BS EN ISO 20932-1:2020+A1:2021

BSI Standards Publication

Textiles — Determination of the elasticity of fabrics

Part 1: Strip tests

bsi.

National foreword

This British Standard is the UK implementation of EN ISO 20932-1:2020+A1:2021. It is identical to ISO 20932-1:2018, incorporating amendment 1:2021. It supersedes BS EN ISO 20932-1:2020, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO text carry the number of the ISO amendment. For example, text altered by ISO amendment 1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee TCI/24, Physical testing of textiles.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Published by BSI Standards Limited 2021

ISBN 978 0 539 14648 6

ICS 59.080.30

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2020.

Amendments/corrigenda issued since publication

Date	Text affected
31 December 2021	Implementation of ISO amendment 1:2021 with CEN endorsement A1:2021

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 20932-1:2020 +A1

November 2021

ICS 59.080.30

Supersedes EN 14704-1:2005

English Version

Textiles - Determination of the elasticity of fabrics - Part 1: Strip tests (ISO 20932-1:2018)

Textiles - Détermination de l'élasticité des étoffes - Partie 1: Essais sur bande (ISO 20932-1:2018)

Textilien - Bestimmung der Elastizität von textilen Flächengebilden - Teil 1: Streifenprüfungen (ISO 20932-1:2018)

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN ISO 20932-1:2020+A1:2021: E

European foreword

The text of ISO 20932-1:2018 has been prepared by Technical Committee ISO/TC 38 "Textiles" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 20932-1:2020 by Technical Committee CEN/TC 248 "Textiles and textile products" the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.

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Endorsement notice

The text of ISO 20932-1:2018 has been approved by CEN as EN ISO 20932-1:2020 without any modification.

European foreword to amendment A1

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Endorsement notice

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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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 14704-1[1].

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INTERNATIONAL STANDARD **ISO 20932-1:2018+A1:2021**

Textiles — Determination of the elasticity of fabrics —

Part 1: Strip tests

1 Scope

This document describes the methods of test using strips of fabric in straight strip form or as loops, which can be used to measure elasticity and related properties of fabrics, excluding narrow fabrics.

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 4915, *Textiles — Stitch types — Classification and terminology*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification 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.

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

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

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

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

3.5
loop test specimen
test specimen in which a seam is made to create a loop of the full width of the specimen and which is placed around a loop bar assembly positioned on the testing machine

Note 1 to entry: This method of preparation is useful when any ageing or exposure testing is to be carried out on the specimens after measurement.

3.6
gauge length
distance between the two effective clamping or holding points of a testing device

Note 1 to entry: For strip tests, method A: distance between the two contact points of the line clamps.

Note 2 to entry: For loop tests, method B: half of the circumference around the loop bar assembly.

3.7
slack mounting
insertion of a *strip test specimen* (3.4) 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

3.8
initial length
length of the test specimen between the two effective clamping or holding points, at the beginning of the test (after *slack mounting* (3.7) or under specified pretension)

3.9
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.

[SOURCE: ISO 13934-1:2013, 3.5, modified — References to 3.4 and 3.7 have been removed from Note 1 to entry.]

3.10
extension
increase in length of a test specimen during testing

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

3.11
elongation
ratio of the *extension* (3.10) of the test specimen to its initial length

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

3.12
maximum force
force at the position when a test specimen is taken to a fixed *extension* (3.10)

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

3.13
maximum extension
extension (3.10) 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.

3.14
force at specified elongation
force measured at a given *elongation* (3.11) on either the load or unload curves

3.15
cycle
process whereby a fabric is taken from the *gauge length* (3.6) to a fixed load or fixed extension or elongation and returned to gauge length

3.16
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 at 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).

3.17
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* (3.6) and a specified elongation

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

3.18
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.

3.19
recovered elongation
〚A1〛ratio of recovered extension of the test specimen after cycling (to a specified force or specified extension) to its initial length

Note 1 to entry: The recovered elongation is the complement of the *permanent deformation* (3.18) to the *elongation* (3.11).

