SLOVENSKI STANDARD
SIST EN 13758-1:2002

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Tekstilije - Zaģļ itne lastnosti pred sonļ nimi ultravijoliļ nimi ģarki - 1. del: Metoda preskuģanja za oblaļ ilne tekstilije

Textiles - Solar UV protective properties - Part 1: Method of test for apparel fabrics

Textilien - Schutzeigenschaften gegen ultraviolette Sonnenstrahlung - Teil 1: Prüfverfahren für Bekleidungstextilien

Textiles - Propriétés de protection contre le rayonnement UV solaire - Partie 1: Méthode d'essai pour étoffes destinées a l'habillement

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ICS:

59.080.30	Tkanine	Textile fabrics
61.020	Oblaļ ila	Clothes

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Textiles - Solar UV protective properties - Part 1: Method of test for apparel fabrics

Textilien - Schutzeigenschaften gegen ultraviolette Sonnenstrahlung - Teil 1: Prüfverfahren für Bekleidungstextilien

This European Standard was approved by CEN on 5 October 2001.

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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 Management Centre has the same status as the official versions.

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

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by May 2002, and conflicting national standards shall be withdrawn at the latest by May 2002.

This standard includes a normative annex A and informative annexes B and C.

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

1 Scope

This European Standard specifies a method for the determination of the erythemally weighted ultraviolet (UV) radiation transmittance of standard conditioned apparel fabrics to assess their solar UV protective properties.

This method is not suitable for fabrics which offer protection at a distance such as umbrellas, shade structures or artificial sources.

NOTE This standard may not be appropriate for fabrics with small colour and construction variations.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 20139:1992, *Textiles — Standard atmospheres for conditioning and testing (ISO 139:1973).*

3 Terms, definitions and abbreviations

For the purposes of this European Standard the following terms and definitions apply.

3.1.1
wavelength (λ)
spatial period of radiation expressed in nanometres

3.1.2
ultraviolet radiation (UVR)
electromagnetic radiation with wavelength between 180 and 400 nm

UV-A: ultraviolet radiation with wavelength between 315 and 400 nm

UV-B: ultraviolet radiation with wavelength between 280 and 315 nm

3.1.3
solar irradiance (E(λ))
quantity of energy emitted by the sun received at the surface of the earth per unit wavelength and per unit area. It is expressed as W m^{-2} nm^{-1}. The solar UVR spectrum as measured at the earth's surface extends between 290 nm and 400 nm

3.1.4
erythema
reddening of the skin caused by various physical or chemical agents

3.1.5
erythema action spectrum *ε(λ)*
relative erythemal effectiveness of radiation with wavelength λ

3.1.6
spectral transmittance T(λ)
ratio of transmitted radiation and incident radiation at a wavelength λ

3.1.7
integrating sphere
hollow sphere whose internal surface is a non-selective diffuse reflector

3.1.8
fluorescence
absorption of radiation of a particular wavelength and its re-emission within a short time as optical radiation of greater wavelength

3.1.9
spectral bandwidth
width in nanometres at half peak intensity of optical radiation emerging from a monochromator

3.1.10
sample recess error
error introduced when the sample is recessed from the port of the integrating sphere (e.g. by using a filter between the port and the sample). In this case part of the diffused transmitted radiation is intercepted and will not enter the sphere. The sample recess error depends on sample construction, distance of sample from port and ratio of port and illumination patch dimensions

3.1.11
shade
particular hue, depth or lightness of colour

3.1.12
construction
set of parameters such as materials, interlacing, pattern, ... which describe the fabric

3.1.13
Ultraviolet Protection Factor (UPF)
expression of the level of protection as attained by the method described in this standard

4 Principle

The UPF of a textile material is determined from the total spectral transmittance $T(\lambda)$ as follows:

$$UPF = \frac{\sum_{\lambda = 290}^{\lambda = 400} E(\lambda)\varepsilon(\lambda)\Delta\lambda}{\sum_{\lambda = 290}^{\lambda = 400} E(\lambda)T(\lambda)\varepsilon(\lambda)\Delta\lambda}$$

with:

$E(\lambda)$: the solar irradiance (see annex A);

$\varepsilon(\lambda)$: the erythema action spectrum (see annex A);

$\Delta\lambda$: the wavelength interval of the measurements;

T(λ): the spectral transmittance at wavelength λ.

The total spectral transmittance is measured by irradiating the sample with monochromatic or polychromatic UV radiation and collecting the total (diffuse and direct) transmitted radiation. In the case of polychromatic incident radiation, the transmitted radiation is collected monochromatically. The apparatus shall either irradiate the sample with a parallel beam and collect all transmitted radiation with an integrating sphere or irradiate the sample hemispherically and collect a parallel beam of transmitted radiation.

5 Apparatus

The measurement device consists of the following:

5.1 A UV source, providing UV radiation throughout the wavelength range 290 nm to 400 nm. Suitable UV sources include Xenon arc lamps, Deuterium lamps and Solar simulators.

5.2 An integrating sphere, having total openings representing not more than 10 % of the internal spherical surface. The internal surface shall be lined with a highly reflective matt surface, e.g. barium sulphate paint. It shall be fitted with baffles to shield the inner detector or the inner source from the specimen port and, if applicable, the sphere wall where the incident flux is measured.

