INTERNATIONAL STANDARD

ISO 12311

First edition
2013-08-01

Corrected version
2014-08-15

Personal protective equipment — Test methods for sunglasses and related eyewear

Équipement de protection individuelle — Méthodes d'essai pour lunettes de soleil et articles de lunetterie associés

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

Reference number
ISO 12311:2013(E)

© ISO 2013

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

COPYRIGHT PROTECTED DOCUMENT

© ISO 2013

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

 © ISO 2013 – All rights reserved

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. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 6, *Eye and face protection*.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

This corrected version of ISO 12311:2013 incorporates the following correction:

— the second paragraph of 9.7.3.1 has been added.

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

Personal protective equipment — Test methods for sunglasses and related eyewear

1 Scope

This International Standard specifies reference test methods for determining the properties of sunglasses given in ISO 12312 (all parts). It is applicable to all sunglasses and related eyewear.

Other test methods may be used if proven to be equivalent.

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.

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 1042:1998, *Laboratory glassware — One-mark volumetric flasks*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/d6f25bf2-a71f-442a-b6f8-a55faea61188/iso-12311-2013

ISO 4007, *Personal protective equipment — Eye and face protection — Vocabulary*

ISO 8596, *Ophthalmic optics — Visual acuity testing — Standard optotype and its presentation*

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

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

ISO 12312-1:2013, *Eye and face protection — Sunglasses and related eyewear — Part 1: Sunglasses for general use*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4007 apply.

4 Prerequisites

The following parameters shall be specified prior to testing [see ISO 12312 (all parts)]:

— the number of specimens;

— specimen preparation;

— any conditioning prior to testing;

— characteristics to be assessed subjectively (inappropriate);

© ISO 2013 – All rights reserved

— pass/fail criteria.

5 General test requirements

Unless otherwise specified, the values stated in this International Standard are expressed as nominal values. Except for temperature limits, values which are not stated as maxima or minima shall be subject to a tolerance of ± 5 %. Unless otherwise specified, the ambient temperature for testing shall be between 16 °C and 32 °C. Where other temperature limits are specified they shall be subject to an accuracy of ± 1 °C. Relative humidity shall be maintained at (50 ± 20) %.

Unless otherwise specified, the filters shall be tested at the reference points as defined in ISO 4007.

6 Test methods for assessing the construction and materials

6.1 Prior assessment of construction, marking and information

Prior to applying the test methods, a visual inspection shall be carried out with normal or corrected vision, without magnification. Marking and information supplied by the manufacturer and safety data sheets (if applicable) or declaration relevant to the materials used in its construction shall also be assessed.

6.2 Test method for assessment of filter material and surface quality

iTeh STANDARD PREVIEW
(standards.iteh.ai)

6.2.1 Principle

The quality of the filter material and surface is assessed by visual inspection.

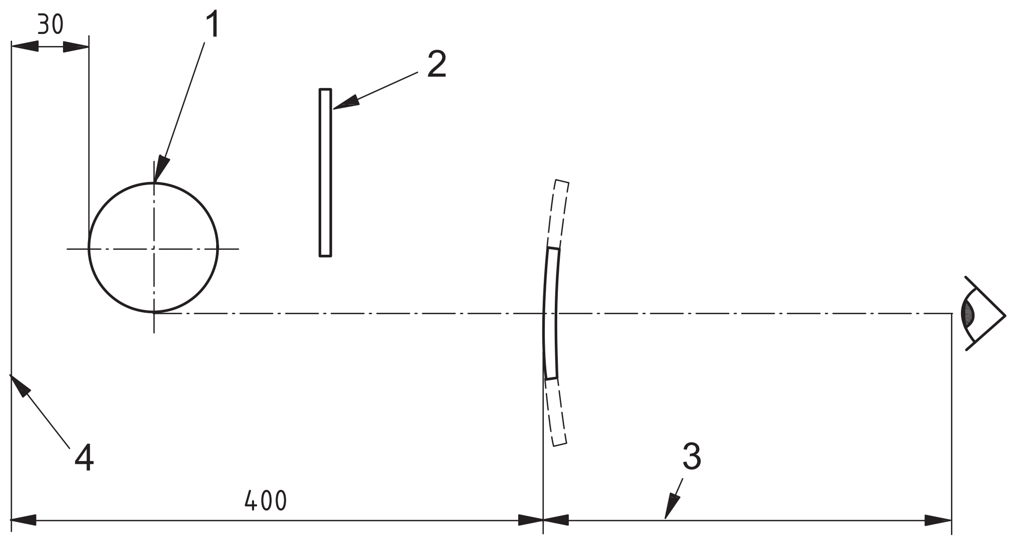
ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

6.2.2 Apparatus

A suitable apparatus is shown in Figure 1.

