INTERNATIONAL STANDARD

ISO 7619-1

First edition
2004-05-15

Rubber, vulcanized or thermoplastic — Determination of indentation hardness —

Part 1: Durometer method (Shore hardness)

Caoutchouc vulcanisé ou thermoplastique — Détermination de la dureté par pénétration —

Partie 1: Méthode au duromètre (dureté Shore)

Reference number
ISO 7619-1:2004(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 7619-1 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analyses*.

This first edition of ISO 7619-1, together with ISO 7619-2, cancels and replaces ISO 7619:1997, which has been technically revised as follows in respect of the durometer method now covered exclusively by Part 1:

— a specified pressure-foot area has been introduced;

— a test time of 3 s replaces the formerly specified "within 1 s", giving a more accurate value, as the hardness value drops significantly during the first few seconds;

— a test time of 15 s has been introduced for TPE materials, as the hardness value continues to decrease over a longer period of time than for vulcanized rubber, this test time being the same as that specified for plastics in ISO 868 [1];

— the AO scale for soft materials has been added;

— the AM scale for thin samples has been added;

— the use of stands is described in more detail;

— changes of tolerances, etc. have been made to improve precision.

ISO 7619 consists of the following parts, under the general title *Rubber, vulcanized or thermoplastic — Determination of indentation hardness*:

— *Part 1: Durometer method (Shore hardness)*

— *Part 2: IRHD pocket meter method*

Introduction

The hardness of rubber, as measured by the durometer or the IRHD pocket meter, is a complex response to an applied indentation. The measurement will depend upon

a) the elastic modulus of the rubber,

b) the viscoelastic properties of the rubber,

c) the thickness of the test piece,

d) the geometry of the indentor,

e) the pressure exerted,

f) the rate of increase of pressure, and

g) the interval at which the hardness is recorded.

Because of these factors, it is inadvisable to relate results using a durometer directly to IRHD values, although correlations have been established for some individual rubbers or compounds.

NOTE ISO 48[2] specifies hardness measurements for determination of hardness between 10 IRHD and 100 IRHD. Further information on the relation between the durometer values and IRHD values is given in the literature [5], [6], [7].

Rubber, vulcanized or thermoplastic — Determination of indentation hardness —

Part 1: Durometer method (Shore hardness)

1 Scope

This part of ISO 7619 specifies a method for determining the indentation hardness (Shore hardness) of vulcanized or thermoplastic rubber using durometers with the following scales:

— the A scale for rubbers in the normal hardness range;

— the D scale for rubbers in the high hardness range;

— the AO scale for rubbers in the low hardness range and cellular rubbers;

— the AM scale for thin rubber test pieces in the normal hardness range.

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 23529, *Physical test methods — Preparation and conditioning of test pieces and preferred test conditions*[1)]

3 Principle and choice of durometer type

The measured property is the penetration of a specified indentor forced into the material under specified conditions.

When using durometers, the scale should be chosen as follows.

— For values less than 20 with Type D durometer: Type A.

— For values less than 20 with Type A durometer: Type AO.

— For values over 90 with Type A durometer: Type D.

— For thin test pieces (less than 6 mm thick): Type AM.

1) To be published. (Revision of ISO 471:1995)

4 Apparatus

4.1 Durometer Types A, D and AO

These durometers consist of the components specified in 4.1.1 to 4.1.5.

4.1.1 Pressure foot

The pressure foot for Types A and D shall have a diameter of 18 mm ± 0,5 mm and a central hole of diameter 3 mm ± 0,1 mm. For Type AO, the pressure foot shall have a minimum area of 500 mm^2 with a 5,4 mm ± 0,2 mm central hole. The tolerances on the dimension of the centre hole and the requirement for the size of the pressure foot only apply to instruments used on a stand.

4.1.2 Indentor

The indentor shall be formed from a hardened steel rod of 1,25 mm ± 0,15 mm diameter to the shape and dimension shown in Figure 1, for Type A durometers, and Figure 2 for Type D durometers. Type AO durometers shall have a round indentor with a radius of 2,5 mm ± 0,02 mm according to Figure 3.

