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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

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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).

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.

5.3.5.2.2 Solar UV absorption

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

5.3.5.2.3 Solar UV transmittance

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

5.3.5.2.4 Solar UV-A absorption

In the case where it is claimed that a filter has *x* % solar UV-A absorption, the solar UV-A transmittance of the filter $\tau_{SUVA\ 380}$ shall not exceed (100,5 - *x*) %.

5.3.5.2.5 Solar UV-A transmittance

In the case where it is claimed that a filter has less than *x* % solar UV-A transmittance, the solar UV-A transmittance of the filter $\tau_{SUVA\ 380}$ shall not exceed (*x* + 0,5) %.

5.3.5.2.6 Solar UV-B absorption

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

5.3.5.2.7 Solar UV-B transmittance

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

5.3.5.3 Antireflective coated sunglasses

In the case where sunglasses are claimed to be antireflective coated, the luminous reflectance $\rho_{v\ D65}$ of the filter as measured from the eye-side of the filter according to ISO 18526-2:2020, Clause 13 with the specular-included geometry specified in ISO 18526-2:2020, 12.2.2, and using CIE standard illuminant D65 according to ISO 11664-2, shall be less than 2,5 %.

In case of photochromic filters, the requirement for antireflective coated sunglasses is measured only in the faded state.

5.3.5.4 Reduced reflection coated sunglasses

In the case where sunglasses are claimed to have reduced reflections, the luminous reflectance ρ_v of the filter, measured from the eye-side according to ISO 18526-2:2020, Clause 13 with the specular-included geometry specified in ISO 18526-2:2020, 12.2.2, and using CIE standard illuminant D65 according to ISO 11664-2, shall be less than 8 %.

5.3.5.5 Enhanced infrared absorption

Sunglass filters for which enhanced infrared absorption is claimed shall meet the requirements as given in column 6 of Table 1.

6 Refractive power

6.1 Spherical and astigmatic power

The requirements apply in the "as-worn" position and the sunglass shall be tested according to ISO 18526-1:2020, 6.1.

The spherical power and astigmatic power shall not exceed the tolerances given in Table 3, where F_1 and F_2 are the powers in the two principal meridians of the sunglass filter.

Table 3 — Spherical and astigmatic power

Spherical power	Astigmatic power
Mean value of the focal powers (F_1, F_2) in the two principal meridians. $(F_1 + F_2)/2$ dioptres (D)	Absolute difference between the focal powers (F_1, F_2) in the two principal meridians. $\lvert F_1 - F_2 \rvert$ dioptres (D)
±0,12	≤0,12

The difference between the spherical powers of the right and the left filters in the mounted state shall not exceed 0,18 dioptres.

6.2 Spatial deviation

If during the measurements in accordance with ISO 18526-1:2020, 6.1, a doubling or other aberration of the image is observed, then the plano filter shall be further assessed in accordance with ISO 18526-1:2020, 6.3. The plano filter shall be free from irregular distortions likely to impair vision.

6.3 Prism imbalance (relative prism error)

The complete sunglass shall be tested in the "as-worn" position according to ISO 18526-2:2020, 6.2.

For adults' sunglasses, use the diaphragm LB_2 with X^b = (32,0 ± 0,2) mm or one based on the headform utilized.

For children's sunglasses, use the diaphragm LB_2 with X^b = (26,0 ± 0,2) mm in the case of child headform 1-C6 or X^b = (29 ± 0,2) mm in case of child headform 1-C12. This corresponds to the interpupillary distance of 52 mm of the child headform 1-C6 and the interpupillary distance of 58 mm of the child headform 1-C12.

Alternatively, it is also possible to use a diaphragm with a different X^b if the manufacturer specifies it, or a diaphragm based on the headform specified by the manufacturer, according to ISO 18252-4.

The prismatic power difference shall not exceed the values in Table 4.

Table 4 — Prism imbalance

Horizontal		Vertical
Base out prism dioptres (Δ)	**Base in** prism dioptres (Δ)	prism dioptres (Δ)
1,00	0,25	0,25

7 Robustness

7.1 Minimum robustness of filters

For complete sunglasses, including the filter portion of those where the sunglass frame and filter are integral parts of each other, when tested as specified in ISO 18526-3:2020, 7.2.1, none of the following defects shall appear.

a) Filter fracture. A filter is considered to have fractured when

   — it cracks through its entire thickness into two or more pieces, or

   — a trained observer can see, when viewing without magnification but wearing the appropriate correction, if any, for near vision, that either a piece of material that has become detached from the filter surface or a corresponding surface defect.

b) Filter deformation. A filter is considered to have been deformed if a mark appears on the contact indicating medium on the opposite side to that contacted by the ball.

