



SLOVENSKI STANDARD

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Gumirane ali plastificirane tekstilije - Mehanske preskusne metode pri dvoosnih napetostnih stanjih - 1. del: Lastnosti natezne togosti

Rubber or plastics-coated fabrics - Mechanical test methods under biaxial stress states – Part 1: Tensile stiffness properties

Mit Kautschuk oder Kunststoff beschichtete Textilien - Mechanische Prüfverfahren unter biaxialen Spannungszuständen - Teil 1: Zugsteifigkeitseigenschaften

Supports textiles revêtus de caoutchouc - Méthodes d'essais mécaniques sous contraintes biaxiales - Partie 22 : Propriétés de rigidité sous traction

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ICS:

59.080.40	Površinsko prevlečene tekstilije	Coated fabrics
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EUROPEAN STANDARD

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Rubber or plastics-coated fabrics - Mechanical test methods under biaxial stress states - Part 1: Tensile stiffness properties

Supports textiles revêtus de caoutchouc ou de plastique - Méthodes d'essais mécaniques sous contraintes biaxiales - Partie 1 : Propriétés de rigidité à la traction

Mit Kautschuk oder Kunststoff beschichtete Textilien - Mechanische Prüfverfahren unter biaxialen Spannungszuständen - Teil 1: Zugsteifigkeitseigenschaften

This European Standard was approved by CEN on 4 September 2018.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents	Page
European foreword.....	4
Introduction.....	5
1 Scope	6
2 Normative references	6
3 Terms and definitions.....	6
4 Principle.....	10
5 Apparatus	10
5.1 Biaxial test equipment.....	10
5.2 Measurement of load.....	10
5.3 Measurement of strain	10
6 Sampling and preparation of test specimens.....	11
6.1 Bulk sample (number of pieces from a shipment or lot)	11
6.2 Number of laboratory samples.....	11
6.3 Specimen geometry and preparation.....	11
6.3.1 General	11
6.3.2 Contact strain measurement.....	12
6.3.3 Non-contact strain measurement.....	12
7 Atmosphere for conditioning and testing.....	12
8 Test procedure	12
8.1 Mounting of the specimen	12
8.2 Loading.....	12
8.3 Recording	13
9 Representation of test results.....	13
10 Calculation of tensile stiffnesses (tensile moduli) and Poisson's ratios.....	13
11 Test report	14
Annex A (informative) Examples of biaxial test equipment	15
A.1 Generality.....	15
A.2 Biaxial test equipment - example I.....	15
A.3 Biaxial test equipment - example II.....	16
A.4 Biaxial test equipment - example III.....	18
Annex B (informative) Features of a biaxial test specimen.....	19
B.1 Primary features of a biaxial test specimen	19
B.2 Biaxial test specimen -example with non-orthogonal yarns and extensometer layout	21
Annex C (informative) Typical profiles.....	22
C.1 Example of a typical load profile.....	22
C.2 Example of a typical strain-time plot	23
C.3 Example of a typical load-strain plot (only one of three load cycles illustrated).....	23

Annex D (informative) Example methods for the determination of tensile stiffnesses (tensile moduli) and Poisson's ratios from biaxial load-strain test data	30
D.1 General	30
D.2 Method A.....	31
D.3 Method B.....	32
D.4 Method C	32
D.5 Method D.....	33
D.6 Method E	34
D.7 Method F	34
Annex E (informative) Determination of comparative elastic constants.....	36
E.1 Scope and Field of Applications.....	36
E.2 Symbols	36
E.3 Constitutive law used	36
E.4 Determination procedure	36
Annex F (informative) Rationale.....	37
Bibliography	38

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EN 17117-1:2018 (E)**European foreword**

This document (EN 17117-1:2018) 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 May 2019, and conflicting national standards shall be withdrawn at the latest by May 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

EN 17117 consists of the following parts, under the general title *Rubber- or plastics-coated fabrics — Mechanical test methods under biaxial stress states*:

— *Part 1: Tensile stiffness properties*

— *Part 2: Determination of the pattern compensation values* (in preparation)

An additional part related to shear stiffness properties will be proposed after the publication of the previous parts.

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

Introduction

Conventional mechanical test methods (based on uniaxial method) are not always suitable within the purpose of the design of specific products using coated fabrics such as architectural tensioned covers.

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EN 17117-1:2018 (E)

1 Scope

This document describes methods of test using biaxial stress states for the determination of the tensile stiffness properties of biaxially oriented coated fabrics (properties along anisotropic directions, such as the weft and warp yarns for woven based coated fabrics, or along the courses and wales of knitted based coated fabrics).

Other mechanical properties (such as pattern compensation values, shear stiffness, and strength) will be described in other parts.

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.

