INTERNATIONAL STANDARD

ISO
6507-2

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Metallic materials — Vickers hardness test —

Part 2:
Verification of testing machines

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

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.

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.

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

This second edition of ISO 6507-2 cancels and replaces ISO 146:1984 and ISO 146-2:1993 as follows:

— Combination of the two different International Standards for the verification of the hardness testing machines (ISO 146:1989 and ISO 146-2:1993) into this part of ISO 6507.

— Addition of a new table (table 3) for the estimation capability and the maximum permissible error of the measuring device.

— Changing of the values for the repeatability of the hardness testing machine in table 4.

— Addition of a new clause 6 concerning the intervals between the verifications.

— Addition of a new annex A "Example of a method for an indirect verification of the measuring device" (using a reference indentation).

— Addition of a new annex B "Notes on diamond indenters".

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

— *Part 1: Test method*

— *Part 2: Verification of testing machines*

— *Part 3: Calibration of reference blocks*

Annexes A and B of this part of ISO 6507 are for information only.

Metallic materials — Vickers hardness test —

Part 2:
Verification 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 describes a direct verification method for checking the main functions of the machine, and an indirect verification method suitable for the overall checking of the machine. The indirect verification 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 is essential that it is verified independently for each method.

Portable hardness testing machines shall comply with all the requirements of this part of ISO 6507, but the word "relocation" in 6.1a) does not apply.

The force values in this part of ISO 6507 were calculated from kilogram force values. They were introduced before the SI-system was adopted. It was decided to keep the values based on the old units for this edition, but for the next revision it will be necessary to consider the advantage of introducing rounded values of test force and the consequence on the hardness scales.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6507. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6507 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 376:—[1], *Metallic materials — Calibration of force-proving instruments used for the verification of uniaxial testing machines.*

ISO 3878:1983, *Hardmetals — Vickers hardness test.*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method.*

ISO 6507-3:1997, *Metallic materials — Vickers hardness test — Part 3: Calibration of reference blocks.*

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1) To be published. (Revision of ISO 376:1987)

3 General conditions

Before a Vickers hardness testing machine is verified, it shall be checked to ensure that

a) the machine is properly set up;
b) the plunger holding the indenter is capable of sliding in its guide;
c) the indenter-holder is firmly mounted in the plunger;
d) the test force can be applied and removed without shock or vibration and in such a manner that the readings are not influenced;
e) if the measuring device is integral with the machine

   1) the change from removing the test force to measuring mode does not influence the readings,
   2) illumination does not affect the readings,
   3) 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

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.

The instruments used for verification shall have a certified traceability using the International System of Units (SI).

Direct verification involves

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

4.1 Verification of the test force

4.1.1 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.

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

a) by means of an elastic proving device in accordance with ISO 376, class 1,

b) by balancing against a force, accurate to ± 0,2 %, applied by means of standardized masses with mechanical advantage.

4.1.3 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.

4.1.4 Each measurement for the force shall be within the tolerances of the nominal value of the test force, as given in table 1.

Table 1

Ranges of test force, F N	Tolerances %
$F \geqslant 1,961$	± 1,0
$0,098\,07 \leqslant F < 1,961$	± 1,5

4.2 Verification of the indenter

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

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

4.2.3 The angle between the opposite faces at the vertex of the diamond pyramid shall be 136° ± 0,5° (see figure 1).

4.2.4 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 0,5°. The four faces shall meet in a point; the maximum permissible length of the line of conjunction between opposite faces is given in table 2 (see also figure 2).

