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METHODS FOR
THE DETERMINATION OF TENSILE PROPERTIES OF FABRICS
PART 1 : DETERMINATION OF MAXIMUM FORCE USING THE STRIP METHOD
(Second Revision)

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard

METHODS FOR THE DETERMINATION OF TENSILE PROPERTIES OF FABRICS
PART 1 : DETERMINATION OF MAXIMUM FORCE USING THE STRIP METHOD

(Second Revision)

SLS 43 Part 1 : 2014
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SRI LANKA.

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

Sri Lanka Standard
METHODS FOR THE DETERMINATION OF TENSILE PROPERTIES OF FABRICS
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NATIONAL FOREWORD

This 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 2014-09-02.

This Sri Lanka Standard was first published in 1969. The first revision was in 2001 which was an adoption of ISO 13934-1 Textiles –Tensile Properties fabrics Part 1 : Determination of maximum force using the strip method which has been revised in 2013. This second revision is an adoption of ISO 13934-1:2013 published by the International Organization for Standardization (ISO).

TERMINOLOGY AND CONVENTIONS

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) Wherever the words “International Standard” 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 current practice to use a full point on the baseline as the decimal marker.

c) Whenever page numbers are quoted, they are ISO page numbers.

CROSS REFERENCES

International Standard	Corresponding Sri Lanka Standard
ISO 139 Textiles – Standard atmospheres for conditioning and testing.	SLS 16 Standard atmospheres for conditioning and testing of textiles.
ISO 3696 Water for analytical laboratory use – Specification and test methods	No equivalent Sri Lanka Standard
ISO 7500-1 Metallic material - Verification of staticunaxial testing machine Part 1 : Tension/compression tesing machines - Verification and calibration of the force - measuring system	No equivalent Sri Lanka Standard
ISO 10012-1 Quality Assurance requirements for measuring equipment Part 1 : Metrological confirmation system for measuring system	No equivalent Sri Lanka Standard

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INTERNATIONAL STANDARD

ISO 13934-1

Second edition
2013-04-15

Textiles — Tensile properties of fabrics —

Part 1: Determination of maximum force and elongation at maximum force using the strip method

Textiles — Propriétés des étoffes en traction —

Partie 1: Détermination de la force maximale et de l'allongement à la force maximale par la méthode sur bande

Reference number
ISO 13934-1:2013(E)

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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.

The first edition of this International Standard ISO 13934-1 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 38, Textiles, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 13934-1 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 24, *Conditioning atmospheres and physical tests for textile fabrics*.

This second edition cancels and replaces the first edition (ISO 13934-1:1999), of which it constitutes a minor revision.

ISO 13934 consists of the following parts, under the general title *Textiles — Tensile properties of fabrics*:

— *Part 1: Determination of maximum force and elongation at maximum force using the strip method*

— *Part 2: Determination of maximum force using the grab method*

Introduction

This part of ISO 13934 has been prepared in the context of several test methods for determination of certain mechanical properties of textiles using mainly tensile testing machines, e.g. tensile properties, seam tensile properties, tear properties, seam slippage. The procedure for these standards agrees where appropriate. The results obtained by one of the methods should not be compared with those obtained by the other methods.

INTERNATIONAL STANDARD **ISO 13934-1:2013(E)**

Textiles — Tensile properties of fabrics —

Part 1: Determination of maximum force and elongation at maximum force using the strip method

1 Scope

This part of ISO 13934 specifies a procedure to determine the maximum force and elongation at maximum force of textile fabrics using a strip method.

NOTE ISO 13934-2 describes the method known as the grab method. For informative references, see Bibliography.

The method is mainly applicable to woven textile fabrics, including fabrics which exhibit stretch characteristics imparted by the presence of an elastomeric fibre, mechanical, or chemical treatment. It can be applicable to fabrics produced by other techniques. It is not normally applicable to geotextiles, nonwovens, coated fabrics, textile-glass woven fabrics, and fabrics made from carbon fibres or polyolefin tape yarns (see Bibliography).

