39	19.36	19.34	19.32	19.29	19.27
1.70	19.25	19.23	19.20	19.18	19.16	19.14	19.11	19.09	19.07	19.05
1.71	19.03	19.00	18.98	18.96	18.94	18.91	18.89	18.87	18.85	18.83
1.72	18.80	18.78	18.76	18.74	18.72	18.70	18.67	18.65	18.63	18.61
1.73	18.59	18.57	18.54	18.52	18.50	18.48	18.46	18.44	18.42	18.40
1.74	18.37	18.35	18.33	18.31	18.29	18.27	18.25	18.23	18.21	18.19
1.75	18.17	18.14	18.12	18.10	18.08	18.06	18.04	18.02	18.00	17.98
1.76	17.96	17.94	17.92	17.90	17.88	17.86	17.84	17.82	17.80	17.78
1.77	17.76	17.74	17.72	17.70	17.68	17.66	17.64	17.62	17.60	17.58
1.78	17.56	17.54	17.52	17.50	17.48	17.46	17.44	17.42	17.40	17.38
1.79	17.36	17.34	17.32	17.30	17.29	17.27	17.25	17.23	17.21	17.19
1.80	17.17	17.15	17.13	17.11	17.09	17.08	17.06	17.04	17.02	17.00
1.81	16.98	16.96	16.94	16.92	16.91	16.89	16.87	16.85	16.83	16.81
1.82	16.79	16.78	16.76	16.74	16.72	16.70	16.68	16.67	16.65	16.63
1.83	16.61	16.59	16.58	16.56	16.54	16.52	16.50	16.49	16.47	16.45
1.84	16.43	16.41	16.40	16.38	16.36	16.34	16.33	16.31	16.29	16.27
1.85	16.25	16.24	16.22	16.20	16.18	16.17	16.15	16.13	16.11	16.10
1.86	16.08	16.06	16.05	16.03	16.01	15.99	15.98	15.96	15.94	15.93
1.87	15.91	15.89	15.87	15.86	15.84	15.82	15.81	15.79	15.77	15.76
1.88	15.74	15.72	15.71	15.69	15.67	15.66	15.64	15.62	15.61	15.59
1.89	15.57	15.56	15.54	15.52	15.51	15.49	15.48	15.46	15.44	15.43
1.90	15.41	15.39	15.38	15.36	15.35	15.33	15.31	15.30	15.28	15.27
1.91	15.25	15.23	15.22	15.20	15.19	15.17	15.15	15.14	15.12	15.11
1.92	15.09	15.08	15.06	15.04	15.03	15.01	15.00	14.98	14.97	14.95
1.93	14.93	14.92	14.90	14.89	14.87	14.86	14.84	14.83	14.81	14.80
1.94	14.78	14.77	14.75	14.74	14.72	14.71	14.69	14.68	14.66	14.65
1.95	14.63	14.62	14.60	14.59	14.57	14.56	14.54	14.53	14.51	14.50

Table 9. Vickers hardness scale HV 30 (load 30 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.96	14.48	14.47	14.45	14.44	14.42	14.41	14.39	14.38	14.36	14.35
1.97	14.33	14.32	14.31	14.29	14.28	14.26	14.25	14.23	14.22	14.20
1.98	14.19	14.18	14.16	14.15	14.13	14.12	14.10	14.09	14.08	14.06
1.99	14.05	14.03	14.02	14.01	13.99	13.98	13.96	13.95	13.94	13.92

Table 10. Vickers hardness scale HV 50 (load 50 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.21	2102.00	2083.00	2063.00	2044.00	2025.00	2006.00	1987.00	1969.00	1951.00	1933.00
0.22	1916.00	1898.00	1881.00	1864.00	1848.00	1831.00	1815.00	1799.00	1784.00	1768.00
0.23	1753.00	1738.00	1723.00	1708.00	1693.00	1679.00	1665.00	1651.00	1637.00	1623.00
0.24	1610.00	1596.00	1583.00	1570.00	1557.00	1545.00	1532.00	1520.00	1508.00	1495.00
0.25	1483.00	1472.00	1460.00	1449.00	1437.00	1426.00	1415.00	1404.00	1393.00	1382.00
0.26	1372.00	1361.00	1351.00	1340.00	1330.00	1320.00	1310.00	1301.00	1291.00	1281.00
0.27	1272.00	1262.00	1253.00	1244.00	1235.00	1226.00	1214.00	1208.00	1200.00	1191.00
0.28	1183.00	1174.00	1166.00	1158.00	1150.00	1142.00	1134.00	1126.00	1118.00	1110.00
0.29	1102.00	1095.00	1087.00	1080.00	1073.00	1065.00	1058.00	1051.00	1044.00	1037.00
0.30	1030.00	1023.00	1017.00	1010.00	1003.00	997.00	990.00	984.00	977.00	971.00
0.31	965.00	959.00	952.00	946.00	940.00	934.00	929.00	923.00	917.00	911.00
0.32	905.00	900.00	894.00	889.00	883.00	878.00	872.00	867.00	862.00	857.00
0.33	851.00	846.00	841.00	836.00	831.00	826.00	821.00	816.00	812.00	807.00
0.34	802.00	797.00	793.00	788.00	784.00	779.00	774.00	770.00	766.00	761.00
0.35	757.00	753.00	748.00	744.00	740.00	736.00	732.00	727.00	723.00	719.00
0.36	715.00	711.00	708.00	704.00	700.00	696.00	692.00	688.00	685.00	681.00
0.37	677.00	674.00	670.00	666.00	663.00	659.00	656.00	652.00	649.00	645.00
0.38	642.00	639.00	635.00	632.00	629.00	626.00	622.00	619.00	616.00	613.00
0.39	610.00	606.00	603.00	600.00	597.00	594.00	591.00	588.00	585.00	582.00
0.40	579.00	577.00	574.00	571.00	568.00	565.00	562.00	560.00	557.00	554.00
0.41	552.00	549.00	546.00	544.00	541.00	538.00	536.00	533.00	531.00	528.00
0.42	526.00	523.00	521.00	518.00	516.00	513.00	511.00	509.00	506.00	504.00
0.43	501.00	499.00	497.00	495.00	492.00	490.00	488.00	486.00	483.00	481.00
0.44	479.00	477.00	475.00	472.00	470.00	468.00	466.00	464.00	462.00	460.00
0.45	458.00	456.00	454.00	452.00	450.00	448.00	446.00	444.00	442.00	440.00
0.46	438.00	436.00	434.00	433.00	431.00	429.00	427.00	425.00	423.00	422.00
0.47	420.00	418.00	416.00	414.00	413.00	411.00	409.00	408.00	406.00	404.00
0.48	402.00	401.00	399.00	397.00	396.00	394.00	393.00	391.00	389.00	388.00
0.49	386.00	385.00	383.00	381.00	380.00	378.00	377.00	375.00	374.00	372.00
0.50	371.00	369.00	368.00	366.00	365.00	364.00	362.00	361.00	359.00	358.00
0.51	356.00	355.00	354.00	352.00	351.00	350.00	348.00	347.00	346.00	344.00
0.52	343.00	342.00	340.00	339.00	338.00	336.00	335.00	334.00	333.00	331.00
0.53	330.00	329.00	328.00	326.00	325.00	324.00	323.00	322.00	320.00	319.00
0.54	318.00	317.00	316.00	314.00	313.00	312.00	311.00	310.00	309.00	308.00
0.55	307.00	305.00	304.00	303.00	302.00	301.00	300.00	299.00	298.00	297.00
0.56	296.00	295.00	294.00	293.00	291.00	290.00	289.00	288.00	287.00	286.00
0.57	285.00	284.00	283.00	282.00	281.00	280.00	279.00	278.50	277.50	276.60
0.58	275.60	274.70	273.70	272.80	271.90	270.90	270.00	269.10	268.20	267.30
0.59	266.40	265.50	264.60	263.70	262.80	261.90	261.00	260.10	259.30	258.40
0.60	257.60	256.70	255.80	255.00	254.20	253.30	252.50	251.60	250.80	250.00
0.61	249.20	248.40	247.60	246.70	245.90	245.10	244.30	243.60	242.80	242.00
0.62	241.20	240.40	239.70	238.90	238.10	237.40	236.60	235.80	235.10	234.30
0.63	233.60	232.90	232.10	231.40	230.70	229.90	229.20	228.50	227.80	227.10
0.64	226.40	225.70	225.00	224.30	223.60	222.90	222.20	221.50	220.80	220.10
0.65	219.50	218.80	218.10	217.40	216.80	216.10	215.50	214.80	214.10	213.50

