

# Metallic materials — Brinell hardness test —

## Part 1: Test method

金属材料——布氏硬度试验

第 1 部分：试验方法

The European Standard EN ISO 6506-1:1999 has the status of a  
British Standard

ICS 77.040.10

# National foreword

This British Standard is the English language version of EN ISO 6506-1:1999. It is identical with ISO 6506-1:1999. It supersedes BS EN 10003-1:1995 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee ISE/NFE/4, Mechanical testing of metals, to Subcommittee ISE/NFE/4/5, Indentation hardness testing, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

### Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN ISO title page, page 2, the ISO title page, pages ii to iv, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

### Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 November 1999

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English version

# Metallic materials — Brinell hardness test — Part 1: Test method

(ISO 6506-1:1999)

Matériaux métalliques — Essai de dureté  
Brinell — Partie 1: Méthode d'essai  
(ISO 6506-1:1999)

Metallische Werkstoffe — Härteprüfung nach  
Brinell — Teil 1: Prüfverfahren  
(ISO 6506-1:1999)

This European Standard was approved by CEN on 8 July 1999.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

## CEN

European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

**Central Secretariat: rue de Stassart 36, B-1050 Brussels**

## Foreword

The text of the International Standard ISO 6506-1:1999 has been prepared by Technical Committee ISO/TC 164 “Mechanical testing of metals” in collaboration with Technical Committee ECISS/TC 1 “Steel testing”, the secretariat of which is held by AFNOR.

This European Standard supersedes EN 10003-1:1994.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2000, and conflicting national standards shall be withdrawn at the latest by March 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## Endorsement notice

The text of the International Standard ISO 6506-1:1999 was approved by CEN as a European Standard without any modification.

NOTE Normative references to International Standards are listed in Annex ZA (normative).

# INTERNATIONAL STANDARD

**ISO  
6506-1**

First edition  
1999-09-01

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## **Metallic materials — Brinell hardness test —**

### **Part 1: Test method**

*Matériaux métalliques — Essai de dureté Brinell —  
Partie 1: Méthode d'essai*



Reference number  
ISO 6506-1:1999(E)

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard 6506-1 was prepared by the Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 3, *Hardness testing*.

This first edition of ISO 6506-1 cancels and replaces ISO 6506:1981 and ISO 410:1982, of which it constitutes a technical revision as follows:

- Deletion of the steel ball indenter.
- Integration of the table for the determination of Brinell hardness values for use in tests made on flat surfaces (ISO 410:1982) into Annex C of this part of ISO 6506.
- Deletion of the 2 mm ball indenter.
- Addition of Annex A concerning a procedure for periodic checks of the testing machines by the user.

ISO 6506 consists of the following parts, under the general title *Metallic materials — Brinell hardness test*:

- *Part 1: Test method*;
- *Part 2: Verification and calibration of testing machines*;
- *Part 3: Calibration of reference blocks*.

Annex B and Annex C form a normative part of this part of ISO 6506. Annex A is for information only.



## Introduction

The force values in this part of ISO 6506 were calculated from kilogram force values. They were introduced before the SI-system was adopted. It was decided to keep the values based on the old units for this part of ISO 6506 but for the next revision it will be necessary to consider the advantage of introducing rounded values of test force and possible consequences on the hardness scales.

Attention is drawn to the fact that in this part of ISO 6506, only the use of the hardmetal ball indenter is specified.

The designation of the Brinell hardness is HBW and should not be confused with the former designation HB, or HBS when a steel ball indenter was used.

## 1 Scope

This part of ISO 6506 specifies the method for the Brinell hardness test for metallic materials and is applicable up to the limit of 650 HBW.

For specific materials and/or products, particular International Standards exist (i.e. ISO 4498-1).

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 6506. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 6506 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 4498-1, *Sintered metal materials, excluding hardmetals — Determination of apparent hardness — Part 1: Materials of essentially uniform section hardness*.

ISO 6506-2:1999, *Metallic materials — Brinell hardness test — Part 2: Verification and calibration of testing machines*.

## 3 Principles

An indenter (hardmetal ball with diameter  $D$ ) is forced into the surface of a test piece and the diameter of the indentation  $d$  left in the surface after removal of the force  $F$  is measured.

The Brinell hardness is proportional to the quotient obtained by dividing the test force by the curved surface area of the indentation. The indentation is assumed to be spherical with a radius corresponding to half of the diameter of the ball.

## 4 Symbols and designations

See Figure 1 and Table 1.

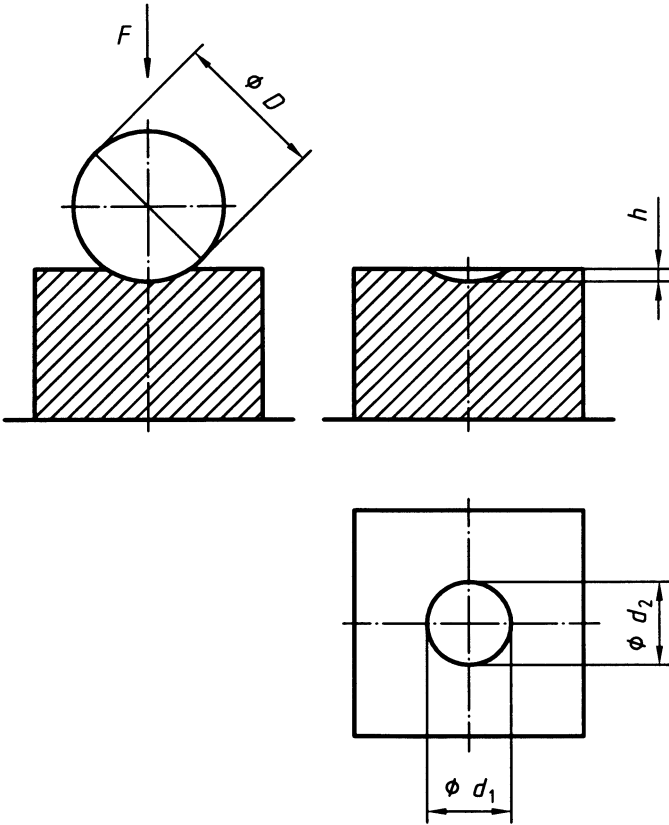


Figure 1 — Principle of test

Table 1 — Symbols and designations

| Symbol  | Designation  | Unit              |
|---|--|-------------------|
| $D$   | Diameter of the ball   | mm                |
| $F$   | Test force   | N                 |
| $d$   | Mean diameter of the indentation<br>$\left( d = \frac{d_1 + d_2}{2} \right)$   | mm                |
| $d_1, d_2$  | Indentation diameters measured at 90°  | mm                |
| $h$   | Depth of indentation<br>$= \frac{D - \sqrt{D^2 - d^2}}{2}$   | mm                |
| HBW   | Brinell hardness<br><br>$= \text{Constant} \times \frac{\text{Test force}}{\text{Surface area of indentation}}$<br>$= 0,102 \times \frac{2F}{\pi D \left( D - \sqrt{D^2 - d^2} \right)}$<br><br>force-diameter ratio | N/mm <sup>2</sup> |
| NOTE<br>Constant = $\frac{1}{g_n} = \frac{1}{9,806\,65} = 0,102$<br>$g_n$ = acceleration due to gravity |  |                   |

**4.1** The Brinell hardness is denoted by HBW.

NOTE In former standards, in cases when a steel ball had been used, the Brinell hardness was denoted by HB or HBS.

**4.2** The letters HBW are preceded by the hardness value and supplemented by an index indicating the test conditions in the order:

- a) the diameter of the ball, in millimetres;
- b) a figure representing the test force (see Table 2);
- c) the duration of application of test force, in seconds, if different from the specified time (see 7.5).

EXAMPLE 1 350 HBW 5/750 = Brinell hardness of 350 determined with a ball of 5 mm diameter and with a test force of 7,355 kN applied for 10 s to 15 s.

EXAMPLE 2 600 HBW 1/30/20 = Brinell hardness of 600 determined with a ball of 1 mm diameter and with a test force of 294,2 N applied for 20 s.

## 5 Testing machine

**5.1 Testing machine**, capable of applying a predetermined test force or forces within the range of 9,807 N to 29,42 kN in accordance with ISO 6506-2.

**5.2 Indenter**, a polished hardmetal ball, as specified in ISO 6506-2.

**5.3 Measuring device**, as specified in ISO 6506-2.

NOTE A suggested procedure for periodic checks by the user is given in Annex A.

## 6 Test piece

**6.1** The test shall be carried out on a surface which is smooth and even, free from oxide scale, foreign matter and, in particular, free from lubricants. The test piece shall have a surface finish that will allow an accurate measurement of the diameter of the indentation.

**6.2** Preparation shall be carried out in such a way that any alteration of the surface, for example due to heat- or cold-working, is minimized.

**6.3** The thickness of the test piece shall be at least eight times the depth of indentation. Values for the minimum thickness of the test piece in relation to the mean diameter of indentation are given in Annex B.

Visible deformation at the back of the test piece can indicate that the test piece is too thin.

## 7 Procedure

**7.1** In general, the test is to be carried out at ambient temperature within the limits of 10 °C to 35 °C. Tests carried out under controlled conditions shall be made at a temperature of  $(23 \pm 5) ^\circ\text{C}$ .

**7.2** The test forces given in Table 2 shall be used.

**7.3** The test force shall be chosen so that the diameter of the indentation  $d$  lies between the values  $0,24 D$  and  $0,6 D$ .

The force-diameter ratio  $(0,102 \times F/D^2)$  shall be chosen according to the material and the hardness test as indicated in Table 3.

