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Textiles — Determination of the elasticity of fabrics —

Part 3: Narrow fabrics

Textiles — Détermination de l'élasticité des étoffes —

Partie 3: Etoffes étroites

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Foreword

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the ISO 20932 series can be found on the ISO website.

Introduction

This document was developed as a result of technical advancements in yarn and fabric structures and properties, which increase product range and developments.

This document is based on EN 14704-3[1].

Textiles — Determination of the elasticity of fabrics —

Part 3:
Narrow fabrics

1 Scope

This document specifies the test methods which can be used to measure the elasticity and related properties of narrow fabrics. Two methods are itemized: one for the purpose of product quality assurance (method A) and the other for product performance when in use (method B).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 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*

ISO 22198, *Textiles — Fabrics — Determination of width and length*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
narrow fabric
woven or knitted construction intended for use as a trim, binding, edging, strapping or harness, and designed to be used in its full width

[SOURCE: ISO 20932-1:2018, 3.1]

3.2
elasticity
<material> ability to recover original size and shape immediately after the removal of the force causing deformation

[SOURCE: ISO 20932-1:2018, 3.2]

3.3
constant-rate-of-extension testing machine
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

[SOURCE: ISO 20932-1:2018, 3.3]

3.4
strip test specimen
test specimen in which the full width is gripped in the jaws of the testing machine

[SOURCE: ISO 20932-1:2018, 3.4]

3.5
gauge length
distance between the two effective clamping points of a testing device

Note 1 to entry: For this method where line clamps are employed, it is the distance between the two contact points.

3.6
slack mounting
insertion of a strip test specimen in the line clamps of the upper jaw, allowing it to hang freely under its own weight, guided by the hand to ensure perpendicular alignment to the line of pulling force, without any force being applied

[SOURCE: ISO 20932-1:2018, 3.7]

3.7
initial length
length of the test specimen between the two effective clamping or holding points, at the beginning of the test (after slack mounting or under specified pretension)

[SOURCE: ISO 20932-1:2018, 3.8]

3.8
pretension
force applied to a test specimen at the beginning of certain tests

[SOURCE: ISO 20932-1:2018, 3.9]

3.9
extension
increase in length of a test specimen during testing

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

[SOURCE: ISO 20932-1:2018, 3.10]

3.10
elongation
ratio of the extension of the test specimen to its initial length

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

[SOURCE: ISO 20932-1:2018, 3.11]

3.11
maximum force
force at the position when a test specimen is taken to a fixed extension

Note 1 to entry: Maximum forced is expressed in newtons.

[SOURCE: ISO 20932-1:2018, 3.12]

3.12
maximum extension
extension recorded in millimetres at the position when a test specimen is taken to a fixed load

Note 1 to entry: Maximum extension is expressed in units of the length.

[SOURCE: ISO 20932-1:2018, 3.13]

3.13
force at specified elongation
force measured at a given elongation on either the load or unload curves

[SOURCE: ISO 20932-1:2018, 3.14]

3.14
cycle
process whereby a fabric is taken from the gauge length to a fixed load or fixed extension or elongation, and returned to gauge length

[SOURCE: ISO 20932-1:2018, 3.15]

3.15
force decay due to time
loss of force measured over time when a test specimen is stretched to a specified elongation or force and held in this position for a given time period

Note 1 to entry: The decay in force is expressed as a percentage of the original force recorded at the specified position (see Annex A, Figure A.1).

[SOURCE: ISO 20932-1:2018, 3.16]

3.16
force decay due to exercising
loss of force, calculated and expressed as a percentage, as measured and recorded at the same elongation point on two different cycles when the test specimen is cycled several times between the gauge length and a specified elongation

Note 1 to entry: See Annex A, Figure A.1.

[SOURCE: ISO 20932-1:2018, 3.17]

3.17
permanent deformation
ratio of unrecovered extension of the test specimen after cycling (to a specified force or specified extension) to its initial length

Note 1 to entry: Permanent deformation is expressed as a percentage.

[SOURCE: ISO 20932-1:2018, 3.18]

3.18
recovered elongation
complement of permanent deformation to 100 %

[SOURCE: ISO 20932-1:2018, 3.19]

3.19
elastic recovery
recovered elongation of the total elongation

Note 1 to entry: Elastic recovery is expressed as a percentage.

