INTERNATIONAL STANDARD

ISO 2440

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Flexible and rigid cellular polymeric materials — Accelerated ageing tests

Matériaux polymères alvéolaires souples et rigides — Essais de vieillissement accéléré

INTERNATIONAL ISO

Reference number
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Foreword

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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.

International Standard ISO 2440 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This third edition cancels and replaces the second edition (ISO 2440:1983), which has been technically revised.

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Flexible and rigid cellular polymeric materials – Accelerated ageing tests

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

This International Standard 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 may 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.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 471:1995, *Rubber — Temperatures, humidities and times for conditioning and testing.*

3 Apparatus

3.1 For heat ageing

3.1.1 Oven, with forced circulation, capable of maintaining the required temperature to within ±1 °C.

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

3.2 For humidity ageing

3.2.1 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.

3.2.2 Steam autoclave or similar vessel, capable of maintaining the required temperature to within ±1 °C and of withstanding absolute pressures up to 300 kPa.

3.2.3 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 ±1 °C.

3.3 For physical-property measurements

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

4 Test pieces

4.1 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.

4.2 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 471:

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.

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

5 Procedure

5.1 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.

5.2 Dry heat ageing

5.2.1 Temperatures

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

NOTE — 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.

5.2.2 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.

5.3 Humidity ageing

5.3.1 Humidity

Use 100 % relative humidity or saturated steam.

5.3.2 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: ±2 °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.

5.4 Reconditioning

After exposure to the ageing conditions, test pieces undergoing humidity ageing shall be dried at 70 °C ± 2 °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.

6 Expression of results

6.1 Calculation

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

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

where

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

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

6.2 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).

7 Test report

The test report shall contain the following information:

a) a reference to this International Standard;

b) a description of the material;

c) the procedure and conditions used;

d) the average final value of the property;

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

f) the date of the test;

g) any deviations from this International Standard.

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Descriptors: cellular materials, flexible cellular materials, cellular plastics, foam rubber, tests, accelerated tests, ageing tests (materials).

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