Note 2 to entry: Recovered elongation is expressed as a percentage.〚/A1〛

3.20
elastic recovery
recovered elongation (3.19) of the total elongation

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

4 Principle

A fabric test specimen of specified dimensions is extended at a constant rate to either a specified force or elongation for an agreed number of cycles, and its elasticity determined by measuring certain characteristics.

5 Sampling

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

6.2 Line clamps (for method A).

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.

Line clamps, as shown in Annex C, 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.

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 of 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 Loop bar assembly (for method B).

The loop bar assembly shall be as shown in Annex C, Figure C.2 a) or b) and typically comprises two steel bars of circular cross-section and the diameter between 4 mm and 8 mm. The specimen is looped over these bars and extended as the bars move apart. The axes of the bars shall be perpendicular to the line of increasing force. The steel bar holders shall have a minimum internal dimension of 80 mm.

6.4 Equipment, for cutting test specimens and for fraying, where applicable to the required dimensions.

6.5 Sewing machine, capable of producing a type 301 lockstitch as defined in ISO 4915, furnished with a medium ballpoint needle (90s SUK) and 470 decitex (ticket 75's) polyester core-spun thread.

NOTE If there is a risk of damage to the fabric, a finer needle and corresponding polyester core spun thread can be used.

6.6 Calibrated metal rule, graduated in millimetres.

7 Atmosphere for conditioning and testing

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

The fabric samples shall be conditioned for a minimum of 20 h in a tension free state. The prepared test specimens shall be conditioned in a tension free state for a further 4 h after preparation, to minimize the effects of handling during preparation.

8 Preparation of test specimens

8.1 General

From each laboratory sample, a set of test specimens shall be cut in the direction(s) of the stretch.

A set shall consist of a minimum of five test specimens. No test specimen shall be cut from within 150 mm of either edge of the laboratory sample. No test specimen taken from the longitudinal direction shall contain the same yarns and no test specimen taken from the transversal direction shall contain the same yarns unless otherwise specified between interested parties.

NOTE An example of a suitable pattern for cutting test specimens from laboratory sample is given in Annex D, Figure D.1.

8.2 Test specimen preparation

8.2.1 Woven fabrics

8.2.1.1 Strip test specimens (for method A)

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 on both sides. Threads shall be removed in approximately equal numbers from each of the long edges of the cut strip to create fringes, until a width (not including the fringes) of (50,0 ± 1,0) mm or 1 complete thread, is achieved. The width of fringes shall be such that during testing no longitudinal threads escape the fringes. The length of the specimen shall be cut between 250 mm and 300 mm.

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

For fabrics, which cannot be frayed in this manner, test specimens shall be cut along lines (50,0 ± 1,0) mm apart and parallel to the machine or the cross-machine direction.

For fabrics in form of band with a maximum width of 100 mm, test specimen can be tested in full width without fraying them.

If permanent deformation is to be determined at the end of the test, place 100 mm reference (bench) marks parallel to the specimen short side, centrally on the specimen.

If a pretension is used, placing of reference marks is not required, since the length at pretension is used for calculation.

8.2.1.2 Loop test specimens (for method B)

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 on both sides. Threads shall be removed in approximately equal numbers from each of the long edges of the cut strip to create fringes, until a width (not including the fringes) of (75,0 ± 1,0) mm or one complete thread, is achieved. The length of the specimen shall be cut to (250 ± 1) mm. The width of fringes shall be such that during testing no longitudinal threads escape the fringes.

A fine stitch line shall be marked 25 mm from one end and then a further fine stitch line marked at a distance of 200 mm from the first line. The specimen shall be folded in half, parallel to the short dimension lining up the stitch lines.

Using a type 301 lockstitch, starting in the centre of the stitch line, the test specimen shall be sewn along the line to one edge, turned at the edge, without cutting the sewing threads, and sewn along the same line, then turned at the other edge and sewn to the centre. The stitch density shall be 3,5 ± 0,5 per cm.

NOTE 1 For the majority of fabrics, fringes of a width approximately 5 mm or 15 threads is sufficient. For very closely woven fabrics, a much narrower fringe might be satisfactory. Fabrics of very open weave can require up to 10 mm.

For fabrics, which cannot be frayed in this manner, test specimens shall be cut along lines (75,0 ± 1,0) mm apart and parallel to the machine or the cross-machine direction.

