INTERNATIONAL STANDARD

ISO 12312-1

Second edition
2022-06

Eye and face protection — Sunglasses and related eyewear —

Part 1: Sunglasses for general use

Protection des yeux et du visage — Lunettes de soleil et articles de lunetterie associés —

Partie 1: Lunettes de soleil pour usage général

Reference number
ISO 12312-1:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword .... **iv**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Construction and materials **3**

4.1 Construction 3

4.2 Filter material and surface quality 3

4.3 Physiological compatibility 3

4.4 Headforms 4

5 Transmittance **4**

5.1 Test methods 4

5.2 Transmittance and filter categories 4

5.3 General transmittance requirements 5

5.3.1 Uniformity of luminous transmittance 5

5.3.2 Requirements for road use and driving 6

5.3.3 Wide-angle scatter 6

5.3.4 Additional transmittance requirements for specific filter types 6

5.3.5 Claimed transmittance properties 8

6 Refractive power **10**

6.1 Spherical and astigmatic power 10

6.2 Spatial deviation 10

6.3 Prism imbalance (relative prism error) 10

7 Robustness **11**

7.1 Minimum robustness of filters 11

7.2 Frame deformation and retention of filters 11

7.3 Impact resistance of sunglasses, strength level 1 (optional specification) 11

7.4 Increased endurance of sunglasses (optional specification) 11

7.5 Resistance to perspiration (optional specification) 12

7.6 Impact resistance of sunglasses, strength level 2 or 3 (optional specification) 12

8 Resistance to solar radiation **13**

9 Resistance to ignition **13**

10 Resistance to abrasion (optional specification) **13**

11 Protective requirements **14**

11.1 Coverage area 14

11.2 Temporal protective requirements 14

12 Information and labelling **15**

12.1 Information to be supplied with each pair of sunglasses 15

12.2 Additional information 17

13 Selection of test samples **18**

13.1 General 18

13.2 Preparation and conditioning of test samples 18

Annex A (informative) **Use of sunglass filters** **21**

Annex B (informative) **Electro-optical sunglare filters** **23**

Annex C (normative) **Unmounted filters used as replacement or alternative filters** **25**

Bibliography **29**

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).

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 (see 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.

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 ISO/TC 94 *Personal safety – Personal protective equipment*, Subcommittee SC 6, *Eye and face protection*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 85, *Eye-protective equipment*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 12312-1:2013), including ISO 12312-1:2013/Amd.1:2015, which has been technically revised.

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

— added a specification for the electro-optical filters;

— replaced the "local variations in refractive power" with the "spatial deviation";

— introduced the activation of photochromic lenses at 5 °C and 35 °C as optional information;

— extended the side protection to children's sunglasses mounting filter category 4 lenses.

A list of all parts in the ISO 12312 series can be found on the ISO website.

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.

Eye and face protection — Sunglasses and related eyewear —

Part 1: Sunglasses for general use

1 Scope

This document is applicable to all afocal (plano power) sunglasses and clip-ons for general use, including road use and driving, intended for protection against solar radiation.

Information on the use of sunglass filters is given in Annex A. Requirements for unmounted filters used as replacement or alternative filters are given in Annex C.

This document is not applicable to:

a) eyewear for protection against radiation from artificial light sources;

b) eye protectors intended for specific sports (e.g. ski goggles or other types – see ISO 18527 (all parts));

c) sunglasses that have been medically prescribed for attenuating solar radiation;

d) products intended for direct observation of the sun, such as for viewing a partial or annular solar eclipse, for which ISO 12312-2 applies;

e) products intended for occupational eye protection – see, for example, ISO 16321 (all parts).

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

ISO 8980-5, *Ophthalmic optics — Uncut finished spectacle lenses — Part 5: Minimum requirements for spectacle lens surfaces claimed to be abrasion-resistant*

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

ISO 12311:—[1)], *Personal protective equipment — Test methods for sunglasses and related eyewear*

ISO 18526-1:2020, *Eye and face protection — Test methods — Part 1: Geometrical optical properties*

ISO 18526-2:2020, *Eye and face protection — Test methods — Part 2: Physical optical properties*

ISO 18526-3:2020, *Eye and face protection — Test methods — Part 3: Physical and mechanical properties*

ISO 18526-4:2020, *Eye and face protection — Test methods — Part 4: Headforms*

3 Terms and definitions

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

1) In preparation. Stage at the time of publication, ISO/DIS 12311:2022.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
related eyewear
eyewear intended for protection in the same wavelength range as solar radiation but not necessarily originating from the Sun

3.2
electro-optical sunglare filter
electro-optical sunglass filter
filter that varies, by electro-optical means, its luminous transmittance depending upon the illuminance and spectral bands to which it is exposed or by manual control

Note 1 to entry: The change in luminous transmittance may be under automatic or manual control, or a combination. For example, where the luminous transmittances in the faded and darkened states are set manually, and transitions between them automatically. The luminous transmittance of the filter therefore varies within certain limits in response to the illuminance.

