BRITISH STANDARD

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14704-1:2005
Incorporating
Corrigendum No. 1

Determination of the elasticity of fabrics —

Part 1: Strip tests

The European Standard EN 14704-1:2005 has the status of a British Standard

ICS 59.080.30

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 14704-1:2005. It supersedes BS 4952:1992 Method of test for elastic fabrics, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee TCI/24, Physical testing of textiles, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 20, an inside back cover and a back cover.

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EUROPEAN STANDARD

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English version

Determination of the elasticity of fabrics - Part 1: Strip tests

Détermination de l'élasticité des étoffes - Partie 1: Essais sur bande

Bestimmung der Elastizität von textilen Flächengebilden - Teil 1: Streifenprüfungen

This European Standard was approved by CEN on 3 March 2005.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 14704-1:2005) has been prepared 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 October 2005, and conflicting national standards shall be withdrawn at the latest by October 2005.

The reasons for the development of this document are because of technical advancements in yarn and fabric structures and properties, which increase product range and developments.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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 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.

EN ISO 139, *Textiles - Standard atmospheres for conditioning and testing (ISO 139:2005).*

EN 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 7500-1:2004).*

EN ISO 10012:2003, *Measurement management systems - Requirements for measurement processes and measuring equipment (ISO 10012:2003)*.

ISO 4915, *Textiles – Stitch types – Classification and terminology.*

3 Terms and definitions

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

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
property of a material by virtue of which it tends to recover its original size and shape immediately after the removal of the force causing deformation

3.3
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

3.4
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 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

a) For strip tests, method A: distance between the two contact points of the line clamps

b) For loop tests, method B: half of the circumference around the loop bar assembly

3.7
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

3.8
initial length
length of the test specimen between the two effective clamping or holding points, before testing

3.9
extension
increase in length of a test specimen produced by a force as a result of testing, expressed in units of length, millimetres

3.10
elongation
ratio of the extension of the test specimen to its initial length, expressed as a percentage

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

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

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

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

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 at this position for a given time period

NOTE The decay in force is expressed as a percentage of the original force recorded at the specified position (see Annex A).

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 zero and a specified elongation (see Annex A)

3.17
un-recovered elongation
ratio of un-recovered extension of the test specimen after cycling, to a specified force or extension, to its initial length, expressed as a percentage

3.18
recovered elongation
un-recovered elongation, expressed as a percentage, subtracted from 100 %

3.19
elastic recovery
recovered elongation expressed as a percentage of the total elongation

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 EN ISO 10012.

The constant-rate-of-extension 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 EN 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 to 500 mm per 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 the centre in line with the applied force. The machine shall be calibrated with the grips in position and the jaw faces closed, where applicable.

   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 (for method A)

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 preferable have a width of (70 ± 6) mm.

NOTE 1 Significant levels of work have shown this type of line clamp is the preferred type for elastane / elastodiene containing fabrics as fabric slippage is eliminated. If a fabric slips the elongation values are inaccurate.

NOTE 2 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 but should not cut or otherwise weaken the test specimen.

Loop bar assembly (for method B)

The loop bar assembly shall be as shown Figures C.2a or C.2b and is typically comprised of 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.

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

6.3 *Sewing machine* capable of producing a type 301 lockstitch as defined in ISO 4915, furnished with a medium ballpoint needle (90's 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.

6.4 *Calibrated metal rule* graduated in millimetres.

7 Atmosphere for conditioning and testing

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

The fabric samples shall be conditioned for a minimum of 20 h in a tension free state. The prepared specimens shall be conditioned in a tension free state for a further 4 h after preparation, to minimise 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. In accordance with Annex D, 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 ends and no test specimen taken from the weft direction shall contain the same picks.

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 ± 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 1 For the majority of fabrics, fringes of a width approximately 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.

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

NOTE 2 If un-recovered elongation 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.

8.2.1.2 Looped 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 ± 1,0) mm or 1 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 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.

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

NOTE 2 Accurate preparation of the looped 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.

NOTE 3 If un-recovered elongation 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.

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 ± 1,0) mm wide.

8.2.2.1.2 Weft knitted fabrics

Warp test specimens 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 ± 1,0) mm wide.

NOTE If un-recovered elongation 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.

8.2.2.2 Looped 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 ± 1,0) mm x (75 ± 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 ± 1,0) mm x (75 ± 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 1 Accurate preparation of the looped 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.

NOTE 2 If un-recovered elongation 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.

8.2.3 Non-woven fabrics

8.2.3.1 Strip test specimens (for method A)

Test specimens for non-woven 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 ± 1,0) mm wide.

