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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 156

VERIFICATION OF BRINELL HARDNESS TESTING MACHINES

2nd EDITION

November 1967

This second edition supersedes the first edition.

For each individual country the only valid standard is the national standard of that country.

Printed in Switzerland

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

BRIEF HISTORY

The ISO Recommendation R 156, *Calibration of Brinell 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 1953 and led, in 1958, to the adoption of a Draft ISO Recommendation.

In January 1959, this Draft ISO Recommendation (No. 275) was circulated to all the ISO Member Bodies for enquiry. It was approved by 26 Member Bodies. Two Member Bodies opposed the approval of the Draft: Australia and New Zealand.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council which decided, in April 1960, to accept it as an ISO RECOMMENDATION.

BRIEF HISTORY CONCERNING THE 2nd EDITION

Working Group ISO/TC 17/WG 1 was entrusted, in 1961, by the Technical Committee ISO/TC 17, *Steel*, with the preparation of the Draft Revision of ISO Recommendation R 156-1960. This work led, in 1965, to the adoption of a Draft Revision.

The new title, *Verification of Brinell Hardness Testing Machines*, supersedes the title of the first edition, *Calibration of Brinell Hardness Testing Machines*; some amendments were made to the text.

In February 1966, this Draft Revision (No. 925) 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	Romania
Australia	India	Spain
Austria	Israel	Sweden
Belgium	Italy	Switzerland
Brazil	Japan	Turkey
Canada	Korea, Rep. of	U.A.R.
Chile	Netherlands	United Kingdom
Czechoslovakia	New Zealand	U.S.A.
Denmark	Norway	U.S.S.R.
France	Poland	Yugoslavia
Germany	Rep. of South Africa	

No Member Body opposed the approval of the Draft.

The Draft Revision of ISO Recommendation R 156-1960 was then submitted to the ISO Council which decided, in November 1967, to accept it.

The present edition (2nd edition) embodies this revision.

ISO Recommendation R 156 November 1967

VERIFICATION OF BRINELL HARDNESS TESTING MACHINES

1. SCOPE

This ISO Recommendation applies to the verification of testing machines for determining Brinell hardness in accordance with ISO Recommendation R 79, * *Brinell Hardness Test for Steel.*

If a testing machine is also to be used for other methods of hardness testing, it should be verified for each method.

It describes the indirect method, which is suitable for machines in service, and the direct method, which is suitable for the initial verification of new machines by the manufacturer and for the verification of rebuilt machines.

2. DIRECT VERIFICATION

Direct verification involves

(1) verification of the load-applying mechanism (see clause 2.1),

(2) verification of the steel balls (see clause 2.2) and

(3) verification of the measuring device (see clause 2.3).

Before verification is carried out, certain details of the testing machine should be checked (see Annex).

2.1 Verification of the load-applying mechanism

2.1.1 The verification of the load-applying mechanism at the required loads should be carried out either by means of standardized weights or by means of an elastic proving device or proving levers.

2.1.2 Each test load should be measured and, wherever possible, this should be done at not less than three positions of the plunger throughout its range of movement.

2.1.3 The test load should be measured by one of the following three methods:

(*a*) balancing against standardized weights accurate to $\pm 0.1\,\%$, or

* 2nd edition, at present Draft ISO Recommendation No. 924.

(*b*) balancing against a load, accurate to ±0.2%, applied by means of standardized weights with mechanical advantage, or

(*c*) measuring by means of the deformation of an elastic proving device previously calibrated to an accuracy of ±0.2%.

2.1.4 Three readings should be taken for each load at each position of the plunger (see clause 2.1.2). Immediately before each reading is taken, the plunger should have been moved in the same direction as during testing.

2.1.5 Each reading of the measured load should be within ± 1.0% of the nominal load.

2.2 Verification of the steel balls

2.2.1 For the purpose of verifying the size and hardness of the steel balls used in indenters it is considered sufficient to test a sample selected at random from a batch. The ball(s) verified for hardness should be discarded.

2.2.2 The user should either measure the balls accurately to ensure that they meet the following requirements or he should obtain balls from a supplier who can ensure that the following conditions are met:

(*a*) the diameter, when measured at not less than three positions, should not differ from the nominal diameter by more than the tolerance given in Table 1;

(*b*) the Vickers hardness should be not less than 850 HV10 when measured in accordance with ISO Recommendation R 81 (2nd edition - 1967), *Vickers Hardness Test for Steel (Load 5 to 100 kgf)*, and applying the appropriate correction for curvature as given in ISO Recommendation R 409, *Tables of Vickers Hardness Values (HV) for Metallic Materials.*

Table 1 gives the tolerance on diameter and the value of the mean diagonal of the indentation corresponding to 850 HV10 for the five sizes of ball.

