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ISO 48-9

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Rubber, vulcanized or thermoplastic — Determination of hardness —

Part 9: Calibration and verification of hardness testers

Caoutchouc vulcanisé ou thermoplastique — Détermination de la dureté —

Partie 9: Étalonnage et vérification des duromètres

Reference number
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This first edition of ISO 48-9 cancels and replaces ISO 18898:2016, of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— a new standard number has been given.

— in the Introduction, an explanation of the purpose of the grouping work has been added.

A list of all parts in the ISO 48 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO/TC 45/SC 2 established a principle that it would be helpful for users if standards on the same subject but covering different aspects or methods were grouped together, preferably with an introductory guidance standard, rather than being scattered throughout the numbering system. This has been achieved for some subjects, for example curemeters (ISO 6502) and dynamic properties (ISO 4664).

In 2017, it was decided to group standards for hardness and, subsequently, it was agreed that they would be grouped under the ISO 48 number. The new standards together with the previously numbered standards are listed below.

— ISO 48-1: former ISO 18517

— ISO 48-2: former ISO 48

— ISO 48-3: former ISO 27588

— ISO 48-4: former ISO 7619-1

— ISO 48-5: former ISO 7619-2

— ISO 48-6: former ISO 7267-1

— ISO 48-7: former ISO 7267-2

— ISO 48-8: former ISO 7267-3

— ISO 48-9: former ISO 18898

Rubber, vulcanized or thermoplastic — Determination of hardness —

Part 9:
Calibration and verification of hardness testers

1 Scope

This document specifies procedures for the calibration and verification of durometers of types A, D, AO and AM (see ISO 48-4), IRHD pocket meters (see ISO 48-5), IRHD dead-load instruments (see ISO 48-2) and dead-load instruments using the very low rubber hardness scale (see ISO 48-3).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 48-3, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 3: Dead-load hardness using the very low rubber hardness (VLRH) scale*

ISO 48-4, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 4: Indentation hardness by durometer method (Shore hardness)*

ISO 48-5, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 5: Indentation hardness by IRHD pocket meter method*

ISO 18899, *Rubber — Guide to the calibration of test equipment*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 48-2 and ISO 18899 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Measurands and metrological requirements for calibration and verification

4.1 Environmental conditions

The ambient temperature of the measurement room in which the calibration or verification is carried out shall be 18 °C to 25 °C.

4.2 Metrological requirements

The measurands, as specified in ISO 48-2, ISO 48-3, ISO 48-4, and ISO 48-5, of indentor and pressure foot for the instrument to be calibrated are depicted in Figures 1 to 7 and requirements are specified in Tables 1 to 10.

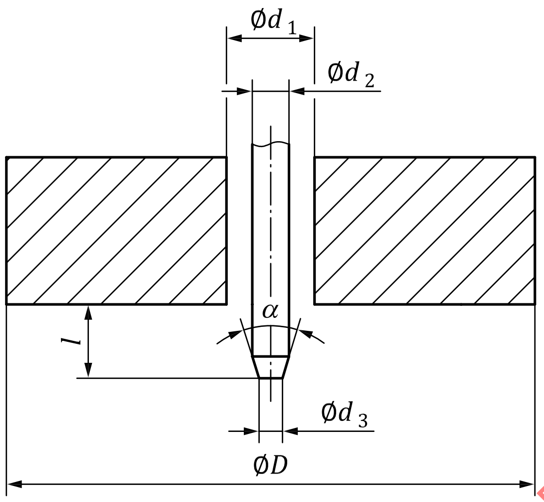

Figure 1 — Indentor and pressure foot for type A durometer

Table 1 — Type A durometer

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Shaft diameter of indentor	d_2	mm	1,25 ± 0,15	5.2.1.2
Cone frustum top diameter	d_3	mm	0,79 ± 0,01	5.2.1.2
Cone angle of indentor	α	°	35,00 ± 0,25	5.2.1.2
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	18,0 ± 0,5	5.2.2.1
Hole diameter of pressure foot	d_1	mm	3,0 ± 0,1	5.2.2.2
Mass on pressure foot	m	kg	$1{,}0^{+0{,}1}_{0{,}0}$	5.2.4.1
Depth of indentation	l	mm	0,00 to 2,50; Δl = ±0,02	5.2.3.1
Spring force on indentor	F	mN	F = 550,0 + 75,0H_A; ΔF = ±37,5 where H_A = hardness reading on type A durometer	5.2.5.1
Duration of force application	t	s	3 or 15	5.2.7

