

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS Z 2243 : 2008

(JISF)

Brinell hardness test — Test method

ICS 77.040.10

Reference number : JIS Z 2243 : 2008 (E)

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Date of Establishment: 1952-06-21
Date of Revision: 2008-02-20
Date of Public Notice in Official Gazette: 2008-02-20
Investigated by: Japanese Industrial Standards Committee
Standards Board
Technical Committee on Iron and Steel

JIS Z 2243 : 2008, First English edition published in 2008-04

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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Printed in Japan

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS Z 2243** : 1998 is replaced with this Standard.

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Brinell hardness test — Test method

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **ISO 6506-1** published in 2005 and the first edition of **ISO 6506-4** published in 2005. This Standard has partially modified the technical contents of **ISO 6506-1**, and integrated **ISO 6506-4** as Annex B without any modifications of the technical contents or the standard structure.

The portions underlined with dots in this Standard are the matters in which the contents of the original International Standard have been modified. A list of modifications with explanations is given in Annex JA.

1 Scope

This Standard specifies the Brinell hardness test method applied mainly for metallic materials and is applicable up to the limit of 650HBW.

NOTE : The International Standards corresponding to this Standard and the symbol of correspondence degree are as follows.

ISO 6506-1:2005 *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6506-4:2005 *Metallic materials — Brinell hardness test — Part 4: Table of hardness values*

(Overall evaluation: MOD)

The symbols which denote the degree of correspondence between **JIS** and the relevant International Standard are IDT (identical), MOD (modified), NEQ (not equivalent) as defined in **ISO/IEC Guide 21**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 7724 *Brinell hardness test — Verification of testing machines*

NOTE : Corresponding International Standard: **ISO/DIS 6506-2:1997** *Metallic materials — Brinell hardness test — Part 2: Verification of testing machines* (IDT)

ISO 4498-1 *Sintered metal materials, excluding hardmetals — Determination of apparent hardness — Part 1: Materials of essentially uniform section hardness*

3 Principle

An indenter of hardmetal ball (diameter D) is forced into the surface of a test piece and, after removal of the test force (F), the diameter of the indentation (d) left in the surface is measured. The Brinell hardness is proportional to the quotient obtained by dividing the test force by the curved surface area of the indentation. (The indentation is assumed to retain the shape of the ball, and its surface area is calculated from the mean indentation diameter and the ball diameter.) (See figure 1 and table 1).

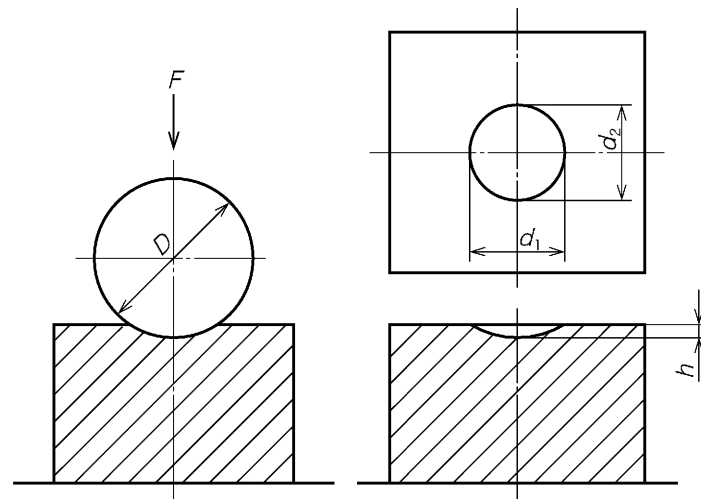


Figure 1 Principle of test

4 Symbols and marking

The symbols and marking shall be as follows.

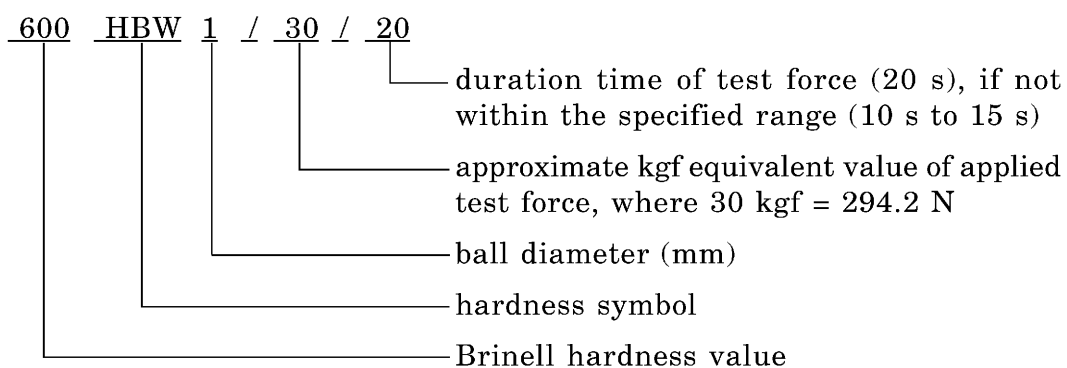
- a) The symbols used for Brinell hardness shall be as shown in table 1.