TABLE 1

Ball diameter	Tolerance * on diameter	Maximum value of mean diagonal of the indentation made with a Vickers indenter at 10 kgf
mm	mm	mm
10	± 0.0045	0.146
5	± 0.004	0.145
2.5	± 0.0035	0.143
2	± 0.0035	0.142
1	± 0.0035	0.139

* These tolerances correspond to Grade 6 of ISO Recommendation R 286, *ISO System of Limits and Fits — Part I: General, Tolerances and Deviations.*

2.3 Verification of the measuring device

2.3.1 The measuring microscope or other measuring device should be verified by measurements made on a stage micrometer at a minimum of five intervals over each working range. The working ranges and the maximum error permitted in each range are indicated in Table 2.

TABLE 2

Working range interval	Maximum permissible error
mm	mm
0.25 to 0.6	0.0025
0.6 to 1.2	0.005
1.2 to 3.0	0.0125
3.0 to 6.0	0.025

3. INDIRECT VERIFICATION

Indirect verification is carried out by means of standardized blocks calibrated in accordance with ISO Recommendation R ..., * *Calibration of Standardized Blocks to be Used for Brinell Hardness Testing Machines.*

Before verification is carried out, certain details of the testing machine should be checked (see Annex).

3.1 On each standardized metal block, five indentations should be made and measured. The tests should be made in accordance with ISO Recommendation R 79. **

3.2 For special purposes, a hardness testing machine may be verified at one hardness value corresponding approximately to the tests to be made, but for the general verification of a testing machine, the following procedure should be adopted:

3.2.1 The testing machine should be verified under applied loads, in kilogrammes-force, equal to $F = 30\ D^2$ for each size of ball normally used in the testing machine. At each load, the testing machine should be tested using standardized blocks having hardnesses within the following ranges:

100 to 200 HB,
250 to 350 HB.

3.3 The procedure should be followed for each test load and each standardized block.

4. REPEATABILITY AND ERROR

For each standardized block, let $d_1, d_2 \ldots\ldots d_5$ be the mean values of the measured diameters, arranged in increasing order of magnitude.

* At present Draft ISO Recommendation No. 926, replacing Draft ISO Recommendation No. 525.
** 2nd edition, at present Draft ISO Recommendation No. 924.

4.1 Repeatability

The repeatability of the testing machine under the particular verification conditions is determined by the following quantity:

$$d_5 - d_1$$

4.2 Error

The error of the testing machine under the particular verification conditions is expressed by the following quantity:

$$\bar{H} - H$$

where $\bar{H} = \dfrac{H_1 + H_2 + \ldots H_5}{5}$

$H_1, H_2, \ldots . H_5$ = hardness values corresponding to $d_1, d_2 \ldots . d_5$,

H = specified hardness of standardized block.

5. ASSESSMENT OF VERIFICATION

5.1 Repeatability

The repeatability of the testing machine verified is not considered satisfactory unless it satisfies the following conditions:

TABLE 3

Brinell hardness of standardized block $\bar{H}$	The repeatability of the testing machine should be less than	Examples of approximate equivalents in hardness units HB
Less than 225	$\dfrac{4}{100}\,\bar{d}$	9 at 100 17 at 200
225 and above	$\dfrac{2}{100}\,\bar{d}$	10 at 250 14 at 350

where $\bar{d} = \dfrac{d_1 + d_2 + \ldots d_5}{5}$

5.2 Error

The error of the testing machine verified should be not more than ±3% of the specified hardness of the standardized block.

ANNEX

Inspection of testing machine

Before a Brinell hardness testing machine is verified, the testing machine should be checked to ensure that

(*a*) the machine is properly set up;

(*b*) the plunger holding the ball is capable of sliding in its guide, under its own weight, but without any appreciable clearance;

(*c*) the ball holder, with a new ball whose nominal diameter has been checked, * is firmly mounted in the plunger;

(*d*) the load can be applied and removed without shock or vibration and in such a manner that the readings are not influenced;

(*e*) if the measuring device is integral with the machine,

(i) the change from loading to measuring does not influence the readings,

(ii) the method of illumination does not affect the readings,

(iii) the centre of the indentation is in the centre of the field of view.

* See Note to clause 3.1 of ISO Recommendation R 79, 2nd edition, at present Draft ISO Recommendation No. 924.