5.3 A monochromator, suited for measurements with a spectral bandwidth of 5 nm or less in the wavelength region 290 nm to 400 nm.

5.4 UV transmitting filter, which transmits significantly only at wavelengths less than approximately 400 nm and which does not fluoresce.

5.5 A specimen holder to hold a specimen in a flat, tensionless or in a predefined stretched state. This device shall not obstruct the entrance port of the integrating sphere and shall ideally position the fabric in the plane of the integrating sphere port.

In the case where a parallel incident beam is used, the surface of the beam should be at least 25 mm^2 and should cover at least 3 times the repeat fabric construction. Moreover, in the case of a monochromatic incident beam and for reducing the sample recess error, the ratio of the smallest dimension of the port of the integrating sphere to the largest dimension of the illumination patch shall also be larger than 1,5. The beam should be normal to the fabric to within ± 5 degrees. The angular divergence of the beam should be less then 5 degrees about the beam axis. These conditions should apply to the collected beam if diffuse illumination is used.

A suitable UV transmitting filter shall be positioned between the sample and the detector if the instrument monochromates before the sample. When this is not practical the filter shall be placed at the specimen port between the specimen and the sphere. The thickness of the UV transmitting filter shall be between 1 mm and 3 mm.

6 Preparation and conditioning of test specimens

6.1 Preparation

For uniform materials, at least 4 specimens shall be prepared. These specimens shall be as widely spaced as possible across the fabric width. The first 5 cm from each selvedge shall be discarded and samples shall not be taken closer than 1 m from the beginning or the end of the fabric piece.

For materials with areas of various shades and/or construction at least two specimens of each colour and of each texture area shall be tested.

The specimen dimensions shall be sufficient to cover the specimen aperture of the instrument.

6.2 Conditions for testing

The conditioning and testing shall be done in accordance with EN 20139:1992. If the testing instrument is not cited in these standard atmospheric conditions transportation and testing of the conditioned test specimen shall be finished within 10 min.

7 Procedure

7.1 Place the specimen to be tested before the entrance port of the integrating sphere such that the face of the fabric intended to be worn away from the skin is exposed to the UV source.

7.2 In instruments that monochromate before the sample, check for fluorescence. If a fluorescent agent is present use a UV transmitting filter and verify its effectiveness.

7.3 Record the transmittance between 290 nm and 400 nm and record the data at least every 5 nm.

8 Calculation and expression of the results

8.1 General

Calculate the arithmetic mean of the UVA transmittance (UVA_i) for each specimen *i* as follows:

$$UVA_i = \frac{1}{m} \sum_{\lambda=315}^{400} T_i(\lambda)$$

Calculate the arithmetic mean of the UVB transmittance (UVB_i) for each specimen *i* as follows:

$$UVB_i = \frac{1}{k} \sum_{\lambda=290}^{315} T_i(\lambda)$$

where

— $T_i(\lambda)$ is the spectral transmittance of specimen *i* at wavelength λ.;

— *m* and *k* are the number of measurement points between 315 nm and 400 nm and between 290 nm and 315 nm respectively.

These definitions are applicable only when the wavelength interval, $\Delta\lambda$, is fixed, e.g. 5 nm, during the measurements.

Calculate the Ultraviolet Protection Factor for each specimen *i* as follows:

$$UPF_i = \frac{\sum_{\lambda=290}^{\lambda=400} E(\lambda)\varepsilon\lambda)\Delta\lambda}{\sum_{\lambda=290}^{\lambda=400} E(\lambda)T_i(\lambda)\varepsilon(\lambda)\Delta\lambda}$$

where:

$E(\lambda)$ = solar spectral irradiance in W m^{-2} nm^{-1}. (See Table 1 - annex A)

$\varepsilon(\lambda)$ = relative erythemal effectiveness (see Table 2 - annex A)

$T(\lambda)$ = spectral transmittance of specimen *i* at wavelength λ

$\Delta\lambda$ = wavelength step in nm

8.1.1 Uniform sample

In the case of a uniform sample, calculate the mean UPF of the sample as follows:

$$UPF_{average} = \frac{1}{n}\sum_{i=1}^{n} UPF_i$$

The standard deviation (s) of the mean SPF is given as follows:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(UPF_i - UPF_{average})^2}{n-1}}$$

with *n* the number of specimens.

The sample *UPF* is given as:

$$UPF = \mathrm{UPF}_{average} - t_{\alpha/2,n-1}\frac{s}{\sqrt{n}}$$

with $t_{\alpha/2,n-1}$ as specified in Table 1:

Table 1 — Determination of $t_{\alpha/2,n-1}$ for α = 0,05

number of specimen	n-1	$t_{\alpha/2,n-1}$
4	3	3,18
5	4	2,77
6	5	2,57
7	6	2,44
8	7	2,36
9	8	2,30
10	9	2,26

When *UPF* is less than the lowest positive *UPF* measured for a particular specimen, then the *UPF* of that specimen shall be reported.

When the sample *UPF* is greater than 50, only "*UPF>50*" need be reported.