

STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 1816.1—2007

Metallic materials—Brinell hardness test

Method 1: Test method (ISO 6506-1:2005, MOD)

RECONFIRMATION NOTICE

Technical Committee MT-009 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 20 March 2017.

The following are represented on Technical Committee MT-009:

Australasian Institute of Surface Finishing
Australian Chamber of Commerce and Industry
Australian Industry Group
Australian Steel Institute
Bureau of Steel Manufacturers of Australia
Galvanizers Association of Australia
Galvanizing Association of New Zealand
New Zealand Metal Roofing Manufacturers

NOTES

Australian Standard®

Metallic materials—Brinell hardness test

Method 1: Test method (ISO 6506-1:2005, MOD)

PREFACE

This Standard was prepared by the Standards Australia Committee MT-006, Mechanical Testing of Metals to supersede AS 1816.1—2002, *Metallic materials—Brinell hardness test*, Method 1: *Test method*.

This Standard is an adoption with national modifications and is reproduced from ISO 6506-1:2005, *Metallic materials—Brinell hardness test*, Part 1: *Test method*.

Variations to the ISO text for Australia are set out in Appendix ZZ. Changes to the ISO text are indicated by a marginal bar.

This Standard modifies ISO 6506-1 to conform with established Australian practices for hardness testing.

This Standard is one of a series of Standards covering the range of hardness testing methods. The series comprises of the follow:

AS

1815 Metallic materials—Rockwell hardness test

1815.1 Method 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)

1815.2 Method 2: Verification and calibration of testing machines (scales A, B, C, D, E, F, G, H, K, N, T)

1815.3 Method 3: Calibration of reference blocks (scales A, B, C, D, E, F, G, H, K, N, T)
(ISO 6508-3:2005, MOD)

1816 Metallic materials—Brinell hardness test

1816.1 Method 1: Test method (ISO 6506-1:2005, MOD) (this Standard)

1816.2 Method 2: Verification and calibration of testing machines

1816.3 Method 3: Calibration of reference blocks

1816.4 Method 4: Table of hardness values

1817 Metallic materials—Vickers hardness test

1817.1 Method 1: Test methods (ISO 6507-1:1994, MOD)

1817.2 Method 2: Verification of testing machines

1817.3 Method 3: Calibration of reference blocks

5016 Metallic materials—Conversion of hardness values

As this Standard is reproduced from an international standard, the following applies:

- (a) Its number appears on the cover and title page while the international standard number appears only on the cover.
- (b) In the source text ‘this part of ISO 6506’ should read ‘this Australian Standard’.
- (c) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>	<i>Australian Standard</i>
ISO	AS
4498 Sintered metal materials, excluding hardmetals—Determination of apparent hardness	—
4498-1 Part 1: Materials of essentially uniform section hardness	
6506 Metallic materials—Brinell hardness test	1816 Metallic materials—Brinell hardness test
6506-2 Part 2: Verification and calibration of testing machines	1816.2 Method 2: Verification and calibration of testing machines
6506-4 Part 4: Table of hardness values	1816.4 Method 4: Table of hardness values

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex or appendix to which they apply. A ‘normative’ annex or appendix is an integral part of a standard, where an ‘informative’ annex or appendix is only for information and guidance.

1 Scope

This part of ISO 6506 specifies the method for the Brinell hardness test for metallic materials and is applicable up to the limit of 650 HBW.

For specific materials and/or products, particular International Standards exist (i.e. ISO 4498-1).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 6506-2:2005, *Metallic materials — Brinell hardness test — Part 2: Verification and calibration of testing machines*

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

3 Principle

An indenter (hardmetal ball with diameter D) is forced into the surface of a test piece and, after removal of the 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.

4 Symbols and abbreviated terms

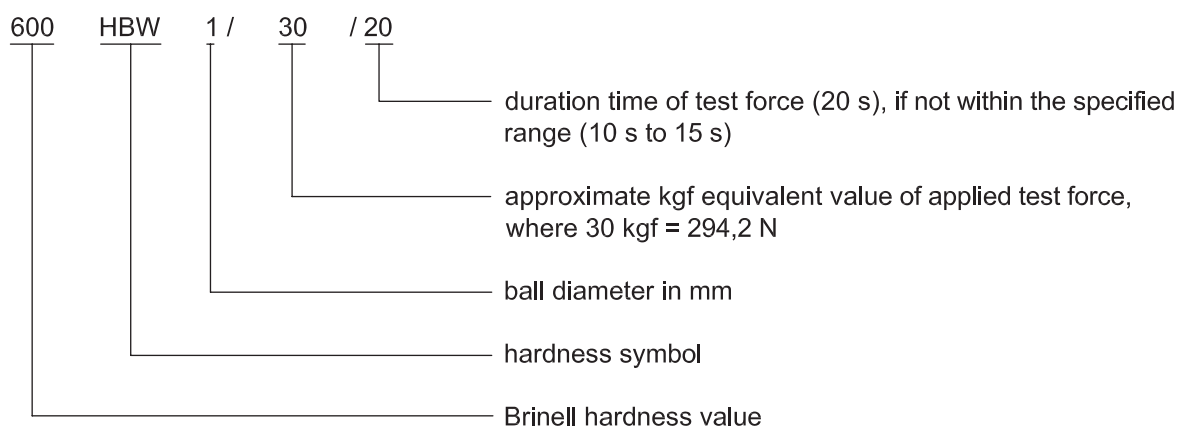
4.1 See Figure 1 and Table 1.

