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Road vehicles — Safety glazing materials — Method for the determination of solar transmittance

Véhicules routiers — Vitrages de sécurité — Méthode de détermination du facteur de transmission du rayonnement solaire

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee *[for Project Committee]* ISO/TC *[for ISO/PC]* 22, *Road vehicle*, Subcommittee SC 35, *Lighting and visibility*.

This second edition cancels and replaces the first edition (ISO 13837:2008), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Unify convention A and B (see clause 5, ISO 13837:2008 clause 6);

— Add calculation methods for visible luminous transmittance, solar direct reflectance, solar direct absorbance and colorimetry.(see clause 5.3.1, 5.3.5, 5.3.6 and 5.3.8);

— Move the texts of Annex B to clause 5.3.7.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

A review of existing standards and industry specifications and procedures reveals a lack of agreement with respect to the basis for defining and measuring the ultraviolet (UV), visible (VIS) , infrared (IR) transmittance and colorimetry(L*, a*, b*) properties of glazing materials. To avoid the continued preparation and promulgation of conflicting standards by individual entities, there is an interest in the automotive and glazing industries to harmonize on a worldwide basis the test procedures and protocol used to assess the solar transmittance properties of glazing materials.

Road vehicles — Safety glazing materials — Method for the determination of solar transmittance

1 Scope

This International Standard specifies test methods to determine the visible luminous, the direct, total solar transmittance and the colorimetry of safety glazing materials for road vehicles.

This International Standard applies to monolithic or laminated, clear or tinted samples of safety glazing materials. Essentially flat sections of glazing parts can be used in this test, as well as flat samples of the same materials.

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.

ISO 9845-1:1992, *Solar energy — Reference solar spectral irradiance at the ground at different receiving conditions — Part 1: Direct normal and hemispherical solar irradiance for air mass 1,5*

ISO 9050:2003, *Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors*

ISO 11664-1:2007, *Colorimetry —Part 1: CIE standard colorimetric observers*

ISO 11664-2:2007, *Colorimetry — Part 2: CIE standard illuminants*

ISO 11664-3:2012, *Colorimetry —Part 3: CIE Tristimulus Values*

ISO 11664-4:2008, *Colorimetry —Part 4: CIE 1976 L*a*b* Color space*

ISO 10292, *Glass in building — Calculation of steady-state U values (thermal transmittance) of multiple glazing*

3 Terms and definitions and symbols

3.1 Terms and definitions

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

3.1.1
standardize
adjust an instrument output to correspond to a previously established calibration, using one or more homogeneous specimens or reference materials.

3.1.2
transmittance/ reflectance
ratio of transmitted/reflectance flux to incident flux, under specified geometric and spectral conditions.

3.1.3
air mass (ratio)
ratio of the mass of atmosphere in the actual observer-sun path to the mass that would exist if the observer were at sea level, at standard barometric pressure, and the sun were directly overhead.

3.2 Symbols

Table 1 — Symbol definition

Symbol	Symbol Definition
T_λ	the transmittance through a glazing at wavelength λ within a specified Δλ
R_λ	the external reflectance(R) of a glazing at wavelength λ within a specified Δλ
LT_A	the visible luminous transmittance for illuminant A with 2 degree view through a glazing
T_{UV}	ultraviolet (UV) direct solar energy transmitted through a glazing
T_{UV} (400)	ultraviolet (UV) direct solar energy transmitted through a glazing at a specified upper limit value (400nm)
T_e	direct solar energy (e) transmitted through a glazing
q_i	secondary heat transfer to the inside of a glazing
T_{TS}	total solar energy ($T_e + q_i$) transmitted to the inside of a glazing
R_e	direct solar energy (e) reflected by a glazing
a_e	direct solar energy (e) absorbed by a glazing
λ	wavelength, in nm
Δλ	uniform λ interval
E'_λ (n)	normalized relative spectral distribution of global solar radiation
$W(\lambda)$	values x(λ), y(λ) ,z(λ) times S(λ)
$S(\lambda)$	relative spectral distribution of global solar radiation
X_{10}, Y_{10}, Z_{10}	tristimulus values calculated using the CIE 1964 standard colorimetric observer under illuminant D65 spectral power distribution (6500 K correlated color temperature)
L^*, a^*, b^*	the coordinates of the CIE 1976 L*a*b* color space. L*, CIELAB lightness; a*, b*, CIELAB coordinates

4 Apparatus

This method requires spectral transmittance data to be obtained from samples of glazing materials using a scanning spectrophotometer. This instrument, preferably equipped with an integrating sphere, shall be capable of measuring transmittance over that part of the electromagnetic spectrum in which the solar energy is transmitted to the earth's surface.

5 Procedure

5.1 Sample preparation

Cut out (if necessary) and clean the flattest area of curved test specimens with distilled water and reagent grade ethanol, or use an alternate procedure appropriate to the material, if necessary. Cut and clean flat samples similarly.

5.2 Measurement

Standardize the spectrophotometer in accordance with the manufacturer's instructions. Measure transmittance/reflectance of cleaned sample and record the sample spectral data in accordance with the instrument manufacturer's recommendation. Note its film/coating side and curvature orientation, if applicable.

5.3 Calculation method

5.3.1 Visible luminous transmittance[LT_A]

Compute luminous transmittance LT_A by integration using weight data of visible light of Illuminate A in Table 2. Transmission (T) for the visible range (380 to 780 nm) determined by the following function:

$$LT_A = \sum_{380}^{780} T_\lambda \times W_\lambda \tag{1}$$

5.3.2 Solar UV transmittance [T_{UV}]

Compute solar UV transmittance T_{UV} by integration using the solar weight data in Table 3. Transmission (T) for solar range (300 nm to 380 nm) is determined by the following functions:

$$T_{UV} = \sum_{300}^{380} T_\lambda \times E'_\lambda(n) \tag{2}$$

5.3.3 Solar UV transmittance [T_{UV} (400)]

Compute solar UV transmittance T_{UV} (400) by integration using the solar weight data in Table 4. Transmission (T) for solar range (300 nm to 400 nm) is determined by the following functions:

$$T_{UV}(400) = \sum_{300}^{400} T_\lambda \times E'_\lambda(n) \tag{3}$$

5.3.4 Solar direct transmittance [T_e]

Compute solar direct transmittance T_e by integration using the solar weight data in Table 5. Transmission (T_e) for solar range (300 nm to 2 500 nm) is determined by the following functions:

$$T_e = \sum_{300}^{2500} T_\lambda \times E'_\lambda(n) \tag{4}$$

5.3.5 Solar direct reflectance [R_e]

Compute solar direct reflectance R_e by integration using the solar weight data in Table 5. Reflectance (R_e) for solar range (300 nm to 2 500 nm) is determined by the following functions:

$$R_e = \sum_{300}^{2500} R_\lambda \times E'_\lambda(n) \tag{5}$$

5.3.6 Solar direct absorbance [a_e]

Solar direct absorbance (a_e) is determined by the following functions:

$$a_e = 100\% - T_e - R_e \tag{6}$$

5.3.7 Total solar transmittance[T_{TS}]

5.3.7.1 Definitions

The total solar transmittance, T_{TS}, of a safety glazing material is the sum of the solar direct transmittance, T_e (300 nm to 2 500 nm), and of the secondary heat transfer factor, q_i, of the glazing