INTERNATIONAL STANDARD

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Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break

Supports textiles revêtus de caoutchouc ou de plastique — Détermination de la force de rupture et de l'allongement à la rupture

Reference number
ISO 1421:1998(E)

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 1421 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition cancels and replaces the first edition (ISO 1421:1977), which has been technically revised.

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Rubber- or plastics-coated fabrics — 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

1.1 This International Standard describes two methods for the determination of the tensile strength of fabrics coated with rubber or plastics:

Method 1 — the strip test method, which is a method for the determination of tensile strength and elongation at break;

Method 2 — the grab test method, which is a method for the determination of tensile strength only.

1.2 The methods apply to test pieces in equilibrium with specific standard atmospheres for testing, and to wet test pieces.

1.3 Both methods require the use of a constant rate of extension (CRE) tensile-testing machine.

2 Normative references

The following standards contains 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 applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing.*

ISO 2286-2:1998, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 2: Methods for determination of total mass per unit area, mass per unit area of coating and mass per unit area of substrate.*

ISO 7500-1:1986, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tensile testing machines.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 maximum force: The maximum force recorded in extending the test piece to breaking point (see figure 1).

3.2 elongation; extension (*E*)**:** The increase in length of a test piece, expressed in units of length, e.g. cm or mm.

3.3 percentage elongation: The elongation expressed as a percentage of the nominal gauge length.

3.4 force at break: The tensile force recorded at the moment of break (see figure 2).

NOTE — Figure 3 corresponds to the rupture of one of the elements constituting the coated fabric. Typical examples are:

a) a "rigid" polymer layer on an extensible fabric: rupture of the polymer layer;

b) a very extensible, thick polymer layer on a weak, less extensible fabric or nonwoven: rupture of the woven fabric or of the nonwoven.

3.5 elongation at break: The elongation of a test piece corresponding to the force at the breaking point (see figure 2), usually expressed as a percentage of the nominal gauge length.

3.6 nominal gauge length: The length of a test piece under a specified pre-tension, measured from nip to nip of the jaws of the holding clamps with the clamps in their starting position.

NOTE — The nominal gauge length is also referred to as the initial gauge length.

3.7 elongation at maximum force: The elongation of a test piece produced by the maximum force (see figure 1).

3.8 constant rate of extension (CRE): A means of conducting a tensile test in which the rate of increase in the length of the test piece is uniform with time.

NOTE — The rate of increase of the force is dependent upon the extension characteristics of the test piece.

3.9 strip test: A tensile strength test in which the full width of the test piece is gripped in the jaws.

3.10 grab test: A tensile strength test in which only the central part of the width of the test piece is gripped in the jaws.

4 Principle

A test piece is extended at a constant rate of extension until it breaks. For method 1 (clause 7), the maximum force and the elongation at maximum force and, if required, the force at break and the elongation at break are determined. For method 2 (clause 8), the maximum force only is determined.

5 Apparatus

5.1 Constant rate of extension (CRE) tensile testing machine, having the following general characteristics:

The machine shall be provided with means for reading and recording both the force applied to the test piece in stretching it to the breaking point and the corresponding extension of the test piece. It shall be provided with a strength indicator having several scales in order to ensure that the rupture of each test piece is obtained with a strength of 15 % to 85 % of the maximum of the scale used. Under conditions of use, the accuracy of the apparatus shall be class 1 as defined in ISO 7500-1. The error of the indicated or recorded maximum force at any point in the range in which the machine is used shall not exceed ±1 %, and the error of the indicated or recorded jaw separation shall not exceed 1 mm.

After the first 2 s of the test, the rate of increase in the distance between the clamps shall be uniform to within 5 %.

If the force and elongation are recorded by means of data acquisition boards and software, the frequency of data collection shall be at least 8 s^{-1}.