 © ISO 2013 – All rights reserved

Dimensions in millimetres



Key

1 lamp

2 adjustable opaque dull black mask

3 near vision distance (≈300)

4 dull black background (200 × 360)

iTeh STANDARD PREVIEW

Figure 1 — Arrangement of apparatus for assessment of quality of material and surface

(standards.iteh.ai)

6.2.3 Test procedure

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-
a55faea61188/iso-12311-2013

Carry out the assessment of the quality of material and surface by visual inspection with the aid of a “light box” or illuminated grid.

NOTE One method of inspection in current use consists of an illuminated grid as a background to be viewed through the filter which is held at various distances from the eye. Another method is to illuminate the filter by means of a fluorescent lamp mounted within a dull black chamber and with the amount of illumination adjusted by means of an adjustable opaque black mask. A suitable arrangement is shown in Figure 1.

6.2.4 Verification and test report

Except for a marginal area 5 mm wide at the edge of the eye protector, any significant defects likely to impair vision in use shall be recorded in the verification and test report.

7 Test methods for measuring spectrophotometric properties

7.1 Measurement of spectral transmittance $\tau(\lambda)$

7.1.1 Spectral transmittance

7.1.1.1 General

Test methods shall be used which have relative uncertainties in spectral transmittance less than or equal to those given in Table 1.

© ISO 2013 – All rights reserved

Table 1 — Relative uncertainty of measured spectral transmittance

Spectral transmittance value		Uncertainty %
Less than %	to %	
100	17,8	±2 absolute
17,8	0,44	±10 relative
0,44	0,023	±15 relative
0,023	0,0012	±20 relative
0,0012	0,000023	±30 relative

The general methods of evaluating the components of uncertainty are set out in ISO/IEC Guide 98-3. Annex A shows how uncertainty of measurement is to be applied in the reporting of results and compliance and Annex B is a guide to the sources of uncertainty in spectrophotometry, their minimization and evaluation.

The location and direction of measurement of transmittance shall be as specified in ISO 12312-1. If the measurements are not made normal to the surface of the filter, then particular attention should be paid to the effects of beam displacement (see Annex B). If the direction of measurement is not specified then it shall be measured normal to the surface of the filter when unmounted.

Calculations shall be carried out at not more than 5 nm intervals ($\Delta\lambda$ = 5 nm) in the ultraviolet-visible region (280 nm to 780 nm) and not more than 10 nm in the infrared region (780 nm to 2 000 nm). The necessary data at these intervals are provided in Annexes D, E, F, H and I.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

7.1.1.2 Test procedure

Place the filter in order to follow the location and direction of measurement of transmittance as specified in ISO 12312-1.

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

7.1.2 Calculations of luminous transmittance τ_V

Luminous transmittance is calculated as a percentage from the spectral transmittances and with reference to a standard observer and a source or illuminant. For the purposes of this International Standard all calculations use the CIE 2° Standard Observer [ISO 11664-1 and CIE Standard Illuminant D65 (ISO 11664-2)].

$$\tau_V = 100 \times \frac{\int_{380}^{780} \tau(\lambda) \cdot S_{D65}(\lambda) \cdot V(\lambda) \cdot \mathrm{d}\lambda}{\int_{380}^{780} S_{D65}(\lambda) \cdot V(\lambda) \cdot \mathrm{d}\lambda} \qquad (1)$$

where

λ is the wavelength of the light in nanometres;

$\tau(\lambda)$ is the spectral transmittance of the filter;

$V(\lambda)$ is the spectral luminous efficiency function for photopic vision;

$S_{D65}(\lambda)$ is the spectral distribution of radiation of CIE Standard Illuminant D65 (see ISO 11664-2).