The method specifies the determination of the maximum force and elongation at maximum force of test specimens in equilibrium with the standard atmosphere for testing, and of test specimens in the wet state.

The method is restricted to the use of constant rate of extension (CRE) testing machines.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

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

ISO 10012, *Measurement management systems — Requirements for measurement processes and measuring equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
constant-rate-of-extension (CRE) testing machine
tensile-testing machine provided with one clamp which is stationary and another clamp which moves with a constant speed throughout the test, the entire testing system being virtually free from deflection

3.2
strip test
tensile test in which the full width of the test specimen is gripped in the jaws of the testing machine

3.3
gauge length
distance between the two effective clamping points of a testing device

Note 1 to entry: The effective clamping points (or lines) of jaws can be checked by clamping a test specimen under defined pretension with carbon copy paper to produce a gripping pattern on the test specimen and/or the jaw faces.

3.4
initial length
length of a test specimen under specified pretension between the two effective clamping points at the beginning of certain tests

Note 1 to entry: See also 3.3.

3.5
pretension
force applied to a test specimen at the beginning of certain tests

Note 1 to entry: Pretension is used to determine the initial length of the test specimen (see also 3.4 and 3.7).

3.6
extension
increase in length of a test specimen produced by a force

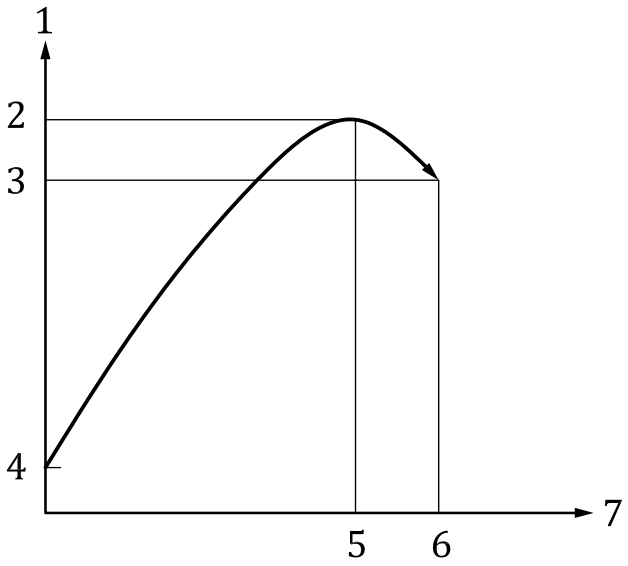
Note 1 to entry: Extension is expressed in units of length.

3.7
elongation
ratio of the extension of a test specimen to its initial length

Note 1 to entry: Elongation is expressed as a percentage.

3.8
elongation at maximum force
elongation of a test specimen produced by the maximum force

Note 1 to entry: See Figure 1.



Key

1 force
2 maximum force
3 force at rupture
4 pretension
5 elongation at max. force
6 elongation at rupture
7 elongation

Figure 1 — Example of force-elongation curve

3.9
elongation at rupture
elongation of a test specimen corresponding to the force at rupture

Note 1 to entry: See Figure 1.

3.10
force at rupture
force recorded at the point of rupture of a test specimen during a tensile test

Note 1 to entry: See Figure 1.

3.11
maximum force
maximum force recorded when a test specimen is taken to rupture during a tensile test under the specified conditions

Note 1 to entry: See Figure 1.

4 Principle

A fabric test specimen of specified dimensions is extended at a constant rate until it ruptures. The maximum force and the elongation at maximum force and, if required, the force at rupture and the elongation at rupture are recorded.

5 Sampling

Select samples either in accordance with the procedure laid down in the material specification for the fabric, or as agreed between the interested parties.

In the absence of an appropriate material specification, the example of a suitable sampling procedure given in Annex A may be used.

An example of a suitable pattern for cutting test specimens from the laboratory sample is given in Annex B. Avoid test specimens from folded or creased areas, selvedges, and areas not representative of the fabric.

6 Apparatus

6.1 CRE machine

Metrological confirmation system of the tensile-testing machine shall be in accordance with ISO 10012.