For clip-ons neither a) nor b) are applicable.

This test is not necessary if the sunglasses meet 7.3 or 7.6.

Regulations in some countries can require certain robustness tests, e.g. in US CFR21 801.410 impact resistance test.

7.2 Frame deformation and retention of filters

When tested in accordance with ISO 12311:—, Clause 6, the frame fitted with filters shall not:

a) fracture or crack at any point;

b) be permanently deformed from its original configuration by more than 2 % of the distance, *c*, between the boxed centres of the sunglass frame, that is the residual deformation *x* shall not exceed 0,02*c* (see ISO 12311:—, Figure 18);

c) neither filter shall be displaced from the frame.

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

When tested in accordance with ISO 18526-3:2020, 7.3.1, using a steel ball of nominal diameter 16 mm and mass not less than 16 g dropped from a height of $\left(1{,}27_{0}^{+0{,}03}\right)$ m above its upper surface, the filter shall not fracture. A filter is considered to have fractured when

— it cracks through its entire thickness into two or more pieces, or

— a trained observer can see, when viewing without magnification but wearing any appropriate correction for near vision, either a piece of material that has become detached from the filter surface or a corresponding surface defect

— the test ball passes through the filter, or

— the filter is displaced from the frame.

This requirement also applies to the filter portions of complete sunglasses where the frame and the filters are integral parts of each other.

7.4 Increased endurance of sunglasses (optional specification)

When an increased endurance is claimed, a complete sunglass is tested according to ISO 12311:—, 9.7.

The sunglass shall not:

a) fracture at any point;

b) be permanently deformed (the sunglass is considered to be permanently deformed if the original distance between the sides at the measuring points has changed by more than 5 mm after 500 cycles);

c) except for sunglasses with frames fitted with sprung joints, require more than light finger pressure to open and close the sides;

d) for sunglasses with frames that are not fitted with sprung joints, have a side that closes under its own weight at any point in the opening/closing cycle, or for sides fitted with a sprung joint, the side shall still support its weight in the open position (i.e. opened to the fullest natural extent without activating the spring mechanism).

7.5 Resistance to perspiration (optional specification)

When the sunglass is tested in accordance with ISO 12311:—, 9.10, there shall be

a) no spotting or colour change (except for loss of gloss) anywhere on the frame, excluding joints and screws, after testing for 8 h, and

b) no corrosion, surface degradation or separation of any coating layer on the parts liable to come into prolonged contact with the skin during wear, i.e. the insides of the sides, bottom and lower parts of the rim and the inside of the bridge, after testing for a total of 24 h.

Such defects shall not be visible to a trained observer under the inspection conditions described in ISO 12311:—, 6.2.

If the sunglass frame is made from natural materials and the manufacturer recommends use of a product such as a cream or wax for its maintenance, then, before testing, the frame(s) shall be prepared with this product in accordance with the manufacturer's instructions. At the end of the test, if the frame fails to meet this requirement when checked for colour change or surface degradation, use the product and wait for one day before checking again for colour change or surface degradation. If the frame has recovered its original colour and surface finish, the sunglass frame is considered to have passed the test; if the frame remains discoloured, the frame is considered to have failed the test.

If the sunglass frame is fitted with readily interchangeable soft nosepads or endcovers (side tips), and at the end of the 24 h test the frame would have passed the test but these components have changed appearance but without surface degradation, then the sunglass frame is considered to have passed the test.

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

If an increased level of impact resistance strength is claimed, when tested as specified in ISO 18526-3:2020, 7.3.1 or 7.3.2, the filter shall not fracture.

— Strength level 2: using a steel ball of nominal diameter 22 mm and mass not less than 43 g dropped from a height of $\left(1{,}27_{0}^{+0{,}03}\right)$ m above its upper surface.

— Strength level 3: using a steel ball of nominal diameter 6 mm and mass not less than 0,86 g at a speed of $\left(45_{0}^{+1{,}5}\right)$ m/s impacting above its front surface.

A filter is considered to have fractured when

— it cracks through its entire thickness into two or more pieces, or

— a trained observer can see, when viewing without magnification but wearing any appropriate correction for near vision, either a piece of material that has become detached from the filter surface or a corresponding surface defect,

— if applicable, the test ball passes through the filter, or

— the filter shall not be displaced from the frame.

