
Verification and calibration of 'Rockwell B'
hardness standardized Blocks

**(intended for the calibration of Rockwell B system
testing machines for the hardness of materials)**

Vérification et étalonnage des blocs de référence
de dureté Rockwell B

(destinés au tarage des machines d'essai dans le système Rockwell B
de la dureté des matériaux)



Foreword

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

- **International Recommendations (OIML R)**, which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity ; the OIML Member States shall implement these Recommendations to the greatest possible extent;
- **International Documents (OIML D)**, which are informative in nature and intended to improve the work of the metrological services.

OIML Draft Recommendations and Documents are developed by technical committees or subcommittees which are formed by the Member States. Certain international and regional institutions also participate on a consultation basis.

Cooperative agreements are established between OIML and certain institutions, such as ISO and IEC, with the objective of avoiding contradictory requirements; consequently, manufacturers and users of measuring instruments, test laboratories, etc. may apply simultaneously OIML publications and those of other institutions.

International Recommendations and Inter-national Documents are published in French (F) and English (E) and are subject to periodic revision.

This publication – reference OIML R 11 (E), edition 1974 – was developed by the Pilot Secretariat SP 19*. It was submitted to the Third International Conference of Legal Metrology in October 1968 for formal sanction.

OIML publications may be obtained from the Organization's headquarters:

Bureau International de Métrologie Légale
11, rue Turgot - 75009 Paris - France
Telephone: 33 (0)1 48 78 12 82 and 42 85 27 11
Fax: 33 (0)1 42 82 17 27
E-mail: biml@oiml.org
Internet: www.oiml.org

* Note: This publication is now under the responsibility of TC 10/SC 5 “*Hardness standardized blocks and hardness testing machines*”.

VERIFICATION AND CALIBRATION OF 'ROCKWELL B' HARDNESS STANDARDIZED BLOCKS

FIELD OF APPLICATION

The present specifications apply to the verification and calibration of 'hardness standardized blocks' intended for the calibration of 'Rockwell B' system testing machines for the hardness of materials^(*).

CHAPTER A CONSTRUCTION REQUIREMENTS

1 Materials

1.1. The standardized blocks must be made of a material of which the homogeneity and the stability over a period of time (ageing) are known ;

if this material is ferro-magnetic, the blocks must be demagnetised.

2 Form

2.1. The blocks must have two plane parallel surfaces, one of which will be used as a test surface and the other as a supporting surface.

2.2. They must be at least 6 millimetres thick.

2.2.1. The parallelism of the two surfaces must be such that the thickness of the block does not vary by more than 0.010 mm per 50 mm of length in all directions,
errors in the flatness of each surface must not exceed 0.005 mm,
the roughness of the test surface must not exceed $R_a = 0.3 \mu\text{m}$,

These conditions are not compulsory within a 1 mm margin around the edge of the block.

^(*) Note

The present Recommendation in no way prejudices decision to be made about legal units of measurement for forces and for their application in different "hardness systems".

At present, these systems use : the kilogram-force or its equivalent the kilopond,

1 kilogram-force (kgf) = 1 kilopond (kp) = 9.80665 newtons (N).

Translator's Note : The SI derived unit, with special name, for force is the newton (symbol N) (equivalent in terms of SI base units to m.kg.s^{-2}). The units kilogram-force and kilopond are from the "technical metric system".

2.3. The supporting surface must have a fine ground finish.

2.4. The test surface must not be spoiled by any deterioration or defect likely to affect the measurement of the indentations.

3 Markings

3.1. On one of the side surfaces of each standardized block the manufacturer must indicate :

3.1.1. his name or his mark,

3.1.2. the manufacturing number,

3.1.3. the initials HRB — indicating that it is a Rockwell B hardness standardized block.

A free space must be reserved in front of the initials HRB for a 4-digit number, for inserting the hardness index determined during calibration :

3.1.4. The above markings must be applied in such a way that the test surface is on top when the letters are vertical and in normal reading position:

Note: one of the side surfaces must have a free space for the application of the verification stamp.

CHAPTER B

HARDNESS CHARACTERISTICS

4 Hardness index

4.1. The HRB hardness index of a block is defined as the arithmetic mean value of 5 indentations carried out with a standard Rockwell B system testing machine and uniformly distributed over the whole test surface :

5 Repeatability of hardness

5.1. The repeatability of hardness is defined as the value expressed in Rockwell units of the difference between the largest and the smallest of the remaining^(*) depths of penetration of the 5 indentations.

5.2. The relative repeatability of hardness is defined as the ratio, expressed in %, of the above defined value which indicates the repeatability of hardness to the value expressed in Rockwell units of the arithmetic mean $\bar{e}$ of the remaining depths of penetration e of the 5 indentations.

5.2.1. The relative repeatability must not exceed 3%.

6 Stability of hardness

6.1. The stability over a period of time of the hardness of the block must be such that, during the 2 year period between two successive periodic verifications, the hardness of the block does not vary more than $\pm 3 \%$, with respect to the initial index determined during the first calibration.