The constant-rate-of-extension (CRE) machine shall have the general characteristics given in 6.1.1 to 6.1.6.

6.1.1 The tensile-testing machine shall be provided with means for indicating or recording both the force applied to the test specimen in stretching it to rupture and the corresponding extension of the test specimen. Under conditions of use, the accuracy of the apparatus shall be class 1 of 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.

6.1.2 If a class 2 tensile-testing machine according to ISO 7500-1 is to be used, this shall be stated in the test report.

6.1.3 If recording of force and elongation is obtained by means of data acquisition boards and software, the frequency of data collection shall be at least eight per second.

6.1.4 The machine shall be capable of constant rates of extension of 20 mm/min and 100 mm/min, with an accuracy of ± 10 %.

6.1.5 The machine shall be capable of setting the gauge length to 100 mm and 200 mm, to within ± 1 mm.

6.1.6 The clamping device of the machine shall be positioned with the centre of the two jaws in the line of applied force, the front edges shall be at right angles to the line of applied force, and their clamping faces shall be in the same plane.

The jaws shall be capable of holding the test specimen without allowing it to slip and designed so that they do not cut or otherwise weaken the test specimen.

The faces of the jaws shall be smooth and flat, except that when, even with packing, the test specimen cannot be held satisfactorily with flat-faced jaws, engraved or corrugated jaws can be used to prevent slippage. Other auxiliary materials for use with either smooth or corrugated jaws to improve specimen gripping include paper, leather, plastics, or rubber.

NOTE 1 It is recommended that serrated metal faced jaws are used when testing fabrics with stretch properties. Different jaw face surfaces may lead to different elongation results.

NOTE 2 If jaw breaks or slippage cannot be prevented with flat jaws, capstan jaws have often been found suitable. Extension measurement can be carried out by means of an extensiometer which follows the movement of two reference points on the test specimen.

The jaws preferably should have a width of at least 60 mm but shall not be less than the width of the test specimen.

6.2 Equipment, for cutting test specimens and for fraying them to obtain the required width.

6.3 Equipment, in which test specimens can be immersed in water preparatory to wet testing.

6.4 Grade 3 water, in accordance with ISO 3696 for wetting test specimens.

6.5 Nonionic wetting agent.

7 Atmosphere for conditioning and testing

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

NOTE It is recommended that samples be conditioned for at least 24 h in the relaxed state.

Preconditioning and conditioning are not required for tests in the wet condition.

8 Preparation of test specimen

8.1 General

From each laboratory sample, cut two sets of test specimens, one set in the warp direction and the other in the weft direction (or in the machine and cross-machine directions, where applicable).

Each set shall consist of at least five test specimens, except that if a higher degree of precision is required, more test specimens shall be tested. In accordance with Clause 5 and Annex B, no test specimens shall be cut from within 150 mm of either edge of the laboratory sample. No test specimen taken from the warp direction shall contain the same longitudinal threads and no test specimen taken from the weft direction shall contain the same picks.

8.2 Dimensions

The width of each test specimen shall be 50 mm ± 0,5 mm (excluding any fringe) and its length shall be long enough to allow a gauge length of 200 mm, except that for fabrics where it is suspected or known from previous experience that elongation at maximum force values greater than 75 % will be obtained, the gauge length may be reduced to 100 mm. Test specimens having widths other than the preferred width of 50 mm may be tested if agreed by interested parties. In this case, the width of the test specimens shall be stated in the test report.

8.3 Preparation of test specimens

For woven fabrics, each test specimen shall be cut with its length parallel to the warp or the weft of the fabric and shall be sufficiently wide to allow the necessary fringes. Threads shall be removed in approximately equal numbers from each of the long edges of the cut strip until the width of the test specimen is as described in 8.2. The width of the fringes shall be such that during testing no longitudinal threads escape from the fringes.

NOTE For the majority of fabrics, fringes of about 5 mm or 15 threads will be sufficient. For very closely woven fabrics, a much narrower fringe may be satisfactory. Fabrics of very open weave can require up to 10 mm.