Table 10. Vickers hardness scale HV 50 (load 50 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.66	212.90	212.20	211.60	210.90	210.30	209.70	209.00	208.40	207.80	207.20
0.67	206.50	205.90	205.30	204.70	204.10	203.50	202.90	202.30	201.70	201.10
0.68	200.50	199.90	199.30	198.80	198.20	197.60	197.00	196.50	195.90	195.30
0.69	194.70	194.20	193.60	193.10	192.50	192.00	191.40	190.90	190.30	189.80
0.70	189.20	188.70	188.10	187.60	187.10	186.50	186.00	185.50	185.00	184.40
0.71	183.90	183.40	182.90	182.40	181.90	181.40	180.90	180.40	179.90	179.40
0.72	178.90	178.40	177.90	177.40	176.90	176.40	175.90	175.40	174.90	174.50
0.73	174.00	173.50	173.00	172.60	172.10	171.60	171.20	170.70	170.20	169.80
0.74	169.30	168.90	168.40	168.00	167.50	167.10	166.60	166.20	165.70	165.30
0.75	164.80	164.40	164.00	163.50	163.10	162.70	162.20	161.80	161.40	160.90
0.76	160.50	160.10	159.70	159.30	158.80	158.40	158.00	157.60	157.20	156.80
0.77	156.40	156.00	155.60	155.20	154.80	154.40	154.00	153.60	153.20	152.80
0.78	152.40	152.00	151.60	151.20	150.80	150.50	150.10	149.70	149.30	148.90
0.79	148.60	148.20	147.80	147.40	147.10	146.70	146.30	146.00	145.60	145.20
0.80	144.90	144.50	144.20	143.80	143.40	143.10	142.70	142.40	142.00	141.70
0.81	141.30	141.00	140.60	140.30	139.90	139.60	139.20	138.90	138.60	138.20
0.82	137.90	137.60	137.20	136.90	136.60	136.20	135.90	135.60	135.20	134.90
0.83	134.60	134.30	133.90	133.60	133.30	133.00	132.70	132.30	132.00	131.70
0.84	131.40	131.10	130.80	130.50	130.20	129.90	129.50	129.20	128.90	128.60
0.85	128.30	128.00	127.70	127.40	127.10	126.80	126.50	126.20	125.90	125.70
0.86	125.40	125.10	124.80	124.50	124.20	123.90	123.60	123.30	123.10	122.80
0.87	122.50	122.20	121.90	121.70	121.40	121.10	120.80	120.50	120.30	120.00
0.88	119.70	119.50	119.20	118.90	118.60	118.40	118.10	117.80	117.60	117.30
0.89	117.10	116.80	116.50	116.30	116.00	115.70	115.50	115.20	115.00	114.70
0.90	114.50	114.20	114.00	113.70	113.50	113.20	113.00	112.70	112.50	112.20
0.91	112.00	111.70	111.50	111.20	111.00	110.70	110.50	110.30	110.00	109.80
0.92	109.50	109.30	109.10	108.80	108.60	108.40	108.10	107.90	107.70	107.40
0.93	107.20	107.00	106.70	106.50	106.30	106.10	105.80	105.60	105.40	105.20
0.94	104.90	104.70	104.50	104.30	104.00	103.80	103.60	103.40	103.20	103.00
0.95	102.70	102.50	102.30	102.10	101.90	101.70	101.40	101.20	101.00	100.80
0.96	100.60	100.40	100.20	100.00	99.80	99.60	99.40	99.20	98.90	98.70
0.97	98.50	98.30	98.10	97.90	97.70	97.50	97.30	97.10	96.90	96.70
0.98	96.50	96.30	96.10	96.00	95.80	95.60	95.40	95.20	95.00	94.80
0.99	94.60	94.40	94.20	94.00	93.80	93.70	93.50	93.30	93.10	92.90
1.00	92.70	92.50	92.30	92.20	92.00	91.80	91.60	91.40	91.30	91.10
1.01	90.90	90.70	90.50	90.40	90.20	90.00	89.80	89.60	89.50	89.30
1.02	89.10	88.90	88.80	88.60	88.40	88.30	88.10	87.90	87.70	87.60
1.03	87.40	87.20	87.10	86.90	86.70	86.60	86.40	86.20	86.10	85.90
1.04	85.70	85.60	85.40	85.20	85.10	84.90	84.70	84.60	84.40	84.30
1.05	84.10	83.90	83.80	83.60	83.50	83.30	83.10	83.00	82.80	82.70
1.06	82.50	82.40	82.20	82.10	81.90	81.70	81.60	81.40	81.30	81.10
1.07	81.00	80.80	80.70	80.50	80.40	80.20	80.10	79.90	79.80	79.60
1.08	79.50	79.30	79.20	79.10	78.90	78.80	78.60	78.50	78.30	78.20
1.09	78.00	77.90	77.80	77.60	77.50	77.30	77.20	77.00	76.90	76.80
1.10	76.60	76.50	76.30	76.20	76.10	75.90	75.80	75.70	75.50	75.40