In order to test the largest representative area of the test piece, the diameter of the testing ball shall be chosen to be as large as possible.

When the thickness of the test piece permits, a 10 mm diameter ball is preferred.

**7.4** The test piece shall be placed on a rigid support. The contact surfaces shall be clean and free from foreign matter (scale, oil, dirt, etc). It is important that the test piece lie firmly on the support so that displacement cannot occur during the test.

**7.5** Bring the indenter into contact with the test surface and apply the test force in a direction perpendicular to the surface, without shock, vibration or overrun, until the applied force attains the specified value. The time from the initial application of force to the time the full test force is reached shall not be less than 2 s nor greater than 8 s. Maintain the test force for 10 s to 15 s. For certain materials, where a longer dwell time is required; this time shall be applied with a tolerance of  $\pm 2$  s.

**7.6** Throughout the test, the testing machine shall be protected from significant shock or vibration which can influence the test result.

**7.7** The distance from the edge of the test piece to the centre of each indentation shall be a minimum of two and a half times the mean indentation diameter.

The distance between the centres of two adjacent indentations shall be at least three times the mean indentation diameter.

Table 2 — Test forces for the different testing conditions

| Hardness symbol | Ball diameter<br><i>D</i><br>mm | Force-diameter ratio<br>$0,102 \times F/D^2$<br>N/mm <sup>2</sup> | Nominal value of test force<br><i>F</i><br>N |
|-----------------|---------------------------------|---|--|
| HBW 10/3 000    | 10                              | 30  | 29 420                                       |
| HBW 10/1 500    | 10                              | 15  | 14 710                                       |
| HBW 10/1 000    | 10                              | 10  | 9 807  |
| HBW 10/500      | 10                              | 5   | 4 903  |
| HBW 10/250      | 10                              | 2,5   | 2 452  |
| HBW 10/100      | 10                              | 1   | 980,7  |
| HBW 5/750       | 5                               | 30  | 7 355  |
| HBW 5/250       | 5                               | 10  | 2 452  |
| HBW 5/125       | 5                               | 5   | 1 226  |
| HBW 5/62,5      | 5                               | 2,5   | 612,9  |
| HBW 5/25        | 5                               | 1   | 245,2  |
| HBW 2,5/187,5   | 2,5                             | 30  | 1 839  |
| HBW 2,5/62,5    | 2,5                             | 10  | 612,9  |
| HBW 2,5/31,25   | 2,5                             | 5   | 306,5  |
| HBW 2,5/15,625  | 2,5                             | 2,5   | 153,2  |
| HBW 2,5/6,25    | 2,5                             | 1   | 61,29  |
| HBW 1/30        | 1                               | 30  | 294,2  |
| HBW 1/10        | 1                               | 10  | 98,07  |
| HBW 1/5         | 1                               | 5   | 49,03  |
| HBW 1/2,5       | 1                               | 2,5   | 24,52  |
| HBW 1/1         | 1                               | 1   | 9,807  |

Table 3 — The force-diameter ratio for different metallic materials

| Material                                 | Brinell hardness<br>HBW     | Force-diameter ratio<br>$0,102 \times F/D^2$<br>N/mm <sup>2</sup> |
|--|-----------------------------|---|
| Steel – Nickel alloys<br>Titanium alloys |                             | 30  |
| Cast iron <sup>a</sup>                   | < 140<br>≥ 140              | 10<br>30  |
| Copper and copper alloys                 | < 35                        | 5   |
|  | 35 to 200                   | 10  |
|  | > 200                       | 30  |
| Light metals and their alloys            | < 35                        | 2,5<br>5  |
|  | 35 to 80                    | 10<br>15  |
|  |                             | 10<br>15  |
|  |                             | > 80  |
|  | Lead, tin<br>Sintered metal |   |
|  |                             | See ISO 4498-1  |

<sup>a</sup> For the testing of cast iron the nominal diameter of the ball shall be 2,5 mm, 5 mm or 10 mm.

**7.8** Measure the diameter of each indentation in two directions perpendicular to each other. The arithmetic mean of the two readings shall be taken for the calculation of the Brinell hardness.

NOTE For some testing machines, the following should be used:

- the average of a greater number of symmetrically placed measurements;
- an assessment of the projected indentation area into the material surface.

**7.9** Table C.1 (see Annex C) contains calculation tables which shall be used to determine the Brinell hardness for tests on flat surfaces.

## 8 Uncertainty of the results

The uncertainty of results is dependent on various parameters which may be separated into two categories:

- a) parameters dependent on the Brinell hardness testing machine (including the uncertainty of the verification of the testing machine and on the calibration of the reference blocks);
- b) parameters dependent on the application of the test method (variation of the operating conditions).

NOTE A complete evaluation of the uncertainty should be carried out according to the *Guide to the Expression of Uncertainty in Measurement*[1]. Indicative values of the extended uncertainty at a confidence level of 95 % can be taken to be equal to the maximum permissible error given in Table 2 of ISO 6506-2:1999.

## 9 Test report

The test report shall include the following information:

- a) a reference to this International Standard, i.e. ISO 6506-1;
- b) all details necessary for the complete identification of the test piece;
- c) the test temperature if it is not within the limits  $(23 \pm 5) ^\circ\text{C}$ ;
- d) the result obtained;
- e) additional requirements outside the scope of this part of ISO 6506;
- f) details of any occurrence which may have affected the result.

NOTE 1 There is no general process of accurately converting Brinell hardness into other scales of hardness or into tensile strength. These conversions should therefore be avoided, unless a reliable basis for the conversion can be obtained by comparative tests.

NOTE 2 It should be noted that for anisotropic materials, for example those which have been heavily cold-worked, there may be a difference between the lengths of the two diameters of the indentation. The specification for the product may indicate limits for such differences.

**Annex A (informative)****Procedure for periodic checks of the testing machines by the user**

The indirect verification procedure is too time consuming and costly for routine checking. The following procedure is recommended for this purpose.

Make at least one periodic check of the testing machine each day that it is used.

Before making the check, make at least two preliminary indentations to ensure that the test piece, indenter and anvil are seated correctly. The results of these preliminary indentations should be ignored.

Make at least one hardness indentation on a reference block with approximately the same hardness as the material being tested. If the difference between mean value of the hardness readings of the test material and the hardness of the reference block are within the limits given in Table 2 of ISO 6506-2:1999, the machine may be regarded as satisfactory. If not, an indirect verification should be performed.

**Annex B (normative)****Minimum thickness of the test piece in relation to the mean diameter of indentation**

Table B.1 gives values for minimum thickness of the test piece in relation to the mean diameter of indentation.

**Table B.1**

Dimensions in millimetres

| Mean diameter of the indentation<br><i>d</i> | Minimum thickness of the test piece |                |              |               |
|--|-------------------------------------|----------------|--------------|---------------|
|  | Diameter of the ball                |                |              |               |
|  | <i>D</i> = 1                        | <i>D</i> = 2,5 | <i>D</i> = 5 | <i>D</i> = 10 |
| 0,2  | 0,08                                |                |              |               |
| 0,3  | 0,18                                |                |              |               |
| 0,4  | 0,33                                |                |              |               |
| 0,5  | 0,54                                |                |              |               |
| 0,6  | 0,8                                 | 0,29           |              |               |
| 0,7  |                                     | 0,4            |              |               |
| 0,8  |                                     | 0,53           |              |               |
| 0,9  |                                     | 0,67           |              |               |
| 1  |                                     | 0,83           |              |               |
| 1,1  |                                     | 1,02           |              |               |
| 1,2  |                                     | 1,23           | 0,58         |               |
| 1,3  |                                     | 1,46           | 0,69         |               |
| 1,4  |                                     | 1,72           | 0,8          |               |
| 1,5  |                                     | 2              | 0,92         |               |
| 1,6  |                                     |                | 1,05         |               |
| 1,7  |                                     |                | 1,19         |               |
| 1,8  |                                     |                | 1,34         |               |
| 1,9  |                                     |                | 1,5          |               |
| 2  |                                     |                | 1,67         |               |
| 2,2  |                                     |                | 2,04         |               |
| 2,4  |                                     |                | 2,46         | 1,17          |
| 2,6  |                                     |                | 2,92         | 1,38          |
| 2,8  |                                     |                | 3,43         | 1,6           |
| 3  |                                     |                | 4            | 1,84          |
| 3,2  |                                     |                |              | 2,1           |
| 3,4  |                                     |                |              | 2,38          |
| 3,6  |                                     |                |              | 2,68          |
| 3,8  |                                     |                |              | 3             |
| 4  |                                     |                |              | 3,34          |
| 4,2  |                                     |                |              | 3,7           |
| 4,4  |                                     |                |              | 4,08          |
| 4,6  |                                     |                |              | 4,48          |
| 4,8  |                                     |                |              | 4,91          |
| 5  |                                     |                |              | 5,36          |
| 5,2  |                                     |                |              | 5,83          |
| 5,4  |                                     |                |              | 6,33          |
| 5,6  |                                     |                |              | 6,86          |
| 5,8  |                                     |                |              | 7,42          |
| 6  |                                     |                |              | 8             |



**Annex C (normative)****Determination of the Brinell hardness for testing on flat surfaces**

The determination of the Brinell hardness for testing on flat surfaces is given in Table C.1.

