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Metallic materials — Hardness test — Verification of Rockwell superficial hardness testing machines (scales 15N, 30N, 45N, 15T, 30T and 45T)

Matériaux métalliques — Essai de dureté — Contrôle des machines d'essai de dureté superficielle Rockwell (échelles 15N, 30N, 45N, 15T, 30T et 45T)

Reference number
ISO 1079 : 1989 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1079 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals.*

It cancels and replaces ISO Recommendation R 1079 : 1969, of which it constitutes a technical revision.

Annexes A and B form an integral part of this International Standard.

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Metallic materials — Hardness test — Verification of Rockwell superficial hardness testing machines (scales 15N, 30N, 45N, 15T, 30T and 45T)

1 Scope

This International Standard specifies a method of verification of testing machines for determining Rockwell superficial hardness (scales 15N, 30N, 45N, 15T, 30T and 45T) in accordance with ISO 1024.

It describes a direct verification method for checking the main functions of the machine, and an indirect verification method suitable for the overall checking of the machine. The indirect verification method may be used on its own for periodic routine checking of the machine in service.

If a testing machine is also to be used for other methods of hardness testing, it shall be verified independently for each method.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1024 : 1989, *Metallic materials — Hardness test — Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T).*

ISO 1355 : 1989, *Metallic materials — Hardness test — Calibration of standardized blocks to be used for Rockwell superficial hardness testing machines (scales 15N, 30N, 45N, 15T, 30T and 45T).*

ISO 6507-1 : 1982, *Metallic materials — Hardness test — Vickers test — Part 1:* HV 5 *to* HV 100.

3 General conditions

Before a Rockwell superficial hardness testing machine is verified, it shall be checked to ensure that

a) the machine is properly set up;

b) the plunger holding the indenter is capable of sliding in its guide, by its own weight, but without any appreciable clearance;

c) the indenter-holder is firmly mounted in the plunger;

d) the test force can be applied and removed without shock or vibration and in such a manner that the readings are not influenced;

e) the readings are not affected either by movements of the test piece or by deformations of the frame. When a device is supplied which locks the test piece against the upper part of the frame, the locking force shall exceed the total test force. The influence of deformations may be checked by using a plain plunger instead of the indenter, bearing directly against the anvil and using the locking device (when it is supplied). The readings of the measuring device before application and after removal of the additional test force shall not differ by more than 1,0 Rockwell superficial unit.

4 Direct verification

Direct verification involves

— verification of the test force;

— verification of the indenter;

— verification of the measuring device.

4.1 Verification of the test force

4.1.1 The preliminary test force F_0 (see 4.1.4) and each total test force F used (see 4.1.5) shall be measured, and, whenever applicable, this shall be done at not less than three positions of the plunger spaced throughout its range of movement during testing.

4.1.2 The forces shall be measured by one of the following two methods:

a) measurement by means of an elastic proving device previously calibrated to an accuracy of ± 0,2 %,

or

b) balancing against a force, accurate to ± 0,2 %, applied by means of standardized masses with mechanical advantage.

4.1.3 Three readings shall be taken for each force at each position of the plunger. Immediately before each reading is taken, the plunger shall have been moved in the same direction as during testing.

4.1.4 The tolerance on the preliminary test force F_0 before application and after removal of the additional test force F_1 shall be ± 2,0 %.

4.1.5 The tolerance on the total test force F shall be ± 0,7 %.

4.2 Verification of the indenter

4.2.1 Diamond cone indenters (scales 15N, 30N and 45N) shall be verified following the procedure given in 4.2.1.1 to 4.2.1.6.

4.2.1.1 The surface of the diamond cone and spherical tip shall be positioned for a penetration depth of 0,20 mm and shall be free from surface defects.

4.2.1.2 The verification of the shape of the indenter can be made by direct measurement or by measurement of its projection on a screen. The verification shall be made at not less than four sections.

4.2.1.3 The diamond cone shall have an included angle of 120° ± 0,35°.

Deviations from straightness of the generator of the diamond cone, adjacent to the blend, shall not exceed 0,001 mm over a minimum length of 0,35 mm.

4.2.1.4 The angle between the axis of the diamond cone and the axis of the indenter-holder (normal to the seating surface) shall not exceed 0,5°.

4.2.1.5 The spherical tip of the diamond cone shall have a mean radius of 0,200 mm ± 0,010 mm. In each measured section, the radius shall be 0,200 mm ± 0,015 mm and local deviations from it shall not exceed 0,002 mm.

The surfaces of the cone and spherical tip shall blend in a truly tangential manner.

4.2.1.6 The hardness values given by the testing machine do not depend only on the dimensions given in 4.2.1.3 and 4.2.1.5, but also on the surface roughness and the position of the crystallographic axes of the diamond, and the seating of the diamond in its holder.

For this reason, an indirect verification is considered necessary. The performance of the test indenter shall be compared in a standardizing machine with the performance of the standardizing machine indenter. The test shall be in accordance with ISO 1355.

