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Cellular plastics — Polyethylene — Methods of test

Plastiques alvéolaires — Polyéthylène — Méthodes d'essai

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.

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 7214 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

This second edition cancels and replaces the first edition (ISO 7214:1985), which has been technically revised.

Annex A forms an integral part of this International Standard.

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Cellular plastics – Polyethylene – Methods of test

1 Scope

1.1 This International Standard specifies methods for testing flexible and semi-rigid cellular plastics made from polyethylene. Cellular plastics containing copolymers of ethylene or blends of polymers with polyethylene may also be tested by the procedures of this International Standard, provided these materials have characteristics similar to polyethylene as described in ISO 1872-1, or copolymers of ethylene as described in ISO 4613-1.

1.2 Basic tests suitable for characterization of cellular polyethylene, regardless of end use, are described in clause 7. Clause 8 describes supplementary tests for the determination of properties that are relevant to certain uses.

1.2.1 Basic tests

	Subclause
Apparent density	7.1
Compressive stress-strain	7.2
Compression set	7.3
Tensile strength and elongation	7.4
Thermal stability	7.5
Water absorption	7.6
Burning characteristics	7.7

1.2.2 Supplementary tests

	Subclause
Dynamic cushioning performance	8.1
Compressive creep	8.2
Thermal conductivity	8.3
Water vapour transmission	8.4
Dynamic stiffness	8.5
Cell count	8.6

2 Normative references

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

ISO 845:1988, *Cellular plastics and rubbers - Determination of apparent (bulk) density.*

ISO 1663:–[1)], *Rigid cellular plastics - Determination of water vapour transmission properties.*

ISO 1798:1997, *Flexible cellular polymeric materials - Determination of tensile strength and elongation at break.*

ISO 1856:1980, *Polymeric materials, cellular flexible - Determination of compression set.*

ISO 1872-1:1993, *Plastics - Polyethylene (PE) moulding and extrustion materials - Part 1: Designation system and basis for specifications.*

ISO 1923:1981, *Cellular plastics and rubbers - Determination of linear dimensions.*

ISO 2896:1987, *Cellular plastics, rigid - Determination of water absorption.*

ISO 3386-1:1986, *Polymeric materials, cellular flexible - Determination of stress-strain characteristics - Part 1: Low-density materials.*

ISO 3582:1978, *Cellular plastic and cellular rubber materials - Laboratory assessment of horizontal burning characteristics of small specimens subjected to a small flame.*

ISO 4613-1:1993, *Plastics - Ethylene/vinyl acetate (E/VAC) moulding and extrusion materials - Part 1: Designation and specification.*

ISO 4651:1988, *Cellular rubbers and plastics - Determination of dynamic cushioning performance.*

ISO 7850:1986, *Cellular plastics, rigid - Determination of compressive creep.*

ISO 8301:1991, *Thermal insulation - Determination of steady-state thermal resistance and related properties - Heat flow meter apparatus.*

ISO 8302:1991, *Thermal insulation, Determination of steady-state thermal resistance and related properties - Guarded hot plate apparatus.*

ISO 8497:1994, *Thermal insulation - Determination of steady-state thermal transmission properties of thermal insulation for circular pipes.*

ISO 9772:1994, *Cellular plastics - Determination of horizontal burning characteristics of small specimens subjected to a small flame.*

1) To be published. (Revision of 1663:1981)

3 Test specimens

3.1 Cut the specimens so that the edges are clean and the sides are planar and normal to the surface. Take the specimens from parts of the sample in such a way that for each property investigated a representative value can be determined. If the sample is believed to be anisotropic, cut specimens in directions oriented so that the properties pertaining to the directions most important for practical purposes can be determined.

The numbers, shapes and dimensions of specimens shall comply with the requirements of clauses 7 and 8. The surfaces of specimens shall be essentially in the same conditions as that of the surface of the material as it is used in practice, except as required by specific test procedures.

4 Conditioning

At least 72 h shall elapse between manufacture of the material and the testing of the specimens. The material shall be stored under normal ambient conditions until the specimens are prepared. Unless otherwise specified in clauses 7 and 8, condition the specimens immediately before testing for at least 16 h at a temperature of 23 °C ± 2 °C. The conditioning period may form part of the 72 h period.[2)]

5 Atmosphere during test

Test the specimens at 23 °C ± 2 °C and (50 ± 5) % relative humidity, unless otherwise specified.

6 Measurement of dimensions

Where possible, use the apparatus described in ISO 1923. However, if the specimens are not planar over the area of measurement because they are cut from curved articles, measure dimensions not exceeding 30 mm by means of a hand-held dial gauge with a circular foot of 20 mm diameter. Up to 1 kPa pressure may be applied to the foot, provided that the deformation of the specimen is less than the required accuracy of measurement.

7 Basic tests

7.1 Apparent density

Perform the test in accordance with ISO 845.

7.2 Compressive stress-strain

Perform the compressive test in accordance with ISO 3386-1. For materials less than 10 mm thickness, stack to at least 10 mm. Use the following details:

2) Some materials may require up to 30 days ageing after manufacture for physical properties to stabilize.
If the intended application is under tropical conditions, the recommended temperature is 27 °C ± 2 °C and the relative humidity is (65 ± 5) %.

7.2.1 Select a speed for the advancement of the compression platen of the test machine such that the rate of compression is as close to 50 % of the initial specimen thickness per minute as possible.

