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**Metallic materials — Vickers hardness  
test —**

**Part 2:  
Verification and calibration of testing  
machines**

iTeh STANDARD PREVIEW

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

ISO 6507-2:2005

<https://standards.iteh.ai/catalog/standards/sist/2e0f55a6-da28-4fa3-8458-990c4972dc71/iso-6507-2-2005>



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Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

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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 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 6507-2 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 3, *Hardness testing*.

This third edition cancels and replaces the second edition (ISO 6507-2:1997), which has been technically revised.

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ISO 6507 consists of the following parts, under the general title *Metallic materials — Vickers hardness test*:

- Part 1: Test method <https://standards.iteh.ai/catalog/standards/sist/2e0f55a6-da28-4fa3-8458-990c4972dc71/iso-6507-2-2005>
- 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 2: Verification and calibration of testing machines

### 1 Scope

This part of ISO 6507 specifies a method of verification of testing machines for determining Vickers hardness in accordance with ISO 6507-1.

It specifies a direct verification method for checking the main functions of the machine operation, and an indirect method suitable for the overall checking of the machine. The indirect method may be used on its own for periodic routine checking of the machine in service.

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

This part of ISO 6507 is also applicable to portable hardness testing machines.

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### 2 Normative references

[ISO 6507-2:2005](#)

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 3878, *Hardmetals — Vickers hardness test*

ISO 6507-1:2005, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6507-3, *Metallic materials — Vickers hardness test — Part 3: Calibration of reference blocks*

### 3 General conditions

Before a Vickers 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:

- the plunger holding the indenter is capable of sliding in its guide;
- the indenter-holder is firmly mounted in the plunger;
- the test force can be applied and removed without shock or vibration and in such a manner that the readings are not influenced;

- d) if the measuring system is integral with the machine
  - the change from removing the test force to measuring mode does not influence the readings,
  - illumination does not affect the readings,
  - the centre of the indentation is in the centre of the field of view, if necessary.

The illumination device of the measuring microscope shall produce uniform lighting of the whole observed field and maximum contrast between the indentation and the surrounding surface.

## 4 Direct verification

### 4.1 General

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

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

**4.1.3** Direct verification involves:

- a) calibration of the test force;
- b) verification of the indenter;
- c) calibration of the measuring system;
- d) verification of the testing cycle.

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### 4.2 Calibration of the test force

**4.2.1** Each test force used within the working range of the testing machine shall be measured. Whenever applicable, this shall be done at not less than three positions of the plunger uniformly spaced throughout its range of movement during testing.

**4.2.2** Three readings shall be taken for each test force at each position of the plunger. Immediately before each reading is taken, the plunger shall have been moved in the same direction as during testing.

**4.2.3** The test force shall be measured by one of the following two methods:

- by means of an elastic proving device in accordance with ISO 376:2004, class 1, or
- by balancing against a force, accurate to  $\pm 0,2$  %, applied by means of calibrated masses or another method with the same accuracy.

**4.2.4** Each measurement of the force shall be within the tolerances of the nominal value of the test force, as given in Table 1.

Table 1

Ranges of the test force, $F$ N	Tolerances %
$F \geq 1,961$	$\pm 1,0$
$0,098\ 07 \leq F < 1,961$	$\pm 1,5$

### 4.3 Verification of the indenter

4.3.1 The four faces of the square-based diamond pyramid shall be polished and free from surface defects.

4.3.2 The verification of the shape of the indenter can be made by direct measurement or by measurement of its projection on a screen.

4.3.3 The angle between the opposite faces at the vertex of the diamond pyramid shall be  $136^\circ \pm 0,5^\circ$  (see Figure 1).

NOTE The angle between the opposite faces may also be determined by the angle between the opposite edges; this value is  $148,11^\circ \pm 0,76^\circ$ .

4.3.4 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  $0,50^\circ$ . The four faces shall meet at a point; the maximum permissible length of the line of conjunction between opposite faces is given in Table 2 (see also Figure 2).

