SRI LANKA STANDARD 1233 : 2002
ISO 5079 : 1995

METHOD FOR

DETERMINATION OF BREAKING FORCE AND ELONGATION AT BREAK OF INDIVIDUAL FIBRES

SRI LANKA STANDARDS INSTITUTION

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Sri Lanka Standard

METHOD FOR DETERMINATION OF BREAKING FORCE AND ELONGATION AT BREAK OF INDIVIDUAL FIBRES

NATIONAL FOREWORD

The Sri Lanka Standard was approved by the Sectoral Committee on Textiles, Clothing and Leather and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2002-6-03

This Sri Lanka Standard is identical with ISO 5079 : 1995, Textile fibres - Determination of breaking force and elongation at break of individual fibres, published by the International Organization for Standardization.

Terminology and Convention

The text of the International Standard has been accepted as suitable for publication without deviation, as a Sri Lanka Standard. However certain terminology and conventions are not identical with those used in Sri Lanka Standards; attention is therefore drawn to the following:

a) Whenever the words "International Standard Publication" appear referring to this standard, they should be interpreted as "Sri Lanka Standard".

b) The comma has been used throughout as a decimal marker. In Sri Lanka Standards it is the common practice to use a full point on the base line as the decimal marker.

Wherever page numbers are quoted, they are ISO page numbers.

Cross references

For the following International Standards referred to in the text, there are corresponding Sri Lanka Standards; and they are listed below.

International Standard	Corresponding Sri Lanka Standard
ISO 139 : 1973, Textiles – Standard atmospheres for conditioning and testing	SLS 16 : 1998 – Standard atmospheres for conditioning and testing textiles
ISO 1130 : 1975, Textile fibres Some methods of sampling for testing	SLS 504 : 1980 – Method of sampling of textile fibres for testing

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Textile fibres — Determination of breaking force and elongation at break of individual fibres

1 Scope

This International Standard specifies the method and conditions of test for the determination of the breaking force and elongation at break of individual fibres in the conditioned or wet state.

The determination of these fibre properties, when carried out on different kinds of testing equipment, will not generally give identical results. To avoid such differences, this International Standard is restricted to the use of constant-rate-of-extension testing apparatus.

The method is applicable to all fibres, including crimped fibres, provided that the length of fibre available enables the initial length specified in this International Standard to be used.

NOTE 1 For natural fibres (especially wool and cotton) the breaking test most commonly performed is that of bundles of fibres (see ISO 3060 and IWTO 32-82).

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

ISO 139:1973, *Textiles — Standard atmospheres for conditioning and testing.*

ISO 1130:1975, *Textile fibres — Some methods of sampling for testing.*

ISO 1973:1995, *Textile fibres — Determination of linear density — Gravimetric method and vibroscope method.*

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

ISO 3060:1974, *Textiles — Cotton fibres — Determination of breaking tenacity of flat bundles.*

IWTO 32-82, *Determination of the bundle strength of wool fibres,* International Wool Textile Organization, Brussels.

3 Definitions

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

3.1 breaking force: Maximum force applied to a test specimen carried to rupture during a tensile test under specified conditions (see A_1 in figure 1).

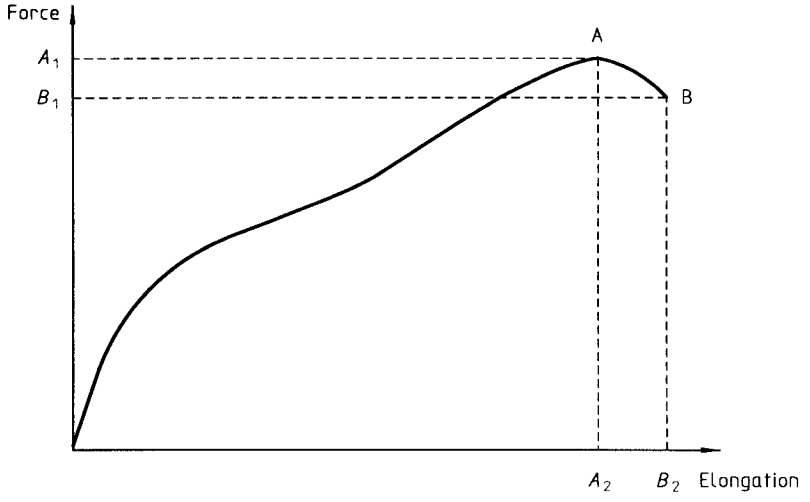

Figure 1 — Typical force/elongation curve

3.2 force at rupture: Final force just before complete rupture of the test specimen (see B_1 in figure 1).

