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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 192

LIGHT METALS AND THEIR ALLOYS

VICKERS HARDNESS TEST

(TEST LOADS FROM 1 TO 100 kgf)

2nd EDITION

October 1971

This second edition supersedes the first edition

Printed in Switzerland

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

BRIEF HISTORY

The ISO Recommendation R 192, *Vickers hardness test for light metals and their alloys*, was drawn up by Technical Committee ISO/TC 79, *Light metals and their alloys*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question led to the adoption of Draft ISO Recommendation No. 265, which was circulated to all the ISO Member Bodies for enquiry in December 1958. It was approved by 24 Member Bodies. One Member Body opposed the approval of the Draft (Romania).

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

BRIEF HISTORY RELATING TO THE 2nd EDITION

Work on the revision of ISO Recommendation R 192-1961 began in 1966 and led to the adoption of Draft ISO Recommendation No. 2086. In July 1970, this Draft ISO Recommendation was submitted to all ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Belgium	Iran	Romania
Canada	Ireland	South Africa, Rep. of
Czechoslovakia	Israel	Spain
Denmark	Japan	Sweden
Finland	Korea, Rep. of	Switzerland
France	Netherlands	Thailand
Germany	New Zealand	U.A.R.
Greece	Norway	United Kingdom
Hungary	Poland	U.S.A.
India	Portugal	U.S.S.R.

No Member Body opposed the approval of the Draft.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as the second edition of ISO Recommendation R 192. The title of that Recommendation has been modified to read as follows : *Light metals and their alloys – Vickers hardness test (Test loads from 1 to 100 kgf).*

This edition (second edition) supersedes the first edition of ISO Recommendation R 192-1961.

ISO Recommendation R 192 October 1971

LIGHT METALS AND THEIR ALLOYS

VICKERS HARDNESS TEST

(TEST LOADS FROM 1 TO 100 kgf)

1. SCOPE

This ISO Recommendation describes the Vickers hardness testing of light metals and their alloys with test loads from 1 to 100 kgf.

2. PRINCIPLE

The test consists in forcing an indenter, in the form of a right pyramid with a square base and specified angle α between opposite faces at the vertex, under a load F, into the metal, and measuring the diagonal d of the indentation left in the surface after removal of the load.

The Vickers hardness, HV, is the quotient obtained by dividing the test load F (expressed in kilogrammes-force) by the sloping area (expressed in square millimetres) of the indentation, considered as a right pyramid with a square base, of diagonal d, and having at the vertex the same angle as the indenter.

3. SYMBOLS AND DESIGNATIONS

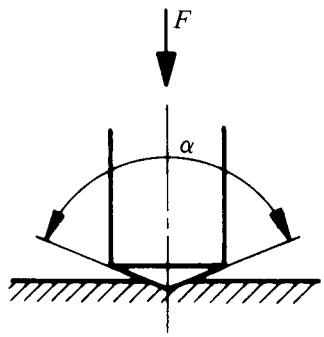

FIGURE 1

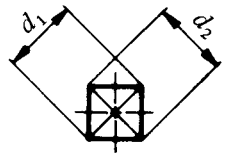

FIGURE 2

Symbol	Designation
α	Angle between opposite faces at the vertex of the pyramidal indenter = 136 ± 0.5°
F	Test load, in kilogrammes-force
d	Arithmetic mean of the two diagonals, d_1 and d_2, in millimetres
HV	Vickers hardness = $\frac{\text{Test load}}{\text{Area of indentation}} = \frac{2F \sin \frac{136^\circ}{2}}{d^2} = 1.854 \frac{F}{d^2}$ (approx.)

NOTE. – The symbol HV is supplemented by an index indicating the load and a further index indicating the duration of loading, when the latter differs from 10 to 15 seconds, which is the normal time of application.

Examples

HV10 = Vickers hardness, measured under a load of 10 kgf, applied for 10 to 15 seconds.

HV10/20 = Vickers hardness, measured under a load of 10 kgf, applied for 20 seconds.

