INTERNATIONAL STANDARD

ISO 146-2

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Metallic materials — Verification of Vickers hardness testing machines —

Part 2:
Less than HV 0,2

Matériaux métalliques — Contrôle des machines d'essai de dureté Vickers —

Partie 2: Inférieure à HV 0,2

Reference number
ISO 146-2:1993(E)

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 146-2 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Sub-Committee SC 3, *Hardness testing*.

ISO 146 consists of the following parts, under the general title *Metallic materials — Verification of Vickers hardness testing machines*:

— *Part 1: HV 0,2 to HV 100* (Actually published as ISO 146:1984)

— *Part 2: Less than HV 0,2*

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Metallic materials — Verification of Vickers hardness testing machines —

Part 2:
Less than HV 0,2

1 Scope

This part of ISO 146 specifies a method of verification of testing machines for determining Vickers hardness using test forces of less than 1,961 N (HV 0,2) in accordance with ISO 6507-3.

The method is applicable only for indentations with diagonals $\geqslant$ 20 µm.

This part of ISO 146 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.

NOTE 1 If a testing machine is also to be used for other methods of hardness testing, it will have to be verified independently for each method.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 146. 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 146 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 640-2:1993, *Metallic materials — Calibration of standardized blocks to be used for Vickers hardness testing machines — Part 2: Less than HV 0,2.*

ISO 6507-3:1989, *Metallic materials — Hardness test — Vickers test — Part 3: Less than HV 0,2.*

3 General conditions

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

— the machine is properly set up;

— the plunger holding the indenter is capable of sliding in its guide without any appreciable clearance;

— 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;

— 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.

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 involves

— verification of the test force;

— verification of the indenter;

— verification of the measuring device.

4.1 Verification of the test force

4.1.1 Procedure

4.1.1.1 Measure each test force used (chosen from table 1), within the working range of the testing machine, at not less than two positions of the plunger approximating the limits of travel during testing. The movement of the plunger shall be unrestricted by friction.

4.1.1.2 Measure the test force by one of the following two methods:

a) by means of an elastic proving device previously calibrated to an accuracy of ± 0,2 %;

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

4.1.1.3 Take three readings for each test force at each position of the plunger. Immediately before each reading is taken, move the plunger in the same direction as during testing.

4.1.2 Requirements

Each test force shall not deviate from the nominal value by more than ± 1,5 % for test forces over HV 0,01, or by more than ± 2,0 % for test forces less than or equal to HV 0,01.

4.2 Verification of the indenter

4.2.1 Procedure

4.2.1.1 Check the faces of the indenter for surface defects.

4.2.1.2 Verify the shape of the indenter by direct measurements, using a device with an accuracy of ± 0,07°.

4.2.2 Requirements

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

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

4.2.2.3 The angle between the axis of the diamond pyramid and the axis of the indenter holder (normal to the seating surface) shall not exceed 0,5°. The four faces shall meet in a point, with any line of junction between opposite faces being less than 0,5 µm (see figure 2).

4.3 Verification of the measuring device

4.3.1 Procedure

Calibrate the measuring device for measuring the diagonals of the indentation against an accurately ruled line-scale (stage micrometer) or device of equivalent accuracy. The errors of the line-scale shall be known within an uncertainty of 0,2 µm.

4.3.2 Requirements

4.3.2.1 The measuring device shall permit estimation of the diagonals of the indentation to within ± 0,2 µm.

4.3.2.2 The maximum permissible error of the measuring device shall be ± 1,0 % or 0,4 µm, whichever is the greater.

Alternatively, when using a calibration factor or curve, it shall be chosen such that the error scatter does not exceed 0,4 µm.

5 Indirect verification

Indirect verification may be carried out by means of standardized blocks, when available[1)] calibrated in accordance with ISO 640-2.

5.1 Procedure

5.1.1 When verifying testing machines used for several test forces, choose at least two different forces. One of the forces shall be the lowest force in the range of the machine and the other force shall be chosen in the upper half of the range. For each test force chosen, use two different standardized blocks within the range for which the machine is used. The ratio of the hardness values for the two blocks shall be equal to or greater than 2.

1) When this part of ISO 146 was published, blocks were available for verification of force and hardness equal to or greater than 100 HV 0,1.

5.1.2 When verifying testing machines used only for one test force, use three standardized blocks, uniformly distributed over the range of the machine.

5.1.3 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.

5.1.4 On each standardized block, make five indentations and measure them. The test shall be made in accordance with ISO 6507-3.

Attention is drawn to ISO 409-3:—, *Metallic materials — Hardness test — Tables of Vickers hardness values for use in tests made on flat surfaces — Part 3: Less than HV 0,2* (to be published), for use in tests made on flat surfaces.

5.1.5 For each standardized block, arrange the arithmetic mean values of the measured two diagonals of the indentations in increasing order of magnitude, and identify them as d_1, d_2, ..., d_5.