**Table C.1**

| Ball indenter<br><i>D</i><br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |        |       |       |       |       |
|--|-------|---------|-------|--|--------|-------|-------|-------|-------|
|  |       |         |       | 30   | 15     | 10    | 5     | 2,5   | 1     |
|  |       |         |       | Test force<br><i>F</i><br>N                  |        |       |       |       |       |
| 10   |       |         |       | 29 420                                       | 14 710 | 9 807 | 4 903 | 2 452 | 980,7 |
|  | 5     |         |       | 7 355  | —      | 2 452 | 1 226 | 612,9 | 245,2 |
|  |       | 2,5     |       | 1 830  | —      | 612,9 | 306,5 | 153,2 | 61,29 |
|  |       |         | 1     | 294,2  | —      | 98,07 | 49,03 | 24,52 | 9,807 |
| Mean diameter of the indentation<br><i>d</i><br>mm |       |         |       | Brinell hardness<br>HBW                      |        |       |       |       |       |
| 2,40   | 1,200 | 0,600 0 | 0,240 | 653  | 327    | 218   | 109   | 54,5  | 21,8  |
| 2,41   | 1,205 | 0,602 4 | 0,241 | 648  | 324    | 216   | 108   | 54,0  | 21,6  |
| 2,42   | 1,210 | 0,605 0 | 0,242 | 643  | 321    | 214   | 107   | 53,5  | 21,4  |
| 2,43   | 1,215 | 0,607 5 | 0,243 | 637  | 319    | 212   | 106   | 53,1  | 21,2  |
| 2,44   | 1,220 | 0,610 0 | 0,244 | 632  | 316    | 211   | 105   | 52,7  | 21,1  |
| 2,45   | 1,225 | 0,612 5 | 0,245 | 627  | 313    | 209   | 104   | 52,2  | 20,9  |
| 2,46   | 1,230 | 0,615 0 | 0,246 | 621  | 311    | 207   | 104   | 51,8  | 20,7  |
| 2,47   | 1,235 | 0,617 5 | 0,247 | 616  | 308    | 205   | 103   | 51,4  | 20,5  |
| 2,48   | 1,240 | 0,620 0 | 0,248 | 611  | 306    | 204   | 102   | 50,9  | 20,4  |
| 2,49   | 1,245 | 0,622 5 | 0,249 | 606  | 303    | 202   | 101   | 50,5  | 20,2  |
| 2,50   | 1,250 | 0,625 0 | 0,250 | 601  | 301    | 200   | 100   | 50,1  | 20,0  |
| 2,51   | 1,255 | 0,627 5 | 0,251 | 597  | 298    | 199   | 99,4  | 49,7  | 19,9  |
| 2,52   | 1,260 | 0,630 0 | 0,252 | 592  | 296    | 197   | 98,6  | 49,3  | 19,7  |
| 2,53   | 1,265 | 0,632 5 | 0,253 | 587  | 294    | 196   | 97,8  | 48,9  | 19,6  |
| 2,54   | 1,270 | 0,635 0 | 0,254 | 582  | 291    | 194   | 97,1  | 48,5  | 19,4  |
| 2,55   | 1,275 | 0,637 5 | 0,255 | 578  | 289    | 193   | 96,3  | 48,1  | 19,3  |
| 2,56   | 1,280 | 0,640 0 | 0,256 | 573  | 287    | 191   | 95,5  | 47,8  | 19,1  |
| 2,57   | 1,285 | 0,642 5 | 0,257 | 569  | 284    | 190   | 94,8  | 47,4  | 19,0  |
| 2,58   | 1,290 | 0,645 0 | 0,258 | 564  | 282    | 188   | 94,0  | 47,0  | 18,8  |
| 2,59   | 1,295 | 0,647 5 | 0,259 | 560  | 280    | 187   | 93,3  | 46,6  | 18,7  |
| 2,60   | 1,300 | 0,650 0 | 0,260 | 555  | 278    | 185   | 92,6  | 46,3  | 18,5  |
| 2,61   | 1,305 | 0,652 5 | 0,261 | 551  | 276    | 184   | 91,8  | 45,9  | 18,4  |
| 2,62   | 1,310 | 0,655 0 | 0,262 | 547  | 273    | 182   | 91,1  | 45,6  | 18,2  |
| 2,63   | 1,315 | 0,657 5 | 0,263 | 543  | 271    | 181   | 90,4  | 45,2  | 18,1  |
| 2,64   | 1,320 | 0,660 0 | 0,264 | 538  | 269    | 179   | 89,7  | 44,9  | 17,9  |
| 2,65   | 1,325 | 0,662 5 | 0,265 | 534  | 267    | 178   | 89,0  | 44,5  | 17,8  |
| 2,66   | 1,330 | 0,665 0 | 0,266 | 530  | 265    | 177   | 88,4  | 44,2  | 17,7  |
| 2,67   | 1,335 | 0,667 5 | 0,267 | 526  | 263    | 175   | 87,7  | 43,8  | 17,5  |
| 2,68   | 1,340 | 0,670 0 | 0,268 | 522  | 261    | 174   | 87,0  | 43,5  | 17,4  |
| 2,69   | 1,345 | 0,672 5 | 0,269 | 518  | 259    | 173   | 86,4  | 43,2  | 17,3  |
| 2,70   | 1,350 | 0,675 0 | 0,270 | 514  | 257    | 171   | 85,7  | 42,9  | 17,1  |
| 2,71   | 1,355 | 0,677 5 | 0,271 | 510  | 255    | 170   | 85,1  | 42,5  | 17,0  |
| 2,72   | 1,360 | 0,680 0 | 0,272 | 507  | 253    | 169   | 84,4  | 42,2  | 16,9  |
| 2,73   | 1,365 | 0,682 5 | 0,273 | 503  | 251    | 168   | 83,8  | 41,9  | 16,8  |
| 2,74   | 1,370 | 0,685 0 | 0,274 | 499  | 250    | 166   | 83,2  | 41,6  | 16,6  |
| 2,75   | 1,375 | 0,687 5 | 0,275 | 495  | 248    | 165   | 82,6  | 41,3  | 16,5  |
| 2,76   | 1,380 | 0,690 0 | 0,276 | 492  | 246    | 164   | 81,9  | 41,0  | 16,4  |