If this requirement is met, testing according to 7.1 (minimum robustness) is not necessary.

The maximum level of impact strength that can be claimed is 3.

This requirement also applies to the filter portions of complete sunglasses where the frame and the filters are integral parts of each other.

8 Resistance to solar radiation

Following irradiation as specified in ISO 18526-3:2020, 6.8.2, the relative change in the luminous transmittance of the filters referred to the initial $\tau_{v\ D65}$ (for photochromic filters and electro-optical filters, in the faded state) shall be less than or equal to the values shown in Table 5.

Table 5 — Relative change in the luminous transmittance

Filter category	Relative change in the luminous transmittance $\Delta\tau_v/\tau_v = (\tau_v' - \tau_v)/\tau_v$
0	±3 %
1	±5 %
2	±8 %
3	±10 %
4	±10 %
NOTE τ_v' is the luminous transmittance after irradiation.	

In addition, the following shall be met:

a) the wide-angle scatter shall not exceed the value of 3 %;

b) for electro-optical filters, the reduced luminance coefficient (l^*) shall not exceed 3,0 (cd/m^2)/lx in their faded and darkened states (narrow angle scatter).

c) for photochromic filters, $\tau_{v\ 0}/\tau_{v\ 1}$ shall be ≥1,25;

d) the UV requirements for the initial filter category shall continue to be satisfied; and

e) all claimed transmittance requirements.

9 Resistance to ignition

When sunglasses are tested in accordance with ISO 18526-3:2020, 6.10, they shall not ignite or continue to glow after withdrawal of the test rod.

10 Resistance to abrasion (optional specification)

Filters or filter surfaces that are claimed to provide a basic level of abrasion resistance shall meet the requirements of ISO 8980-5.

A filter that is claimed to be abrasion resistant shall meet the requirement on both surfaces. If only one surface is claimed to be abrasion resistant, it shall be specified on the information that is supplied with the product.

The surface form of the filter is restricted for testing; however, test results on one surface form of the filter are applicable to claims for filters and filter surfaces with identical properties other than surface curvature.

NOTE This document does not attempt to define the properties of filter surfaces with abrasion resistance claimed to be superior to the basic level.

11 Protective requirements

11.1 Coverage area

When viewed from the front, the sunglasses (filter plus frame) shall cover two ellipses with a horizontal diameter of (40 ± 1) mm and a vertical diameter of (28 ± 1) mm, the centres of which are separated by 64 mm (1-M headform) or as defined by the headform utilized, and symmetrically placed on each side of the centre of the bridge of the frame, i.e. its vertical symmetry axis. The vertical positioning of the sunglass is not restricted.

The sunglass shall prevent UV radiation, as specified in Table 1 and incident normally on the sunglass front, from reaching the defined elliptical areas. The covered area needs to be protected at least from UV radiation as in Table 1.

For sunglasses intended to be worn by children, the sunglasses shall cover two ellipses with a horizontal diameter of 34 mm and a vertical diameter of 24 mm, the centres of which are separated by 52 mm (1-C6 headform) or 58 mm (1-C12 headform) and symmetrically placed on either side of the centre of the bridge of the frame.

A different interpupillary distance based on the headform specified by the manufacturer in accordance with ISO 18526-4 to be appropriate for the sunglass can be used.

11.2 Temporal protective requirements

Very dark special purpose sunglasses (filter category 4) shall provide temporal shielding such that the ultraviolet transmittances of the sunglass filter, frame and side comply with the requirements for category 4 filters in Table 1 in the area PPTT shown in Figure 1, defined as follows:

a) in the line of intersection of the frontal plane (tangent to the corneal vertex) with the inner surface of the sunglass structure, to elevations of 11 mm (9 mm for sunglasses intended to be worn by children with an interpupillary distance up to 54 mm) above and below the horizontal plane through the reference point;

