
**Plastics and ebonite — Determination of
indentation hardness by means of a
durometer (Shore hardness)**

*Plastiques et ébonite — Détermination de la dureté par pénétration au
moyen d'un duromètre (dureté Shore)*



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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 868 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

This third edition cancels and replaces the second edition (ISO 868:1985), which has been technically revised.

Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)

1 Scope

1.1 This International Standard specifies a method for the determination of the indentation hardness of plastics and ebonite by means of durometers of two types: type A is used for softer materials and type D for harder materials (see the Note to 8.2). The method permits measurement either of the initial indentation or of the indentation after a specified period of time, or both.

NOTE The durometers and the methods specified in this International Standard are referred to as type A Shore and type D Shore durometers and durometer methods, respectively.

1.2 This method is an empirical method intended primarily for control purposes. No simple relationship exists between indentation hardness determined by this method and any fundamental property of the material tested. For specification purposes, it is recommended that ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*, be used for the softer materials.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing*

3 Principle

A specified indenter is forced into the test material under specified conditions and the depth of penetration measured.

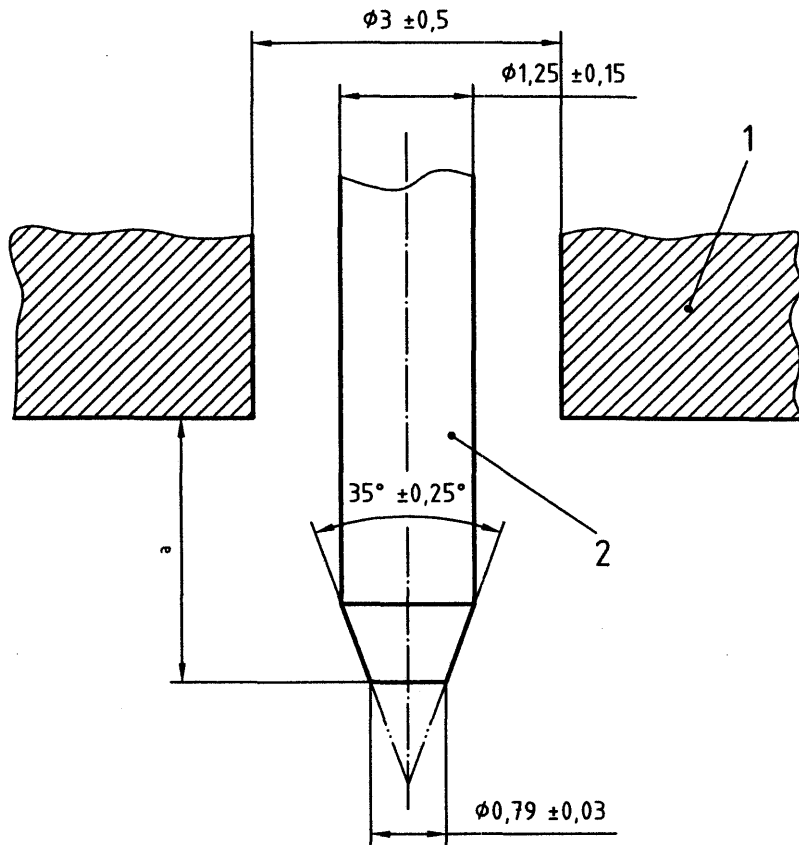
The indentation hardness is inversely related to the penetration and is dependent on the modulus of elasticity and the viscoelastic properties of the material. The shape of the indenter, the force applied to it and the duration of its application influence the results obtained so that there may be no 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

Use either a type A or type D Shore durometer consisting of the following components:

4.1 Presser foot, with a hole of diameter $3 \text{ mm} \pm 0,5 \text{ mm}$ centred at least 6 mm from any edge of the foot.

4.2 Indenter, formed from a hardened steel rod of diameter $1,25 \text{ mm} \pm 0,15 \text{ mm}$ to the shape and dimensions shown in Figure 1 for type A durometers and Figure 2 for type D durometers.