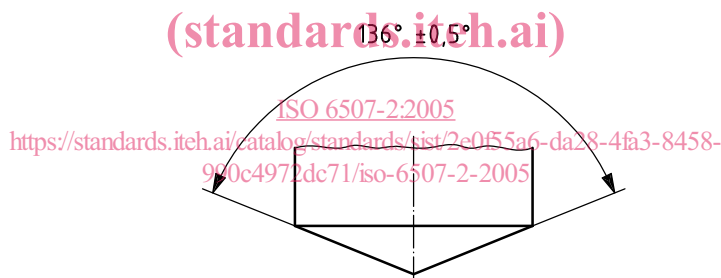
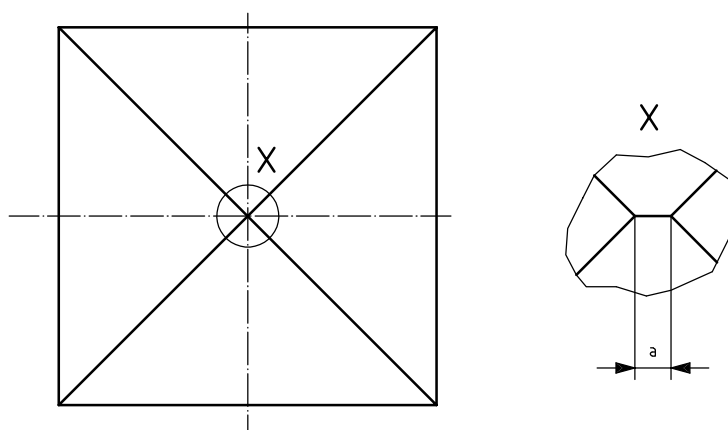


Figure 1 — Angle of the diamond pyramid



#### Key

$a$  = length of line of conjunction

Figure 2 — Line of conjunction on the top of the indenter (schematic)

Table 2

Ranges of test force, $F$ N	Maximum permissible length of the line of conjunction, $a$ mm
$F \geq 49,03$	0,002
$1,961 \leq F < 49,03$	0,001
$0,098\ 07 \leq F < 1,961$	0,000 5

**4.4 Calibration of the measuring system**

4.4.1 The resolution required of the measuring system depends on the size of the smallest indentation to be measured.

The scale of the measuring system shall be graduated to permit estimation of the diagonals of the indentation in accordance with Table 3.

Table 3

Diagonal length, $d$ mm	Resolution of the measuring system	Maximum permissible error
$d \leq 0,040$	0,000 2 mm	0,000 4 mm
$0,040 < d \leq 0,200$	0,5 % of $d$	1,0 % of $d$
$d > 0,200$	0,001 mm	0,002 mm

NOTE The diagonal length of the indentation determines the necessary magnification of the measuring system according to the following condition:  
 $V \times d \geq 14$  mm  
 For indentation diagonals  $d < 0,035$  mm this condition may not be fulfilled, but the magnification should be at least  $\times 400$ .

The resolution of the measuring system for Vickers hardness testing of hardmetals is specified in ISO 3878.

4.4.2 The measuring system shall be verified by measurements made on an object micrometer at a minimum of five intervals over each working range.

The maximum permissible error shall not exceed the values given in Table 3.

**4.5 Verification of the testing cycle**

The testing cycle shall be timed with an uncertainty of  $\pm 1,0$  s and shall conform to the testing cycle of ISO 6507-1.

**5 Indirect verification**

5.1 Indirect verification should be carried out at a temperature of  $(23 \pm 5)$  °C by means of reference blocks calibrated in accordance with ISO 6507-3. If the verification is made outside this temperature range, this shall be reported in the verification report.



**5.2** On each reference block, the reference indentation shall be measured. For each block, the difference between the mean measured value and the certified mean diagonal shall not exceed the maximum permissible errors given in Table 3.

**5.3** The machine shall be verified at each test force which is used. For each test force, two reference blocks shall be selected from the hardness ranges specified below. The blocks shall be chosen so that at least one reference block in each hardness range is used for the verification.

—  $\leq 225$  HV

— 400 HV to 600 HV

—  $> 700$  HV

**5.4** When verifying testing machines using only one test force, three reference blocks shall be used, one in each of the ranges specified in 5.2.

**5.5** On each reference block, five indentations shall be made and measured. The test shall be carried out in accordance with ISO 6507-1.

**5.6** For special purposes, a hardness testing machine may be verified at one hardness value only, corresponding approximately to that of the tests to be made.