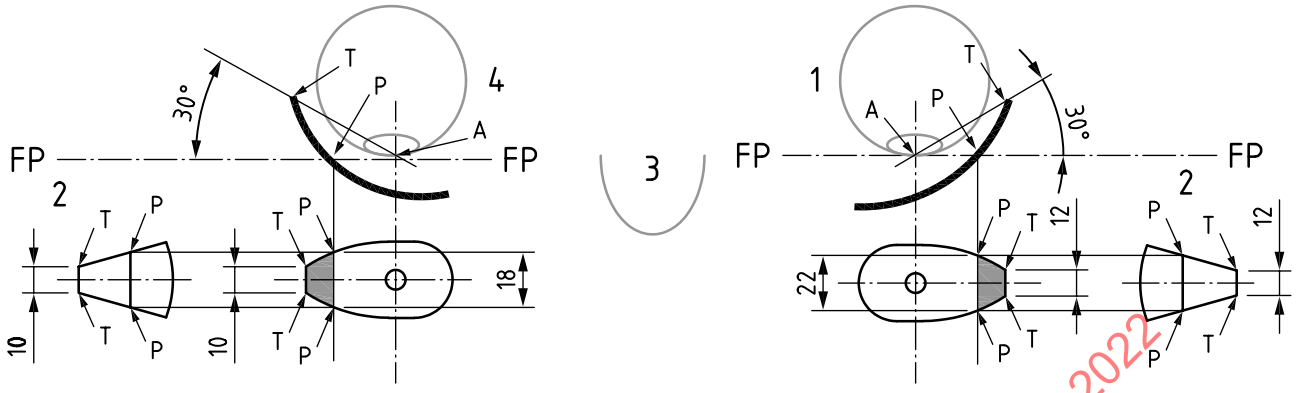
and

b) in a vertical line in the inner structure of the sunglass that is 30° back from the frontal plane and relative to the corneal vertex, and to elevations of 6 mm (5 mm for sunglasses intended to be worn by children with an interpupillary distance up to 54 mm) above and below the horizontal plane through the reference point.

The relevant dimensions on the chosen 1-C6 and 1-C12 shall be scaled in the ratio of the interpupillary dstance.

Tolerance on sizes is ±1mm

Dimensions in millimetres



a) Dimensions for children **b) Dimensions for adults**

Key

1	left eye
2	details of frontal and lateral views
3	nose
4	right eye
1, 3 and 4	viewed from above
FP -FP	frontal plane – vertical plane tangent to the apex of the cornea
A	corneal vertex
P – P	minimum height of sunglass at the intersection with the frontal plane
T – T	minimum height of sunglass at the temple, 30° behind frontal plane relative to the apex of the cornea

Figure 1 — Required temporal coverage for category 4 sunglasses

12 Information and labelling

12.1 Information to be supplied with each pair of sunglasses

The manufacturer shall provide information for the user with each pair of sunglasses. This information shall be in the form of markings on the frame or separate information on labels, packaging, etc. that accompanies the sunglasses at the point of sale. Where pictograms are used, an explanation of the significance of these pictograms shall also be available.

National regulations with respect to the content of the user information should be observed.

The user information shall contain the following items:

a) Identification of model;

b) Name and address of the manufacturer;

c) Reference to this document;

d) Type of filter, if photochromic, polarizing, electro-optical or a combination of these;

e) Number of the filter category (in both the faded and darkened states for photochromic filters and electro-optical filters);

NOTE In some regions, i.e. Europe, regulations require this to be marked on the frame or on the filter.

f) Description of the filter category in the form of a symbol and/or verbal description given in the usage column in Table 6. The minimum height of the symbols shall be 5 mm;

g) Restrictions of use, which shall include at least the following:

   1) not for direct observation of the sun;

   2) not for protection against artificial radiation sources;

   3) not for use as eye protection against mechanical impact hazards (for products not satisfying the requirements of 7.3 or 7.6);

   4) electro-optical sunglare filters/electro-optical sunglass filters are not for use by individuals who are susceptible to photosensitive seizures;

   5) any other restrictions deemed appropriate to be communicated by the manufacturer, e.g. increased or decreased transmittance of photochromic sunglasses due to high or low temperatures or to reduced light conditions.

h) When the filter does not meet the requirements for road use and driving or is a filter category 4, the following warning: "Not suitable for road use and driving" in the form of either of the symbols shown in Figure 2 and/or in writing. The minimum height of the symbol shall be 5 mm;

i) When the filter has a luminous transmittance lower than 75 % and higher than 8 %, the following warning: "Not suitable for driving in twilight or at night" or "Not suitable for driving at night or under conditions of dull light". The same warning applies to photochromic filters for which the luminous transmittance in the faded condition is lower than 75 %;

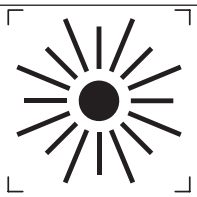
j) If relevant, instructions for care and cleaning. If the wrong choice of cleaning product could damage the sunglasses, then a list of damaging products not suitable for cleaning should be provided.