Key

- 1 presser foot
- 2 indenter

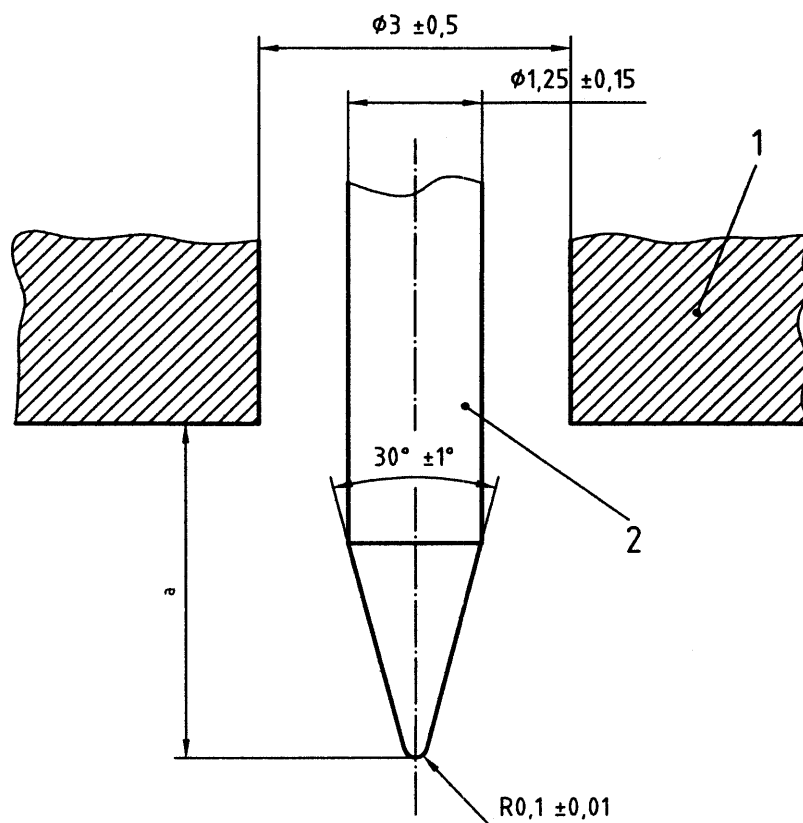
^a full protrusion: 2,5 mm \pm 0,04 mm

Figure 1 — Indenter for type A durometer

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

NOTE The device may include means for indicating the initial indentation obtained when the indenter is applied under load, to provide a maximum reading for use as an instantaneous reading if required (see 8.1).

Dimensions in millimetres

**Key**

- 1 presser foot
2 indenter

^a full protrusion: $2,5 \text{ mm} \pm 0,04 \text{ mm}$

Figure 2 — Indenter for type D durometer

4.4 Calibrated spring, for applying force to the indenter in accordance with one of the following equations:

$$F = 550 + 75H_A \quad (1)$$

where

F is the applied force, in millinewtons;

H_A is the hardness reading on the type A durometer

or

$$F = 445H_D \quad (2)$$

where

F is the applied force, in millinewtons;

H_D is the hardness reading on the type D durometer.

5 Test specimens

5.1 The thickness of the test specimen shall be at least 4 mm. A test specimen may be composed of thinner layers to obtain the necessary thickness, but determinations made on such test specimens may not agree with those made on one-piece test specimens because the surfaces between the plies may not be in complete contact.

5.2 The dimensions of the test specimen shall be sufficient to permit measurements at least 9 mm away from any edge, unless it is known that identical results are obtained when measurements are made at a lesser distance from an edge. The surface of the test specimen shall be flat over an area sufficient to permit the presser foot to be in contact with the test specimen over an area having a radius of at least 6 mm from the indenter point. Satisfactory durometer hardness determinations cannot be made on rounded, uneven or rough surfaces.

6 Calibration

The spring (4.4) of the durometer is calibrated by supporting the durometer in a vertical position and resting the point of the indenter (4.2) on a small metal spacer at the centre of one pan of a balance, as shown in Figure 3, in order to prevent interference between the presser foot (4.1) 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 indenter point. The mass of the spacer is balanced by a weight on the opposite pan of the balance. Weights are added to the opposite pan to balance the force on the indenter at various scale readings. The measured force shall be equal to the force calculated by either equation (1) to within ± 75 mN or equation (2) to within ± 445 mN.

Instruments specifically designed for calibration of durometers may be used. Balances or instruments used for calibration shall be capable of measuring or applying a force on the point of the indenter to within 3,9 mN for the type A durometer and to within 19,6 mN for the type D durometer.