5.2 Clamping device, with the central point of the two jaws of the machine in the line of pull, the front edges at right angles to the line of pull and their clamping faces in the same plane. The jaws shall be capable of holding the test piece without allowing it to slip. They shall be designed so that they do not damage the test piece or reduce its strength. Smooth, flat or engraved corrugated jaws can be used for clamping. Using suitable packing materials in the jaws, e.g. paper, leather, plastics or rubber, avoids difficulties in clamping in many cases.

When tests are carried out and the test pieces either break at the jaws or tend to slip, the results may often be discarded. In order to obtain legitimate results by avoiding jaw breaks and the effect of slippage, the use of capstan jaws or any other self-locking device can be a suitable alternative to ordinary flat jaws. When information on strain is required, elongation measurements are made by means of an extensometer which follows the movements of two reference points on the test piece. The use of such jaws and an extensometer shall be reported in the test report (see 7.4, item k).

For the strip test method, the jaws shall be not less than the width of the test piece and should preferably have a width of at least 60 mm.

For the grab test method, the dimensions of one of the jaws of each clamp shall be 25 mm ± 0,5 mm by 25 mm ± 0,5 mm. The other jaw of each clamp shall be at least as wide as the one to which it is attached and should preferably be 50 mm wide.

5.3 Equipment for cutting test pieces and fraying them down to the required width.

5.4 Equipment in which the test pieces can be immersed in water prior to wet testing.

5.5 Distilled or deionized water, for wetting out the test pieces.

5.6 Wetting agent or **surfactant**.

6 Atmosphere for conditioning and testing

The atmosphere used for conditioning and testing shall be one of those specified in ISO 2231. The sample shall be conditioned for not less than 24 h.

NOTE — If the test results are to be representative of the properties of the coated fabric at the time of manufacturing and distribution, the tests must be carried out no longer than 3 months after the date of manufacture.

7 Method 1: strip test method

7.1 Sampling and preparation of test pieces

From each sample, cut two sets of test pieces, one set in the longitudinal direction and the other in the transverse direction. Each set shall consist of not less than five test pieces. If, by agreement between the interested parties, a higher degree of precision is required, test more test pieces.

Select the test pieces from the full usable width and length of the sample in accordance with ISO 2286-2. An example of how test pieces may be cut out is given in figure 4.

Each test piece shall be 50 mm ± 0,5 mm wide and of sufficient length to allow a distance of 200 mm ± 1 mm between the jaws of the test machine. If the elongation exceeds 75 %, reduce the length to 100 mm ± 1 mm.

If there is a woven support, take a wider strip and reduce the width to 50 mm ± 0,5 mm by fraying if possible. Should fraying not be possible, cut the test pieces in the direction of testing as exactly as possible along a thread.

If it is not possible to cut exactly along a thread because of distortion of the threads or the presence of an invisible support, use another test method, for example method 2.

If there is a knitted support, cut the test pieces to their final dimensions by following a wale or course. If it is not possible to cut a suitable test piece because of distortion of the threads or the presence of an invisible support, use another test method, for example method 2.

If there is a nonwoven support such as felt, cut rectangular test pieces in the longitudinal and transverse directions with tidy edges.

If tests are to be made on wet test pieces, completely immerse these for 1 h, or longer if specified, at room temperature in an aqueous solution of a wetting agent of concentration not more than 0,1 % (*V*/*V*). Rinse thoroughly in water and test within 1 min of removal from the water.

7.2 Procedure

7.2.1 Mounting the test piece in place

7.2.1.1 General

Set the jaws of the test machine 200 mm ± 1 mm apart, or 100 mm ± 1 mm apart if more appropriate. Clamp a test piece in the stationary jaws so that its longitudinal axis passes through the centre of the front edge of each jaw.

Test pieces can be mounted under pre-tension or in the slack condition. When test pieces are mounted under pre-tension, check that the pre-tension does not produce an elongation greater than 5 %. If these conditions cannot be met, mount the test piece in the slack condition.