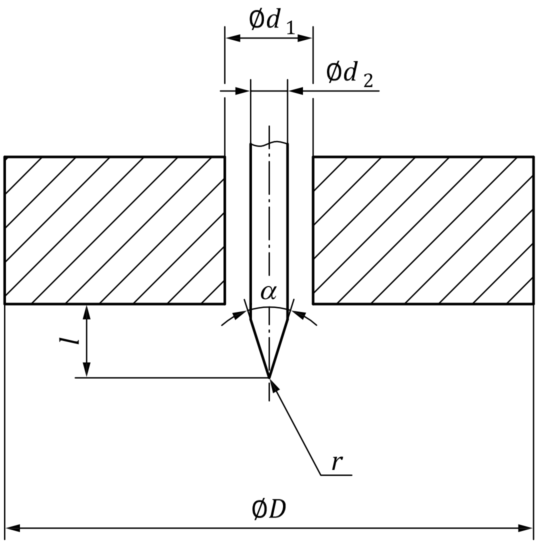

Figure 2 — Indentor and pressure foot for type D durometer

Table 2 — Type D durometer

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Shaft diameter of indentor	d_2	mm	1,25 ± 0,15	5.2.1.3
Radius of indentor	r	mm	0,10 ± 0,01	5.2.1.3
Cone angle of indentor	α	°	30,00 ± 0,25	5.2.1.3
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	18,0 ± 0,5	5.2.2.1
Hole diameter of pressure foot	d_1	mm	3,0 ± 0,1	5.2.2.2
Mass on pressure foot	m	kg	$5{,}0^{+0{,}5}_{0{,}0}$	5.2.4.1
Depth of indentation	l	mm	0,00 to 2,50; $\Delta l = \pm 0{,}02$	5.2.3.2
Spring force on indentor	F	mN	$F = 445{,}0 H_D$; $\Delta F = \pm 222{,}5$ where H_D = hardness reading on type D durometer	5.2.5.2
Duration of force application	t	s	3 or 15	5.2.7

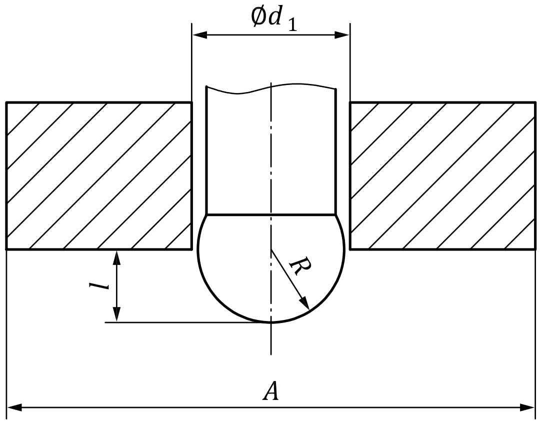

Figure 3 — Indentor and pressure foot for type AO durometer

Table 3 — Type AO durometer

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Radius of indentor	R	mm	2,50 ± 0,02	5.2.1.4
Centrality of pressure foot			Central	
Area of pressure foot	A	mm²	500 minimum	5.2.2.1
Hole diameter of pressure foot	d_1	mm	5,4 ± 0,2	5.2.2.2
Mass on pressure foot	m	kg	$1{,}0^{+0{,}1}_{0{,}0}$	5.2.4.1
Depth of indentation	l	mm	0,00 to 2,50; Δl = ±0,02	5.2.3.3
Spring force on indentor	F	mN	F = 550,0 + 75,0H_{AO}; ΔF = ±37,5 where H_{AO} = hardness reading on type AO durometer	5.2.5.3
Duration of force application	t	s	3 or 15	5.2.7

