SLOVENSKI STANDARD
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Metallic materials -- Hardness test -- Vickers test -- Part 1: HV 5 to HV 100

Matériaux métalliques -- Essai de dureté -- Essai Vickers -- Partie 1: HV 5 à HV 100

Ta slovenski standard je istoveten z: **ISO 6507-1:1982**

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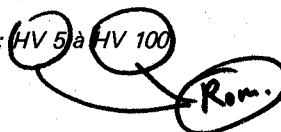
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International Standard ISO 6507/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Metallic materials — Hardness test — Vickers test — Part 1 : HV 5 to HV 100

Matériaux métalliques — Essai de dureté — Essai Vickers — Partie 1 : HV 5 à HV 100

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ISO 6507/1-1982 (E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6507/1 was developed by Technical Committee ISO/TC 164, *Mechanical testing of metals*, and was circulated to the member bodies in June 1981.

It has been approved by the member bodies of the following countries :

Australia	Hungary	Romania
Austria	India	South Africa, Rep. of
Brazil	Japan	Spain
Canada	Korea, Rep. of	Sweden
China	Mexico	Switzerland
Czechoslovakia	Netherlands	USA
Egypt, Arab Rep. of	Norway	USSR
France	Poland	
Germany, F. R.	Portugal	

The member body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

This International Standard cancels and replaces ISO Recommendations R 81-1967, R 192-1971 and R 399-1964, of which it constitutes a technical revision.

INTERNATIONAL STANDARD ISO 6507/1-1982 (E)

Metallic materials — Hardness test — Vickers test — Part 1 : HV 5 to HV 100

0 Introduction

Three types of Vickers hardness test exist, characterized by different ranges of test forces. See table 1.

NOTE — In general, decreasing test force increases the scatter of results of the measurements. This is particularly true for low load Vickers hardness tests and for Vickers microhardness tests.

1 Scope and field of application

This Part of ISO 6507 specifies the method of Vickers hardness test HV 5 to HV 100 (test forces from 49,03 to 980,7 N) for metallic materials.

For specific materials and/or products particular International Standards exist. (See clause 2.)

2 References

ISO 146, *Verification of Vickers hardness testing machines.*[1]

ISO 409/1, *Metallic materials — Hardness test — Tables of Vickers hardness values for use in tests made on flat surfaces — Part 1 : HV 5 to HV 100.*[2]

ISO 640, *Calibration of standardized blocks to be used for Vickers hardness testing machines.*[3]

ISO 3878, *Hardmetals — Vickers hardness test.*[4]

ISO 4498/1, *Sintered metal materials, excluding hardmetals — Determination of apparent hardness — Part 1 : Materials of essentially uniform section hardness.*

ISO 6507/2, *Metallic materials — Hardness test — Vickers test — Part 2 : HV 0,2 to less than HV 5.*[5]

ISO 6507/3, *Metallic materials — Hardness test — Vickers test — Part 3 : Less than HV 0,2.*[5]

3 Principle

Forcing a diamond indenter in the form of a right pyramid with a square base and with a specified angle between opposite faces at the vertex into the surface of a test piece and measuring the diagonals of the indentation left in the surface after removal of the test force, F. (See figure 1.)

The Vickers hardness is proportional to the quotient obtained by dividing the test force by the sloping area of the indentation which is assumed to be a right pyramid with a square base, and having at the vertex the same angle as the indenter.

Table 1

Designation	Hardness symbol	Test force, F N	Test method
Vickers hardness test	HV 5 to HV 100	49,03 to 980,7	ISO 6507/1
Low load Vickers hardness test	HV 0,2 to < HV 5	1,961 to < 49,03	ISO 6507/2
Vickers microhardness test	< HV 0,2	< 1,961	ISO 6507/3

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1) At present at the stage of draft. (Revision of ISO/R 146-1968.)

2) At present at the stage of draft. (Revision of ISO/R 409-1964.)

3) At present at the stage of draft. (Revision of ISO/R 640-1967.)

4) At present at the stage of draft. (Revision of ISO 3878-1978.)

5) At present at the stage of draft.

4 Symbols and designations

4.1 See table 2 and figures 1 and 2.

Table 2

Symbol	Designation
α	Angle between the opposite faces at the vertex of the pyramidal indenter (136°)
F	Test force, in newtons
d	Arithmetic mean, in millimetres, of the two diagonals d_1 and d_2
HV	Vickers hardness $= \text{Constant} \times \dfrac{\text{Test force}}{\text{Surface area of indentation}}$ $= 0{,}102 \dfrac{2 F \sin \frac{136°}{2}}{d^2} \approx 0{,}189\,1 \dfrac{F}{d^2}$

NOTE — Constant $= \dfrac{1}{g_n} = \dfrac{1}{9{,}806\,65} \approx 0{,}102$

4.2 The Vickers hardness is denoted by the symbol HV preceded by the hardness value and completed by :

a) a number representing the test force (see table 3);

b) the duration of loading, in seconds, if different from the time specified in 7.4.