**5.7** For each reference block, let  $d_1, d_2, d_3, d_4, d_5$  be the arithmetic mean values of the measured lengths of the two diagonals of the indentations, arranged in increasing order of magnitude, and

$$\bar{d} = \frac{d_1 + d_2 + d_3 + d_4 + d_5}{5} \quad (\text{standards.iteh.ai}) \quad (1)$$

**5.8** The repeatability of the testing machine, under the particular verification conditions, is determined by the difference

$$r = d_5 - d_1 \quad (2)$$

The repeatability, expressed as a percentage of  $\bar{d}$ , is calculated as:

$$r_{\text{rel}} = 100 \times \frac{d_5 - d_1}{\bar{d}} \quad (3)$$

The repeatability of the testing machine verified is not considered satisfactory unless it satisfies the conditions given in Table 4.

Table 4

Hardness of the reference block	Repeatability of the testing machine max						
	$r_{rel}$ , %			$r$ HV <sup>b</sup>			
	HV 5 to HV 100	HV 0,2 to < HV 5	< HV 0,2	HV 5 to HV 100		HV 0,2 to < HV 5	
			Hardness of the reference block	HV	Hardness of the reference block	HV	
≤ 225 HV	3,0 <sup>a</sup>	6,0 <sup>a</sup>	9,0 <sup>a</sup>	100	6	100	12
				200	12	200	24
> 225 HV	2,0 <sup>a</sup>	4,0 <sup>a</sup>	5,0 <sup>a</sup>	250	10	250	20
				350	14	350	28
				600	24	600	48
				750	30	750	60

<sup>a</sup> or 0,001 mm, whichever is greater.  
<sup>b</sup> HV: Vickers hardness.

5.9 The error,  $E$ , of the testing machine under the particular verification conditions is characterized by the difference:

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$$E = \bar{H} - H_c \tag{4}$$

where

$$\bar{H} = \frac{H_1 + H_2 + H_3 + H_4 + H_5}{5} \tag{5}$$

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where

$H_1, H_2, H_3, H_4, H_5$  are the hardness values corresponding to  $d_1, d_2, d_3, d_4, d_5$ ;

$H_c$  is the specified hardness of the reference block used.

The percent error,  $E_{rel}$ , is calculated by the following equation:

$$E_{rel} = 100 \times \frac{\bar{H} - H_c}{H_c} \tag{6}$$

The maximum error of the testing machine, expressed as a percentage of the specified hardness of the reference block, shall not exceed the values given in Table 5.

Table 5

Hardness symbol	Maximum permissible percentage error $E_{rel}$ of the hardness testing machine															
	Hardness, HV															
	50	100	150	200	250	300	350	400	450	500	600	700	800	900	1 000	1 500
HV 0,01																
HV 0,015	10															
HV 0,02	8															
HV 0,025	8	10														
HV 0,05	6	8	9	10												
HV 0,1	5	6	7	8	8	9	10	10	11							
HV 0,2		4		6		8		9		10	11	11	12	12		
HV 0,3		4		5		6		7		8	9	10	10	11	11	
HV 0,5		3		5		5		6		6	7	7	8	8	9	11
HV 1		3		4		4		4		5	5	5	6	6	6	8
HV 2		3		3		3		4		4	4	4	4	4	5	6
HV 3		3		3		3		3		3	4	4	4	4	4	5
HV 5		3		3		3		3		3	3	3	3	3	4	4
HV 10		3		3		3		3		3	3	3	3	3	3	3
HV 20		3		3		3		3		3	3	3	3	3	3	3
HV 30		3		3		2		2		2	2	2	2	2	2	2
HV 50		3		3		2		2		2	2	2	2	2	2	2
HV 100				3		2		2		2	2	2	2	2	2	2

NOTE 1 Values are not given when the length of the indentation diagonal is less than 0,020 mm.

NOTE 2 For intermediate values, the maximum permissible error may be obtained by interpolation.

NOTE 3 The values for microhardness testing machines are based on a maximum permissible error of 0,001 mm or 2 % of the mean diagonal length of indentation, whichever is the greater.

**5.10** The determination of the uncertainty of measurement of the calibration results of the hardness testing machine is given in Annex B.

## 6 Intervals between verifications

The specifications for the direct verifications of hardness testing machines are given in Table 6.

Indirect verification shall be performed at least once every 12 months and after a direct verification has been performed.