International Standard 6508

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Metallic materials — Hardness test — Rockwell test (scales A — B — C — D — E — F — G — H — K)

Matériaux métalliques — Essai de dureté — Essai Rockwell (échelles A — B — C — D — E — F — G — H — K)

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

International Standard ISO 6508 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*.

It cancels and replaces ISO Recommendation R 80-1968 and International Standard ISO 2713-1973, of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Metallic materials — Hardness test — Rockwell test (scales A — B — C — D — E — F — G — H — K)

1 Scope and field of application

This International Standard specifies the method for the Rockwell hardness test (scales and field of application according to table 1) for metallic materials.

For specific materials and/or products, particular International Standards exist (see clause 2).

NOTE — For certain materials, the fields of application may be narrower than those indicated.

2 References

ISO 716, *Metallic materials — Hardness test — Verification of Rockwell hardness testing machines (scales A — B — C — D — E — F — G — H — K).*

ISO 3738/1, *Hardmetals — Rockwell hardness test (scale A) — Part 1: Test method.*

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

3 Principle

Forcing an indenter (diamond cone or steel ball) into the surface of a test piece in two steps under specified conditions (see clause 7). Measuring the permanent increase e of the depth of indentation.

The unit of measurement for e is 0,002 mm. From the value of e, a number known as the Rockwell hardness is derived.

Table 1

Rockwell hardness scale	Hardness symbol	Type of indenter	Preliminary test force F_0	Additional test force F_1	Total test force F	Field of application (Rockwell hardness range)
A	HRA	Diamond cone	98,07 N	490,3 N	588,4 N	20 to 88 HRA
B	HRB	Steel ball 1,587 5 mm	98,07 N	882,6 N	980,7 N	20 to 100 HRB
C	HRC	Diamond cone	98,07 N	1,373 kN	1,471 kN	20 to 70 HRC
D	HRD	Diamond cone	98,07 N	882,6 N	980,7 N	40 to 77 HRD
E	HRE	Steel ball 3,175 mm	98,07 N	882,6 N	980,7 N	70 to 100 HRE
F	HRF	Steel ball 1,587 5 mm	98,07 N	490,3 N	588,4 N	60 to 100 HRF
G	HRG	Steel ball 1,587 5 mm	98,07 N	1,373 kN	1,471 kN	30 to 94 HRG
H	HRH	Steel ball 3,175 mm	98,07 N	490,3 N	588,4 N	80 to 100 HRH
K	HRK	Steel ball 3,175 mm	98,07 N	1,373 kN	1,471 kN	40 to 100 HRK

4 Symbols and designations

See tables 1 and 2 and figures 1 and 2.

Table 2

Symbol	Designation
α	Angle of the diamond cone
R	Radius of curvature at the tip of the diamond cone
D	Diameter of steel ball
F_0	Preliminary test force
F_1	Additional test force
F	Total test force
h_0	Depth of indentation under preliminary test force before application of additional test force
h_1	Increase in depth of indentation under additional test force
e	Permanent increase of depth of indentation under preliminary test force after removal of additional test force, expressed in units of 0,002 mm
HRA HRC HRD	Rockwell hardness = $100 - e$
HRB HRE HRF HRG HRH HRK	Rockwell hardness = $130 - e$

The Rockwell hardness is denoted by the symbol HR preceded by the hardness value and completed by a letter indicating the scale.

Example

59 HRC = Rockwell hardness of 59, measured on the C scale.

5 Apparatus

5.1 Testing machine, capable of applying predetermined forces as shown in table 1, and in accordance with ISO 716.

5.2 Conical diamond indenter in accordance with ISO 716, having an angle of 120° and radius of curvature at the tip of 0,200 mm.

5.3 Steel ball indenter in accordance with ISO 716, having a diameter of 1,587 5 or 3,175 mm.

5.4 Measuring device in accordance with ISO 716.

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, completely free from lubricants.

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

6.3 The thickness of the test piece or of the layer under test shall be at least ten times the permanent increase of depth e (see annex A).