Table C.1

| Ball indenter<br>$D$<br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |     |     |      |      |      |
|---|-------|---------|-------|--|-----|-----|------|------|------|
| 10  | 5     | 2,5     | 1     | 30   | 15  | 10  | 5    | 2,5  | 1    |
| Mean diameter of the indentation<br>$d$<br>mm |       |         |       | Brinell hardness<br>HBW                      |     |     |      |      |      |
| 2,77  | 1,385 | 0,692 5 | 0,277 | 488  | 244 | 163 | 81,3 | 40,7 | 16,3 |
| 2,78  | 1,390 | 0,695 0 | 0,278 | 485  | 242 | 162 | 80,8 | 40,4 | 16,2 |
| 2,79  | 1,395 | 0,697 5 | 0,279 | 481  | 240 | 160 | 80,2 | 40,1 | 16,0 |
| 2,80  | 1,400 | 0,700 0 | 0,280 | 477  | 239 | 159 | 79,6 | 39,8 | 15,9 |
| 2,81  | 1,405 | 0,702 5 | 0,281 | 474  | 237 | 158 | 79,0 | 39,5 | 15,8 |
| 2,82  | 1,410 | 0,705 0 | 0,282 | 471  | 235 | 157 | 78,4 | 39,2 | 15,7 |
| 2,83  | 1,415 | 0,707 5 | 0,283 | 467  | 234 | 156 | 77,9 | 38,9 | 15,6 |
| 2,84  | 1,420 | 0,710 0 | 0,284 | 464  | 232 | 155 | 77,3 | 38,7 | 15,5 |
| 2,85  | 1,425 | 0,712 5 | 0,285 | 461  | 230 | 154 | 76,8 | 38,4 | 15,4 |
| 2,86  | 1,430 | 0,715 0 | 0,286 | 457  | 229 | 152 | 76,2 | 38,1 | 15,2 |
| 2,87  | 1,435 | 0,717 5 | 0,287 | 454  | 227 | 151 | 75,7 | 37,8 | 15,1 |
| 2,88  | 1,440 | 0,720 0 | 0,288 | 451  | 225 | 150 | 75,1 | 37,6 | 15,0 |
| 2,89  | 1,445 | 0,722 5 | 0,289 | 448  | 224 | 149 | 74,6 | 37,3 | 14,9 |
| 2,90  | 1,450 | 0,725 0 | 0,290 | 444  | 222 | 148 | 74,1 | 37,0 | 14,8 |
| 2,91  | 1,455 | 0,727 5 | 0,291 | 441  | 221 | 147 | 73,6 | 36,8 | 14,7 |
| 2,92  | 1,460 | 0,730 0 | 0,292 | 438  | 219 | 146 | 73,0 | 36,5 | 14,6 |
| 2,93  | 1,465 | 0,732 5 | 0,293 | 435  | 218 | 145 | 72,5 | 36,3 | 14,5 |
| 2,94  | 1,470 | 0,735 0 | 0,294 | 432  | 216 | 144 | 72,0 | 36,0 | 14,4 |
| 2,95  | 1,475 | 0,737 5 | 0,295 | 429  | 215 | 143 | 71,5 | 35,8 | 14,3 |
| 2,96  | 1,480 | 0,740 0 | 0,296 | 426  | 213 | 142 | 71,0 | 35,5 | 14,2 |
| 2,97  | 1,485 | 0,742 5 | 0,297 | 423  | 212 | 141 | 70,5 | 35,3 | 14,1 |
| 2,98  | 1,490 | 0,745 0 | 0,298 | 420  | 210 | 140 | 70,1 | 35,0 | 14,0 |
| 2,99  | 1,495 | 0,747 5 | 0,299 | 417  | 209 | 139 | 69,6 | 34,8 | 13,9 |
| 3,00  | 1,500 | 0,750 0 | 0,300 | 415  | 207 | 138 | 69,1 | 34,6 | 13,8 |
| 3,01  | 1,505 | 0,752 5 | 0,301 | 412  | 206 | 137 | 68,6 | 34,3 | 13,7 |
| 3,02  | 1,510 | 0,755 0 | 0,302 | 409  | 205 | 136 | 68,2 | 34,1 | 13,6 |
| 3,03  | 1,515 | 0,757 5 | 0,303 | 406  | 203 | 135 | 67,7 | 33,9 | 13,5 |
| 3,04  | 1,520 | 0,760 0 | 0,304 | 404  | 202 | 135 | 67,3 | 33,6 | 13,5 |
| 3,05  | 1,525 | 0,762 5 | 0,305 | 401  | 200 | 134 | 66,8 | 33,4 | 13,4 |
| 3,06  | 1,530 | 0,765 0 | 0,306 | 398  | 199 | 133 | 66,4 | 33,2 | 13,3 |
| 3,07  | 1,535 | 0,767 5 | 0,307 | 395  | 198 | 132 | 65,9 | 33,0 | 13,2 |
| 3,08  | 1,540 | 0,770 0 | 0,308 | 393  | 196 | 131 | 65,5 | 32,7 | 13,1 |
| 3,09  | 1,545 | 0,772 5 | 0,309 | 390  | 195 | 130 | 65,0 | 32,5 | 13,0 |
| 3,10  | 1,550 | 0,775 0 | 0,310 | 388  | 194 | 129 | 64,6 | 32,3 | 12,9 |
| 3,11  | 1,555 | 0,777 5 | 0,311 | 385  | 193 | 128 | 64,2 | 32,1 | 12,8 |
| 3,12  | 1,560 | 0,780 0 | 0,312 | 383  | 191 | 128 | 63,8 | 31,9 | 12,8 |
| 3,13  | 1,565 | 0,782 5 | 0,313 | 380  | 190 | 127 | 63,3 | 31,7 | 12,7 |
| 3,14  | 1,570 | 0,787 0 | 0,314 | 378  | 189 | 126 | 62,9 | 31,5 | 12,6 |
| 3,15  | 1,575 | 0,787 5 | 0,315 | 375  | 188 | 125 | 62,5 | 31,3 | 12,5 |
| 3,16  | 1,580 | 0,790 0 | 0,316 | 373  | 186 | 124 | 62,1 | 31,1 | 12,4 |
| 3,17  | 1,585 | 0,792 5 | 0,317 | 370  | 185 | 123 | 61,7 | 30,9 | 12,3 |
| 3,18  | 1,590 | 0,795 0 | 0,318 | 368  | 184 | 123 | 61,3 | 30,7 | 12,3 |
| 3,19  | 1,595 | 0,797 5 | 0,319 | 366  | 183 | 122 | 60,9 | 30,5 | 12,2 |
| 3,20  | 1,600 | 0,800 0 | 0,320 | 363  | 182 | 121 | 60,5 | 30,3 | 12,1 |
| 3,21  | 1,605 | 0,802 5 | 0,321 | 361  | 180 | 120 | 60,1 | 30,1 | 12,0 |
| 3,22  | 1,610 | 0,805 0 | 0,322 | 359  | 179 | 120 | 59,8 | 29,9 | 12,0 |
| 3,23  | 1,615 | 0,807 5 | 0,323 | 356  | 178 | 119 | 59,4 | 29,7 | 11,9 |
| 3,24  | 1,620 | 0,810 0 | 0,324 | 354  | 177 | 118 | 59,0 | 29,5 | 11,8 |
| 3,25  | 1,625 | 0,812 5 | 0,325 | 352  | 176 | 117 | 58,6 | 29,3 | 11,7 |
| 3,26  | 1,630 | 0,815 0 | 0,326 | 350  | 175 | 117 | 58,3 | 29,1 | 11,7 |
| 3,27  | 1,635 | 0,817 5 | 0,327 | 347  | 174 | 116 | 57,9 | 29,0 | 11,6 |
| 3,28  | 1,640 | 0,820 0 | 0,328 | 345  | 173 | 115 | 57,5 | 28,8 | 11,5 |
| 3,29  | 1,645 | 0,822 5 | 0,329 | 343  | 172 | 114 | 57,2 | 28,6 | 11,4 |
| 3,30  | 1,650 | 0,825 0 | 0,330 | 341  | 170 | 114 | 56,8 | 28,4 | 11,4 |
| 3,31  | 1,655 | 0,827 5 | 0,331 | 339  | 169 | 113 | 56,5 | 28,2 | 11,3 |
| 3,32  | 1,660 | 0,830 0 | 0,332 | 337  | 168 | 112 | 56,1 | 28,1 | 11,2 |

Table C.1

| Ball indenter<br>$D$<br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |     |      |      |      |      |
|---|-------|---------|-------|--|-----|------|------|------|------|
| 10  | 5     | 2,5     | 1     | 30   | 15  | 10   | 5    | 2,5  | 1    |
| Mean diameter of the indentation<br>$d$<br>mm |       |         |       | Brinell hardness<br>HBW                      |     |      |      |      |      |
| 3,33  | 1,665 | 0,832 5 | 0,333 | 335  | 167 | 112  | 55,8 | 27,9 | 11,2 |
| 3,34  | 1,670 | 0,835 0 | 0,334 | 333  | 166 | 111  | 55,4 | 27,7 | 11,1 |
| 3,35  | 1,675 | 0,837 5 | 0,335 | 331  | 165 | 110  | 55,1 | 27,5 | 11,0 |
| 3,36  | 1,680 | 0,840 0 | 0,336 | 329  | 164 | 110  | 54,8 | 27,4 | 11,0 |
| 3,37  | 1,685 | 0,842 5 | 0,337 | 326  | 163 | 109  | 54,4 | 27,2 | 10,9 |
| 3,38  | 1,690 | 0,845 0 | 0,338 | 325  | 162 | 108  | 54,1 | 27,0 | 10,8 |
| 3,39  | 1,695 | 0,847 5 | 0,339 | 323  | 161 | 108  | 53,8 | 26,9 | 10,8 |
| 3,40  | 1,700 | 0,850 0 | 0,340 | 321  | 160 | 107  | 53,4 | 26,7 | 10,7 |
| 3,41  | 1,705 | 0,852 5 | 0,341 | 319  | 159 | 106  | 53,1 | 26,6 | 10,6 |
| 3,42  | 1,710 | 0,855 0 | 0,342 | 317  | 158 | 106  | 52,8 | 26,4 | 10,6 |
| 3,43  | 1,715 | 0,857 5 | 0,343 | 315  | 157 | 105  | 52,5 | 26,2 | 10,5 |
| 3,44  | 1,720 | 0,860 0 | 0,344 | 313  | 156 | 104  | 52,2 | 26,1 | 10,4 |
| 3,45  | 1,725 | 0,862 5 | 0,345 | 311  | 156 | 104  | 51,8 | 25,9 | 10,4 |
| 3,46  | 1,730 | 0,865 0 | 0,346 | 309  | 155 | 103  | 51,5 | 25,8 | 10,3 |
| 3,47  | 1,735 | 0,867 5 | 0,347 | 307  | 154 | 102  | 51,2 | 25,6 | 10,2 |
| 3,48  | 1,740 | 0,870 0 | 0,348 | 306  | 153 | 102  | 50,9 | 25,5 | 10,2 |
| 3,49  | 1,745 | 0,872 5 | 0,349 | 304  | 152 | 101  | 50,6 | 25,3 | 10,1 |
| 3,50  | 1,750 | 0,875 0 | 0,350 | 302  | 151 | 101  | 50,3 | 25,2 | 10,1 |
| 3,51  | 1,755 | 0,877 5 | 0,351 | 300  | 150 | 100  | 50,0 | 25,0 | 10,0 |
| 3,52  | 1,760 | 0,880 0 | 0,352 | 298  | 149 | 99,5 | 49,7 | 24,9 | 9,95 |
| 3,53  | 1,765 | 0,882 5 | 0,353 | 297  | 148 | 98,9 | 49,4 | 24,7 | 9,89 |
| 3,54  | 1,770 | 0,885 0 | 0,354 | 295  | 147 | 98,3 | 49,2 | 24,6 | 9,83 |
| 3,55  | 1,775 | 0,887 5 | 0,355 | 293  | 147 | 97,7 | 48,9 | 24,4 | 9,77 |
| 3,56  | 1,780 | 0,890 0 | 0,356 | 292  | 146 | 97,2 | 48,6 | 24,3 | 9,72 |
| 3,57  | 1,785 | 0,892 5 | 0,357 | 290  | 145 | 96,6 | 48,3 | 24,2 | 9,66 |
| 3,58  | 1,790 | 0,895 0 | 0,358 | 288  | 144 | 96,1 | 48,0 | 24,0 | 9,61 |
| 3,59  | 1,795 | 0,897 5 | 0,359 | 286  | 143 | 95,5 | 47,7 | 23,9 | 9,55 |
| 3,60  | 1,800 | 0,900 0 | 0,360 | 285  | 142 | 95,0 | 47,5 | 23,7 | 9,50 |
| 3,61  | 1,805 | 0,902 5 | 0,361 | 283  | 142 | 94,4 | 47,2 | 23,6 | 9,44 |
| 3,62  | 1,810 | 0,905 0 | 0,362 | 282  | 141 | 93,9 | 46,9 | 23,5 | 9,39 |
| 3,63  | 1,815 | 0,907 5 | 0,363 | 280  | 140 | 93,3 | 46,7 | 23,3 | 9,33 |
| 3,64  | 1,820 | 0,910 0 | 0,364 | 278  | 139 | 92,8 | 46,4 | 23,2 | 9,28 |
| 3,65  | 1,825 | 0,912 5 | 0,365 | 277  | 138 | 92,3 | 46,1 | 23,1 | 9,23 |
| 3,66  | 1,830 | 0,915 0 | 0,366 | 275  | 138 | 91,8 | 45,9 | 22,9 | 9,18 |
| 3,67  | 1,835 | 0,917 5 | 0,367 | 274  | 137 | 91,2 | 45,6 | 22,8 | 9,12 |
| 3,68  | 1,840 | 0,920 0 | 0,368 | 272  | 136 | 90,7 | 45,4 | 22,7 | 9,07 |
| 3,69  | 1,845 | 0,922 5 | 0,369 | 271  | 135 | 90,2 | 45,1 | 22,6 | 9,02 |
| 3,70  | 1,850 | 0,925 0 | 0,370 | 269  | 135 | 89,7 | 44,9 | 22,4 | 8,97 |
| 3,71  | 1,855 | 0,927 5 | 0,371 | 268  | 134 | 89,2 | 44,6 | 22,3 | 8,92 |
| 3,72  | 1,860 | 0,930 0 | 0,372 | 266  | 133 | 88,7 | 44,4 | 22,2 | 8,87 |
| 3,73  | 1,865 | 0,932 5 | 0,373 | 265  | 132 | 88,2 | 44,1 | 22,1 | 8,82 |
| 3,74  | 1,870 | 0,935 0 | 0,374 | 263  | 132 | 87,7 | 43,9 | 21,9 | 8,77 |
| 3,75  | 1,875 | 0,937 5 | 0,375 | 262  | 131 | 87,2 | 43,6 | 21,8 | 8,72 |
| 3,76  | 1,880 | 0,940 0 | 0,376 | 260  | 130 | 86,8 | 43,4 | 21,7 | 8,68 |
| 3,77  | 1,885 | 0,942 5 | 0,377 | 259  | 129 | 86,3 | 43,1 | 21,6 | 8,63 |
| 3,78  | 1,890 | 0,945 0 | 0,378 | 257  | 129 | 85,8 | 42,9 | 21,5 | 8,58 |
| 3,79  | 1,895 | 0,947 5 | 0,379 | 256  | 128 | 85,3 | 42,7 | 21,3 | 8,53 |
| 3,80  | 1,900 | 0,950 0 | 0,380 | 255  | 127 | 84,9 | 42,4 | 21,2 | 8,49 |
| 3,81  | 1,905 | 0,952 5 | 0,381 | 253  | 127 | 84,4 | 42,2 | 21,1 | 8,44 |
| 3,82  | 1,910 | 0,955 0 | 0,382 | 252  | 126 | 83,9 | 42,0 | 21,0 | 8,39 |
| 3,83  | 1,915 | 0,957 5 | 0,383 | 250  | 125 | 83,5 | 41,7 | 20,9 | 8,35 |
| 3,84  | 1,920 | 0,960 0 | 0,384 | 249  | 125 | 83,0 | 41,5 | 20,8 | 8,30 |
| 3,85  | 1,925 | 0,962 5 | 0,385 | 248  | 124 | 82,6 | 41,3 | 20,6 | 8,26 |
| 3,86  | 1,930 | 0,965 0 | 0,386 | 246  | 123 | 82,1 | 41,1 | 20,5 | 8,21 |
| 3,87  | 1,935 | 0,967 5 | 0,387 | 245  | 123 | 81,7 | 40,9 | 20,4 | 8,17 |
| 3,88  | 1,940 | 0,970 0 | 0,388 | 244  | 122 | 81,3 | 40,6 | 20,3 | 8,13 |