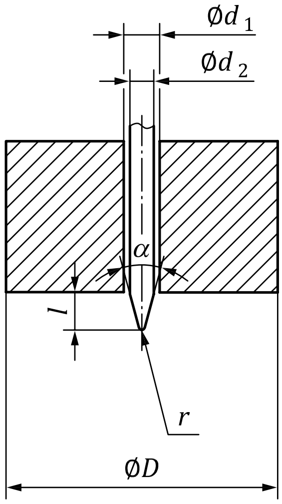

Figure 4 — Indentor and pressure foot for type AM durometer

Table 4 — Type AM durometer

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Shaft diameter of indentor	d_2	mm	0,790 ± 0,025	5.2.1.5
Radius of indentor	r	mm	0,10 ± 0,01	5.2.1.5
Cone angle of indentor	α	°	30,00 ± 0,25	5.2.1.5
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	9,0 ± 0,3	5.2.2.1
Hole diameter of pressure foot	d_1	mm	1,19 ± 0,03	5.2.2.2
Mass on pressure foot	m	kg	$0{,}25^{+0{,}05}_{0{,}00}$	5.2.4.1
Depth of indentation	l	mm	0,00 to 1,25; Δl = ±0,01	5.2.3.4
Spring force on indentor	F	mN	F = 324,0 + 4,4H_{AM}; ΔF = ±8,8 where H_{AM} = hardness reading on type AM durometer	5.2.5.4
Duration of force application	t	s	3 or 15	5.2.7

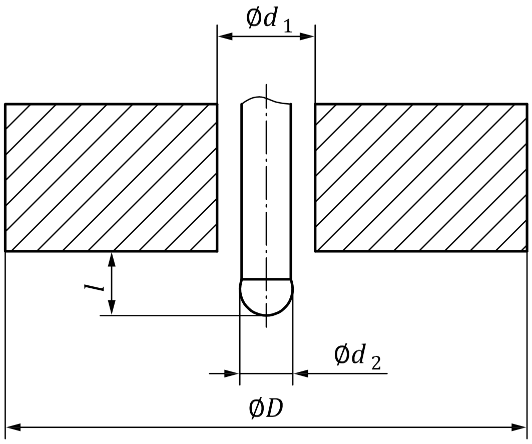

Figure 5 — Indentor and pressure foot for IRHD dead-load tester

Table 5 — IRHD dead-load method N

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Ball diameter of indentor	d_2	mm	2,50 ± 0,01	5.2.1.6
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	20 ± 1	5.2.2.1
Hole diameter of pressure foot	d_1	mm	6 ± 1	5.2.2.2
Force on pressure foot	F_f	N	8,3 ± 1,5	5.2.4.2
Incremental indentation depth	l	mm	$l = f$(IRHD) (see Table 15) $\Delta l = \pm 0{,}01$	5.2.3.5
Contact force on indentor	F_c	N	0,30 ± 0,02	5.2.6.1
Total force on indentor	F_t	N	5,70 ± 0,03	5.2.6.1
Duration of application of total force, t_t, and contact force, t_c		s	$t_t = 30$; $t_c = 5$	5.2.7

Table 6 — IRHD dead-load method H

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Ball diameter of indentor	d_2	mm	1,00 ± 0,01	5.2.1.6
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	20 ± 1	5.2.2.1
Hole diameter of pressure foot	d_1	mm	6 ± 1	5.2.2.2
Force on pressure foot	F_f	N	8,3 ± 1,5	5.2.4.2
Incremental indentation depth	l	mm	$l = f$(IRHD) (see Table 16) $\Delta l = \pm 0{,}01$	5.2.3.6
Contact force on indentor	F_c	N	0,30 ± 0,02	5.2.6.1
Total force on indentor	F_t	N	5,70 ± 0,03	5.2.6.1
Duration of application of total force, t_t, and contact force, t_c		s	$t_t = 30$; $t_c = 5$	5.2.7

