International Standard 7619

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

Rubber — Determination of indentation hardness by means of pocket hardness meters

Caoutchouc — Détermination de la dureté par pénétration au moyen d'un duromètre de poche

First edition — 1986-08-01

UDC 678.4 : 620.178.15 **Ref. No. ISO 7619-1986 (E)**

Descriptors : rubber, tests, indentation hardness tests, test equipment.

Price based on 4 pages

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7619 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

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

Printed in Switzerland

Rubber — Determination of indentation hardness by means of pocket hardness meters

1 Scope and field of application

1.1 This International Standard specifies a method for the determination of the indentation hardness of rubber by means of pocket hardness meters of two types:

a) the Shore-type durometer;

b) a meter calibrated in IRHD.

Two types of Shore-type durometer are described; durometer type A is used for rubbers in the normal hardness range and type D for rubbers in the high hardness range.

1.2 The use of pocket meters is primarily intended for control purposes and is not recommended for specification purposes. For such purposes, the methods given in ISO 48, ISO 1400 and ISO 1818 should be used. It is possible to increase the precision by fixing the pocket hardness tester on a support.

1.3 A similar method for measuring the hardness of plastics is given in ISO 868, *Plastics — Determination of indentation hardness by means of a durometer (Shore hardness).*

2 References

ISO 48, *Vulcanized rubbers — Determination of hardness (hardness between 30 and 85 IRHD).*

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 1400, *Vulcanized rubbers of high hardness (85 to 100 IRHD) — Determination of hardness.*

ISO 1818, *Vulcanized rubbers of low hardness (10 to 35 IRHD) — Determination of hardness.*

3 Principle

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

The indentation hardness is inversely related to the penetration and is dependent on the modulus of elasticity and the viscoelastic properties of the material. The shape of the indentor and the force applied to it influence the results obtained, so that there may be no simple relationship between the results obtained with one type of durometer and those obtained with either another type of durometer or another instrument for measuring hardness.

4 Apparatus

4.1 Shore-type durometers: Types A and D

The durometers consist of the following components:

4.1.1 Pressure foot, with a central hole of diameter between 2,5 and 3,2 mm, centred at least 6 mm from any edge of the foot.

4.1.2 Indentor, formed from a hardened steel rod of 1,25 ± 0,15 mm diameter to the shape and dimension shown in figure 1, for type A durometers, and figure 2 for type D durometers.

4.1.3 Indicating device, for reading the extent of protrusion of the point of the indentor beyond the face of the pressure foot; this may be read directly in terms of units ranging from 0, for the full protrusion of 2,50 ± 0,04 mm, to 100 for nil protrusion obtained by placing the pressure foot and indentor in firm contact with a flat piece of glass.

4.1.4 Calibrated spring, to apply force to the indentor in accordance with one of the following equations:

a) $F = 550 + 75\,H_A$

where

F is the applied force, in millinewtons;

H_A is the hardness reading of the type A durometer.

b) $F = 4\,445\,H_D$

where

F is the applied force, in millinewtons;

H_D is the hardness reading on the type D durometer.

4.2 The IRHD pocket hardness meter

The meter calibrated in IRHD consists of the following components:

4.2.1 Pressure foot, 20 ± 2,5 mm square with a central hole of diameter between 2,0 and 3,0 mm.

4.2.2 Indentor, the end being hemispherical, of diameter 1,55 mm to 1,60 mm.

4.2.3 Indicating device, for recording the extent of protrusion of the indentor beyond the face of the pressure foot; this shall be calibrated directly in terms of IRHD from 28°, for maximum protrusion of 1,65 mm, to 100° for nil protrusion obtained by placing the pressure foot and indentor in firm contact with a flat piece of glass.

4.2.4 Calibrated spring, for applying a substantially constant force to the indentor of 2,65 ± 0,15 N over the 28 to 100 IRHD range.

5 Test piece

5.1 For the determination of hardness by pocket hardness meters, the thickness of the test piece shall be at least 6 mm. For thinner sheets, a test piece may be composed of not more than three thinner layers, none of which shall be thinner than 2 mm, to obtain the necessary thickness, but determinations made on such test pieces may not agree with those made on single thickness pieces.

NOTE — For comparison purposes, the test pieces should be similar.

5.2 The other dimensions of the test piece shall be sufficient to permit measurements at least 12 mm away from any edge. The surface of the test piece shall be flat over the area in contact with the pressure foot.