ISO 7000-2952A

ISO 7000-2952B

Figure 2 — Symbol: "Not suitable for road use and driving"

Table 6 — Description of filter categories and assigned symbols

Filter category	Description	Usage	Symbol
0	Light tint sunglasses	Very limited reduction of sunglare Limited UV protection	 IEC 60417-5955
1		Limited protection against sunglare Moderate UV protection	 ISO 7000-2948
2	General purpose sunglasses	Good protection against sunglare Good UV protection	 ISO 7000-2949
3		High protection against sunglare Good UV protection	 ISO 7000-2950
4	Very dark special purpose sunglasses, very high sunglare reduction	Very high protection against extreme sunglare, e.g. at sea, over snowfields, on high mountains, or in desert Good UV protection	 ISO 7000-2951
NOTE 1 The wording and/or the pictograms can be used. NOTE 2 Where superior numerical claims are made according to 5.3.5.2.2 or 5.3.5.2.3, the UV information may be omitted.			

12.2 Additional information

The following information shall be available from the manufacturer on request.

a) An explanation of the trademarks that are not universally recognized or foreseen by the users of this document;

b) The position of the reference point when different from the one defined in this document;

c) Transmittance requirements applicable to this product;

d) Polarizing efficiency in cases of polarizing filters;

e) The base material of filters and frame.

NOTE In some countries, the country of origin can be mandatory.

13 Selection of test samples

13.1 General

The minimum level of conformity testing requires samples to be selected at random. These specimens shall be selected by the manufacturer or its representative, and shall be identified as defined in Table 7, and shall be conditioned as described in 13.2 before testing.

NOTE When conformity to this document is claimed, the manufacturer or its representative has the responsibility to ensure that conformity of the product with this document is valid during the lifetime of manufacture, and not only at its first launch on the market.

13.2 Preparation and conditioning of test samples

Immediately before starting the series of tests, the test samples shall be conditioned for at least 4 h at an ambient temperature of 23 °C ± 5 °C, in the condition received from the manufacturer or supplier, without realignment, adjustment or lubrication.

The testing schedule in Table 7 shall be applied to type testing of complete sunglasses with the same filter type. At least 4 (6 if the nickel release test is to be performed) samples are required for testing. If testing for optical requirements , more than 8 samples may be necessary. See Table 8 for testing schedule for unmounted filters used as replacement or alternative filters and Table 9 for testing schedule for complete clip-ons.

Table 7 — Testing schedule for complete sunglasses

Order of testing	Requirements	According to clause/ subclause	Sunglasses number					
			1	2	3	4	5 to 6	7 to 8
1	Construction	4.1	+					
2	Filter material and surface quality	4.2	+ 1)					
3	Physiological compatibility	4.3					+ 3)	
4	Transmittance and filter categories	5.2	+ 1)					
5	General transmittance requirements	5.3	+ 1)					
6	Refractive power	Clause 6		+ 1)				
7	Minimum robustness of filters	7.1			+ 1)			
8	Frame deformation and retention of filters	7.2				+		
9	Impact resistance of sunglasses, strength level 1 (optional specification)	7.3			+ 1) 2)			

Explanation of the symbols:

\+ Testing to be carried out on the indicated specimen.

Empty field: No testing specified.

1) Test both right and left filters.

2) If this specification is met, testing according to 7.1 (minimum robustness) is not necessary.

3) If nickel release is tested, that testing is carried out on those parts of metal and combination sunglass frames that come into direct and prolonged contact with the skin of the wearer.

4) Left filter from sample 8 and right filter from sample 7.

5) Left filter from sample 7 and right filter from sample 8.

Table 7 *(continued)*

Order of testing	Requirements	According to clause/ subclause	Sunglasses number					
			1	2	3	4	5 to 6	7 to 8
10	Increased endurance of sunglasses (optional specification)	7.4				+		
11	Resistance to perspiration (optional specification)	7.5		+				
12	Impact resistance of sunglasses, strength level 2 or 3 (optional specification)	7.6						+ 4) 2)
13	Resistance to solar radiation	Clause 8	+ 1)					
14	Resistance to ignition	Clause 9			+			
15	Resistance to abrasion (optional specification)	Clause 10						+ 5)
16	Coverage area	11.1			+			
17	Temporal protective requirements	11.2			+			
18	Information and labelling	Clause 12	+					

Explanation of the symbols:

\+ Testing to be carried out on the indicated specimen.

