SLOVENSKI STANDARD
SIST EN 12898:2001

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Steklo v stavbah - Ugotavljanje emisivnosti

Glass in building - Determination of the emissivity

Glas im Bauwesen - Bestimmung des Emissionsgrades

Verre dans la construction - Détermination de l'émissivité

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81.040.20 Steklo v gradbeništvu Glass in building

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English version

Glass in building - Determination of the emissivity

Verre dans la construction - Détermination de l'émissivité

Glas im Bauwesen - Bestimmung des Emissionsgrades

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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 129 "Glass in building", the secretariat of which is held by IBN.

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of an identical text or by endorsement, at the latest by July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

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 procedure for determining the emissivity at room temperature of the surfaces of glass and coated glass.

The emissivity is necessary for taking into account heat transfer by radiation from surfaces at the standard temperature of 283 K in the determination of the U value and of the total solar transmittance of glazing according to [1] to [5].

The procedure, being based on spectrophotometric regular reflectance measurements at near normal incidence on non-infrared transparent materials, is not applicable to glazing components with at least one of the following characteristics:

a) with rough or structured surfaces where the incident radiation is diffusely reflected;
b) with curved surfaces where the incident radiation is regularly reflected at angles unsuitable to reach the detector while using regular reflectance accessories;
c) infrared transparent.

However, it may be applied with caution to any glazing component provided its surfaces are flat and non-diffusing (see 3.6) and it is non-infrared transparent (see 3.7).

2 Symbols

ε	total corrected emissivity at 283 K
ε_n	total normal emissivity at 283 K
E	reading of the spectrophotometer with the sample placed on the sample support of the reflectance accessory
E_0	the instrument reading without placing anything on the sample support
E_{st}	the instrument reading with the reference mirror replacing the sample
R_n	total normal reflectance at 283 K
$R_n(\lambda)$	spectral normal reflectance
$R_{n,st}$	spectral normal reflectance of the reference mirror
$T_n(\lambda)$	spectral normal transmittance
T_n	total normal transmittance at 283 K

3 Terms and definitions

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

3.1 infrared
5 μm to 50 μm spectral range.

3.2
emissivity
ratio of the energy emitted by a given surface at a given temperature to that of a perfect emitter (black body with normal and corrected emissivity = 1,0) at the same temperature.

NOTE Two different definitions of emissivity should theoretically be used to describe radiation exchange between:

a) glass surfaces facing each other in multiple glazing (effective emissivity)
b) a glass surface facing a room (hemispherical emissivity).

However, in practice numerical differences were found to be negligibly small (see [6]). Thus corrected emissivity is used to describe both types of heat exchange with a close approximation.

3.3
regular (specular) reflectance
reflectance according to the laws of geometrical optics, without diffusion.

3.4
diffuse reflectance
reflectance not containing any regular component, due to rough surfaces and/or transparent materials containing inhomogeneous particles.

3.5
hemispherical reflectance
the sum of regular and diffuse reflectance.

3.6
non-diffusing glazing component
glazing component with a diffuse reflectance, measured at the near infrared wavelength of 2 µm, ≤ 0,05 (see clause 7).

NOTE The purpose of this measurement is to ensure that the sample is non-diffusing in the measurement range. Diffuse reflectance measurements in the infrared range are difficult to perform.

3.7
non-infrared transparent glazing component
glazing component with a total normal transmittance at 283 K, measured spectrophotometrically, ≤ 0,05.

3.8
reference mirror
reference material whose spectral regular reflectance is traceable to a standard material certified by a metrological laboratory.

4 Brief outline of the procedure to determine corrected emissivity

The procedure for determining the corrected emissivity of coated glass surfaces includes the following steps:

a) the spectral regular reflectance of a non-infrared transparent glazing component at near normal incidence, $R_n(\lambda)$, shall be determined with an infrared spectrophotometer in the range (5 to 50) µm (see clause 5);

b) total normal reflectance at 283 K, R_n, shall be calculated using the integration procedure specified in clause 6 from the corresponding spectral reflectance values measured according to step a);

c) total normal emissivity, ε_n, shall be calculated from the total normal reflectance as specified in clause 6;

d) the corresponding corrected emissivity, ε, shall be determined by multiplying normal emissivity by the ratio, $\varepsilon / \varepsilon_n$, given in Table A.2.