After the test, no deformation shall be visible on the surface of the test piece opposite the indentation.

6.4 For tests on convex cylindrical surfaces and spherical surfaces the corrections given in annex B, table 3 or 4 and table 5 in annex C, shall be applied. In the absence of corrections for tests on concave surfaces, tests on such surfaces shall be the subject of special agreement.

7 Procedure

7.1 In general, the test should be carried out at ambient temperature within the limits of 10 to 35 °C. Tests carried out under controlled conditions shall be made at a temperature of 23 ± 5 °C.

7.2 The test piece shall be placed on a rigid support and supported in such a manner that the surface to be indented is in a plane normal to the axis of the indenter and the line of the indenting force.

Products of cylindrical shape shall be suitably supported, for example, on centering V-blocks of steel with a Rockwell hardness of at least 60 HRC. Special attention shall be given to the correct seating, bearing and alignment of the indenters, the test piece, the centering V-blocks and the specimen holder of the testing machine since any perpendicular misalignment may result in incorrect observations.

7.3 Bring the indenter into contact with the test surface and apply the preliminary test force F_0 = 98,07 N without shock or vibration.

7.4 Set the measuring device to its datum position and, without shock or vibration, increase the force from F_0 to F in not less than 2 nor greater than 8 s.

F = 588,4 N for scales A, F and H

F = 980,7 N for scales B, D and E

F = 1,471 kN for scales C, G and K

7.5 While maintaining the preliminary force F_0, remove the additional force F_1, so that

— for materials which, under the conditions of the test, show no time-dependent plasticity, the duration of the total test force F shall be not less than 1 s nor greater than 3 s;