Table 10. Vickers hardness scale HV 50 (load 50 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.11	75.30	75.10	75.00	74.80	74.70	74.60	74.40	74.30	74.20	74.00
1.12	73.90	73.80	73.70	73.50	73.40	73.30	73.10	73.00	72.90	72.70
1.13	72.60	72.50	72.40	72.20	72.10	72.00	71.80	71.70	71.60	71.50
1.14	71.30	71.20	71.10	71.00	70.80	70.70	70.60	70.50	70.40	70.20
1.15	70.10	70.00	69.90	69.70	69.60	69.50	69.40	69.30	69.10	69.00
1.16	68.90	68.80	68.70	68.50	68.40	68.30	68.20	68.10	68.00	67.80
1.17	67.70	67.60	67.50	67.40	67.30	67.20	67.00	66.90	66.80	66.70
1.18	66.60	66.50	66.40	66.30	66.10	66.00	65.90	65.80	65.70	65.60
1.19	65.50	65.40	65.30	65.10	65.00	64.90	64.80	64.70	64.60	64.50
1.20	64.40	64.30	64.20	64.10	64.00	63.90	63.70	63.60	63.50	63.40
1.21	63.30	63.20	63.10	63.00	62.90	62.80	62.70	62.60	62.50	62.40
1.22	62.30	62.20	62.10	62.00	61.90	61.80	61.70	61.60	61.50	61.40
1.23	61.30	61.20	61.10	61.00	60.90	60.80	60.70	60.60	60.50	60.40
1.24	60.30	60.20	60.10	60.00	59.90	59.80	59.70	59.60	59.50	59.40
1.25	59.30	59.24	59.15	59.06	58.96	58.87	58.77	58.68	58.59	58.49
1.26	58.40	58.31	58.22	58.12	58.03	57.94	57.85	57.76	57.67	57.58
1.27	57.49	57.40	57.30	57.21	57.13	57.04	56.95	56.86	56.77	56.68
1.28	56.59	56.50	56.41	56.33	56.24	56.15	56.06	55.98	55.89	55.80
1.29	55.72	55.63	55.54	55.46	55.37	55.29	55.20	55.12	55.03	54.95
1.30	54.86	54.78	54.69	54.61	54.53	54.44	54.36	54.28	54.19	54.11
1.31	54.03	53.95	53.86	53.78	53.70	53.62	53.54	53.46	53.37	53.29
1.32	53.21	53.13	53.05	52.97	52.89	52.81	52.73	52.65	52.57	52.49
1.33	52.42	52.34	52.26	52.18	52.10	52.02	51.95	51.87	51.79	51.71
1.34	51.64	51.56	51.48	51.41	51.33	51.25	51.18	51.10	51.03	50.95
1.35	50.87	50.80	50.72	50.65	50.57	50.50	50.43	50.35	50.28	50.20
1.36	50.13	50.06	49.98	49.91	49.84	49.76	49.69	49.62	49.54	49.47
1.37	49.40	49.33	49.26	49.18	49.11	49.04	48.97	48.90	48.83	48.76
1.38	48.69	48.62	48.55	48.48	48.41	48.34	48.27	48.20	48.13	48.06
1.39	47.99	47.92	47.85	47.78	47.71	47.65	47.58	47.51	47.44	47.37
1.40	47.31	47.24	47.17	47.10	47.04	46.97	46.90	46.84	46.77	46.70
1.41	46.64	46.57	46.50	46.44	46.37	46.31	46.24	46.18	46.11	46.05
1.42	45.98	45.92	45.85	45.79	45.72	45.66	45.60	45.53	45.47	45.40
1.43	45.34	45.28	45.21	45.15	45.09	45.03	44.96	44.90	44.84	44.78
1.44	44.71	44.65	44.59	44.53	44.47	44.40	44.34	44.28	44.22	44.16
1.45	44.10	44.04	43.98	43.92	43.86	43.80	43.74	43.68	43.62	43.56
1.46	43.50	43.44	43.38	43.32	43.26	43.20	43.14	43.08	43.02	42.97
1.47	42.91	42.85	42.79	42.73	42.67	42.62	42.56	42.50	42.44	42.39
1.48	42.33	42.27	42.22	42.16	42.10	42.04	41.99	41.93	41.88	41.82
1.49	41.76	41.71	41.65	41.60	41.54	41.48	41.43	41.37	41.32	41.26
1.50	41.21	41.15	41.10	41.04	40.99	40.93	40.88	40.83	40.77	40.72
1.51	40.66	40.61	40.56	40.50	40.45	40.40	40.34	40.29	40.24	40.18
1.52	40.13	40.08	40.03	39.97	39.92	39.87	39.82	39.76	39.71	39.66
1.53	39.61	39.56	39.50	39.45	39.40	39.35	39.30	39.25	39.20	39.15
1.54	39.10	39.04	38.99	38.94	38.89	38.84	38.79	38.74	38.69	38.64
1.55	38.59	38.54	38.49	38.44	38.39	38.34	38.30	38.25	38.20	38.15