NOTE 2 Accurate preparation of the loop test specimens in this manner ensures correct fit of the specimen circumference around the loop assembly bars, preventing too tight or too slack a fit.

If permanent deformation is to be determined at the end of the test, place 100 mm reference (bench) marks parallel to the specimen short side, centrally on the specimen.

If a pretension is used, placing of reference marks is not required, since the length at pretension is used for calculation.

8.2.2 Knitted fabrics

8.2.2.1 Strip test specimens (for method A)

8.2.2.1.1 Warp knitted fabrics

Warp test specimens shall be cut with their length parallel to the wales and the weft test specimens at right angles to the wales. The specimen shall be between 250 mm and 300 mm in length and (50,0 ± 1,0) mm wide.

8.2.2.1.2 Weft knitted fabrics

Warp test specimen shall be cut with their length parallel to the wales and the weft test specimens parallel to the courses. The specimen shall be between 250 mm and 300 mm in length and (50,0 ± 1,0) mm wide.

If permanent deformation is to be determined at the end of the test, place 100 mm reference (bench) marks parallel to the specimen short side, centrally on the specimen.

If a pretension is used, placing of reference marks is not required, since the length at pretension is used for calculation.

8.2.2.2 Loop test specimens (for method B)

8.2.2.2.1 Warp knitted fabrics

Warp test specimen shall be cut with its length parallel to the wales and the weft test specimens at right angles to the wales. The length of the specimen shall be (250,0 ± 1,0) mm × (75,0 ± 1,0) mm wide.

8.2.2.2.2 Weft knitted fabrics

Warp test specimen shall be cut with its length parallel to the wales and the weft test specimens parallel to the courses. The length of the specimen shall be (250,0 ± 1,0) mm × (75,0 ± 1,0) mm wide.

A fine stitch line shall be marked 25 mm from one end and then a further fine stitch line marked at a distance of 200 mm from the first line. The specimen shall be folded in half, parallel to the short dimension lining up the stitch lines.

Using a type 301 lockstitch, starting in the centre of the stitch line, the test specimen shall be sewn along the line to one edge, turned at the edge, without cutting the sewing threads, and sewn along the same line, then turned at the other edge and sewn to the centre. The stitch density shall be 3,5 ± 0,5 per cm.

NOTE Accurate preparation of the loop test specimens in this manner ensures correct fit of the specimen circumference around the loop assembly bars, preventing too tight or too slack a fit.

If permanent deformation is to be determined at the end of the test, place 100 mm reference (bench) marks parallel to the specimen short side, centrally on the specimen.

If a pretension is used, placing of reference marks is not required, since the length at pretension is used for calculation.

8.2.3 Nonwoven fabrics

8.2.3.1 Strip test specimens (for method A)

Test specimens for nonwovens shall be cut along lines parallel to the machine or the cross-machine direction. The specimen shall be between 250 mm and 300 mm in length and (50,0 ± 1,0) mm wide.

8.2.3.2 Loop test specimens (for method B)

Test specimens for nonwoven shall be cut along lines parallel to the machine or the cross-machine direction. The length of the specimen shall be (250,0 ± 1,0) mm × (75,0 ± 1,0) mm wide.

A fine stitch line shall be marked 25 mm from one end and then a further fine stitch line marked at a distance of 200 mm from the first line. The specimen shall be folded in half, parallel to the short dimension lining up the stitch lines

Using a type 301 lockstitch, starting in the centre of the stitch line, the test specimen shall be sewn along the line to one edge, turned at the edge, without cutting the sewing threads, and sewn along the same line, then turned at the other edge and sewn to the centre. The stitch density shall be 3,5 ± 0,5 per cm.

NOTE Accurate preparation of the loop test specimens in this manner ensures correct fit of the specimen circumference around the loop assembly bars, preventing too tight or too slack a fit.

If permanent deformation is to be determined at the end of the test, place 100 mm reference (bench) marks parallel to the specimen short side, centrally on the specimen.

If a pretension is used, placing of reference marks is not required, since the length at pretension is used for calculation.

