INTERNATIONAL STANDARD

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Flexible cellular polymeric materials — Determination of tensile strength and elongation at break

Matériaux polymères alvéolaires souples — Détermination de la résistance à la traction et de l'allongement à la rupture

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 1798 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 1798:1997), which has been technically revised. It also incorporates the Technical Corrigendum ISO 1798:1997/Cor.1:2003. The main change is the introduction of a second type of test piece (see Figure 1) and a comparison of the results obtained with the two test pieces (see Annex A).

Flexible cellular polymeric materials — Determination of tensile strength and elongation at break

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 a method for determining the strength and deformation properties of flexible cellular materials when a test piece is extended at a constant rate until it breaks.

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 1923, *Cellular plastics and rubbers — Determination of linear dimensions*

ISO 7500-1:2004, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 9513, *Metallic materials — Calibration of extensometers used in uniaxial testing*

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.

3.1
tensile strength
TS
maximum tensile stress applied when stretching a test piece to rupture

3.2
elongation at break
E_b
percentage elongation of a test piece at rupture

4 Apparatus

4.1 Tensile-testing machine, complying with the following requirements:

— the rate of travel of the power-actuated grip shall be 500 mm/min ± 50 mm/min and shall be uniform at all times;

— the accuracy of the machine shall conform to class 0,5 or class 1 of ISO 7500-1:2004 for force-measurement over the range of loading employed.

For the determination of elongation at break, the machine may be equipped with either a mechanical or an optical extensometer. If used, however, the extensometer shall comply with the following requirements which shall be verified in accordance with ISO 9513:

— initial gauge length accurate to ± 1 %;

— gauge length at break accurate to ± 1,25 mm.

When a mechanical contact extensometer is used, care shall be taken that the contact elements do not damage the test piece. In addition, their mass and inertia shall not influence the determination of the maximum tensile strength by more than 1 %.

5 Test pieces

5.1 Direction of sampling

If the product shows a predominant direction of the cellular structure (orientation of the cells), the test pieces for the tensile test shall be taken in such a way that their longitudinal axes lie at right angles to this predominant direction. If it is not possible, the location of the longitudinal axis with respect to the predominant direction shall be stated in the test report.

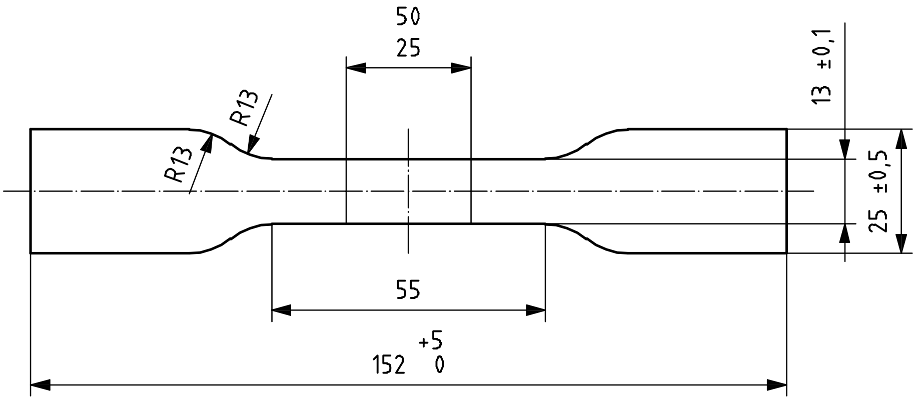
5.2 Shape and dimensions

The test pieces shall be rectangular in cross-section, with or without skin, and without visible defects. The test pieces shall be cut out with one of the two types of test piece cutter shown in Figure 1 and shall be 10 mm to 15 mm thick.