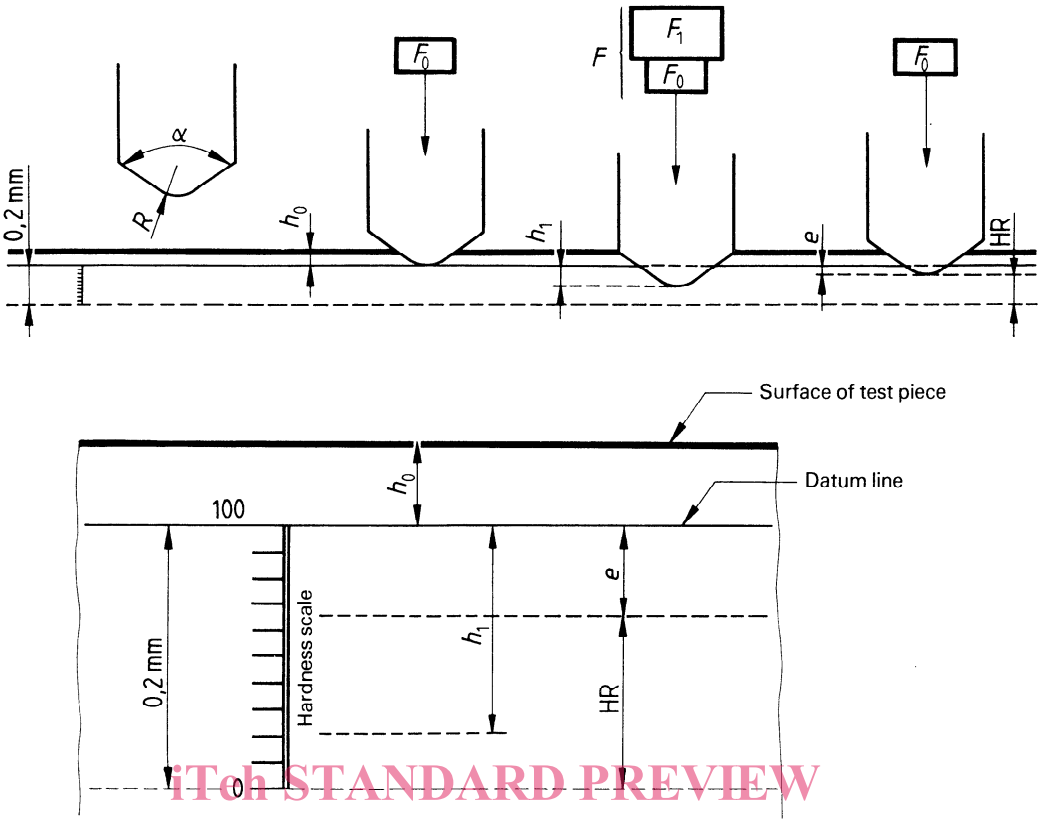

Figure 1 — Surface of test piece with diamond cone (Rockwell scales A, C or D)

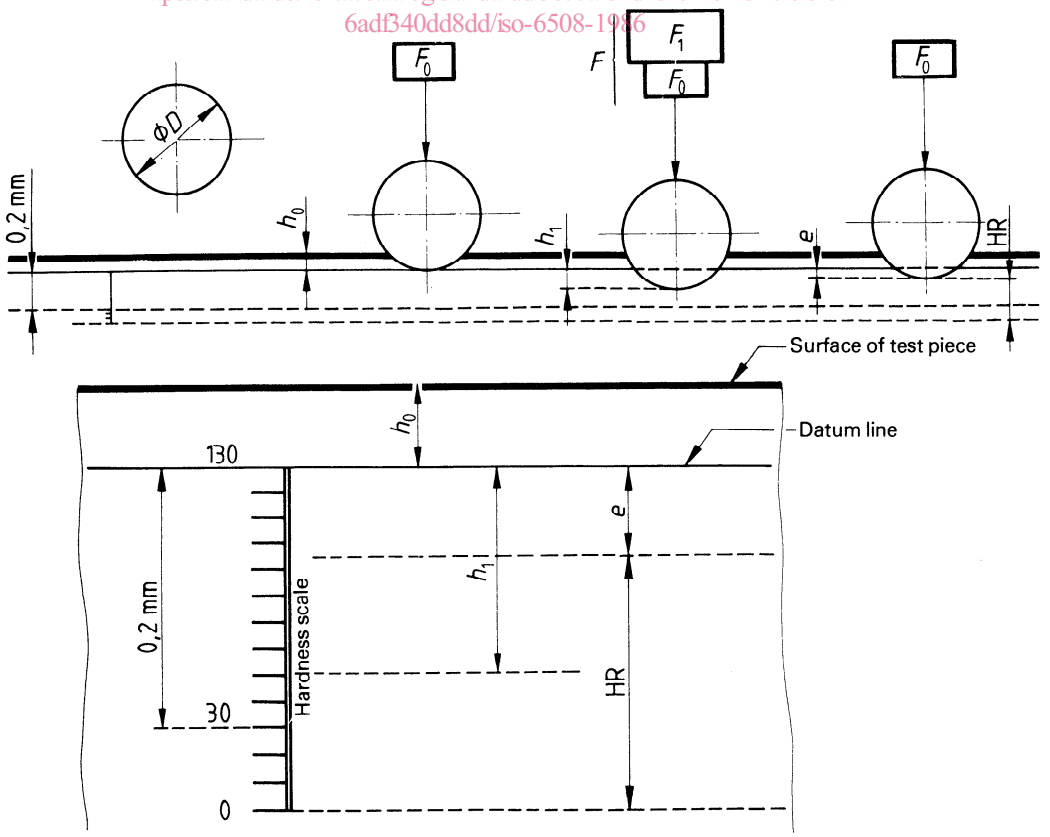

Figure 2 — Surface of test piece with steel ball (Rockwell scales B, E, F, G, H or K)

— for materials which, under the conditions of the test, show some time-dependent plasticity, the duration of the total test force F shall be not less than 1 s nor greater than 5 s;

— for materials which, under the conditions of the test, show considerable time-dependent plasticity, the duration of total test force F shall be not less than 10 s nor greater than 15 s.

