INTERNATIONAL STANDARD

ISO 6506-2

Fourth edition
2017-10

Metallic materials — Brinell hardness test —

Part 2: Verification and calibration of testing machines

Matériaux métalliques — Essai de dureté Brinell —
Partie 2: Vérification et étalonnage des machines d'essai

Reference number
ISO 6506-2:2017(E)

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Foreword

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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).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This fourth edition cancels and replaces the third edition (ISO 6506-2:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Clause 3 has been added;

— Table 3 has been modified.

A list of all parts in the ISO 6506 series can be found on the ISO website.

Metallic materials — Brinell hardness test —

Part 2: Verification and calibration of testing machines

1 Scope

This document specifies methods of direct and indirect verification of testing machines used for determining Brinell hardness in accordance with ISO 6506-1 and also specifies when these two types of verification have to be performed.

The direct verification involves checking that individual machine performance parameters fall within specified limits whereas the indirect verification utilizes hardness measurements of reference blocks, calibrated in accordance with ISO 6506-3, to check the machine's overall performance.

If a testing machine is also to be used for other methods of hardness testing, it has to be verified independently for each method.

This document is applicable to both fixed location and portable hardness testing machines. For machines that are incapable of satisfying the specified force-time profile, the direct verification of force and testing cycle can be modified by the use of Annex B.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 6506-3, *Metallic materials — Brinell hardness test — Part 3: Calibration of reference blocks*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 General conditions

Before a Brinell hardness testing machine is verified, the machine shall be checked to ensure that it is properly set up in accordance with the manufacturer's instructions.

Especially, it should be checked that:

a) the mount holding the ball-holder slides correctly in its guide;

b) every ball-holder with a ball used during the calibration is firmly held in the mount;

c) the test force is applied and removed without shock, vibration, or overrun and in such a manner that the readings are not influenced; and

d) if the indentation diameter measuring system is integrated into the machine,

— the change from removing the test force to measuring mode does not influence the diameter measurements,

— the illumination does not affect the diameter measurements, and

— the centre of the indentation is in the centre of the field of view, if necessary.

5 Direct verification

5.1 General

5.1.1 Direct verification should be carried out at a temperature of (23 ± 5) °C. If the verification is made outside this temperature range, this shall be reported in the verification report.

5.1.2 The instruments used for verification shall be traceable to the SI.

5.1.3 Direct verification involves:

a) measurement of the test forces;

b) measurement of the diameter, hardness, and density of the indenter ball;

c) calibration of the indentation diameter measuring system; and

d) measurement of the testing cycle.

For each of the above items, direct verification also includes assessment of the results against the specified tolerances.

5.2 Measurement of the test forces

5.2.1 Each test force shall be measured within the working range of the testing machine. When the force is applied in open-loop mode by a lever or other system employing a mechanical advantage, this shall be done at no fewer than three positions of the indenter uniformly spaced throughout its range of movement during testing.

5.2.2 Three measurements shall be made for each force at each position of the indenter. Immediately before each measurement is taken, the indenter shall be moved in the same direction as during testing.

5.2.3 The force shall be measured by one of the following two methods:

— by means of a force-proving instrument in accordance with ISO 376 Class 1 or better;

— by balancing against a force, accurate to ±0,2 %, applied by means of calibrated masses or another method with the same accuracy.

5.2.4 Each measurement of a force shall be within ±1,0 % of the nominal test force [see Formula (A.2)], as defined in ISO 6506-1.

5.3 Measurement of the properties of the indenter ball

5.3.1 The indenter consists of a ball and an indenter holder. The verification applies only to the ball.

5.3.2 For the purpose of verifying the size and the hardness of the balls, a minimum of two balls, selected at random from a batch, shall be tested. Each sampled ball shall be verified for size and hardness and then discarded.

5.3.3 The balls shall be polished and free from surface defects.

5.3.4 The user shall either measure the balls to ensure that they meet the following requirements or shall obtain balls from a supplier certifying that the following conditions are met.

5.3.4.1 The diameter shall be determined by taking the mean value of not less than three single values of diameter measured at different positions on the ball. No single value shall differ from the nominal diameter by more than the tolerance given in Table 1.

Table 1 — Tolerances for the different ball diameters

Ball diameter mm	Tolerance mm
10	±0,005
5	±0,004
2,5	±0,003
1	±0,003

5.3.4.2 The characteristics of the tungsten carbide composite balls shall be as follows.

a) Hardness: The hardness shall be not less than 1 500 HV, when determined in accordance with ISO 6507-1. The tungsten carbide composite ball can be tested directly on its spherical surface or by sectioning the ball and testing on the ball interior.

b) Density: ρ = (14,8 ± 0,2) g/cm^3.

The density can be determined from the sampled balls, prior to hardness testing, or from the whole batch. The following chemical composition is recommended:

— tungsten carbide (WC): balance;

— total other carbides: 2,0 %;

— cobalt (Co): 5,0 % to 7,0 %.

5.4 Calibration of the indentation diameter measuring system

5.4.1 For systems where the indentation diameter is measured directly, the scale of the system shall be graduated to permit estimation of the diameter to within ±0,5 %. The indentation diameter measuring system shall be calibrated for every objective lens and for each incorporated line scale, in two perpendicular measurement axes (if applicable), by measurements made on a standard scale at a minimum of four intervals, arranged centrally in the field of view, for each working range. For each measurement, the magnitude of the difference between the measured and reference values shall not be greater than 0,5 % [see Formula (A.4)].