



SLOVENSKI STANDARD

SIST EN 10003-1:199*

01-jUbi Uf-1- - *

Kovinski materiali - Preskus trdote po Brinellu - 1. del: Preskusna metoda

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

Metallische Werkstoffe - Härteprüfung nach Brinell - Teil 1: Prüfverfahren

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

Ta slovenski standard je istoveten z: EN 10003-1:1994

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ICS:

77.040.10 Mehansko preskušanje kovin Mechanical testing of metals

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EUROPEAN STANDARD

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NORME EUROPÉENNE

EUROPÄISCHE NORM

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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'essaiMetallische Werkstoffe - Härteprüfung Brinell
- Teil 1: Prüfverfahren**(standards.iteh.ai)**PSIST EN 10003-1:1999<https://standards.iteh.ai/catalog/standards/sist/97449af5-824a-45f1-87ef-8caac7fdde16/psist-en-10003-1-1999>

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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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CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

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

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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of an identical text or by endorsement, at the latest by April 1995, and conflicting national standards shall be withdrawn at the latest by April 1995.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.

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, which corresponds to half of the diameter of the ball.

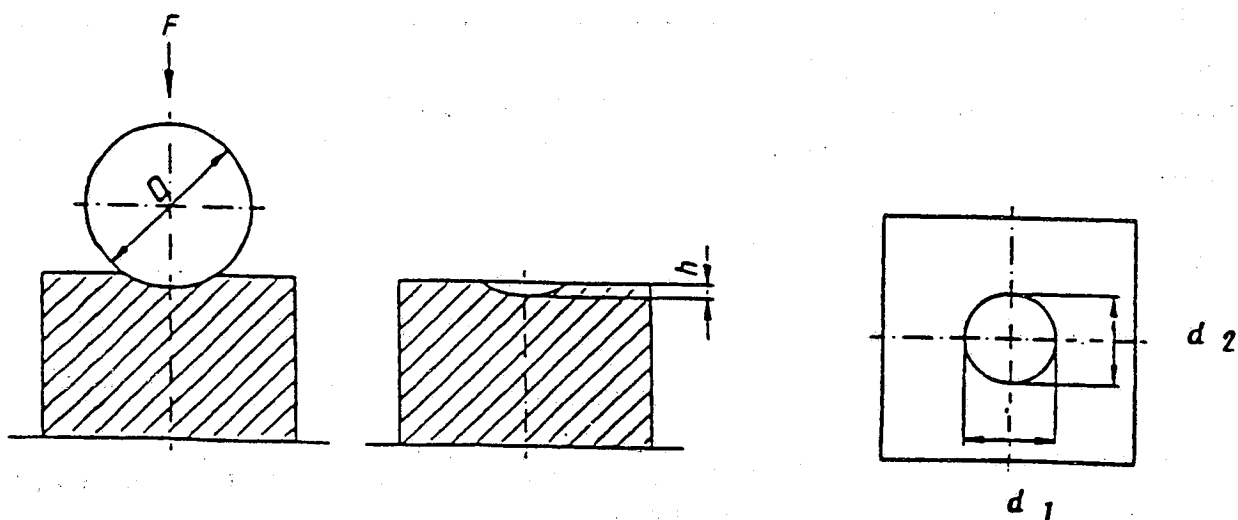


Figure 1 : Principle of test

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 $(d = \frac{d_1 + d_2}{2})$
h	Depth, in millimetres, of the indentation $= \frac{D - \sqrt{D^2 - d^2}}{2}$
HBS or HBW	Brinell hardness PSIST EN 10003-1:1999 $= \text{Constant} \times \frac{\text{Test force}}{\text{Surface area of indentation}}$ $= 0,102 \frac{2F}{\pi D (D - \sqrt{D^2 - d^2})}$

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 hardmetal ball is used.

NOTE : In former standards, in cases 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 :

- a) diameter of the ball, in millimetres,
- b) a figure representing the test force (see table 2),
- c) 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 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.

7 Procedure

7.1 In general, the test is carried out at ambient temperature within the limits of 10 °C and 35 °C. Tests carried out under controlled conditions shall be made at a temperature of $(23 \pm 5)^\circ\text{C}$.