9 Procedure

9.1 Woven and nonwoven fabrics (other than knitted)

9.1.1 Method A — Strip test specimens

9.1.1.1 Locate the line clamps in the jaws of the tensile testing machine and set the gauge length to (200 ± 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; measure the distance with the calibrated rule.

9.1.1.2

〈A1〉Set the extension and retraction rate of the specimen at 100 % of the initial length per minute. It means that, for examples, if the initial length is 100 mm, set up the rate at 100 mm/min; if the initial length is 200 mm, set up the rate at 200 mm/min.〈A1〉

9.1.1.3 Set the required cycling limits to between gauge length and a load of 6 N/cm width (other loading can be used as agreed between parties).

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

9.1.1.5 For automatic calculation, set a pretension of 1 cN/cm width to define the initial length at start of test and to measure the permanent deformation after cycling.

9.1.2 Method B — Loop test specimens

9.1.2.1 Locate the loop bar assembly in the tensile testing machine and set the gauge length such that the circumference around the loop bars is 200 mm.

NOTE The circumference can be measured by using either a calibrated tape measure or a loop gauge made of non-stretching material.

9.1.2.2 Set the extension and retraction rate of the specimen at 100 mm/min.

9.1.2.3 Set the required cycling limits to between gauge length and a load of 12 N/cm width (other loading can be used as agreed between parties).

9.1.2.4 Position the loop test specimen around the bars. Adjust the specimen around the bars so that the seam lies midway between the bars. Check that the specimen is not too tight or slack on the loop bars.

9.1.2.5 For automatic calculation, set a pretension of 2 cN/cm width to define the initial length at start of test and to measure the permanent deformation after cycling.

9.2 Knitted fabrics

9.2.1 Method A — Strip test specimens

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 measure 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 Set the required cycling limits to between gauge length and either

a) a fixed load per cm width, chosen from one of the loads given in Table 1,

b) a fixed elongation (50 %, 70 %, 80 % or 100 %), or

c) as agreed between parties.

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

9.2.1.5 For automatic calculation, set a pretension of 0,5 cN/cm width to define the initial length at start of test and to measure the permanent deformation after cycling.

9.2.2 Method B — Loop test specimens

9.2.2.1 Locate the loop bar assembly in the tensile testing machine and set the gauge length such that the circumference around the loop bars is 200 mm.

NOTE The circumference can be measured by using either a calibrated tape measure or a loop gauge made of non-stretching material.

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

9.2.2.3 Set the required cycling limits to between gauge length and either

a) a fixed load per cm width, chosen from one of the loads given in Table 1,

b) a fixed elongation (50 %, 70 %, 80 % or 100 %), or

c) as agreed between parties.

9.2.2.4 Position the loop test specimen around the bars. Adjust the specimen around the bars so that the seam lies midway between the bars. Check that the specimen is not too tight or slack on the loop bars.

9.2.2.5 For automatic calculation, set a pretension of 1 cN/ cm width to define the initial length at start of test and to measure the permanent deformation after cycling.

Table 1 — Cycling loads

Weft knit	Warp knit	Loading /cm width	
		Strip	Loop
≤ 5 % elastane	≤ 5 % elastane	3 N	6 N
5 % < % elastane < 12 %	5 % < % elastane < 12 %	4 N	8 N
—	12 % to 20 % elastane	5 N	10 N
—	> 20 % elastane	7 N	14 N

9.3 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 is 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 five 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, on the final cycle set the CRE testing machine to "hold" at the maximum force for the chosen period.

Re-measure at 1 min ± 5 s, the distance between the reference marks previously made on the specimen or calculate it automatically at the specified pretension.

If it is required to determine the permanent deformation, read the results directly from the recorded curve. If not, 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.

Recommended recovery periods are 1 min and 30 min.

Automatic determination of permanent deformation is allowed.

If a pretension is used, placing of reference marks is not required, since the length at pretension is used for calculation. Here, the cross-head loads the specimen again above the pretension after the specified recovery period to measure the permanent deformation.

10 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.