The values of $S_{D65}(\lambda).V(\lambda)$ are given in Annex D.

NOTE These calculations are normally carried out as summations and not as integrations. The equivalent summations are provided in Annex C.

 © ISO 2013 – All rights reserved

7.2 Measurement of uniformity of luminous transmittance

7.2.1 Unmounted filters covering one eye

7.2.1.1 Test method

Locate the defined reference point defined in ISO 4007. Determine a circular area around the reference point with diameter *d* calculated as follows (see Figure 2):

a) for filters equal to or greater than 50 mm in vertical depth at the reference point, *d* = (40,0 ± 0,5) mm;

b) for filters less than 50 mm in vertical depth at the reference point, *d* = [vertical depth of filter (h) - 10 ± 0,5] mm.

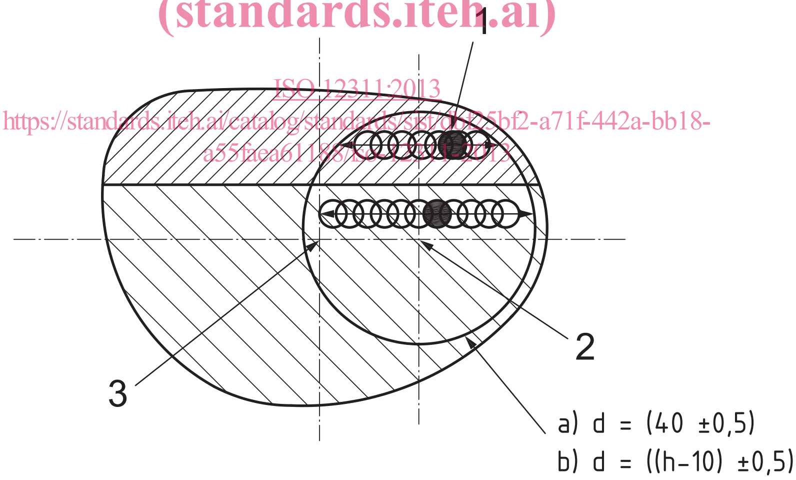
A 5 mm wide portion around the edge of the filter shall be excluded from this circular area.

Scan this circular area with a 5 mm nominal diameter light beam white light or a narrow spectral band with a maximum spectral energy at (555 ± 25) nm and measure the luminous transmittance with a detector whose spectral responsivity approximates that of the CIE 2° Standard Observer (ISO 11664-1). The effects of displacement of the light beam by any prismatic effect of the filter (see B.3.4.1) shall be compensated for, and variations in thickness shall be corrected as in Annex L.

For filters with bands or gradients of different luminous transmittance, the requirement for variations in luminous transmittance applies in this circular area but perpendicular to the gradient (see Figure 2). Two example scans perpendicular to the gradient are shown in Figure 2.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

Dimensions in millimetres



Key

1 light beam 5 mm diameter

2 reference point

3 geometric or boxed centre

Figure 2 — Luminous transmittance uniformity measurement for filters with bands or gradients of different luminous transmittance

The filter and the light beam are positioned so that the incident light falls normally on the surface of the filter at the reference point or parallel to that direction at other locations on the filter.

Measure and record the maximum value of luminous transmittance τ_{vmax}, and the minimum value of luminous transmittance τ_{vmin}.

© ISO 2013 – All rights reserved

7.2.1.2 Calculations

Calculate the value of Δ_F as percentage, from the following formulae:

$$\Delta_F = 100 \times \frac{(\tau_{vmax} - \tau_{vmin})}{\tau_{vmax}} \quad (2)$$

where

τ_{vmax} is the maximum value of luminous transmittance;

τ_{vmin} is the minimum value of luminous transmittance.

7.2.1.3 Test report

Record Δ_F as the uniformity of luminous transmittance.

7.2.2 Mounted filters and unmounted filters covering both eyes

7.2.2.1 Test method

Locate the defined reference points defined in ISO 4007. Define two circular areas around the reference points with diameter *d,* calculated as follows:

Circular areas are determined around each of these centres with diameters *d*, calculated as follows:

iTeh STANDARD PREVIEW
(standards.iteh.ai)

a) for filters equal to or greater than 50 mm in vertical depth at the reference point, *d* = (40,0 ± 0,5) mm;

b) for filters less than 50 mm in vertical depth at the reference point, *d* = [vertical depth of filter (h) - 10 ± 0,5] mm.

