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Metallic materials — Vickers hardness test —

Part 2:
Verification and calibration of testing machines

Matériaux métalliques — Essai de dureté Vickers —

Partie 2: Vérification et étalonnage des machines d'essai

Reference number
ISO 6507-2:2005(E)

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Foreword

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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.

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*

INTERNATIONAL STANDARD **ISO 6507-2:2005(E)**

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.

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 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:

a) the plunger holding the indenter is capable of sliding in its guide;

b) the indenter-holder is firmly mounted in the plunger;

c) 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 ± 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.

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 ± 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 %
$F \geqslant 1{,}961$	± 1,0
$0{,}098\ 07 \leqslant F < 1{,}961$	± 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° ± 0,5° (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° ± 0,76°.

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°. 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).

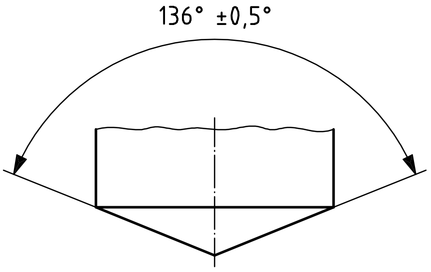
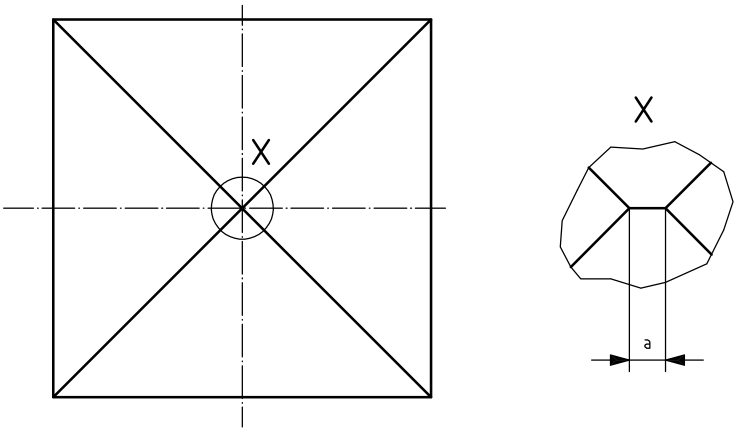


Figure 1 — Angle of the diamond pyramid



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
$F \geqslant 49{,}03$	0,002
$1{,}961 \leqslant F < 49{,}03$	0,001
$0{,}098\,07 \leqslant F < 1{,}961$	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
$d \leqslant 0{,}040$	0,000 2 mm	0,000 4 mm
$0{,}040 < d \leqslant 0{,}200$	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 V of the measuring system according to the following condition:

$V \times d \geqslant 14$ mm

For indentation diagonals $d < 0{,}035$ mm this condition may not be fulfilled, but the magnification should be at least × 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 ± 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 ± 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.

— $\leqslant$ 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

$$\bar{d} = \frac{d_1 + d_2 + d_3 + d_4 + d_5}{5} \tag{1}$$

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

$$r = d_5 - d_1 \tag{2}$$

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

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

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 [b]			
	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 [a]	6,0 [a]	9,0 [a]	100	6	100	12
				200	12	200	24
> 225 HV	2,0 [a]	4,0 [a]	5,0 [a]	250	10	250	20
				350	14	350	28
				600	24	600	48
				750	30	750	60

[a] or 0,001 mm, whichever is greater.

[b] HV: Vickers hardness.

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

$$E = \bar{H} - H_{\text{c}} \tag{4}$$

where

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

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:

$$E_{\text{rel}} = 100 \times \frac{\bar{H} - H_{\text{c}}}{H_{\text{c}}} \tag{6}$$

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	5	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.

Table 6

Requirements of verification	Force	Measuring device	Test cycle	Indenter [a]
Before setting to work first time	x	x	x	x
After dismantling and reassembling, if force, measuring system or test cycle are affected	x	x	x	
Failure of indirect verification [b]	x	x	x	
Indirect verification > 14 months ago	x	x	x	

[a] In addition, it is recommended that the indenter be directly verified after 2 years of use.

[b] Direct verification of these parameters may be carried out sequentially (until the machine passes indirect verification) and is not required if it can be demonstrated (e.g. by tests with a reference indenter) that the indenter was the cause of the failure.

7 Verification report/calibration certificate

The verification report/calibration certificate shall include the following information:

a) a reference to this part of ISO 6507;

b) method of verification (direct and/or indirect);

c) identification data of the hardness testing machine;

d) means of verification (reference blocks, elastic proving devices, etc);

e) test forces verified;

f) verification temperature;

g) the result obtained;

h) date of verification and reference to the verification institution;

i) uncertainty of the verification result.