7.2.1.2 Pre-tension setting

Apply the appropriate pre-tension from the following:

a) 2 N for coated fabrics up to and including 200 g/m^2;

b) 5 N for coated fabrics over 200 g/m^2 and up to and including 500 g/m^2;

c) 10 N for coated fabrics over 500 g/m^2.

7.2.1.3 Slack mounting

When test pieces are mounted in the slack condition, the starting point of the curve corresponds to a 0,5 N pre-tension force. Add the corresponding elongation to the initial gauge length.

7.2.2 Operation

Engage any device for reading the breaking strength and elongation. Set the moving clamp in motion, at a constant rate of 100 mm/min ± 10 mm/min unless otherwise agreed between the interested parties, and extend the test piece to the breaking point. Repeat the procedure for each test piece.

7.2.3 Slippage

Disregard any test results where the test piece slips asymmetrically or slips by more than 2 mm.

When results are discarded, repeat the test on a replacement test piece taken, if practicable, from the same part of the sample as the discarded test piece.

7.2.4 Jaw breaks

Disregard any test results where the test piece breaks within 5 mm of the face of a jaw.

When results are discarded, repeat the test on a replacement test piece taken, if practicable, from the same part of the sample as the discarded test piece.

If, in spite of taking care, all breaks are within 5 mm of the face of a jaw, use method 2.

7.2.5 Tests on wet test pieces

Remove the test piece from the water (see 7.1, last paragraph), press it lightly between two sheets of blotting paper and immediately carry out the test as described in 7.2.1 to 7.2.4, except that, for the wet test, apply half the normal pre-tension.

7.3 Calculation and expression of results

Record the maximum force and the force at break (this has to be recorded to ascertain whether it differs from the maximum force or not) for each of the five test pieces in both the longitudinal and the transverse directions and calculate the mean value of the maximum force and the mean value of the force at break in each direction. Round both the mean maximum force and the mean force at break to the nearest 1 N or to 1 % of the calculated value. Calculate the coefficient of variation in each case and, if required, the confidence limits of the mean.

Record, to the nearest 1 mm, the elongation at maximum force (and, if different, the elongation at break) of each of the five test pieces in each direction. Express the elongation at maximum force and elongation at break values as a percentage of the distance between the jaws (200 mm or 100 mm when a pre-tension has been applied, or as a percentage of the gauge length, correcting the gauge length for test pieces that have been slack-mounted by taking the pre-tension value from the point on the stress-strain curve corresponding to the transition from "slack" to "extension".

Calculate the mean values of the elongation at maximum force and elongation at break. Round these mean values to the nearest 0,2 % when the mean elongation does not exceed 8 %, to the nearest 0,5 % when it is 8 % to 50 % and to the nearest 1 % when it is greater than 50 %. Calculate the coefficient of variation in each case and, if required, the confidence limits of the mean.

7.4 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) the method used (method 1: strip test method);

c) the sampling scheme used;

d) the number of test pieces tested from each sample;

e) the conditioning and test atmosphere used;

f) the gauge length and the way in which the test pieces were mounted (pre-tension or slack);

g) the state of the test pieces (conditioned or wet) and the time of conditioning or immersion;

h) the type of tensile testing machine used and its load capacity;

i) the values of the maximum force and, if different, the force at break, for each test piece and the mean maximum force and force at break, in newtons, for each sample, for the longitudinal and transverse directions separately, as well as the coefficient of variation for each force and each direction and, if required, the confidence limits of the mean;

j) the values of the elongation at maximum force and, if different, the elongation at break of each test piece and the mean elongation at maximum force and elongation at break, in millimetres, for each sample, for the longitudinal and transverse directions separately, as well as the coefficient of variation and, if required, the confidence limits of the mean;

k) details of any deviation from the specified procedure;

l) the date of the test.

8 Method 2: grab test method

8.1 Sampling and preparation of test pieces

From each sample, cut two sets of test pieces, one set in the longitudinal direction and the other in the transverse direction. Each set shall consist of not less than five test pieces. If, by agreement between the interested parties, a higher degree of precision is required, test more test pieces.