7.6 Throughout the test, the apparatus shall be protected from shock or vibration.

7.7 The Rockwell hardness number is derived from the permanent increase in depth of indentation e, and is usually read directly from the measuring device. The derivation of the Rockwell hardness number is illustrated in figures 1 and 2.

7.8 After each change, or removal and replacement, of the indenter or the test piece support, it shall be ascertained that the new indenter or the new support is correctly mounted in its housing. The first two readings after such a change has been made shall be disregarded.

7.9 The distance between the centres of two adjacent indentations shall be at least four times the diameter of the indentation (but at least 2 mm).

The distance from the centre of any indentation to an edge of the test piece shall be at least two and a half times the diameter of the indentation (but at least 1 mm).

8 Test report

The test report shall include the following information:

a) reference to this International Standard;

b) all details necessary for identification of the test sample;

c) the result obtained (see note 1);

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

e) details of any occurrence which may have affected the result (see note 2).

NOTES

1 There is no general process for accurately converting Rockwell hardness into other scales of hardness or into tensile strength. Such conversions therefore should be avoided, unless a reliable basis for conversion can be obtained by comparison tests.

2 There is evidence that some materials may be sensitive to the rate of straining which causes small changes in the value of the yield stress. The corresponding effect on the termination of the formation of an identation can make alterations in the hardness value.

Annex A

Minimum thickness of the test piece in relation to the Rockwell hardness

(This annex forms an integral part of the Standard.)