Table 10. Vickers hardness scale HV 50 (load 50 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.56	38.10	38.05	38.00	37.95	37.90	37.86	37.81	37.76	37.71	37.66
1.57	37.62	37.57	37.52	37.47	37.42	37.38	37.33	37.28	37.24	37.19
1.58	37.14	37.09	37.05	37.00	36.95	36.91	36.86	36.81	36.77	36.72
1.59	36.68	36.63	36.58	36.54	36.49	36.45	36.40	36.35	36.31	36.26
1.60	36.22	36.17	36.13	36.08	36.04	35.99	35.95	35.90	35.86	35.81
1.61	35.77	35.73	35.68	35.64	35.59	35.55	35.50	35.46	35.42	35.37
1.62	35.33	35.29	35.24	35.20	35.16	35.11	35.07	35.03	34.98	34.94
1.63	34.90	34.85	34.81	34.77	34.73	34.68	34.64	34.60	34.56	34.52
1.64	34.47	34.43	34.39	34.35	34.31	34.26	34.22	34.18	34.14	34.10
1.65	34.06	34.02	33.97	33.93	33.89	33.85	33.81	33.77	33.73	33.69
1.66	33.65	33.61	33.57	33.53	33.49	33.45	33.41	33.37	33.33	33.29
1.67	33.25	33.21	33.17	33.13	33.09	33.05	33.01	32.97	32.93	32.89
1.68	32.85	32.81	32.77	32.73	32.70	32.66	32.62	32.58	32.54	32.50
1.69	32.46	32.42	32.39	32.35	32.31	32.27	32.23	32.20	32.16	32.12
1.70	32.08	32.04	32.01	31.97	31.93	31.89	31.86	31.82	31.78	31.75
1.71	31.71	31.67	31.63	31.60	31.56	31.52	31.49	31.45	31.41	31.38
1.72	31.34	31.30	31.27	31.23	31.20	31.16	31.12	31.09	31.05	31.02
1.73	30.98	30.94	30.91	30.87	30.84	30.80	30.77	30.73	30.69	30.66
1.74	30.62	30.59	30.55	30.52	30.48	30.45	30.41	30.38	30.34	30.31
1.75	30.28	30.24	30.21	30.17	30.14	30.10	30.07	30.03	30.00	29.97
1.76	29.93	29.90	29.86	29.83	29.80	29.76	29.73	29.70	29.66	29.63
1.77	29.60	29.56	29.53	29.49	29.46	29.43	29.40	29.36	29.33	29.30
1.78	29.26	29.23	29.20	29.17	29.13	29.10	29.07	29.03	29.00	28.97
1.79	28.94	28.91	28.87	28.84	28.81	28.78	28.74	28.71	28.68	28.65
1.80	28.62	28.59	28.55	28.52	28.49	28.46	28.43	28.40	28.36	28.33
1.81	28.30	28.27	28.24	28.21	28.18	28.15	28.11	28.08	28.05	28.02
1.82	27.99	27.96	27.93	27.90	27.87	27.84	27.81	27.78	27.75	27.72
1.83	27.69	27.66	27.63	27.60	27.57	27.54	27.51	27.48	27.45	27.42
1.84	27.39	27.36	27.33	27.30	27.27	27.24	27.21	27.18	27.15	27.12
1.85	27.09	27.06	27.03	27.00	26.97	26.94	26.92	26.89	26.86	26.83
1.86	26.80	26.77	26.74	26.71	26.69	26.66	26.63	26.60	26.57	26.54
1.87	26.51	26.49	26.46	26.43	26.40	26.37	26.35	26.32	26.29	26.26
1.88	26.23	26.21	26.18	26.15	26.12	26.09	26.07	26.04	26.01	25.98
1.89	25.96	25.93	25.90	25.87	25.85	25.82	25.79	25.77	25.74	25.71
1.90	25.68	25.66	25.63	25.60	25.58	25.55	25.52	25.50	25.47	25.44
1.91	25.42	25.39	25.36	25.34	25.31	25.28	25.26	25.23	25.20	25.18
1.92	25.15	25.13	25.10	25.07	25.05	25.02	25.00	24.97	24.94	24.92
1.93	24.89	24.87	24.84	24.81	24.79	24.76	24.74	24.71	24.69	24.66
1.94	24.64	24.61	24.58	24.56	24.53	24.51	24.48	24.46	24.43	24.41
1.95	24.38	24.36	24.33	24.31	24.28	24.26	24.23	24.21	24.18	24.16
1.96	24.14	24.11	24.09	24.06	24.04	24.01	23.99	23.96	23.94	23.92
1.97	23.89	23.87	23.84	23.82	23.79	23.77	23.75	23.72	23.70	23.67
1.98	23.65	23.63	23.60	23.58	23.55	23.53	23.51	23.48	23.46	23.44
1.99	23.41	23.39	23.37	23.34	23.32	23.30	23.27	23.25	23.23	23.20

