

Metallic materials — Brinell hardness test

Part 1. Test method

The European Standard EN 10003-1 : 1994 has the status of a
British Standard

ICS 77.040.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee ISE/NFE/4, Mechanical testing of metals, upon which the following bodies were represented:

- AEA Technology
- Aluminium Federation
- British Non-Ferrous Metals Federation
- British Railways Board
- British Steel Industry
- Copper Development Association
- Department of Trade and Industry (National Physical Laboratory)
- Department of Trade and Industry (National Measurement Accreditation Service)
- ERA Technology Ltd.
- Electricity Association
- GAMBICA (BEAMA Ltd.)
- Institute of Materials
- Light Metal Founders' Association
- Ministry of Defence
- Society of British Aerospace Companies Limited
- University College London
- Welding Institute

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Department of Trade and Industry (National Engineering Laboratory)
- Society of Motor Manufacturers and Traders Limited

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 December 1995

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The following BSI references relate to the work on this standard:
Committee reference ISE/NFE/4
Draft for comment 91/47710 DC

ISBN 0 580 25333 3

Amendments issued since publication

Amd. No.	Date	Text affected
9147	August 1996	Indicated by a sideline in the margin

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National foreword

This British Standard has been prepared by Technical Committee ISE/NFE/4 and is the English language version of EN 10003-1 : 1994 *Metallic materials — Brinell hardness test — Part 1: Test method* published by ECISS (European Committee for Iron and Steel Standardization).

It supersedes BS 240 : 1986 which is withdrawn.

Cross-references

Publication referred to	Corresponding British Standard
EN 10003-2	BS EN 10003 <i>Metallic materials — Brinell hardness test Part 2 : 1995 Verification of Brinell hardness testing machines</i>
EN 24498-1	BS EN 24498 <i>Sintered metal materials, excluding hardmetals — Determination of apparent hardness Part 1 : 1993 Materials of essentially uniform section hardness</i>

Compliance with a British Standard does not of itself confer immunity from legal obligations.

ICS 77.040.10

Descriptors: Metallurgical products, mechanical tests, hardness tests, Brinell hardness, indentation hardness tests

English version

Metallic materials — Brinell hardness test — Part 1: Test method

Matériaux métalliques —
Essai de dureté Brinell —
Partie 1: Méthode d'essai

Metallische Werkstoffe —
Härteprüfung nach Brinell —
Teil 1: Prüfverfahren

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Ref. No. EN 10003-1:1994 E
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Foreword

This European Standard has been prepared by the Technical Committee ECISS/TC 1A, Mechanical and physical tests, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 1995, and conflicting national standards shall be withdrawn at the latest by April 1995.

During its preparation, the two following points have been discussed.

- a) Rounding of the values of test force: it was decided to keep for this edition the values based on the old unit (kgf). However for the next revision of this European Standard it is necessary to think about the advantage of introducing rounded values of test force and the consequence on the Brinell scale.
- b) Deletion of the steel ball indenter: it was agreed that :
 - compared with the steel ball, the hardmetal ball will have a smaller residual deformation leading to a higher reliability of the hardness measurements,
 - the hardmetal ball allows a higher number of tests to be carried out at an acceptable cost;
 - steel balls complying with the requirement of EN 10003-2 are not readily available;
 - the two types of ball give essentially identical results for hardness values up to 350;
 - the steel ball is included in the corresponding ISO standard.

For these reasons it was decided to maintain the steel ball in this European Standard but at its next revision only the hard metal ball will be retained. Users of this European Standard shall take this decision into account.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

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0 Introduction

The standard EN 10003 is valid for metallic materials and comprises the following parts:

- Part 1: *Metallic materials — Brinell hardness — Part 1: Test method*
- Part 2: *Metallic materials — Brinell hardness — Part 2: Verification of Brinell hardness testing machines*
- Part 3: *Metallic materials — Brinell hardness — Part 3: Calibration of standardized blocks to be used for Brinell hardness testing machines*

1 Scope

This European Standard specifies the method for the Brinell hardness test for metallic materials.

Special European Standards exist for particular materials and/or products (see clause 2).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- EN 10003-2 *Metallic materials — Brinell hardness test Part 2: Verification of Brinell hardness testing machines*
- EN 24498-1 *Sintered metal materials excluding hardmetals — Determination of apparent hardness — Part 1: Materials of essentially uniform section hardness*

3 Principle

Forcing an indenter (hardened steel ball or hardmetal ball with diameter D) into the surface of a test piece and measuring the diameter of the indentation d left in the surface after removal of the force F .

The steel ball is used for materials with a Brinell hardness not exceeding 350.

The hardmetal ball is used for materials with a Brinell hardness not exceeding 650.

The Brinell hardness is proportional to the quotient obtained by dividing the test force by the curved surface area of the indentation which is assumed to be spherical with a radius that corresponds to half of the diameter of the ball.