Examples :

640 HV 30 = Vickers hardness of 640 determined with a test force of 294,2 N applied for 10 to 15 s.

640 HV 30/20 = Vickers hardness of 640 determined with a test force of 294,2 N applied for 20 s.

5 Apparatus

5.1 Testing machine, capable of applying a predetermined force or forces within the range of 49,03 to 980,7 N, in accordance with ISO 146.

5.2 Indenter, a diamond in the shape of a right pyramid with a square base, as specified in ISO 146.

5.3 Measuring device, as specified in ISO 146.

6 Test piece

6.1 The test shall be carried out on a surface which is smooth and even, free from oxide scale, foreign matter and, in particular, completely free from lubricants. The finish of the surface shall permit accurate determination of the diagonals of the indentation.

6.2 Preparation shall be carried out in such a way that any alteration of the surface hardness, due to heat or cold-working, for example, is minimized.

6.3 The thickness of the test piece or of the layer under test shall be at least 1,5 times the diagonal of the indentation. (See annex A.)

No deformation shall be visible at the back of the test piece after the test.

6.4 For tests on curved surfaces the corrections given in annex B, tables 4 to 9 shall be applied.

6.5 For test pieces of small cross-section or of irregular shape, it may be necessary to provide some form of additional support, for example mounting in plastics material.

7 Procedure

7.1 In general, the test is carried out at ambient temperature within the limits of 10 to 35 °C. Tests carried out under controlled conditions shall be made at a temperature of 23 ± 5 °C.

7.2 The following test forces shall be used.

Table 3

Hardness symbol	Test force F Nominal value
HV 5	49,03 N
HV 10	98,07 N
HV 20	196,1 N
HV 30	294,2 N
HV 50	490,3 N
HV 100	980,7 N

7.3 The test piece shall be placed on a rigid support. The contact surfaces shall be clean and free from foreign matter (scale, oil, dirt etc.). It is important that the test piece lies firmly on the support so that displacement cannot occur during the test.

7.4 Bring the indenter into contact with the test surface and apply the test force in a direction perpendicular to the surface, without shock or vibration, until the applied force attains the specified value. The time from the initial application of the force until the full test force is reached shall not be less than 2 s nor greater than 8 s. The duration of the test force shall be 10 to 15 s. For particular materials a longer time for maintaining the force is provided; this time shall be applied with a tolerance of ± 2 s.

7.5 Throughout the test, the apparatus shall be protected from shock or vibration.

7.6 The distance between the centre of any indentation and the edge of the test piece shall be at least 2,5 times the mean diagonal of the indentation in the case of steel, copper and copper alloys and at least three times the mean diagonal of the indentation in the case of light metals, lead and tin and their alloys.

The distance between the centres of two adjacent indentations shall be at least three times the mean diagonal of the indentation in the case of steel, copper and copper alloys, and at least six times the mean diagonal in the case of light metals, lead and tin and their alloys. If two adjacent indentations differ in size, the spacing shall be based on the mean diagonal of the larger indentation.

7.7 Measure the lengths of the two diagonals. The arithmetical mean of the two readings shall be taken for the calculation of the Vickers hardness.

7.8 Attention is drawn to ISO 409/1, which contains calculation tables for use in tests made on flat surfaces.

8 Test report

The test report shall include the following information :

a) reference to this Part of ISO 6507;

b) all details necessary for identification of the test sample;

c) the result obtained;

d) all operations not specified by this Part of ISO 6507, or regarded as optional;

e) details of any occurrence which may have affected the results.

NOTES

1 There is no general process of accurately converting Vickers hardness into other scales of hardness or into tensile strength. Such conversions therefore should be avoided, unless a reliable basis for conversion can be obtained by comparison tests.

2 It should be noted that for anisotropic materials, for example those which have been heavily cold-worked, there will be a difference between the lengths of the two diagonals of the indentation. Where possible, the indentation should be made so that the diagonals are inclined at approximately 45° to the direction of cold-working. The specification for the product may indicate limits for the differences between the two diagonals.