Table 11. Vickers hardness scale HV 100 (load 100 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.30	2060.00	2047.00	2033.00	2020.00	2007.00	1993.00	1980.00	1968.00	1955.00	1942.00
0.31	1930.00	1917.00	1905.00	1893.00	1881.00	1869.00	1857.00	1845.00	1834.00	1822.00
0.32	1811.00	1800.00	1788.00	1777.00	1766.00	1756.00	1745.00	1734.00	1724.00	1713.00
0.33	1703.00	1693.00	1682.00	1672.00	1662.00	1652.00	1643.00	1633.00	1623.00	1614.00
0.34	1604.00	1595.00	1585.00	1576.00	1567.00	1558.00	1549.00	1540.00	1531.00	1522.00
0.35	1514.00	1505.00	1497.00	1488.00	1480.00	1471.00	1463.00	1455.00	1447.00	1439.00
0.36	1431.00	1423.00	1415.00	1407.00	1400.00	1392.00	1384.00	1377.00	1369.00	1362.00
0.37	1355.00	1347.00	1340.00	1333.00	1326.00	1319.00	1312.00	1305.00	1298.00	1291.00
0.38	1284.00	1277.00	1271.00	1264.00	1258.00	1251.00	1245.00	1238.00	1232.00	1225.00
0.39	1219.00	1213.00	1207.00	1201.00	1195.00	1189.00	1183.00	1177.00	1171.00	1165.00
0.40	1159.00	1153.00	1147.00	1142.00	1136.00	1131.00	1125.00	1119.00	1114.00	1109.00
0.41	1103.00	1098.00	1092.00	1087.00	1082.00	1077.00	1072.00	1066.00	1061.00	1056.00
0.42	1051.00	1046.00	1041.00	1036.00	1031.00	1027.00	1022.00	1017.00	1012.00	1008.00
0.43	1003.00	998.00	994.00	989.00	985.00	980.00	975.00	971.00	967.00	962.00
0.44	958.00	953.00	949.00	945.00	941.00	936.00	932.00	928.00	924.00	920.00
0.45	916.00	912.00	908.00	904.00	900.00	896.00	892.00	888.00	884.00	880.00
0.46	876.00	873.00	869.00	865.00	861.00	858.00	854.00	850.00	847.00	843.00
0.47	839.00	836.00	832.00	829.00	825.00	822.00	818.00	815.00	812.00	808.00
0.48	805.00	802.00	798.00	795.00	792.00	788.00	785.00	782.00	779.00	775.00
0.49	772.00	769.00	766.00	763.00	760.00	757.00	754.00	751.00	748.00	745.00
0.50	742.00	739.00	736.00	733.00	730.00	727.00	724.00	721.00	719.00	716.00
0.51	713.00	710.00	707.00	705.00	702.00	699.00	696.00	694.00	691.00	688.00
0.52	686.00	683.00	681.00	678.00	675.00	673.00	670.00	668.00	665.00	663.00
0.53	660.00	658.00	655.00	653.00	650.00	648.00	645.00	643.00	641.00	638.00
0.54	636.00	634.00	631.00	629.00	627.00	624.00	622.00	620.00	617.00	615.00
0.55	613.00	611.00	609.00	606.00	604.00	602.00	600.00	598.00	596.00	593.00
0.56	591.00	589.00	587.00	585.00	583.00	581.00	579.00	577.00	575.00	573.00
0.57	571.00	569.00	567.00	565.00	563.00	561.00	559.00	557.00	555.00	553.00
0.58	551.00	549.00	547.00	546.00	544.00	542.00	540.00	538.00	536.00	535.00
0.59	533.00	531.00	529.00	527.00	526.00	524.00	522.00	520.00	519.00	517.00
0.60	515.00	513.00	512.00	510.00	508.00	507.00	505.00	503.00	502.00	500.00
0.61	498.00	497.00	495.00	493.00	492.00	490.00	489.00	487.00	486.00	484.00
0.62	482.00	481.00	479.00	478.00	476.00	475.00	473.00	472.00	470.00	469.00
0.63	467.00	466.00	464.00	463.00	461.00	460.00	458.00	457.00	456.00	454.00
0.64	453.00	451.00	450.00	449.00	447.00	446.00	444.00	443.00	442.00	440.00
0.65	439.00	438.00	436.00	435.00	434.00	432.00	431.00	430.00	428.00	427.00
0.66	426.00	424.00	423.00	422.00	421.00	419.00	418.00	417.00	416.00	414.00
0.67	413.00	412.00	411.00	409.00	408.00	407.00	406.00	405.00	403.00	402.00
0.68	401.00	400.00	399.00	398.00	396.00	395.00	394.00	393.00	392.00	391.00
0.69	389.00	388.00	387.00	386.00	385.00	384.00	383.00	382.00	381.00	380.00
0.70	378.00	377.00	376.00	375.00	374.00	373.00	372.00	371.00	370.00	369.00
0.71	368.00	367.00	366.00	365.00	364.00	363.00	362.00	361.00	360.00	359.00
0.72	358.00	357.00	356.00	355.00	354.00	353.00	352.00	351.00	350.00	349.00
0.73	348.00	347.00	346.00	345.00	344.00	343.00	342.00	341.00	340.50	339.60
0.74	338.60	337.70	336.80	335.90	335.00	334.10	333.20	332.30	331.40	330.50

Table 11. Vickers hardness scale HV 100 (load 100 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
0.75	329.70	328.80	327.90	327.00	326.20	325.30	324.50	323.60	322.70	321.90
0.76	321.00	320.20	319.40	318.50	317.70	316.90	316.00	315.20	314.40	313.60
0.77	312.80	312.00	311.10	310.30	309.50	308.70	307.90	307.20	306.40	305.60
0.78	304.80	304.00	303.20	302.50	301.70	300.90	300.20	299.40	298.60	297.90
0.79	297.10	296.40	295.60	294.90	294.10	293.40	292.70	291.90	291.20	290.50
0.80	289.70	289.00	288.30	287.60	286.90	286.20	285.40	284.70	284.00	283.30
0.81	282.60	281.90	281.20	280.60	279.90	279.20	278.50	277.80	277.10	276.50
0.82	275.80	275.10	274.40	273.80	273.10	272.50	271.80	271.10	270.50	269.80
0.83	269.20	268.50	267.90	267.20	266.60	266.00	265.30	264.70	264.10	263.40
0.84	262.80	262.20	261.60	260.90	260.30	259.70	259.10	258.50	257.90	257.30
0.85	256.70	256.10	255.50	254.90	254.30	253.70	253.10	252.50	251.90	251.30
0.86	250.70	250.10	249.60	249.00	248.40	247.80	247.30	246.70	246.10	245.60
0.87	245.00	244.40	243.90	243.30	242.80	242.20	241.70	241.10	240.60	240.00
0.88	239.50	238.90	238.40	237.80	237.30	236.80	236.20	235.70	235.20	234.60
0.89	234.10	233.60	233.10	232.50	232.00	231.50	231.00	230.50	230.00	229.40
0.90	228.90	228.40	227.90	227.40	226.90	226.40	225.90	225.40	224.90	224.40
0.91	223.90	223.40	222.90	222.50	222.00	221.50	221.00	220.50	220.00	219.60
0.92	219.10	218.60	218.10	217.70	217.20	216.70	216.30	215.80	215.30	214.90
0.93	214.40	213.90	213.50	213.00	212.60	212.10	211.70	211.20	210.80	210.30
0.94	209.90	209.40	209.00	208.50	208.10	207.70	207.20	206.80	206.30	205.90
0.95	205.50	205.00	204.60	204.20	203.80	203.30	202.90	202.50	202.10	201.60
0.96	201.20	200.80	200.40	200.00	199.50	199.10	198.70	198.30	197.90	197.50
0.97	197.10	196.70	196.30	195.90	195.50	195.10	194.70	194.30	193.90	193.50
0.98	193.10	192.70	192.30	191.90	191.50	191.10	190.70	190.40	190.00	189.60
0.99	189.20	188.80	188.40	188.10	187.70	187.30	186.90	186.60	186.20	185.80
1.00	185.40	185.10	184.70	184.30	184.00	183.60	183.20	182.90	182.50	182.10
1.01	181.80	181.40	181.10	180.70	180.40	180.00	179.60	179.30	178.90	178.60
1.02	178.20	177.90	177.50	177.20	176.80	176.50	176.20	175.80	175.50	175.10
1.03	174.80	174.50	174.10	173.80	173.40	173.10	172.80	172.40	172.10	171.80
1.04	171.40	171.10	170.80	170.50	170.10	169.80	169.50	169.20	168.80	168.50
1.05	168.20	167.90	167.60	167.20	166.90	166.60	166.30	166.00	165.70	165.30
1.06	165.00	164.70	164.40	164.10	163.80	163.50	163.20	162.90	162.60	162.30
1.07	162.00	161.70	161.40	161.10	160.80	160.50	160.20	159.90	159.60	159.30
1.08	159.00	158.70	158.40	158.10	157.80	157.50	157.20	156.90	156.70	156.40
1.09	156.10	155.80	155.50	155.20	154.90	154.70	154.40	154.10	153.80	153.50
1.10	153.30	153.00	152.70	152.40	152.10	151.90	151.60	151.30	151.00	150.80
1.11	150.50	150.20	150.00	149.70	149.40	149.20	148.90	148.60	148.40	148.10
1.12	147.80	147.60	147.30	147.00	146.80	146.50	146.30	146.00	145.70	145.50
1.13	145.20	145.00	144.70	144.50	144.20	143.90	143.70	143.40	143.20	142.90
1.14	142.70	142.40	142.20	141.90	141.70	141.40	141.20	141.00	140.70	140.50
1.15	140.20	140.00	139.70	139.50	139.20	139.00	138.80	138.50	138.30	138.00
1.16	137.80	137.60	137.30	137.10	136.90	136.60	136.40	136.20	135.90	135.70
1.17	135.50	135.20	135.00	134.80	134.50	134.30	134.10	133.90	133.60	133.40
1.18	133.20	133.00	132.70	132.50	132.30	132.10	131.80	131.60	131.40	131.20
1.19	130.90	130.70	130.50	130.30	130.10	129.90	129.60	129.40	129.20	129.00