In all other cases, the stability is inadequate.

^(*) *Translator's Note:* The "remaining depth of penetration" is the increase in the depth of penetration of the indenter after it has been subjected to the test load and while it is still subject to the support load, compared with the initial penetration while it is subject to the support load and before it has been subjected to the test load. This is defined as "e" in the Annex.

CHAPTER C

INSTRUCTIONS ON CALIBRATION

7 Calibration

7.1. The calibration of hardness standardized blocks must be carried out with a standard testing machine in which the support force^(*) and the test force^(*), the form of the indenter and the device for measuring the depth of the indentation can be checked by direct measurements.

7.2. The support force and the test force must be applied by means of weights, the mass of which is adjusted according to the values of these forces.

They must be accurate to within ± 0.1 %.

7.3. The forces must be applied and withdrawn without shock.

The mechanism controlling the application of the forces must have either :

- (a) a device for reducing the speed of penetration, or
- (b) a regulating device for keeping the speed of penetration constant.

In machines of the first type, the initial speed of the indenter, before it penetrates the block, must not exceed 1 mm/s,

in machines of the second type, the speed of penetration must be between 0.003 and 0.012 mm/s.

7.4. The apparatus for measuring the depth of the indentations must allow the vertical displacements of the indenter to be measured with an accuracy of ± 0.1 Rockwell unit (± 0.0002 mm).

7.5. The indenter must be a hardened steel spherical ball with a minimum hardness of 850 HV 10 ; the nominal diameter of this ball must be 1.5875 mm.

Its sphericity must be such that none of its diameters differ from the nominal diameter by more than ± 0.001 mm.

The surface must be highly polished and free from defects, wear or damage.

^(*) *Translator's Note:* The "support force" is referred to as the "preliminary load" in ISO Recommendation R.674-1968.
 The "test force" is referred to as the "additional load" in ISO Recommendation R.674-1968.

8 Making the measurement

- 8.1. The tests are carried out at a temperature of $(20 \pm 2) ^\circ\text{C}$ in temperate climates and $(27 \pm 2) ^\circ\text{C}$ in tropical climates.
- 8.2. Apply the support force, which must remain constant, for 10 to 20 seconds, take, as quickly as possible, the initial reading l_0 of the device for measuring the depths of penetration (to ± 0.1 scale divisions),
- apply the test force, which must remain constant, for 30 to 35 seconds,
- withdrawn the test force,
- take, as quickly as possible, the final reading l of the device for measuring the depths (to ± 0.1 scale divisions).

CHAPTER D

LIABILITY TO METROLOGICAL CONTROLS

9 Metrological controls

When, in any country, hardness standardized blocks are submitted to State metrological controls ; these must include, according to the internal legislation of that country, all or some of the following checks :

9.1. Pattern approval

Each pattern of hardness standardized block from each manufacturer will be subject to the pattern approval procedure.

Without special authorization no modification may be made to an approved pattern.

9.2. Initial verification and calibration

New hardness standardized blocks must undergo the initial verification tests at the time when their hardness index is determined by calibration.

9.3. Periodic verifications

During these it will be ascertained whether the standardized blocks have retained their specified properties.

9.4. The control procedures will be fixed by the national regulations of each country.

10 Marking the hardness index

10.1. The hardness index determined during calibration will be marked by the verification and calibration Service in the free space provided in front of the initials HRB marked on one of the side surfaces (Paragraph 3.1.3).

11 Control marks

11.1. A control mark as proof of verification and calibration will be applied in the appropriate free space on one of the side surfaces (see note on page 5).

11.2. A guarantee mark will also be applied on the test surface in such a position that it does not interfere with the use of the block, but will indicate that the surface has not been ground subsequently.

CHAPTER E

USE AND STORAGE

12 Use

Only the test surface may be used for indentations.

13 Storage

The standardized blocks must be carefully stored and protected against any damage or deterioration, both of the test surface and of the supporting surface.

ANNEX

Example of repeatability requirement (See Chapter B)

Mean of the remaining depths of penetration of the indentations in units of the Rockwell scale	Hardness index of the block HRB (*)	Repeatability requirement in units of the Rockwell scale
30	100	0.9 (3%)
50	80	1.5
70	60	2.1
90	40	2.7

(*) $HRB = 130 - \bar{e}$

$\bar{e}$ = arithmetic mean of the remaining depths of penetration "e" of 5 indentations expressed in units of the Rockwell scale (0.002 mm).

e = remaining depth of penetration, which is the increase in the penetration of the indenter, after it has been subjected to the test load and while it is still under the support load.

The indentations are made with a spherical steel indenter with a diameter of 1.5875 mm under an initial support load of 10kg applied for 10-20s, then increased by a test load of 90kg applied for 30-35s.

Contents

<i>Foreword</i>	2
Chapter A, Construction requirements.....	3
Chapter B, Hardness characteristics.....	5
Chapter C, Instructions on calibration.....	6
Chapter D, Liability to metrological controls.....	8
Chapter E, Use and storage.....	8
Annex.....	9