INTERNATIONAL STANDARD

ISO 2440

Fourth edition
2019-10

Flexible and rigid cellular polymeric materials — Accelerated ageing tests

Matériaux polymères alvéolaires souples et rigides — Essais de vieillissement accéléré

Reference number
ISO 2440:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (others than hoses).*

This fourth edition cancels and replaces the third edition (ISO 2440:1997), of which it constitutes a minor revision to incorporate the Amendments ISO 2440:1997/Amd.1:2010 and ISO 2440:1997/Amd.2:2014.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Flexible and rigid cellular polymeric materials — Accelerated ageing tests

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 practices and to determine the applicability of any other restrictions.

1 Scope

This document specifies, for flexible and rigid cellular polymeric materials, laboratory procedures which are intended to imitate the effects of naturally occurring reactions such as oxidation or hydrolysis by humidity. The physical properties of interest are measured before and after the application of the specified treatments.

Test conditions are only given for open cellular latex, both open- and closed-cell polyurethane foams, and closed-cell polyolefin foams. Conditions for other materials will be added as required.

The effect of the ageing procedures on any of the physical properties of the material can be examined, but those normally tested are either the elongation and tensile properties, or the compression or indentation hardness properties.

These tests do not necessarily correlate either with service behaviour or with ageing by exposure to light.

If desired, the ageing conditions contained in this document can be applied to composite structures containing any of the above types of cellular material. This can be helpful in the investigation of possible interactions between cellular materials and other substrates. Composite constructions can be in the form of complete finished products or representative small specimens cut there-from

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

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Apparatus

4.1 For dry heat ageing

4.1.1 Oven, with forced circulation, capable of maintaining the required temperature to within ± 3 °C.

It is recommended that a device be used to record the temperature, preferably continuously.

4.2 For humidity ageing

4.2.1 Ageing apparatus, of such a size that the total volume of the test pieces does not exceed 10 % of the free air space, and such that the test pieces are free of strain, freely exposed to the ageing atmosphere on all sides and not exposed to light.

4.2.2 Steam autoclave or similar vessel, capable of maintaining the required temperature to within ± 3 °C and of withstanding absolute pressures up to 300 kPa.

4.2.3 Glass vessel, with a suitable closure, and a **water-bath** or **drying oven** for heating the vessel, capable of maintaining the required temperature to within ± 3 °C.

4.3 For physical –property measurements

Use apparatus appropriate to the measurements of the physical property to be examined.

5 Test pieces

5.1 Number, size and shape

The number of test pieces, and their size and shape, shall be appropriate to the property being examined. They shall be prepared, before ageing, to the dimensions used in the particular test.

5.2 Conditioning

Material shall not be tested less 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 those 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 °C ± 2 °C, (50 ± 5) % relative humidity;

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

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

It is recommended that for reference purposes the test be performed 7 days or more after the cellular material has been manufactured.

6 Procedure

6.1 General

After conditioning, the test of the required physical property shall be performed and the test pieces shall be brought rapidly to the ageing condition. If the test to be performed is destructive, for example the examination of tensile properties, it is recommended that the tests on both reference and aged material be performed at the same time, that is after the exposure of the latter to the ageing conditions.

The ageing conditions shall be chosen from the following alternatives which should be appropriate to the material under test. It is recommended that materials differing in chemical composition should not be aged in the same enclosure. If a finished product is being studied for interaction effects, ensure that the test enclosure contains only that finished product test specimen.

6.2 Dry heat ageing

6.2.1 Temperature

Polyolefin	70 °C
Latex	70 °C or 100 °C
Polyurethane	80 °C, 125 °C or 140 °C

The use of the non-standard temperature of 140 °C is included for the following technical reason: the temperature of the ageing test should be as high as possible to enable results to be obtained in the minimum time, but above this critical temperature the changes which occur when polyurethane foam is tested are not those which are found in service, so that the ageing test will no longer discriminate between foams of different behaviour in service.

6.2.2 Duration of ageing

Use 16 h, 22 h, 72 h, 96 h, 168 h, 240 h or some multiple of 168 h, with a tolerance ± 5 %, but not more than ± 4 h.

6.3 Humidity ageing

6.3.1 Humidity

Use 100 % relative humidity or saturated steam.

6.3.2 Temperatures and duration of ageing

Material	Conditions
Polyurethane (all types)	85 °C for 20 h or 105 °C for 3 h
Polyurethane (polyether only)	120 °C for 5 h

Tolerance on temperature: ± 3 °C

Tolerance on duration of ageing: +5 % but not more than ± 2 h, the time being measured from the time when the air in the vessel has been replaced by water vapour or steam.

NOTE In this test for resistance to hydrolysis, the use of the non-standard temperatures of 105 °C and 120 °C is included for the following technical reasons: 105 °C is used because this temperature requires the use of a closed vessel so that control of the conditions is better than at the alternative of 100 °C; 120 °C is used because much experimental evidence has been accumulated at this temperature, but little or none at the alternative of 125 °C. Until these background data are collected it is not considered possible to change to 125 °C.

6.4 Reconditioning

After exposure to the ageing conditions, test pieces undergoing humidity ageing shall be dried at 70 °C ± 3 °C for 3 h per 25 mm of thickness, subject to a minimum of 3 h. The humidity-aged test pieces shall then be reconditioned in the atmosphere specified in 4.2 for 3 h per 25 mm of thickness. Dry-heat-aged test pieces shall merely undergo the reconditioning procedure.

After reconditioning, the properties of the aged test pieces shall be tested.

7 Expression of results

7.1 Calculation

The percentage change in the property being examined is given by the formula

$$\frac{\bar{X}_a - \bar{X}_0}{\bar{X}_0} \times 100$$

where

$\bar{X}_0$ is the average value of the property before ageing;

$\bar{X}_a$ is the average value of the property after ageing.

7.2 Format

The value of the percentage change shall be stated, followed by the test condition in parentheses, in order time, temperature and method.

EXAMPLE

Value % (16 h, 70 °C, dry heat)

8 Test report

The test report shall contain the following information:

a) a reference to this document including its year of publication;

b) a description of the material or composite construction;

c) the procedure and conditions used;

d) the average final value of the property of the cellular material;

e) the percentage change in property, expressed as indicated in Clause 6;

f) the date of the test;

