SLOVENSKI STANDARD
oSIST prEN ISO 6507-3:2016

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Kovinski materiali - Preskus trdote po Vickersu - 3. del: Umerjanje primerjalnih ploščic (ISO/DIS 6507-3:2016)

Metallic materials - Vickers hardness test - Part 3: Calibration of reference blocks (ISO/DIS 6507-3:2016)

Metallische Werkstoffe - Härteprüfung nach Vickers - Teil 3: Kalibrierung von Härtevergleichsplatten (ISO/DIS 6507-3:2016)

Matériaux métalliques - Essai de dureté Vickers - Partie 3: Étalonnage des blocs de référence (ISO/DIS 6507-3:2016)

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77.040.10 Mehansko preskušanje kovin Mechanical testing of metals

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Metallic materials — Vickers hardness test —

Part 3: Calibration of reference blocks

Matériaux métalliques — Essai de dureté Vickers —

Partie 3: Étalonnage des blocs de référence

ICS: 77.040.10

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

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Foreword

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ISO 6507-3 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 6507-3:2005), which has been technically revised.

ISO 6507 consists of the following parts, under the general title *Metallic materials — Vickers 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 — Vickers hardness test — Part 3: Calibration of reference blocks

1 Scope

This part of ISO 6507 specifies a method for the calibration of reference blocks to be used for the indirect verification of Vickers hardness testing machines, as specified in ISO 6507-2.

The method is applicable only for indentations with diagonals ≥ 0,020 mm.

2 Normative references

The following referenced documents are indispensable for the application 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 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

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

ISO 6507-2, *Metallic materials — Vickers hardness test — Part 2: Verification and calibration of testing machines*

3 Manufacture of reference blocks

3.1 General

The block shall be specially manufactured for use as a hardness-reference block using a manufacturing process that will give the necessary homogeneity, stability of structure and uniformity of surface hardness.

3.2 Thickness

Each metal block to be calibrated shall be of a thickness not less than 5 mm.

3.3 Magnetism

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

3.4 Flatness and parallelism

The maximum deviation in flatness of the test and support surfaces shall not exceed 0,005 mm in 50 mm. The maximum error in parallelism shall not exceed 0,010 mm in 50 mm.

3.5 Surface roughness

The test surface shall be free from scratches that interfere with the measurement of the indentations. The surface roughness R_a shall not exceed 0,05 µm for the test surface. The sampling length l shall be 0,80 mm (see ISO 4287). The bottom surface shall be a finely ground finish or better.

3.6 Prevention of the regrind of the test surface

To verify that no material has been subsequently removed from the reference block, its thickness at the time of calibration shall be marked on the reference block to the nearest 0,01 mm, or an identifying mark shall be made on the test surface [see 8.1 e)].

4 Calibration machine

4.1 General

In addition to fulfilling the general requirements specified in ISO 6507-2, the calibration machine shall also meet the requirements given in 4.2 to 4.7.

4.2 Direct verification

The calibration machine shall be verified directly at intervals not exceeding 12 months.

Direct verification involves

a) verification of the test force;

b) verification of the indenter;

c) calibration and verification of the diagonal measuring system ;

d) verification of the testing cycle; if this is not possible, at least the force versus time behaviour.

4.3 Traceability of verification instruments

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

4.4 Test force

Each test force shall be verified at 3 different positions of the plunger, spaced at approximately equal increments covering the limits of travel used during testing. At each position, the force shall be measured three times using an elastic proving device according to ISO 376 Class 0,5 or better, or by another method having the same or better accuracy. Each measurement shall agree with the nominal value to within ± 0,2 % for normal hardness, to within ± 0,3 % for low-force hardness, and to within ± 0,5 % for microhardness.

4.5 Indenter

The indenter shall comply with ISO 6507-2, clause 4.3 and meet the following requirements:

a) The four faces of the square-based diamond pyramid shall be highly polished, free from surface defects, and flat within 0,000 3 mm.

b) The angle between the opposite faces of the vertex of the diamond pyramid shall be 136° ± 0,1°.

c) The angle between the axis of the diamond pyramid and the axis of the indenter-holder (normal to the seating surface) shall be less than 0,3°.

d) The point of the diamond indenter shall be examined with a high-power measuring microscope or preferably with an interference microscope and, if the four faces do not meet at a point, the line of junction between opposite faces shall comply with the values in Table 1.