NOTE — Satisfactory hardness determinations cannot be made on rounded, uneven or rough surfaces using pocket meters. However, their use in certain specialized applications is recognized, e.g. for determination of hardness of rubber-covered rolls. In such applications, the limitations of their use should be clearly identified.

6 Conditioning

Where possible, test pieces shall be conditioned immediately before testing for a minimum period of 1 h at the standard laboratory temperature in accordance with ISO 471. The same temperature shall be used throughout any one test or series of tests intended to be comparable.

7 Procedure

7.1 Place the test piece on a hard, rigid surface. Hold the hardness meter in position with the centre of the indenter at least 12 mm from the edges of the test piece. Apply the pressure foot to the test piece as rapidly as possible, without shock, keeping the foot parallel to the surface of the test piece ensuring that the indentor is normal to the rubber surface.

Apply just sufficient force to obtain firm contact between the pressure foot and the test piece. Unless otherwise specified, take the reading within 1 s after the pressure foot is in firm contact with the test piece. When a reading after another time-interval is specified, hold the pressure foot in contact with the test piece without change in position and pressure and take the reading after the specified time.

7.2 Make five measurements of hardness at different positions on the test piece at least 6 mm apart and determine the mean value.

7.3 When using Shore-type durometers, it is recommended that measurements be made with the type D instrument when values above 90 are obtained with the type A durometer and that measurements be made with the type A instrument when values less than 20 are obtained with type D durometers. Values below 10 on the type A apparatus are inexact and should not be reported.

NOTE — Better reproducibility may be obtained by using either a stand or a weight centred on the axis of the indentor, or both, to apply the pressure foot to the test piece. For Shore-type durometers, masses of 1 kg and 5 kg are recommended for type A and type D respectively.

8 Calibration

8.1 Shore-type durometers

The spring of the durometer shall be calibrated by supporting the durometer in a vertical position and resting the point of the indentor on a small spacer at the centre of one pan of a balance, as shown in figure 3, in order to prevent interference between the pressure foot and the pan. The spacer has a small cylindrical stem of height approximately 2,5 mm and diameter approximately 1,25 mm, and is slightly cupped on top to accommodate the indentor point. The weight of the spacer shall be balanced by a weight on the opposite pan of the balance. Weights shall be added to the opposite pan to balance the force on the indentor at various scale readings. The measured force shall be equal to the force calculated by the relevant equation given in 4.1.4. For type A instruments, the force shall be within ± 80 mN of the calculated value and for type D instruments within ± 440 mN.

Alternatively, electronic balances or instruments specifically designed for calibration of durometers may be used. Balances or instruments used for calibration should be capable of measuring or applying force on the point of the indentor within 8,0 mN for the type A durometer and within 44,0 mN for the type D durometer.

8.2 IRHD pocket hardness meter

8.2.1 General

The instrument shall be calibrated and adjusted frequently, preferably against a range of standard rubber blocks that have been previously calibrated against a dead-load gauge by the method given in ISO 48. Calibration of the instrument by mechanical means is recommended only where no suitable standard rubber test pieces are available. In such cases the manufacturer's instructions should be followed.

8.2.2 Calibration 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 covering the range approximately 30 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 at 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 given in ISO 48 at intervals not exceeding 6 months.

It is recommended that instruments in regular use be recalibrated at least each week against the standard rubbers.

9 Test report

The test report shall include the following particulars:

a) reference to this International Standard;

b) complete identification of the material tested;

c) description of test piece, including thickness and, in the case of a composite test piece, the number of layers;

d) temperature of test, and relative humidity when hardness of the material is dependent on humidity;

e) type of instrument used;

f) time elapsed between the preparation of the test piece and the measurement of hardness;

g) individual values of indentation hardness and time-interval after which each reading was taken if different from 1 s;

NOTE — For Shore-type durometers, readings may be reported in the form A 45/1, where A is the type of durometer, 45 the reading, and 1 the time, in seconds, between bringing the pressure foot in firm contact with the test piece and taking the reading, or alternatively A 45 when the preferred time of reading of 1 s is being used.

h) values, median and range of indentation hardness, expressed either in IRHD or in Shore A or Shore D units;

i) date of test;

j) details of procedure not specified in this International Standard and any incidents likely to have had an influence on the results.

