SLOVENSKI STANDARD
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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:

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

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European foreword

This document (prEN 17117-1:2017) has been prepared by Technical Committee CEN/TC 248 "Textiles and textile products", the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

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.

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.

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

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

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 at specified installation

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 load-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

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

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 move or 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

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 shall be applied in the directions of the yarns. 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 ± 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 0,1 %. The error of the indicated or recorded deformations shall not exceed the equivalent of 0,1 % 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.