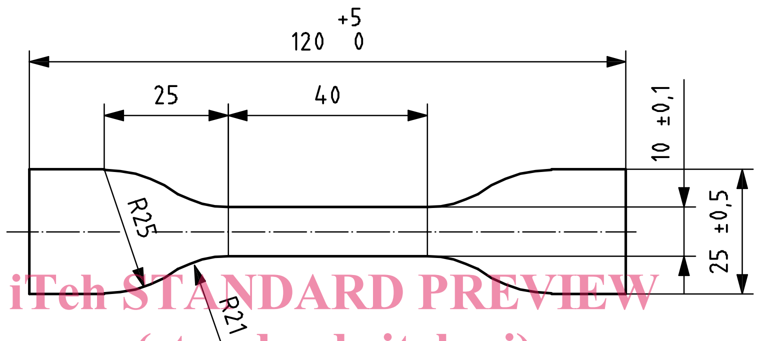
5.3 Number of test pieces

Unless agreed otherwise between the interested parties, sufficient test pieces shall be tested to provide five breaks within the gauge length.

Dimensions in millimetres



a) Type 1



b) Type 1A

Figure 1 — Test-piece cutters

5.4 Conditioning

5.4.1 The test pieces or the material from which the test pieces are to be cut shall be prepared and conditioned in accordance with ISO 23529, unless otherwise specified.

5.4.2 Materials 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 results do 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 or the material from which the test pieces are to be cut shall be conditioned for at least 16 h in one of the following atmospheres:

— 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.

5.4.3 In the case of quality-control tests, test pieces can be taken 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.

6 Procedure

6.1 After conditioning as specified in 5.4, measure the thickness of the material at five evenly distributed points in the area from which the test pieces are to be cut. These measurements shall be made in accordance with ISO 1923 and shall not vary from each other by more than ± 2 %. If desired, thickness measurements can be performed on cut test pieces, but test pieces whose thickness falls outside these limits shall be rejected.

6.2 Mark the gauge length on each test piece with two reference lines, using a marker with two parallel marking edges. Measure the distance between the inside edges of the lines to an accuracy of ± 1 % (these lines shall be at least 25 mm and not more than 50 mm apart for type 1 test pieces and not more than 40 mm apart for type 1A test pieces).

6.3 Set the load-indicating device to zero and place a test piece in the grips of the tensile-testing machine (4.1), taking care to mount the test piece symmetrically so that the tension will be distributed uniformly over its cross-section. A preload stress of up to 0,1 kPa or a preload extension of up to 0,5 % may be applied. When using an extensometer, zero it on completion of the preload. Start the machine at a jaw-separation rate of 500 mm/min ± 50 mm/min and record the maximum force (measured to ± 1 %) and the distance between the inside edges of the two reference lines (measured to ± 1,25 mm) immediately prior to break of the test piece. Reject test pieces which break outside the gauge length, and continue testing until five satisfactory results are obtained. Sufficient material will have to be available to ensure that retesting can be carried out.

6.4 Carry out the test at the same temperature and humidity as that used for conditioning the test material.

NOTE In the case of the type 1 cutter, the probability of test pieces being rejected can be minimized by selecting a gauge length close to the maximum permitted value of 50 mm.

7 Calculation

7.1 Tensile strength

Calculate the average thickness of each test piece.

Calculate the average initial cross-sectional area of each test piece on the basis of the average thickness and the width of the central section of the test piece cutter (13 mm for type 1 and 10 mm for type 1A).

The tensile strength (TS) of each test piece, expressed in kilopascals, is given by the equation

$$\mathrm{TS} = \frac{F}{A} \times 10^3$$

where

F is the maximum force, in newtons;

A is the average initial cross-sectional area, in square millimetres.

7.2 Elongation at break

The elongation at break, E_b, expressed as a percentage of the original gauge length, is given by the equation

$$E_\mathrm{b} = \frac{L - L_0}{L_0} \times 100$$

where

L is the gauge length at break, in millimetres;

L_0 is the initial gauge length, in millimetres.

8 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) the nature of the cellular material;

c) the type of test piece used;

d) details of test piece conditioning;

e) the location in the product from which the test pieces were taken, and the predominant direction of the cellular structure, if any;

f) the location and number of surfaces with skin, if any;

g) the test piece thickness;

h) the median value of the tensile strength, in kilopascals;

i) the median value of the elongation at break, in percent;

j) any deviations from this International Standard.