INTERNATIONAL STANDARD

ISO 6506-3

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Metallic materials — Brinell hardness test —

Part 3:
Calibration of reference blocks

Matériaux métalliques — Essai de dureté Brinell —
Partie 1: Étalonnage des blocs de référence

Reference number
ISO 6506-3:1999(E)

Contents

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

This first edition of ISO 6506-3 cancels and replaces ISO 726:1982, of which it constitutes a technical revision as follows:

— Expansion of clause 8, concerning an accompanied document for the reference blocks.

— Addition of clause 9 concerning the validity of the reference blocks.

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*

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.

Metallic materials — Brinell hardness test —

Part 3:
Calibration of reference blocks

1 Scope

This part of ISO 6506 specifies a method for the calibration of reference blocks which are intended for use in the indirect verification of Brinell hardness testing machines as described in ISO 6506-2.

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 376, *Metallic materials — Calibration of force-proving instruments used for the verification of uniaxial testing machines.*

ISO 3878, *Hardmetals — Vickers hardness test.*

ISO 4287*, Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters.*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method.*

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

3 Manufacture of reference blocks

3.1 The block shall be specially manufactured for use as a hardness reference block.

NOTE Attention is drawn to the need to use a manufacturing process which will give the necessary homogeneity, stability of structure and uniformity of surface hardness.

3.2 Each metal block to be calibrated shall be of a thickness no less than

— 16 mm for 10 mm balls;

— 12 mm for 5 mm balls;

— 6 mm for smaller balls.

3.3 The reference blocks shall be free of magnetism. It is recommended that the manufacturer ensure that the blocks, if of steel, have been demagnetized at the end of the manufacturing process.

3.4 The flatness of the two surfaces and the parallelism of the reference block shall be in accordance with Table 1.

Table 1 — Requirements for the reference blocks

Diameter of ball mm	Tolerance in flatness of the surfaces mm	Tolerance in parallelism mm on 50 mm	Permissible surface roughness Ra[a] µm	
			Test surface	Bottom surface
10	0,04	0,05	0,3	0,8
5	0,03	0,04	0,2	0,8
< 5	0,02	0,03	0,1	0,8

[a] Sampling length: l = 0,8 mm (see ISO 4287).

3.5 The test surface shall be free from scratches which interfere with the measurement of the indentations (see Table 1).

3.6 To verify that no material is subsequently removed from the reference block, the thickness at the time of calibration shall be marked on it to the nearest 0,1 mm, or an identifying mark shall be made on the test surface (see clause 8).

4 Calibration machine

4.1 In addition to fulfilling the general requirements specified in clause 3 of ISO 6506-2:1999, the calibration machine shall also meet the requirements given in 4.2 to 4.8.

4.2 The machine shall be verified directly in intervals not exceeding 12 months. Direct verification involves:

a) calibration of the test force

b) verification of the indenter

c) calibration of the measuring device

d) verification of the testing cycle

4.3 The instruments used for verification and calibration shall be traceable to national standards.

4.4 Each test force shall be correct to within ± 0,1 % of the nominal test force as defined in ISO 6506-1.

The force shall be measured with force-proving instruments of class 0,5 in accordance with ISO 376.

4.5 The indenters shall be verified and shall meet the requirements given in 4.3 of ISO 6506-2:1999 with the exception that the tolerances on the diameter of the balls shall meet requirements given in Table 2.

Table 2 — Tolerances for different ball diameters

Dimensions in millimetres

Ball diameter	Tolerance
10	± 0,003
5	± 0,002
2,5	± 0,001
1	± 0,001

4.6 The scale of the measuring microscope shall be graduated to read to 0,002 mm for indentations made with 10 mm and 5 mm balls and 0,001 mm for indentations made with balls of less than 5 mm diameter.

The scale of the measuring microscope shall be verified by measurements made on a stage micrometer at a minimum of five intervals over each working range. The accuracy of the measuring device in relation to the diameters of indentation shall be as given in Table 3.

Table 3 — Accuracy of the measuring device

Dimensions in millimetres

Diameter of indentation	Accuracy
$d < 1$	± 0,000 5
$1 \leqslant d < 2{,}5$	± 0,001
$d \geqslant 2{,}5$	± 0,002

4.7 The testing cycle shall conform to the testing cycle described in ISO 6506-1 and shall be timed with an uncertainty less than ± 0,5 s.

4.8 The characteristics of the hardmetal balls shall be the following:

— hardness: the hardness shall be no less than 1 500 HV 10, when determined in accordance with ISO 3878;

— density: ρ = (14,8 ± 0,2) g/cm^3.

NOTE The following chemical composition is recommended:

tungsten carbide (WC)	balance
total other carbides	2,0 %
cobalt (Co)	5,0 % to 7,0 %

5 Calibration procedure

The reference blocks shall be calibrated in a calibration machine as described in clause 4, at a temperature of (23 ± 5) °C, using the general procedure described in ISO 6506-1.

The time from the initial application of force to the time the full test force is reached shall not be less than 6 s nor greater than 8 s. The duration of the test force shall be 10 s to 15 s.

The mechanism which controls the application of the force shall ensure that the speed of approach of the ball immediately before it touches the block is no more than 1 mm/s.

6 Number of indentations

On each reference block, five indentations shall be made uniformly and distributed over the entire test surface.

7 Uniformity of hardness

7.1 Let d_1, d_2, d_3, d_4, d_5 be the mean values of the measured diameters of the indentations arranged in increasing order of magnitude.

The uniformity of the block under the particular conditions of calibration is characterized by:

$$d_5 - d_1$$

and expressed in percent of $\bar{d}$

where

$$\bar{d} = \frac{d_1 + d_2 + d_3 + d_4 + d_5}{5}$$

7.2 The maximum permissible value of non-uniformity of a reference block shall be as specified in Table 4.

Table 4 — Maximum permissible value of non-uniformity

$\bar{d}$ mm	**Maximum permissible value of non-uniformity** % of $\bar{d}$
$\bar{d} < 0{,}5$	2,0
$0{,}5 \leqslant \bar{d} \leqslant 1$	1,5
$\bar{d} > 1$	1,0
NOTE For a hardness value less than 200 HBW the maximum permissible value of non-uniformity may be 2,0 % of $\bar{d}$.	

8 Marking

8.1 Each reference block shall be marked with the following:

a) the arithmetic mean of the hardness values found in the standardizing test, for example: 348 HBW 5/750;

b) the name or mark of the supplier or manufacturer;

c) the serial number;

d) the name or mark of the calibration agency;

e) the thickness of the block or an identifying mark on the test surface (see 3.6);

f) the year of calibration, if not indicated in the serial number.

8.2 Any mark put on the side of the block shall be upright when the test surface is the upper face.

8.3 Each delivered reference block shall be accompanied by a document giving at least the following information:

a) a reference to this standard, i.e. ISO 6506-3;

b) the identity of the block;

c) the date of calibration;

d) the arithmetic mean of the hardness values or the value characterizing the uniformity of the block (see 7.1).

NOTE One of the five indentations may be selected as a reference indentation for the indirect verification of the measuring device as defined in annex A of ISO 6506-2:1999. Therefore, it should be identified with a permanent mark in line with one of the measured diameters.

9 Validity

The hardness reference block is only valid for the scale for which it was calibrated and provided that the block fulfils the requirements of clause 3.

NOTE The calibration validity should be limited to a duration of 5 years.