BS ISO 18898:2016

BSI Standards Publication

# Rubber — Calibration and verification of hardness testers

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**National foreword**

This British Standard is the UK implementation of ISO 18898:2016. It supersedes BS ISO 18898:2012 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/22, Testing and analysis of rubber.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 86054 6

ICS 83.060

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 February 2016.

**Amendments issued since publication**

| Date | Text affected |
| --- | --- |

BS ISO 18898:2016

# INTERNATIONAL STANDARD

# ISO 18898

Third edition
2016-02-15

# Rubber — Calibration and verification of hardness testers

*Caoutchouc — Étalonnage et vérification des duromètres*

Reference number
ISO 18898:2016(E)

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This third edition cancels and replaces the second edition (ISO 18898:2012), which has been technically revised with the following change:

— calibration and verification for determination of dead-load hardness using the very low rubber hardness scale (VLRH) has been incorporated.

 

# 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), IRHD dead-load instruments (see ISO 48) and dead-load instruments using the very low rubber hardness scale (see ISO 27588).

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 18899, *Rubber — Guide to the calibration of test equipment*

ISO 27588, *Rubber, vulcanized or thermoplastic — Determination of dead-load hardness using the very low rubber hardness (VLRH) scale*

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 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 7 and requirements are specified in Tables 1 to 10.

 

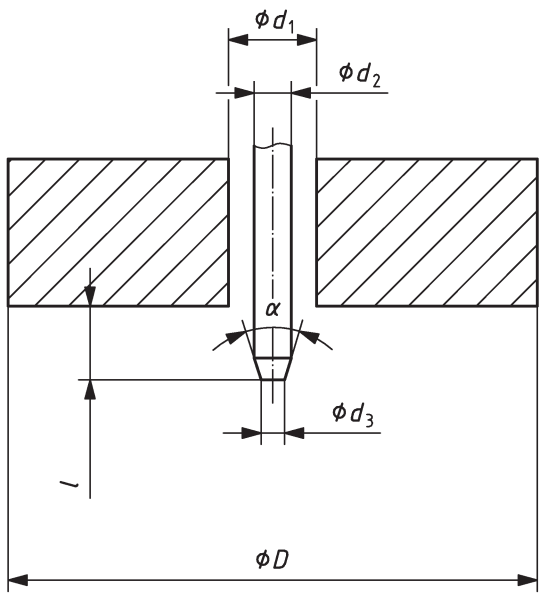


**Figure 1 — Indentor and pressure foot for type A durometer**

**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 | $\alpha$ | ° | 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 | $1{,}0^{+0{,}1}_{\phantom{+}0{,}0}$ | 5.2.4.1 |
| Depth of indentation | $l$ | mm | 0,00 to 2,50; $\Delta l$ = ± 0,02 | 5.2.3.1 |
| Spring force on indentor | $F$ | mN | $F = 550{,}0 + 75{,}0H_A$; $\Delta F = \pm\ 37{,}5$[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.

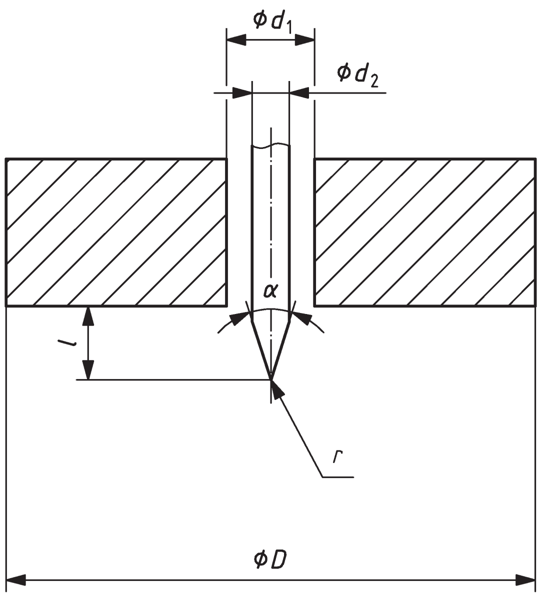


**Figure 2 — Indentor and pressure foot for type D durometer**

**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 | $\alpha$ | ° | 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 | $5{,}0\,^{+0{,}5}_{\phantom{+}0{,}0}$ | 5.2.4.1 |
| Depth of indentation | $l$ | mm | 0,00 to 2,50; $\Delta l$ = ± 0,02 | 5.2.3.2 |
| Spring force on indentor | $F$ | mN | $F = 445{,}0H_D$; $\Delta F$ = ± 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.