Table C.1

| Ball indenter<br><i>D</i><br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |      |      |      |      |      |
|--|-------|---------|-------|--|------|------|------|------|------|
| 10   | 5     | 2,5     | 1     | 30   | 15   | 10   | 5    | 2,5  | 1    |
| Mean diameter of the indentation<br><i>d</i><br>mm |       |         |       | Brinell hardness<br>HBW                      |      |      |      |      |      |
| 3,89   | 1,945 | 0,972 5 | 0,389 | 242  | 121  | 80,8 | 40,4 | 20,2 | 8,08 |
| 3,90   | 1,950 | 0,975 0 | 0,390 | 241  | 121  | 80,4 | 40,2 | 20,1 | 8,04 |
| 3,91   | 1,955 | 0,977 5 | 0,391 | 240  | 120  | 80,0 | 40,0 | 20,0 | 8,00 |
| 3,92   | 1,960 | 0,980 0 | 0,392 | 239  | 119  | 79,5 | 39,8 | 19,9 | 7,95 |
| 3,93   | 1,965 | 0,982 5 | 0,393 | 237  | 119  | 79,1 | 39,6 | 19,8 | 7,91 |
| 3,94   | 1,970 | 0,985 0 | 0,394 | 236  | 118  | 78,7 | 39,4 | 19,7 | 7,87 |
| 3,95   | 1,975 | 0,987 5 | 0,395 | 235  | 117  | 78,3 | 39,1 | 19,6 | 7,83 |
| 3,96   | 1,980 | 0,990 0 | 0,396 | 234  | 117  | 77,9 | 38,9 | 19,5 | 7,79 |
| 3,97   | 1,985 | 0,992 5 | 0,397 | 232  | 116  | 77,5 | 38,7 | 19,4 | 7,75 |
| 3,98   | 1,990 | 0,995 0 | 0,398 | 231  | 116  | 77,1 | 38,5 | 19,3 | 7,71 |
| 3,99   | 1,995 | 0,997 5 | 0,399 | 230  | 115  | 76,7 | 38,3 | 19,2 | 7,67 |
| 4,00   | 2,000 | 1,000 0 | 0,400 | 229  | 114  | 76,3 | 38,1 | 19,1 | 7,63 |
| 4,01   | 2,005 | 1,002 5 | 0,401 | 228  | 114  | 75,9 | 37,9 | 19,0 | 7,59 |
| 4,02   | 2,010 | 1,005 0 | 0,402 | 226  | 113  | 75,5 | 37,7 | 18,9 | 7,55 |
| 4,03   | 2,015 | 1,007 5 | 0,403 | 225  | 113  | 75,1 | 37,5 | 18,8 | 7,51 |
| 4,04   | 2,020 | 1,010 0 | 0,404 | 224  | 112  | 74,7 | 37,3 | 18,7 | 7,47 |
| 4,05   | 2,025 | 1,012 5 | 0,405 | 223  | 111  | 74,3 | 37,1 | 18,6 | 7,43 |
| 4,06   | 2,030 | 1,015 0 | 0,406 | 222  | 111  | 73,9 | 37,0 | 18,5 | 7,39 |
| 4,07   | 2,035 | 1,017 5 | 0,407 | 221  | 110  | 73,5 | 36,8 | 18,4 | 7,35 |
| 4,08   | 2,040 | 1,020 0 | 0,408 | 219  | 110  | 73,2 | 36,6 | 18,3 | 7,32 |
| 4,09   | 2,045 | 1,022 5 | 0,409 | 218  | 109  | 72,8 | 36,4 | 18,2 | 7,28 |
| 4,10   | 2,050 | 1,025 0 | 0,410 | 217  | 109  | 72,4 | 36,2 | 18,1 | 7,24 |
| 4,11   | 2,055 | 1,027 5 | 0,411 | 216  | 108  | 72,0 | 36,0 | 18,0 | 7,20 |
| 4,12   | 2,060 | 1,030 0 | 0,412 | 215  | 108  | 71,7 | 35,8 | 17,9 | 7,17 |
| 4,13   | 2,065 | 1,032 5 | 0,413 | 214  | 107  | 71,3 | 35,7 | 17,8 | 7,13 |
| 4,14   | 2,070 | 1,035 0 | 0,414 | 213  | 106  | 71,0 | 35,5 | 17,7 | 7,10 |
| 4,15   | 2,075 | 1,037 5 | 0,415 | 212  | 106  | 70,6 | 35,3 | 17,6 | 7,06 |
| 4,16   | 2,080 | 1,040 0 | 0,416 | 211  | 105  | 70,2 | 35,1 | 17,6 | 7,02 |
| 4,17   | 2,085 | 1,042 5 | 0,417 | 210  | 105  | 69,9 | 34,9 | 17,5 | 6,99 |
| 4,18   | 2,090 | 1,045 0 | 0,418 | 209  | 104  | 69,5 | 34,8 | 17,4 | 6,95 |
| 4,19   | 2,095 | 1,047 5 | 0,419 | 208  | 104  | 69,2 | 34,6 | 17,3 | 6,92 |
| 4,20   | 2,100 | 1,050 0 | 0,420 | 207  | 103  | 68,8 | 34,4 | 17,2 | 6,88 |
| 4,21   | 2,105 | 1,052 5 | 0,421 | 205  | 103  | 68,5 | 34,2 | 17,1 | 6,85 |
| 4,22   | 2,110 | 1,055 0 | 0,422 | 204  | 102  | 68,2 | 34,1 | 17,0 | 6,82 |
| 4,23   | 2,115 | 1,057 5 | 0,423 | 203  | 102  | 67,8 | 33,9 | 17,0 | 6,78 |
| 4,24   | 2,120 | 1,060 0 | 0,424 | 202  | 101  | 67,5 | 33,7 | 16,9 | 6,75 |
| 4,25   | 2,125 | 1,062 5 | 0,425 | 201  | 101  | 67,1 | 33,6 | 16,8 | 6,71 |
| 4,26   | 2,130 | 1,065 0 | 0,426 | 200  | 100  | 66,8 | 33,4 | 16,7 | 6,68 |
| 4,27   | 2,135 | 1,067 5 | 0,427 | 199  | 99,7 | 66,5 | 33,2 | 16,6 | 6,65 |
| 4,28   | 2,140 | 1,070 0 | 0,428 | 198  | 99,2 | 66,2 | 33,1 | 16,5 | 6,62 |
| 4,29   | 2,145 | 1,072 5 | 0,429 | 198  | 98,8 | 65,8 | 32,9 | 16,5 | 6,58 |
| 4,30   | 2,150 | 1,075 0 | 0,430 | 197  | 98,3 | 65,5 | 32,8 | 16,4 | 6,55 |
| 4,31   | 2,155 | 1,077 5 | 0,431 | 196  | 97,8 | 65,2 | 32,6 | 16,3 | 6,52 |
| 4,32   | 2,160 | 1,080 0 | 0,432 | 195  | 97,3 | 64,9 | 32,4 | 16,2 | 6,49 |
| 4,33   | 2,165 | 1,082 5 | 0,433 | 194  | 96,8 | 64,6 | 32,3 | 16,1 | 6,46 |
| 4,34   | 2,170 | 1,085 0 | 0,434 | 193  | 96,4 | 64,2 | 32,1 | 16,1 | 6,42 |
| 4,35   | 2,175 | 1,087 5 | 0,435 | 192  | 95,9 | 63,9 | 32,0 | 16,0 | 6,39 |
| 4,36   | 2,180 | 1,090 0 | 0,436 | 191  | 95,4 | 63,6 | 31,8 | 15,9 | 6,36 |
| 4,37   | 2,185 | 1,092 5 | 0,437 | 190  | 95,0 | 63,3 | 31,7 | 15,8 | 6,33 |
| 4,38   | 2,190 | 1,095 0 | 0,438 | 189  | 94,5 | 63,0 | 31,5 | 15,8 | 6,30 |
| 4,39   | 2,195 | 1,097 5 | 0,439 | 188  | 94,1 | 62,7 | 31,4 | 15,7 | 6,27 |
| 4,40   | 2,200 | 1,100 0 | 0,440 | 187  | 93,6 | 62,4 | 31,2 | 15,6 | 6,24 |
| 4,41   | 2,205 | 1,102 5 | 0,441 | 186  | 93,2 | 62,1 | 31,1 | 15,5 | 6,21 |
| 4,42   | 2,210 | 1,105 0 | 0,442 | 185  | 92,7 | 61,8 | 30,9 | 15,5 | 6,18 |
| 4,43   | 2,215 | 1,107 5 | 0,443 | 185  | 92,3 | 61,5 | 30,8 | 15,4 | 6,15 |
| 4,44   | 2,220 | 1,110 0 | 0,444 | 184  | 91,8 | 61,2 | 30,6 | 15,3 | 6,12 |