8.2.3.2 Looped test specimens (for method B)

Test specimens for non-woven shall be cut along lines parallel to the machine or the cross-machine direction. The length of the specimen shall be (250 ± 1,0) mm x (75 ± 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 1 Accurate preparation of the looped 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.

NOTE 2 If un-recovered elongation 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.

9 Procedure

9.1 Woven and non-woven 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. 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 Set the extension and retraction rate of the specimen at 100 mm/min.

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.

9.1.2 Method B - Looped 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 looped 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 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, or

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.

9.2.2 Method B - Looped 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, or

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

c) as agreed between parties.

9.2.2.4 Position the looped 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.

Table 1 — Cycling loads

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

9.3 Operation

NOTE 1 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 5 cycles.

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.

NOTE 2 A recommended period is 1 min.

If it is required to determine the Un-recovered elongation, 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.

NOTE 3 Recommended recovery periods are 1 min and 30 min.

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 modulus 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) Elongation, *S*, expressed as a percentage

$$S = \frac{E - L}{L} \times 100 \quad (1)$$

where

E is the extension (mm) at maximum force on the 5th cycle

L is the initial length (mm)

b) Force decay due to time, *A* - expressed as a percentage

$$A = \frac{V - W}{V} \times 100 \quad (2)$$

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

$$B = \frac{X - Y}{X} \times 100 \quad (3)$$

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) Un-recovered elongation, *C,* expressed as a percentage

$$C = \frac{Q - P}{P} \times 100 \quad (4)$$

where

Q is the distance between applied reference marks (mm) after a specified recovery period

P is the initial distance between applied reference marks (mm)

e) Recovered elongation, *D,* expressed as a percentage

$$D = (100 - C) \quad (5)$$

f) Elastic recovery, *R,* expressed as a percentage

$$R = \frac{D}{S} \times 100 \quad (6)$$

12 Test report

The test report shall include the following information:

a) reference to this part of EN 14704 and 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 5;

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

h) type of specimen prepared – strip or loop;

i) any deviation from this procedure;

j) maximum cycling force;

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

l) arithmetic mean of modulus, the elongation point and cycle;

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

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

o) arithmetic mean of un-recovered elongation, when required;

p) arithmetic mean of recovered elongation, when required;

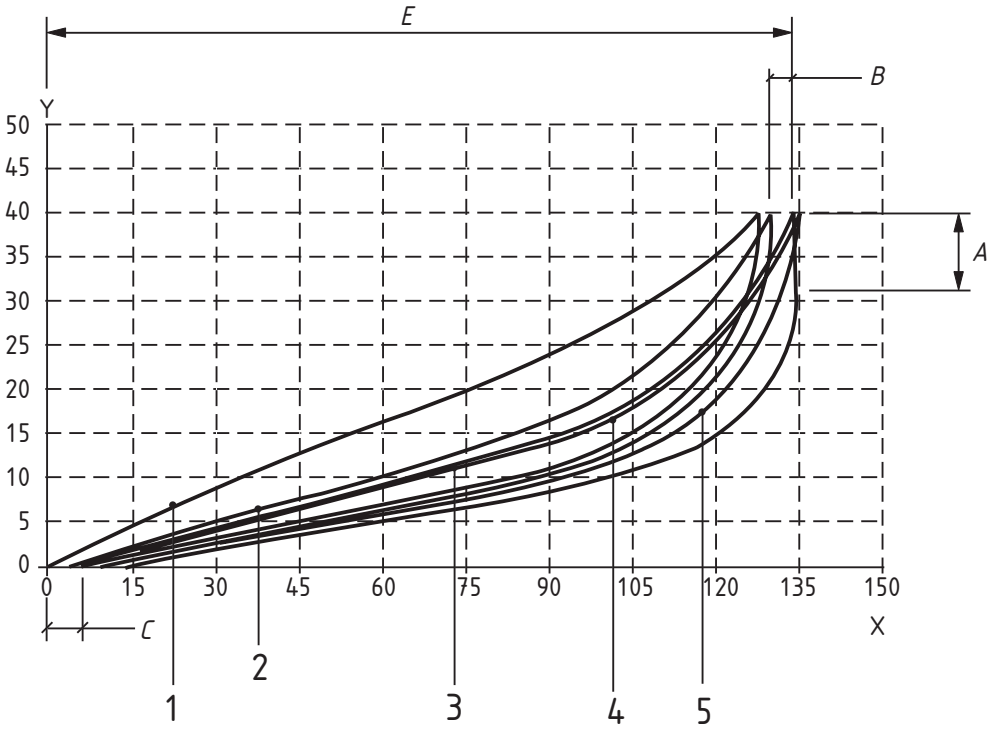
q) if required, the coefficient of variation for the relevant measured and calculated values;

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

s) any deviations from the procedure.