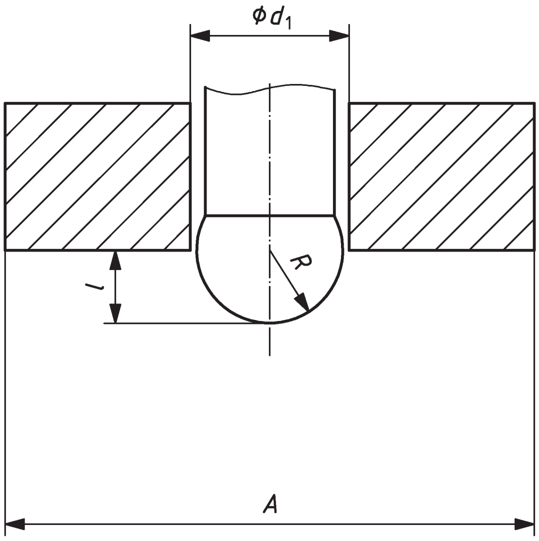


**Figure 3 — Indentor and pressure foot for type AO durometer**

**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; $\Delta l$ = ± 0,02 | 5.2.3.3 |
| Spring force on indentor | $F$ | mN | $F = 550{,}0 + 75{,}0H_{AO}$; $\Delta F$ = ± 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.

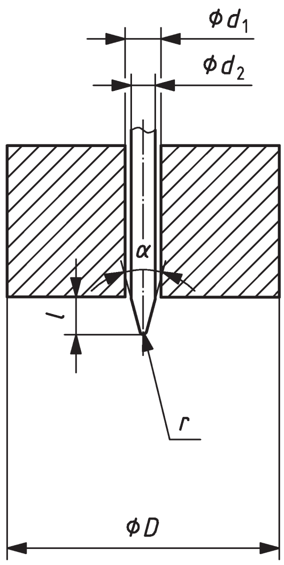


**Figure 4 — Indentor and pressure foot for type AM durometer**

**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 | $\alpha$ | ° | 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; $\Delta l$ = ± 0,01 | 5.2.3.4 |
| Spring force on indentor | $F$ | mN | $F$ = 324,0 + 4,4$H_{AM}$; $\Delta F$ = ± 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 |

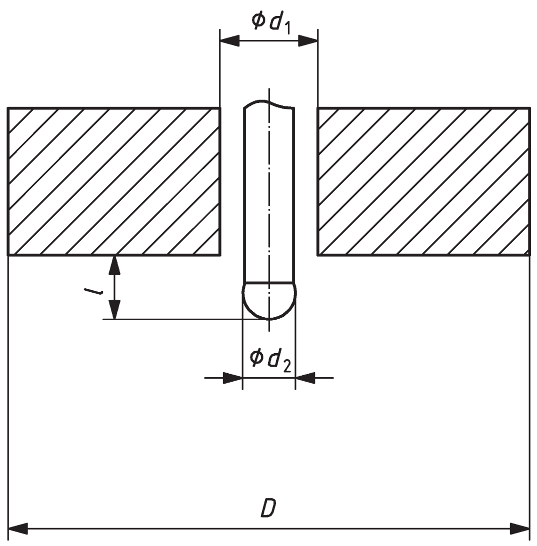


**Figure 5 — Indentor and pressure foot for IRHD dead-load tester**

**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)<br>$\Delta l = \pm 0{,}01$ | 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)<br>$\Delta l = \pm 0{,}01$ | 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)<br>$\Delta l = \pm 0{,}01$ | 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 18)<br>$\Delta l = \pm 0{,}002$ | 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 |

 