3.3
reaction time
t_r
‹electro-optical sunglare filter› response time of an *electro-optical sunglare filter* (3.2) to darken from its luminous transmittance in the *faded state* ($\tau_{v\,0}$) towards its luminous transmittance in the darkened state ($\tau_{v\,1}$) when activated or to fade from its *darkened state* towards its *faded state.*

Note 1 to entry: The reaction time is the time taken for the filter to change its luminous transmittance from the fully darkened or faded state by 90 % of the difference between the luminous transmittances in the faded and darkened states , i.e. from $\tau_{v\,0}$ to $\{\tau_{v\,0} - 0{,}9 \times (\tau_{v\,0} - \tau_{v\,1})\}$ or from $\tau_{v\,1}$ to $\{\tau_{v\,1} + 0{,}9 \times (\tau_{v\,0} - \tau_{v\,1})\}$,

where

$\tau_{v\,0}$ is the luminous transmittance of the lens or filter in the faded state;

$\tau_{v\,1}$ is the luminous transmittance of the lens or filter in the darkened state.

Note 2 to entry: Darkening and fading times may be different.

3.4
absorption ratio
A_R
‹electro-optical sunglare filter› ratio of the luminous transmittance in the faded state to that in the darkened state

Note 1 to entry: The absorption ratio, *AR*, is calculated from the following formula:

$$A_R = \frac{\tau_{v\,0}}{\tau_{v\,1}}$$

where

$\tau_{v\,0}$ is the *luminous transmittance* of the *lens* or *filter* in the faded state;

$\tau_{v\,1}$ is the *luminous transmittance* of the *lens* or *filter* in the darkened state.

3.5
default mode
luminous transmittance state of an *electro-optical sunglare filter* (3.2) when the power supply is disconnected or malfunctions

Note 1 to entry: The power supply can be mains electricity, a battery or a photovoltaic cell.

4 Construction and materials

4.1 Construction

When tested in accordance with ISO 18526-3:2020, 6.1, areas of the sunglass, including the frame and, if in a rimless or semi-rimless style, the edges of the filters, that may come into contact with the wearer during intended use shall be smooth and without sharp projections.

NOTE Manufacturers are recommended to use the range of screw sizes and threads used in sunglass frames as specified in ISO 11381.

4.2 Filter material and surface quality

When tested in accordance with ISO 18526-3:2020, 6.6, except in a marginal area 5 mm wide, sunglass filters shall have no material or machining defects within an area of 30 mm diameter centred on the reference point that could impair vision, e.g. bubbles, scratches, inclusions, dull spots, pitting, mould marks, notches, reinforced areas, specks, beads, water specks, pock marks, gas inclusions, splintering, cracks, polishing defects or undulations. If this 5 mm wide portion around the edge of the test sample intrudes into this circular area, then this intrusion shall be excluded from testing.

4.3 Physiological compatibility

Sunglasses shall be designed, manufactured and packaged in such way that, when used under normal conditions, they will not compromise the health or safety of the wearer. The risks posed by substances leaking or evaporating from the sunglasses that can come into prolonged contact with the wearer shall be reduced by the manufacturer to within the limit of any applicable regulatory requirement.

Special attention shall be given to substances that are allergenic, carcinogenic, mutagenic or toxic to reproduction.

NOTE 1 Excessive pressure due to a poor fit on the head, chemical irritation and allergy are known to produce reactions. Rare or idiosyncratic reactions to any material can occur and the individual wearer is well advised to avoid those types of frame materials.

Substances recommended for cleaning, maintenance or disinfection shall be known to be unlikely to have any adverse effect upon the wearer, when applied in accordance with the instructions given in the information to be supplied by the manufacturer.

Manufacturers/suppliers shall perform an appropriate risk analysis on potentially harmful substances contained in the sunglasses that, when the sunglasses are used under normal conditions, the health (and safety) of the wearer shall not be compromised.

