
International Standard



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Hardmetals — Rockwell hardness test (scale A) — Part 1 : Test method

Métaux-durs — Essai de dureté Rockwell (échelle A) — Partie 1 : Méthode d'essai

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Foreword

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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.

International Standard ISO 3738/1 was developed by Technical Committee ISO/TC 119, *Powder metallurgy*, and was circulated to the member bodies in February 1982.

It has been approved by the member bodies of the following countries :

Brazil	Ireland	Spain
Bulgaria	Italy	Sweden
China	Korea, Rep. of	Switzerland
Czechoslovakia	Mexico	USA
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The member body of the following country expressed disapproval of the document on technical grounds :

United Kingdom

This International Standard cancels and replaces International Standard ISO 3738-1976 of which it constitutes a technical revision.

Hardmetals — Rockwell hardness test (scale A) —

Part 1 : Test method

1 Scope and field of application

This part of ISO 3738 specifies the Rockwell hardness test (scale A) for hardmetals.

2 References

- ISO/R 80, *Rockwell hardness test (B and C scales) for steel.*
- ISO/R 716, *Verification of Rockwell B and C scale hardness testing machines.*

3 Principle

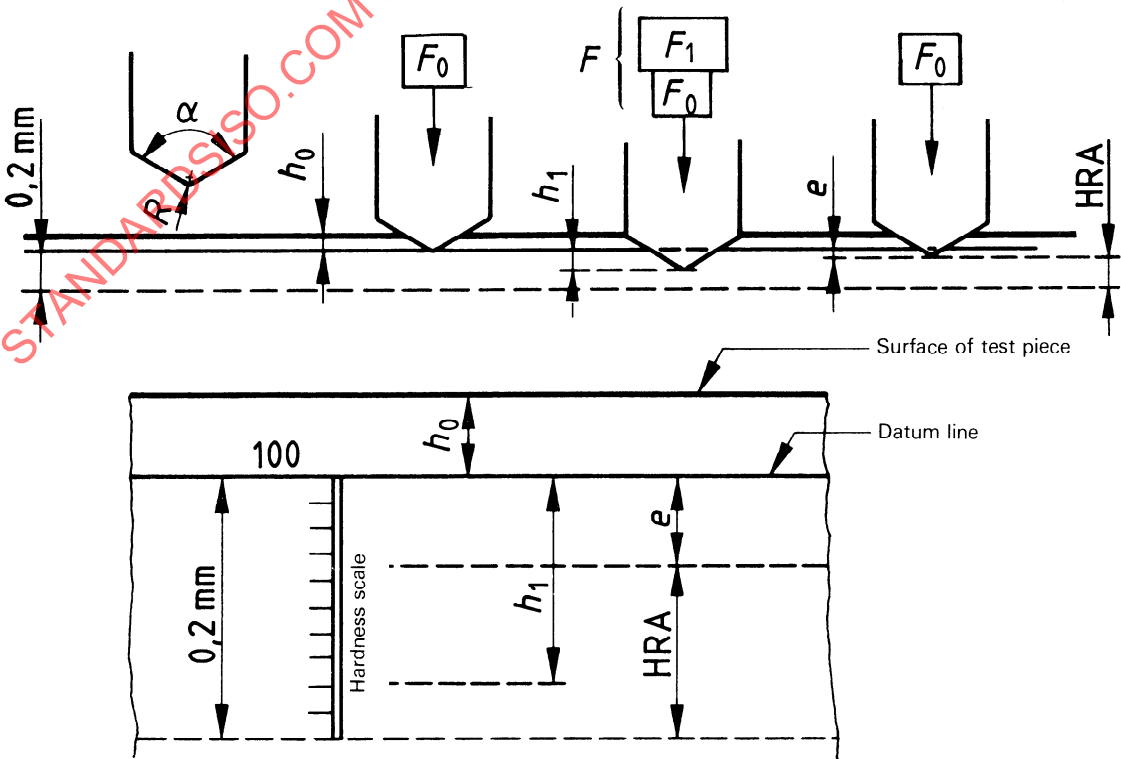
Forcing a conical diamond indenter into a test piece in two operations and measurement of the permanent increase, e , of the depth of indentation by means of a depth gauge under defined conditions.

4 Symbols, designations and values of parameters

See table 1 and the figure.