Select the test pieces from the full usable width of the sample.

The width of each test piece shall be 100 mm ± 2 mm and its length shall not be less than 150 mm.

On each test piece, draw a line 37 mm from one of the long edges, parallel to the edge, along the full length of the test piece (see figure 5).

If tests are to be made on wet test pieces, completely immerse these for a minimum of 1 h at room temperature in an aqueous solution of a wetting agent of concentration not more than 0,1 % (*V*/*V*). Rinse thoroughly in water and test within 1 min of removal from the water.

8.2 Procedure

8.2.1 Mounting the test piece in place

Set the jaws of the test machine either 100 mm ± 1 mm or 75 mm ± 1 mm apart, by agreement between the interested parties. Clamp a test piece in the stationary jaws (5.2) so that its longitudinal axis passes through the centre of the front edge of each jaw and is perpendicular to the edges of the jaws, and so that the line drawn on the test piece coincides with the appropriate edge of each jaw (see figure 5).

8.2.2 Operation

Engage any device for reading the maximum force. Set the moving clamp in motion at a constant rate of 100 mm/min ± 10 mm/min unless otherwise agreed between the interested parties, and extend the test piece to the breaking point. Repeat the procedure for each test piece.

8.2.3 Slippage

Disregard any test results where the test piece slips asymmetrically or slips by more than 2 mm.

When results are discarded, repeat the test on a replacement test piece taken, if practicable, from the same part of the sample as the discarded test piece.

8.2.4 Jaw breaks

Disregard any test results where the test piece breaks within 5 mm of the face of a jaw.

When results are discarded, repeat the test on a replacement test piece taken, if practicable, from the same part of the sample as the discarded test piece.

8.2.5 Tests on wet test pieces

Remove the test piece from the water (see 8.1, last paragraph), press it lightly between two sheets of blotting paper and immediately carry out the test as described in 8.2.1 to 8.2.4.

8.3 Calculation and expression of results

Record the maximum force for each of the five test pieces in both the longitudinal and the transverse directions and calculate the mean value in each direction. Round the mean maximum force to the nearest 1 N or to 1 % of the calculated value. Calculate the coefficient of variation and, if required, the confidence limits of the mean.

8.4 Test report

The test report shall include the following particulars:

a) a reference to this International Standard;

b) the method used (method 2: grab test method);

c) the sampling scheme used;

d) the number of test pieces tested from each sample;

e) the conditioning and test atmosphere used;

f) the gauge length;

g) the state of the test pieces (conditioned or wet) and the time of conditioning or immersion;

h) the type of tensile testing machine used and its load capacity;

i) the values of the maximum force for each test piece and the mean maximum force, in newtons, for each sample, for the longitudinal and transverse directions separately, as well as the coefficient of variation and, if required, the confidence limits of the mean;

j) details of any deviation from the specified procedure;

k) the date of the test.