The following are examples of documents that represent the appropriate information:

a) specification of the material(s);

b) safety data sheets relating to the materials;

c) information relating to the suitability of the materials for use in medical devices, or other relevant applications;

d) information relating to toxicological, allergenic, carcinogenic, toxic to reproduction, or mutagenic investigations on the materials.

NOTE 2 Attention is drawn to specific national regulations that restrict substances, e.g. Nickel release requirements.

4.4 Headforms

Unless the manufacturer specifies the headform(s) in accordance with ISO 18526-4 that is/are compatible with the sunglasses, the test methods where (a) headform(s) is/are required shall use the headform 1-M for adult's sunglasses and (1-C6) or (1-C12) for children's sunglasses as specified in ISO 18526-4 as the default.

5 Transmittance

5.1 Test methods

Transmittance values shall be determined in accordance with ISO 18526-2:2020, Clause 7. If the direction of measurement is not specified, then the direction of measurement shall be normal to the surface of the test sample at its geometrical centre.

The relative uncertainty of measured spectral transmittance shall be less than or equal to those given in ISO 18526-2:2020, Table 1, except for the range 100 % to 17,8 %, for which it shall be 2 % instead of 5 %

5.2 Transmittance and filter categories

Sunglass filters for general use shall be assigned to one of five filter categories based on the luminous transmittance at their reference point.

The ranges of luminous transmittance of these five categories are given by the values in Table 1. An overlap of the transmittance values shall be not more than ±2 % (absolute) between adjacent categories 0, 1, 2 and 3. There is no overlap in transmittance values between categories 3 and 4.

For gradient-tinted filters, the overlap in luminous transmittance allowed between categories shall be double that for uniformly tinted filters.

In the case of gradient-tinted filters, the transmittance value at the reference point shall be used to characterize the luminous transmittance and the category of the filter.

The maximum deviation for the declared luminous transmittance value shall be ±3 % absolute for the transmittance values falling in categories 0 to 3 and ± 30 % relative to the declared value for the transmittance values falling in category 4.

For gradient-tinted and/or mirrored filters, the maximum deviation for the declared luminous transmittance value shall be double that for uniformly tinted lenses.

When describing the transmittance properties of photochromic and electro-optical filters, two categories for transmittance values are generally used. These two values correspond to the faded state and to the darkened state of the filter.

Table 1 also specifies the UV requirements for sunglass filters for general use and, when the filters are claimed by the manufacturer to protect against IR radiation, the IR requirements.

Table 1 — Transmittance for sunglass filters for general use

Consumer label	Technical label	Requirements			
Usage	Filter category	Ultraviolet spectral range		Visible spectral range	Enhanced infrared absorption[a]
		Maximum value of solar UV-B transmittance τ_{SUVB} 280 nm to 315 nm	Maximum value of solar UV-A transmittance $\tau_{SUVA\ 380}$ 315 nm to 380 nm	Range of luminous transmittance $\tau_{V\ D65}$ 380 nm to 780 nm	Maximum value of solar IR transmittance τ_{SIR} 780 nm to 2 000 nm
Very limited reduction of sunglare	0	0,05 $\tau_{v\ D65}$	$\tau_{v\ D65}$	$\tau_{v\ D65} > 80\ \%$	$\tau_{v\ D65}$
Limited protection from sunglare	1	0,05 $\tau_{v\ D65}$	$\tau_{v\ D65}$	$43\ \% < \tau_{v\ D65} \leq 80\ \%$	$\tau_{v\ D65}$
Good protection against sunglare	2	1,0 % absolute or 0,05 $\tau_{v\ D65}$, whichever is greater	0,5 $\tau_{v\ D65}$	$18\ \% < \tau_{v\ D65} \leq 43\ \%$	$\tau_{v\ D65}$
High protection against sunglare	3	1,0 % absolute	$0{,}5\tau_{v\ D65}$	$8\ \% < \tau_{v\ D65} \leq 18\ \%$	$\tau_{v\ D65}$
Very high protection against extreme sunglare, e.g. at sea, over snowfields, on high mountain, or in desert	4	1,0 % absolute	1,0 % absolute or 0,25 $\tau_{V\ D65}$, whichever is greater	$3\ \% < \tau_{v\ D65} \leq 8\ \%$	$\tau_{v\ D65}$

NOTE Some requirements in different standards stipulate 400 nm as the long wavelength limit of UV-A.

[a] Only applicable to sunglass filters claimed by the manufacturer as a protection against infrared radiation.