Annex A
(informative)

Notes on diamond indenters

Experience has shown that a number of initially satisfactory indenters can become defective after use for a comparatively short time. This is due to small cracks, pits or other flaws in the surface. If such faults are detected in time, many indenters may be reclaimed by regrinding. If not, any small defects on the surface rapidly worsen and make the indenter useless.

Therefore,

- the condition of indenters should be monitored by visually checking the aspect of the indentation on a reference block, each day the testing machine is used;
- the verification of the indenter is no longer valid when the indenter shows defects;
- reground or otherwise repaired indenters shall be reverified.

Annex B
(informative)

Uncertainty of measurement of the calibration results of the hardness testing machine

The metrological chain necessary to define and disseminate hardness scales is shown in Figure D.1 in ISO 6507-1:2005.

B.1 Direct calibration of the hardness testing machine

B.1.1 Calibration of the test force

The combined relative standard uncertainty of the test force calibration is calculated according to the following equation:

$$u_{\mathrm{F}} = \sqrt{u_{\mathrm{FRS}}^2 + u_{\mathrm{FHTM}}^2} \tag{B.1}$$

where

u_{FRS} is the relative uncertainty of measurement of the force transducer (from calibration certificate);

u_{FHTM} is the relative standard uncertainty of the test force generated by the hardness testing machine.

The uncertainty of measurement of the reference instrument, force transducer, is indicated in the corresponding calibration certificate. The influence quantities, like

- temperature dependence,
- long-term stability, and
- interpolation deviation,

should be considered for critical applications. Depending on the design of the force transducer, the rotational position of the transducer related to the indenter axis of the hardness testing machine should be considered.

EXAMPLE

Uncertainty of measurement of the force transducer (from calibration certificate):	$U_{\mathrm{FRS}} = 0{,}12$ % ($k = 2$)
Calibration value of the force transducer	$F_{\mathrm{RS}} = 294{,}2$ N

Table B.1 — Results of the test force calibration

Number of height position for test force calibration	**Series 1** F_1, N	**Series 2** F_2, N	**Series 3** F_3, N	**Mean value** $\bar{F}$, N	**Relative deviation** ΔF_{rel}, %	**Relative standard measurement uncertainty** u_{FHTM}, %
1	294,7	294,9	294,5	294,7	0,17	0,04
2	293,9	294,5	294,6	294,3	0,03	0,07
3	293,1	294,0	293,7	293,6	0,20	0,09

where

$$\Delta F_{\text{rel}} = \frac{F_{\text{RS}} - \bar{F}}{\bar{F}} \tag{B.2}$$

$$u_{\text{FHTM}} = \frac{s_{\text{F}i}}{\bar{F}} \cdot \frac{1}{\sqrt{n}}, \ (n = 3) \tag{B.3}$$

$s_{\text{F}i}$ is the standard deviation of the test-force indication values in the i-th height position.

In Table B.2, the maximum value of u_{FHTM} from Table B.1 is used.

Table B.2 — Calculation of the uncertainty of measurement of the test force

Quantity X_i	**Estimated value** x_i	**Relative limit values** a_i	**Distribution type**	**Relative standard measurement uncertainty** $u(x_i)$	**Sensitivity coefficient** c_i	**Relative uncertainty contribution** $u_i\ (H)$
u_{FRS}	294,2 N		Normal	$6{,}0 \times 10^{-4}$	1	$6{,}0 \times 10^{-4}$
u_{FHTM}	0,06 N		Normal	$9{,}0 \times 10^{-4}$	1	$9{,}0 \times 10^{-4}$
Relative combined standard uncertainty $u(F)$						$1{,}08 \times 10^{-3}$
Relative expanded uncertainty of measurement $U(F)$ $(k = 2)$						$2{,}2 \times 10^{-3}$

Table B.3 — Calculation of the maximum relative deviation of the test force including the uncertainty of measurement of the reference instrument

Relative deviation of test force ΔF_{rel} %	**Expanded relative measurement uncertainty of test force** U_F %	**Max. relative deviation of test force including measurement uncertainty of reference instrument** ΔF_{max} %
0,20	0,22	0,42

where

$$\Delta F_{\text{max}} = |\Delta F_{\text{rel}}| + U_{\text{F}} \tag{B.4}$$

The result of the example means that the deviation of the test force, including the uncertainty of measurement of the reference instrument specified in 4.2 amounting to ± 1,0 % is complied with.

