
International Standard



2439

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

Polymeric materials, cellular flexible — Determination of hardness (indentation technique)

Matériaux polymères alvéolaires souples — Détermination de la dureté (technique par indentation)

Second edition — 1980-11-01

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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.

International Standard ISO 2439 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition was submitted directly to the ISO Council, in accordance with clause 5.10.1 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 2439-1972), which had been approved by the member bodies of the following countries :

Austria	India	Spain
Canada	Italy	Switzerland
Ceylon	Netherlands	Turkey
Czechoslovakia	New Zealand	United Kingdom
Egypt, Arab Rep. of	Poland	USA
France	Portugal	USSR
Germany, F.R.	Romania	Yugoslavia
Hungary	South Africa, Rep. of	

The member body of the following country had expressed disapproval of the document on technical grounds :

Sweden



INTERNATIONAL STANDARD ISO 2439-1980 (E)/ERRATUM

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5.3 Indentor

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In line 3, delete " $10 \begin{smallmatrix} + \\ 0 \end{smallmatrix} 0,5 \text{ mm}$ ", and substitute " $1,0 \begin{smallmatrix} + \\ 0 \end{smallmatrix} 0,5 \text{ mm}$ ".

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Polymeric materials, cellular flexible — Determination of hardness (indentation technique)

1 Scope

This International Standard specifies three methods for determining the indentation hardness of flexible cellular materials :

- **method A** (indentation hardness index), which gives a single indentation measurement for laboratory test purposes;
- **method B** (indentation hardness characteristics), which provides information about the shape of the hardness indentation curve;
- **method C** (indentation hardness check), which is a quick procedure suitable for quality control testing

2 Field of application

The indentation hardness of flexible cellular materials is a measure of their load-bearing properties. The methods specified can be used for testing finished articles and for the characterization of bulk material.

At present, the methods are applicable only to latex, urethane foam and PVC foam of the open cell type.

The results obtained by these methods relate only to the test conditions specified and cannot, in general, be used directly for design purposes.

3 Definition

indentation hardness : The total force, in newtons, required to produce, under specified conditions, a specified indentation of a standard test piece with a standard apparatus using the test procedure specified below.

4 Principle

Measurement of the forces required to produce specified indentations under specified conditions.

5 Apparatus

5.1 Testing machine, capable of indenting the test piece between a supporting surface and an indenter which shall have a uniform relative motion, in the vertical direction, of 100 ± 20 mm/min.

The testing machine shall have a means of measuring the force required to produce the specified indentation with a precision of $\pm 1\%$ or ± 1 N, whichever is the greater, and of measuring the test piece thickness under load with a precision of $\pm 0,25$ mm.

The testing machine for method C shall have its force gauge fitted with a tell-tale needle and/or shall be equipped to make autographic load-indentation plots.

The testing machine shall also be capable of maintaining the specified degree of indentation with a precision of $\pm 0,25$ mm for the specified period.

5.2 Supporting surface

Unless otherwise specified, the test pieces shall be supported on a smooth, flat, horizontal and rigid surface, larger than the test piece and suitably vented with holes approximately 6 mm in diameter and of approximately 20 mm pitch, to allow the escape of air from below the test piece.

5.3 Indentor

The indenter shall be mounted by a ball joint free from vertical movement. It shall be flat and circular, with a diameter of $200 + \frac{3}{0}$ mm and a $10 + \frac{0,5}{0}$ mm radius at the lower edge. The lower surface shall be smooth but not polished.

6 Test pieces

6.1 Form and dimensions

Material shall be cut to obtain a standard size square of length of side $380 + \frac{20}{0}$ mm with a thickness of 50 ± 2 mm. Sheets of less than this standard thickness shall be plied together to approximate as closely as possible to the standard thickness.

Finished articles may be tested as agreed between purchaser and supplier.

NOTE — Results on plied material and on finished articles may not be the same as would be obtained with the standard test piece.