EN ISO 2231, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing (ISO 2231)*

EN ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system (ISO 7500-1)*

3 Terms and definitions

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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:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

biaxial

related to measurement or application along two axes simultaneously

3.2

tensile stiffness

resistance to deformation along the directions of the yarns (e.g. weft and warp)

3.3

compensation

adjustment in size of a cutting pattern to achieve a prestress

3.4

stress

force per unit width (expressed in kN/m)

3.5

gauge length

distance between two effective points of a testing device

3.6

initial length

length of the test specimen between two effective points, before testing

3.7**ultimate tensile strength (UTS)**

mean tensile strength obtained by the application of EN ISO 1421, method 1 (expressed in kN/m)

Note 1 to entry: UTS is used as an input data.

3.8**extension**

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

3.9**elongation**

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

3.10**tensile modulus**

ratio of stress to corresponding strain of a material when deformed under the action of a tensile force

Note 1 to entry: Example of methods for the determination of tensile stiffnesses (tensile moduli) and Poisson's ratios from biaxial stress (3.4)-strain test data are given in Annex D.

3.11**strain**

deformation representing the extension relative to the initial length

3.12**Poisson's ratio (ν)**

ratio of the contraction or transverse strain to the extension or axial strain (in the direction of the applied load)

3.13**cycle**

process in which a coated fabric is taken from the gauge length or an initial fixed load, to a fixed load or fixed extension or elongation, and returned to the gauge length or initial fixed load

3.14**WF1**

loads applied as a prestress in the warp and fill (respectively wale and course) directions with magnitudes that are the maximum of either 1kN/m or 1% of the ultimate tensile strength (UTS) in the warp and fill (respectively wale and course) directions

Note 1 to entry: the expression "fill direction" is used instead of "weft direction" in order to introduce the use of "F" and avoid confusion with "W" used for the warp direction.

3.15**W25**

load applied in the warp (respectively wale) direction with a magnitude of 25% of the ultimate tensile strength (UTS) in the warp (respectively wale) direction

3.16**F25**

load applied in the fill (respectively course) direction with a magnitude of 25% of the ultimate tensile strength (UTS) in the fill (respectively course) direction

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EN 17117-1:2018 (E)**3.17****MIN25**

minimum of W25 and F25

3.18**W25/2**

load applied in the warp (respectively wale) direction with a magnitude of W25 divided by 2

3.19**F25/2**

load applied in the fill (respectively course) direction with a magnitude of F25 divided by 2

3.20**load ratio 1:1**

load applied in warp and fill (respectively wale and course) with equal magnitudes of MIN25

3.21**load ratio 2:1**

load applied in the warp (respectively wale) direction with a magnitude of W25 and in the fill (respectively course) direction with a magnitude of W25/2

3.22**load ratio 1:2**

load applied in the warp (respectively wale) direction with a magnitude of F25/2 and in the fill (respectively course) direction with a magnitude of F25

3.23**load ratio 1:P**

load applied in the warp (respectively wale) direction with a magnitude of W25 and in the fill (respectively course) direction with a magnitude of WF1

Note 1 to entry: "P" refers to "prestress".

3.24**load ratio P:1**

load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of F25

3.25**load cycle 1:1**

load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1, followed by load applied in the warp (respectively wale) direction with a magnitude of MIN25 and in the fill (respectively course) direction with a magnitude of MIN25, followed by load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1

3.26**load cycle 2:1**

load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1, followed by load applied in the warp (respectively wale) direction with a magnitude of W25 and in the fill (respectively course) direction with a magnitude of W25/2, followed by load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1

3.27**load cycle 1:2**

load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1, followed by load applied in the warp (respectively wale) direction with a magnitude of F25/2 and in the fill (respectively course) direction with a magnitude of F25, followed by load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1

3.28**load cycle 1:P**

load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1, followed by load applied in the warp (respectively wale) direction with a magnitude of W25 and in the fill (respectively course) direction with a magnitude of WF1, followed by load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1

3.29**load cycle P:1**

load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1, followed by load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of F25, followed by load applied in the warp (respectively wale) direction with a magnitude of WF1 and in the fill (respectively course) direction with a magnitude of WF1

3.30**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

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3.31**applied load**

load applied in either warp or fill (respectively wale and course) directions expressed in kN/m

3.32**creep**

tendency of a fabric to slowly deform permanently under the influence of constant applied loads

3.33**stiffness change due to cyclic loading**

change of stiffness, calculated and expressed as a percentage, as measured and recorded at the same force point on two different cycles when the test specimen is cycled several times between two specified loads

3.34**raw data**

data from the test downloaded from data logging equipment and not subjected to any post-processing

EN 17117-1:2018 (E)**4 Principle**

A test specimen of cruciform shape is biaxially loaded in the plane of the fabric. The loads are applied cyclically in the warp and fill (respectively wale and course) directions simultaneously. Measurements of stress and strain are used to derive biaxial properties of the fabric.