B.1.2 Calibration of the optical measuring system

The combined relative standard uncertainty of the reference instrument for the measuring system is calculated as follows:

$$u_L = \sqrt{u_{LRS}^2 + u_{ms}^2 + u_{LHTM}^2} \tag{B.5}$$

where

u_{LRS} is the relative uncertainty of measurement of the object micrometer (reference standard) from the calibration certificate for $k = 1$;

u_{ms} is the relative uncertainty of measurement due to the resolution of the measuring system;

u_{LHTM} is the relative standard uncertainty of measurement of the hardness testing machine.

The uncertainty of measurement of the reference instrument for the optical measuring system, the object micrometer, is indicated in the corresponding calibration certificate. The influence quantities, for example,

- temperature dependence,
- long-term stability, and
- interpolation deviation,

do not exert an essential influence on the uncertainty of measurement of the object micrometer.

EXAMPLE

Uncertainty of measurement of the object micrometer:	$U_{LRS} = 0{,}000\,5$ mm ($k = 2$)
Resolution of the measuring system	$\delta_{ms} = 0{,}1$ µm

Table B.4 — Results of the calibration of the measuring system

Indication value of the object micrometer L_{RS} mm	**Series 1** L_1 mm	**Series 2** L_2 mm	**Series 3** L_3 mm	**Mean value** $\bar{L}$ mm	**Relative deviation** ΔL_{rel} %	**Relative standard measurement uncertainty** u_{LHTM} %
0,05	0,050 0	0,050 0	0,050 1	0,050 1	0,07	0,07
0,10	0,100 2	0,100 0	0,100 1	0,100 1	0,10	0,06
0,20	0,200 1	0,199 9	0,200 1	0,200 0	0,02	0,03
0,30	0,299 7	0,300 1	0,300 1	0,300 0	− 0,01	0,04
0,40	0,400 2	0,400 1	0,400 3	0,400 2	0,05	0,01

where

$$u_{LHTM} = \frac{s_{Li}}{\bar{L}} \cdot \frac{1}{\sqrt{n}}, \ (n = 3) \tag{B.6}$$

$$\Delta L_{rel} = \frac{\bar{L} - L_{RS}}{L_{RS}} \tag{B.7}$$

$s_{\mathrm{L}i}$ is the standard deviation of the length indication values for the i-th indication value of the object micrometer.

Table B.5 — Calculation of the uncertainty of measurement of the measuring system

Quantity X_i	Estimated value x_i	Limit value a_i	Distribution type	Relative standard measurement uncertainty $u(x_i)$	Sensitivity coefficient c_i	Relative uncertainty contribution $u_i\ (H)$
u_{LRS}	0,40 mm	0,5 µm	Normal	$1{,}0 \times 10^{-4}$	1	$1{,}0 \times 10^{-4}$
u_{ms}	0 mm	0,1 µm	Rectangular	$0{,}7 \times 10^{-4}$	1	$0{,}7 \times 10^{-4}$
u_{LHTM}	0		Normal	$6{,}7 \times 10^{-4}$	1	$6{,}7 \times 10^{-4}$
Relative combined uncertainty of measurement u_{L}, % (related to $L_{\mathrm{RS}} = 0{,}4$ mm)						0,07
Relative expanded uncertainty of measurement U_{L} ($k = 2$), %						0,14

Table B.6 — Calculation of the maximum relative deviation of the measuring system including the uncertainty of measurement of the length reference instrument

Test length L_{RS}	Relative deviation of the measuring system ΔL_{rel} %	Expanded relative uncertainty of measurement U_{L} %	Max. relative deviation of measuring system incl. measurement uncertainty of length reference instrument ΔL_{max} %
0,40 mm	0,10	0,14	0,24

where

$$\Delta L_{\mathrm{max}} = |\Delta L_{\mathrm{rel}}| + U_{\mathrm{L}} \tag{B.8}$$

The result of the example means that the deviation of the measuring system, including the uncertainty of measurement of the length reference instrument specified in 4.4 amounting to ± 0,5 % is complied with.

B.1.3 Verification of the indenter

The indenter, consisting of indenter tip and holder, cannot be verified, respectively calibrated, in-site. A valid calibration certificate of an accredited calibration laboratory shall exist which confirms the geometrical deviations of the indenter (see 4.3).

B.1.4 Verification of the test cycle

In 4.5, the permissible deviation for every section of the test cycle is stipulated as ± 0,5 s. While measuring with a usual time measuring system (stopwatch), the uncertainty of measurement can be indicated as 0,1 s. Therefore, an estimation of the uncertainty of measurement is not necessary.