4. INDENTER

The indenter consists of a diamond in the form of a right pyramid with a square base (see Figure 1). The angle at the vertex between opposite faces of the indenter should be 136 ± 0.5°.

4.1 All four faces of the indenter should be equally inclined to the axis of the indenter (within 0.5°) and meet in a point, i.e. any line of junction between opposite faces should be less than 0.002 mm in length. A common form of point, when examined under high magnification, is shown in Figure 3. The limiting length of 0.002 mm is shown in the same Figure.

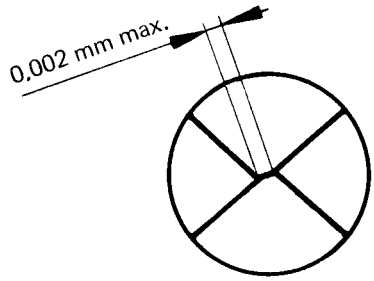

FIGURE 3

4.2 The indenter should be well polished and free from cracks or other surface defects.

5. TEST REQUIREMENTS

5.1 The test should be carried out at ambient temperature, unless otherwise specified. Throughout the test, the apparatus should be protected from shock or vibration.

5.2 The indenter, when normal to and in contact with the surface to be tested, should be forced, without shock or vibration, into this surface until the applied load attains the specified value. This load should be maintained for 10 to 15 seconds.

5.3 The test should be carried out on a test surface which is sufficiently smooth and even to permit the accurate determination of the diagonal of the indentation. This surface should be free from foreign matter. Care should be taken in preparing the surface to avoid any prejudicial change in condition, for example, due to heating or cold-working. The finish of the surface must be such that the accuracy of measurement detailed in clause 5.9 may be obtained.

5.4 For tests on curved surfaces the hardness values should be corrected by the use of the appropriate factors (see Note 1).

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

5.6 The thickness of the test piece or of the layer under test should be at least 1.5 times the diagonal of the indentation. No deformation should be visible at the back of the test piece after the test.

5.7 The distance from the centre of any indentation to the edge of the test piece or the edge of any other indentation should be not less than 2.5 times the diagonal of the indentation.

5.8 The standard test load is 10 kgf. It is possible to use larger or smaller loads, provided that the loads are within the range of 1 to 100 kgf. The tolerance on the test load should be ± 1 %.

5.9 The lengths of the two diagonals of the indentation should be measured. The arithmetic mean of the lengths of the two diagonals should be used for the calculation of the Vickers hardness. The measuring microscope or other measuring device should be capable of reading the length of the diagonal to an accuracy of ± 0.001 mm for a diagonal of less than 0.2 mm, and to an accuracy of ± 0.5 % of the diagonal for a diagonal of 0.2 mm and over.

5.10 The satisfactory condition of the indenter should be verified frequently. Any irregularities in the shape of the indentation may indicate poor condition of the indenter. If the examination of the indenter confirms this, then the test should be rejected.

NOTES

1. Attention is drawn to ISO Recommendation R 409, *Tables of Vickers hardness values (HV) for metallic materials*, which contains tables for loads of 1 – 2.5 – 3 – 5 – 10 – 20 – 30 – 50 and 100 kgf for use in tests made on flat surfaces, and includes tables of correction factors for use in tests made on spherical or cylindrical, convex and concave surfaces.

2. There is no general process for converting accurately Vickers hardness into other scales of hardness or tensile strength. These conversions therefore should be avoided, except for special cases where a reliable basis for the conversion has been obtained by comparison tests. Even in such cases, the relation between Vickers hardness and tensile strength or other scales of hardness is only indicative.

3. It should be noted that for anisotropic materials, such as those which have been heavily cold-worked, there may be a difference between the lengths of the two diagonals of the indentation.

4. For the verification of Vickers hardness testing machines and the calibration of standardized blocks, see ISO Recommendations R 146, *Verification of Vickers hardness testing machines*, and R 640, *Calibration of standardized blocks to be used for Vickers hardness testing machines.*