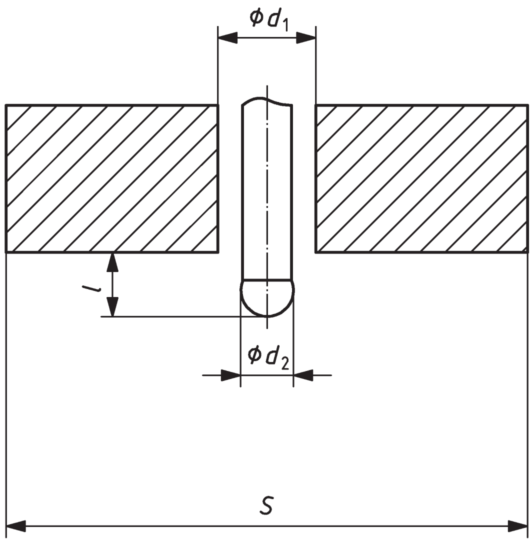


**Figure 6 — Indentor and pressure foot for IRHD pocket meter**

**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<br>or<br>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)<br>$\Delta l$ = ± 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 |

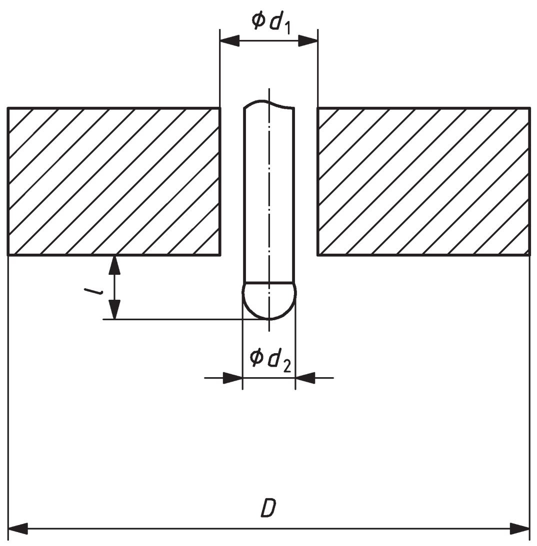


**Figure 7 — Indentor and pressure foot for VLRH meter**

**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)<br>$\Delta l = \pm 5$ | 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 ($\Delta l$ = ± 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 $\Delta l$ = ± 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 ($\Delta l = \pm$ 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 |

### 5.2.3.10 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 1000 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 ($\Delta l = \pm$ 5 µm) |
|---|---|
| 100 | 0 |
| 90 | 100 |
| 80 | 200 |
| 70 | 300 |
| 60 | 400 |
| 50 | 500 |
| 40 | 600 |
| 30 | 700 |
| 20 | 800 |
| 10 | 900 |
| 0 | 1000 |

### 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 $g_n = 9{,}806\ 65\ \text{m/s}^2$ (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 $1 \times 10^{-3}\ \text{m/s}^2$, but the value is not known, it can be calculated, in $\text{m/s}^2$, according to the following approximation formula:

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

where $\varphi$ 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 ($\Delta F$ = ± 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 ($\Delta F$) may be ± 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 22.

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 22 — Type D spring force versus hardness**

| Shore D value | Value of spring force, $F$, in mN ($\Delta F$ = ± 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 ($\Delta F$) 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 23.

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 23 — Type AO spring force versus hardness**

| Shore AO value | Value of spring force, $F$, in mN ($\Delta F$ = ± 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 ($\Delta F$) 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 24.

The number of measuring points may be reduced from 10 to seven if seven points can be shown to be sufficient.

 

**Table 24 — Type AM spring force versus hardness**

| Shore AM value | Value of spring force, $F$, in mN ($\Delta F$ = ± 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 25.

**Table 25 — 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 26.

 

**Table 26 — 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 |

#### 5.2.6.3 VLRH dead-load method

The method is the same as that described in 5.2.5.1, but the range of the force-measuring device is 0 mN to 110 mN.

The measuring table shall be flat and normal to the axis of the plunger. The specified forces and their tolerances are given in Table 27.

**Table 27 — Contact, indenting and total forces for VLRH**

| Measurand | | Value of force, in mN |
|---|---|---|
| Pre force | $F_c$ | 8,30 ± 0,5 |
| Indenting force | $F_i$ | 91,7 ± 0,5 |
| Total force | $F_t$ | 100 ± 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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