
**Metallic materials — Brinell hardness
test —**

**Part 3:
Calibration of reference blocks**

Matériaux métalliques — Essai de dureté Brinell —

Partie 3: Étalonnage des blocs de référence

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ISO 6506-3:2014

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 3, *Hardness testing*.

This third edition cancels and replaces the second edition (ISO 6506-3:2005), which has been technically revised.

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
- Part 4: Tables of hardness values

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 to be used in the indirect verification of Brinell hardness testing machines as described in ISO 6506-2.

The procedures necessary to ensure metrological traceability of the calibration machine are also specified.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 6506-1:2014, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6506-2:2014, *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 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 not less than

- 16 mm for 10 mm balls,
- 12 mm for 5 mm balls, or
- 6 mm for smaller balls.

NOTE 12 mm for 10 mm balls can be used only if the hardness of the reference block is greater than 150 HBW.

3.3 The reference blocks shall be free of magnetism. It is recommended that the manufacturer shall 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 over 50 mm	Permissible surface roughness <i>Ra</i> ^a µm	
			Test surface	Bottom surface
10	0,040	0,050	0,3	0,8
5	0,030	0,040	0,2	0,8
2,5	0,020	0,030	0,1	0,8
1,0	0,020	0,030	0,05	0,8

^a Sampling length: $l = 0,80$ 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 8.1, item e)].

4 Calibration machine

4.1 In addition to fulfilling the general requirements specified in ISO 6506-2:2014, Clause 3, the calibration machine shall also meet the requirements given in 4.2 to 4.7.

4.2 The machine shall be verified directly in intervals not exceeding 12 months.

Direct verification involves <https://standards.iteh.ai/catalog/standards/sist/ed35f64d-6144-45b3-a9a5-23763adb32b9/iso-6506-3-2014>

- measurement of the test forces,
- measurement of the diameter, hardness, and density of the indenter ball,
- calibration of the indentation diameter measuring device, and
- measurement of the testing cycle, if this is not possible, at least the force versus time behaviour.

4.3 The instruments used for verification and calibration shall be traceable to the SI.

4.4 Each test force shall be measured a minimum of three times using an elastic proving device of ISO 376 class 0,5 or better. For machines that apply the force by hydraulic or weight systems, these force measurements shall be made at each of three different indenter positions uniformly spaced throughout its range of movement during machine operation. The mean measurement (at each indenter position, where applicable) shall agree with the nominal value to within $\pm 0,1$ %.

4.5 The indenters shall be measured as specified in ISO 6506-2:2014, 4.3, and shall meet the size, hardness, and density requirements given there.

4.6 The scale of the indentation diameter measuring system 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 indentation diameter measuring system shall be calibrated against a standard scale at a minimum of five intervals over each working range. The performance of the indentation diameter measuring system (defined as the sum of the measured deviation from the standard scale and the expanded uncertainty of the standard scale) in relation to the diameters of indentation shall be as given in Table 2.

Table 2 — Performance of the indentation diameter measuring device

Diameter of indentation mm	Performance mm
$d < 1$	$\pm 0,000\ 5$
$1 \leq d < 2,5$	$\pm 0,001\ 0$
$d \geq 2,5$	$\pm 0,002\ 0$

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 $\pm 0,5$ s.

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. During calibration, the thermal drift should not exceed 1 °C.

The maximum velocity of the indenter immediately before it touches the surface of the test block shall be as specified in [Table 3](#).

Table 3 — Maximum indenter approach velocity

Ball diameter mm	Maximum velocity mm·s ⁻¹
1	0,3
2,5	0,6
5 or 10	1,0

The time from the initial application of force to the time the full test force is reached shall be (7 ± 1) s. The duration of the test force shall be (14 ± 1) s.

6 Number of indentations

On each reference block, at least five indentations shall be made, uniformly distributed over the entire test surface. At least one of the indentations shall be identified as a reference indentation [see [8.3](#), item e)].

NOTE Performing more than five indentations might reduce the measurement uncertainty.

7 Non-uniformity of reference block

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

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

$$R = d_5 - d_1 \quad (1)$$

and is expressed as a percentage of \bar{d}

$$R_{\text{rel}} = 100 \times \frac{(d_5 - d_1)}{\bar{d}} \quad (2)$$

where

$$\bar{d} = \frac{d_1 + d_2 + d_3 + d_4 + d_5}{5} \quad (3)$$

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, R_{rel} %
$\bar{d} < 0,5$	2,0
$0,5 \leq \bar{d} \leq 1$	1,5
$\bar{d} > 1$	1,0

NOTE For hardness values less than 225 HBW, the maximum permissible value of non-uniformity can be 2,0 %.

7.3 Methods for determining the uncertainty of measurement of hardness reference blocks are given in [Annex A](#) and Reference [6].

8 Marking

8.1 Each reference block shall be marked with the following:

- arithmetic mean of the hardness values found in the block calibration, for example: 348 HBW 5/750;
- name or mark of the supplier or manufacturer;
- serial number;
- name or mark of the calibration agency;
- thickness of the block or an identifying mark on the test surface (see [3.6](#));
- 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 part of ISO 6506 (i.e. ISO 6506-3);
- b) the identity of the block;
- c) the date of calibration;
- d) the arithmetic mean of the hardness values and its associated uncertainty and the value characterizing the non-uniformity of the block (see [7.1](#));
- e) information about the location of the reference indentation(s) and the orientations and values of the measured diameters, together with the mean measured diameter(s).

9 Validity

The hardness-reference block is only valid for the scale for which it was calibrated.

The calibration validity should be limited to a duration of five years. Attention is drawn to the fact that, for Al- and Cu-alloys, the calibration validity should be reduced to two to three years.

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