Table C.1

| Ball indenter<br><i>D</i><br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |      |      |      |      |      |
|--|-------|---------|-------|--|------|------|------|------|------|
| 10   | 5     | 2,5     | 1     | 30   | 15   | 10   | 5    | 2,5  | 1    |
| Mean diameter of the indentation<br><i>d</i><br>mm |       |         |       | Brinell hardness<br>HBW                      |      |      |      |      |      |
| 4,45   | 2,225 | 1,112 5 | 0,445 | 183  | 91,4 | 60,9 | 30,5 | 15,2 | 6,09 |
| 4,46   | 2,230 | 1,115 0 | 0,446 | 182  | 91,0 | 60,6 | 30,3 | 15,2 | 6,06 |
| 4,47   | 2,235 | 1,117 5 | 0,447 | 181  | 90,5 | 60,4 | 30,2 | 15,1 | 6,04 |
| 4,48   | 2,240 | 1,120 0 | 0,448 | 180  | 90,1 | 60,1 | 30,0 | 15,0 | 6,01 |
| 4,49   | 2,245 | 1,122 5 | 0,449 | 179  | 89,7 | 59,8 | 29,9 | 14,9 | 5,98 |
| 4,50   | 2,250 | 1,125 0 | 0,450 | 179  | 89,3 | 59,5 | 29,8 | 14,9 | 5,95 |
| 4,51   | 2,255 | 1,127 5 | 0,451 | 178  | 88,9 | 59,2 | 29,6 | 14,8 | 5,92 |
| 4,52   | 2,260 | 1,130 0 | 0,452 | 177  | 88,4 | 59,0 | 29,5 | 14,7 | 5,90 |
| 4,53   | 2,265 | 1,132 5 | 0,453 | 176  | 88,0 | 58,7 | 29,3 | 14,7 | 5,87 |
| 4,54   | 2,270 | 1,135 0 | 0,454 | 175  | 87,6 | 58,4 | 29,2 | 14,6 | 5,84 |
| 4,55   | 2,275 | 1,137 5 | 0,455 | 174  | 87,2 | 58,1 | 29,1 | 14,5 | 5,81 |
| 4,56   | 2,280 | 1,140 0 | 0,456 | 174  | 86,8 | 57,9 | 28,9 | 14,5 | 5,79 |
| 4,57   | 2,285 | 1,142 5 | 0,457 | 173  | 86,4 | 57,6 | 28,8 | 14,4 | 5,76 |
| 4,58   | 2,290 | 1,145 0 | 0,458 | 172  | 86,0 | 57,3 | 28,7 | 14,3 | 5,73 |
| 4,59   | 2,295 | 1,147 5 | 0,459 | 171  | 85,6 | 57,1 | 28,5 | 14,3 | 5,71 |
| 4,60   | 2,300 | 1,150 0 | 0,460 | 170  | 85,2 | 56,8 | 28,4 | 14,2 | 5,68 |
| 4,61   | 2,305 | 1,152 5 | 0,461 | 170  | 84,8 | 56,5 | 28,3 | 14,1 | 5,65 |
| 4,62   | 2,310 | 1,155 0 | 0,462 | 169  | 84,4 | 56,3 | 28,1 | 14,1 | 5,63 |
| 4,63   | 2,315 | 1,157 5 | 0,463 | 168  | 84,0 | 56,0 | 28,0 | 14,0 | 5,60 |
| 4,64   | 2,320 | 1,160 0 | 0,464 | 167  | 83,6 | 55,8 | 27,9 | 13,9 | 5,58 |
| 4,65   | 2,325 | 1,162 5 | 0,465 | 167  | 83,3 | 55,5 | 27,8 | 13,9 | 5,55 |
| 4,66   | 2,330 | 1,165 0 | 0,466 | 166  | 82,9 | 55,3 | 27,6 | 13,8 | 5,53 |
| 4,67   | 2,335 | 1,167 5 | 0,467 | 165  | 82,5 | 55,0 | 27,5 | 13,8 | 5,50 |
| 4,68   | 2,340 | 1,170 0 | 0,468 | 164  | 82,1 | 54,8 | 27,4 | 13,7 | 5,48 |
| 4,69   | 2,345 | 1,172 5 | 0,469 | 164  | 81,8 | 54,5 | 27,3 | 13,6 | 5,45 |
| 4,70   | 2,350 | 1,175 0 | 0,470 | 163  | 81,4 | 54,3 | 27,1 | 13,6 | 5,43 |
| 4,71   | 2,355 | 1,177 5 | 0,471 | 162  | 81,0 | 54,0 | 27,0 | 13,5 | 5,40 |
| 4,72   | 2,360 | 1,180 0 | 0,472 | 161  | 80,7 | 53,8 | 26,9 | 13,4 | 5,38 |
| 4,73   | 2,365 | 1,182 5 | 0,473 | 161  | 80,3 | 53,5 | 26,8 | 13,4 | 5,35 |
| 4,74   | 2,370 | 1,185 0 | 0,474 | 160  | 79,9 | 53,3 | 26,6 | 13,3 | 5,33 |
| 4,75   | 2,375 | 1,187 5 | 0,475 | 159  | 79,6 | 53,0 | 26,5 | 13,3 | 5,30 |
| 4,76   | 2,380 | 1,190 0 | 0,476 | 158  | 79,2 | 52,8 | 26,4 | 13,2 | 5,28 |
| 4,77   | 2,385 | 1,192 5 | 0,477 | 158  | 78,9 | 52,6 | 26,3 | 13,1 | 5,26 |
| 4,78   | 2,390 | 1,195 0 | 0,478 | 157  | 78,5 | 52,3 | 26,2 | 13,1 | 5,23 |
| 4,79   | 2,395 | 1,197 5 | 0,479 | 156  | 78,2 | 52,1 | 26,1 | 13,0 | 5,21 |
| 4,80   | 2,400 | 1,200 0 | 0,480 | 156  | 77,8 | 51,9 | 25,9 | 13,0 | 5,19 |
| 4,81   | 2,405 | 1,202 5 | 0,481 | 155  | 77,5 | 51,6 | 25,8 | 12,9 | 5,16 |
| 4,82   | 2,410 | 1,205 0 | 0,482 | 154  | 77,1 | 51,4 | 25,7 | 12,9 | 5,14 |
| 4,83   | 2,415 | 1,207 5 | 0,483 | 154  | 76,8 | 51,2 | 25,6 | 12,8 | 5,12 |
| 4,84   | 2,420 | 1,210 0 | 0,484 | 153  | 76,4 | 51,0 | 25,5 | 12,7 | 5,10 |
| 4,85   | 2,425 | 1,212 5 | 0,485 | 152  | 76,1 | 50,7 | 25,4 | 12,7 | 5,07 |
| 4,86   | 2,430 | 1,215 0 | 0,486 | 152  | 75,8 | 50,5 | 25,3 | 12,6 | 5,05 |
| 4,87   | 2,435 | 1,217 5 | 0,487 | 151  | 75,4 | 50,3 | 25,1 | 12,6 | 5,03 |
| 4,88   | 2,440 | 1,220 0 | 0,488 | 150  | 75,1 | 50,1 | 25,0 | 12,5 | 5,01 |
| 4,89   | 2,445 | 1,222 5 | 0,489 | 150  | 74,8 | 49,8 | 24,9 | 12,5 | 4,98 |
| 4,90   | 2,450 | 1,225 0 | 0,490 | 149  | 74,4 | 49,6 | 24,8 | 12,4 | 4,96 |
| 4,91   | 2,455 | 1,227 5 | 0,491 | 148  | 74,1 | 49,4 | 24,7 | 12,4 | 4,94 |
| 4,92   | 2,460 | 1,230 0 | 0,492 | 148  | 73,8 | 49,2 | 24,6 | 12,3 | 4,92 |
| 4,93   | 2,465 | 1,232 5 | 0,493 | 147  | 73,5 | 49,0 | 24,5 | 12,2 | 4,90 |
| 4,94   | 2,470 | 1,235 0 | 0,494 | 146  | 73,2 | 48,8 | 24,4 | 12,2 | 4,88 |
| 4,95   | 2,475 | 1,237 5 | 0,495 | 146  | 72,8 | 48,6 | 24,3 | 12,1 | 4,86 |
| 4,96   | 2,480 | 1,240 0 | 0,496 | 145  | 72,5 | 48,3 | 24,2 | 12,1 | 4,83 |
| 4,97   | 2,485 | 1,242 5 | 0,497 | 144  | 72,2 | 48,1 | 24,1 | 12,0 | 4,81 |
| 4,98   | 2,490 | 1,245 0 | 0,498 | 144  | 71,9 | 47,9 | 24,0 | 12,0 | 4,79 |
| 4,99   | 2,495 | 1,247 5 | 0,499 | 143  | 71,6 | 47,7 | 23,9 | 11,9 | 4,77 |
| 5,00   | 2,500 | 1,250 0 | 0,500 | 143  | 71,3 | 47,5 | 23,8 | 11,9 | 4,75 |