5.2 Requirements

5.2.1 Repeatability

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

$$d_5 - d_1$$

5.2.1.2 The repeatability of the testing machine being verified is not considered satisfactory unless it is less than or equal to 0,05 $\bar{d}$, where

$$\bar{d} = \frac{d_1 + d_2 + \ldots + d_5}{5}$$

5.2.2 Error

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

$$\bar{H} - H$$

where

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

in which

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 standardized block used.

5.2.2.2 The maximum error of the testing machine, expressed as a percentage of the specified hardness of the standardized block, shall not exceed the values given in table 1.

Table 1

Test force symbol	Test force N	Maximum permissible error, expressed as a percentage of the specified hardness of the standardized block used								
		Hardness								
		50	100	150	200	250	300	350	400	450
HV 0,01	$98{,}07 \times 10^{-3}$	—	—	—	—	—	—	—	—	—
HV 0,02	0,196 1	8	—	—	—	—	—	—	—	—
HV 0,025	0,245 2	8	10	—	—	—	—	—	—	—
HV 0,05	0,490 3	6	8	9	10	—	—	—	—	—
HV 0,1	0,980 7	5	6	7	8	8	9	10	10	11

NOTES

1 Values are based on a maximum error of 1,0 µm or 2 % of the mean diagonal of indentation, whichever is the greater.

2 Values are not given when the indentation diagonal is less than 0,020 mm.

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

6 Verification report

The verification report shall contain the following information:

a) reference to this part of ISO 146;

b) identification data of the hardness testing machine;

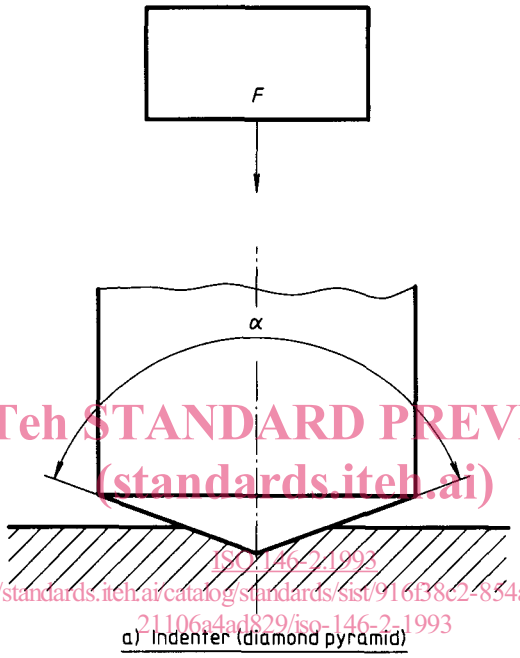
c) the result obtained;

d) date of verification and reference to the testing institution;

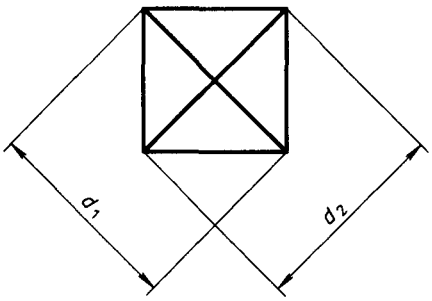
e) method of verification (direct or indirect);

f) test forces verified;

g) hardness values of standardized blocks used.



a) Indenter (diamond pyramid)



b) Vickers identation

Figure 1

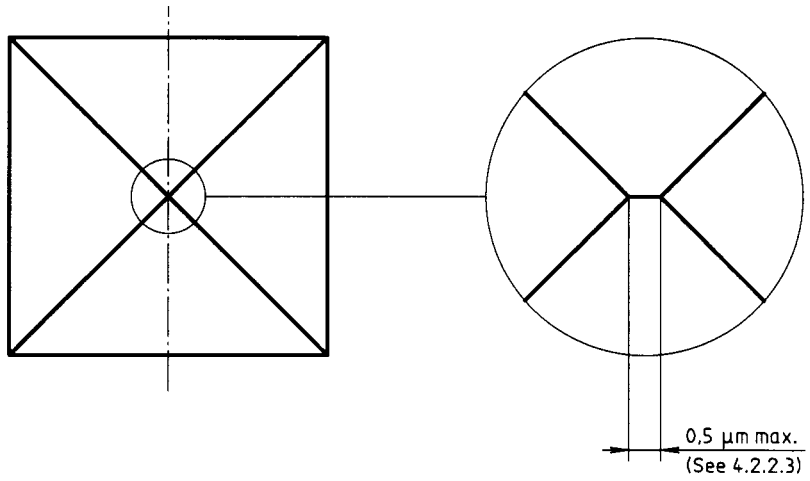


Figure 2

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Descriptors: metals, tests, hardness tests, Vickers hardness, test equipment, hardness testers, verification.

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