Table 11. Vickers hardness scale HV 100 (load 100 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.20	128.80	128.60	128.30	128.10	127.90	127.70	127.50	127.30	127.10	126.90
1.21	126.70	126.40	126.20	126.00	125.80	125.60	125.40	125.20	125.00	124.80
1.22	124.60	124.40	124.20	124.00	123.80	123.60	123.40	123.20	123.00	122.80
1.23	122.60	122.40	122.20	122.00	121.80	121.60	121.40	121.20	121.00	120.80
1.24	120.60	120.40	120.20	120.00	119.80	119.60	119.40	119.30	119.10	118.90
1.25	118.70	118.50	118.30	118.10	117.90	117.70	117.50	117.40	117.20	117.00
1.26	116.80	116.60	116.40	116.20	116.10	115.90	115.70	115.50	115.30	115.20
1.27	115.00	114.80	114.60	114.40	114.30	114.10	113.90	113.70	113.50	113.40
1.28	113.20	113.00	112.80	112.70	112.50	112.30	112.10	112.00	111.80	111.60
1.29	111.40	111.30	111.10	110.90	110.70	110.60	110.40	110.20	110.10	109.90
1.30	109.70	109.60	109.40	109.20	109.10	108.90	108.70	108.60	108.40	108.20
1.31	108.10	107.90	107.70	107.60	107.40	107.20	107.10	106.90	106.70	106.60
1.32	106.40	106.30	106.10	105.90	105.80	105.60	105.50	105.30	105.10	105.00
1.33	104.80	104.70	104.50	104.40	104.20	104.00	103.90	103.70	103.60	103.40
1.34	103.30	103.10	103.00	102.80	102.70	102.50	102.40	102.20	102.10	101.90
1.35	101.70	101.60	101.40	101.30	101.10	101.00	100.90	100.70	100.60	100.40
1.36	100.30	100.10	100.00	99.80	99.70	99.50	99.40	99.20	99.10	98.90
1.37	98.80	98.70	98.50	98.40	98.20	98.10	97.90	97.80	97.70	97.50
1.38	97.40	97.20	97.10	97.00	96.80	96.70	96.50	96.40	96.30	96.10
1.39	96.00	95.80	95.70	95.60	95.40	95.30	95.20	95.00	94.90	94.70
1.40	94.60	94.50	94.30	94.20	94.10	93.90	93.80	93.70	93.50	93.40
1.41	93.30	93.10	93.00	92.90	92.70	92.60	92.50	92.40	92.20	92.10
1.42	92.00	91.80	91.70	91.60	91.40	91.30	91.20	91.10	90.90	90.80
1.43	90.70	90.60	90.40	90.30	90.20	90.10	89.90	89.80	89.70	89.60
1.44	89.40	89.30	89.20	89.10	88.90	88.80	88.70	88.60	88.40	88.30
1.45	88.20	88.10	88.00	87.80	87.70	87.60	87.50	87.40	87.20	87.10
1.46	87.00	86.90	86.80	86.60	86.50	86.40	86.30	86.20	86.00	85.90
1.47	85.80	85.70	85.60	85.50	85.30	85.20	85.10	85.00	84.90	84.80
1.48	84.70	84.50	84.40	84.30	84.20	84.10	84.00	83.90	83.80	83.60
1.49	83.50	83.40	83.30	83.20	83.10	83.00	82.90	82.70	82.60	82.50
1.50	82.40	82.30	82.20	82.10	82.00	81.90	81.80	81.70	81.50	81.40
1.51	81.30	81.20	81.10	81.00	80.90	80.80	80.70	80.60	80.50	80.40
1.52	80.30	80.20	80.10	79.90	79.80	79.70	79.60	79.50	79.40	79.30
1.53	79.20	79.10	79.00	78.90	78.80	78.70	78.60	78.50	78.40	78.30
1.54	78.20	78.10	78.00	77.90	77.80	77.70	77.60	77.50	77.40	77.30
1.55	77.20	77.10	77.00	76.90	76.80	76.70	76.60	76.50	76.40	76.30
1.56	76.20	76.10	76.00	75.90	75.80	75.70	75.60	75.50	75.40	75.30
1.57	75.20	75.10	75.00	74.90	74.85	74.75	74.66	74.56	74.47	74.38
1.58	74.28	74.19	74.09	74.00	73.91	73.81	73.72	73.63	73.54	73.44
1.59	73.35	73.26	73.17	73.07	72.98	72.89	72.80	72.71	72.62	72.53
1.60	72.44	72.35	72.26	72.17	72.08	71.99	71.90	71.81	71.72	71.63
1.61	71.54	71.45	71.36	71.27	71.19	71.10	71.01	70.92	70.83	70.75
1.62	70.66	70.57	70.48	70.40	70.31	70.22	70.14	70.05	69.97	69.88
1.63	69.79	69.71	69.62	69.54	69.45	69.37	69.28	69.20	69.11	69.03
1.64	68.95	68.86	68.78	68.69	68.61	68.53	68.44	68.36	68.28	68.20

Table 11. Vickers hardness scale HV 100 (load 100 kgf)