Table C.1

| Ball indenter<br>$D$<br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |      |      |      |      |      |
|---|-------|---------|-------|--|------|------|------|------|------|
| 10  | 5     | 2,5     | 1     | 30   | 15   | 10   | 5    | 2,5  | 1    |
| Mean diameter of the indentation<br>$d$<br>mm |       |         |       | Brinell hardness<br>HBW                      |      |      |      |      |      |
| 5,01  | 2,505 | 1,252 5 | 0,501 | 142  | 71,0 | 47,3 | 23,7 | 11,8 | 4,73 |
| 5,02  | 2,510 | 1,255 0 | 0,502 | 141  | 70,7 | 47,1 | 23,6 | 11,8 | 4,71 |
| 5,03  | 2,515 | 1,257 5 | 0,503 | 141  | 70,4 | 46,9 | 23,5 | 11,7 | 4,69 |
| 5,04  | 2,520 | 1,260 0 | 0,504 | 140  | 70,1 | 46,7 | 23,4 | 11,7 | 4,67 |
| 5,05  | 2,525 | 1,262 5 | 0,505 | 140  | 69,8 | 46,5 | 23,3 | 11,6 | 4,65 |
| 5,06  | 2,530 | 1,265 0 | 0,506 | 139  | 69,5 | 46,3 | 23,2 | 11,6 | 4,63 |
| 5,07  | 2,535 | 1,267 5 | 0,507 | 138  | 69,2 | 46,1 | 23,1 | 11,5 | 4,61 |
| 5,08  | 2,540 | 1,270 0 | 0,508 | 138  | 68,9 | 45,9 | 23,0 | 11,5 | 4,59 |
| 5,09  | 2,545 | 1,272 5 | 0,509 | 137  | 68,6 | 45,7 | 22,9 | 11,4 | 4,57 |
| 5,10  | 2,550 | 1,275 0 | 0,510 | 137  | 68,3 | 45,5 | 22,8 | 11,4 | 4,55 |
| 5,11  | 2,555 | 1,277 5 | 0,511 | 136  | 68,0 | 45,3 | 22,7 | 11,3 | 4,53 |
| 5,12  | 2,560 | 1,280 0 | 0,512 | 135  | 67,7 | 45,1 | 22,6 | 11,3 | 4,51 |
| 5,13  | 2,565 | 1,282 5 | 0,513 | 135  | 67,4 | 45,0 | 22,5 | 11,2 | 4,50 |
| 5,14  | 2,570 | 1,285 0 | 0,514 | 134  | 67,1 | 44,8 | 22,4 | 11,2 | 4,48 |
| 5,15  | 2,575 | 1,287 5 | 0,515 | 134  | 66,9 | 44,6 | 22,3 | 11,1 | 4,46 |
| 5,16  | 2,580 | 1,290 0 | 0,516 | 133  | 66,6 | 44,4 | 22,2 | 11,1 | 4,44 |
| 5,17  | 2,585 | 1,292 5 | 0,517 | 133  | 66,3 | 44,2 | 22,1 | 11,1 | 4,42 |
| 5,18  | 2,590 | 1,295 0 | 0,518 | 132  | 66,0 | 44,0 | 22,0 | 11,0 | 4,40 |
| 5,19  | 2,595 | 1,297 5 | 0,519 | 132  | 65,8 | 43,8 | 21,9 | 11,0 | 4,38 |
| 5,20  | 2,600 | 1,300 0 | 0,520 | 131  | 65,5 | 43,7 | 21,8 | 10,9 | 4,37 |
| 5,21  | 2,605 | 1,302 5 | 0,521 | 130  | 65,2 | 43,5 | 21,7 | 10,9 | 4,35 |
| 5,22  | 2,610 | 1,305 0 | 0,522 | 130  | 64,9 | 43,3 | 21,6 | 10,8 | 4,33 |
| 5,23  | 2,615 | 1,307 5 | 0,523 | 129  | 64,7 | 43,1 | 21,6 | 10,8 | 4,31 |
| 5,24  | 2,620 | 1,310 0 | 0,524 | 129  | 64,4 | 42,9 | 21,5 | 10,7 | 4,29 |
| 5,25  | 2,625 | 1,312 5 | 0,525 | 128  | 64,1 | 42,8 | 21,4 | 10,7 | 4,28 |
| 5,26  | 2,630 | 1,315 0 | 0,526 | 128  | 63,9 | 42,6 | 21,3 | 10,6 | 4,26 |
| 5,27  | 2,635 | 1,317 5 | 0,527 | 127  | 63,6 | 42,4 | 21,2 | 10,6 | 4,24 |
| 5,28  | 2,640 | 1,320 0 | 0,528 | 127  | 63,3 | 42,2 | 21,1 | 10,6 | 4,22 |
| 5,29  | 2,645 | 1,322 5 | 0,529 | 126  | 63,1 | 42,1 | 21,0 | 10,5 | 4,21 |
| 5,30  | 2,650 | 1,325 0 | 0,530 | 126  | 62,8 | 41,9 | 20,9 | 10,5 | 4,19 |
| 5,31  | 2,655 | 1,327 5 | 0,531 | 125  | 62,6 | 41,7 | 20,9 | 10,4 | 4,17 |
| 5,32  | 2,660 | 1,330 0 | 0,532 | 125  | 62,3 | 41,5 | 20,8 | 10,4 | 4,15 |
| 5,33  | 2,665 | 1,332 5 | 0,533 | 124  | 62,1 | 41,4 | 20,7 | 10,3 | 4,14 |
| 5,34  | 2,670 | 1,335 0 | 0,534 | 124  | 61,8 | 41,2 | 20,6 | 10,3 | 4,12 |
| 5,35  | 2,675 | 1,337 5 | 0,535 | 123  | 61,5 | 41,0 | 20,5 | 10,3 | 4,10 |
| 5,36  | 2,680 | 1,340 0 | 0,536 | 123  | 61,3 | 40,9 | 20,4 | 10,2 | 4,09 |
| 5,37  | 2,685 | 1,342 5 | 0,537 | 122  | 61,0 | 40,7 | 20,3 | 10,2 | 4,07 |
| 5,38  | 2,690 | 1,345 0 | 0,538 | 122  | 60,8 | 40,5 | 20,3 | 10,1 | 4,05 |
| 5,39  | 2,695 | 1,347 5 | 0,539 | 121  | 60,6 | 40,4 | 20,2 | 10,1 | 4,04 |
| 5,40  | 2,700 | 1,350 0 | 0,540 | 121  | 60,3 | 40,2 | 20,1 | 10,1 | 4,02 |
| 5,41  | 2,705 | 1,352 5 | 0,541 | 120  | 60,1 | 40,0 | 20,0 | 10,0 | 4,00 |
| 5,42  | 2,710 | 1,355 0 | 0,542 | 120  | 59,8 | 39,9 | 19,9 | 9,97 | 3,99 |
| 5,43  | 2,715 | 1,357 5 | 0,543 | 119  | 59,6 | 39,7 | 19,9 | 9,93 | 3,97 |
| 5,44  | 2,720 | 1,360 0 | 0,544 | 119  | 59,3 | 39,6 | 19,8 | 9,89 | 3,96 |
| 5,45  | 2,725 | 1,362 5 | 0,545 | 118  | 59,1 | 39,4 | 19,7 | 9,85 | 3,94 |
| 5,46  | 2,730 | 1,365 0 | 0,546 | 118  | 58,9 | 39,2 | 19,6 | 9,81 | 3,92 |
| 5,47  | 2,735 | 1,367 5 | 0,547 | 117  | 58,6 | 39,1 | 19,5 | 9,77 | 3,91 |
| 5,48  | 2,740 | 1,370 0 | 0,548 | 117  | 58,4 | 38,9 | 19,5 | 9,73 | 3,89 |
| 5,49  | 2,745 | 1,372 5 | 0,549 | 116  | 58,2 | 38,8 | 19,4 | 9,69 | 3,88 |
| 5,50  | 2,750 | 1,375 0 | 0,550 | 116  | 57,9 | 38,6 | 19,3 | 9,66 | 3,86 |
| 5,51  | 2,755 | 1,377 5 | 0,551 | 115  | 57,7 | 38,5 | 19,2 | 9,62 | 3,85 |
| 5,52  | 2,760 | 1,380 0 | 0,552 | 115  | 57,5 | 38,3 | 19,2 | 9,58 | 3,83 |
| 5,53  | 2,765 | 1,382 5 | 0,553 | 114  | 57,2 | 38,2 | 19,1 | 9,54 | 3,82 |
| 5,54  | 2,770 | 1,385 0 | 0,554 | 114  | 57,0 | 38,0 | 19,0 | 9,50 | 3,80 |
| 5,55  | 2,775 | 1,387 5 | 0,555 | 114  | 56,8 | 37,9 | 18,9 | 9,47 | 3,79 |
| 5,56  | 2,780 | 1,390 0 | 0,556 | 113  | 56,6 | 37,7 | 18,9 | 9,43 | 3,77 |