[SOURCE: ISO 20932-1:2018, 3.20]

4 Principle

4.1 Method A

A narrow test specimen of specified length dimensions is extended at a constant rate to a specified force for an agreed number of cycles. Several characteristics can be measured to determine the performance and profile of the narrow fabric.

4.2 Method B

A narrow test specimen of specified length dimensions is extended at a constant rate to a specified force and elongation for one cycle of a specified sequence. Characteristics are measured to show the performance of the narrow fabric in use.

5 Sampling

Narrow fabric samples shall be selected in accordance with the product specification. In the absence of a product specification for the fabric, the sampling method given in Annex B may be used.

6 Apparatus

6.1 CRE testing machine.

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

The constant-rate-of-extension (CRE) testing machine shall conform to the following:

a) The tensile testing machine shall be provided with the means for indicating or recording the force and elongation values when cycling between gauge length and either a fixed load or fixed extension. Under conditions of use, the accuracy of the apparatus shall be at least 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.

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

c) The machine shall be capable of constant rates of extension including 20 mm/min to 500 mm/min with an accuracy of ±10 %.

d) The machine shall be capable of variable gauge length settings including 100 mm to 250 mm, to an accuracy of ±1 mm.

e) Clamping or holding devices shall be positioned with the central point of the two jaws in line of the applied force. The machine shall be calibrated, where applicable, with the grips in position and the jaw faces closed.

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.

6.2 Line clamps.

Line clamps, as shown in Figure C.1, shall consist of two jaws, one being of steel plate, the other having a convex 3 mm radius. The line of contact of the jaws shall be perpendicular to the line of increasing force. The clamping faces shall be in the same plane. The line clamp jaws shall not be less than the width of the test specimen and preferably have a width of (70 ± 6) mm.

NOTE Significant levels of work have shown this type of line clamp is the preferred type for elastane/elastodiene containing fabrics as fabric slippage is insignificant. If a fabric slips the elongation values are inaccurate.

Pneumatic operated grips are recommended as hand tightening or manual grips can cause distortion of the test specimen. The air pressure should be sufficient to prevent slippage when compensating the decreasing thickness of the fabric but should not cut or otherwise weaken the test specimen.

6.3 Equipment, for cutting test specimens to the required dimensions.

6.4 Calibrated metal rule, graduated in mm.

7 Atmosphere for conditioning and testing

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

The narrow fabric samples shall be conditioned for a minimum of 20 h in a tension-free state.

8 Preparation of test specimens

8.1 General

A set of test specimens from each laboratory sample shall be cut in the length direction.

A set shall consist of a minimum of five test specimens. If the sample is supplied on role and of sufficient length, remove and discard the first 500 mm. Cut the required number of specimens to the correct length, rejecting a minimum of 300 mm in between each of the specimens.

If the length of the laboratory sample is not sufficient, reduce the discarded and rejected lengths and report the sampling modifications.

8.2 Test specimen preparation

For method A and method B, each test specimen shall be cut to a length of 150 mm.

If for method A permanent deformation is determined at the end of the test, place (100 ± 1) mm reference (bench) marks centrally and perpendicular to the specimen length. In case a pretension is used, placing of reference marks is not required, since the length at pretension after end of testing is used for calculation.

9 Procedure

9.1 Method A

9.1.1 General

9.1.1.1 Locate the line clamps in the jaws of the tensile testing machine and set the gauge length to (100 ± 1) mm, unless otherwise agreed between interested parties. Check this gauge length setting using carbon paper and paper which will generate gauge (bench) marks on the paper. The distance is measured with the calibrated rule.

9.1.1.2 Set the extension and retraction rate of the specimen at 100 %/min.

9.1.1.3 Set the required cycling limits to between gauge length and the appropriate load as given in Table 1. Load is determined according to the mass per length (g/m).

Measure the width of the test specimen according to ISO 22198.

For bra straps, set the load at 35,0 N.

Table 1 — Loads and masses to be used in measuring elasticity properties

Fabric mass at the specimen width (g/m)	Loading (N)
Up to 2,0	7,5
2,01 to 3,75	12,0
3,76 to 5,00	15,0
5,01 to 7,50	25,0
7,51 to 11,0	34,0
11,01 to 17,00	42,0
17,01 to 25,00	53,0
25,01 to 36,00	61,0
>36,00	74,0

9.1.1.4 Slack mount the specimen centrally between the two sets of line clamps.

9.1.1.5 A pretension of 0,1 % of the loading (as in Table 1) may be specified to define the initial length at start of test, and as a reference tension to measure the un-recovered extension after the end of testing.

