UDC 669.14 Ref. No.: ISO/R 640 - 1967 (E)

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 640

CALIBRATION OF STANDARDIZED BLOCKS TO BE USED FOR VICKERS HARDNESS TESTING MACHINES

1st EDITION
November 1967

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations

BRIEF HISTORY

The ISO Recommendation R 640, *Calibration of Standardized Blocks to be Used for Vickers Hardness Testing Machines*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1961 and led, in 1965, to the adoption of a Draft ISO Recommendation.

In February 1966, this Draft ISO Recommendation (No. 923) which superseded Draft ISO Recommendation No. 524, was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Argentina	Hungary	Republic of South Africa
Australia	India	Romania
Austria	Israel	Spain
Belgium	Italy	Sweden
Canada	Japan	Turkey
Chile	Korea, Rep. of	U.A.R.
Czechoslovakia	Mexico	United Kingdom
Denmark	Netherlands	U.S.A.
Finland	New Zealand	U.S.S.R.
France	Norway	Yugoslavia
Germany	Poland	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1967, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 640 November 1967

CALIBRATION OF STANDARDIZED BLOCKS TO BE USED FOR VICKERS HARDNESS TESTING MACHINES

1. SCOPE

This ISO Recommendation applies to the calibration of standardized blocks for the indirect verification of hardness testing machines as described in ISO Recommendation R 146,* *Verification of Vickers Hardness Testing Machines*. It does not necessarily apply to the calibration of test blocks which are used in the routine checking of the testing machine by the user, but it is not intended to preclude the use of blocks calibrated in accordance with this ISO Recommendation for the routine checking of a machine.**

2. MANUFACTURE

2.1 Each metal block to be standardized should be of a thickness not less than 6 mm (1/4 in).

2.2 The block should be especially prepared and the attention of the manufacturer is drawn to the need to use a manufacturing process which will give the necessary homogeneity, stability of structure and uniformity of surface hardness. It is recommended that the fineness and regularity of grain and the uniformity of the metallurgical structure be verified by microscopical examination. A microscopical examination may also be made by the standardizing authority.

2.3 The standardized blocks should not be magnetized. It is recommended that the manufacturer should ensure that the blocks, if of steel, have been demagnetized.

2.4 The upper and lower surfaces of the standardized block should be flat within 0.005 mm and the parallelism of the block should be such that the thickness does not vary by more than 0.010 mm per 50 mm.

2.5 The lower surface of the standardized block should have a fine ground finish.

2.6 The test surface (upper surface) should be highly polished and its surface roughness should not exceed 0.0001 mm (centre line average). It should also be free from scratches which interfere with the measurement of the indentations.

2.7 To permit checking that no material is subsequently removed from the standardized block, its thickness at the time of standardization should be marked on it to the nearest 0.01 mm (0.0004 in), or an official mark should be made on the test surface (see section 13).

---

* 2nd edition, at present Draft ISO Recommendation No. 922.

** Test blocks that are used in routine checking of the testing machine may be calibrated, using the load duration specified in clause 4.2 of ISO Recommendation R 81 (2nd edition - 1967), *Vickers Hardness Test for Steel (Load 5 to 100 kgf)*.

3. STANDARDIZING PROCEDURE

The standardized blocks should be calibrated in a standardizing machine complying with the requirements of sections 4 to 8 at a temperature of 20 ± 2 °C in temperate climates and 27 ± 2 °C in tropical climates using the general procedure described in ISO Recommendation R 81, (2nd edition - 1967) *Vickers Hardness Test for Steel (Load 5 to 100 kgf)*.

4. STANDARDIZING MACHINE

The standardizing machine is one in which the load applied, the form of the indenter and the measuring device can be verified by fundamental measurement. The load should be applied by means of weights giving correct values of force.

5. LOADS

The loads should be correct within ± 0.1 %.

6. FORM OF INDENTER

6.1 The four faces of the diamond pyramid at the tip of the indenter should be highly polished, free from flaws, and flat within 0.0002 mm.

The angle between opposite faces of the diamond pyramid should be 136 ± 0.1°.

The angle between the four faces of the pyramid and the axis of the indenter should be 68 ± 0.3°.

6.2 The point of the diamond should be examined in a high power microscope or preferably in an interference microscope and, if the four faces do not meet in a point, the line of junction between opposite faces should be less than 0.0005 mm.

