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# International Standard



# 726

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## **Metallic materials — Hardness test — Calibration of standardized blocks to be used for Brinell hardness testing machines**

*Matériaux métalliques — Essai de dureté — Étalonnage des blocs de référence à utiliser pour les machines d'essai de dureté Brinell*

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## Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 726 was developed by Technical Committee ISO/TC 164, *Mechanical testing of metals*, and was circulated to the member bodies in June 1981.

It has been approved by the member bodies of the following countries :

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United Kingdom

# Metallic materials — Hardness test — Calibration of standardized blocks to be used for Brinell hardness testing machines

## 1 Scope and field of application

This International Standard specifies a method for the calibration of standardized blocks to be used in Brinell hardness testing machines, for the indirect verification of these machines, as described in ISO 156.

## 2 References

ISO 156, *Metallic materials — Hardness test — Verification of Brinell hardness testing machines.*<sup>1)</sup>

ISO 468, *Surface roughness — Parameters, their values and general rules for specifying surfaces.*<sup>2)</sup>

ISO 6506, *Metallic materials — Hardness test — Brinell test.*

## 3 Manufacture

**3.1** The block shall be specially prepared and the attention of the manufacturer is drawn to the need to use a manufacturing process which will give the necessary homogeneity, stability of structure and uniformity of surface hardness.

**3.2** Each metal block to be standardized shall be of a thickness not less than

- 16 mm for 10 mm balls;
- 12 mm for 5 mm balls;
- 6 mm for smaller balls.

The surface area of the test block shall be

- < 150 cm<sup>2</sup> for balls ≥ 5 mm in diameter;
- < 40 cm<sup>2</sup> for balls < 5 mm in diameter.

**3.3** The standardized blocks shall be free of magnetism. It is recommended that the manufacturer shall ensure that the blocks, if of steel, have been demagnetized at the end of the manufacturing process.

**3.4** The flatness of the two surfaces and the parallelism of the standardized block shall be in accordance with table 1.

Table 1

Diameter of ball mm	Maximum deviation in flatness of the surfaces mm	Maximum error in parallelism mm/50 mm	Surface roughness, maximum $R_a^*$ μm	
			Test surface	Bottom surface
> 5	0,020	0,040	0,4	0,8
< 5	0,005	0,010	0,2	0,8

\* Sampling length  $l = 0,80$  mm. (See ISO 468).

**3.5** The test surface shall be free from scratches which interfere with the measurement of the indentations. (See table 1).

1) At present at the stage of draft. (Revision of ISO/R 156-1960.)

2) At present at the stage of draft. (Revision of ISO/R 468-1966.)

**3.6** To permit checking that no material is subsequently removed from the standardized block, its thickness at the time of standardization shall be marked on it to the nearest 0,1 mm, or an identifying mark shall be made on the test surface. (See clause 8).

**4 Standardizing machine**

**4.1** In addition to fulfilling the general requirements specified in ISO 156, clause 3, the standardizing machine shall also meet the requirements in sub-clauses 4.2.1 to 4.2.3 of this International Standard.

**4.2** The machine shall be verified directly. Direct verification involves

- verification of the test force (see 4.2.1);
- verification of the indenter (see 4.2.2);
- verification of the measuring device (see 4.2.3).

**4.2.1** Each test force shall be correct to within  $\pm 0,1\%$  of the nominal test force. (See table 2.)

**Table 2**

Hardness symbol	Ball diameter $D$ mm	Test force $F$	
		$0,102 F / D^2$	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) 10/125	10	1,25	1,226 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/ 31,25	5	1,25	306,5 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/ 7,812 5	2,5	1,25	76,61 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/ 5	2	1,25	49,03 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/ 1,25	1	1,25	12,26 N
HBS (HBW) 1/ 1	1	1	9,807 N

**4.2.2** The indenters shall be verified, and shall meet the requirements given in ISO 156, clause 4.2.

However the tolerances on the diameter of the balls shall meet the requirements given in table 3.

**Table 3**

Diameter of ball mm	Tolerance mm
10	$\pm 0,003$
5	$\pm 0,002$
2,5	$\pm 0,001$
2	$\pm 0,001$
1	$\pm 0,001$

**4.2.3** The scale of the measuring microscope shall be graduated to read to 0,002 mm for indentations made with 10 and 5 mm balls and 0,001 mm for indentations made with balls of less than 5 mm diameter.

The scale of the measuring microscope shall be verified by measurements made on a stage micrometer at a minimum of five intervals over each working range. The difference between readings corresponding to any two graduation lines of the measuring microscope shall be correct

- within  $\pm 0,002$  mm for 5 and 10 mm diameter balls;
- within  $\pm 0,001$  mm for smaller balls.

**5 Standardizing procedure**

The standardized blocks shall be calibrated in a standardizing machine as described in clause 4, at a temperature of  $23 \pm 5$  °C, using the general procedure described in ISO 6506.

The time from the initial application of force until the full test force is reached shall not be less than 6 s nor greater than 8 s. The duration of the test force shall be 10 to 15 s.

The mechanism which controls the application of the force shall ensure that the speed of approach of the ball immediately before it touches the block is not more than 1 mm/s.

**6 Number of indentations**

On each standardized block five indentations shall be made uniformly distributed over the entire test surface.

**7 Uniformity of hardness**

**7.1** Let  $d_1, d_2, \dots, d_5$  be the values of the mean measured diameters, arranged in increasing order of magnitude.

The non-uniformity of the block under the particular conditions of standardization is characterized by

$$d_5 - d_1$$

and expressed in percent of  $\bar{d}$ ,

where

$$\bar{d} = \frac{d_1 + d_2 + \dots + d_5}{5}$$

**7.2** The block is not sufficiently uniform in hardness for standardization purposes unless the uniformity satisfies the conditions given in table 4.

**Table 4**

Hardness of block HBS (HBW)	Maximum permissible non-uniformity of $\bar{d}$ %
< 225	2
> 225	1

## 8 Marking

**8.1** Each standardized block shall be marked with the following :

- a) arithmetic mean of the hardness values found in the standardizing test, for example :  
398 HBS (HBW) 5/750;
- b) name or mark of the supplier;
- c) serial number;
- d) name or mark of the standardizing authority;
- e) thickness of the block or an identifying mark on the test surface.

**8.2** Any mark put on the side of the block shall be upright when the test surface is the upper face.

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