9.1.2 Operation

Many of the parameters measured can be determined by manual analysis of graphs and by software data collection procedures. It is recommended that assessment of the individual software be carried out to establish accuracy of the data collected.

Engage the device for recording the force and elongation measurements required. Put the cross-head in motion and cycle the test specimen between gauge length and the required force for the agreed number of cycles. In case a pretension is used, the cross-head moves to this pretension to record the initial length.

If it is required to determine force decay due to time, set the CRE testing machine to "hold" at the maximum force on the final curve for the chosen period.

Recommended period is 1 min.

If it is required to determine the permanent deformation, remove the test specimen carefully from the CRE testing machine and lay on a flat surface for a chosen period. Re-measure the distance between the reference marks previously made on the specimen, using the calibrated steel rule. Handling of the test specimen shall be kept to a minimum to avoid variations in results. Alternatively, the cross-head loads the specimen again above the pretension after the specified recovery period to measure the unrecovered extension.

Recommended recovery periods are 1 min and 30 min.

NOTE Permanent deformation can automatically be determined by software, based on the length measurement at pretension after end of testing.

9.1.3 Recording

Record the extension and/or elongation at the maximum force, from the curves or data generated in the test, as agreed between the relevant parties.

Record the force at specified elongation at any elongation point along the load or unload curves as agreed between the relevant parties.

9.1.4 Expressions and calculations of test results

The following values shall, where applicable, be calculated from the data recorded during the test.

Elongation, S, expressed as a percentage, as shown in Formula (1):

$$S = \frac{E - L}{L} \times 100 \tag{1}$$

where

E is the extension [mm] at maximum force on the final cycle (e.g. fifth cycle);

L is the initial length [mm].

Force decay due to time, A, expressed as a percentage, as shown in Formula (2):

$$A = \frac{V - W}{V} \times 100 \tag{2}$$

where

V is the maximum force from the final cycle [N];

W is the maximum force on the final cycle, after a specified holding period [N].

Force decay due to exercising, B, expressed as a percentage, as shown in Formula (3):

$$B = \frac{X - Y}{X} \times 100 \tag{3}$$

where

X is the maximum force at the specified elongation on an initial (specified) cycle [N];

Y is the maximum force at the same specified elongation on a subsequent (specified) cycle [N].

Permanent deformation, C, expressed as a percentage, as shown in Formula (4):

$$C = \frac{Q - P}{P} \times 100 \tag{4}$$

where

Q is the distance between applied reference marks; or, in case a pretension is used, the un-recovered extension [mm] after a specified recovery period;

P is the initial distance between applied reference marks; or, in case a pretension is used, the initial length [mm].

Recovered elongation, *D*, expressed as a percentage, as shown in Formula (5):

$$D = (100 - C) \tag{5}$$

Elastic recovery, *R*, expressed as a percentage, as shown in Formula (6):