Dimensions in millimetres

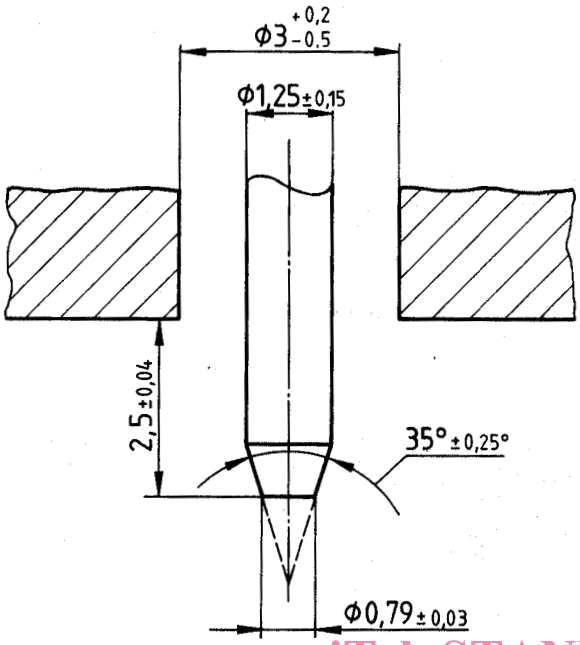

Figure 1 — Indentor for type A durometer

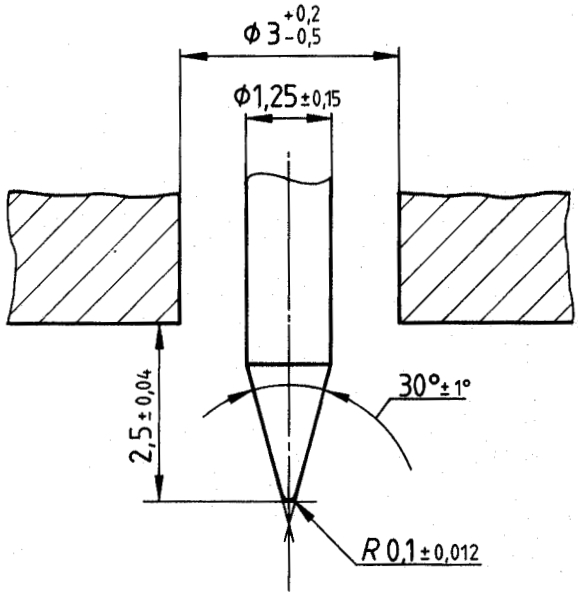

Figure 2 — Indentor for type D durometer

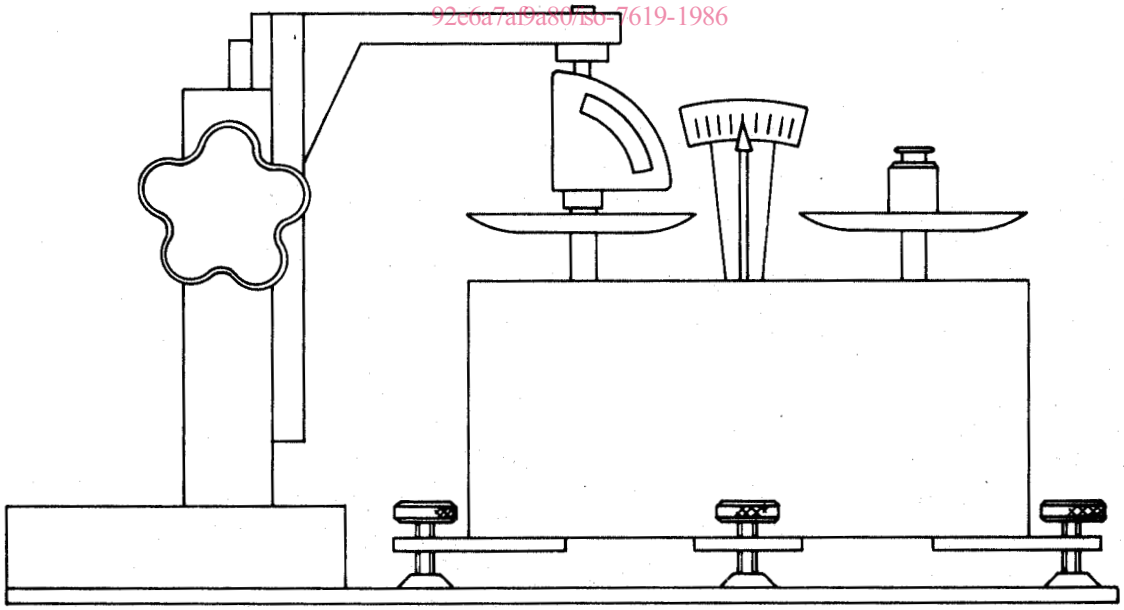

Figure 3 — Apparatus for calibration of durometer spring