Table 7 — IRHD dead-load method L

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Ball diameter of indentor	d_2	mm	5,00 ± 0,01	5.2.1.6
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	22 ± 1	5.2.2.1
Hole diameter of pressure foot	d_1	mm	10 ± 1	5.2.2.2
Force on pressure foot	F_f	N	8,3 ± 1,5	5.2.4.2
Incremental indentation depth	l	mm	$l = f$(IRHD) (see Table 17) Δl = ±0,01	5.2.3.7
Contact force on indentor	F_c	N	0,30 ± 0,02	5.2.6.1
Total force on indentor	F_t	N	5,70 ± 0,03	5.2.6.1
Duration of application of total force, t_t, and contact force, t_c		s	t_t = 30; t_c = 5	5.2.7

Table 8 — IRHD dead-load method M

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Ball diameter of indentor	d_2	mm	0,395 ± 0,005	5.2.1.6
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	3,35 ± 0,15	5.2.2.1
Hole diameter of pressure foot	d_1	mm	1,00 ± 0,15	5.2.2.2
Force on pressure foot	F_f	mN	235 ± 30	5.2.4.3
Incremental indentation depth	l	mm	$l = f$(IRHD) (see Table 18) Δl = ±0,002	5.2.3.8
Contact force on indentor	F_c	mN	8,3 ± 0,5	5.2.6.2
Total force on indentor	F_t	mN	153,3 ± 1,0	5.2.6.2
Duration of application of total force, t_t, and contact force, t_c		s	t_t = 30; t_c = 5	5.2.7

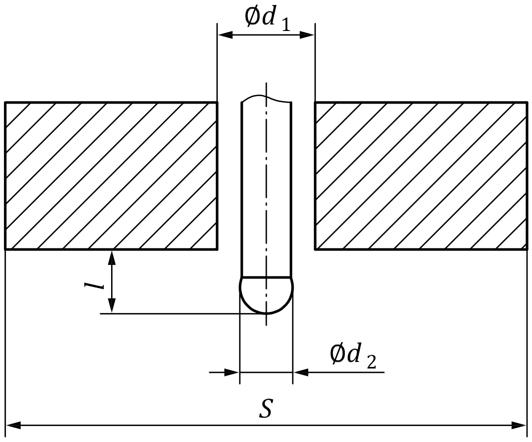

Figure 6 — Indentor and pressure foot for IRHD pocket meter

Table 9 — IRHD pocket meter

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Ball diameter of indentor	d_2	mm	1,575 ± 0,025	5.2.1.6
Centrality of pressure foot			Central	
Size of pressure foot	S	mm	length of side 20,0 ± 2,5 if square or diameter 22,5 ± 2,5 if circular	5.2.2.1
Hole diameter of pressure foot	d_1	mm	2,5 ± 0,5	5.2.2.2
Depth of indentation	l	mm	$l = f$(IRHD) (see Table 19) $\Delta l = \pm 0{,}02$	5.2.3.9
Spring force on indentor	F	N	2,65 ± 0,15	5.2.5.5
Duration of force application	t	s	3 or 15	5.2.7

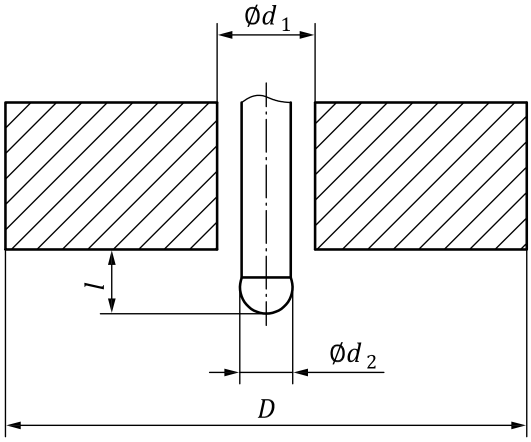

Figure 7 — Indentor and pressure foot for VLRH meter

Table 10 — VLRH meter

Measurand		Unit	Metrological requirement	Calibration and verification instructions
Ball diameter of indentor	d_2	mm	2,5 ± 0,01	5.2.1.7
Centrality of pressure foot			Central	
Diameter of pressure foot	D	mm	6,0 ± 0,50	5.2.2.1
Hole diameter of pressure foot	d_1	mm	3,0 ± 0,10	5.2.2.2
Depth of indentation	l	µm	$l = f$(VLRH) (see Table 20) $\Delta l = \pm 5$	5.2.3.10
Force on pressure foot	F_f	mN	250 ± 30	5.2.4.4
Pre force on indentor	F_C	mN	8,3 ± 0,5	5.2.6.3
Indenting force on indentor	F_t	mN	100,0 ± 1,0	5.2.6.3
Duration of pre force application	t_C	s	5	5.2.7
Duration of indenting force application	t_t	s	30	5.2.7