Tests shall be made on a minimum of two blocks in the 30N scale, one at a hardness level near the lower limit, the second near the upper limit of the field of application of this scale. For each block the mean hardness value of three indentations made using the indenter to be verified shall not differ from the mean hardness of the three indentations obtained with the standardizing indenter by more than ± 0,8 Rockwell superficial hardness units. The indentations with the indenter to be verified and with the standardizing indenter shall be located so that the indentations of the two indenters are in each case adjacent. The test shall be made in accordance with ISO 1355.

NOTE — The standardizing indenter is the indenter or the indenters recognized as the reference indenter(s) at national level.

4.2.2 Steel ball indenters (scales 15T, 30T and 45T) shall be verified following the procedure given in 4.2.2.1 to 4.2.2.3.

4.2.2.1 For the purpose of verifying the size and the hardness of the steel balls it is considered sufficient to test a sample ball selected at random from a batch. The ball verified for hardness shall be discarded.

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

4.2.2.3 The user shall either measure the balls to ensure that they meet the following requirements, or he shall obtain balls from a supplier who can certify that the following conditions are met:

a) the diameter, when measured at not less than three positions, shall be 1,587 5 mm ± 0,003 5 mm.

b) the hardness of the steel balls shall be not less than 850 HV 10, when determined in accordance with ISO 6507-1, and applying the appropriate correction for curvature as given in annex B of ISO 6507-1 : 1982 (the maximum value of the mean diagonal of the indentation made on the ball with a Vickers indenter at 98,07 N is therefore 0,141 mm).

4.3 Verification of the measuring device

The depth-measuring device shall be verified over not less than three intervals, including the intervals corresponding to the lowest and highest hardnesses for which the scales are normally used, by making known incremental movements of the indenter in the direction of increasing hardness values.

The instrument used to verify the depth-measuring device shall have an accuracy of 0,000 2 mm. The depth-measuring device shall correctly indicate within ± 0,000 5 mm, i.e. within ± 0,5 Rockwell superficial hardness units, over each range.

5 Indirect verification

Indirect verification may be carried out by means of standardized blocks calibrated in accordance with ISO 1355.

5.1 Procedure

5.1.1 For indirect verification of a testing machine, the following procedures shall be applied.

The testing machine shall be verified for each scale for which it is normally used. For each scale to be verified, standardized blocks from at least two of the hardness ranges given in table 1 shall be used. The hardness values of the blocks shall approximate to the limits of intended use.

Table 1a

Rockwell hardness scale	Hardness range of standardized block
15N	70 to 75 HR15N 78 to 88 HR15N 89 to 91 HR15N
30N	42 to 50 HR30N 55 to 73 HR30N 75 to 80 HR30N
45N	20 to 31 HR45N 37 to 61 HR45N 63 to 70 HR45N

Table 1b

Rockwell hardness scale	Hardness range of standardized block
15T	73 to 80 HR15T 80 to 87 HR15T 87 to 93 HR15T
30T	43 to 56 HR30T 57 to 70 HR30T 70 to 82 HR30T
45T	12 to 33 HR45T 34 to 54 HR45T 54 to 72 HR45T

5.1.2 For purposes of routine checking, a hardness testing machine may be checked at one hardness value only, corresponding approximately to that of the tests to be made.

5.1.3 On each standardized block, five indentations shall be made and each hardness number observed to within 0,2 Rockwell superficial hardness units. Before making these indentations, at least two preliminary indentations shall be made to ensure that the machine is working freely and that the standardized block, the indenter and the anvil are seated correctly. The results of these preliminary indentations shall be ignored. The test shall be made in accordance with ISO 1024.

5.2 Repeatability

5.2.1 For each standardized block, let e_1, e_2, ..., e_5 be the values of the measured increase in depth of indentation, arranged in increasing order of magnitude, where $\bar{e}$ is in units of 0,001 mm as defined in ISO 1024.

The repeatability of the testing machine under the particular verification conditions is determined by the following quantity:

$$e_5 - e_1$$

5.2.2 The maximum permissible repeatability of the testing machine at each hardness level verified shall be

— for the scales 15N, 30N and 45N: 0,04 $\bar{e}$ or 1,2 Rockwell superficial hardness units, whichever is the greater (see annex B);

— for the scales 15T, 30T and 45T: 0,06 $\bar{e}$ or 2,4 Rockwell superficial hardness units, whichever is the greater (see annex B);

where

$$\bar{e} = \frac{e_1 + e_2 + \ldots + e_5}{5}$$

5.3 Error

5.3.1 The error of the testing machine under the particular verification conditions is expressed by the following quantity:

$$\bar{H} - H$$

where

$$\bar{H} = \frac{H_1 + H_2 + \ldots + H_5}{5}$$

$H_1, H_2, \ldots, H_5$ are the hardness values corresponding to $e_1, e_2, \ldots, e_5$;

H is the specified hardness of the standardized block used.

