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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

Reference number
ISO 13837:2008(E)

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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.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13837 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 11, *Safety glazing materials*.

This corrected version of ISO 13837:2008 incorporates the following correction:

— Equation (B.4) on page 15 has been corrected.

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) and infrared (IR) transmittance 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 direct and total solar transmittance of safety glazing materials for road vehicles. Two computational conventions (denoted convention “A” and convention “B”) are included, both of which are consistent with current international needs and practices.

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 referenced documents are indispensable for the application 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*

CIE 85:1989, *Solar spectral irradiance*

3 Terms, 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
ratio of transmitted 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

3.1.4
solar indirect transmittance
fraction of the solar radiation absorbed by the safety glazing materials and reradiated to the interior

NOTE The fraction is the secondary heat transfer factor as defined in ISO 9050.

3.2 Symbols

Symbol	Definition
T_{UV}	ultraviolet (UV) direct solar energy transmitted through a glazing
T_{DS}	direct solar (DS) energy transmitted through a glazing
q_i	secondary heat transfer to the inside of a glazing
T_{TS}	total solar energy ($T_{DS} + q_i$) transmitted to the inside of a glazing
λ	wavelength, in nm
$\Delta\lambda$	uniform λ interval
E_λ	solar energy within a $\Delta\lambda$
E'_λ	E_λ in trapezoidal form $\left(E_1/2, E_2 \cdots E_{n-1}, E_n/2\right)$
$E'_\lambda(n)$	normalized $\left[E'_\lambda \Big/ \sum\left(E'_{300} \cdots E'_{2\,500}\right)\right]$
NOTE Additional definitions are specific to the computational convention chosen and are defined with the appropriate convention.	

4 Computational conventions

4.1 Convention “A”

Convention “A” defines the UV range from 300 nm to 400 nm for air mass 1,5 global. This definition is consistent with ISO 3917 and CIE 20:1972, and the best average solar flux specified in ISO 9845-1:1992, Table 1, Column 5.

4.2 Convention “B”

Convention “B” defines the UV range from 300 nm to 380 nm for air mass 1,0 global. This definition is consistent with ISO 9050 and EN 410, and the maximum possible solar flux found in CIE 85:1989, Table 4.

NOTE This International Standard defines each convention and computations are based on established methods (see Annex A). The tables incorporated in each computational convention simplify the calculations, leading to high accuracy with minimum effort. Since the results will differ depending on which convention is chosen, it is essential that the convention chosen be clearly identified when results are reported.

5 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 sun's energy is transmitted to the earth's surface.

6 Procedure

6.1 Sample preparation

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

6.2 Measurement

Standardize the spectrophotometer in accordance with the manufacturer's instructions. Place a clean sample normal to the measuring beam in the transmittance sample position. Note its film side and curvature orientation, if applicable. Record the sample spectral data in accordance with the instrument manufacturer's recommendation.

6.3 Calculation by computational convention "A"

6.3.1 Definitions specific to computational convention "A"

6.3.1.1 Solar UV transmittance [$T_{UV}(400)$]

See Table 1. The transmittance is weighted interval by interval and derived from ISO 9845-1:1992, Table 1, Column 5 (with air mass 1,5 global) from 300 nm to 400 nm, at intervals of 5 nm.

6.3.1.2 Solar direct transmittance [$T_{DS}(1,5)$]

See Table 2. The transmittance is weighted interval by interval and derived from ISO 9845-1:1992, Table 1, Column 5 (with air mass 1,5 global) from 300 nm to 2 500 nm, at intervals of 5 nm, 10 nm and 50 nm.

6.3.1.3 Solar total transmittance [$T_{TS}(1,5)$]

The transmittance is the sum of the direct transmittance as defined in 6.3.1.2 and the indirect transmittance as defined in 3.1.4.