5 Calibration and verification methods

5.1 Requirements to be met by the measuring instruments used for the calibration and verification methods

The uncertainty of measurement of the measuring instruments used for the calibration and verification methods shall not be greater than 0,2 times the tolerances specified in 4.2.

Alternative instruments to those mentioned in 5.2 may be used provided the required uncertainty of measurement is complied with and these instruments allow the calibration or verification methods to be carried out effectively.

5.2 Outline of the calibration and verification methods to be used

5.2.1 Indentors

5.2.1.1 General

A coordinate-measuring device (for example, a measuring microscope) or a profile projector is suitable for measuring the indentors.

5.2.1.2 Type A durometer

By means of the measuring device, verify the geometric requirements of the indentor as illustrated in Figure 1 and listed in Table 1.

5.2.1.3 Type D durometer

By means of the measuring device, verify the geometric requirements of the indentor as illustrated in Figure 2 and listed in Table 2.

5.2.1.4 Type AO durometer

By means of the measuring device, verify the indentor diameter as illustrated in Figure 3 and listed in Table 3.

5.2.1.5 Type AM durometer

By means of the measuring device, verify the geometric requirements of the indentor as illustrated in Figure 4 and listed in Table 4.

5.2.1.6 IRHD dead-load methods N, H, L and M and IRHD pocket meter

By means of the measuring device, verify the indentor diameter as illustrated in Figures 5 and 6 and listed in Tables 5 to 9.

5.2.1.7 VLRH dead-load meter

By means of the measuring device, verify the geometric requirements of the indentor as illustrated in Figure 7 and listed in Table 10.

5.2.2 Geometry of the pressure foot

5.2.2.1 Diameter/length of side of the pressure foot

Verify the diameter/length of side of the pressure foot as illustrated in Figures 1 to 7 and listed in Tables 1 to 10. Vernier callipers are a suitable measuring device.

5.2.2.2 Hole diameter of the pressure foot

Verify the hole diameter as illustrated in Figures 1 to 7 and listed in Tables 1 to 10. Calibrated pins are suitable measuring devices. If there is a chamfered edge to the hole, the measurement shall be made ignoring the chamfer area.

5.2.3 Depth of indentation

5.2.3.1 Type A durometer

The durometer is mounted in an indentation-depth measuring device comprising a length-measuring system with a measuring range from 0 mm to 2,5 mm and a displacement device. A digital micrometer, for example, can be used as the length-measuring system. The measuring axes of the length-measuring system and of the hardness tester to be calibrated shall be in alignment and disposed vertically.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 Shore A to 0 Shore A in steps. Alternatively, displace the indentor a known distance in steps and read the Shore value. Measure the indentation depth at a minimum of four points, including 0 Shore A and 100 Shore A. The values of the indentation depth and the permitted tolerance are given in Table 11.

Table 11 — Shore A versus indentation

Shore A value	Value of indentation depth, l, in mm (Δl = ±0,02 mm)
0	2,50
10	2,25
20	2,00
30	1,75
40	1,50
50	1,25
60	1,00
70	0,75
80	0,50
90	0,25
100	0,00

5.2.3.2 Type D durometer

The method of measurement is the same as that described in 5.2.3.1.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 Shore D to 0 Shore D in steps. Alternatively, displace the indentor a known distance in steps and read the Shore value. Measure the indentation depth at a minimum of four points, including 0 Shore D and 100 Shore D. The values of the indentation depth and the permitted tolerance are given in Table 12.