$$R = \frac{D}{S} \times 100 \tag{6}$$

9.2 Method B

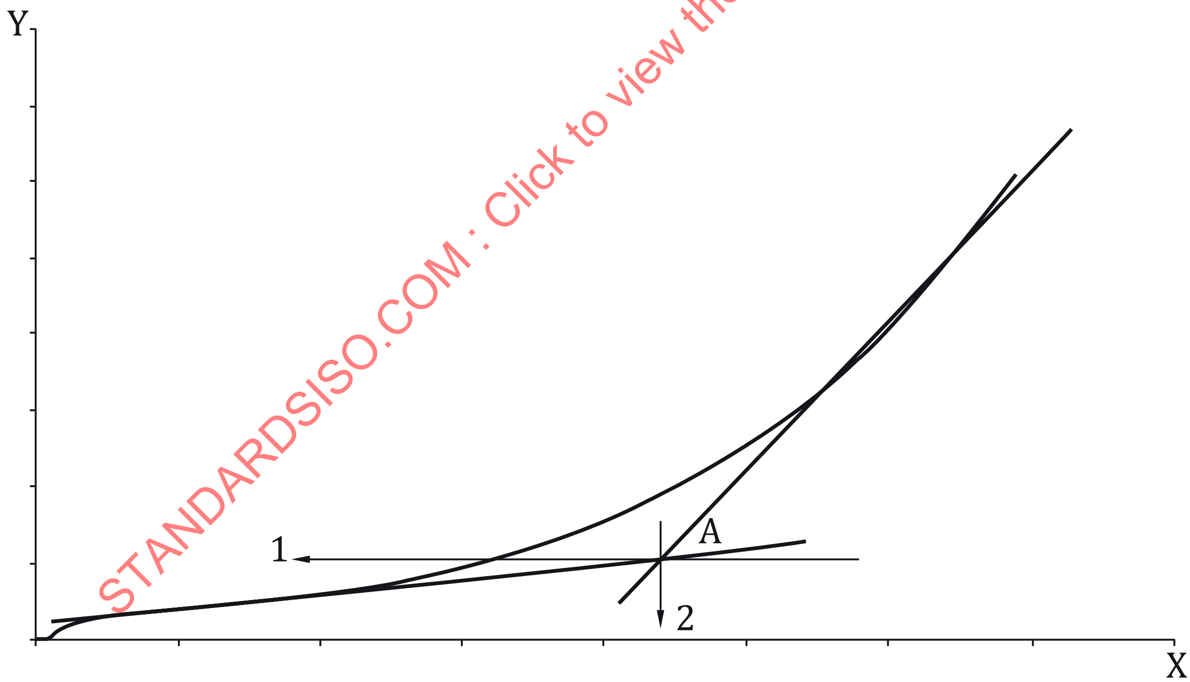
9.2.1 General

9.2.1.1 Locate the line clamps in the jaws of the tensile testing machine and set the gauge length to (100 ± 1) mm. Check this gauge length setting using carbon paper and paper, which will generate gauge (bench) marks on the paper. The distance is measured with the calibrated rule.

9.2.1.2 Set the extension and retraction rate of the specimen at 500 mm/min.

9.2.1.3 Carry out a preliminary test on a test specimen centrally between the two sets of line clamps by slack mounting. Produce a single load and unload cycle taking the sample beyond the point of its available stretch region (see Figure 1).

An additional specimen should be prepared in order to carry out this preliminary test.



Key

X elongation
Y force
A origin point
1 force at specified elongation (N) at A
2 elongation (%) at A

Figure 1 — Preliminary test

9.2.1.4 Determine the force at specified elongation at origin point A, beyond which the narrow is not recoverable and record the force 1 and elongation 2 values at this point.

9.2.1.5 Establish from Table 2 the test parameters for the main test.

Table 2 — Parameters

Elongation (%)		**Loading** (N)		
Preliminary test	**Elongation for main test**	**Preliminary test**	**Loading for main test**	
Force at specified elongation point A	**Elongation to point (b)**	**Force at specified elongation point A**	**Pretension (a)**	**Loading/force (d)**
If elongation is <50 %	10 %	If the load is <15 N	0,15 N	15 N
If elongation is ≥50 % but <80 %	30 %	If the load is ≥15 N but <30 N	0,30 N	30 N
If elongation is ≥80 % but <120 %	50 %	If the load is ≥30 N but <50N	0,50 N	50 N
If elongation is ≥120 %	80 %	If the load is ≥50 N but <70 N	0,70 N	70 N
	80 %	If the load is ≥70 N	1,00 N	100 N

9.2.2 Operation

Mount the first specimen centrally between the two sets of line clamps. Apply the pretension (a), equal to (1,00 ± 0,25) % of the maximum force to be applied during the test (see Table 2).

Engage the device for recording the force and elongation measurements required, put the cross-head in motion and conduct a cycle to the following sequence:

