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ISO 18898

Second edition
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Rubber — Calibration and verification of hardness testers

Caoutchouc — 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 18898 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This second edition cancels and replaces the first edition (ISO 18898:2006), which has been technically revised as follows:

— for hand-held durometers of types A, D and AO, an increased spring force tolerance is now allowed (see footnotes to Tables 1, 2 and 3 and Tables 19, 20 and 21);

— for type A, D and AO durometers, the number of spring force measuring points may be less than ten, as long as linearity of measurement is ensured, but not less than three (see 5.2.5.1, 5.2.5.2 and 5.2.5.3);

— the size of the pressure foot in Table 9 has been redefined to include circular pressure feet.

Rubber — Calibration and verification of hardness testers

1 Scope

This International Standard specifies procedures for the calibration and verification of durometers of types A, D, AO and AM (see ISO 7619-1), IRHD pocket meters (see ISO 7619-2) and IRHD dead-load instruments (see ISO 48).

2 Normative references

The following referenced documents are indispensable for the application 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, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 7619-1, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*

ISO 7619-2, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 2: IRHD pocket meter method*

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

ISO 18899:2004, *Rubber — Guide to the calibration of test equipment*

3 Terms and definitions

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

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 of indentor and pressure foot for the instrument to be calibrated are depicted in Figures 1 to 6 and requirements are specified in Tables 1 to 9.

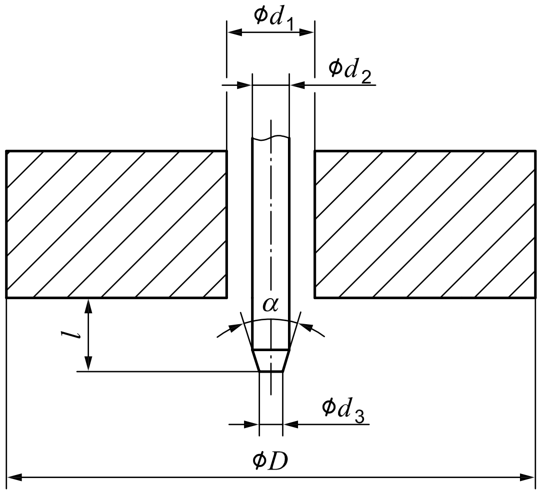

Figure 1 — Indentor and pressure foot for type A durometer

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; $\Delta l = \pm 0{,}02$	5.2.3.1
Spring force on indentor	F	mN	$F = 550{,}0 + 75{,}0 H_A$; $\Delta F = \pm 37{,}5$ [a] 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

[a] For hand-held durometers, the tolerance may be doubled.

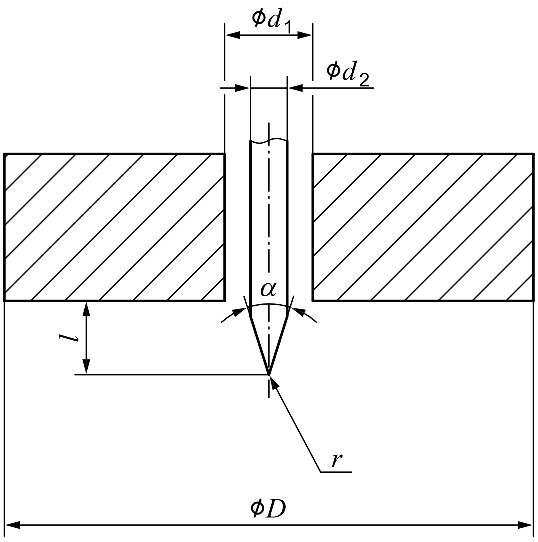

Figure 2 — Indentor and pressure foot for type D durometer

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	$F = 445{,}0 H_D$; $\Delta F = \pm 222{,}5$ [a] 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

[a] For hand-held durometers, the tolerance may be doubled.

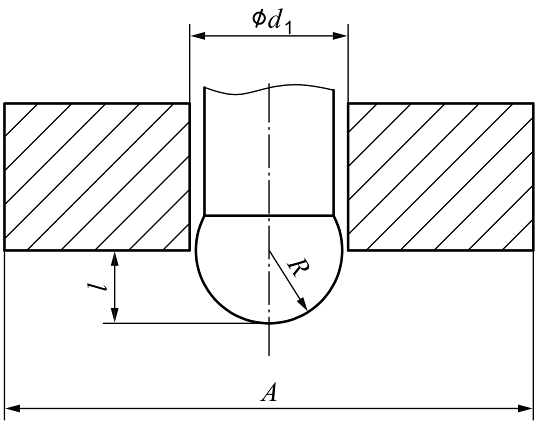

Figure 3 — Indentor and pressure foot for type AO durometer

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	mm^2	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; $\Delta l = \pm 0{,}02$	5.2.3.3
Spring force on indentor	F	mN	$F = 550{,}0 + 75{,}0 H_{AO}$; $\Delta F = \pm 37{,}5$ [a] 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

[a] For hand-held durometers, the tolerance may be doubled.