In the case of fabrics containing only a few threads per centimetre, a test specimen shall be frayed as close as possible to the required width (see 8.2). The number of threads across the width of the test specimen shall be counted and if > 20, the remaining test specimens in the set shall be frayed to the same number of threads. If the number of threads in the strip is below 20, then the width of the test specimens shall accommodate at least 20 threads. If the width of the test specimen is not 50 mm ± 0,5 mm, then the width and the number of threads shall be reported in the test report.

For fabrics which cannot be frayed in this manner, test specimens shall be cut along lines 50 mm apart and parallel to the machine or the cross-machine direction. In some woven fabrics, the direction of threads cannot be determined except by tearing, but the test specimen shall not be reduced to the specified width in this way.

8.4 Wet test specimens

8.4.1 When the maximum force of the wet fabric is required in addition to the maximum force when dry, strips of the appropriate width and at least twice as long as the test specimens required for a dry test shall be cut (see Annex B). Each end of each strip shall be numbered, frayed down (if relevant), and then each test specimen shall be cut crosswise into two parts, one for determining the dry maximum force and the other for determining the wet maximum force. This ensures that each pair of test specimens contains the same longitudinal yarns. For fabrics where it is suspected or known from previous experience that excessive shrinkage will occur when wet, the length of test specimens for the determination of wet maximum force shall be greater than that of test specimens for dry maximum force tests.

8.4.2 For tests in the wet condition, immerse the test specimen for a period of 1 h in grade 3 water in accordance with ISO 3696 at a temperature of 20 °C ± 2 °C. An aqueous solution containing not more than 1 g of a nonionic wetting agent per litre may be used instead of water.

NOTE For tropical regions, temperature according to ISO 139 can be applied.

9 Procedure

9.1 Gauge length

Set the gauge length of the tensile-testing machine to 200 mm ± 1 mm for fabrics with elongation at maximum force up to 75 % or to 100 mm ± 1 mm for fabrics having an elongation at maximum force of more than 75 % (see 8.2 and 9.2).

9.2 Rate of extension or elongation

Set the rate of extension or elongation of the tensile-testing machine as a function of the elongation at maximum force of the fabric as specified in Table 1.

Table 1 — Rate of extension or elongation

Gauge length mm	**Elongation at maximum force of fabric** %	**Rate of elongation** %/min	**Rate of extension** mm/min
200	< 8	10	20
200	8 to 75	50	100
100	> 75	100	100

9.3 Mounting of test specimens

Test specimens can be mounted with pretension or with “slack mounted”, i.e. hanging freely under its own mass.

9.3.1 Slack mounted

Place the test specimen in the clamps of the upper jaw, allowing it to hang freely under its own mass then guide by hand to ensure perpendicular alignment to the line of pulling force, while closing lower jaw.

The extension of the test specimen is measured from the point of the force/extension curve that corresponds to the pretensioning force as given in 9.3.2. The extension necessary to reach the pretension shall be added to the gauge length, thus determining the initial length needed for the calculation of the elongation at maximum force.

If using electronic devices for recording the extension, ensure that the correct initial length is used for calculation of elongation.

9.3.2 Mounted with pretension

Apply the appropriate pretension specified as follows:

— for all fabrics with stretch characteristics: 0,5 N

— for fabrics without stretch characteristics according to mass per unit area:

a) ≤ 200 g/m^2: 2 N

b) > 200 g/m^2 to 500 g/m^2: 5 N

c) > 500 g/m^2: 10 N

9.4 Operation

Clamp a test specimen centrally so that its longitudinal centre-line passes through the centre point of the front edges of the jaws.

Engage any device for recording the maximum force and elongation at maximum force. Put the movable clamp in motion and extend the test specimen to the point of rupture. Record

a) the maximum force, and, if required, the force at rupture, in newtons; and

b) the extension in millimetres, or the elongation in percent, at maximum force, and, if required, at rupture.

Record the extension or the elongation at least to the nearest

— 0,4 mm or 0,2 % for elongations < 8 %

— 1 mm or 0,5 % for elongations 8 % to < 75 %

— 2 mm or 1 % for elongations > 75 %.

