



SLOVENSKI STANDARD
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Kovinski materiali - Preskus trdote po Rockwellu - 3. del: Umerjanje primerjalnih ploščic (ISO/DIS 6508-3:2022)

Metallic materials - Rockwell hardness test - Part 3: Calibration of reference blocks (ISO/DIS 6508-3:2022)

Metallische Werkstoffe - Härteprüfung nach Rockwell - Teil 3: Kalibrierung von Härtevergleichsplatten (ISO/DIS 6508-3:2022)

Matériaux métalliques - Essai de dureté Rockwell - Partie 3: Étalonnage des blocs de référence (ISO/DIS 6508-3:2022)

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Metallic materials — Rockwell hardness test —

Part 3: Calibration of reference blocks

*Matériaux métalliques — Essai de dureté Rockwell —**Partie 3: Étalonnage des blocs de référence*

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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).

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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 6508-3:2005), which has been technically revised.

ISO 6508 consists of the following parts, under the general title *Metallic materials — Rockwell hardness test*:

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

Metallic materials — Rockwell hardness test —

Part 3: Calibration of reference blocks

1 Scope

This part of ISO 6508 specifies a method for the calibration of reference blocks to be used for the indirect and daily verification of Rockwell hardness testing machines and indenters, as specified in ISO 6508-2. This part also specifies requirements for Rockwell machines and indenters used for calibrating reference blocks and specifies methods for their calibration and verification.

Attention is drawn to the fact that the use of hard metal for ball indenters is considered to be the standard type of Rockwell indenter ball. Steel indenter balls can be used only when complying with the Annex of ISO 6508-1 that specifies the “Special HR30T_{Sm} and HR15T_{Sm} test for thin products.”

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 6508-1:2015, *Metallic materials — Rockwell hardness test — Part 1: Test method 0-*

ISO 6508-2:2015, *Metallic materials — Rockwell hardness test — Part 2: Verification and calibration of testing machines and indenters*

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 hardness reference block shall be of a thickness not less than 6 mm. To minimize the effect of hardness change with increasing number of indents, thicker blocks should be used.

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

3.4 The deviation from surface flatness of the top and bottom surfaces shall be $\leq 0,01$ mm. The bottom of the blocks shall not be convex. The deviation from parallelism of the top and bottom surfaces shall be $\leq 0,02$ mm per 50 mm.

3.5 The test surface and bottom surface shall be free from damage, such as notches, scratches, oxide layers, etc., which can interfere with the measurement of the indentations. The surface roughness,

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R_a , shall not exceed 0,3 μm for the test surface and 0,8 μm for the bottom surface. Sampling length is $l = 0,8$ mm (see ISO 4287:1997, 3.1.9).

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 e)].

4 Calibration machine and calibration indenter

4.1 General

4.1.1 Calibrations and verifications of Rockwell calibration machines and calibration indenters shall be carried out at a temperature of (23 ± 5) °C.

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

4.2 Direct verification of the calibration machine

4.2.1 In addition to fulfilling the "General conditions" clause specified in ISO 6508-2, the calibration machine shall also meet the requirements given in 4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.2.6 and 4.2.7 determined by the procedures specified in the "Direct verification of the testing machine" clause of ISO 6508-2.

4.2.2 The machine shall be directly verified annually, not to exceed 13 months. Direct verification involves calibration and verification of the following:

- a) test force;
- b) measuring system;
- c) testing cycle; if this is not possible, at least the force versus time behaviour.
- d) machine hysteresis test.

4.2.3 The test force shall be measured by means of an elastic proving device (according to ISO 376) class 0,5 or better and calibrated for reversibility, or by another method having the same or better accuracy.

Evidence should be available to demonstrate that the output of the force-proving device does not vary by more than 0,1 % in a period of 1 s to 30 s, following a stepped change in force.

4.2.4 Each test force shall be measured and shall agree with the nominal preliminary test force, F_0 , to within $\pm 0,2$ % and the nominal total test force, F , to within $\pm 0,1$ %.

4.2.5 The measuring system shall have a resolution of $\pm 0,000$ 1 mm and a maximum expanded uncertainty of 0,000 2 mm, when calculated with a confidence level of 95 % over its working range.