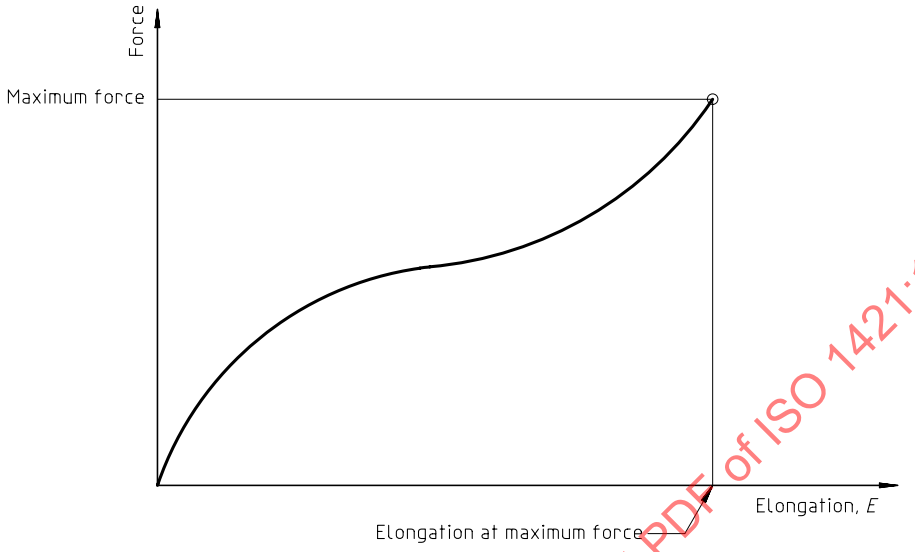

Figure 1 — Maximum force at break

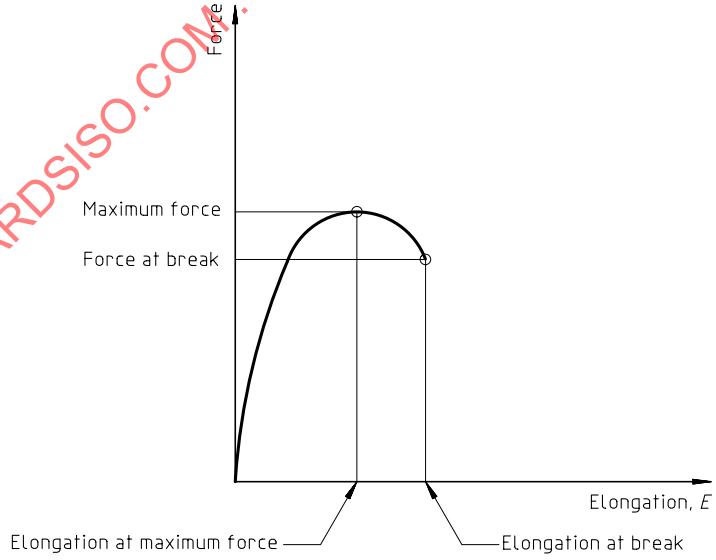

Figure 2 — Tensile force at break

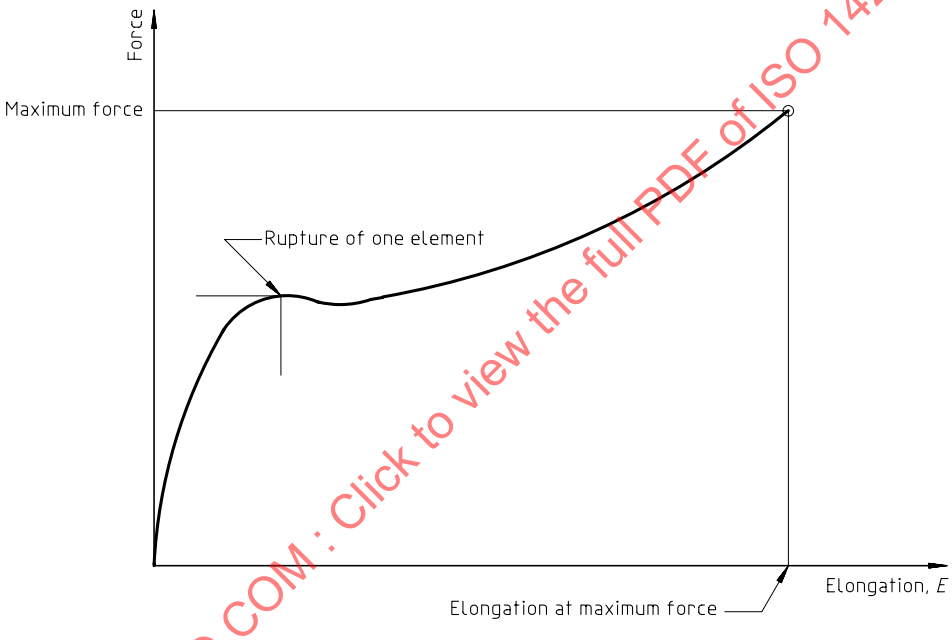

Figure 3 — Rupture of one element of a coated fabric