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Plastics and ebonite — Verification of Shore durometers

Plastiques et ébonite — Vérification des duromètres 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 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 21509 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

Plastics and ebonite — Verification of Shore durometers

1 Scope

This International Standard concerns the verification of type A and D Shore durometers used to conduct hardness tests as described in ISO 868.

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 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 868:2003, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
verification
all of the operations carried out in order to determine compliance of the device with the requirements of this International Standard

3.2
durometer
apparatus allowing the determination of hardness by forcing an indenter into a material

4 Measuring instruments and temperature of verification

The verification methods described in this document require the use of both dimensional and dynamometric instruments.

NOTE Usually, the measurement uncertainty should be 1/5 of the tolerance on the value to be verified.

The verification shall be conducted at an ambient temperature of 21 °C to 25 °C or 25 °C to 29 °C for tropical countries if agreed on by all parties (see ISO 291).

5 Verification of the durometer

5.1 Elements to be verified

— geometry of the indenter;

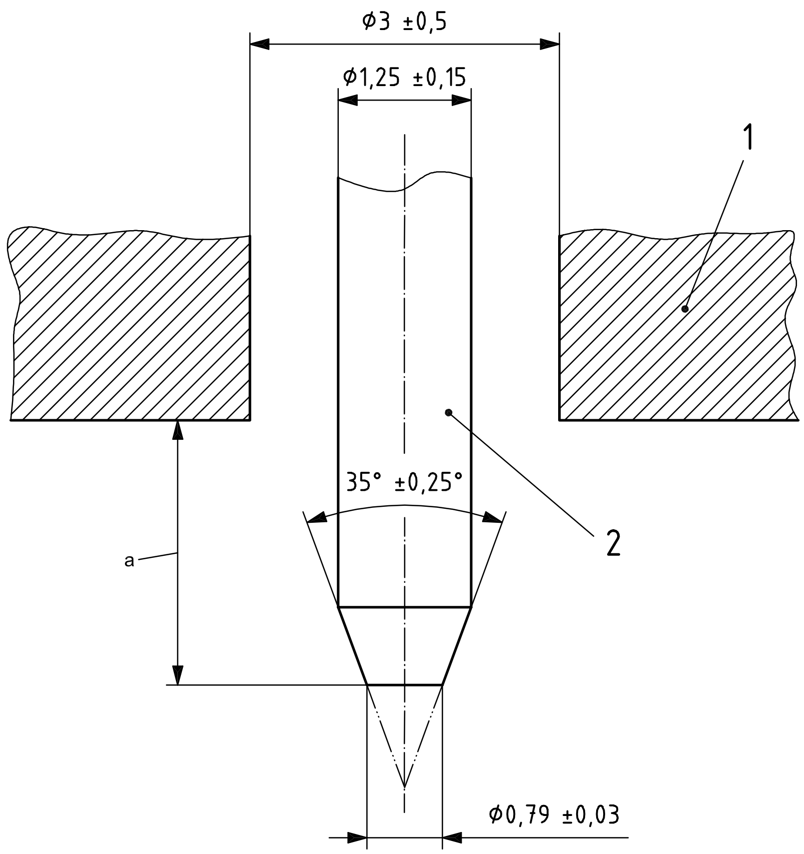
- maximum protrusion of the indenter beyond the base of the presser foot;
- geometry of the presser foot;
- scale of the indicating device;
- force exerted by the measurement spring on the indenter.

5.2 Verification of the geometry and of the maximum protrusion of the indenter beyond the base of the presser foot

Using a suitable optical or mechanical device (e.g. a profile projector, a binocular optical measurement instrument, callipers or similar device), verify that the dimensions of the indenter comply with the geometry specified in ISO 868 and indicated in Figure 1 (for a type A Shore durometer) and in Figure 2 (for a type D Shore durometer); likewise, verify that the maximum protrusion of the indenter beyond the base of the presser foot lies within the tolerances given in Figure 1 or 2.

Repeat the measurement three times and record each measurement for each durometer. It is recommended that the measurements be recorded in tables as shown in Table A.1 for the type A durometer and Table A.2 for the type D durometer.