4.2.6 The testing cycle shall be timed with an uncertainty less than $\pm 0,5$ s and shall conform to the testing cycle of [Clause 5](#).

4.2.7 The average of the last three tests when evaluating the hysteresis of the calibration machine shall indicate a hardness number of $(130 \pm 0,5)$ Rockwell units when the regular Rockwell ball scales B, E, F, G, H, and K are used, or within $(100 \pm 0,5)$ Rockwell units when any other Rockwell scale is used.

4.3 Calibration diamond indenter

4.3.1 The geometric shape and performance of calibration diamond indenters shall be calibrated as defined below. Direct verification of the geometric shape shall be made before first use. The condition of the diamond shall be checked at frequent intervals using appropriate optical devices (microscope, magnifying glass, etc.) as specified in the “Inspection of diamond indenters” Annex of ISO 6508-1.

Verification of the indenter performance, as specified in [4.3.3](#), shall be made before first use and annually, not to exceed 13 months.

4.3.2 The diamond indenter shall be measured on at least eight unique axial section planes equidistant from each other (e.g. the eight cross-sections will be spaced approximately 22,5° apart at 0°, 22,5°, 45°, 67,5°, 90°, 112,5°, 135°, 157,5°), and shall meet the following requirements:

- a) The cone angle shall be measured adjacent to the blend. The diamond cone shall have a mean included angle of $(120 \pm 0,1)^\circ$. In each measured axial section, the included angle shall be $(120 \pm 0,17)^\circ$.
- b) The mean deviation from straightness of the generatrix of the diamond cone adjacent to the blend shall not exceed 0,000 5 mm over a minimum length of 0,4 mm. In each measured section, the deviation shall not exceed 0,000 7 mm.
- c) The radius of the spherical tip of the diamond shall be measured adjacent to the blend. The tip shall have a mean radius of $(0,200 \pm 0,005)$ mm. In each measured section, the radius shall be within $(0,200 \pm 0,007)$ mm and local deviations from a true radius shall not exceed 0,002 mm.

NOTE The tip of the diamond indenter is usually not truly spherical, but often varies in radius across its surface. Depending on the crystallographic orientation of the diamond stone with respect to the indenter axis, diamond tends to preferentially polish away more easily or with more difficulty at the tip, producing an increasingly flat or sharp surface in the central indenter axis region. The sphericity of the diamond tip can be better evaluated by measuring multiple measurement windows of varying width. The measurement window would be bounded by widths measured along a line normal to the indenter axis. For example, the following window sizes can be evaluated:

- between ± 80 μm from the indenter axis;
 - between ± 60 μm from the indenter axis;
 - between ± 40 μm from the indenter axis.
- d) The surfaces of the cone and the spherical tip shall blend in a smooth tangential manner. The location where the spherical tip and the cone of the diamond blend together will vary depending on the values of the tip radius and cone angle. Ideally for a perfect indenter geometry, the blend point is located at 100 μm from the indenter axis measured along a line normal to the indenter axis. To avoid including the blend area in the measurement of the tip radius and cone angle, the portion of the diamond surface between 90 μm and 110 μm should be ignored.
 - e) The inclination of the axis of the diamond cone to the axis of the indenter holder (normal to the seating surface) shall be within 0,3°.

4.3.3 Calibration diamond indenters shall be performance verified by performing comparison tests with reference diamond indenter(s) that meet the requirements of [Annex C](#). Calibration diamond indenters can be verified for use on either regular or superficial Rockwell diamond scales or both. The test blocks used for the comparison testing shall meet the requirements of [Clause 3](#) and be calibrated at the hardness levels given in [Table 1](#), [Table 2](#), [Table 3](#), or [Table 4](#), depending on the scales for which the indenter is verified. The testing shall be carried out in accordance with ISO 6508-1.

NOTE The alternate hardness levels given in [Table 2](#) are provided to accommodate indenters calibrated to other International Standards. It is believed that calibrations conducted to [Table 1](#) or [Table 2](#) will yield equivalent results.