Annex A
(informative)

Example of a typical cycling graph



Key
A Force decay due to time
B Force decay due to exercising
C Un-recovered elongation
E Maximum extension
1 Pre-cycle
2 Second load cycle
3 Fifth load cycle
4 Sixth load cycle
5 Fifth unload cycle

Figure A.1

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

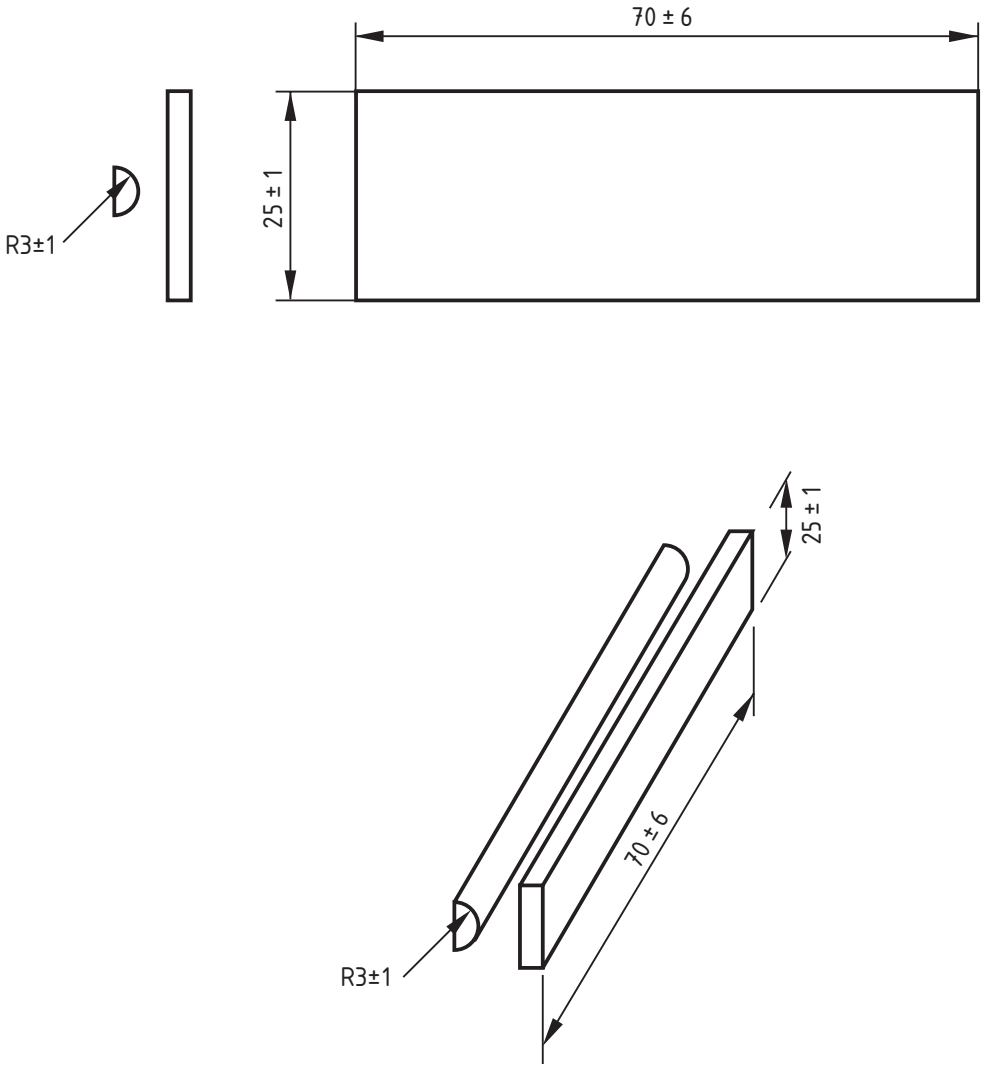
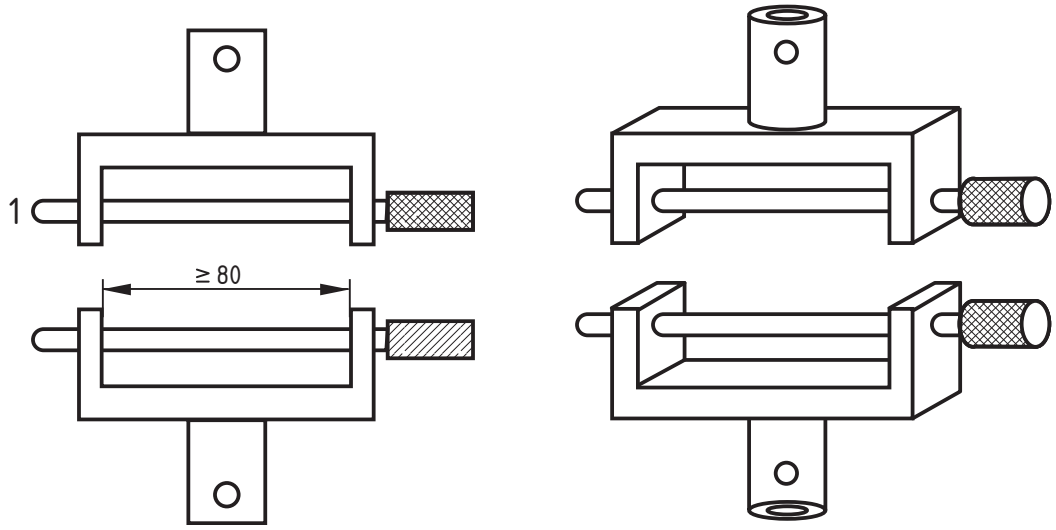


