INTERNATIONAL

RECOMMENDATION

OIML R 10

Edition 1974 (E)

Verification and calibration of ‘Vickers’ hardness standardized blocks

(intended for the calibration of Vickers system testing machines for the hardness of materials)

Vérification et étalonnage des blocs de référence de dureté ‘Vickers’

(destinés au tarage des machines d'essai dans le système Vickers de la dureté des matériaux)

OIML R 10 Edition 1974 (E)

ORGANISATION INTERNATIONALE DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY

Foreword

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* *Note*: This publication is now under the responsibility of TC 10/SC 5 "*Hardness standardized blocks and hardness testing machines*".

VERIFICATION AND CALIBRATION OF 'VICKERS' HARDNESS STANDARDIZED BLOCKS

FIELD OF APPLICATION

The present specifications apply to the verification and calibration of "hardness standardized blocks" intended for the calibration of 'Vickers' system testing machines for the hardness of materials.*

CHAPTER A

CONSTRUCTION REQUIREMENTS

1 Materials

1.1 The standardized blocks must be made of a material of which the homogeneity and the stability over a period of time (ageing) are known; if this material is ferro-magnetic, the blocks must be demagnetised.

2 Form

2.1. The blocks must have two plane parallel surfaces, one of which will be used as a test surface and the other as a supporting surface.

2.2. They must be at least 6 millimetres thick.

2.2.1. The parallelism of the two surfaces roust be such that the thickness of the block does not vary by more than 0.010 mm per 50 mm of length in all directions,

errors in the flatness of each surface must not exceed 0.005 mm,

the roughness of the test surface must not exceed R_a = 0.1 µm

These conditions are not compulsory within a 1 mm margin around the edge of the block.

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* Note: The present Recommendation in no way prejudges decisions to be made about legal units of measurement for forces and for their application in the different "hardness systems".

At present, these systems use : the kilogram-force or its equivalent the kilopond, 1 kilogram-force (kgf) = 1 kilopond = 9.80665 newtons (N).

Translator's Note: The SI derived unit, with special name, for force is the newton (symbol N) (equivalent in terms of SI base units to $m.kg.s^{-2}$). The units kilogram-force and kilopond are from the "technical metric system".

2.3. The supporting surface must have a fine ground finish.

2.4. The test surface must not be spoiled by any deterioration or defect likely to affect the measurement of the indentations.

3 Markings

3.1 On one of the side surfaces of each standardized block the manufacturer must indicate:

3.1.1 his name or his mark,

3.1.2 the manufacturing number,

3.1.3 the initials HV - indicating that it is a Vickers hardness standardized block - followed by: the value of the test force* and the value in seconds of the duration of application of this force.

A free space must be reserved in front of the initials HV for a 4-digit number for inserting the hardness index determined during calibration.

3.1.4. The above markings must be applied in such a way that the test surface is on top when the letters are vertical and in normal reading position.

Note: one of the side surfaces must have a free space for the application of the verification stamp.

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* In authorized units of force: at the present tirne: kilogram-force or kilopond.

eg HV 30/30 = test force of 30 kgf applied for 30 seconds.

CHAPTER B

HARDNESS CHARACTERISTICS

4 Hardness index

4.1. The HV hardness index of a block is defined as the arithmetic mean value of 5 or 10 indentations carried out with a standard Vickers system testing machine, and uniformly distributed over the whole test surface.

4.1.1. Determination of this index will be carried out while maintaining the test conditions – the value of the ***test force and the duration of application of this force – indicated on the block (Paragraph 3.1.3)*.

5 Repeatability of hardness

5.1. The repeatability of hardness is defined as the value expressed in mm of the difference between the mean of the diagonals of the largest and the mean of the diagonals of the smallest of the 5 or 10 indentations.**

5.2. The relative repeatability of hardness is defined as the ratio, expressed in %, of the above defined value which indicates the repeatability of hardness to the value expressed in mm of the arithmetic mean of the means of the diagonals of the 5 or 10 indentations.

5.2.1. The relative repeatability must not exceed,
for 10 indentations:
2% for an index below 225,
1% for an index between 225 and 400,
1.5% for an index above 400,
for 5 indentations:
10/15ths of the above values.

6 Stability of hardness

6.1. The stability over a period of time of the hardness of the block must be such that, during the 2 year period between two successive periodic verifications, the hardness index of the block does not vary by more than :

when determined by 10 indentations :

for an index below 225..... ± 2 %

for an index between 225 and 400..... ± l %

for an index above 400.....… ± 1.5 %

when determined by 5 indentations :

10/15ths respectively of the above values,

with respect to the initial index determined at the first calibration.

In all other cases, the stability is inadequate.