NOTE 1 The corrected emissivity, calculated from the normal emissivity with the help of a multiplicative correction factor, takes into account the effect of the angular distribution of emissivity in the heat transfer calculations of glazing according to [1] to [5].

NOTE 2 Both the normal and the corrected emissivity are total emissivities at 283 K, i.e. they are integrated over the relevant spectral range using as a weighting function Planck 's radiation function for a black body at 283 K (see [7]).

For uncoated soda lime glass surfaces or for soda lime glass surfaces with coatings which have no effects on the emissivity the corrected emissivity to be used in the calculations specified in [1] to [5] shall be 0,837 (see [8]). For all other glazing materials or components it shall be measured.

NOTE 3 With reasonable confidence $\varepsilon = 0{,}837$ can be used for uncoated borosilicate glass and glass ceramics (see [8]).

NOTE 4 For temperatures included in the range 253 to 313 K emissivity is not strongly dependent on the temperature (see [8] and [9]).

5 Spectral normal reflectance and transmittance measurements

5.1 Sample preparation

Samples with a size suitable for being inserted into the sample compartment or placed on the reflectance accessory shall be obtained by cutting or drilling. In doing so, care shall be taken to ensure that the portion of the coated surface probed by the instrument beam is free of damage or any surface contamination.
The procedures recommended by the producer for storing the samples and cleaning their surfaces shall be followed.

The sample shall be supported in a suitable way to ensure that the measuring spot during transmittance and reflectance measurements falls on a flat part.

5.2 Spectral normal reflectance measurements

The spectral regular reflectance curve of the sample at near normal incidence between (5 and 50) µm shall be determined with an infrared spectrophotometer equipped with a specular reflectance accessory at near normal incidence.

5.2.1 Test apparatus

The following equipment shall be used for the measurements:

- a spectrophotometer covering the spectral range 5 µm to 50 µm;

- a reference mirror (free of surface scratches and contamination, see [7], [9] and [10]) whose spectral regular reflectance at near normal incidence $R_{n,st}$ (λ) shall be traceable to a standard material certified by a metrological laboratory;

- a specular reflectance accessory consisting of a suitable array of mirrors and a sample support. When the accessory is placed in the sample compartment of the spectrophotometer and the sample (or reference mirror) placed on the sample support, the instrument beam reaches the detector after being specularly reflected on the surface of the sample (reference mirror) at an angle of incidence ≤ 10°.

5.2.2 Measurement

The spectral regular reflectance curve of the sample at near normal incidence shall be determined with the relative method. The following measurements are required to determine the spectral normal reflectance of the sample R_n (λ_i) at each wavelength λ_i reported in Table A.1:

- E the instrument reading with the sample placed on the sample support of the reflectance accessory;

- E_{st} the instrument reading with the standard replacing the sample;

- E_0 the instrument reading without placing anything on the sample support.

At each wavelength λ_i the sample reflectance R_n (λ_i) shall be calculated as follows:

$$R_n(\lambda_i) = \frac{E - E_0}{E_{st} - E_0} \cdot R_{n,st}(\lambda_i) \qquad (1)$$

with $R_{n,st}$ (λ_i) = spectral normal reflectance of the reference mirror at the wavelength λ_i.

NOTE Metrological laboratories determine the absolute reflectance by comparing the energy of the beam reflected from the sample to that of the incident beam or with the help of a double reflection accessory called “V-W” or “Strong-type” (see [10]). Commercial versions of such devices exist but their construction is far short of the careful layout of the original version. Their accuracy is critically dependent on alignment and beam characteristics (size and divergence)