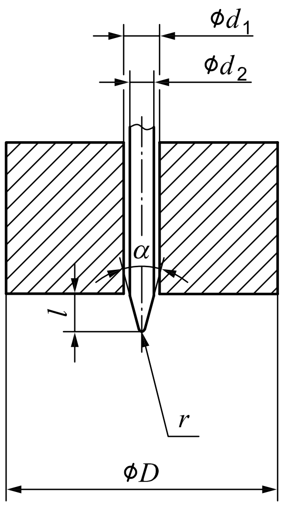

Figure 4 — Indentor and pressure foot for type AM durometer

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; $\Delta l = \pm 0{,}01$	5.2.3.4
Spring force on indentor	F	mN	$F = 324{,}0 + 4{,}4H_{AM}$; $\Delta F = \pm 8{,}8$ 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

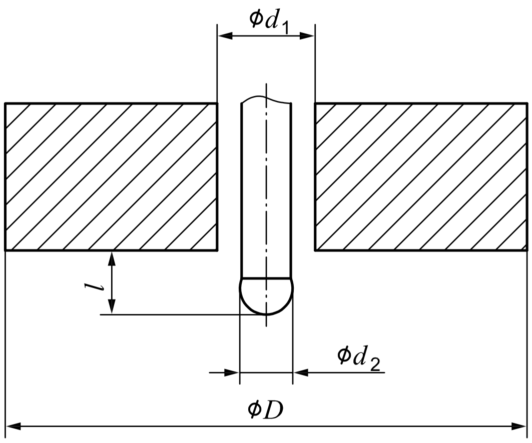

Figure 5 — Indentor and pressure foot for IRHD dead-load tester

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 14) $\Delta l = \pm 0{,}01$	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 15) $\Delta l = \pm 0{,}01$	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 16) $\Delta l = \pm 0{,}01$	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 17) $\Delta l = \pm 0{,}002$	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

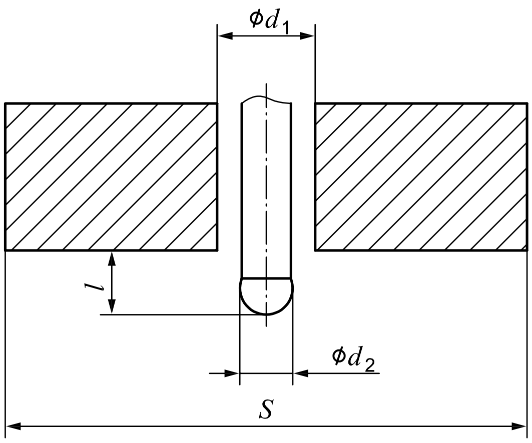

Figure 6 — Indentor and pressure foot for IRHD pocket meter

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 18) $\Delta l = \pm 0{,}02$	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

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.

5.2.2 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 6 and listed in Tables 1 to 9. Vernier calipers 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 6 and listed in Tables 1 to 9. 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 10.

Table 10 — Shore A versus indentation

Shore A value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}02$ 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 11.

Table 11 — Shore D versus indentation

Shore D value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}02$ 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 12.

Table 12 — Shore AO versus indentation

Shore AO value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}02$ 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 13.

Table 13 — Shore AM versus indentation

Shore AM value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}010$ 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 14.

Table 14 — IRHD (method N) versus indentation

IRHD value	Value of indentation depth l, in mm ($\Delta l = \pm 0,01$ 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 15.

Table 15 — IRHD (method H) versus indentation

IRHD value	Value of indentation depth l, in mm ($\Delta l = \pm 0,01$ 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 16.

Table 16 — IRHD (method L) versus indentation

IRHD value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}01$ 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 17.

Table 17 — IRHD (method M) versus indentation

IRHD value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}002$ 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 $\Delta l = \pm 0{,}01$ 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 18.

Table 18 — IRHD (pocket meter) versus indentation

IRHD value	Value of indentation depth l, in mm ($\Delta l = \pm 0{,}020$ 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

5.2.4 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.

5.2.5 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 approximation equation:

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

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 19.

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

Table 19 — Type A spring force versus hardness

Shore A value	Value of spring force F, in mN ($\Delta F = \pm 37,5$ mN) [a]
0	550,0
10	1 300,0
20	2 050,0
30	2 800,0
40	3 550,0
50	4 300,0
60	5 050,0
70	5 800,0
80	6 550,0
90	7 300,0
100	8 050,0

[a] For hand-held durometers, the spring force tolerance (ΔF) may be $\pm 75,0$ mN.