Table 1 — Symbols and abbreviated terms

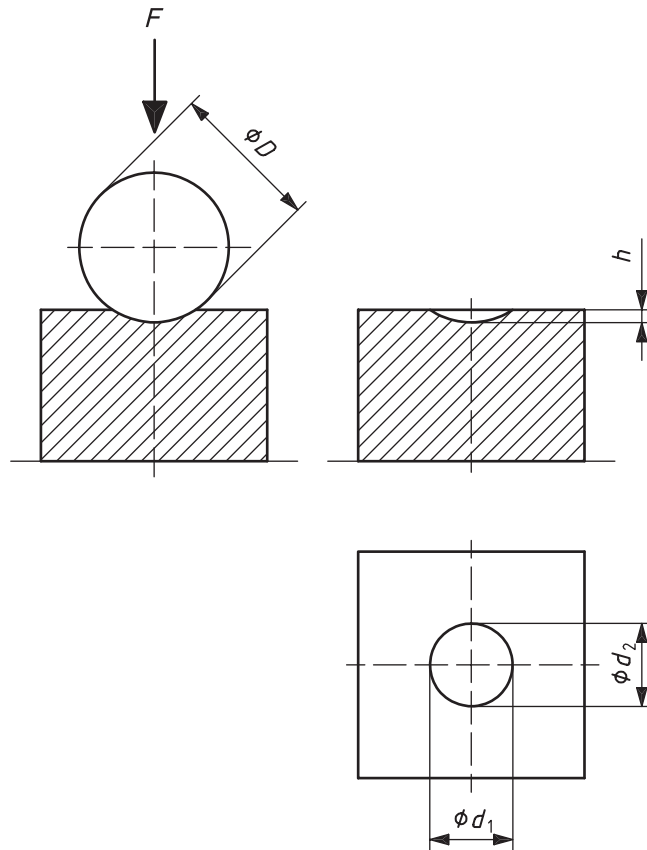
Symbol / Abbreviated term	Designation	Unit
D	Diameter of the ball	mm
F	Test force	N
d	Mean diameter of the indentation $d = \frac{d_1 + d_2}{2}$	mm
d_1, d_2	Indentation diameters measured at 90°	mm
h	Depth of indentation $h = \frac{D}{2} (1 - \sqrt{1 - d^2/D^2})$	mm
HBW	Brinell hardness = Constant $\times \frac{\text{Test force}}{\text{Surface area of indentation}}$ $\text{HBW} = 0,102 \times \frac{2 F}{\pi D^2 (1 - \sqrt{1 - d^2/D^2})}$	
$0,102 \times F/D^2$	force-diameter ratio	N/mm ²
NOTE Constant = $0,102 \approx \frac{1}{9,806\,65}$, where 9,806 65 is the conversion factor from kgf to N.		

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

EXAMPLE



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



For symbols, see Table 1.

Figure 1 — Principle of test

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 ISO 6506-2.

5.2 Indenter, a polished hardmetal ball, as specified in ISO 6506-2.

5.3 Measuring device, as specified in ISO 6506-2.

NOTE A suggested procedure for periodic checks by the user is given in Annex A.

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 excessive heating or cold-working, is minimized.

6.3 The thickness of the test piece shall be at least eight times the depth of indentation. Values for the minimum thickness of the test piece in relation to the mean diameter of indentation are given in Annex B.

Visible deformation at the back of the test piece can indicate that the test piece is too thin.

7 Procedure

7.1 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 The test forces given in Table 2 shall be used.

NOTE Other test forces and force-diameter ratios may be used by special agreement.

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

Table 3 indicates recommended force-diameter ratios $(0,102 \times F/D^2)$ that are appropriate for use when testing certain materials and hardness levels.

In order to test the largest representative area of the 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.

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 to the time the full test force is reached shall not be less than 2 s nor greater than 8 s. Maintain the test force for 10 s to 15 s. For certain materials, where a longer duration of the test force is required; this time shall be applied with a tolerance of ± 2 s.

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

7.7 The distance of the edge of the test piece to the centre of each indentation shall be a minimum of two and a half times the mean indentation diameter.

The distance between the centres of two adjacent indentations shall be at least three times the mean indentation diameter.

7.8 Measure the diameter of each indentation in two directions perpendicular to each other. The arithmetic mean of the two readings shall be taken for the calculation of the Brinell hardness.

NOTE For automatic measuring systems, the following may be used:

- the average of a greater number of equally spaced measurements;
- an assessment of the projected indentation area into the material surface.

7.9 ISO 6506-4 contains a calculation table, which shall be used to determine the Brinell hardness for tests on flat surfaces.