4.1.3 Indicating device

This is a device for allowing the extent of protrusion of the point of the indentor beyond the face of the pressure foot to be read. It shall be calibrated directly in terms of units ranging from 0 for the maximum protrusion of 2,50 mm ± 0,02 mm to 100 for zero protrusion obtained by placing the pressure foot and indentor in firm contact with a suitable flat hard surface.

4.1.4 Calibrated spring

This shall be used to apply a force, F, expressed in millinewtons, to the indentor in accordance with one of the following equations.

— For durometer Type A:

$$F = 550 + 75\ H_A$$

where H_A is the hardness reading taken from a Type A durometer.

— For durometer Type D:

$$F = 445\ H_D$$

where H_D is the hardness reading taken from a Type D durometer.

— For durometer Type AO:

$$F = 550 + 75\ H_{AO}$$

where H_{AO} is the hardness reading taken from a Type AO durometer.

4.1.5 Automatic timing device (optional)

The timer shall be automatically activated when the pressure foot is in contact with the test piece, and shall indicate the end of the test time or lock the test value at its completion. Use of a timing device for the test time improves precision. When used in a stand, the time tolerance shall be ± 0,3 s.

4.2 Durometer Type AM

This durometer consists of the components specified in 4.2.1 to 4.2.5.

4.2.1 Pressure foot

The pressure foot shall have a diameter of 9 mm ± 0,3 mm and a central hole of diameter 1,19 mm ± 0,03 mm.

4.2.2 Indentor

The indentor shall be formed from a hardened steel rod of 0,79 mm ± 0,025 mm diameter to the shape and dimension shown in Figure 4.

4.2.3 Indicating device

This is a device for allowing the extent of protrusion of the point of the indentor beyond the face of the pressure foot to be read. It shall be calibrated directly in terms of units ranging from 0 for the maximum protrusion of 1,25 mm ± 0,01 mm to 100 for zero protrusion obtained by placing the pressure foot and indentor in firm contact with a suitable flat hard surface.

4.2.4 Calibrated spring

To shall be used to apply a force, F, expressed in millinewtons, to the indentor in accordance with the equation:

$$F = 324 + 4{,}4\ H_{AM}$$

where H_{AM} is the hardness reading taken from a Type AM durometer.

4.2.5 Automatic timing device (optional)

The timer shall be automatically activated when the pressure foot is in contact with the test piece, and shall indicate the end of the test time or lock the test value at its completion. Use of a timing device for the test time improves precision. When used in a stand, the time tolerance shall be ± 0,3 s.

4.3 Stand

Better precision is obtained by using a stand with a weight centred on the axis of the indentor to apply the pressure foot to the test piece. Durometer Types A, D and AO may be used either as pocket meters by hand, or mounted on a stand. Durometer Type AM shall always be mounted on a stand.

4.3.1 General

The operating stand shall be capable of supporting the durometer pressure-foot surface parallel to the test piece support table.

4.3.2 Operating speed

The stand shall be capable of applying the test piece to the indentor, or vice versa, without shock, at a maximum speed of 3,2 mm/s.

4.3.3 Masses

The total mass of the durometer and extra mass to overcome the spring force shall be

$1\ ^{0}_{+0,1}$ kg for Types A and AO

$5\ ^{0}_{+0,5}$ kg for Type D

$0,25\ ^{0}_{+0,05}$ kg for Type AM

4.4 Durometer spring force calibration

The force values shall be in accordance with Table 1.

Table 1 — Durometer spring forces

Indicated durometer value	Spring forces mN		
	Type AM	Type A and AO	Type D
0	324	550	—
10	368	1 300	4 450
20	412	2 050	8 900
30	456	2 800	13 350
40	500	3 550	17 800
50	544	4 300	22 250
60	588	5 050	26 700
70	632	5 800	31 150
80	676	6 550	35 600
90	720	7 300	40 050
100	764	8 050	44 500
Millinewtons (mN) per unit	4,4	75	445
Spring calibration tolerance	± 8,8	± 37,5	± 222,5

5 Test piece

5.1 Thickness

For the determination of hardness using Shore A, D and AO durometers, the thickness of the test piece shall be at least 6 mm.