3 There is evidence that some materials may be sensitive to the rate of straining which causes small changes in the value of the yield stress. The corresponding effect on the termination of the formation of an indentation can make alterations in the hardness value.

4 A strict comparison of hardness values is only possible at identical test forces.
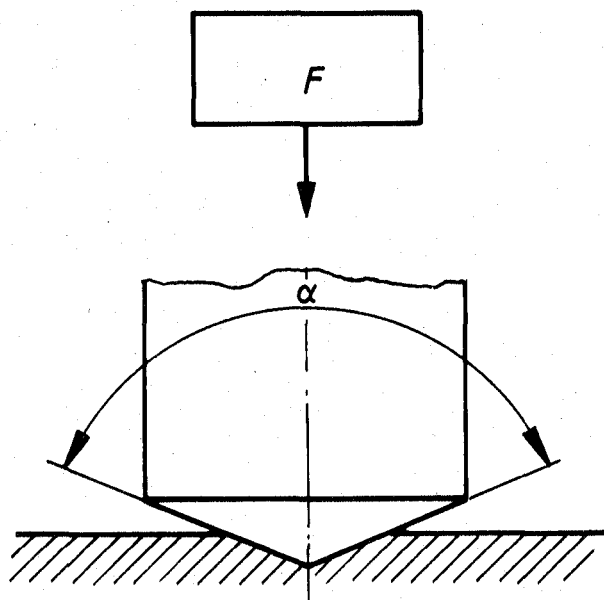
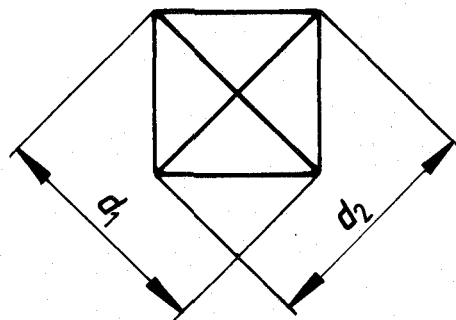Figure 1 — Indenter (diamond pyramid)

Figure 2 — Vickers indentation

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Annex A

Minimum thickness of the test piece in relation to the test force and to the hardness

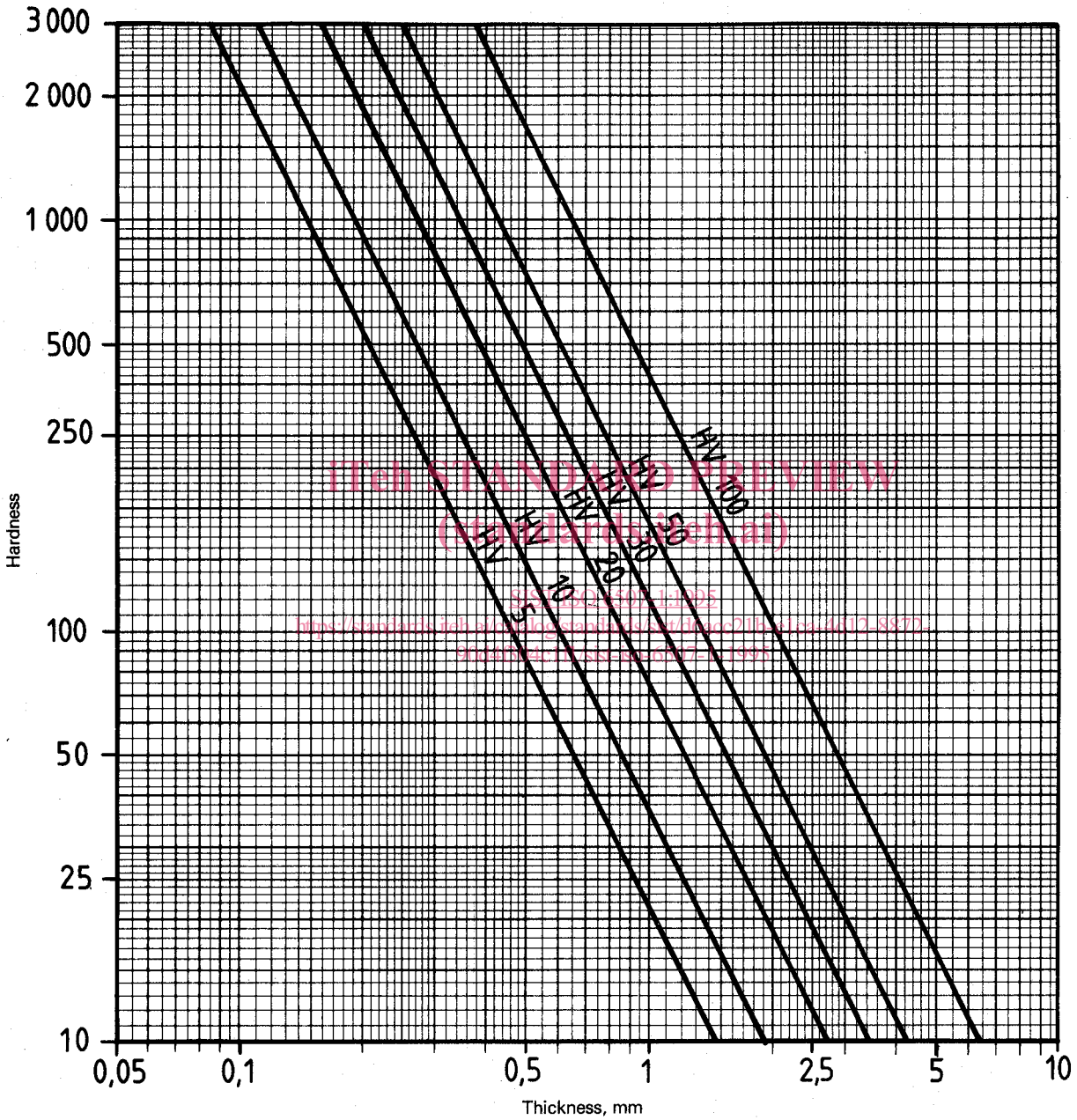
Figure 3 — Minimum thickness of the test piece in relation to the test force and to the hardness