Perform the test on at least five test specimens of each fabric direction.

9.4.1 Slippage

Disregard any test results where the test specimen slips asymmetrically or by greater than 2 mm along the clamping line.

9.4.2 Jaw breaks

Record any break which occurs within 5 mm of the clamping line of the jaws and record the result as a jaw break. At the end of the five tests, examine the results obtained. If any of the jaw break results falls above the lowest “normal” break result, then it can be included. If any of the jaw break results falls below the lowest “normal” break result, then it shall be excluded and further tests carried out to obtain five “normal” breaks.

If all the results are jaw breaks, or if five “normal” breaks cannot be obtained, then the individual results shall be reported without the coefficient of variation or confidence limits.

Jaw break results shall be indicated as such in the test report, and the results discussed between the interested parties.

9.5 Tests on wet test specimens

Perform the test according 9.1 to 9.4 immediately after removal of a test specimen from the liquid (see 8.4.2) and briefly placing it on blotting paper to remove excess water. For wet tests, apply half of the pretension specified in 9.3.2.

10 Calculation and expression of results

Calculate the arithmetic mean of the maximum force and, if required, the arithmetic mean of the force at rupture, in newtons, for each direction tested.

Round the results for values

—	< 100 N	to the nearest	1 N
—	100 N to < 1000 N	to the nearest	10 N
—	1000 N	to the nearest	100 N.

Calculate the arithmetic mean of the elongation at maximum force, and, if required, at rupture, for each direction tested and round it to the nearest

—	0,2 %	for elongations	< 8 %
—	0,5 %	for elongations	8 to < 75 %
—	1 %	for elongations	> 75 %

If required, calculate the coefficient of variation to the nearest 0,1 % and the 95 % confidence limits of the relevant properties tested, rounded to the same precision as the mean values.

11 Test report

The test report shall include the following information.

a) a reference to this part of ISO 13934 and the date of test;

b) identification of test sample and sampling procedure, if required;

c) gauge length used, in millimetres;

d) rate of elongation used, in percent per minute, or rate of extension, in millimetres per minute;

e) pretension applied, in newtons;

f) state of test specimens (conditioned or wet);

g) number of test specimens, including number of tests rejected and reasons for this;

h) width of strip if not 50 mm ± 0,5 mm and number of threads in the strip;

i) any deviation from the given procedure;

j) arithmetic mean of the maximum force and, if required, of the force at rupture, in newtons;

k) arithmetic mean of the elongation at maximum force and, if required, of the elongation at rupture, in percent;

l) if required, the coefficient of variation of the relevant force and of the relevant elongation, in percent;

m) if required, the 95 % confidence limits of the relevant force, in newtons, and of the relevant elongation, in percent.

Annex A
(informative)

Suggested procedure for sampling

A.1 Bulk sample (number of pieces from a shipment or lot)

The appropriate number of pieces should be taken at random from the shipment or lot as specified in Table A.1. No piece that shows signs of damage or dampness incurred during transit should be included in the sample.