5.2.5.2 Type D durometer

The method is the same as that described in 5.2.5.1, but the range of the force-measuring device is 0 N to 45 N.

Displace the indentor of the hardness tester in accordance with its scale indication from 0 Shore D to 100 Shore D in steps of 10 Shore D. Measure the spring forces resulting from this process. The values of the spring force and the permitted tolerance are given in Table 20.

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

Table 20 — Type D spring force versus hardness

Shore D value	Value of spring force F, in mN ($\Delta F = \pm 222,5$ mN) [a]
0	—
10	4 450,0
20	8 900,0
30	13 350,0
40	17 800,0
50	22 250,0
60	26 700,0
70	31 150,0
80	35 600,0
90	40 050,0
100	44 500,0

[a] For hand-held durometers, the spring force tolerance (ΔF) may be ±445,0 mN.

5.2.5.3 Type AO durometer

The method is the same as that described in 5.2.5.1, but the range of the force-measuring device is 0 N to 9 N.

Displace the indentor of the hardness tester in accordance with its scale indication from 0 Shore AO to 100 Shore AO in steps of 10 Shore AO. 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 ten, but not less than three.

Table 21 — Type AO spring force versus hardness

Shore AO value	Value of spring force F, in mN ($\Delta F = \pm 37,5$ mN) [a]
0	550,0
10	1 300,0
20	2 050,0
30	2 800,0
40	3 550,0
50	4 300,0
60	5 050,0
70	5 800,0
80	6 550,0
90	7 350,0
100	8 050,0

[a] For hand-held durometers, the spring force tolerance (ΔF) may be ±75,0 mN.

5.2.5.4 Type AM durometer

The method is the same as that described in 5.2.5.1, but the range of the force-measuring device is 0 N to 0,8 N.

Displace the indentor of the hardness tester in accordance with its scale indication from 0 Shore AM to 100 Shore AM in steps of 10 Shore AM. Measure the spring forces resulting from this process. The values of the spring force and the permitted tolerance are given in Table 22.

The number of measuring points may be reduced from ten to seven if seven points can be shown to be sufficient.

Table 22 — Type AM spring force versus hardness

Shore AM value	Value of spring force F, in mN ($\Delta F = \pm 8{,}8$ mN)
0	324,0
10	368,0
20	412,0
30	456,0
40	500,0
50	544,0
60	588,0
70	632,0
80	676,0
90	720,0
100	764,0

5.2.5.5 IRHD pocket meter

The method is the same as that described in 5.2.5.1, but the range of the force-measuring device is 0 N to 3 N.

Displace the indentor of the hardness tester in accordance with its scale indication from 30 IRHD to 100 IRHD in steps of 10 IRHD. Measure the spring forces resulting from this process. Over the range of hardness values from 30 IRHD to 100 IRHD, the force shall be 2,65 N ± 0,15 N.

The number of measuring points may be reduced from eight to a lower number if a lower number can be shown to be sufficient, but not to less than three.

5.2.6 Contact and total force of IRHD dead-load instruments

5.2.6.1 IRHD dead-load methods N, H and L

The method is the same as that described in 5.2.5.1, but the range of the force-measuring device is 0 N to 6 N.

Apply the contact force F_c (minor load) and measure its value. Apply the indenting force F_i so that the total force F_t acts on the force-measuring device, and measure its value. The indenting force is obtained from the relationship $F_i = F_t - F_c$. The specified forces and their tolerances are given in Table 23.

Table 23 — Contact, indenting and total forces for IRHD (methods N, H and L)

Measurand		Value of force, in N
Contact force	F_c	0,30 ± 0,02
Indenting force	F_i	5,40 ± 0,01
Total force	F_t	5,70 ± 0,03

5.2.6.2 IRHD dead-load method M

The method is the same as that described in 5.2.6.1, but the range of the force-measuring device is 0 mN to 160 mN. Special care shall be taken that the force from the hardness tester is applied vertically to the force-measuring device, and a hinged support may be used to aid force application.

The specified forces and their tolerances are given in Table 24.

Table 24 — Contact, indenting and total forces for IRHD (method M)

Measurand		Value of force, in mN
Contact force	F_c	8,3 ± 0,5
Indenting force	F_i	145,0 ± 0,5
Total force	F_t	153,3 ± 1,0

5.2.7 Duration of force application

A tolerance on the time of application of the force is only given in the case of a durometer in a stand with an automatic timing device. The tolerance is then ±0,3 s. The device shall be calibrated in accordance with ISO 18899.

6 Calibration and verification certificate

The calibration and verification certificate shall be in accordance with ISO/IEC 17025.

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