Dimensions in millimetres



Key

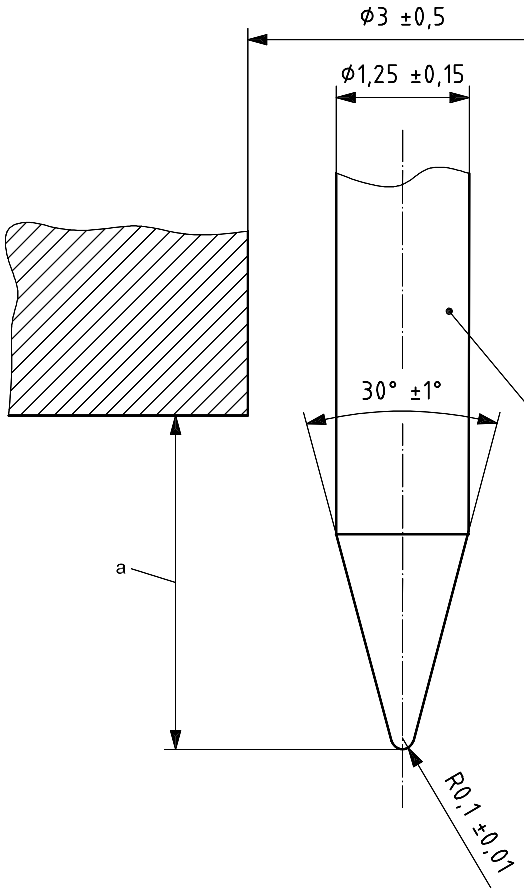
1 presser foot

2 indenter

a Full protrusion: 2,5 mm ± 0,04 mm.

Figure 1 — Indenter for type A durometer

Dimensions in millimetres



Key

1 presser foot
2 indenter

a Full protrusion: 2,5 mm ± 0,04 mm.

Figure 2 — Indenter for type D durometer

5.3 Verification of the geometry of the presser foot

Using calipers, calibrated pins or a suitable optical device, ascertain that the diameter of the hole of the presser foot is between 2,5 mm and 3,5 mm and that this hole is centred at least 6 mm from the edges of the foot.

Repeat the measurement three times and record each measurement for each durometer. It is recommended that the measurements be recorded in tables as shown in Table A.1 for the type A durometer and Table A.2 for the type D durometer.

NOTE Some manufacturers chamfer the edge of the presser foot hole. In such cases, the chamfer area is not taken into account by the measurement.

5.4 Verification of the scale of the indicating device

Verify the points 0 and 100 on the indicating device scale. Point 0 corresponds to the maximum protrusion of the indenter beyond the base of the presser foot (indenter at rest); point 100 corresponds to nil protrusion obtained by placing the presser foot and indenter in firm contact with a flat sheet of glass or any other object which will not affect the integrity of the tip.

NOTE In view of the stiffness of the measurement spring and the geometry of the indenter of the type D Shore durometer, the tip of the cone is fragile. When verifying point 100, therefore, it is recommended that a durometer support be used and that the indenter be applied to the bearing surface perpendicularly so as not to break the tip or bend the indenter centring device.

If the durometer has a maximum-reading indicator, it is necessary to ascertain that the maximum-reading indicator coincides with the measurement pointer at all points on the scale.

Repeat the measurement three times and record each measurement. It is recommended that the measurements be recorded in a table as shown in Table A.3.

5.5 Verification of the force exerted by the measurement spring on the indenter

5.5.1 Method 1: Use of a dynamometric verification device

When using a dynamometric verification device, the measurement spring is verified by fixing the latter in a vertical position and, if necessary, resting the tip of the indenter on a small metal spacer in order to prevent any contact between the presser foot and the dynamometric verification device.

The method normally employed is as follows: forces corresponding to different durometer readings ranging from Shore hardness 20 to 90 in increments of approximately 10 are exerted on the indenter. In the case of a pointer-type durometer, the pointer shall coincide with the mark on the selected dial.

Repeat the series of measurements three times with increasing load and record the results. Then carry out a series with decreasing load and record these results. It is recommended that the measurements be recorded in a table as shown in Table A.4 or A.5.

None of the readings shall be outside the indicated tolerance limits. At each load increment, the force measured by the dynamometric device F_i is compared with the force F calculated using the appropriate stiffness equation for the spring, viz:

$F = 550 + 75\text{HA}$ for a type A Shore durometer;

$F = 445\text{HD}$ for a type D Shore durometer;

where

F is the force applied, in mN;

HA or HD is the hardness reading on the type A or D Shore durometer, respectively.

F_i shall be equal to F to within ± 75 mN for the type A Shore durometer or to within ± 445 mN for the type D Shore durometer.

NOTE 1 The spacer can be a small cylindrical stem of height approximately 2,5 mm and diameter approximately 1,25 mm, slightly cupped on top in order to accommodate the indenter tip.

Any dynamometric device may be employed provided that it is able to apply and measure a force to within 10 mN (0,13 Shore A) for the type A Shore durometer and to within 50 mN (0,11 Shore D) for the type D Shore durometer. For example, a balance having a capacity of 1 kg or 5 kg and a maximum permissible error of 1 g would be suitable for verifying the measurement spring of a type A or type D Shore durometer, respectively.