6.3 It should be verified that the quadrilateral which would be formed by the intersection of the faces with a plane perpendicular to the axis of the indenter has angles of 90 ± 0.2°.

7. APPLICATION OF LOAD

7.1 The load should be applied and removed without shock.

NOTE. — External vibrations may affect the results of the calibration.

7.2 The mechanism which controls the application of the load should

(*a*) either employ a device, e.g. a spring, to reduce the velocity of penetration of the indenter during the period of penetration,

(*b*) or employ a device to maintain a constant velocity of penetration during the formation of the indentation.

7.3 In standard machines of the type mentioned in clause 7.2 (*a*), the "initial velocity" (i.e. the velocity of the indenter prior to penetration of the test block) should be not greater than 1 mm/s. In machines of the type mentioned in clause 7.2 (*b*), the velocity of penetration should be not less than 0.003 mm/s and not greater than 0.012 mm/s.

NOTE. — When making an indentation, the load-applying mechanism becomes clear of the load before the indenter has come to rest, so that the last stage in the indenting process is under the control of the load and the standardized block alone. It has been established experimentally that the size of the indentation, and therefore the hardness value obtained, is dependent upon the velocity of penetration and that variable hardness values are obtained if excessively slow velocities of penetration are used.

8. DURATION OF APPLICATION OF FULL LOAD

The full load should be applied for 30 to 35 seconds.

9. NUMBER OF INDENTATIONS

On each block either five or ten indentations should be made randomly distributed over the entire test surface.

10. MEASUREMENT OF THE DIMENSIONS OF THE INDENTATIONS

10.1 The illuminating system of the measuring microscope should be adjusted to give uniform intensity over the field of view and maximum contrast between the indentation and the undisturbed surface of the block.

10.2 The intervals between graduation lines of the measuring microscope should be easily subdivisible so that readings to 0.0002 mm at least can be made.

10.3 The scale of the microscope should be checked by a stage micrometer or by other suitable means. The calibration is on the difference between readings corresponding to any two graduation lines of the instrument. The difference should not exceed ± 0.0005 mm.

10.4 It is recommended that each indentation should be measured by at least two observers.

11. REPEATABILITY

Let $d_1, d_2, \ldots . d_n$ be the values of the mean measured diagonals, arranged in increasing order of magnitude.

The repeatability of the block is expressed by the following quantities:

(1) $d_n - d_1$ if $n = 10$, i.e. if 10 indentations have been made in the standardized block (see section 9);

(2) $1.5\,(d_n - d_1)$ if $n = 5$, i.e. if 5 indentations have been made in the standardized block (see section 9).

12. UNIFORMITY OF HARDNESS

12.1 The test for uniformity of hardness should be carried out with the standard load of 30 kgf specified in clause 4.8 of ISO Recommendation R 81 (2nd edition - 1967).

The standardized block should have a hardness sufficiently uniform for the purpose of verifying hardness testing machines (see examples given in the Appendix).

12.2 The uniformity of the hardness of the standardized block is not considered satisfactory unless it satisfies the following conditions:

Hardness of blocks HV	Maximum permissible repeatability
less than 225	$\frac{2}{100}\,\bar{d}$
from 225 to 400	$\frac{1}{100}\,\bar{d}$
more than 400	$\frac{1.5}{100}\,\bar{d}$

where $\bar{d} = \dfrac{d_1 + d_2 + \ldots\ldots d_n}{n}$

12.3 The hardness value assigned to the standardized block is the average of the values obtained when testing the uniformity of the standardized block and it should be marked on the block. The hardness value of the block may also be determined by the standardizing authority by using 5 or 10 indentations at any or all the loads of 5, 10 and 100 kgf and the average values obtained marked on it.

13. MARKING

13.1 Each standardized block should be marked with the following:

(*a*) The arithmetic mean of the hardness values found in the standardizing tests, e.g. 640 HV 30/30 (see ISO Recommendation R 81 (2nd edition - 1967), *Vickers Hardness Test for Steel (Load 5 to 100 kgf)*),

(*b*) The name or mark of the supplier,

(*c*) The serial number,

(*d*) The name or mark of the standardizing authority,

(*e*) The thickness of the standardized block or an official mark on the test surface,

(*f*) The symbol of the hardness.

13.2 At least one of the marks, or a special mark, should be on the test surface. Alternatively, the marking may be on the side of the standardized block, the marking being upright when the test surface is the upper face.