Table 1

Symbol	Designation
α	Angle of the diamond cone ($120 \pm 0,5^\circ$)
R	Radius of curvature at the tip of the cone ($0,2 \pm 0,002$ mm)
F_0	Preliminary test force ($98,07 \pm 1,96$ N)
F_1	Additional test force ($490,3$ N)
F	Total test force ($98,07 + 490,3 = 588,4 \pm 3,92$ N)
h_0	Depth of indentation under preliminary test force before application of the additional force
h_1	Increase in depth of indentation under additional force
e	Permanent increase in depth of indentation under preliminary force after removal of additional force, expressed in units of $0,002$ mm
HRA	Rockwell hardness A = $100 - e$



Figure

5 Apparatus

5.1 Testing equipment, such that the measurements can be made of 0,2 HRA or better.

5.2 Diamond indenter, as specified in ISO/R 716.

A performance test of the indenter shall be carried out on a machine for which the force-application and depth-measuring device shall have been verified. At least five indentations shall be made on each of a series of five standard hardmetal test blocks. Calculate the mean hardness for each test block. Determine the difference between this mean hardness and the certified hardness of the block. Determine the arithmetical mean and the range of these five differences. If the average is not more than $\pm 0,3$ HRA and the range is not more than 0,6 HRA, the indenter shall be accepted.

5.3 Standard hardmetal test blocks, of all or any of the nominal hardnesses given in table 2.

Table 2

Standard test block No.	Nominal hardness of the test block
	HRA
1	85,5
2	88,5
3	91,0
4	92,0
5	93,0

6 Test pieces

6.1 The test shall be carried out on a test piece with a surface so prepared that its roughness is $R_a \leq 0,2 \mu\text{m}$.

The thickness of the layer removed from the as-sintered surface shall be not less than 0,2 mm.

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

When determining the hardness of a test piece with a curved surface, the radius of curvature shall be not less than 15 mm.

In order to determine the hardness of a test piece with a radius of curvature less than 15 mm, a flat surface, at least 3 mm wide, shall be prepared on which to carry out the test.

6.2 The prepared test piece shall be at least 1,6 mm thick.

6.3 The surface of the test piece on which the indenter is applied shall be parallel to the support surface within 0,1 mm for each 10 mm of length.

7 Procedure

7.1 The order of procedure shall be in accordance with ISO/R 80, with the following amendments.

7.1.1 The first two readings after a new indenter has been mounted shall be disregarded.

7.1.2 The speed of applying the additional force shall be limited so that the movement of the weights is completed in 6 to 8 s with no test piece on the testing equipment.

7.1.3 The time of maintaining the additional force after the movement of the pointer has stopped shall not exceed 2 s. While maintaining the preliminary force, remove the additional force gradually within 2 s.

7.1.4 The anvil should be chosen to ensure adequate support of the test piece.

7.2 Select a standard test block having a value closest to the expected hardness of the test piece. Determine the Rockwell A hardness at three points on the block. The average of the three readings shall be within $\pm 0,5$ HRA of the certified hardness of that block.

If the average value differs from the hardness of the block by more than $\pm 0,5$ HRA, check the diamond indenter and the testing equipment, and eliminate the cause of the error.

If the average value differs from the hardness number of the block by $\pm 0,5$ HRA or less, correct the average value of the hardness of the test pieces, giving due regard to the algebraic sign.

7.3 Before determining the hardness, take an initial reading on the test piece. This reading shall be disregarded. Then determine the hardness on the test piece with at least three indentations made at random.

7.4 The distance between the centres of any two adjacent indentations, and the distance between the centre of any indentation and the edge of the test piece, shall be at least 1,5 mm.

7.5 Read each determination obtained to the reading accuracy of the machine.

8 Expression of results

The hardness of an individual test piece shall be the arithmetical mean of the readings rounded as in table 3.

Table 3

Reading accuracy	Rounded to the nearest, (Number of indentations)	
	3 or 4	over 4
0,2 HRA	0,2 HRA	0,1 HRA
0,1 HRA	0,1 HRA	0,1 HRA

9 Test report

The test report shall include the following information :

- a) a reference to this International Standard;
- b) all details necessary for identification of the test sample;
- c) the result obtained;

d) all operations not specified by this International Standard, or regarded as optional;

e) details of any occurrence which may have affected the results.

NOTE — There is no general process for converting accurately Rockwell hardness into other scales of hardness. Such conversions, therefore, should be avoided, except cases where a reliable basis for conversion can be obtained by comparison tests.

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