SLOVENSKI STANDARD
kSIST-TS FprCEN/TS 927-12:2023

01-januar-2023

Barve in laki - Premazi in premazni sistemi za zaščito lesa za zunanjo uporabo - 12. del: Prepustnost ultravijoličnih in vidnih žarkov

Paints and varnishes - Coating materials and coating systems for exterior wood - Part 12: Ultraviolet and visible radiation transmittance

Beschichtungsstoffe - Beschichtungsstoffe und Beschichtungssysteme für Holz im Außenbereich - Teil 12: Durchlässigkeit für ultraviolette und sichtbare Strahlung

Peintures et vernis - Produits de peinture et systèmes de peinture pour le bois extérieur - Partie 12: Transmission du rayonnement ultraviolet et visible

Ta slovenski standard je istoveten z: FprCEN/TS 927-12

ICS:

71.100.50	Kemikalije za zaščito lesa	Wood-protecting chemicals
87.040	Barve in laki	Paints and varnishes

kSIST-TS FprCEN/TS 927-12:2023 en

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

FINAL DRAFT
FprCEN/TS 927-12

December 2022

ICS 87.040

English Version

Paints and varnishes - Coating materials and coating systems for exterior wood - Part 12: Ultraviolet and visible radiation transmittance

Peintures et vernis - Produits de peinture et systèmes de peinture pour le bois extérieur - Partie 12: Transmission du rayonnement ultraviolet et visible

Beschichtungsstoffe - Beschichtungsstoffe und Beschichtungssysteme für Holz im Außenbereich - Teil 12: Durchlässigkeit für ultraviolette und sichtbare Strahlung

This draft Technical Specification is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 139.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Ref. No. FprCEN/TS 927-12:2022 E

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European foreword

This document (FprCEN/TS 927-12:2022) has been prepared by Technical Committee CEN/TC 139 “Paints and varnishes — Coating materials and coating systems for exterior wood — Ultraviolet and visible radiation transmittance”, the secretariat of which is held by DIN.

This document is currently submitted to the Vote on TS.

Introduction

Wood is a natural material that must be protected against solar radiation, heat, rain, and microorganisms to maintain its appearance and mechanical integrity when used outdoors. Wood and its components (especially lignin) are sensitive to photo oxidation and must therefore be protected by suitable coatings, particularly against ultraviolet (UV) and visible (VIS) radiation in the violet and blue region.

Clear and transparent coating films may be modified by fine sized transparent (mostly yellow or red ferrous oxide-based) pigments and more or less colourless, organic and inorganic UV-absorbers to reduce the harmful part of solar radiation. As these additives are not visible, there is a demand for a test method to determine their efficiency.

The transmittance in a specific wavelength range allows to evaluate the UV and VIS radiation protection of a coating film.

1 Scope

This document describes a test method to measure the ultraviolet (UV) and visible (VIS) spectral transmittance in the wavelength range from 280 nm to 700 nm of coatings for exterior wood. From the spectral transmittance the transmittance of UV, VIS and the combined UV and VIS wavelength range can be calculated.

It is applicable to free coatings films or coatings applied on a UV-transparent substrate.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 2808, *Paints and varnishes - Determination of film thickness (ISO 2808)*

EN ISO 4618, *Paints and varnishes - Terms and definitions (ISO 4618)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 4618 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

3.1
transmittance
τ
quotient of transmitted radiant flux, Φ_t, and incident radiant flux, Φ_m

$$\tau = \frac{\Phi_t}{\Phi_m}$$

Note 1 to entry: Transmittance is also defined spectrally in terms of wavelength, in which case, “spectral” is added before the quantity name.

Note 2 to entry: Due to energy conservation, $\alpha + \rho + \tau = 1$ except when polarized radiation is observed, where α is absorptance and ρ is reflectance.

Note 3 to entry: Transmittance, τ, is the sum of regular transmittance, τ_r, and diffuse transmittance, τ_d: $\tau = \tau_r + \tau_d$.

Note 4 to entry: The transmittance has unit one.

[SOURCE: CIE S 017:2020]

4 Abbreviations

UV ultraviolet radiation in the wavelength range from 280 nm to 400 nm

VIS visible radiation in the wavelength range from 400 nm to 700 nm

5 Principle

The UV and VIS transmittance through a coating film is measured using an UV/VIS spectrophotometer equipped with a radiation source, a limiting aperture, an integrating sphere (Ulbricht sphere), and a spectroradiometer with a diffraction element and a detector.

