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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 403

iTeh STANDARD PREVIEW
BRINELL HARDNESS TEST
(standards.iteh.ai)
FOR COPPER AND COPPER ALLOYS

ISO/R 403:1964

<https://standards.iteh.ai/catalog/standards/sist/7eab34e6-00cd-4f93-9987-29df822e4ee/iso-r-403-1964>

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BRIEF HISTORY

The ISO Recommendation R 403, *Brinell Hardness Test for Copper and Copper Alloys*, was drawn up by Technical Committee ISO/TC 26, *Copper and Copper Alloys*, the Secretariat of which is held by the Deutscher Normenausschuss (DNA).

Work on this question by the Technical Committee began in 1958 and led, in 1961, to the adoption of a Draft ISO Recommendation.

In February 1962, this Draft ISO Recommendation (No. 501) was circulated to all the ISO Member Bodies for enquiry. It was approved by the following Member Bodies:

Australia	Germany	Republic of South Africa
Bulgaria	India	Spain
Burma	Italy	Sweden
Canada	Japan	Switzerland
Denmark	Netherlands	Turkey
Finland	Poland	United Kingdom
France	Portugal	Yugoslavia

Three Member Bodies opposed the approval of the Draft:

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Belgium

U.S.A.

U.S.S.R.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1964, to accept it as an ISO RECOMMENDATION.

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BRINELL HARDNESS TEST FOR COPPER AND COPPER ALLOYS

1. PRINCIPLE OF TEST

The test consists in forcing a steel ball of diameter D , under a load F , into the test piece and measuring the diameter d of the indentation left in the surface after removal of the load.

The Brinell hardness HB is the ratio of the test load F (expressed in kilogrammes-force) to the curved surface area (expressed in square millimetres) of the indentation which is assumed to be spherical and of diameter D .

The test is carried out at ambient temperature, unless otherwise specified.

2. SYMBOLS AND DESIGNATIONS

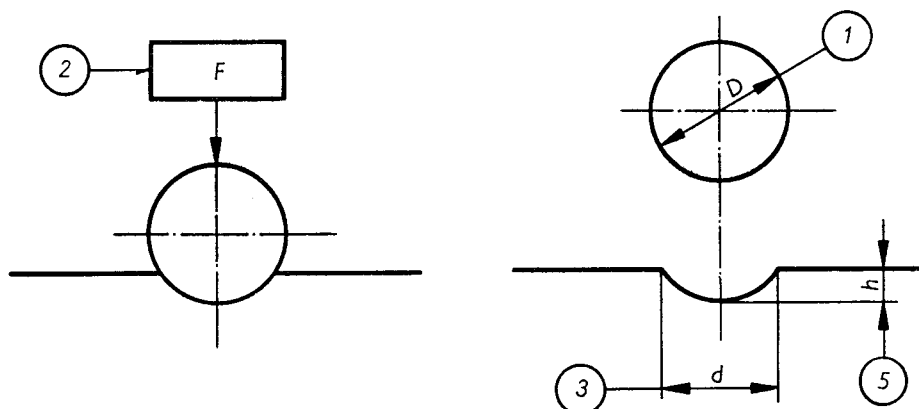
Number	Symbol	Designation
1	D	Diameter of the ball, in millimetres
2	F	Test load, in kilogrammes-force
3	d	Diameter of indentation, in millimetres
4	HB	Brinell hardness $= \frac{\text{test load in kgf}}{\text{surface area of indentation in mm}^2}$ $= \frac{2F}{\pi D (D - \sqrt{D^2 - d^2})}$
5	h	Depth of indentation, in millimetres $= \frac{F}{\pi D \times \text{HB}}$

NOTE

The Brinell hardness is denoted by the symbol HB supplemented by an index indicating the test conditions in the order :

diameter of ball,
load,
duration of loading.

Example: HB 10/500/15 = Brinell hardness measured with a ball of 10 mm diameter and with a load of 500 kgf applied for 15 seconds.



3. TESTING EQUIPMENT

3.1 The diameter and tolerances of the approved ball should be:

Diameter of ball millimetres	Tolerance * millimetres
10	± 0.0045
5	± 0.0040
2.5	± 0.0035
2	± 0.0035
1	± 0.0035

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3.2 The ball is of hardened and tempered steel** having a hardness of at least 850 HV (taking into account the curvature of the ball, when testing); it should be polished and free from surface defects. The indenter should be examined regularly for damage or defects and replaced whenever these are found. The result of any test found to have been made with a damaged or distorted ball should be discarded.

3.3 2.5 mm, 2 mm and 1 mm diameter balls should not be used for cast material.

4. TEST PROCEDURE

4.1 The ball is brought into contact with the surface of the test piece and pressure is applied normal to the surface. The pressure is increased gradually without vibration or sudden shocks until the test load is attained. The test load is maintained for 10 to 15 s. Other durations with appropriate tolerances may be specified by special agreement.

* The tolerances correspond to Grade 6 of the ISA System (ISA Bulletin 25). Balls for ball bearings normally satisfy these tolerances.

** If for any reason a ball of material other than hardened and tempered steel is used, the test should be described as a modified Brinell test and the symbol "HB" should not be employed.

- 4.2 The surface of the piece to be tested should be sufficiently smooth and even to permit the accurate determination of the diameter of the indentation. It should be free from scale and foreign matter. Care should be taken in preparing the surface to avoid any change in condition, e.g. due to heating or cold working. The finish of the surface should be such that the accuracy of measurement detailed in Clause 4.7 may be obtained.
- 4.3 The test piece should be placed on a rigid support. The contact surfaces should 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.
- 4.4 The test load should be chosen according to the hardness of the material under test as indicated in the following table.

Brinell hardness	F/D^2	Test load in kilogrammes-force				
		10 mm ball	5 mm ball	2.5 mm ball	2 mm ball	1 mm ball
35 to 200	10	1000	250	62.5	40	10
less than 40	5	500	125	31.25	20	5
greater than 190	30	3000	750	187.5	120	30

The test loads in the table are chosen so that the diameter of the indentation lies between the values $0.25 D$ and $0.6 D$.

The F/D^2 ratio of 10 is preferred as this covers the majority of coppers and copper alloys, and it is recommended that whenever another ratio is to be used the notation described in the note under the table of definitions and symbols is always quoted.

The tolerance on the load should be ± 1.0 per cent.

- 4.5 The thickness of the test piece should be not less than 10 times the depth of indentation h . No deformation should be visible at the back of the test piece after test.
- 4.6 The test is carried out in such a way that nothing occurs to falsify the test result (such as bulging at the edge or distortion of the test piece). The distance from the centre of the indentation to the edge of the test piece should be at least $2\frac{1}{2}$ times the diameter of the indentation and the distance between the centres of two adjacent indentations should be at least 4 times the diameter of the indentation.
- 4.7 The diameter of each indentation is measured in two directions at right angles, and the mean value of the two readings is used for the purpose of determining the hardness number. The measuring microscope or other measuring device should be capable of measuring the diameter of indentations to an accuracy of ± 0.25 per cent of the diameter of the ball.

NOTES

1. There is no general process for converting accurately Brinell 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.
2. It is essential to note that experimental evidence is available to show that the Brinell hardness of most copper and copper alloys will vary with the diameter of the ball and the magnitude of the test load.

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