7.2 The following test forces shall be used :

Table 2

Hardness symbol	Ball diameter D mm	$\frac{0,102 F}{D^2}$ ratio	Test force F Nominal value
HBS (HBW) 10/3 000	10	30	29,42 kN
HBS (HBW) 10/1 500	10	15	14,71 kN
HBS (HBW) 10/1 000	10	10	9,807 kN
HBS (HBW) 10/ 500	10	5	4,903 kN
HBS (HBW) 10/ 250	10	2,5	2,452 kN
HBS (HBW) 10/ 100	10	1	980,7 N
HBS (HBW) 5/750	5	30	7,355 kN
HBS (HBW) 5/250	5	10	2,452 kN
HBS (HBW) 5/125	5	5	1,226 kN
HBS (HBW) 5/ 62,5	5	2,5	612,9 N
HBS (HBW) 5/ 25	5	1	245,2 N
HBS (HBW) 2,5/187,5	2,5	30	1,839 kN
HBS (HBW) 2,5/ 62,5	2,5	10	612,9 N
HBS (HBW) 2,5/ 31,25	2,5	5	306,5 N
HBS (HBW) 2,5/ 15,625	2,5	2,5	153,2 N
HBS (HBW) 2,5/ 6,25	2,5	1	61,29 N
HBS (HBW) 2/120	2	30	1,177 kN
HBS (HBW) 2/ 40	2	10	392,3 N
HBS (HBW) 2/ 20	2	5	196,1 N
HBS (HBW) 2/ 10	2	2,5	98,07 N
HBS (HBW) 2/ 4	2	1	39,23 N
HBS (HBW) 1/30	1	30	294,2 N
HBS (HBW) 1/10	1	10	98,07 N
HBS (HBW) 1/ 5	1	5	49,03 N
HBS (HBW) 1/ 2,5	1	2,5	24,52 N
HBS (HBW) 1/ 1	1	1	9,807 N

7.3 The test force shall be chosen so that the diameter of the indentation d lies between the values $0,24 D$ and $0,6 D$.

The degree of loading ($0,102 F/D^2$ ratio) shall be chosen according to the material and the hardness test as indicated in table 3.

Table 3

Material	Brinell hardness	$0,102 F/D^2$
Steel - Nickel alloys Titanium alloys		30
Cast iron 1)	< 140	10
	≥ 140	30
Copper and copper alloys	< 35	5
	35 to 200	10
	> 200	30
Light metals and their alloys	< 35	2,5
	35 to 80	5
		10
		15
	> 80	10
	15	
Lead, tin		1
Sintered metal	See EN 24498-1	
1) For the testing of cast iron the nominal diameter of the ball shall be 2,5 - 5 or 10 mm.		

In order to test the largest representative area of the test piece, the diameter of the testing ball shall be chosen as large as possible.

When the thickness of the test piece permits, a 10 mm diameter ball is preferred.

7.4 The test piece shall be placed on a rigid support. The contact surfaces shall 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.

7.5 Bring the indenter into contact with the test surface and apply the test force in a direction perpendicular to the surface, without shock, vibration or overrun, until the applied force attains the specified value. The time from the initial application of force until the full test force is reached shall not be less than 2 s nor greater than 8 s. Maintain the test force for 10 to 15 s. For certain materials, a longer dwell time is provided ; this time shall be applied with a tolerance of ± 2 s.

7.6 Throughout the test, the apparatus shall be protected from significant shock or vibration which can influence the test result.

7.7 The distance of the centre of each indentation from the edge of the test piece shall be at a minimum of two and half times the mean indentation diameter for materials with a hardness of more than or equal to 150 HB and at a minimum of three times the mean indentation diameter for materials with a hardness of less than 150 HB.

The distance between the centre of two adjacent indentations shall be at least four times the mean diameter of the indentation in the case of materials with a hardness of more than or equal to 150 HB, and at least six times the mean diameter of the indentation in the case of materials with a hardness of less than 150 HB.

7.8 Measure the diameter of each indentation in two directions at right angles. The arithmetic mean of the two readings shall be taken for the calculation of the Brinell hardness.

NOTE : For some machines it may be necessary to utilize :

- the average of a greater number of symmetrically placed measurements,
- an assessment of the projected indentation area in the material surface.

7.9 Attention is drawn to the table A.2 which contains calculation tables for use in tests made on flat surfaces.

8 Test report

The test report when requested shall include the following information :

- a) reference to this European Standard,
- b) all details necessary for identification of the test sample,
- c) the result obtained,
- d) additional requirements outside the scope of this European Standard,
- e) details of any occurrence which may have affected the result,
- f) the test temperature if it is not within the limits $(23 \pm 5)^{\circ}$ C.

NOTE 1 : There is no general process of accurately converting Brinell hardness into other scales of hardness or into tensile strength. These conversions should therefore be avoided, unless a reliable basis for the conversion can be obtained by comparative tests.

NOTE 2 : It should be noted that for anisotropic materials, for example those which have been heavily cold-worked, there may be a difference between the lengths of the two diameters of the indentation. The specification for the product may indicate limits for such differences.