Figure C.1 — Line clamps

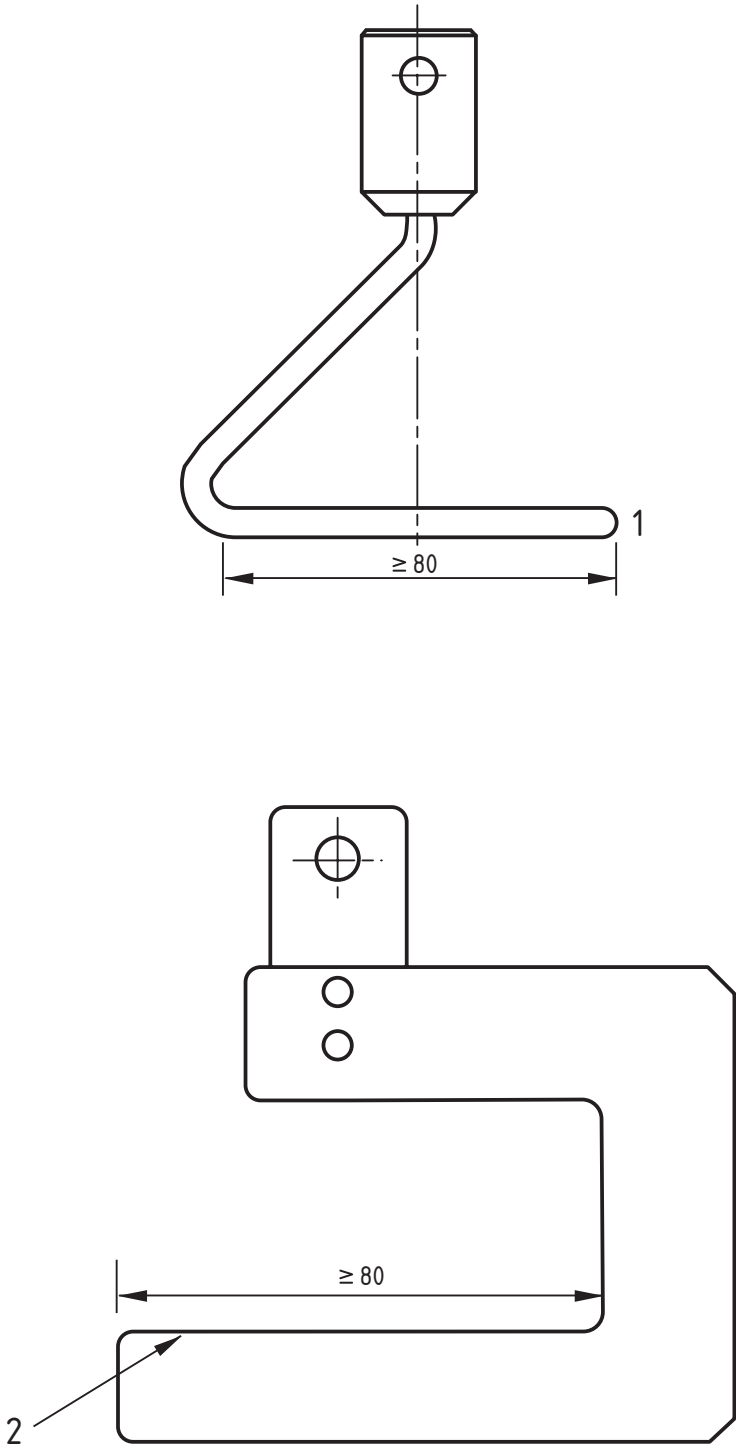
Dimensions in millimetres



Key
1 Bar diameter 4 mm to 8 mm

Figure C.2a — Loop bars

Dimensions in millimetres