11 Expressions and calculations of test results

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

a) 〈A1〉 Elongation, $S_{\%}$, expressed as a percentage, as shown in Formula (1):

$$S_{\%} = 100 \times \frac{E}{P} \tag{1}$$

where

E is the extension (mm), increase in length of the initial distance (mm) between applied reference marks at maximum force on the fifth cycle; or, in case a pretension is used, increase in length of the clamp distance (mm) from the initial length (mm) at maximum force on the fifth cycle;

P is the initial distance (mm) between applied reference marks; or, in case a pretension is used, the initial length (mm). 〈A1〉

b) 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;

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

c) 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;

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

d) [A1] Permanent deformation, C, expressed as a distance, and permanent deformation $C_{\%}$, expressed as a percentage, as shown in Formula (4) and in Formula (5), respectively:

$$C = Q - P \tag{4}$$

$$C_{\%} = 100 \times \frac{Q - P}{P} \tag{5}$$

where

Q is the distance (mm) between applied reference marks after the measurement and specified recovery period; or, in case a pretension is used, the final clamp distance (mm) at pretension after a specified recovery period;

P is the initial distance (mm) between applied reference marks; or, in case a pretension is used, the initial length (mm). [A1]

e) [A1] Recovered extension, D, expressed as a distance, and recovered elongation $D_{\%}$, expressed as a percentage, as shown in Formula (6) and in Formula (7), respectively:

$$D = E - C \tag{6}$$

$$D_{\%} = 100 \times \frac{E - C}{P} \tag{7}$$

where

E is the extension (mm) as measured in 11, a);

C is the permanent deformation (mm) as calculated in 11, d);

P is the initial distance (mm) between applied reference marks; or, in case a pretension is used, the initial length (mm). [A1]

f) [A1] Elastic recovery, R, expressed as a distance, and elastic recovery $R_{\%}$, expressed as percentage as shown in Formula (8) and in Formula (9), respectively:

$$R = (P + E) - Q = E - (Q - P) = E - C \tag{8}$$

$$R_{\%} = 100 \times \frac{E - C}{E} = 100 \times \left(1 - \frac{C}{E}\right) \tag{9}$$

where

E is the extension (mm) as measured in 11, a);

C is the permanent deformation (mm) as calculated in 11, d). A1

12 Test report

The test report shall include the following information:

a) a reference to this document (i.e. ISO 20932-1:2018) and the date of test;

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

c) gauge length used, in millimetres;

d) rate of extension used in millimetres per minute;

e) state or condition of test specimens (original, washed, aged);

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

g) width of specimen if not as per the dimensions specified within this procedure;

h) type of specimen prepared – strip or loop;

i) If used, the pretension (cN/cm);

j) any deviation from this procedure;

k) maximum cycling force;

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

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

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

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

p) arithmetic mean of permanent deformation, when required;

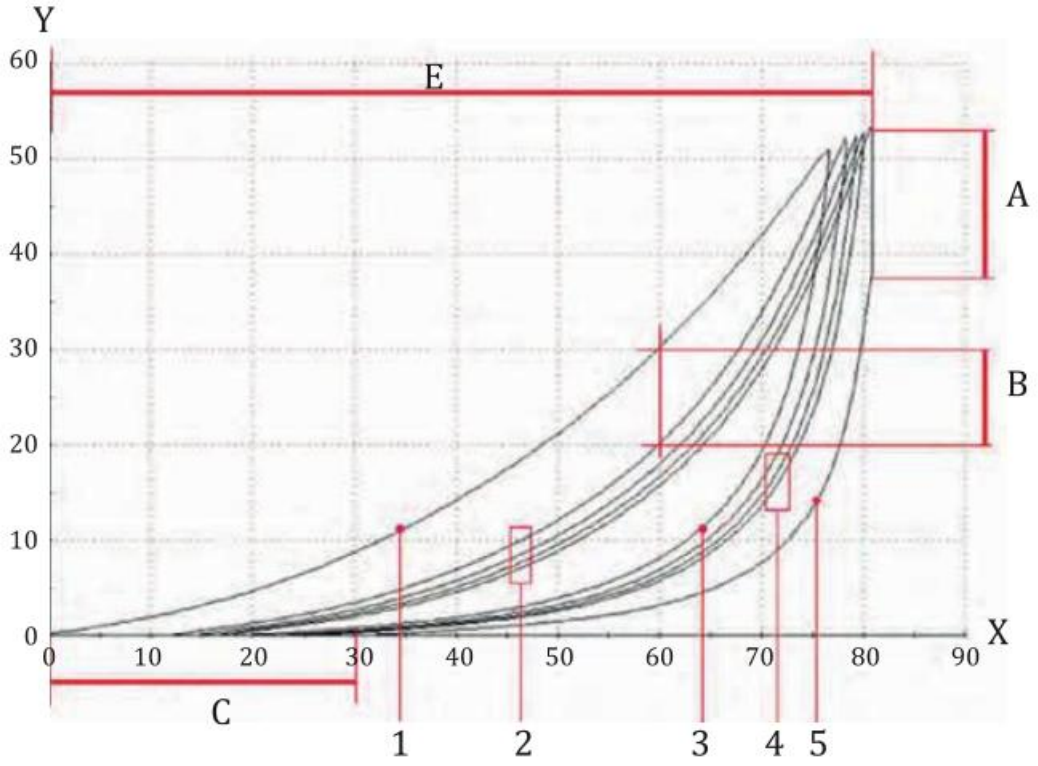
q) arithmetic mean of recovered elongation, when required;