Table C.1

| Ball indenter<br><i>D</i><br>mm                    |       |         |       | Force-diameter ratio<br>$0,102 \times F/D^2$ |      |      |      |      |      |
|--|-------|---------|-------|--|------|------|------|------|------|
| 10   | 5     | 2,5     | 1     | 30   | 15   | 10   | 5    | 2,5  | 1    |
| Mean diameter of the indentation<br><i>d</i><br>mm |       |         |       | Brinell hardness<br>HBW                      |      |      |      |      |      |
| 5,57   | 2,785 | 1,392 5 | 0,557 | 113  | 56,3 | 37,6 | 18,8 | 9,39 | 3,76 |
| 5,58   | 2,790 | 1,395 0 | 0,558 | 112  | 56,1 | 37,4 | 18,7 | 9,35 | 3,74 |
| 5,59   | 2,795 | 1,397 5 | 0,559 | 112  | 55,9 | 37,3 | 18,6 | 9,32 | 3,73 |
| 5,60   | 2,800 | 1,400 0 | 0,560 | 111  | 55,7 | 37,1 | 18,6 | 9,28 | 3,71 |
| 5,61   | 2,805 | 1,402 5 | 0,561 | 111  | 55,5 | 37,0 | 18,5 | 9,24 | 3,70 |
| 5,62   | 2,810 | 1,405 0 | 0,562 | 110  | 55,2 | 36,8 | 18,4 | 9,21 | 3,68 |
| 5,63   | 2,815 | 1,407 5 | 0,563 | 110  | 55,0 | 36,7 | 18,3 | 9,17 | 3,67 |
| 5,64   | 2,820 | 1,410 0 | 0,564 | 110  | 54,8 | 36,5 | 18,3 | 9,14 | 3,65 |
| 5,65   | 2,825 | 1,412 5 | 0,565 | 109  | 54,6 | 36,4 | 18,2 | 9,10 | 3,64 |
| 5,66   | 2,830 | 1,415 0 | 0,566 | 109  | 54,4 | 36,3 | 18,1 | 9,06 | 3,63 |
| 5,67   | 2,835 | 1,417 5 | 0,567 | 108  | 54,2 | 36,1 | 18,1 | 9,03 | 3,61 |
| 5,68   | 2,840 | 1,420 0 | 0,568 | 108  | 54,0 | 36,0 | 18,0 | 8,99 | 3,60 |
| 5,69   | 2,845 | 1,422 5 | 0,569 | 107  | 53,7 | 35,8 | 17,9 | 8,96 | 3,58 |
| 5,70   | 2,850 | 1,425 0 | 0,570 | 107  | 53,5 | 35,7 | 17,8 | 8,92 | 3,57 |
| 5,71   | 2,855 | 1,427 5 | 0,571 | 107  | 53,3 | 35,6 | 17,8 | 8,89 | 3,56 |
| 5,72   | 2,860 | 1,430 0 | 0,572 | 106  | 53,1 | 35,4 | 17,7 | 8,85 | 3,54 |
| 5,73   | 2,865 | 1,432 5 | 0,573 | 106  | 52,9 | 35,3 | 17,6 | 8,82 | 3,53 |
| 5,74   | 2,870 | 1,435 0 | 0,574 | 105  | 52,7 | 35,1 | 17,6 | 8,79 | 3,51 |
| 5,75   | 2,875 | 1,437 5 | 0,575 | 105  | 52,5 | 35,0 | 17,5 | 8,75 | 3,50 |
| 5,76   | 2,880 | 1,440 0 | 0,576 | 105  | 52,3 | 34,9 | 17,4 | 8,72 | 3,49 |
| 5,77   | 2,885 | 1,442 5 | 0,577 | 104  | 52,1 | 34,7 | 17,4 | 8,68 | 3,47 |
| 5,78   | 2,890 | 1,445 0 | 0,578 | 104  | 51,9 | 34,6 | 17,3 | 8,65 | 3,46 |
| 5,79   | 2,895 | 1,447 5 | 0,579 | 103  | 51,7 | 34,5 | 17,2 | 8,62 | 3,45 |
| 5,80   | 2,900 | 1,450 0 | 0,580 | 103  | 51,5 | 34,3 | 17,2 | 8,59 | 3,43 |
| 5,81   | 2,905 | 1,452 5 | 0,581 | 103  | 51,3 | 34,2 | 17,1 | 8,55 | 3,42 |
| 5,82   | 2,910 | 1,455 0 | 0,582 | 102  | 51,1 | 34,1 | 17,0 | 8,52 | 3,41 |
| 5,83   | 2,915 | 1,457 5 | 0,583 | 102  | 50,9 | 33,9 | 17,0 | 8,49 | 3,39 |
| 5,84   | 2,920 | 1,460 0 | 0,584 | 101  | 50,7 | 33,8 | 16,9 | 8,45 | 3,38 |
| 5,85   | 2,925 | 1,462 5 | 0,585 | 101  | 50,5 | 33,7 | 16,8 | 8,42 | 3,37 |
| 5,86   | 2,930 | 1,465 0 | 0,586 | 101  | 50,3 | 33,6 | 16,8 | 8,39 | 3,36 |
| 5,87   | 2,935 | 1,467 5 | 0,587 | 100  | 50,2 | 33,4 | 16,7 | 8,36 | 3,34 |
| 5,88   | 2,940 | 1,470 0 | 0,588 | 99,9   | 50,0 | 33,3 | 16,7 | 8,33 | 3,33 |
| 5,89   | 2,945 | 1,472 5 | 0,589 | 99,5   | 49,8 | 33,2 | 16,6 | 8,30 | 3,32 |
| 5,90   | 2,950 | 1,475 0 | 0,590 | 99,2   | 49,6 | 33,1 | 16,5 | 8,26 | 3,31 |
| 5,91   | 2,955 | 1,477 5 | 0,591 | 98,8   | 49,4 | 32,9 | 16,5 | 8,23 | 3,29 |
| 5,92   | 2,960 | 1,480 0 | 0,592 | 98,4   | 49,2 | 32,8 | 16,4 | 8,20 | 3,28 |
| 5,93   | 2,965 | 1,482 5 | 0,593 | 98,0   | 49,0 | 32,7 | 16,3 | 8,17 | 3,27 |
| 5,94   | 2,970 | 1,485 0 | 0,594 | 97,7   | 48,8 | 32,6 | 16,3 | 8,14 | 3,26 |
| 5,95   | 2,975 | 1,487 5 | 0,595 | 97,3   | 48,7 | 32,4 | 16,2 | 8,11 | 3,24 |
| 5,96   | 2,980 | 1,490 0 | 0,596 | 96,9   | 48,5 | 32,3 | 16,2 | 8,08 | 3,23 |
| 5,97   | 2,985 | 1,492 5 | 0,597 | 96,6   | 48,3 | 32,2 | 16,1 | 8,05 | 3,22 |
| 5,98   | 2,990 | 1,495 0 | 0,598 | 96,2   | 48,1 | 32,1 | 16,0 | 8,02 | 3,21 |
| 5,99   | 2,995 | 1,497 5 | 0,599 | 95,9   | 47,9 | 32,0 | 16,0 | 7,99 | 3,20 |
| 6,00   | 3,000 | 1,500 0 | 0,600 | 95,5   | 47,7 | 31,8 | 15,9 | 7,96 | 3,18 |

## Bibliography

[1] *Guide to the Expression of Uncertainty in Measurement*, ISO, 1993.



**Annex ZA (normative)**  
**Normative references to international publications with their relevant European publications**

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

| Publication | Year | Title  | EN         | Year |
|-------------|------|--|------------|------|
| ISO 4498-1  | 1990 | <i>Sintered metal materials, excluding hardmetals — Determination of apparent hardness — Part 1: Materials of essentially uniform section hardness</i> | EN 24498-1 | 1993 |

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