A beam of optical radiation, limited by an aperture, with an incident radiant flux Φ_m is directed on a film specimen. The transmitted radiant flux Φ_t enters an integrating sphere. The sphere is equipped with the input optics of a spectroradiometer with which spectrally resolved measurements of the unfiltered $\Phi_m(\lambda)$ and the filtered (transmitted) radiant flux $\Phi_t(\lambda)$ can be performed. The quotient $\Phi_t(\lambda)/\Phi_m(\lambda)$ is the spectral transmittance $\tau(\lambda)$. $\tau(\lambda)$ multiplied by 100 represents the percentage of the transmitted radiant flux at a specific wavelength or wavelength range passing through the film compared to the incident radiant flux $\Phi_m(\lambda)$. From the spectral transmittance, the transmittance in a specific wavelength range can be calculated as described in 7.4.

The spectral transmittance is recorded in wavelength increments over the entire wavelength range of 280 nm to 700 nm continuously during a wavelength scanning (e.g. in 2 nm to 10 nm steps depending on the apparatus used and the resolution needed). Depending on the application the transmittance of the specific wavelength ranges for UV, VIS, and UV+VIS can be calculated.

6 Apparatus and materials

6.1 Film applicator for coating material

A suitable doctor blade to apply coatings films of defined wet layer thickness shall be used. As an example for high build wood stains a dry film thickness of approximately 90 µm to 120 µm should be achieved.

6.2 Substrate for free coating film preparation

6.2.1 Preparation of free film and test specimen

A clean and plane substrate shall be used to apply the wet coating materials to prepare the free coating films of correct uniform layer thickness. Ideal as substrate to separate later the coating film without damage is a PTFE[1)] coated smooth metal plate or a PE-, PP-foil, or silicone paper fixed on e.g. a smooth glass or metal plate. In case of low viscosity coatings silicone rubber rings can be used after balancing them horizontally, on e.g. a glass plate to fill in the liquid coating material. The coating material normally is sufficiently dry after a minimum of 7 days or better of 28 days at (23 ± 2) °C at (50 ± 5) % relative humidity (according to EN 23270) or as per the coating supplier's specification.

NOTE Soaking in water is another suitable method for the detachment of free films from a substrate. But this method of preparation of free films can influence the test results. The usual method for preparation of free films is without using water on a low energy substrate such as polypropylene. Alternatively, the coatings can be measured directly on a UV-transparent substrate like quartz.

For each coating, a minimum of three specimens shall be cut out from a uniform section of the film without any damages. The size of the specimens shall be adjusted to the specific spectrophotometer under use.

6.2.2 Coating application

The coating shall be applied on a 1 mm to 2 mm thick quartz substrate with a spectral transmittance of at least 90 % in the wavelength range from 280 nm to 700 nm.

[1)] PTFE – Poly tetra flour ethylene.

6.3 Film thickness measurement

The film thickness shall be measured according to EN ISO 2808.

6.4 UV/VIS spectrophotometer

The following are the minimum requirements for the UV/VIS spectrophotometer:

a) Wavelength range: 280 nm to 700 nm;

b) Radiation source: alternatively or both:

   1) Deuterium,

   2) FEL (quartz halogen lamp);

c) Limiting aperture: defines the radiation beam so that all radiation enters the integrating sphere;

d) Integrating sphere: to guarantee that all transmitted radiation is measured:

   1) cosine response. the normalized response matches the ideal cosine function to within 6 % of the cosine value up to incident angles of 60° and to within 8 % up to 80°,

   2) minimum sphere diameter 50 mm (see Note 4),

   3) maximum size of the input aperture: 20 % of the sphere diameter,

   4) barium sulphate or PTFE-coated.

e) Spectro-radiometer: to measure the spectral irradiance:

   1) stray light suppression: dynamic range 3 decades (see NOTE 1),

   2) dark current correction: shall be performed as appropriate (see NOTE 2),

   3) higher order correction: shall be performed as appropriate (see NOTE 3),

   4) facility for wavelength calibration,

   5) wavelength resolution 2 nm,

   6) measuring increments at least 2 nm,

   7) detector sensitive in the wavelength range from 280 nm to 700 nm.

f) Software to calculate the spectral transmittance.