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

A 5 mm wide portion around the edge of the filter shall be excluded from this circular area.

Scan this circular area with a 5 mm nominal diameter light beam white light or a narrow spectral band with a maximum spectral energy at (555 ± 25) nm and measure the luminous transmittance with a detector whose spectral responsivity approximates that of the CIE 2° Standard Observer (ISO 11664-1). The effects of displacement of the light beam by the any prismatic effect of the filter (see B.3.4.1) shall be compensated for and variations in thickness shall be corrected as in Annex L.

For filters with bands or gradients of different luminous transmittance, assessments of variations in luminous transmittance shall be for sections parallel to the line joining the reference points.

Measure and record the value of luminous transmittance τ_{VL} at the left eye reference point and the value of luminous transmittance τ_{VR} at the right eye reference point.

 © ISO 2013 – All rights reserved

7.2.2.2 Calculations

Divide the absolute difference between the values of the luminous transmittance at the two reference points τ_{VL} and τ_{VR} by the higher value of the luminous transmittance at one of the two reference points and express this ratio, as a percentage Δ_P.

$$\Delta_P = 100 \times \frac{\left|\tau_{VR} - \tau_{VL}\right|}{\max\left(\tau_{VR}, \tau_{VL}\right)} \tag{3}$$

where

τ_{VL} is the value of luminous transmittance at the reference point of the left filter;

τ_{VR} is the value of luminous transmittance at the reference point of the right filter.

EXAMPLE If one filter transmits 38,0 % and the other transmits 40,0 %, then the result is 100 × (2,0/40,0) = 5,0 %.

7.2.2.3 Test report

Record the value Δ_P as a percentage.

7.3 Calculation of ultraviolet transmittance

iTeh STANDARD PREVIEW
(standards.iteh.ai)

7.3.1 Solar UV-transmittance τ_{SUV}

The calculation of τ_{SUV} (see ISO 4007) as a percentage is:

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/db25b1f2-a71f-442a-bb18-a55faea61188/iso-12311-2013

$$\tau_{SUV} = 100 \times \frac{\int_{280}^{380} \tau(\lambda) \cdot E_s(\lambda) \cdot S(\lambda) \cdot d\lambda}{\int_{280}^{380} E_s(\lambda) \cdot S(\lambda) \cdot d\lambda} = 100 \times \frac{\int_{280}^{380} \tau(\lambda) \cdot W(\lambda) \cdot d\lambda}{\int_{280}^{380} W(\lambda) \cdot d\lambda} \tag{4}$$

where

λ is the wavelength in nanometres;

$\tau(\lambda)$ is the spectral transmittance;

$E_S(\lambda)$ is the solar radiation at sea level for air mass 2;[7]

$S(\lambda)$ is the relative spectral effectiveness function for UV radiation;[8]

$W(\lambda)$ $= E_S(\lambda) \cdot S(\lambda)$ and is the complete weighting function of this product.

The values of $E_S(\lambda)$, $S(\lambda)$ and $W(\lambda)$ are given in Annex E.

7.3.2 Solar UVA-transmittance τ_{SUVA}

Solar UVA-transmittance is the result of the mean of the spectral transmittance between 315 nm and 380 nm and appropriate weighting functions.

© ISO 2013 – All rights reserved

The calculation of τ_{SUVA} (see ISO 4007) as a percentage is as follows:

$$\tau_{SUVA} = 100 \times \frac{\int_{315}^{380} \tau(\lambda)\cdot E_S(\lambda)\cdot S(\lambda)\cdot d\lambda}{\int_{315}^{380} E_S(\lambda)\cdot S(\lambda)\cdot d\lambda} = 100 \times \frac{\int_{315}^{380} \tau(\lambda)\cdot W(\lambda)\cdot d\lambda}{\int_{315}^{380} W(\lambda)\cdot d\lambda} \quad (5)$$

where

λ is the wavelength in nanometres;

$\tau(\lambda)$ is the spectral transmittance;

$E_S(\lambda)$ is the solar radiation at sea level for air mass 2;[7]

$S(\lambda)$ is the relative spectral effectiveness function for UV radiation;[8]

$W(\lambda)$ $= E_S(\lambda)\cdot S(\lambda)$ and is the complete weighting function of this product.