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For each block, the mean hardness value of three indentations made using the calibration diamond indenter to be verified shall not differ from the mean hardness value of three indentations obtained with a reference diamond indenter by more than $\pm 0,4$ Rockwell units. The indentations made with the calibration diamond indenter to be verified and with the reference diamond indenter should be adjacent.

Table 1 — Hardness levels for indenters to be used for calibrating Rockwell regular and superficial scale test blocks (A, C, D, and N)

Scale	Nominal hardness	Ranges
HRC	23	20 to 26
HRC	55	52 to 58
HR45N	43	40 to 46
HR15N	91	88 to 94

Table 2 — Alternate hardness levels for indenters to be used for calibrating Rockwell regular and superficial scale test blocks (A, C, D, and N)

Scale	Nominal hardness	Ranges
HRC	25	22 to 28
HRC	63	60 to 65
HR30N	64	60 to 69
HR15N	91	88 to 94

Table 3 — Hardness levels for indenters to be used for calibrating Rockwell regular scale test blocks only (A, C, and D)

Scale	Nominal hardness	Ranges
HRC	25	22 to 28
HRC	45	42 to 50
HRC	63	60 to 65
HRA	81	78 to 84

Table 4 — Hardness levels for indenters to be used for calibrating Rockwell superficial scale test blocks only (N)

Scale	Nominal hardness	Ranges
HR15N	91	88 to 94
HR30N	64	60 to 69
HR30N	46	42 to 50
HR45N	25	22 to 29

4.4 Calibration ball indenter

4.4.1 The calibration tungsten carbide composite ball shall be replaced at a frequency no greater than 12 months.

4.4.2 Calibration tungsten carbide composite balls shall meet the requirements of ISO 6508-2, with the exception of the following tolerances for the ball diameter:

- $\pm 0,002$ mm for the ball of diameter 1,587 5 mm;
- $\pm 0,003$ mm for the ball of diameter 3,175 mm.

4.5 Performance verification of the calibration machine and indenter

4.5.1 Performance verification involves verification of the calibration machine with the calibration indenter by performing comparisons with laboratories having measurement capabilities with lower uncertainties. The comparisons shall be made by one or more of the following procedures:

- tests on primary reference blocks calibrated by National Metrology Institutes
- intercomparisons with National Metrology Institutes
- intercomparisons with other Rockwell calibration laboratories having lower or equivalent stated measurement uncertainties, such as part of a Proficiency Testing (PT) program.

4.5.2 The calibration laboratory shall schedule the performance verification comparisons such that, at a minimum, the following number of Rockwell scales are compared during each performance verification interval depending on the reference blocks calibrated by the laboratory. Comparisons are only required for the scales that blocks will be calibrated in the future.

- One (1) regular Rockwell diamond scale (A, C, D)
- One (1) superficial Rockwell diamond scale (15N, 30N, 45N)
- One (1) 1,587 5 mm ball scale (B, F, G)
- One (1) 3,175 mm ball scale (E, H, K)

4.5.3 For each Rockwell scale to be compared, comparison tests shall be made at hardness levels within each of the hardness ranges specified by the table titled “Hardness ranges for different scales” in ISO 6508-2 (i.e., three hardness levels for each Rockwell scale except two hardness levels for the HRHW scale).

4.5.4 For each subsequent performance verification interval, the Rockwell scales chosen to be compared shall be different scales than compared previously for each category listed in 4.5.2 until all applicable scales are compared. Additional comparisons of previously compared scales can also be included in addition to the required comparisons.

4.5.5 Performance verification of the calibration machine with the calibration indenter shall be performed at least once annually, not to exceed 13 months. The verification measurements shall be carried out at a temperature of (23 ± 5) °C.

4.5.6 The results of each comparison shall be evaluated by appropriate statistical techniques, including calculating the Normalized Error, E_n , according to [Formula \(1\)](#) as

$$E_n = \frac{H_{Lab} - H_{Ref}}{\sqrt{U_{Lab}^2 + U_{Ref}^2}} \quad (1)$$

where

- H_{Lab} is the measurement result of the calibration laboratory
- H_{Ref} is the measurement result of the reference laboratory
- U_{Lab} is the Expanded Uncertainty of the calibration laboratory’s measurement result
- U_{Ref} is the Expanded Uncertainty of the reference laboratory’s measurement result.