5.3 General transmittance requirements

5.3.1 Uniformity of luminous transmittance

The relative difference in the luminous transmittance value between any two points of the filter within a circle (30 ± 1) mm in diameter centred on the reference point shall not be greater than 15 % (relative to the higher value), except for category 4 where it shall not be greater than 20 %. If a 5 mm wide portion around the edge of the test sample intrudes into this circular area, then this intrusion shall be excluded from testing.

The geometric or boxed centre takes the place of the reference point if this is not known.

In the case of mounted gradient filters, this requirement shall be limited to sections parallel to the line connecting the two reference points.

For mounted filters, the relative difference between the luminous transmittance value of the filters at the reference point for the right and left eyes shall not exceed 20 % for gradient-tinted filters and 15 % for all other types (relative to the lighter filter).

Changes of luminous transmittance that are caused by thickness variations due to the design of the filter are permitted. For verification, the test method in ISO 18526-2:2020, 7.4.1.4 shall be used.

5.3.2 Requirements for road use and driving

5.3.2.1 General

Filters suitable for road use and driving shall be of categories 0, 1, 2 or 3 and shall additionally meet the following two requirements.

a) Spectral transmittance. The spectral transmittance of filters suitable for road use and driving for wavelengths between 475 nm and 650 nm shall be not less than 0,20 $\tau_{v\,D65}$.

b) Detection of signal lights. The relative visual attenuation quotient Q of filters of categories 0, 1, 2 and 3 suitable for road use and driving shall be not less than 0,80 for red signal light and not less than 0,60 for yellow, green and blue signal lights. The relative visual attenuation quotient for signal light detection, Q_{signal}, shall be calculated in accordance with ISO 18526-2:2020, Clause 11 (spectral distribution of radiation emitted by incandescent lights).

NOTE Calculations using the values for quartz-halogen lamps and LED signals will give different results. LED signal technology is still evolving, so specific data is not yet available.

5.3.2.2 Road use (including driving) in twilight or at night

Sunglass filters with a luminous transmittance of less than 75 % shall not be used in twilight or at night for road use (including driving). In the case of photochromic sunglass filters, this requirement applies when tested in accordance with ISO 18526-2:2020, 16.3.2.

5.3.3 Wide-angle scatter

When tested in accordance with ISO 18526-2:2020, 14.1, at the reference point, the wide-angle scatter of the filters in the condition as supplied by the manufacturer shall not exceed the value of 3 %.

5.3.4 Additional transmittance requirements for specific filter types

5.3.4.1 Photochromic filters

The luminous transmittance of a photochromic sunglass filter depends primarily on the amount of radiation reaching it and the ambient temperature. The actual conditions of use may result in luminous transmittances that are markedly different from those expressed by the filter categories and measured under test conditions. The categories of the photochromic filter shall be determined by its luminous transmittance in its faded state, $\tau_{v\,0}$, and its luminous transmittance in its darkened state, $\tau_{v\,1}$, achieved after 15 min ± 5 s irradiation according to ISO 18526-2:2020, Clause 16. In both states, the requirements specified in 5.2 and, if applicable, the requirements specified in 5.3.2, shall be met. For photochromic filters, $\tau_{v\,0}/\tau_{v\,1}$ shall be ≥1,25.

Optionally, the luminous transmittance can be measured also at temperatures of 5 °C and 35 °C.

5.3.4.2 Polarizing filters

If the filters in the sunglasses are claimed to be polarizing, when tested in accordance with ISO 18526-2:2020, Clause 15. The sunglass has to be positioned with the pantoscopic angle and the face form angle “as worn” , the filters shall be fitted in the frame so that their planes of transmission do not deviate from the vertical, or from the specified direction if different from the vertical, by more than ±5°. Additionally, any misalignment between the planes of transmission of the left and right filters shall not be greater than 6°.

In the case of clip-ons, the misalignment shall be tested in the position assumed to be taken when mounted on the spectacles or sunglasses.

When tested in accordance with ISO 18526-2:2020, Clause 15, the polarizing efficiency shall be >78 % for filter categories 2, 3, 4 and > 60 % for filter category 1. Filters of category 0 do not have any useful polarizing effect.

NOTE The polarizing efficiency values of 78 % and 60 % are approximately equal to polarizing ratio values of 8:1 and 4:1 respectively.

5.3.4.3 Gradient-tinted filters

5.3.4.3.1 General

All parts of a gradient-tinted filter within a 10 mm ± 1 mm radius circle centred on the reference point shall comply with the transmittance requirements in 5.2 and, for filters suitable for road use and driving, 5.3.2 (except for the filter category which is defined by the transmittance at the reference point). Uniformity of transmission is subject to the requirements of 5.3.1.