6.2 Samples showing orientation

If samples show orientation of the cellular structure, the direction in which the indentation is to be carried out shall be agreed between the interested parties. Normally, testing should be carried out in that direction in which the finished product will be stressed under service conditions.

6.3 Conditioning

Materials shall not be tested for at least 72 h after manufacture. Prior to the test, the test pieces shall be conditioned for at least 16 h in one of the following atmospheres :

20 ± 2 °C, 65 ± 5 % relative humidity; or

23 ± 2 °C, 50 ± 5 % relative humidity; or

27 ± 2 °C, 65 ± 5 % relative humidity.

7 Procedure

7.1 Preliminary indentation

Carry out the test, immediately after conditioning, preferably under the same atmospheric conditions as specified in 6.3.

Position the test piece on the supporting surface so that the centre of the test piece, or other agreed test area, is located below the centre of the indenter. Test pieces having cavities on one side shall be placed with the cavity side next to the supporting surface.

Apply a force of $5 \pm \frac{0}{2}$ N to the selected test area and measure the thickness. Indent the test piece at a rate of 100 ± 20 mm/min, to produce an indentation of $70 \pm 2,5$ % of the thickness. After reaching 70 % deflection, release the load at the same rate. Repeat this loading and unloading twice more, then proceed in accordance with 7.2, 7.3 or 7.4 as appropriate.

7.2 Method A — Determination of indentation hardness index

Immediately after the third unloading (see 7.1), indent the test piece to 40 ± 1 % of the thickness. Maintain this deflection for a period of 30 ± 1 s, note the corresponding force, in newtons, and release the force.

Only the result of a test conducted by method A, on the standard size test piece, without plying, shall be known as the **indentation hardness index**.

7.3 Method B — Determination of indentation hardness characteristics

Immediately after the third unloading (see 7.1) :

- a) indent the test specimen to 25 ± 1 % of the thickness;
- b) maintain this indentation for a period of 30 ± 1 s;
- c) measure the force;
- d) increase the indentation to 40 ± 1 %;
- e) maintain this indentation for a period of 30 ± 1 s;
- f) measure the force;
- g) increase the indentation to 65 ± 1 % of the thickness;
- h) maintain this indentation for a period of 30 ± 1 s;
- j) measure the force.

The results of a test conducted by method B on a standard test piece shall be known as the **standard indentation hardness characteristics** of that material. If a product is tested, the results shall be known as the **product indentation hardness characteristics**.

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NOTE — Convenient means of expressing the results obtained by method B are **indentation factors**, which are the ratios of the forces required to obtain the indentation of 25 and 65 % divided by the force required to obtain the indentation of 40 %.

7.4 Method C — Determination of indentation hardness check

Immediately after the third unloading (see 7.1) start the autographic recording, or bring back the tell-tale needle of the force gauge, and indent the test piece to 40 ± 1 % of the thickness.

Record the force in newtons, using the tell-tale needle or the instantaneous maximum of the autographic recorder.

Release the force.

The results of a test conducted by method C shall be known as the **indentation hardness check**.

NOTE — This is a faster, quality control test for indentation hardness. The variability of results obtained in this way will be higher. It should also be noted that the results obtained in this way may be related to results obtained with method A but will usually be higher.

8 Repeat tests

For repeat tests on the same test piece, a minimum recovery period of 16 h shall be observed.

9 Test report

The test report shall include the following information :

- a) the method used and the type of result obtained (for example product indentation hardness characteristics);
- b) the conditioning and test temperatures and relative humidities;
- c) whether bulk material or finished articles were tested;
- d) the dimensions of the test piece and, in particular, the thickness as determined in clause 6;
- e) where applicable, the number of plies constituting the test piece;
- f) whether skins were present and, if so, how many;
- g) the indentation hardness(es) : values up to 100 N shall be quoted to the nearest unit; values over 100 N shall be quoted to the nearest 5 N.

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