NOTE 2 The requirements concerning the verification equipment are less stringent than those specified in ISO 868:2003, Clause 6. ISO 868:2003, Clause 6, will be modified to refer to this International Standard at the next revision of ISO 868.

Figure 3 shows equipment for verification of the spring of a Shore durometer based on the principle of a balance.

If the balance reads in grams, this reading shall be converted into newtons using the local value of the gravitational acceleration.

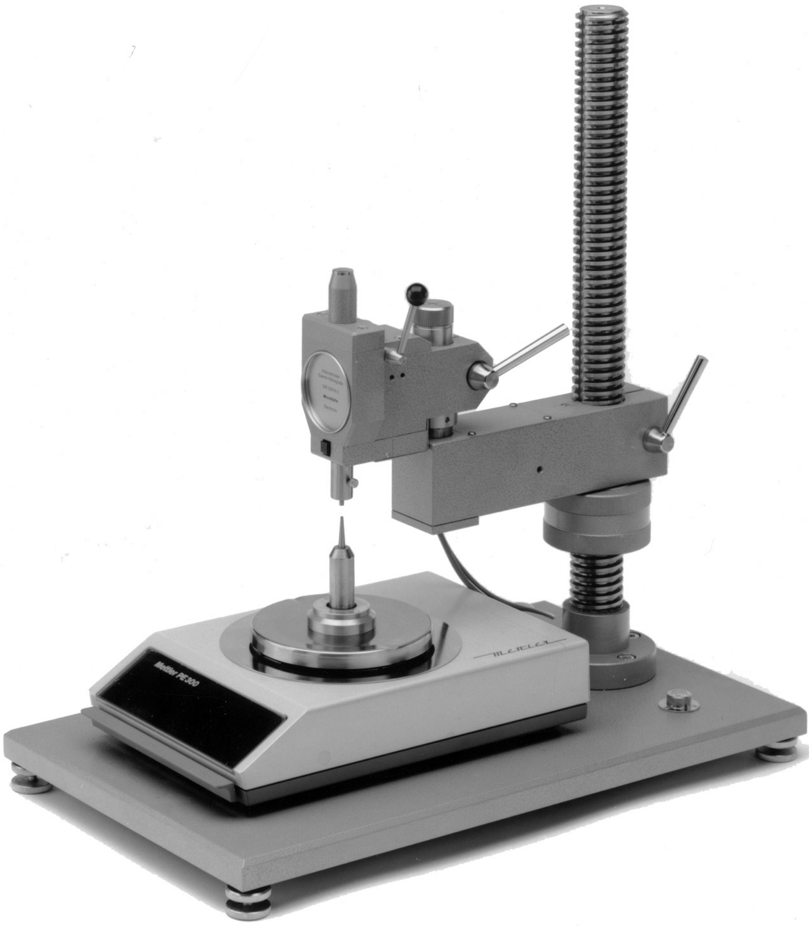


Figure 3 — Balance for verification of the spring of a Shore durometer

5.5.2 Method 2: Use of a specifically designed verification device

With instruments specifically designed for the verification of Shore durometers, such as control-recalibration devices (for an example, see Figure 4), the actual load F_i is given by the movement of the counterweight along a lever arm and applied to the indenter.

The verification device scale shall indicate directly in Shore A and/or Shore D units and apply an actual load F_i to the indentor corresponding to the stiffness equation for the measurement spring, so that no conversion from forces to Shore hardness readings is necessary.

Repeat the series of measurements three times with increasing load and record the results. Then carry out a series with decreasing load and record these results. It is recommended that the measurements be recorded in a table as shown in Table A.4 or A.5.

Calculate separately the maximum and minimum values at each load increment for the increasing loading. None of the readings shall be outside the indicated tolerance limits.

In the event of problems, in particular if the durometer reading is not stable or not reproducible, repeat the procedure.

Figure 4 — Shore durometer verification device

The verification device shall be checked in such a way that, if a given Shore value is chosen by positioning the counterweight, the force applied to the indenter is within given tolerance limits (± 10 mN for the Shore A scale and ± 50 mN for the Shore D scale).

The verification device shall be checked:

- after its production;
- after each repair;
- in case of any kind of damage or doubt;
- at two-year intervals.

6 Frequency of verification

Verification in accordance with this International Standard shall be carried out and the durometer certified:

- after the production of a new durometer;
- after each repair;
- in case of any kind of damage, especially to the indenter;
- at yearly intervals.