5.3.4.3.2 Determination of the filter category

The filter category of gradient-tinted filters shall be determined by the luminous transmittance value at the reference point.

The filter category determined at the reference point shall be used to define whether the filters are suitable for road use and driving according to 5.3.2.

5.3.4.4 Electro-optical sunglare filter, electro-optical sunglass filter

5.3.4.4.1 General

The categories of an electro-optical filter shall be determined by its luminous transmittance in its faded state $\tau_{v\,0}$ and its luminous transmittance in its darkened state $\tau_{v\,1}$ in accordance with ISO 18526-2:2020, 17.11 and Annex E. In both states, the filter shall comply with the requirements specified in 5.2, and, if applicable, the requirements specified in 5.3.2.

In the case of electro-optical filters with manual control, the faded and darkened state have to be set manually as specified by the manufacturer in lieu of illuminance.

Annex B gives further information on electro-optical filters.

5.3.4.4.2 Default mode

Electro-optical sunglare filters, when in the default mode, shall comply with all other relevant requirements.

5.3.4.4.3 Reaction time

The reaction time of electro-optical filters to change from the faded (high transmittance) state to the darkened (low transmittance) state, or, from the darkened state to the faded state, shall be measured when changing from (500 ± 50) lx to (50 000 ± 5 000) lx or vice-versa in accordance with ISO 18526-2:2020, 17.11 and Annex E. The reaction time shall be expressed in seconds.

The measurements shall be taken at a temperature of (23 ± 2) °C and optionally also at (5 ± 2) °C and (35 ± 2) °C.

5.3.4.4.4 Photosensitive seizures

An inherent technology-specific property of an electro-optical filter or external flashing sunlight may, under very rare circumstances, trigger the light detector of an electro-optical filter and provoke

photosensitive seizures, such as outlined in ISO 9241-391. Electro-optical filters are, in view of their reaction time characteristics, not for use by individuals who are susceptible to photosensitive seizures.

5.3.4.4.5 Combined uniformity and angular dependence of luminous transmittance

The combined uniformity and angular dependence of the luminous transmittance in the darkened state of electro-optical filters shall comply with the requirements of Table 2 for the angles of incidence between 0° and ±30°. The darkened state transmittance shall be tested according to ISO 18526-2:2020, 17.9 in the as-worn position.

Table 2 — Combined uniformity and angular dependence of luminous transmittance

Filter category	Range of luminous transmittance $\tau_{v\,D65}$	Maximum value of C_{15} %	Maximum value of C_{30} %	Maximum value of ΔP %
0	$\tau_{v\,D65} > 80$ %	40	60	15
1	43 % < $\tau_{v\,D65} \leq 80$ %	40	60	15
2	18 % < $\tau_{v\,D65} \leq 43$ %	50	70	20
3	8 % < $\tau_{v\,D65} \leq 18$ %	50	70	30
4	3 % < $\tau_{v\,D65} \leq 8$ %	60	80	40

5.3.4.4.6 Narrow angle scatter

Narrow angle scatter shall be evaluated in accordance with ISO 18526-2:2020, 14.2. The reduced luminance coefficient (l^*) of electro-optical sunglare filters shall not exceed 3,0 (cd/m^2)/lx in their faded and darkened states.

NOTE Narrow angle scattering of light can affect the visual acuity of the wearer, given the molecular size, the optical anisotropy and eventually the dopant dyes used in controlling the luminous transmittance of electro-optical sunglare filters.

5.3.5 Claimed transmittance properties

The test methods are as specified in 5.1.

For reference, see Annex A.

5.3.5.1 Solar Blue-light absorption/transmittance

5.3.5.1.1 Solar Blue-light absorption

In the case where it is claimed that a filter has x % solar blue-light absorption, the solar blue-light transmittance, τ_{SB}, of the filter shall not exceed (100,5 - x) %.

5.3.5.1.2 Solar Blue-light transmittance

In the case where it is claimed that a filter has less than x % solar blue-light transmittance, the solar blue-light transmittance, τ_{SB}, of the filter shall not exceed (x + 0,5) %.

5.3.5.2 UV absorption/transmittance

5.3.5.2.1 General

Requirements for the transmittance of filters for sunglasses in UV-A and UV-B shall be as given in Table 1. In cases where it is claimed that a product reaches a certain percentage of UV absorption or UV transmittance better than the requirement in Table 1, the relevant requirement(s) below shall apply.