6.3.2 Computation method

6.3.2.1 Compute direct solar transmittance by integration using the solar weight data in Tables 1 and 2. Transmission (T) for each solar range (λ_1 to λ_n) is determined by the following functions:

$$\%T_{UV}(400) = \sum_{300}^{400} \%T_\lambda \times E'_\lambda(\text{n}) \;\{\text{Table 1}\} \tag{1}$$

$$\%T_{DS}(1{,}5) = \sum_{300}^{2\,500} \%T_\lambda \times E'_\lambda(\text{n}) \;\{\text{Table 2}\} \tag{2}$$

where $E'_\lambda(\text{n})$ is the normalized solar energy computed trapezoidally in wavelength interval ($\Delta\lambda$).

6.3.2.2 Transmittance shall be measured to at least 2 300 nm. If it is not possible to measure transmittance to the recommended 2 500 nm, the last value shall be multiplied by the remaining $E'_\lambda(\text{n})$ weight values in Table 2.

6.4 Calculation by computational convention "B"

6.4.1 Definitions specific to computational convention "B"

6.4.1.1 Solar UV transmittance [$T_{UV}(380)$]

See Table 3. The transmittance is weighted interval by interval and derived from CIE 85:1989, Table 4 (with air mass 1,0 global) from 300 nm to 380 nm, at intervals of 5 nm.

6.4.1.2 Solar direct transmittance [$T_{DS}(1,0)$]

See Table 4. The transmittance is weighted interval by interval and derived from CIE 85:1989, Table 4 (with air mass 1,0 global) from 300 nm to 2 500 nm, at intervals of 5 nm, 10 nm and 50 nm.

6.4.1.3 Solar total transmittance [$T_{TS}(1,0)$]

The transmittance is the sum of the direct transmittance as defined in 6.4.1.2 and the indirect transmittance as defined in 3.1.4.

6.4.2 Computation method

6.4.2.1 Compute direct solar transmittance by integration using the solar weight data in Tables 3 and 4. Transmission (T) for each solar range (λ_1 to λ_n) is determined by the following functions:

$$\%T_{UV}(380) = \sum_{300}^{380} \%T_\lambda \times E'_\lambda(\text{n}) \{\text{Table 3}\} \quad (3)$$

$$\%T_{DS}(1{,}0) = \sum_{300}^{2\,500} \%T_\lambda \times E'_\lambda(\text{n}) \{\text{Table 4}\} \quad (4)$$

where $E'_\lambda(\text{n})$ is the normalized solar energy computed trapezoidally in wavelength interval ($\Delta\lambda$).

6.4.2.2 Transmittance shall be measured to at least 2 300 nm. If it is not possible to measure transmittance to the recommended 2 500 nm, the last value shall be multiplied by the remaining $E'_\lambda(\text{n})$ weight values in Table 4.

6.5 Total solar transmittance

This International Standard defines the determination of the direct solar transmittance of safety glazing materials computed by either of two computational conventions (“A” or “B”). If it is necessary to compute total solar transmittance, use the equations in Annex B and the direct solar transmittance results from 6.3 or 6.4, whichever is appropriate.

7 Expression of results

Record thickness, type, construction, and curvature orientation if applicable, of the specimen; the instrument and computational convention used (“A” or “B”); and the specimen's total UV and direct solar transmittance, and, if necessary, the specimen's total solar properties rounded to 0,1 %, in accordance with the rounding convention in Reference [6].

Table 1 — Solar global radiation through air mass 1,5 and partitioned into uniform spectral trapezoidal intervals

λ nm	E'_{λ}(n)
300	0,000 000
305	0,001 045
310	0,004 634
315	0,011 800
320	0,019 807
325	0,027 019
330	0,043 271
335	0,042 703
340	0,047 644
345	0,048 041
350	0,052 948
355	0,054 947
360	0,056 946
365	0,064 930
370	0,072 925
375	0,075 901
380	0,077 991
385	0,075 890
390	0,073 777
395	0,092 335
400	0,055 446
$\%T_{\text{UV}}(400) = \sum_{300}^{400} \%T_{\lambda} \times E'_{\lambda}(\text{n})$	
NOTE Modified wavelength intervals in ISO 9845-1:1992, Table 1, Column 5.	