Table 1

Ranges of test force, F N	**Maximum permissible length of the line of junction,** a mm
$F \geqq 49{,}03$	0,001
$1{,}961 \leqq F < 49{,}03$	0,000 5
$0{,}009\ 807 \leqq F < 1{,}961$	0,000 25

e) It shall be verified that the quadrilateral which would be formed by the intersection of the faces with a plane perpendicular to the axis of the diamond pyramid has angles of 90° ± 0,2° (see Figure 1).

A valid calibration certificate shall exist which confirms the geometrical deviations of the indenter.

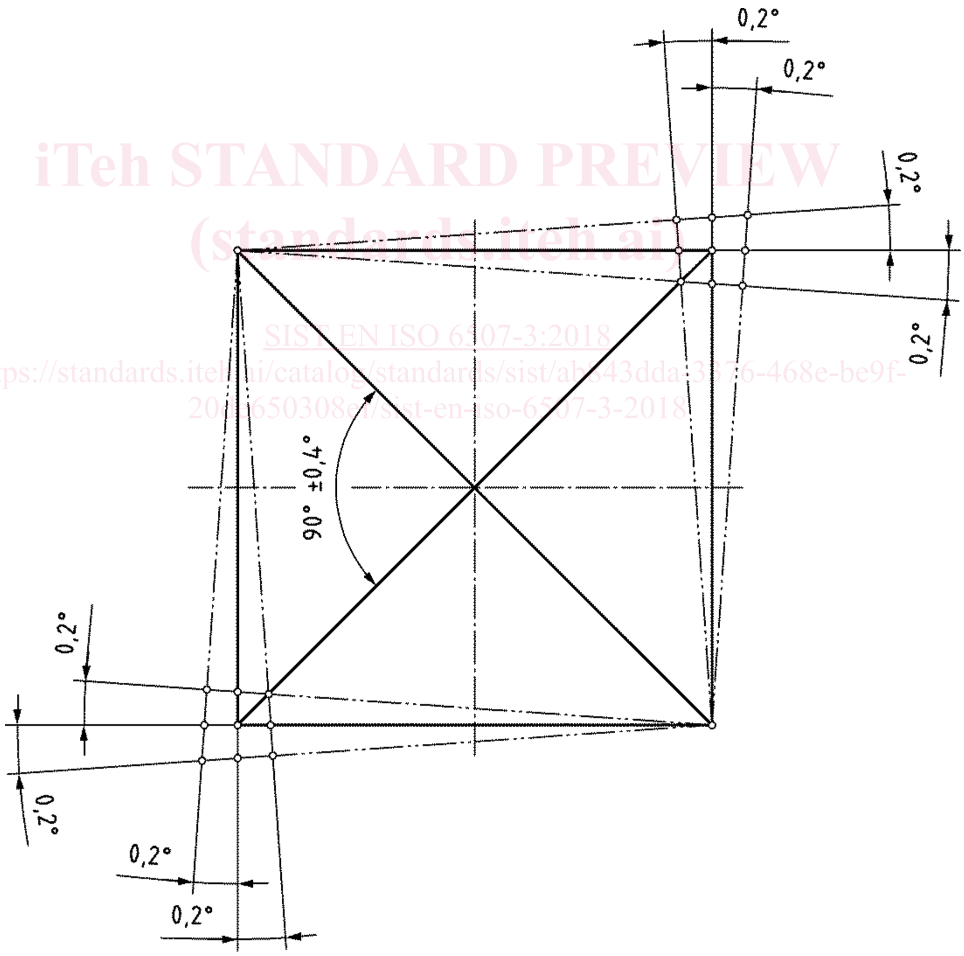

Figure 1 — Permissible difference of the sectional planes of the square form

4.6 Diagonal measuring system

The scale of the diagonal measuring system shall be graduated to permit estimation of the diagonals of the indentation in accordance with Table 2.