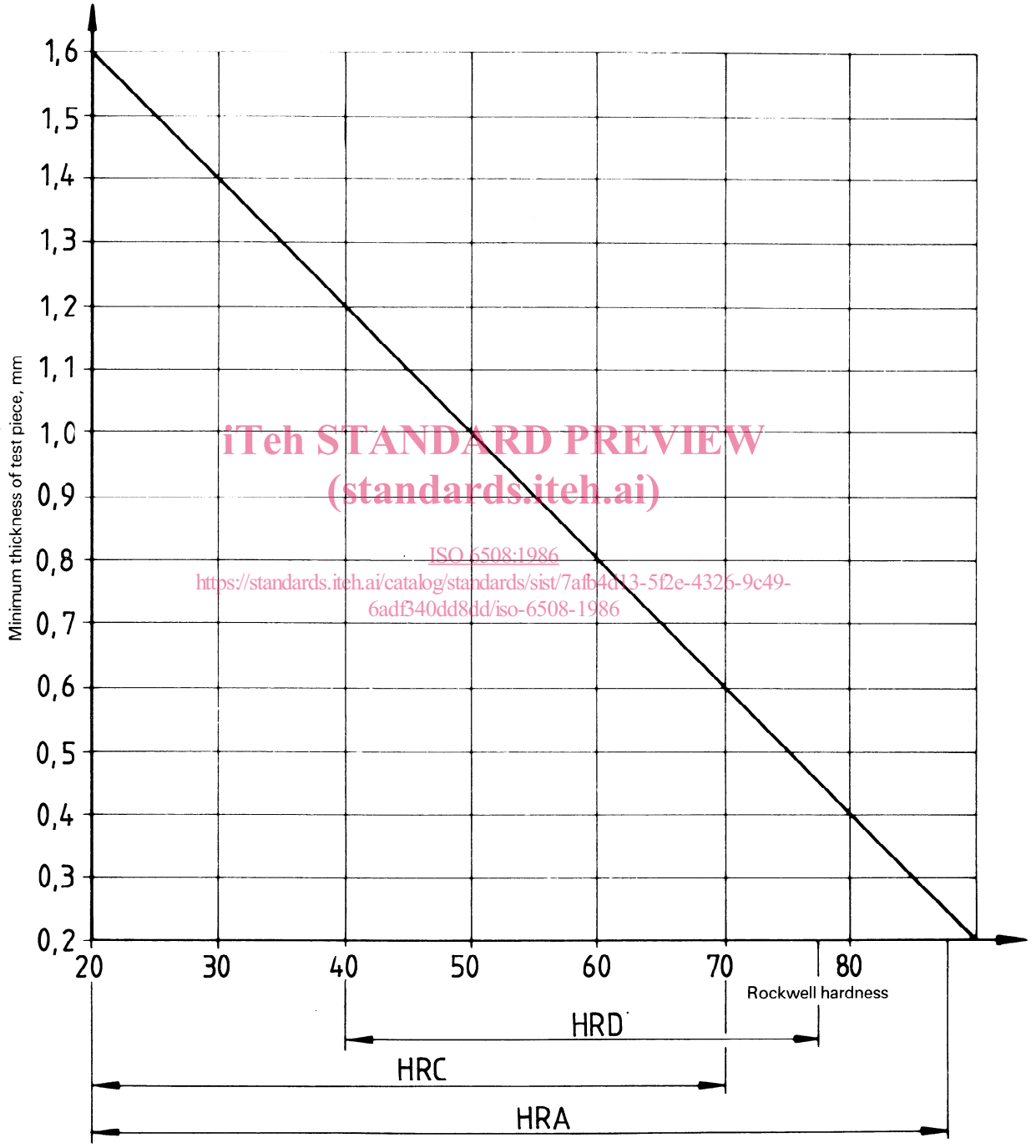

Figure 3 — Test with diamond cone (HRA, HRC, HRD)