The values of $E_S(\lambda)$, $S(\lambda)$ and $W(\lambda)$ are given in Annex E.

7.3.3 Solar UVB-transmittance τ_{SUVB}

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Solar UVB-transmittance is the result of the mean of the spectral transmittance between 280 nm and 315 nm and appropriate weighting functions.

The calculation of τ_{SUVB} (see ISO 4007) as a percentage is as follows:

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

$$\tau_{SUVB} = 100 \times \frac{\int_{280}^{315} \tau(\lambda)\cdot E_S(\lambda)\cdot S(\lambda)\cdot d\lambda}{\int_{280}^{315} E_S(\lambda)\cdot S(\lambda)\cdot d\lambda} = 100 \times \frac{\int_{280}^{315} \tau(\lambda)\cdot W(\lambda)\cdot d\lambda}{\int_{280}^{315} W(\lambda)\cdot d\lambda} \quad (6)$$

where

λ is the wavelength in nanometres;

$\tau(\lambda)$ is the spectral transmittance;

$E_S(\lambda)$ is the solar radiation at sea level for air mass 2;[7]

$S(\lambda)$ is the relative spectral effectiveness function for UV radiation;[8]

$W(\lambda)$ $= E_S(\lambda).S(\lambda)$ and is the complete weighting function of this product.

The values of $E_S(\lambda)$, $S(\lambda)$ and $W(\lambda)$ are given in Annex E.

 © ISO 2013 – All rights reserved

7.4 Calculation of solar blue-light transmittance τ_{sb}

Solar blue-light transmittance is the result of the mean of the spectral transmittance between 380 nm and 500 nm and appropriate weighting functions. The calculation of τ_{sb} (see ISO 4007) as a percentage is as follows:

$$\tau_{sb} = 100 \times \frac{\int_{380}^{500} \tau(\lambda) \cdot E_s(\lambda) \cdot B(\lambda) \cdot d\lambda}{\int_{380}^{500} E_s(\lambda) \cdot B(\lambda) \cdot d\lambda} = 100 \times \frac{\int_{380}^{500} \tau(\lambda) \cdot W_B(\lambda) \cdot d\lambda}{\int_{380}^{500} W_B(\lambda) \cdot d\lambda} \quad (7)$$

where

λ	is the wavelength in nanometres;
$\tau(\lambda)$	is the spectral transmittance;
$E_S(\lambda)$	is the solar radiation at sea level for air mass 2;[7]
$B(\lambda)$	is the blue-light hazard function;[9]
$W_B(\lambda)$	$= E_S(\lambda) \cdot B(\lambda)$ and is the complete weighting function of this product.

The values of $E_S(\lambda)$, $B(\lambda)$ and $W_B(\lambda)$ are given in Annex E.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

7.5 Calculation of solar IR transmittance τ_{SIR}

The calculation of solar IR transmittance τ_{SIR} (see ISO 4007) as a percentage is obtained by integration between the limits 780 nm and 2 000 nm as follows:

ISO 12311:2013
https://standards.iteh.ai/catalog/standards/sist/dbf25bf2-a71f-442a-bb18-a55faea61188/iso-12311-2013

$$\tau_{SIR} = 100 \times \frac{\int_{780}^{2000} \tau(\lambda) \cdot E_s(\lambda) \cdot d\lambda}{\int_{780}^{2000} E_s(\lambda) \cdot d\lambda} \quad (8)$$

where

λ	is the wavelength in nanometres;
$\tau(\lambda)$	is the spectral transmittance;
$E_S(\lambda)$	is the spectral distribution of solar radiation at sea level for air mass 2.[7]

The values of $E_S(\lambda)$ are given in Annex F.

7.6 Measurement of absolute spectral reflectance $\rho(\lambda)$

The test methods to be used shall have relative uncertainties in spectral reflectance less than or equal to those given in Table 2. The angle of incidence is to be ≤ 17°