NOTE 1 Stray light level is the ratio of a measured signal in the blocking range of an absorption filter to the maximum desired signal. Stray light results from a wavelength range which is not part of the measured wavelength range and depends on the used radiation source and the geometry of the spectrophotometer. Stray light influences the dynamic range of the spectrophotometer.

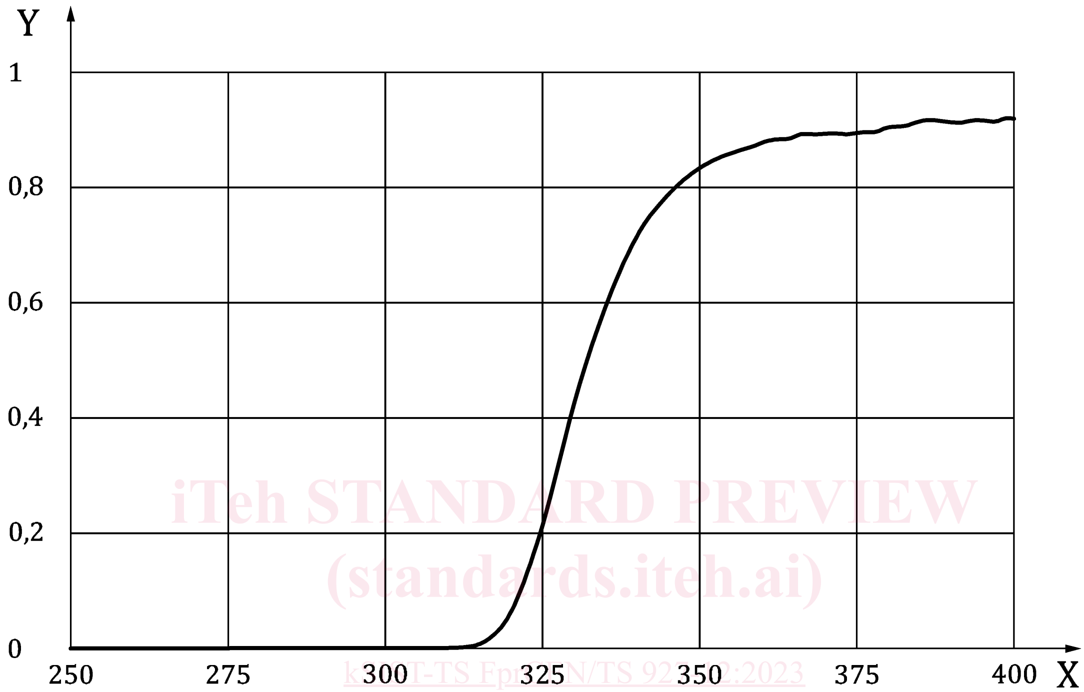
NOTE 2 Dark current is related to the noise of the electronic amplifier (signal-to-noise ratio).

NOTE 3 State of the art spectrophotometers provide high order correction automatically with appropriate filters.

NOTE 4 The diameter of the integrating sphere can have an influence on the measurement. A larger diameter might lead to more accurate results, but this needs to be balanced with the amount of signal that the detector is capable of measuring

6.5 Long-pass filter specification for check

The long-pass filter shall have a transmittance lower than 10^{-4} in the absorption range. The 50 % transmittance shall be in the range from 320 nm to 360 nm (example of transmittance see Figure 1).



Key

X wavelength, in nanometers

Y spectral transmittance

Figure 1 — Example of a spectral transmittance of an long-pass filter.

The filter can be used to check the performance of a UV/VIS spectrophotometer.

7 Test procedure

7.1 Test procedure with spectrophotometer

7.1.1 Measure the spectral distribution ($\Phi_m(\lambda)$) with the spectrophotometer without any filter or films. Dark current measurement and higher order correction shall be provided as appropriate.

NOTE Information about dark current measurement and higher order correction are provided by the instrument manufacturer.

7.1.2 Mount the prepared specimen as close as possible to the entrance port of the integrating sphere to ensure that even scattered radiation enters the sphere.

NOTE The operative instructions and size of the requested specimens depends on the type of spectrophotometer used.