Annex B

Tables of correction factors for use in tests made on curved surfaces

Tables 4 and 5 give the correction factors when tests are made on spherical surfaces.

The correction factors are tabulated in terms of the ratio of the mean diagonal d of the indentation to the diameter D of the sphere.

Example :

Convex sphere	$D = 10$ mm
Test force	$F = 98{,}07$ N
Mean diagonal of indentation	$d = 0{,}150$ mm

$$\frac{d}{D} = \frac{0{,}150}{10} = 0{,}015$$

Vickers hardness $= 0{,}189\,1 \times \dfrac{98{,}07}{(0{,}15)^2} \qquad = 824$ HV 10

Correction factor from table 4, by interpolation $\qquad = 0{,}983$

Hardness of sphere $\simeq 824 \times 0{,}983 \qquad = 810$ HV 10

Table 5 — Concave spherical surfaces

d/D	Correction factor	d/D	Correction factor
0,004	1,005	0,057	1,080
0,008	1,010	0,060	1,085
0,012	1,015	0,063	1,090
0,016	1,020	0,066	1,095
0,020	1,025	0,069	1,100
0,024	1,030	0,071	1,105
0,028	1,035	0,074	1,110
0,031	1,040	0,077	1,115
0,035	1,045	0,079	1,120
0,038	1,050	0,082	1,125
0,041	1,055	0,084	1,130
0,045	1,060	0,087	1,135
0,048	1,065	0,089	1,140
0,051	1,070	0,091	1,145
0,054	1,075	0,094	1,150

Tables 6 to 9 give the correction factors when tests are made on cylindrical surfaces.

The correction factors are tabulated in terms of the ratio of the mean diagonal d of the indentation to the diameter D of the cylinder.

Example :

Concave cylinder, one diagonal of the indentation parallel to axis	$D = 5$ mm
Test force	$F = 294{,}2$ N
Mean diagonal of indentation	$d = 0{,}415$ mm

$$\frac{d}{D} = \frac{0{,}415}{5} = 0{,}083$$

Vickers hardness $= 0{,}189\,1 \times \dfrac{294{,}2}{(0{,}415)^2} \qquad = 323$ HV 30

Correction factor from table 9 $\qquad = 1{,}075$

Hardness of cylinder $= 323 \times 1{,}075 \qquad = 347$ HV 30

Table 4 — Convex spherical surfaces

d/D	Correction factor	d/D	Correction factor
0,004	0,995	0,086	0,920
0,009	0,990	0,093	0,915
0,013	0,985	0,100	0,910
0,018	0,980	0,107	0,905
0,023	0,975	0,114	0,900
0,028	0,970	0,122	0,895
0,033	0,965	0,130	0,890
0,038	0,960	0,139	0,885
0,043	0,955	0,147	0,880
0,049	0,950	0,156	0,875
0,055	0,945	0,165	0,870
0,061	0,940	0,175	0,865
0,067	0,935	0,185	0,860
0,073	0,930	0,195	0,855
0,079	0,925	0,206	0,850