Table 12 — Shore D versus indentation

Shore D value	Value of indentation depth, *l*, in mm (Δl = ±0,02 mm)
0	2,50
10	2,25
20	2,00
30	1,75
40	1,50
50	1,25
60	1,00
70	0,75
80	0,50
90	0,25
100	0,00

5.2.3.3 Type AO durometer

The method of measurement is the same as that described in 5.2.3.1.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 Shore AO to 0 Shore AO in steps. Alternatively, displace the indentor a known distance in steps and read the Shore value. Measure the indentation depth at a minimum of four points, including 0 Shore AO and 100 Shore AO. The values of the indentation depth and the permitted tolerance are given in Table 13.

Table 13 — Shore AO versus indentation

Shore AO value	Value of indentation depth, *l*, in mm (Δl = ±0,02 mm)
0	2,50
10	2,25
20	2,00
30	1,75
40	1,50
50	1,25
60	1,00
70	0,75
80	0,50
90	0,25
100	0,00

5.2.3.4 Type AM durometer

The method of measurement is the same as that described in 5.2.3.1, except that the range of indentation is from 0 mm to 1,25 mm.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 Shore AM to 0 Shore AM in steps. Alternatively, displace the indentor a known distance in steps and read the Shore value. Measure the indentation depth at a minimum of four points, including 0 Shore AM and 100 Shore AM. The values of the indentation depth and the permitted tolerance are given in Table 14.

Table 14 — Shore AM versus indentation

Shore AM value	Value of indentation depth, l, in mm (Δl = ±0,010 mm)
0	1,250
10	1,125
20	1,000
30	0,875
40	0,750
50	0,625
60	0,500
70	0,375
80	0,250
90	0,125
100	0,000

5.2.3.5 IRHD dead-load method N

The method of measurement is the same as that described in 5.2.3.1, except that the range of indentation is from 0 mm to 1,8 mm.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 IRHD to 30 IRHD in steps. Alternatively, displace the indentor a known distance in steps and read the IRHD value. Measure the indentation depth at a minimum of four points, including 100 IRHD. The values of the indentation depth and the permitted tolerance are given in Table 15.

Table 15 — IRHD (method N) versus indentation

IRHD value	Value of indentation depth, l, in mm (Δl = ±0,01 mm)
100,0	0,00
80,2	0,35
70,4	0,51
60,1	0,71
50,2	0,96
40,1	1,30
30,0	1,80

5.2.3.6 IRHD dead-load method H

The method is the same as that described in 5.2.3.1, except that the range of indentation is from 0 mm to 0,44 mm.

Displace the indentor of the hardness tester in accordance with its scale indication to a series of IRHD values and measure the indentation depth at these values. Alternatively, displace the indentor a known distance in steps and read the IRHD value. The values of the indentation depth and the permitted tolerance are given in Table 16.

Table 16 — IRHD (method H) versus indentation

IRHD value	Value of indentation depth, l, in mm (Δl = ±0,01 mm)
100,0	0,00
98,8	0,10
95,4	0,20
91,1	0,30
84,8	0,44

5.2.3.7 IRHD dead-load method L

The method is the same as that described in 5.2.3.1, except that the range of indentation is from 0 mm to 3,2 mm.

Displace the indentor of the hardness tester in accordance with its scale indication to a series of IRHD values and measure the indentation depth at these values. Alternatively, displace the indentor a known distance in steps and read the IRHD value. The values of the indentation depth and the permitted tolerance are given in Table 17.

Table 17 — IRHD (method L) versus indentation

IRHD value	Value of indentation depth, l, in mm (Δl = ±0,01 mm)
34,9	1,10
21,3	1,80
14,1	2,50
9,9	3,18

5.2.3.8 IRHD dead-load method M

The method is the same as that described in 5.2.3.1, except that the range of indentation is from 0 mm to 0,3 mm.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 IRHD to 30 IRHD in steps. Alternatively, displace the indentor a known distance in steps and read the IRHD value. Measure the indentation depth at a minimum of four points, including 100 IRHD. The values of the indentation depth and the permitted tolerance are given in Table 18.