Diagonal of impression	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
mm										
1.65	68.11	68.03	67.95	67.87	67.78	67.70	67.62	67.54	67.46	67.38
1.66	67.29	67.21	67.13	67.05	66.97	66.89	66.81	66.73	66.65	66.57
1.67	66.49	66.41	66.33	66.25	66.17	66.09	66.02	65.94	65.86	65.78
1.68	65.70	65.62	65.55	65.47	65.39	65.31	65.24	65.16	65.08	65.00
1.69	64.93	64.85	64.77	64.70	64.62	64.54	64.47	64.39	64.32	64.24
1.70	64.16	64.09	64.01	63.94	63.86	63.79	63.71	63.64	63.57	63.49
1.71	63.42	63.34	63.27	63.19	63.12	63.05	62.97	62.90	62.83	62.75
1.72	62.68	62.61	62.54	62.46	62.39	62.32	62.25	62.17	62.10	62.03
1.73	61.96	61.89	61.82	61.74	61.67	61.60	61.53	61.46	61.39	61.32
1.74	61.25	61.18	61.11	61.04	60.97	60.90	60.83	60.76	60.69	60.62
1.75	60.55	60.48	60.41	60.34	60.27	60.21	60.14	60.07	60.00	59.93
1.76	59.86	59.80	59.73	59.66	59.59	59.53	59.46	59.39	59.32	59.26
1.77	59.19	59.12	59.06	58.99	58.92	58.86	58.79	58.72	58.66	58.59
1.78	58.53	58.46	58.40	58.33	58.26	58.20	58.13	58.07	58.00	57.94
1.79	57.87	57.81	57.75	57.68	57.62	57.55	57.49	57.42	57.36	57.30
1.80	57.23	57.17	57.11	57.04	56.98	56.92	56.85	56.79	56.73	56.67
1.81	56.60	56.54	56.48	56.42	56.35	56.29	56.23	56.17	56.11	56.04
1.82	55.98	55.92	55.86	55.80	55.74	55.68	55.62	55.55	55.49	55.43
1.83	55.37	55.31	55.25	55.19	55.13	55.07	55.01	54.95	54.89	54.83
1.84	54.77	54.71	54.65	54.59	54.53	54.48	54.42	54.36	54.30	54.24
1.85	54.18	54.12	54.06	54.01	53.95	53.89	53.83	53.77	53.72	53.66
1.86	53.60	53.54	53.49	53.43	53.37	53.31	53.26	53.20	53.14	53.09
1.87	53.03	52.97	52.92	52.86	52.80	52.75	52.69	52.63	52.58	52.52
1.88	52.47	52.41	52.35	52.30	52.24	52.19	52.13	52.08	52.02	51.97
1.89	51.91	51.86	51.80	51.75	51.69	51.64	51.58	51.53	51.48	51.42
1.90	51.37	51.31	51.26	51.21	51.15	51.10	51.04	50.99	50.94	50.88
1.91	50.83	50.78	50.72	50.67	50.62	50.57	50.51	50.46	50.41	50.36
1.92	50.30	50.25	50.20	50.15	50.09	50.04	49.99	49.94	49.89	49.83
1.93	49.78	49.73	49.68	49.63	49.58	49.53	49.47	49.42	49.37	49.32
1.94	49.27	49.22	49.17	49.12	49.07	49.02	48.97	48.92	48.87	48.82
1.95	48.77	48.72	48.67	48.62	48.57	48.52	48.47	48.42	48.37	48.32
1.96	48.27	48.22	48.17	48.12	48.07	48.03	47.98	47.93	47.88	47.83
1.97	47.78	47.73	47.69	47.64	47.59	47.54	47.49	47.44	47.40	47.35
1.98	47.30	47.25	47.21	47.16	47.11	47.06	47.02	46.97	46.92	46.87
1.99	46.83	46.78	46.73	46.69	46.64	46.59	46.55	46.50	46.45	46.41

Appendix E. Tables of correction factors for use in tests made on spherical or cylindrical surfaces

Tables 12 to 17 give the correction factors to be applied to the hardness values obtained from tables 4 to 11 in appendix D when tests are made on spherical or cylindrical surfaces. The correction factors are tabulated in terms of the ratio of the mean diagonal d of the indentation to the diameter D of the sphere or cylinder.

Examples

(a) Convex sphere:

Diameter of sphere, D = 10 mm

Hardness scale = HV 10

Mean diagonal of indentation, d = 0.150 mm

$$\frac{d}{D} = \frac{0.150}{10} = 0.015$$

From table 7, HV = 824

From table 12, by interpolation, correction factor = 0.983

Hardness of sphere = 824 × 0.983 = 810 HV 10

(b) Concave cylinder, one diagonal parallel to axis:

Diameter of cylinder, D = 5 mm

Hardness scale = HV 30

Mean diagonal of indentation, d = 0.415 mm

$$\frac{d}{D} = \frac{0.415}{5} = 0.083$$

From table 9, HV = 323

From table 17, correction factor = 1.075

Hardness of cylinder = 323 × 1.075 = 347 HV 30

Table 12. Convex spherical surfaces

d/D	Correction factor
0.004	0.995
0.009	0.990
0.013	0.985
0.018	0.980
0.023	0.975
0.028	0.970
0.033	0.965
0.038	0.960
0.043	0.955
0.049	0.950
0.055	0.945
0.061	0.940
0.067	0.935
0.073	0.930
0.079	0.925
0.086	0.920
0.093	0.915
0.100	0.910
0.107	0.905
0.114	0.900
0.122	0.895
0.130	0.890
0.139	0.885
0.147	0.880
0.156	0.875
0.165	0.870
0.175	0.865
0.185	0.860
0.195	0.855
0.206	0.850

Table 13. Concave spherical surfaces

d/D	Correction factor
0.004	1.005
0.008	1.010
0.012	1.015
0.016	1.020
0.020	1.025
0.024	1.030
0.028	1.035
0.031	1.040
0.035	1.045
0.038	1.050
0.041	1.055
0.045	1.060
0.048	1.065
0.051	1.070
0.054	1.075
0.057	1.080
0.060	1.085
0.063	1.090
0.066	1.095
0.069	1.100
0.071	1.105
0.074	1.110
0.077	1.115
0.079	1.120
0.082	1.125
0.084	1.130
0.087	1.135
0.089	1.140
0.091	1.145
0.094	1.150

Table 14. Convex cylindrical sufaces : diagonals at 45 ° to axis

d/D	Correction factor
0.009	0.995
0.017	0.990
0.026	0.985
0.035	0.980
0.044	0.975
0.053	0.970
0.062	0.965
0.071	0.960
0.081	0.955
0.090	0.950
0.100	0.945
0.109	0.940
0.119	0.935
0.129	0.930
0.139	0.925
0.149	0.920
0.159	0.815
0.169	0.910
0.179	0.905
0.189	0.900
0.200	0.895