Independent of the intervals between the direct verifications of the testing machines, the indenter shall be verified at intervals not exceeding two years.
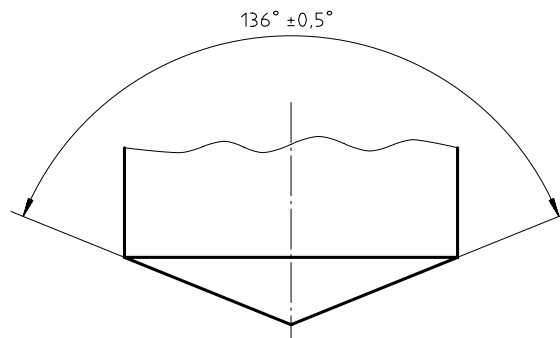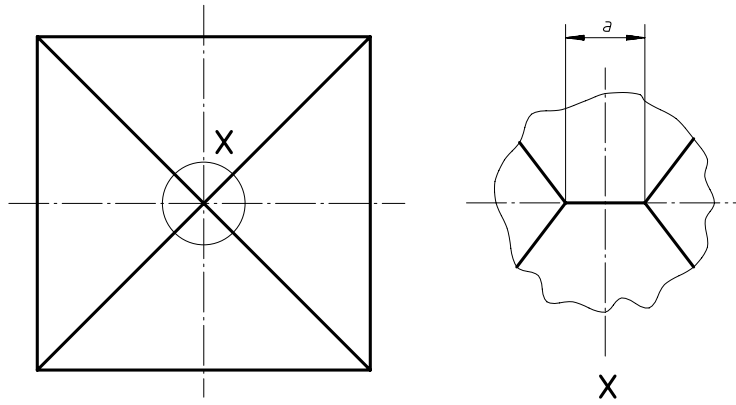
Figure 1 — Angle of the diamond pyramid

a = length of line of conjunction

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

Table 2

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

4.3 Verification of the measuring device

4.3.1 The estimation capability required of the measuring device depends on the size of the smallest indentation to be measured.

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

Table 3

Diagonal length, *d*	Estimation capability of the measuring device	Maximum permissible error
mm		
$d \leqslant 0{,}040$	0,000 2 mm	0,000 4 mm
$d > 0{,}040$	0,5 % of *d*	1,0 % of *d*

The estimation capability of the measuring device for Vickers hardness testing of hardmetals is specified in ISO 3878.

4.3.2 The measuring device shall be verified by measurements made on a stage micrometer at a minimum of five intervals over each working range.

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

4.3.3 In addition to this direct verification, an indirect verification of the measuring device may be carried out in accordance with the procedure described in annex A.

4.4 Verification of the testing cycle

The testing cycle shall be timed with a tolerance of 1 s and shall conform to the testing cycle of ISO 6507-1.

5 Indirect verification

Indirect verification should be carried out at a temperature of (23 ± 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.

5.1 When verifying testing machines which use several test forces, at least two forces shall be chosen. One of the forces shall be the test force most frequently used. For each test force chosen, two different reference blocks shall be selected from the different hardness ranges specified below. The forces and blocks shall be chosen so that at least one reference block in each hardness range shall be used for the verification.

$\leqslant$ 225 HV
400 HV to 600 HV
$>$ 700 HV

5.2 When verifying testing machines using only one test force, three reference blocks shall be used, one in each of the ranges specified in 5.1.

5.3 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.

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

5.5 For each reference block, let d_1, d_2, .., d_5, be the arithmetic mean values of the measured length of the two diagonals of the indentations, arranged in increasing order of magnitude.

5.6 The repeatability of the testing machine under the particular verification conditions is determined by the difference

$$d_5 - d_1$$

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.						
	$\bar{d}$ [1]			HV			
	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	$0,03\ \bar{d}$	$0,06\ \bar{d}$	$0,06\ \bar{d}$	100 200	6 12	100 200	12 24
> 225 HV	$0,02\ \bar{d}$	$0,04\ \bar{d}$	$0,05\ \bar{d}$	250 350 600 750	10 14 24 30	250 350 600 750	20 28 48 60

1) $\bar{d} = \dfrac{d_1 + d_2 + ... + d_5}{5}$

5.7   The error of the testing machine under the particular verification conditions is characterized by the difference:

$$\bar{H} - H$$

where

$$\bar{H} = \frac{H_1 + H_2 + ... + H_5}{5}$$

where

H_1, H_2, ..., H_5 are the hardness values corresponding to d_1, d_2, ..., d_5;

H is the specified hardness of the reference block used.

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 of the hardness testing machine															
	Hardness, HV															
	50	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1500
HV 0,01																
HV 0,015	10															
HV 0,02	8															
HV 0,025	8	10														
HV 0,05	6	8														
HV 0,1	5	6														
HV 0,2		4														
HV 0,3		4														
HV 0,5		3														
HV 1		3														
HV 2		3														
HV 3		3														
HV 5		3														
HV 10		3														
HV 20		3														
HV 30																
HV 50																
HV 100																