Table 18 — IRHD (method M) versus indentation

IRHD value	Value of indentation depth, l, in mm (Δl = ±0,002 mm)	Remarks
100,0	0,000	If the indentation is magnified by a factor of 6 (for example by mechanical means) before the measurements are made, then Δl = ±0,01 mm.
80,2	0,058	
70,4	0,085	
60,1	0,118	
50,2	0,160	
40,1	0,217	
30,0	0,300	

5.2.3.9 IRHD pocket meter

The method of measurement is the same as that described in 5.2.3.1, except that the range of indentation is from 0 mm to 1,650 mm.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 IRHD to 0 IRHD in steps. Alternatively, displace the indentor a known distance in steps and read the IRHD value. Measure the indentation depth at a minimum of four points, including 30 IRHD and 100 IRHD. The values of the indentation depth and the permitted tolerance are given in Table 19.

Table 19 — IRHD (pocket meter) versus indentation

IRHD value	Value of indentation depth, l, in mm (Δl = ±0,020 mm)
100	0,000
90	0,191
80	0,323
70	0,473
60	0,653
50	0,884
40	1,195
30	1,650

5.2.3.10 VLRH dead-load meter

The method of measurement is the same as that described in 5.2.3.1, except that the range of indentation is from 0 µm to 1 000 µm.

Displace the indentor of the hardness tester in accordance with its scale indication from 100 VLRH to 0 VLRH in steps. Alternatively, displace the indentor a known distance in steps and read the VLRH value. Measure the indentation depth at a minimum of 10 points, including 100 VLRH. The values of the indentation depth and the permitted tolerance are given in Table 20.

Table 20 — VLRH versus indentation

VLRH value	Value of indentation depth, l, in µm (Δl = ±5 µm)
100	0
90	100
80	200
70	300
60	400
50	500
40	600
30	700
20	800
10	900
0	1 000

5.2.4 Contact force of the pressure foot

5.2.4.1 Durometers

The use of a durometer on a stand with a standard load to apply a force on the pressure foot is only mandatory for type AM.

Where required, weigh the durometer and the additional load using a suitable balance.

5.2.4.2 IRHD dead-load methods N, H and L

The hardness tester is mounted on a force-measuring device with a capacity of 10 N. The measuring axes of the force-measuring device and the hardness tester shall be in alignment and disposed vertically.

Measure the force exerted by the pressure foot.

5.2.4.3 IRHD dead-load method M

The method of measurement is the same as that described in 5.2.4.2, but the force capacity is 300 mN.

5.2.4.4 VLRH dead-load meter

The hardness tester is mounted on a force-measuring device with range of capacity from 0 N to 10 N. The measuring axes of the force-measuring device and the hardness tester shall be in alignment and disposed vertically.

Measure the force exerted by the pressure foot.

5.2.5 Spring force

5.2.5.1 Type A durometer

The durometer is mounted on a spring force calibration device which comprises a force-measuring device with a measuring range extending from 0 N to 9 N and a displacement device. A force transducer or a weighing instrument is suitable for use as a force-measuring device. If a weighing instrument is used, the mass, *m*, of the weights used or the mass indication shall be converted into force, *F*, using the relationship $F = gm$. If a measurement value for the acceleration due to gravity is not available, the value g_n = 9,806 65 m/s^2 (the conventional value of standard acceleration due to gravity) may be used.

NOTE If the local acceleration due to gravity deviates from the standard acceleration due to gravity by more than 1×10^{-3} m/s^2, but the value is not known, it can be calculated, in m/s^2, according to the following approximate relation:

$$g_m = 9{,}780\,327(1+0{,}005\,302\,4\sin^2\varphi - 0{,}000\,005\,8\sin^2 2\varphi)$$

where φ is the geographical latitude.

The measuring axes of the force-measuring instrument and the hardness tester shall be in alignment and disposed vertically.

Displace the indentor of the hardness tester in accordance with its scale indication from 0 Shore A to 100 Shore A in steps of 10 Shore A. Measure the spring forces resulting from this process. The values of the spring force and the permitted tolerance are given in Table 21.

As long as linearity of measurement is ensured, the number of measuring points selected from the table may be less than 10, but not less than three.

Table 21 — Type A spring force versus hardness

Shore A value	Value of spring force, *F*, in mN (ΔF = ±37,5 mN)
0	550,0
10	1 300,0
20	2 050,0
30	2 800,0
40	3 550,0