For the determination of hardness using Shore AM durometers, the thickness of the test piece shall be at least 1,5 mm.

For sheets thinner than 6 mm and 1,5 mm, a test piece may be composed of not more than three layers, in order to obtain the necessary thickness. However, determinations made on such test pieces may not agree with those made on single-thickness pieces.

For comparison purposes, the test pieces shall be similar.

NOTE The measurement on thin test samples of soft rubber will be influenced by the support table and will show a too high value.

5.2 Surface

The other dimensions of the test piece shall be sufficient to permit measurements at least 12 mm away from any edge for Types A and D, and 15 mm and 4,5 mm away from any edge for Type AO and Type AM, respectively.

The surface of the test piece shall be flat and parallel over an area sufficient to permit the pressure foot to come into contact with the test piece over an area having a radius of at least 6 mm from the indentor point for Types A and D, 9 mm for Type AO and 2,5 mm for Type AM.

Satisfactory hardness determinations cannot be made on rounded, uneven or rough surfaces using durometers. However, their use in certain specialized applications is recognized, e.g. ISO 7267-2 [3] for determination of hardness of rubber-covered rolls. In such applications, the limitations of their use shall be clearly identified.

6 Conditioning

Where practical, test pieces shall be conditioned immediately before testing for a minimum period of 1 h at the standard laboratory temperature in accordance with ISO 23529. The same temperature shall be used throughout any single test or series of tests intended to be comparable.

7 Procedure

7.1 General

Place the test piece on a flat, hard, rigid surface. Apply the pressure foot to the test piece or vice versa, as rapidly as possible, without shock, keeping the foot parallel to the surface of the test piece and ensuring that the indentor is normal to the rubber surface. When using a stand, the maximum speed shall be 3,2 mm/s.

7.2 Test time

Apply a force in accordance with 4.3.3 sufficient only to obtain firm contact between the pressure foot and the test piece and take the reading at the specified time after the pressure foot is in firm contact with the test piece. The standard test time shall be 3 s for vulcanized rubber and 15 s for thermoplastic rubber.

Other test times may be used, provided they are stated in the test report. Rubbers of unknown type should be treated as vulcanized.

7.3 Number of measurements

Make five measurements of hardness at different positions on the test piece at least 6 mm apart for Types A, D and AO and 0,8 mm apart for Type AM, and determine the median value.

8 Calibration and checking

8.1 Calibration

The instrument shall be adjusted and calibrated regularly using suitable instruments for measuring force and dimensions.

NOTE An International Standard for calibration of hardness meters and durometers, ISO 18898, is under preparation [4].

8.2 Checking using standard rubber blocks

Press the instrument against a flat piece of glass and adjust the reading on the scale to give 100 IRHD. Using a set of standard rubber blocks[2)] covering the range approx. 30 IRHD to 90 IRHD, calibrate the instrument. All adjustments shall be made according to the manufacturer's instructions. The set of standard rubber blocks shall consist of a least six test pieces kept lightly dusted with talc in a suitable covered container away from light, heat, oil and grease. The standard rubbers shall themselves be calibrated against the dead-load gauge by the method specified in ISO 48 at intervals not exceeding 6 months. Instruments in regular use should be checked at least each week against standard rubber blocks.

9 Test report

The test report shall include the following information:

a) reference to this international Standard;

b) sample details

- full description of the sample and its origin,
- compound details and curing conditions, if known,
- description of the test piece, including its thickness and, in the case of a composite test piece, the number of layers;

c) test details

- temperature of test, and the relative humidity when the hardness of the material is dependent on the humidity,
- type of instrument used,
- time elapsed between the preparation of the test piece and the measurement of hardness,
- any deviation from the standard procedure,
- details of procedure not specified in this part of ISO 7619, and any incidents likely to have had an influence on the results;

2) Standard rubber blocks are available from different manufacturers of hardness testers.