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

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

Annex A
(informative)

Example of a typical cycling graph



Key

X extension axis (in mm, in this example)
Y force axis (in N, in this example)
A force decay due to time
B force decay due to exercising (on 2 different cycles – on the 1st and 2nd cycles in this example)
C permanent deformation (at the pretension, if used, and on the 5th cycle)
E maximum extension
1 1st load cycle
2 2nd, 3rd, 4th and 5th load cycles
3 1st unload cycle
4 2nd, 3rd and 4th unload cycles
5 5th unload cycle

Figure A.1 — Example of a typical cycling graph

Annex B
(informative)

Procedure for sampling

B.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 B.1 to form the bulk sample (number of pieces from a shipment or lot). No piece that shows signs of damage or dampness incurred during transit should be included in the sample.

Table B.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

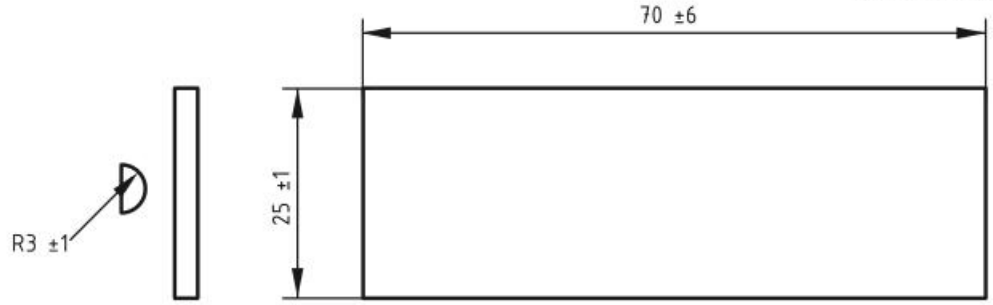
B.2 Number of laboratory samples

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

Annex C
(informative)