Table 1 Symbols and designation

Symbol/ Abbreviated term	Designation	Unit
D	Diameter of the ball	mm
F	Test force	N
d	Mean diameter of the indentation $d = \frac{d_1 + d_2}{2}$	mm
h	Depth of indentation $h = \frac{D}{2} \left(1 - \sqrt{1 - d^2/D^2} \right)$	mm
HBW	Brinell hardness = Constant ^{a)} $\times \frac{\text{Test force}}{\text{Surface area of indentation}}$ $\text{HBW} = 0.102 \times \frac{2 F}{\pi D^2 \left(1 - \sqrt{1 - d^2/D^2} \right)}$	
$0.102 \times F/D^2$	force-diameter ratio	N/mm ²
Note ^{a)} Constant = $0.102 \approx \frac{1}{9.806\,65}$ where 9.806 65 is the conversion factor from kgf to N.		

b) The following is an example of the designation of Brinell hardness, HBW.

Example



NOTE : In former standards, in cases when a steel ball had been used, the Brinell hardness was denoted by HB or HBS.

5 Apparatus

5.1 Testing machine

The testing machine shall be capable of applying a predetermined test force or forces within the range of 9.807 N to 29.42 kN, in accordance with **JIS B 7724**.

5.2 Indenter

The indenter shall be a polished hardmetal ball, as specified in **JIS B 7724**.

5.3 Measuring device

The measuring device shall be as specified in **JIS B 7724**.

6 Specimen (test piece)

6.1 Test surface

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 specimen (test piece) shall have a surface finish that will allow an accurate measurement of the diameter of the indentation.

6.2 Pretreatment

Preparation shall be carried out in such a way that any alteration of the surface, for example, due to excessive heating or cold-working, is minimized.

6.3 Thickness of specimen (test piece)

The thickness of the specimen (test piece) shall be at least eight times the depth of indentation and shall be such that there is no visible deformation at the back of the test piece after the test. Values for the minimum thickness of the specimen (test piece) in relation to the mean diameter of indentation are given in Annex A.

7 Procedure

7.1 General

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

7.2 Test force

The test force to be applied shall be as shown in table 2. The test forces and force-diameter ratios other than that specified in table 2 may be used by special agreement between the interested parties.

Table 2 Hardness symbols and testing conditions

Hardness symbol	Ball diameter D mm	Force-diameter ratio $0.102 \times \frac{F^{a)}}{D^2}$ N/mm ²	Test force F
HBW10/3 000	10	30	29.42 kN
HBW10/1 500	10	15	14.71 kN
HBW10/1 000	10	10	9.807 kN
HBW10/500	10	5	4.903 kN
HBW10/250	10	2.5	2.452 kN
HBW10/100	10	1	980.7 N
HBW5/750	5	30	7.355 kN
HBW5/250	5	10	2.452 kN
HBW5/125	5	5	1.226 kN
HBW5/62.5	5	2.5	612.9 N
HBW5/25	5	1	245.2 N
HBW2.5/187.5	2.5	30	1.839 kN
HBW2.5/62.5	2.5	10	612.9 N
HBW2.5/31.25	2.5	5	306.5 N
HBW2.5/15.625	2.5	2.5	153.2 N
HBW2.5/6.25	2.5	1	61.29 N
HBW1/30	1	30	294.2 N
HBW1/10	1	10	98.07 N
HBW1/5	1	5	49.03 N
HBW1/2.5	1	2.5	24.52 N
HBW1/1	1	1	9.807 N
Note ^{a)} F shall be a value in the unit of N.			

7.3 Choice of test force

- 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 force-diameter ratios ($0.102 \times F/D^2$), that are appropriate for the materials and hardness levels of the specimen (sample), shall be chosen from table 3 and determined based on the indenter diameter.
- In order to obtain the average hardness of the sample (test piece), the diameter of the testing ball shall be chosen to be as large as possible. When the thickness of the test piece permits, a 10 mm diameter ball is preferred.