(*) In general the HV hardness index of a standardized block is determined for a test load of 30 kgf applied for 30 s: it can be determined under other conditions, and the load must then be between 5 and 100 kgf.

(**) The repeatability of hardness is determined for a load of 30 kgf applied for 30 seconds.

(***) *Translator's Note*: The ‘test force’ is referred to as the ‘load’ in ISO Recommendation R.640 -1968.

CHAPTER C

INSTRUCTIONS ON CALIBRATION

7 Calibration

7.1. The calibration of hardness standardized blocks must be carried out with a standard testing machine in which the test force, the form of the indenter and the device for measuring the indentations can be checked by direct measurements.

7.2. The test force must be applied by means of weights, the mass of which is adjusted according to the value of the force,

it must be accurate to within ± 0.1 %.

7.3. The force must be applied and withdrawn without shock.

The mechanism controlling the application of the force must have either :

(a) a device for reducing the speed of penetration, or

(b) a regulating device for keeping the speed of penetration constant.

In machines of the first type, the initial speed of the indenter, before it penetrates the block, must not exceed 1 mm/s,

in machines of the second type, the speed of penetration must be between 0.003 and 0.012 mm/s.

7.4. The microscope or the projector of the device intended to measure the indentations must be adjusted in such a way as to produce uniform~illumination of the entire field of vision, as well as maximum contrast between the indentation and the surface of the test surface.

The length of the scale division must be such that it can be easily subdivided to make readings of at least 0.0002 mm,

each scale division must be accurate to at least ± 0.0005 mm.

7.5. The indenter must be a diamond, in the shape of a right pyramid with a square base ; the angle formed by the opposite surfaces of the pyramid must be 136° ± 0.1°;

the angle formed by each of the four surfaces and the axis of the indenter must be 68° ± 0.3°; each cross-section perpendicular to the axis must be a square with angles equal to 90° ± 0.2°;

if the four surfaces do not meet at the same point, the line joining the opposite surfaces must not be longer than 0.0005 mm ;

the flatness of each surface must be such that it does not vary by more than ± 0.0002 mm.

The surface must be highly polished and have no faults nor cracks.

7.5.1. The axis of the pyramid must coincide with the axis of the indenter mounting to within 0.3°.

8 Making the measurement

8.1. The tests are carried out at a temperature of (20 ± 2) °C in temperate climates and (27 ± 2) °C in tropical climates.

8.2. It is recommended that each indentation should be measured by at least two observers (and the mean of the results should be taken).

CHAPTER D

LIABILITY TO METROLOGICAL CONTROLS

9 Metrological controls

When, in any country, hardness standardized blocks are submitted to State metrological controls these must include, according to the internal legislation of that country, all or some of the following :

9.1. Pattern approval

Each pattern of hardness standardized block from each manufacturer will be subject to the pattern approval procedure.

Without special authorization no modificatian may be made to an approved pattern.

9.2. Initial verification and calibration

New hardness standardized blocks must undergo the initial verification tests at the time when their hardness index is determined by calibration.

9.3. Periodic verifications

During these it will be ascertained whether the standardized blocks have retained their specified properties.

9.4. The control procedures will be fixed by the national regulations of each country.

10 Marking the hardness index

10.1. The hardness index determined during calibration will be marked by the verification and calibration Service in the free space provided in front of the initials HV marked on one of the side surfaces (Paragraph 3.1.3).

11 Control mark

11.1. A control mark as proof of verification and calibration will be applied in the appropriate - free space on one of the side surfaces (see note on Page 5).

11.2. A guarantee mark will also be applied on the test surface in such a position that it does not interfere with the use of the block but will indicate that the surface has not been ground subsequently.

CHAPTER E

USE AND STORAGE

12 Use

Only the test surface may be used for indentations.

13 Storage

The standardized blocks must be carefully stored and protected against any damage or deterioration, both of the test surface and of the supporting surface.

ANNEX

Example of repeatability requirement

(See Chapter B)

Arithmetic mean of the means of the diagonals of the indentations mm	Hardness index of the standardized block HV 30/30 (*)	Repeatability requirement	
		Maximum difference between the means of the diagonals mm	Hardness equivalence HV 30/30
0.746	100	0.0149 (2%)	4
0.527	200	0.0105	8
0.472	250	0.0047 (1%)	5
0.398	350	0.0040	7
0.304	600	0.0046 (1.5%)	18
0.272	750	0.0041	23

(*) $HV = 2\,F \sin 68° / \bar{d}^2$

$\bar{d}$ = arithmetic mean, expressed in mm, of the means of the diagonals, of 5 or 10 indentations.

F = test load applied for a specified time (in this case 30 kgf applied for 30 s).

The indentations are made with a diamond indenter in the shape of a rectangular pyramid with an apex angle of 136°.

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