Table 2

Diagonal length, d mm	Resolution of the diagonal measuring system	Maximum permissible error
$d \le 0{,}060$	0,000 15 mm	±0,000 3 mm
$0{,}060 < d \le 0{,}200$	0,25 % of d	±0,5 % of d
$d > 0{,}200$	0,000 5 mm	±0,001 mm

The system for measuring the diagonal of the indentation shall be verified at each magnification and for each incorporated line scale to be used in two perpendicular measurement axis (if applicable), by performing measurements on an accurately ruled stage micrometer. Measurements shall be made at a minimum of five evenly spaced intervals, arranged centrally in the field of view, covering each working range.

The maximum uncertainty of the line intervals on the stage micrometer shall be 0,000 1 mm or 0,02 %, whichever is greater.

Three measurements shall be made at each of the evenly spaced intervals. The maximum permissible error of each of the three measurements at each interval shall not exceed the values given in Table 2. If necessary, a calibration factor can be applied to comply with this tolerance.

NOTE A helpful technique for adjusting optical systems that have Köhler illumination is given in Annex B.

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 specified in ISO 6507-1.

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

The time from the initial application of force until the full test force is reached, and the approach velocity of the indenter, shall meet the requirements given in Table 3.

The duration of application of the test force shall be 14^{+1}_{-1}s.

For microhardness testing, the maximum allowable vibrational acceleration reaching the calibration machine shall be 0,005 g_n (g_n equals the standard acceleration of gravity: $g_n = 9{,}806\ 65$ m/s^2).

Table 3

Ranges of test force, F N	Time for application of the test force s	Approach velocity of the indenter mm/s
$F < 1{,}961$	≤ 8	0,05 to 0,2
$1{,}961 \le F < 49{,}03$	≤ 8	0,05 to 0,2
$F \ge 49{,}03$	7 ±1 s	0,05 to 1

6 Number of indentations

On each reference block, a minimum of five indentations shall be made, uniformly distributed over the test surface. At least one of the indentations shall be identified as a reference indentation.

For microhardness tests and to reduce the measurement uncertainty, more than 5 indentations should be made. It is recommended to make 10, 15 or 25 indentations on 5 locations on the reference block.

7 Uniformity of hardness

7.1 Relative non-uniformity

For each reference block, let H_1, H_2, …, H_n be the *n* measured hardness values arranged in increasing order of magnitude corresponding to the measured diagonals d_1, d_2, …, d_n in decreasing order of magnitude. The average hardness $\overline{H}$ is calculated according to Formula (1):

$$\overline{H} = \frac{H_1 + H_2 + ... + H_n}{n} \quad (1)$$

The relative non-uniformity r_{rel}, expressed as a percentage of $\overline{H}$, is calculated according to Formula (2):

$$r_{rel} = 100 \times \frac{H_n - H_1}{\overline{H}} \quad (2)$$

The maximum permissible value of non-uniformity r_{rel} of a reference block is given in Tables 4 to 8.

Table 4 — Maximum permissible non-uniformity for *n* = 5

Hardness of block	Maximum permissible value of non-uniformity r_{rel}, %		
	< HV 0,2	≥ HV 0,2 to ≤ HV 5	HV 5 to HV 100
≤ 250 HV [a]	8,0 or $d_1 - d_n$ = 0,001 mm [b]	6,0	4,0
> 250 HV		4,0	2,0

[a] For hardness values < 150 HV, the maximum permissible value of non-uniformity shall be 16 % or $d_1 - d_n$ = 0,001 mm, whichever is greater, where d_1 and d_n are the arithmetic mean diagonal lengths corresponding to H_1 and H_n respectively.

[b] Whichever is greater.

Table 5 — Maximum permissible non-uniformity for *n* = 10

Hardness of block	Maximum permissible value of non-uniformity r_{rel}, %		
	< HV 0,2	≥ HV 0,2 to HV 5	HV 5 to HV 100
≤ 250 HV [a]	10,6 or $d_1 - d_n$ = 0,001 mm [b]	8,0	5,2
> 250 HV		5,2	2,6

[a] For hardness values < 150 HV, the maximum permissible value of non-uniformity shall be 21.2 % or $d_1 - d_n$ = 0,001 mm, whichever is greater, where d_1 and d_n are the arithmetic mean diagonal lengths corresponding to H_1 and H_n respectively.

[b] Whichever is greater.