Table 15. Concave cylindrical surfaces : diagonals at 45 ° to axis

d/D	Correction factor
0.009	1.005
0.017	1.010
0.025	1.015
0.034	1.020
0.042	1.025
0.050	1.030
0.058	1.035
0.066	1.040
0.074	1.045
0.082	1.050
0.089	1.055
0.097	1.060
0.104	1.065
0.112	1.070
0.119	1.075
0.127	1.080
0.134	1.085
0.141	1.090
0.148	1.095
0.155	1.100
0.162	1.105
0.169	1.110
0.176	1.115
0.183	1.120
0.189	1.125
0.196	1.130
0.203	1.135
0.209	1.140
0.216	1.145
0.222	1.150

Table 16. Convex cylindrical surfaces : one diagonal parallel to axis

d/D	Correction factor
0.009	0.995
0.019	0.990
0.029	0.985
0.041	0.980
0.054	0.975
0.068	0.970
0.085	0.965
0.104	0.960
0.126	0.955
0.153	0.950
0.189	0.945
0.243	0.940

Table 17. Concave cylindrical surfaces : one diagonal parallel to axis

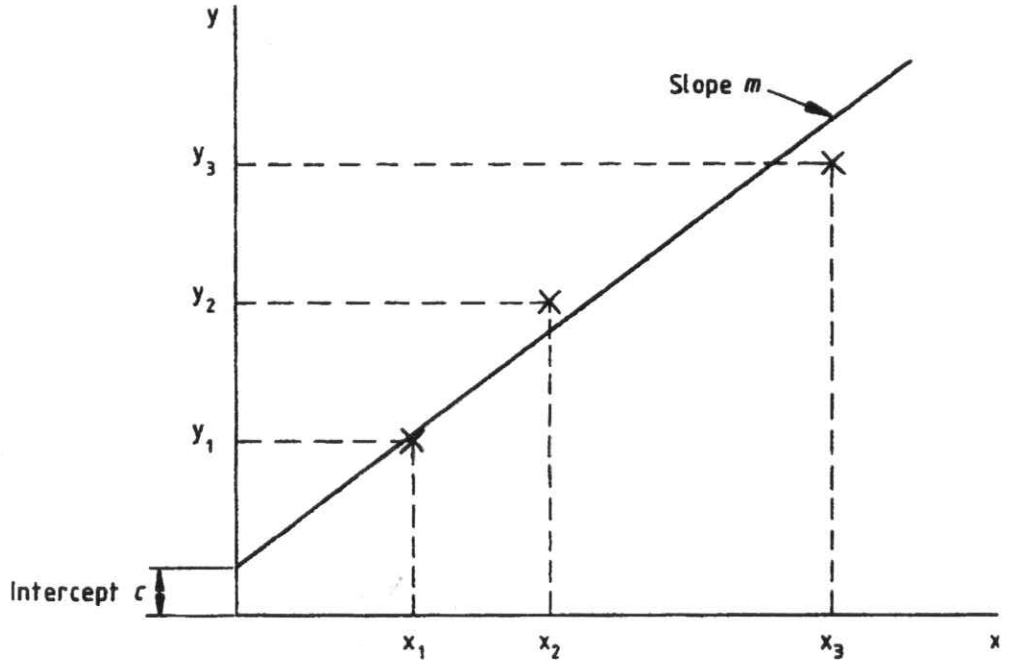
d/D	Correction factor
0.008	1.005
0.016	1.010
0.023	1.015
0.030	1.020
0.036	1.025
0.042	1.030
0.048	1.035
0.053	1.040
0.058	1.045
0.063	1.050
0.067	1.055
0.071	1.060
0.076	1.065
0.079	1.070
0.083	1.075
0.087	1.080
0.090	1.085
0.093	1.090
0.097	1.095
0.100	1.100
0.103	1.105
0.105	1.110
0.108	1.115
0.111	1.120
0.113	1.125
0.116	1.130
0.118	1.125
0.120	1.140
0.123	1.145
0.125	1.150

Appendix F. Calculation of Individual correction factors

F.1 Particularly when measuring small indentations, less than 150 μm, errors in observer readings become significant. It is possible to calibrate an observer by means of measuring indentations on a correctly calibrated microscope.

Individual correction factors should preferably be obtained from observations on three standardized indentations.

F.2 Correction factors m and c (see figure 5) are constants relating to a particular observer in combination with a particular microscope and measuring device.



Key
y_1 is standardized value (in mm) for mean size of indentation in range 0.15 to 0.25 mm
x_1 is mean measured size (in mm) of the indentation
y_2 is standardized value (in mm) for mean size of indentation in range 0.25 to 0.35 mm
x_2 is mean measured size (in mm) of the indentation
y_3 is standardized value (in mm) for mean size of indentation in range 0.35 to 0.45 mm
x_3 is mean measured size (in mm) of the indentation

Figure 5. Definition of correction factors m and c

F.3 To calculate the constants m and c in the equation for a straight line $y = mx + c$, a 'best fit line' to the three points is established, as follows, either:

$$\text{(a) } m = \frac{3\sum_1^3 xy - \sum_1^3 x \sum_1^3 y}{\sum_1^3 x^2 - \left(\sum_1^3 x\right)^2}$$

$$c = \frac{m\sum_1^3 x - \sum_1^3 y}{3}$$

or alternatively,

$$\text{(b) } m = \frac{3\,(x_1y_1 + x_2y_2 + x_3y_3) - (x_1 + x_2 + x_3)\,(y_1 + y_2 + y_3)}{3(x_1^2 + x_2^2 + x_3^2) - (x_1 + x_2 + x_3)^2}$$

$$c = \frac{m\,(x_1 + x_2 + 3) - (y_1 + y_2 + y_3)}{3}$$

F.4 Corrected observations are obtained by calculating a value of y from $y = mx + c$ where x is the measured mean diagonal of an indentation.

F.5 For a special purpose machine where only one indentation is measured, a single correction factor m is calculated from the equation:

$$m = \frac{y_n}{x_n}$$

n being 1, 2, or 3 depending on the nominal indentation size. Corrected observations are obtained by calculating a value of y from $y = mx$.

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Publications referred to

BS 860	Tables for comparison of hardness scales
BS 1134	Assessment of surface texture Part 1 Methods and instrumentation
BS 1610	Materials testing machines and force verification equipment Part 1 Specification for the grading of the forces applied by materials testing machines Part 2 Specification for the grading of equipment used for the verification of the forces applied by materials testing machines

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