7.2.2 Determine the compressive stress during the first compression.

7.2.3 Determine the compressive stress at 10 %, 25 % and 50 % deformation.

7.3 Compression set

Perform the test in accordance with ISO 1856. Compress the specimen to a deformation of 25 % of its original thickness for 22 h at 23 °C ± 2 °C. Measure the thickness after 30 min and 24 h recovery periods.[3)]

Additional tests at other deformations may be agreed upon by supplier and user.

7.4 Tensile strength and elongation

Determine the tensile strength and elongation at break in accordance with ISO 1798 and the following details:

7.4.1 The grip of the test machine shall move at a uniform speed of 500 mm/min.

7.4.2 For material less than 10 mm thick, test the material in the thickness supplied.

7.4.3 Test material 10 mm or greater in thickness at 10 mm ± 1 mm thickness.

7.5 Dimensional stability at elevated temperature

Perform the test in accordance with the principles of ISO 7850:1986, procedure A. Determine the temperature at which the thickness changes by more than 5 % by carrying out the creep test for 7 days with an applied stress of 40 kPa. The thickness of the specimen shall be that of the material supplied. Materials less than 20 mm in thickness shall be stacked to provide test specimens at least 20 mm in thickness. The test temperature shall be increased at 5 °C intervals until the thickness change during the test exceeds 5 %.

7.6 Water absorption

Perform the test in accordance with the principles of ISO 2896. The thickness of the specimen should preferably be that of the material supplied.

7.7 Burning characteristics

Perform the test in accordance with ISO 3582 or ISO 9772.

Additional burning-characteristics testing may be required by regional or national codes and regulations.

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3) If the intended application is under tropical conditions, the recommended temperature is 27 °C ± 2 °C and the relative humidity is (65 ± 5) %.

8 Supplementary tests

8.1 Dynamic cushioning performance

Perform the test in accordance with ISO 4651.

8.2 Compressive creep

Perform the test in accordance with ISO 7850:1986, procedure A. Determine compressive creep curves at 23 °C and 40 °C, in both cases at ambient humidity, at intervals up to a maximum of 1000 h elapsed time. As a minimum requirement, determine the compressive deflection at 0,1 h, 1 h, 24 h and 168 h intervals after the load has been applied.

The applied load shall be such that the initial compressive stress is one-tenth of the compressive stress at 10 % deformation (as determined in accordance with 7.2), unless another stress is agreed upon by the interested parties as being more in accordance with the stress likely to occur in practice.

Use either square or cylindrical-shaped specimens. The area of each loaded face shall not be less than 25 cm^2. The height of the specimen shall not exceed half the width or diameter of the loaded faces.

The preferred specimen size is 50 mm ± 1 mm long and 50 mm ± 1 mm wide with a thickness of 25 mm ± 1 mm. The surfaces in the thickness dimension should not deviate from parallel by more than 1 mm.

8.3 Thermal conductivity

Perform the test in accordance with ISO 8301, 8302 or 8497 at a mean temperature of 10 °C or 23 °C. As an alternative temperature, 40 °C may be used.

8.4 Water vapour transmission

Determine the water vapour transmission rate, permeance and permeability in accordance with ISO 1663. Specimens shall be of the same thickness as the material supplied. Thin specimens can be tested using a thin wire-mesh support, if necessary.

8.5 Dynamic stiffness

Perform the test in accordance with a national standard until an International Standard for the determination of dynamic stiffness has been published.

8.6 Cell count

Perform the test in accordance with annex A.

9 Test report

The report on each test carried out shall include the following information:

a) a reference to this International Standard;

b) all details necessary for complete identification of the product tested, including the manufacturer's lot number;

c) the dimensions of the test specimens;

d) the direction in which the force was applied in relation to any anisotropy;

e) the presence or absence of skins (or facings) on the test specimens and, if applicable, on which faces, and whether the material was homogeneous or laminated;

f) the individual test results and the arithmetic mean;

g) details of any deviation from the testing and conditioning procedures specified.

Annex A
(normative)
Cell count procedure

A.1 Scope

This annex specifies a method for determining the cell count of flexible and rigid cellular polyethylene. Cellular plastics containing copolymers of ethylene or blends of polymers with polyethylene may also be tested by this procedure, provided these materials have characteristics similar to polyethylene or copolymers of ethylene as described in ISO 1872-1.

A.2 Definition

For the purposes of this annex, the following definition applies:

cell count: The number of cells per 25 mm in the cellular polyethylene under specified conditions.

A.3 Apparatus

The apparatus shall consist of a magnifying device (of sufficient power to allow identification of each cell) with a scale, calibrated in millimetres, capable of measuring a length of 25 mm to an accuracy of at least ± 0,1 mm. A 25 mm cloth-counting glass is adequate.

A ×10 magnifying device is adequate for a cell count of 40 or less.

A.4 Test specimens

A.4.1 Preparation

If the material shows a predominant direction of the cellular structure (orientation of the cells), the test specimens shall be cut in such a way that both axes of the cells can be measured.

A.4.2 Shape and dimensions

The test specimen may consist of any sample which is free of skin and has a plane surface large enough to accommodate the counting glass. A 50 mm x 50 mm x 3 mm sample is recommended. Samples shall be cut with a sharp blade in such a manner that the cells are not damaged.

Specimen surfaces showing marked variation in the cellular structure from place to place shall not be measured unless specifically required.

A.4.3 Number of test specimens

A.4.3.1 Five test specimens shall be used.