5 Apparatus**5.1 Biaxial test equipment**

The biaxial test equipment shall be capable of simultaneously applying loads to the test specimen with a specified load ratio in the warp and fill directions (respectively wale and course). It shall be capable of measuring loads, strains and/or displacements at suitable locations simultaneously. The loads in the warp and fill (respectively wale and course) directions should be applied in the directions of the yarns. If not possible, fill (respectively course) loads should be applied orthogonal to the warp (respectively wale) direction. Examples of test rigs are shown in informative Annex A (Figures A.1, A.2 and A.3). The test rigs shown in Annex A (Figures A.1, A.2 and A.3) are not exclusive. Other variants and designs are possible.

The relative directions of yarns may change during the test as the test progresses for certain stress ratios. This may be accommodated in the design of the biaxial test rig.

The centre point of the opposite clamping or holding devices shall be positioned in the line of pull, with the front edges perpendicular to the line of pull, and the clamping or holding devices in the same plane.

The clamping or holding devices shall be capable of holding the test specimen without allowing it to slip and designed so that they minimize damage to the test specimen.

5.2 Measurement of load

The applied loads shall be measured in the warp and fill directions simultaneously (respectively wale and course).

The biaxial tensile testing machine shall be provided with the means for indicating or recording the force when cycling between prescribed loads. 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 force at any point in the range in which the machine is used shall not exceed 1 %.

5.3 Measurement of strain

The strains shall be measured in warp and fill (respectively wale and course) directions simultaneously with the applied loads.

Strain measurement should be made within a field of homogenous strain. The field of homogenous strain should be identified as that area where the strain does not vary by more than $\pm 5\%$ from the strain measures in both warp and fill directions (respectively wale and course) at the geometric centre of the specimen when the specimen subjected to uniaxial and biaxial loading equivalent to 25 % of the Ultimate Tensile Strength (UTS) in each respective direction.

The strain field may be measured using Digital Image Correlation (DIC) techniques.

The strains may be determined by measuring the extensions of the specimen within a field of homogeneous strain with or without contact.

The biaxial tensile testing machine shall be capable of indicating or recording strain or deformation values when cycling between prescribed loads. The error of the indicated or recorded strains shall not exceed 1 %. The error of the indicated or recorded deformations shall not exceed the equivalent of 1 % strain.

6 Sampling and preparation of test specimens

6.1 Bulk sample (number of pieces from a shipment or lot)

A piece shall be taken at random from each lot comprising a shipment to form the bulk sample (comprising a number of pieces from a shipment or lot). No piece that shows signs of damage or dampness incurred during transit shall be included in the sample.

If individual rolls can be identified with manufacturing batches, at least one sample shall be taken from each batch in the consignment. Each sample shall be regarded as being representative of its source, and suitable measures shall be taken to preserve identity between the samples and batch numbers.

If individual rolls cannot be identified in this way, the number of samples to be regarded as being representative of the bulk shall be fixed by agreement between the interested parties. Such samples shall be drawn at random.

6.2 Number of laboratory samples

From each piece in a bulk sample, a minimum of three laboratory samples should be cut from positions taken at random but at least 1m from an end of the piece.

The laboratory samples shall be cut to include the full width of the piece and shall have a length of at least 1,5 m. Areas that are creased or that have a visible fault shall not be included in the sample.

Coated fabric that is 10 % of the overall width of the roll from each selvedge shall be excluded. Coated fabric in at least the first 3 m and last 3 m of a roll consisting of a single coating batch shall be excluded.

If only one or two laboratory samples are used then this information shall be reported.

6.3 Specimen geometry and preparation

6.3.1 General

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The axes of the specimen should be aligned with the warp and fill directions of the laboratory sample (respectively wale and course). If the yarns are not straight, use the tangent at the centre of the specimen in order to define the direction. If for a material with non-orthogonal yarns this is not possible due to the testing equipment used, fill (respectively course) direction should be assumed orthogonal to the warp (respectively wale) direction. The deviation angle to orthogonality shall be reported.

The specimen shall be of sufficient size to provide a representative sample of the coated fabric as a whole. The specimen geometry is intended to produce a field of homogenous strain (defined in 5.3) at the centre.

It is recommended that the homogeneity of the strain distribution and the size and shape of the field of homogenous strain should be checked, under both biaxial and uniaxial conditions, using full-field strain measurement techniques, e.g. Digital Image Correlation (DIC).

The load at the centre of the specimen is normally different to the applied load and may be estimated using numerical simulation to provide a load correction factor to be applied to all measured loads prior to reporting and using the data for calculating mechanical constants.

The primary features of a biaxial test specimen are shown in Figure B.1.

The loading arms of the specimen shall be of equal width. The number of loading arms in the warp (respectively wale) direction shall be equal for both sides. The number of loading arms in the fill (respectively course) direction shall be equal for both sides. Slits forming the loading arms should be cut parallel to the yarns in both warp and fill (respectively wale and course) directions.

The internal corners of the specimen should be rounded with a radius to prevent tear appearance.

The warp and fill (respectively wale and course) directions shall be marked on the surface of the specimen. In case of non-orthogonal yarns, the features of a biaxial test specimen are shown in Figure B.2.