3.3 extension: Increase in length of a test specimen, produced by a force on that specimen, expressed in units of length.

3.4 elongation: Ratio of the extension of a test specimen to its initial length, expressed as a percentage.

3.5 elongation at break: Elongation of a test specimen produced by the breaking force (see A_2 in figure 1).

3.6 elongation at rupture: Elongation of a test specimen corresponding to rupture (see B_2 in figure 1).

3.7 gauge length: Distance between two effective clamping points of a testing device.

3.8 initial length: Length of a test specimen under specified pretension at the beginning of a test.

NOTE 2 For a tensile test, the initial length is measured between the two effective clamping points.

3.9 pretension: Tension applied to a test specimen at the beginning of a tensile test.

3.10 tension: Force tending to cause the extension of a body.

NOTE 3 In textile testing, the tension applied is based on the linear density or cross-sectional area.

3.11 breaking tenacity: Breaking force divided by the linear density.

4 Principle

An individual fibre is extended at a constant rate until rupture occurs. The elongation of the fibre and the force required are measured.

To calculate the breaking tenacity, the linear density of the individual fibres or the mean linear density of the laboratory sample is also required (see ISO 1973).

5 Apparatus and reagents

5.1 Tensile testing machine, with suitable clamps for gripping individual fibres at the required initial length, means for stretching the fibre to rupture at constant rate of extension by moving one of the clamps, and means for recording the force applied to the fibre and the corresponding extension (elongation).

A device giving a force/extension (tenacity/elongation) curve to indicate whether fibre slippage is occurring in the clamps is useful. A digital display or data-collecting system may be used in addition. Advice on mounting of test specimens is given in annex A.

5.1.1 The machine shall be capable of operating at various constant rates of extension between at least 5 mm/min and 20 mm/min.

5.1.2 The machine shall meet the following requirements of accuracy and repeatability.

a) The error in indication of the force shall not exceed ± 1 % of the mean breaking force of the specimen.

b) The error in indication of the extension shall not exceed ± 0,1 mm.

c) The error of the initial length shall not exceed ± 0,2 mm. The constant rate of displacement of the moving clamp shall vary by less than ± 5 %.

5.1.3 The clamps of the machine shall be capable of adjustment, and the surface of the clamp jaws in contact with the specimen shall be of a material to provide the correct gripping force without damage to the fibre, thereby avoiding slippage and jaw breaks (see 8.5).

5.2 Distilled or deionized water, at a temperature of (20 ± 2) °C, to which has been added a nonionic wetting agent to a maximum concentration of 0,1 %, for use if wet testing is to be carried out.

6 Conditioning and testing atmospheres

The atmospheres for preconditioning, conditioning and testing shall be as specified in ISO 139.

7 Sampling

To ensure that the laboratory sample is representative of the material and that the test specimen taken from the laboratory sample is representative of that sample, sampling shall be carried out in accordance with ISO 1130.

8 Procedure

8.1 Condition the test specimens and carry out the tests in one of the standard atmospheres for testing as specified in clause 6.

8.2 Adjust the machine to extend the specimen using a speed of the moving clamp of

a) 50 % elongation per minute, for specimens with a mean elongation at break lower than 8 %,

or

b) 100 % elongation per minute, for specimens with a mean elongation at break equal to or greater than 8 %.

If the nominal elongation at break is not known, establish an approximate value by preliminary tests. In cases where the breaking elongation found in the preliminary test lies around 8 %, one of the above testing speeds shall be agreed upon by the interested parties.

If both linear density and breaking force for the same fibre are required, then the linear density of the fibre shall be determined in accordance with ISO 1973 before the tensile test is performed.

NOTE 4 If the final results vary slightly from those obtained in the preliminary test, a repetition of the test at a different speed is not necessary.

8.3 Prepare and mount an individual fibre (see annex A) under specified pretension in the clamps of the testing machine. For pretensioning, apply a mass piece to the fibre. Ensure that the fibre lies along the axis of extension of the machine.