B.2 Indirect verification of the hardness testing machine

By indirect verification with hardness reference blocks, the overall function of the hardness testing machine is checked and the repeatability, as well as the deviation of the hardness testing machine from the real hardness value, are determined.

The uncertainty of measurement of the indirect verification of the hardness testing machine follows from the equation:

$$u_{\mathrm{HTM}} = \sqrt{u_{\mathrm{CRM}}^2 + u_{\mathrm{CRM-D}}^2 + u_{\mathrm{H}}^2 + u_{\mathrm{ms}}^2} \quad \text{(B.9)}$$

where

u_{CRM} is the calibration uncertainty of the hardness reference block according to the calibration certificate for $k = 1$;

$u_{\mathrm{CRM-D}}$ is the hardness change of the hardness reference block since its last calibration due to drift (negligible for use of the hardness reference block complying with the standard);

u_{H} is the standard uncertainty of hardness testing machine when measuring CRM;

u_{ms} is the uncertainty due to the resolution of the hardness testing machine.

EXAMPLE

Hardness of the hardness reference block	H_{CRM} = (400,0 ± 5,0) HV30
Uncertainty of measurement of the hardness reference block	U_{CRM} = ± 5,0 HV30
Resolution of the hardness testing machine	δ_{ms} = 0,1 µm

Table B.7 — Results of the indirect verification

No.	Measured indentation diagonal d, mm	Calculated hardness value H, HV [a]
1	0,371 6_{min}	$402{,}9_{\mathrm{max}}$
2	0,372 4	401,1
3	0,372 8_{max}	$400{,}3_{\mathrm{min}}$
4	0,371 9	402,2
5	0,372 2	401,5
Mean value $\bar{H}$	0,372 2	401,6
Standard deviation s_{H}		0,99

[a] HV: Vickers hardness.

$$\bar{b} = \bar{H} - H_{\mathrm{CRM}}$$
$$\bar{b} = 401{,}6 - 400{,}0 = 1{,}6 \text{ HV} \quad \text{(B.10)}$$

$$u_{\mathrm{H}} = \frac{t \cdot s_{\mathrm{H}}}{\sqrt{n}} \quad \text{(B.11)}$$

For $t = 1{,}15$, $n = 5$ and $s_{\mathrm{H}} = 0{,}99$ HV follows:

$u_{\mathrm{H}} = 0{,}51$ HV

B.3 Budget of uncertainty of measurement

Table B.8 — Budget of uncertainty of measurement

Quantity X_i	Estimated value x_i	Standard uncertainty of measurement $u(x_i)$	Distribution type	Sensitivity coefficient c_i	Uncertainty contribution $u_i(H)$
u_{CRM}	400 HV [b]	2,50 HV	Normal	1,0	2,50 HV
u_{H}	0 HV	0,51 HV	Normal	1,0	0,51 HV
u_{ms}	0 HV	0,000 03 mm	Rectangular	2 145,1 [a]	0,06 HV
$u_{\mathrm{CMR\text{-}D}}$	0 HV	0 HV	Triangular	1,0	0 HV
Combined uncertainty of measurement u_{HTM}					2,55 HV
Expanded uncertainty of measurement U_{HTM} ($k = 2$)					5,1 HV

[a] $c = \partial H/\partial d = 2(H/d)$ for $H = 400$ HV30 and $d = 0{,}372\,9$ mm.

[b] HV: Vickers hardness.

Table B.9 — Maximum deviation of the hardness testing machine including the uncertainty of measurement

Measured hardness on the hardness testing machine H	Expanded uncertainty of measurement U_{HTM}	Deviation of the testing machine when calibrating with the reference block $\left\|\bar{b}\right\|$	Maximum deviation of the testing machine including uncertainty of measurement $\Delta H_{\mathrm{HTMmax}}$
HV	HV	HV	HV
401,6 HV30	5,1	1,6	6,7

HV: Vickers hardness.

where

$$\bar{b} = \bar{H} - H_{\mathrm{CRM}} \qquad \text{(B.12)}$$

$$\Delta H_{\mathrm{HTMmax}} = U_{\mathrm{HTM}} + \left|\bar{b}\right| = 5{,}1 + 1{,}6 = 6{,}7 \text{ HV}$$

The result of the example above means that the permissible limit deviation of the testing machine, including the uncertainty of measurement of the testing machine specified in Clause 5 amounting to ± 2 % ($\Delta H_{\mathrm{HTMmax}}/H = 1{,}7$ %), is complied with.

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