4 Symbols and designations

4.1 Symbols and designations (see figure 1 and table 1)

Table 1	
Symbol	Designation
D	Diameter, in millimetres, of the ball
F	Test force, in newtons
d	Mean diameter, in millimetres, of the indentation $\left(d = \frac{d_1 + d_2}{2} \right)$
h	Depth, in millimetres, of the indentation $= \frac{D - \sqrt{D^2 - d^2}}{2}$
HBS or HBW	Brinell hardness $= \text{Constant} \times \frac{\text{Test force}}{\text{Surface area of indentation}}$ $\times \frac{2F}{\pi D(D - \sqrt{D^2 - d^2})}$

NOTE. Constant = $\frac{1}{g_n} = \frac{1}{9,80665} = 0,102$

4.2 The Brinell hardness is denoted by the following symbols:

- HBS in cases where a steel ball is used;
- HBW in cases where a hard metal ball is used.

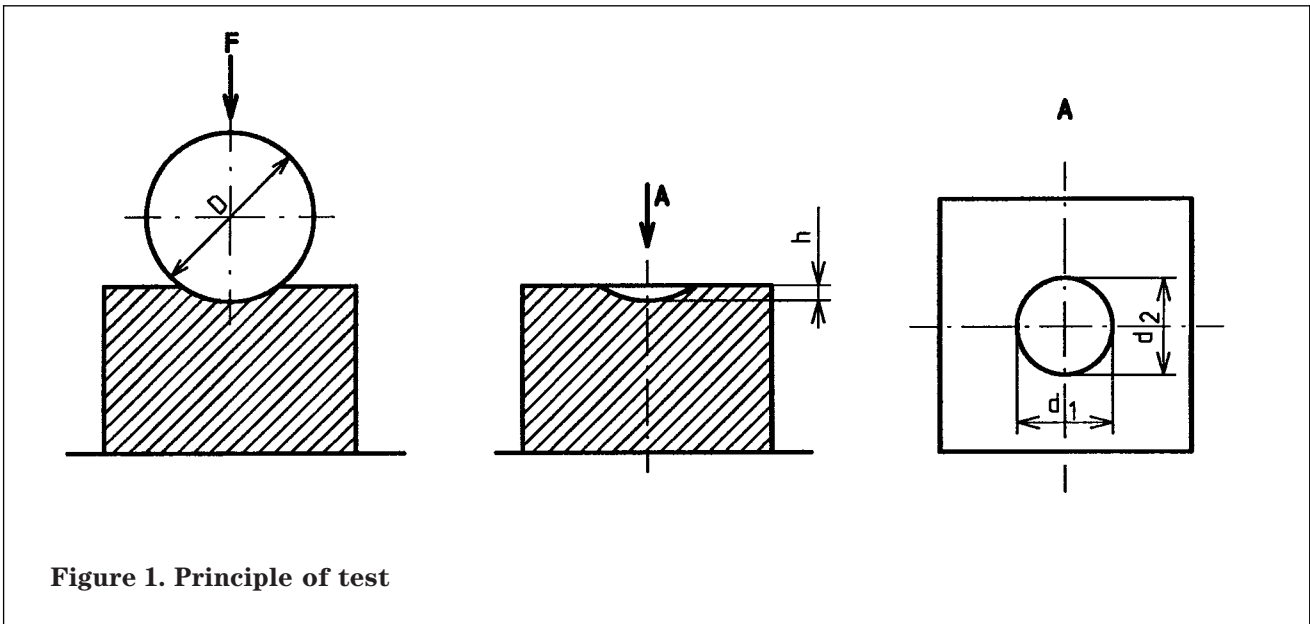
NOTE. In former standards, in case when a steel ball was used, the Brinell hardness was denoted by HB.

The symbol HBS or HBW is preceded by the hardness value and supplemented by an index indicating the test conditions in the order:

- diameter of the ball, in millimetres;
- a figure representing the test force (see table 2);
- duration of loading, in seconds, if different from the specified time (see 7.5).

EXAMPLE 1. 350 HB 5/750 = Brinell hardness of 350 determined with a steel ball of 5 mm diameter and with a test force of 7,355 kN applied for 10 s to 15 s.

EXAMPLE 2. 600 HBW 1/30/20 = Brinell hardness of 600 determined with a hardmetal ball of 1 mm diameter and with a test force of 294,2 N applied for 20 s.



5 Apparatus

5.1 *Testing machine*, capable of applying a predetermined test force or forces within the range of 9,807 N to 29,42 kN, in accordance with EN 10003-2.

5.2 *Indenter*: a hardened and polished steel ball or polished hardmetal ball, as specified in EN 10003-2.

5.3 *Measuring device*, as specified in EN 10003-2.

6 Test piece

6.1 The test shall be carried out on a surface which is smooth and even, free from oxide scale, foreign matter and, in particular, free from lubricants. The test piece shall have a surface finish that will allow an accurate measurement of the diameter of the indentation.

6.2 Preparation shall be carried out in such a way that any alteration of the surface, for example due to heat or coldworking, is minimized.

6.3 The thickness of the test piece shall be at least eight times the depth of indentation (see table A.1).

No deformation shall be visible at the back of the test piece after the test.