5.3.2 The maximum error of the testing machine shall not exceed the values given in table 2.

Table 2

Rockwell superficial hardness scale	Maximum permissible error (Rockwell superficial hardness units)
15N 30N 45N	± 1,5 ± 1,5 ± 1,5
15T 30T 45T	± 2,5 ± 2,5 ± 2,5

6 Verification report

The verification report shall include the following information:

a) reference to this International Standard;

b) method of verification (direct or indirect);

c) identification data of the hardness testing machine;

d) means of verification (test block, elastic proving devices, etc.);

e) the Rockwell superficial hardness scale(s) verified;

f) the result obtained;

g) date of verification and reference to the testing institution.

Annex A
(normative)

Notes on diamond indenters

Experience has shown that initially satisfactory indenters can become defective after use for a comparatively short time. This is due to small cracks, pits or other flaws in the surface. If such faults are detected in time, many indenters may be reclaimed by regrinding. If not, any small defects on the surface rapidly worsen and make the indenter useless.

Therefore,

— the condition of indenters shall be checked initially and at frequent intervals using appropriate optical devices (microscope, magnifying glass, etc.);

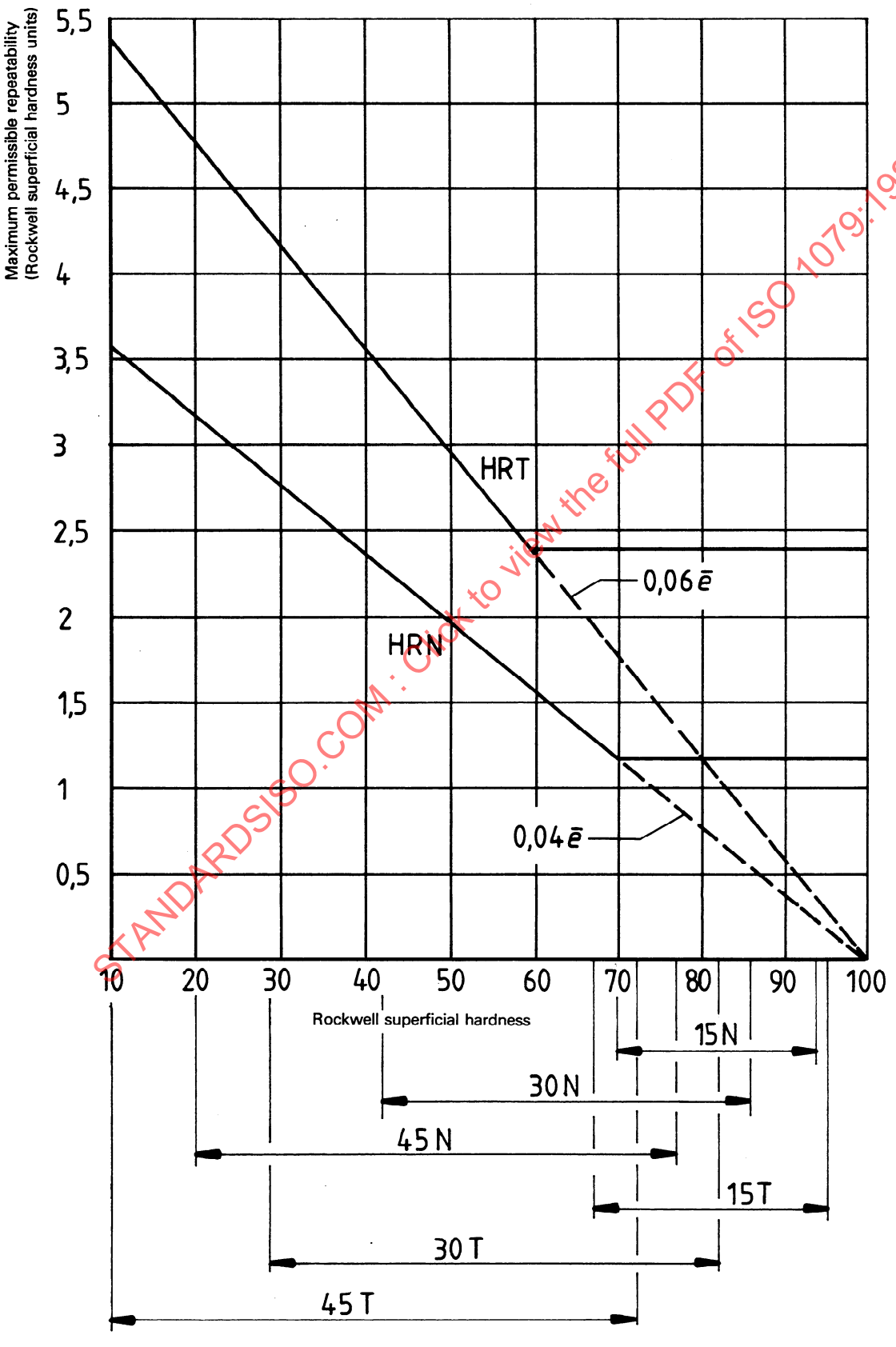
— if the flaw is not on the active part of the indenter, it may be ignored, but if it is on the active part, even if small, the indenter shall not be used;

— the verification of the indenter is no longer valid when the indenter has become unusable because of defects;

— reground or otherwise repaired indenters shall be reverified.

Annex B
(normative)

Repeatability of testing machine



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