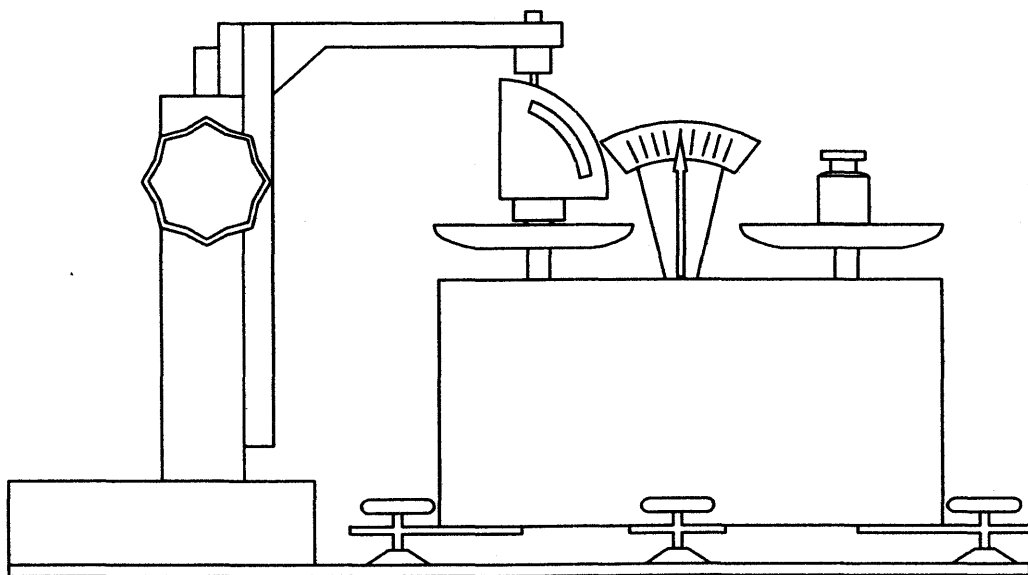


Figure 3 — Apparatus for calibration of durometer spring

7 Conditioning and testing atmospheres

7.1 For materials whose hardness is not dependent on the relative humidity, the durometer and test specimens shall be conditioned at the temperature of test (see 7.2) for at least 1 h before testing. For materials whose hardness is dependent on the relative humidity, the test specimens shall be conditioned in accordance with ISO 291, or in accordance with the relevant material specification.

When a durometer is moved from a location below room temperature to a location with a higher temperature, it shall be placed in a suitable desiccator or airtight container immediately upon removal and allowed to remain there until the temperature of the durometer is above the dew point of the air in the new environment.

7.2 Tests shall be carried out in one of the standard atmospheres specified in ISO 291, unless otherwise stated in the relevant material specification.

8 Procedure

8.1 Place the test specimen on a hard, horizontal, plane surface. Hold the durometer in a vertical position with the point of the indenter (4.2) at least 9 mm from any edge of the test specimen. Apply the presser foot (4.1) to the test specimen as rapidly as possible, without shock, keeping the foot parallel to the surface of the test specimen. Apply just sufficient pressure to obtain firm contact between presser foot and test specimen.

NOTE Better reproducibility may be obtained by using either a durometer stand or a weight centred on the axis of the indenter, or both, to apply the presser foot to the test specimen. Recommended masses are 1 kg for the type A durometer and 5 kg for the type D durometer.

Read the scale of the indicating device (4.3) after $15\text{ s} \pm 1\text{ s}$. If an instantaneous reading is specified, read the scale within 1 s after the presser foot is in firm contact with the test specimen, unless the durometer has a maximum indicator, in which case the maximum reading shall be taken.

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

NOTE It is recommended that measurements be made with the type D durometer when values above 90 are obtained with the type A durometer and that measurements be made with the type A durometer when values less than 20 are obtained with the type D durometer.

9 Test report

The test report shall include the following particulars:

- a) a reference to this International Standard;
- b) all details necessary for complete identification of the material tested;
- c) a description of the test specimen, including its thickness and, in the case of a composite test specimen, the number of layers;
- d) the temperature of test, and the relative humidity when the hardness of the material is dependent on the humidity;
- e) the type of durometer used (A or D);
- f) if known and if required, the time which elapsed between preparation of the test specimen and measurement of hardness;
- g) the individual values of the indentation hardness and the time-interval after which each reading was taken;

NOTE Readings may be reported in the form Shore hardness A/15:45, where A is the type of durometer, 15 is the time, in seconds, between bringing the pressure foot in firm contact with the test specimen and taking the reading, and 45 is the reading. Similarly, Shore hardness D/1:60 indicates a reading of 60 on the type D durometer obtained either within 1 s or from a maximum indication.

- h) the average value of the indentation hardness;
- i) details of any operations not specified in this International Standard, as well as details of any incidents likely to have influenced the results.

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