8.3.1 Use a pretension of (1,0 ± 0,1) cN/tex for the conditioned test and (0,5 ± 0,05) cN/tex for the wet test. For the fibres listed in table 1, use the pretension values indicated.

Table 1 — Pretension forces

Fibre	Pretension[1] cN/tex
Cellulose man-made fibres	
test in conditioned state	0,6 ± 0,06
test in wet state	0,25 ± 0,03
Polyester fibres	
linear density < 2 dtex	2,0 ± 0,2
linear density ⩾ 2 dtex	1,0 ± 0,1

1) A higher pretension, e.g. to remove crimp, may be applied subject to agreement between the interested parties.

Calculate the mass necessary to obtain the required pretension on the basis of the nominal linear density of the fibre.

8.3.2 Use an initial length of 20 mm.

NOTE 5 Where it is impossible to use the 20 mm initial length because of short fibre length, then an initial length of 10 mm may be used. In this case the accuracy of results is reduced.

8.4 After the fibre has been clamped under a specified pretension, set the traversing clamp in motion at the specified testing speed and extend the test specimen to rupture, recording the elongation of the fibre and the force required.

8.5 Test at least 50 fibres, unless otherwise agreed by the interested parties.

Record the number of jaw breaks, i.e. breaks in which none of the broken ends is visible. The condition of the clamps shall be such that the number of jaw breaks does not exceed 20 % of the number of specimens tested, otherwise the jaws shall be examined and, if necessary, changed.

Ascertain during the test that the clamped fibre length is not spuriously increased by slippage of the fibre in the jaws. This shall be done by inspection of the recorded curve or the recorded force and corresponding elongation.

Results obtained from test specimens showing jaw breaks or fibre slippage in the jaws shall be discarded.

8.6 If a wet test is required, first immerse the test specimens for a period of 2 min in distilled or deionized water (5.2).

With the lower clamp open, mount the wetted test specimen under pretension in the upper clamp. Wet the test specimen again for 10 s using a glass vessel filled with water (5.2). Then remove the glass vessel, close the lower clamp, immerse the clamped test specimen and the lower clamp in the water by lifting the water-filled glass vessel, and start the test. Make sure that the surface of the water does not touch the upper clamp.

9 Expression of results

The following results shall be calculated in accordance with ISO 2602:

a) the mean breaking force of the fibres tested, expressed in centinewtons to three significant figures;

b) the mean elongation at break of the fibres tested, expressed in percent to two significant figures;

c) the coefficients of variation, expressed as a percentage of the breaking force and as a percentage of the elongation at break, to the nearest 0,1 %;

d) the 95 % confidence intervals of the breaking force expressed in centinewtons, and of the elongation at break expressed in percent, rounded off to the same precision as the mean values;

e) if required, the breaking tenacity, in centinewtons per tex, to the nearest 0,1 cN/tex.

For the purposes of this International Standard, the breaking tenacity can be calculated by either

a) dividing the breaking force for each fibre by the linear density for the same fibre, measured in accordance with ISO 1973 using the vibroscope method. In this case the mean breaking tenacity and coefficient of variation can be calculated;

or

b) dividing the mean breaking force by the mean value of linear density of the laboratory sample, measured in accordance with ISO 1973 using the gravimetric method.

If applicable, a) is the preferred method.

10 Test report

The test report shall include the following information.

10.1 General

a) reference to this International Standard and date of test;

b) complete identification of the sample;

c) type of package and its condition (e.g. raw, bleached, dyed);

d) conditioning and testing atmosphere used and/or the wet-state treatment of the specimens;

e) sampling scheme used, number of specimens tested and number of fibres discarded because of jaw breaks and/or slippage;

f) type of clamps and jaws used;

g) initial length, rate of elongation, in percent per minute, and pretension;

h) any deviation, by agreement or otherwise, from the procedure specified.

10.2 Test results

a) mean breaking force, in centinewtons;

b) mean elongation at break, in percent;

c) coefficients of variation, in percent of the breaking force and in percent of the elongation at break;

d) 95 % confidence intervals of breaking force in centinewtons, and elongation at break in percent;

e) mean linear density of the fibres, in decitex (if breaking tenacity is required), as well as the method used for determination of linear density;

f) breaking tenacity (if required), in centinewtons per tex.

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SRI LANKA STANDARDS INSTITUTION

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