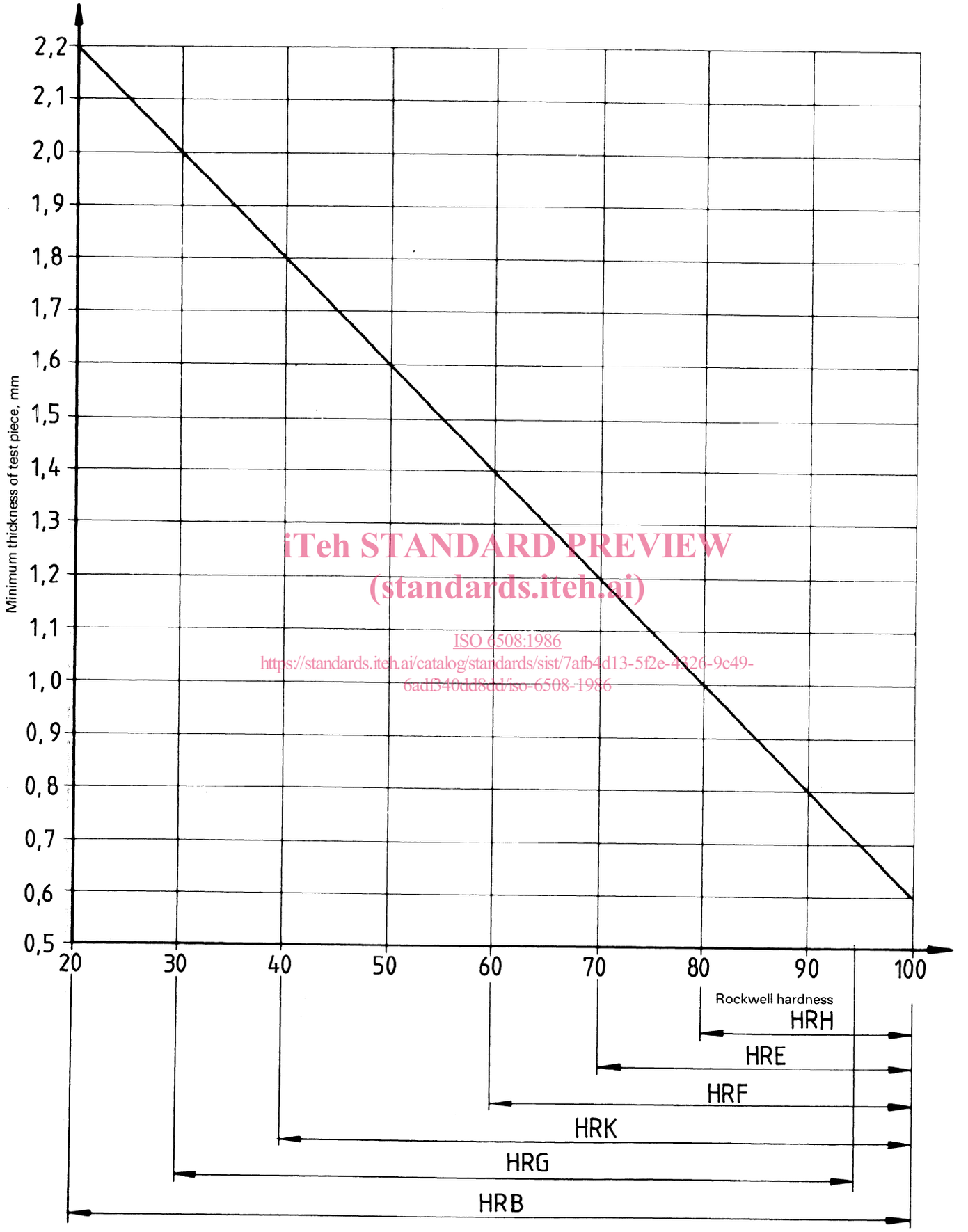

Figure 4 — Test with steel ball (HRB, HRE, HRF, HRG, HRH, HRK)

Annex B

Corrections to be added to Rockwell hardness values obtained on convex cylindrical surfaces

(This annex forms an integral part of the Standard.)

B.1 Test with diamond cone (HRA, HRC, HRD)

Table 3

Rockwell hardness reading	Radius of curvature, mm								
	3	5	6,5	8	9,5	11	12,5	16	19
20				2,5	2,0	1,5	1,5	1,0	1,0
25			3,0	2,5	2,0	1,5	1,0	1,0	1,0
30			2,5	2,0	1,5	1,5	1,0	1,0	0,5
35		3,0	2,0	1,5	1,5	1,0	1,0	0,5	0,5
40		2,5	2,0	1,5	1,0	1,0	1,0	0,5	0,5
45	3,0	2,0	1,5	1,0	1,0	1,0	0,5	0,5	0,5
50	2,5	2,0	1,5	1,0	1,0	0,5	0,5	0,5	0,5
55	2,0	1,5	1,0	1,0	0,5	0,5	0,5	0,5	0
60	1,5	1,0	1,0	0,5	0,5	0,5	0,5	0	0
65	1,5	1,0	1,0	0,5	0,5	0,5	0,5	0	0
70	1,0	1,0	0,5	0,5	0,5	0,5	0,5	0	0
75	1,0	0,5	0,5	0,5	0,5	0,5	0	0	0
80	0,5	0,5	0,5	0,5	0,5	0	0	0	0
85	0,5	0,5	0,5	0	0	0	0	0	0
90	0,5	0	0	0	0	0	0	0	0

NOTE — Corrections greater than 3 HRA, HRC and HRD are not considered acceptable and are not therefore included in the above table.

B.2 Test with 1,587 5 mm steel ball (HRB, HRF, HRG)

Table 4

Rockwell hardness reading	Radius of curvature, mm						
	3	5	6,5	8	9,5	11	12,5
20				4,5	4,0	3,5	3,0
30			5,0	4,5	3,5	3,0	2,5
40			4,5	4,0	3,0	2,5	2,5
50			4,0	3,5	3,0	2,5	2,0
60		5,0	3,5	3,0	2,5	2,0	2,0
70		4,0	3,0	2,5	2,0	2,0	1,5
80	5,0	3,5	2,5	2,0	1,5	1,5	1,5
90	4,0	3,0	2,0	1,5	1,5	1,5	1,0
100	3,5	2,5	1,5	1,5	1,0	1,0	0,5

NOTE — Corrections greater than 5 HRB, HRF, and HRG are not considered acceptable and are not therefore included in the above table.