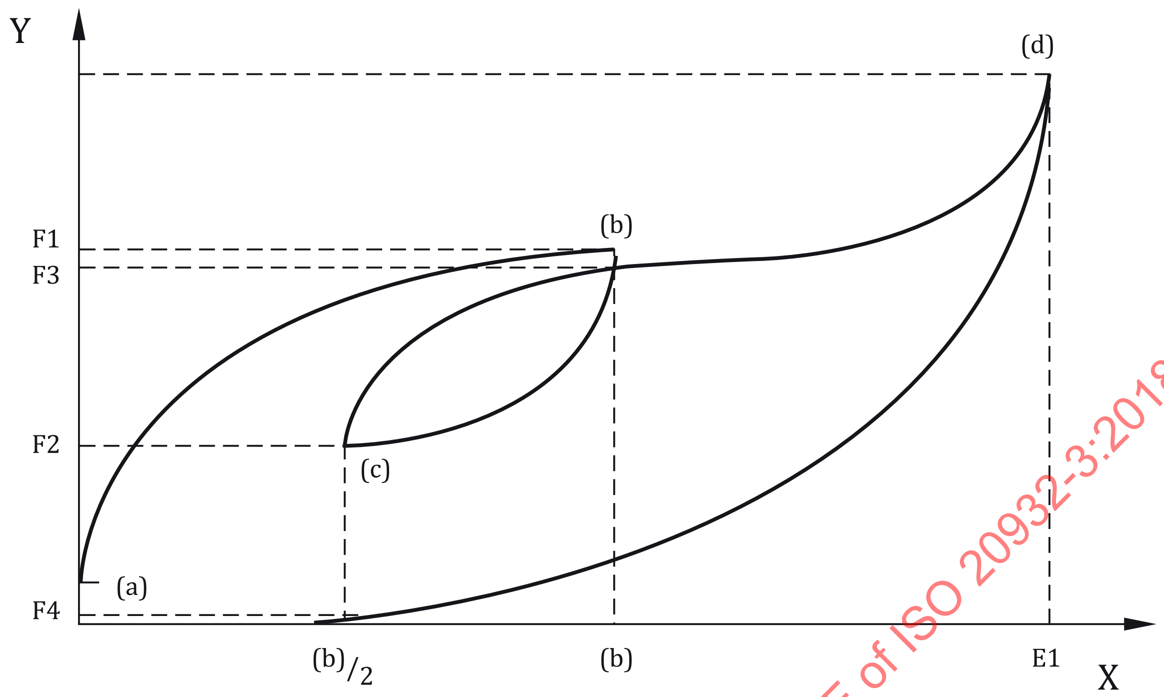
— extend the specimen to the elongation setting (b) as given in Table 2;

— return the cross-head so the specimen is extended to point (c), which is half elongation at point (b), in Figure 2;

— extend the specimen to the maximum force (d) as give in Table 2;

— return the cross-head again recording the force at the reference point, point (c) - which is half elongation at point (b).

Repeat this for the remaining test specimens.



Key

X elongation axis

Y force axis

(a) application fo the pretension as given in Table 2

(b) elongation setting as given in Table 2

(c) elongation setting which is half elongation at point (b)

(d) extention to the maximum force

F1 force at point (b) on the first part of the load curve

F2 force at point (c) on the first part of the retraction curve

F3 force at point (b) on the second part of the load curve

F4 force at point (c) on the second part of the retraction curve

E1 elongation at point (d)

Figure 2 — Description of the cycle sequence

9.2.3 Recording

Record the following values, forces in N and elongation as a percentage (see Figure 2):

— F1 force when the specimen is extended to elongation (b);

— F2 force when the specimen is returned (on the retraction curve) to half elongation (b), at point (c);

— F3 force at point (b) when the specimen is being extended to maximum force (d);

— E1 elongation at maximum force point (d);

— F4 force at point (c), half elongation (b) (on the retraction curve).

9.2.4 Expressions and calculations of test results

Calculate the mean of the forces recorded for F1, F2, F3 and F4 and the mean percentage for elongation E1.

10 Test report

The test report shall include the following information:

a) a reference to this document (i.e. ISO 20932-2:2018) and the date of the test;

b) method used, A or B;

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

d) gauge length used, in mm;

e) rate of extension used in mm/min;

f) number of test specimens, particularly if less than five;

g) width of the specimen;

h) if used for method A, the pretension (cN);

i) any deviation from this procedure;

j) maximum cycling force;

k) arithmetic mean of the maximum extension and/or elongation, whichever is required and for which cycle;

l) arithmetic mean of the force at specified elongation, the elongation point and cycle;

m) arithmetic mean of the force decay – due to time and relevant cycles, when required;

n) arithmetic mean of the force decay – due to exercising and the relevant cycles, when required;

o) arithmetic mean of permanent deformation, when required;

p) arithmetic mean of recovered elongation, when required;

q) if required, the coefficient of variation for the relevant measured and calculated values;

r) if required, the 95 % confidence limits of the relevant measured and calculated values.