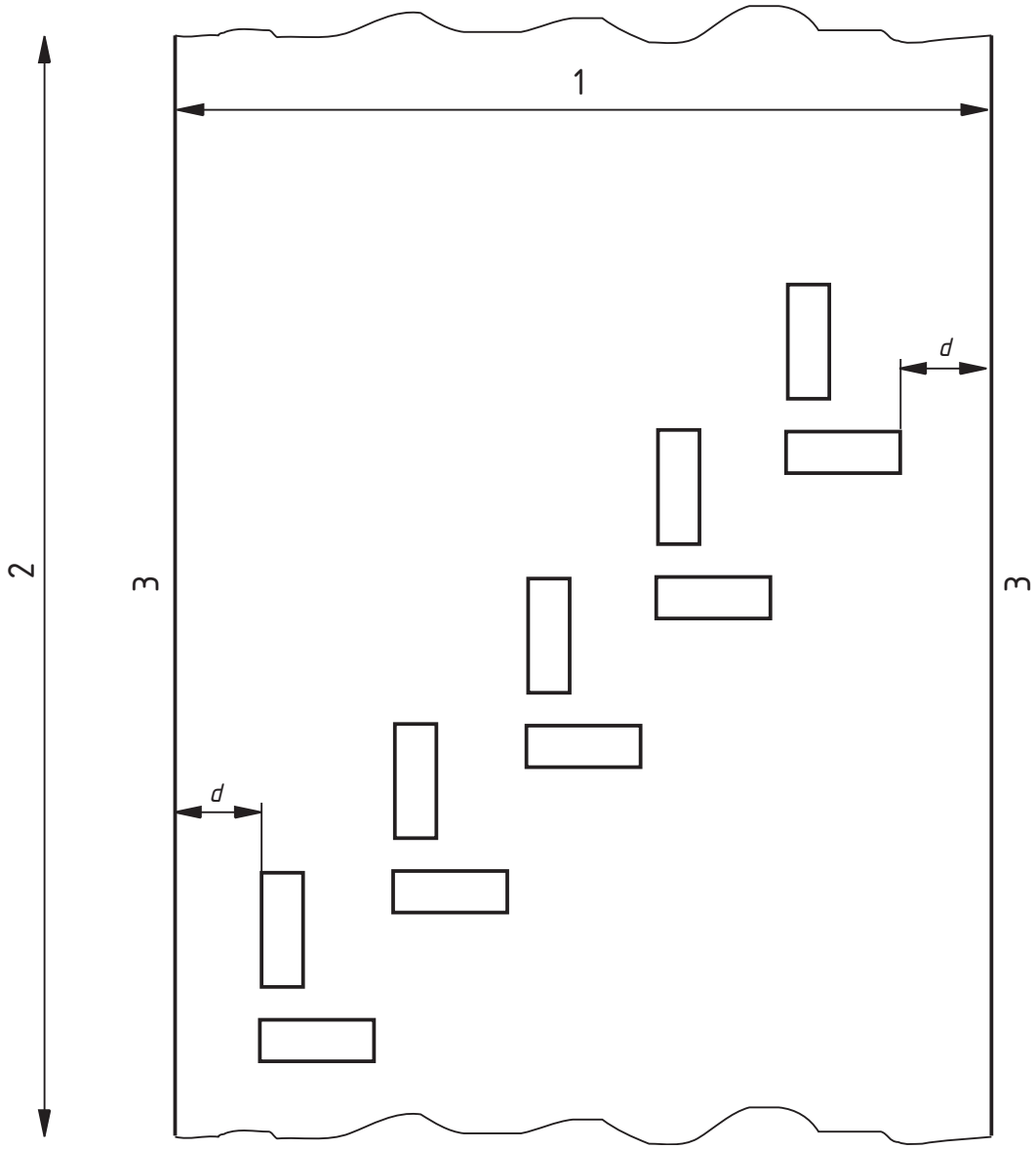


Key
1 Diameter 4 mm to 8 mm
2 Radius of curve R 3 ± 1

Figure C.2b — 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

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