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Flexible cellular polymeric materials — Determination of hardness (indentation technique)

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

Reference number
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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 2439 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

This fourth edition cancels and replaces the third edition (ISO 2439:1997 and ISO 2439:1997/Cor.1:1998), which has been technically revised.

Major modifications in this revised text are:

a) change in Scope to cover five methods;

b) inclusion of Figure 1 to illustrate the force-indentation curve; and

c) inclusion of informative annexes.

Flexible cellular polymeric materials — Determination of hardness (indentation technique)

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This International Standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

The indentation hardness of flexible cellular materials is a measure of their load-bearing properties. This International Standard specifies four methods (A to D) for the determination of indentation hardness and one method (E) for determination of compressive deflection coefficient and hysteresis loss rate of flexible cellular materials. Annex A provides a summary of test parameters and typical force-indentation graphs obtained with these methods.

These five methods are applicable only to latex foam, urethane foam and PVC foam of the open-cell type. The methods specified can be used for testing finished articles and for the characterization of bulk material.

This International Standard specifies the following methods:

a) Method A — Determination of the 40 %/30 s indentation hardness index, which gives a single indentation measurement for laboratory test purposes;

b) Method B — Determination of the 25 %-40 %-65 %/30 s indentation hardness characteristics, which provides information about the shape of the hardness indentation curve;

c) Method C — Determination of the 40 % indentation hardness check, which is a quick procedure suitable for quality control testing;

d) Method D — Determination of the 25 %/20 s low indentation hardness index, which is a quick procedure suitable as an inspection test;

e) Method E — Determination of the compressive deflection coefficient and hysteresis loss rate, which gives additional information about the load-bearing properties of materials.

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

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 1382, *Rubber — Vocabulary*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1382 and the following apply.

3.1
indentation hardness
total force required to produce, under specified conditions, a specified indentation of a standard test piece

NOTE Indentation hardness is expressed in newtons.

3.2
compressive deflection coefficient
S_f
ratio of the 65 % indentation force deflection to the 25 % indentation force deflection

3.3
hysteresis loss rate
A_f
energy difference between the loading and unloading of a test piece under cyclic deformation

NOTE Hysteresis loss rate is expressed as a percentage of the loading energy.

4 Principle

The forces required to produce specified indentations under specified conditions are measured.

5 Apparatus

5.1 Test machine.

The test machine shall be capable of indenting the test piece between a supporting surface (5.2) and an indentor (5.3) having a uniform relative motion, in the vertical direction, of (100 ± 20) mm/min.

The test machine shall have means of measuring force in conformance with Class 1 of ISO 7500-1 or of measuring with a precision of ± 1 N, and of measuring the test piece thickness under load with a precision of ± 0,25 mm.

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

The test machine shall also be capable of maintaining the specified degree of indentation with a precision of ± 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 indentor shall be mounted preferably by a ball joint free from vertical movement, although other methods of mounting are permitted. The indentor shall be flat and circular, with a diameter of 200^{+3}_{0} mm and a $1{,}0^{+0{,}5}_{0}$ mm radius at the lower edge. The lower surface shall be smooth but not polished.

6 Test pieces

6.1 Shape and dimensions

Material shall be cut to obtain a standard-size square of length of side 380^{+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

Material shall not be tested sooner than 72 h after manufacture, unless at either 16 h or 48 h after manufacture it can be demonstrated that the mean result does not differ by more than ± 10 % from that obtained after 72 h. Testing is permitted at either 16 h or 48 h if, at the specified time, the above criterion has been satisfied.

Prior to the test, the test pieces shall be conditioned, undeflected and undistorted, for at least 16 h in one of the following atmospheres, as given in ISO 23529.

— (23 ± 2) °C, (50 ± 5) % relative humidity;

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

This conditioning period can form the latter part of the period following manufacture.

In case of quality control tests, test pieces may be sampled at 12 h after manufacture or later, and testing is permitted after conditioning for at least 6 h in one of the specified atmospheres.

7 Procedure

7.1 General

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

NOTE See Annex A for assistance in understanding each test method.