Clamping and holding devices

Dimensions in millimetres



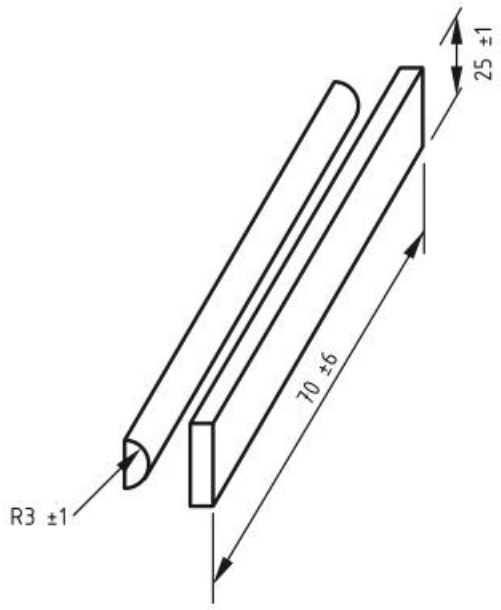
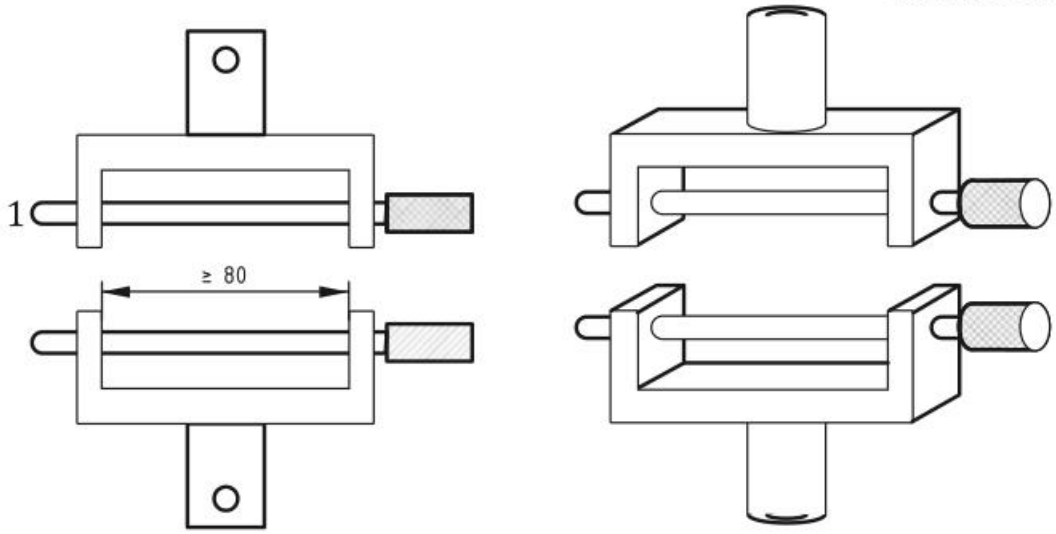
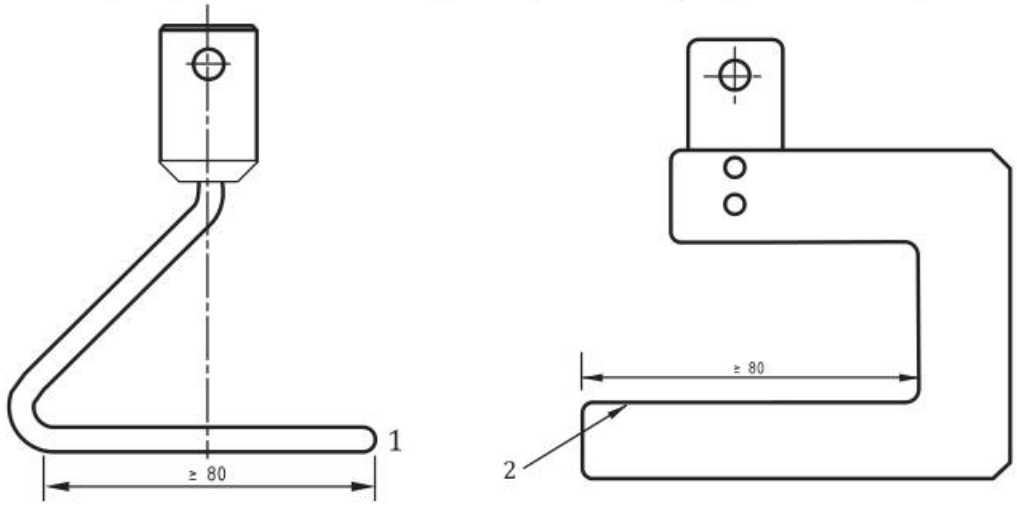


