



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS B 7724 : 2017

(JTM/JSA)

**Brinell hardness test—Verification
and calibration of testing machines**

ICS 77.040.10

Reference number : JIS B 7724 : 2017 (E)

PROTECTED BY COPYRIGHT

Date of Establishment: 1952-06-21

Date of Revision: 2017-08-21

Date of Public Notice in Official Gazette: 2017-08-21

Investigated by: Japanese Industrial Standards Committee
Standards Board for ISO area
Technical Committee on Basic Engineering

JIS B 7724:2017, First English edition published in 2017-10

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2017

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED BY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols and definitions	2
5 General conditions	3
6 Direct verification	3
6.1 General	3
6.2 Measurement of test force	4
6.3 Verification of indenter	4
6.4 Calibration of indentation diameter measuring system	5
6.5 Verification of testing cycle	6
7 Indirect verification	6
7.1 General	6
7.2 Verification range	6
7.3 Reference indentation	6
7.4 Number of measured indentations	7
7.5 Mean value of indentation diameters	7
7.6 Repeatability	7
7.7 Permissible repeatability	7
7.8 Mean hardness value	7
7.9 Error	7
7.10 Uncertainty	8
8 Intervals between direct and indirect calibrations and verifications	8
9 Verification report/calibration certificate	9
Annex A (informative) Uncertainty of measurement of verification results of hardness testing machine	10
Annex B (informative) Verification of hardness testing machines that are incapable of meeting the specified force/time profile	17
Bibliography	18
Annex JA (informative) Comparison table between JIS and corresponding International Standard	19

Foreword

This translation has been made based on the original Japanese Industrial Standard revised 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 Japan Testing Machinery Association (JTM)/Japanese Standards Association (JSA) 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 B 7724:1999** is replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Brinell hardness test—Verification and calibration of testing machines

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 6506-2:2014**, Edition 3, with some modifications of the technical contents in order to correspond to the needs of users in Japan.

The portions with continuous sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies methods of direct and indirect verification of testing machines used for determining Brinell hardness in accordance with **JIS Z 2243**.

This Standard is applicable to both fixed location and portable hardness testing machines (hereafter referred to as testing machines).

For machines that are incapable of satisfying the specified force-time profile, the direct verification of force and testing cycle can be modified by the use of Annex B.

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

ISO 6506-2:2014 *Metallic materials—Brinell hardness test—Part 2: Verification and calibration of testing machines* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

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 7728 *Calibration of force-proving instruments used for the verification of uniaxial testing machines*

NOTE : Corresponding International Standard: ISO 376 *Metallic materials—Calibration of force-proving instruments used for the verification of uniaxial testing machines*

JIS B 7736 *Brinell hardness test—Calibration of reference blocks*

NOTE : Corresponding International Standard: ISO 6506-3 *Metallic materials—Brinell hardness test—Part 3: Calibration of reference blocks*

JIS Z 2243 *Brinell hardness test—Test method*

NOTE : Corresponding International Standard: ISO 6506-1 *Metallic materials—Brinell hardness test—Part 1: Test method*

JIS Z 2244 *Vickers hardness test—Test method*

NOTE : Corresponding International Standard: ISO 6507-1 *Metallic materials—Vickers hardness test—Part 1: Test method*

JIS Z 8103 *Glossary of terms used in measurement*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS Z 2243** and **JIS Z 8103**, and the following apply.

3.1 Brinell hardness testing machine

instrument including force application system and indentation diameter measuring system

3.2 indentation diameter measuring system

device for measuring indentation diameter, integrated into the machine or separated from the machine

3.3 direct verification

verification and calibration for main elements (test force, indenter, indentation diameter measuring system, etc.) of testing machine

3.4 indirect verification

verification of entire testing machine by conducting hardness test with multiple hardness reference blocks

3.5 reference indentation

indentation which is made on the reference block to establish a value and whose position and diameter are indicated

4 Symbols and definitions

For the purposes of this Standard, the symbols and definitions given in Table 1 apply.

Table 1 Symbols and definitions

Symbol	Unit	Definition
ρ	g/cm ³	Density
d_i	mm	Indentation mean diameter (mean of indentations in two directions)
$\bar{d}$	mm	Mean diameter of indentations measured at different positions
r	mm	Repeatability of indentation mean diameter (maximum value minus minimum value)
r_{rel}	%	Repeatability of indentation mean diameter (percentage to the mean value) (repeatability/mean value $\times$ 100)
H_i	(HBW)	Brinell hardness
$\bar{H}$	(HBW)	Mean hardness of Brinell hardnesses measured at different positions
H_c	(HBW)	Certified hardness of reference block
E	(HBW)	Error (mean hardness minus certified hardness)
E_{rel}	%	Error (percentage to the certified value) (error/certified hardness $\times$ 100)

5 General conditions

Before a Brinell hardness testing machine is verified, the machine shall be checked to ensure that it is properly set up in accordance with the manufacturer's instructions.

Especially, it should be checked that

- the mount holding the ball-holder slides correctly in its guide and free from side play,
- every ball-holder with a ball used during the calibration is firmly held in the mount,
- the material of ball used for indenter is tungsten carbide composite (hereafter referred to as hardmetal),
- the test force is applied and removed without shock, vibration, or overrun and in such a manner that the readings are not influenced, and
- if the indentation diameter measuring system is integrated into the machine,
 - the change from removing the test force to measuring mode does not influence the diameter measurements,
 - the illumination does not affect the diameter measurements, and
 - the centre of the indentation is in the centre of the field of view, if necessary.

6 Direct verification

6.1 General

6.1.1 Direct verification should be carried out at a temperature of $(23 \pm 5) ^\circ\text{C}$. If the verification is made outside this temperature range, this shall be reported in the verification report.

6.1.2 The instruments used for verification shall be traceable to the SI.

6.1.3 Direct verification involves

- a) measurement of the test forces,
- b) measurement of the diameter, hardness, and density of the indenter ball,
- c) measurement of indentation diameter measuring system, and
- d) measurement of the testing cycle.

For each of the above items, direct verification also includes assessment of the results against the specified tolerances.

6.2 Measurement of test force

6.2.1 Each test force shall be measured within the working range of the testing machine. When the force is applied in open-loop mode by a lever or other system employing a mechanical advantage, this shall be done at no fewer than three positions of the indenter uniformly spaced throughout its range of movement during testing.

6.2.2 Three measurements shall be made for each force at each position of the indenter. Immediately before each measurement is taken, the indenter shall be moved in the same direction as during testing.

6.2.3 The force shall be measured by one of the following two methods:

- by means of a force-proving instrument in accordance with **JIS B 7728** Class 1 or better;
- by balancing against a force, accurate to $\pm 0.2 \%$, applied by means of calibrated masses;
- or another method with the same accuracy.

6.2.4 Each measurement of a force shall be within $\pm 1.0 \%$ of the nominal test force [see Formula (A.2)], as defined in **JIS Z 2243**.

6.3 Verification of indenter

6.3.1 The indenter consists of a ball and an indenter holder. The verification applies only to the ball.

6.3.2 For the purpose of verifying the size and the hardness of the balls, a minimum of two balls, selected at random from a batch, shall be tested. Each sampled ball shall be verified for size and hardness and then discarded.

6.3.3 The balls shall be polished and free from surface defects.

6.3.4 The user shall either measure the balls to ensure that they meet the following requirements or obtain balls from a supplier certifying that the following conditions are met.

- a) The diameter shall be determined by taking the mean value of not less than three single values of diameter measured at different positions on the ball. No single value shall differ from the nominal diameter by more than the tolerance given in Table 2.