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Flexible cellular polymeric materials — Determination of compression set

Matériaux polymères alvéolaires souples — Détermination de la déformation rémanente après compression

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document 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 1856:2000), which has been technically revised. It also incorporates the Amendment ISO 1856:2000/Amd.1:2007.

The main changes compared to the previous edition are as follows:

— an additional normative reference has been added;

— in 6.1, an additional requirement for the test pieces has been added;

— in 6.4, conditioning of the test pieces has been amended;

— temperature tolerance for method A and B has been added.

Flexible cellular polymeric materials — Determination of compression set

WARNING — Persons using this document should be familiar with normal laboratory practice. This document 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.

1 Scope

This document specifies three methods for determining the compression set of flexible cellular materials.

This document applies to latex and polyurethane foams of thickness greater than 2 mm.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1923, *Cellular plastics and rubbers — Determination of linear dimensions*

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 following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
compression set
difference between the initial thickness and the final thickness of a test piece of the cellular material after compression for a given time at a given temperature and after a given recovery time

Note 1 to entry: The difference is referred to the initial thickness.

4 Principle

A test piece is maintained for a specified time at a specified temperature under constant deflection and the effect on the thickness of the test piece noted after release.

5 Apparatus

5.1 Compression device, consisting of two flat plates having dimensions larger than those of the test pieces, with spacers and clamps such that the plates are held parallel to each other and the space between the plates is adjustable to the required deflected height.

For testing thin materials, the requisite number of square photographic glass mounting slides shall be provided. The thickness of the slides shall be between 1 mm and 1,5 mm and the length of the side shall be between 50 mm and 55 mm.

5.2 Means of measuring the dimensions of test pieces in accordance with ISO 1923.

6 Test pieces

6.1 Requirements

Test pieces shall have parallel top and bottom surfaces and essentially vertical sides. They shall be (50 ± 1) mm long, (50 ± 1) mm wide and (25 ± 1) mm thick. All test pieces shall be free from contamination and skin on the vertical sides.

When thin materials - whose minimum thickness shall be 2 mm are to be tested, sufficient test pieces, of dimensions (50 × 50) mm, shall be taken so that the sum of their thicknesses before compression is at least 25 mm. A minimum of two foam plies shall be used and each shall be interleaved, if the number of test pieces is greater than two, with the photographic mounting slides. The complete assembly shall be treated during the test as a single thick test piece.

6.2 Samples showing orientation

Testing shall be carried out in the direction in which the finished product will be stressed under service conditions.

6.3 Number of test pieces

Five 25 mm-thick test pieces, or five assemblies in the case of thin materials, shall be tested.

6.4 Conditioning

Materials shall not be tested less than 72 h after manufacture unless, it can be demonstrated that the mean results obtained at either 16 h or 48 h after manufacture, do not differ by more than ± 10 % from those obtained at 72 h, in which case testing is permitted 16 h and 48 h, respectively prior to the test. The test pieces shall be conditioned for at least 16 h in one of the following atmospheres according to ISO 23529:

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

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

This conditioning can form the final part of or, in case of testing 16 h after manufacture, the whole of the period following manufacture.

In the case of quality-control tests, test pieces can be taken at a shorter time (down to a minimum of 12 h) after manufacture and testing carried out after conditioning for a shorter period (down to a minimum of 6 h) in one of the atmospheres specified above.

7 Procedure

7.1 General

The test may be carried out by method A, method B or method C, or by all three. The three methods can, however, give different results.

7.2 Method A (compression at 70 °C)

After the test piece has been conditioned as specified in 6.4, measure its initial thickness in accordance with ISO 1923. In the case of thin materials, calculate the thickness of the foam d_0 by deducting the aggregate thickness of the glass slides from the total thickness of the assembly of glass slides and test pieces measured with the assembly in the horizontal position.

Place the test piece or assembly between the plates of the compression device; compress it by either (50 ± 4) % or (75 ± 4) % of its thickness and maintain it under this condition. In special cases, a compression of 90 % may be agreed upon.

Within 15 min, place the compressed test piece or assembly in an oven at (70 ± 1) °C and leave it for (22 ± 0,2) h.

Remove the apparatus from the oven and within 1 min remove the test piece from the apparatus and place it on a surface of low thermal conductivity, such as wood. The surface shall be at the same temperature as that used for conditioning (see 6.4). Allow the test piece to recover for (30 ± 5) min at the same temperature as that used for conditioning.

Remeasure its thickness d_r. In the case of thin materials, take care not to disturb the assembly: calculate the thickness d_r by deducting the aggregate thickness of the glass slides from the measured total thickness of the assembly of glass slides and test pieces.

7.3 Method B (compression at standard conditioning temperature)

Use the procedure specified for method A, but maintain the test piece under compression for (72 ± 0,2) h at the same temperature as that used for conditioning the test piece.

7.4 Method C (compression under specifically specified conditions)

Use the procedure specified for method A, using a time, temperature and level of compression agreed between the interested parties.

8 Calculation and expression of results

The compression set, expressed as a percentage, is given by the formula:

$$\text{c.s.} = \frac{d_0 - d_r}{d_0} \times 100$$

where

d_0 is the original thickness of the test piece;

d_r is the thickness of the test piece after recovery.

Report the value of the compression set, followed by the test conditions, in parentheses, in the order: level of compression, time, and temperature.

For example: c.s. % (50 %, 22 h, 70 °C).

9 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 1856:2018;

b) a description of the material;

c) the temperature and humidity at which the test piece was conditioned;

d) the method used;

e) the thickness of the test piece, if other than that specified;

f) all the values of the compression set, calculated and expressed in accordance with Clause 8;

g) the median value of the compression set, in percent;

h) any deviations from this document;

i) the date of the test.