Figure C.1 — Line clamps

Dimensions in millimetres



a) Loop bars, hold in two points (front and perspective views)



b) Loop bars in hook shapes

Key

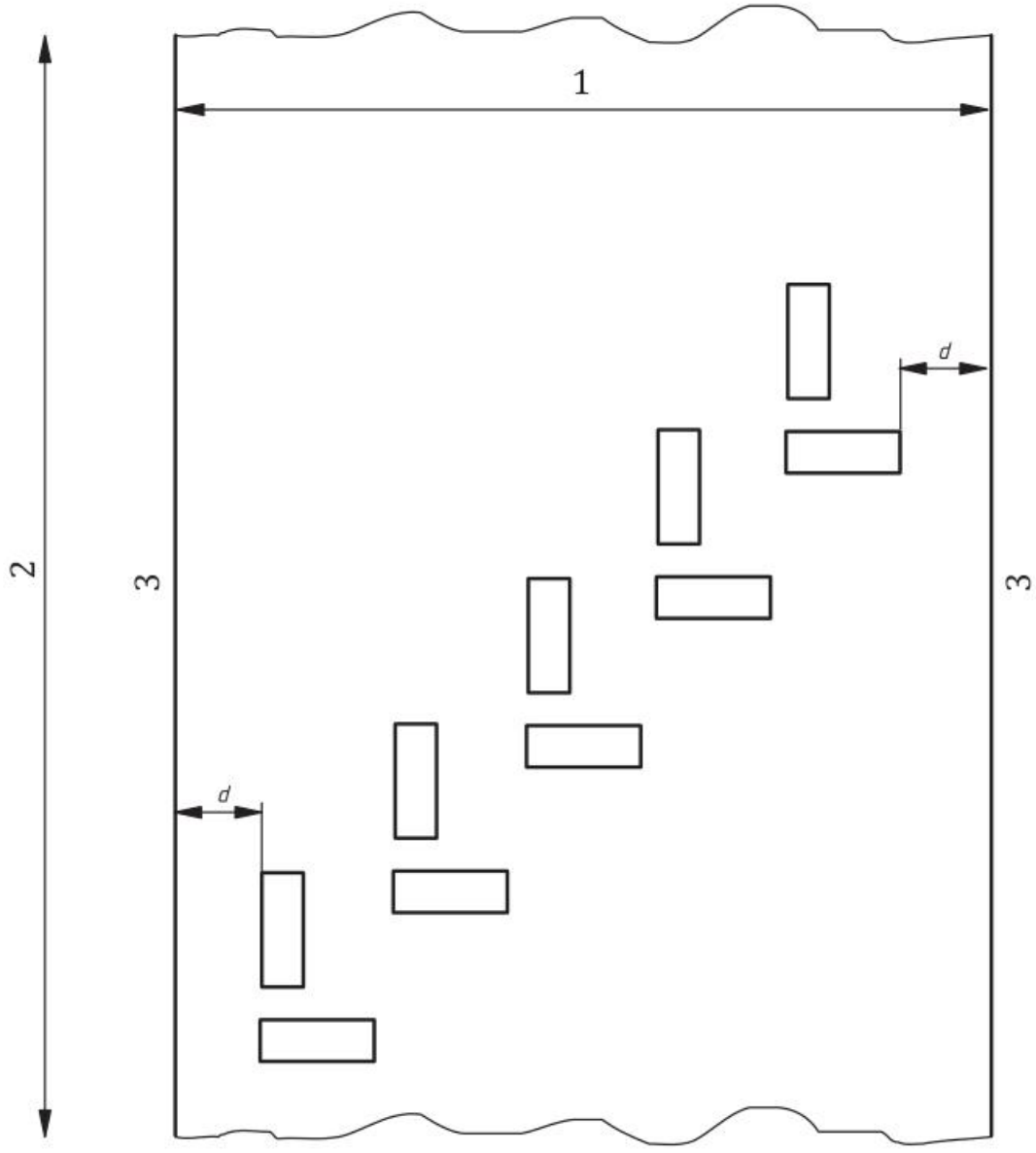
1 diameter 4 mm to 8 mm

2 radius of curve R (3 ± 1) mm

Figure C.2 — Loop bars

Annex D
(informative)

Example of a pattern for cutting test specimens from a laboratory sample



Key

1 width of fabric
2 length of fabric
3 edge
d 150 mm

Figure D.1 — Example of a pattern for cutting test specimens from a laboratory sample

Bibliography

[1] EN 14704-1:2005, *Determination of the elasticity of fabrics — Part 1: Strip tests*

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