7 Verification report

At the end of each verification, a report including the following information shall be made out:

a) the name and address of the body responsible for the verification;

b) the name of the person who carried out the verification;

c) the name and address of the user's company;

d) a description of the Shore durometer, including at least the manufacturer, the type or model and the serial number of the durometer;

e) the date of the verification;

f) a reference to this International Standard;

g) a list of the verification equipment used and all information necessary to establish its traceability (note that accredited laboratories do not need to provide details of the equipment used since accreditation provides the necessary assurance);

h) the records required in Subclauses 5.2, 5.3, 5.4 and 5.5;

i) detailed data concerning any adjustments or repairs which may have been carried out (in such cases, the report can include results before and after the adjustments or repairs);

j) a statement indicating compliance or not with the requirements of this International Standard;

k) the date of the report.

Annex A
(informative)

Example of tables to be included in the verification report

Table A.1 — Verification of the geometry and of the maximum protrusion of the indenter beyond the base of the presser foot for type A durometers

	Value set	Tolerance	Measurements			Greatest value measured	Smallest value measured	OK? (Y/N)	Verification device used
			1	2	3				
Diameter of indenter, mm	1,25	± 0,15							
Diameter of tip, mm	0,79	± 0,03							
Full protrusion, mm	2,50	± 0,04							
Angle of tip, degrees	35,00	± 0,25							
Diameter of presser foot hole, mm	3,0	± 0,5							
Outside diameter of presser foot, mm	> 12								

Table A.2 — Verification of the geometry and of the maximum protrusion of the indenter beyond the base of the presser foot for type D durometers

	Value set	Tolerance	Measurements			Greatest value measured	Smallest value measured	OK? (Y/N)	Verification device used
			1	2	3				
Diameter of indenter, mm	1,25	± 0,15							
Radius of tip, mm	0,100	± 0,012							
Full protrusion, mm	2,50	± 0,04							
Angle of tip, degrees	30	± 1							
Diameter of presser foot hole, mm	3,0	± 0,5							
Outside diameter of presser foot (6,0 mm), mm	> 12								

Table A.3 — Verification of the scale of the indicating device

Protrusion	Value set (Shore)	Tolerance (Shore)	Measurements			Greatest value measured (Shore)	Smallest value measured (Shore)	OK? (Y/N)	Verification device used
			1 (Shore)	2 (Shore)	3 (Shore)				
Full	0	± 1							
Nil	100	± 1							

Table A.4 — Verification of the force exerted by the measurement spring on the indenter of a type A durometer by means of a dynamometric device

Shore value	Force set (mN)	Tolerance (mN)	Measurements				Greatest value measured	Smallest value measured	OK? (Y/N)	Verification device used [c]
			1 [a] (mN)	2 [a] (mN)	3 [a] (mN)	1 [b] (mN)				
20	2 050	± 75								
30	2 800	± 75								
40	3 550	± 75								
50	4 300	± 75								
60	5 050	± 75								
70	5 800	± 75								
80	6 550	± 75								
90	7 300	± 75								

[a] Increasing load.

[b] Decreasing load.

[c] Indicate the make and model.

or with measurements indicated in Shore A values directly:

Shore value (Shore A)	Tolerance (Shore A)	Measurements				Greatest value measured	Smallest value measured	OK? (Y/N)	Verification device used [c]
		1 [a] (Shore A)	2 [a] (Shore A)	3 [a] (Shore A)	1 [b] (Shore A)				
20	± 1								
30	± 1								
40	± 1								
50	± 1								
60	± 1								
70	± 1								
80	± 1								
90	± 1								

[a] Increasing load.

[b] Decreasing load.

[c] Indicate the make and model.

Table A.5 — Verification of the force exerted by the measurement spring on the indenter of a type D durometer by means of a dynamometric device

Shore value	Force set (mN)	Tolerance (mN)	Measurements				Greatest value measured	Smallest value measured	OK? (Y/N)	Verification device used [c]
			1 [a] (mN)	2 [a] (mN)	3 [a] (mN)	1 [b] (mN)				
20	8 900	± 445								
30	13 350	± 445								
40	17 800	± 445								
50	22 250	± 445								
60	26 700	± 445								
70	31 150	± 445								
80	35 600	± 445								
90	40 050	± 445								

[a] Increasing load.

[b] Decreasing load.

[c] Indicate the make and model.

or with measurements indicated in Shore D values directly:

Shore value (Shore D)	Tolerance (Shore D)	Measurements				Greatest value measured	Smallest value measured	OK? (Y/N)	Verification device used [c]
		1 [a] (Shore D)	2 [a] (Shore D)	3 [a] (Shore D)	1 [b] (Shore D)				
20	± 1								
30	± 1								
40	± 1								
50	± 1								
60	± 1								
70	± 1								
80	± 1								
90	± 1								

[a] Increasing load.

[b] Decreasing load.

[c] Indicate the make and model.

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