Table A.1 — Bulk sample

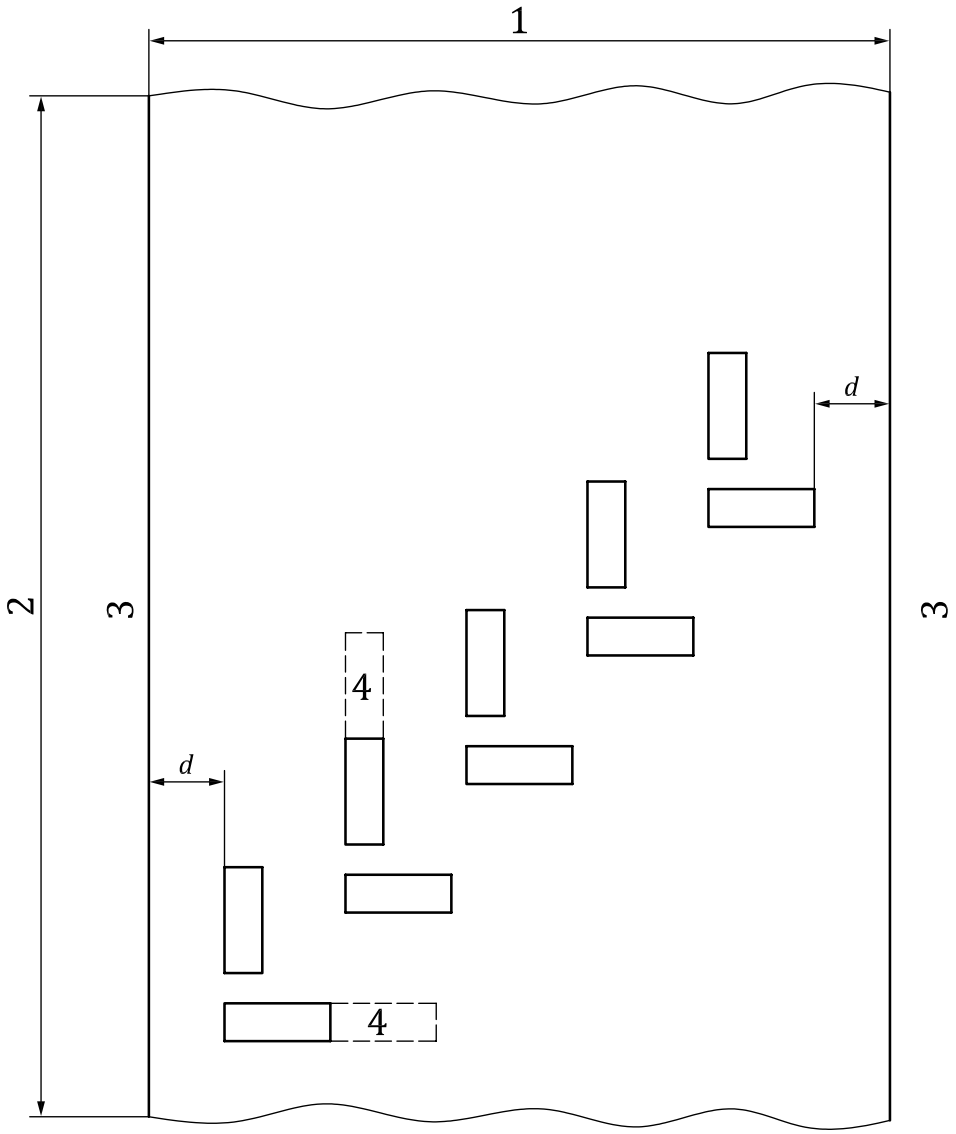
Number of pieces in shipment or lot	Number of pieces in bulk sample, minimum
3 or less	1
4 to 10	2
11 to 30	3
31 to 75	4
76 or more	5

A.2 Number of laboratory samples

From each piece in the bulk sample, a laboratory sample of length at least 1 m and of full width should be cut (from a position taken at random but at least 3 m from an end of the piece). Areas that are creased or that have a visible fault should not be included in the sample.

Annex B
(informative)

Locations of test specimens cut from a laboratory sample



Key

1 width of fabric
2 length of fabric
3 edge
4 additional length for wet tests, if required
d 150 mm

Figure B.1 — Locations of test specimens cut from a laboratory sample

Bibliography

[1] ISO 1421, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break*

[2] ISO 4606, *Textile glass — Woven fabric — Determination of tensile breaking force and elongation at break by the strip method*

[3] ISO 9073-3, *Textiles — Test methods for nonwovens — Part 3: Determination of tensile strength and elongation*

[4] ISO 10319, *Geosynthetics — Wide-width tensile test*

[5] ISO 13934-2, *Textiles — Tensile properties of fabrics — Part 2: Determination of maximum force using the grab method*

[6] ISO 13935-1, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 1: Determination of maximum force to seam rupture using the strip method*

[7] ISO 13935-2, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method*

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The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

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