Empty field: No testing specified.

1) Test both right and left filters.

2) If this specification is met, testing according to 7.1 (minimum robustness) is not necessary.

3) If nickel release is tested, that testing is carried out on those parts of metal and combination sunglass frames that come into direct and prolonged contact with the skin of the wearer.

4) Left filter from sample 8 and right filter from sample 7.

5) Left filter from sample 7 and right filter from sample 8.

Table 8 — Testing schedule for unmounted filters used as replacement or alternative filters

Order of testing	Requirements	According to clause/ subclause	Pairs of filters covering each eye or filters covering both eyes			
			1	2	3	4
1	Construction	4.1	+			
2	Filter material and surface quality	4.2	+ 1)			
4	Transmittance and filter categories	5.2	+ 1)			
5	General transmittance requirements	C.4, C.5	+ 1)			
6	Refractive power	C.1, C.2, C.3		+ 1)		
7	Minimum robustness of filters	C.6			+ 1)	
8	Impact resistance of sunglasses, strength 1 (optional specification)	C.7			+ 1) 2)	
9	Resistance to solar radiation	Clause 8	+ 1)			
10	Resistance to ignition	Clause 9			+	

Explanation of the symbols:

\+ Testing to be carried out on the indicated specimen

Empty field: No testing specified

1) Test both right and left filters

2) If this specification is met, testing according to C.6 (minimum robustness) is not necessary

Table 8 *(continued)*

Order of testing	Requirements	According to clause/ subclause	Pairs of filters covering each eye or filters covering both eyes			
			1	2	3	4
11	Resistance to abrasion (optional specification)	Clause 10				+

Explanation of the symbols:

\+ Testing to be carried out on the indicated specimen

Empty field: No testing specified

1) Test both right and left filters

2) If this specification is met, testing according to C.6 (minimum robustness) is not necessary

Table 9 — Testing schedule for complete clip-ons

Order of testing	Requirements	According to clause/ subclause	Clip-ons number				
			1	2	3	4	5 to 6
1	Construction	4.1	+				
2	Filter material and surface quality	4.2	+ 1)				
3	Physiological compatibility	4.3					+ 3)
4	Transmittance and filter categories	5.2	+ 1)				
5	General transmittance requirements	5.3	+ 1)				
6	Refractive power	Clause 6		+ 1)			
7	Minimum robustness of filters	7.1			+ 1)		
8	Resistance to perspiration (optional specification)	7.5		+			
9	Resistance to solar radiation	Clause 8	+ 1)				
10	Resistance to ignition	Clause 9			+		
11	Resistance to abrasion (optional specification)	Clause 10				+ 1)	
12	Coverage area	11.1		+			
13	Temporal protective requirements	11.2		+			

Explanation of the symbols:

\+ Testing to be carried out on the indicated specimen.

Empty field: No testing specified.

1) One filter from the left and one filter from the right eye.

3) Nickel release testing is conducted for those parts of metal and combination sunglass frames that come into direct and prolonged contact with the skin of the wearer.

Annex A
(informative)

Use of sunglass filters

A.1 Daytime

The main purposes of sunglass filters are to protect the human eye against excessive solar radiation, to reduce eye strain and to improve visual perception. The choice of filter depends on the ambient light level and the individual's sensitivity to glare. If in doubt, professional ophthalmic advice should be sought. In addition to reducing visible glare, sunglasses should protect the eyes from solar ultraviolet radiation. These requirements are taken into account for filters complying with this document. Filter shape and size are often matters of fashion but in some circumstances wrap-around filters in sunglasses or side shields are appropriate. Protection from solar radiation reflected from the environment is required in category 4 filters and is recommended any sunglasses to assist in the prevention of pterygium and cataract.

WARNING — It should be noted that direct viewing of the sun is hazardous because of the high level of light. Only filters complying with ISO 12312-2 are suitable for direct observation (e.g. during eclipses).

Table 6 summarizes the filter categories and their description.

A.2 Reduced light

In reduced light, sunglass filters intended for bright daylight reduce visual perception. The lower the luminous transmittance value of the sunglass filter, the greater the possible impairment of vision. Sunglass filters with a luminous transmittance of less than 75 % are not suitable for use in twilight or at night. Photochromic sunglass filters are considered suitable for use in twilight or at night if they reach a luminous transmittance of 75 % or more after testing as follows:

a) filters are conditioned as described in ISO 18526-2:2020, Clause 16;

b) filters are then exposed to (15 000 ± 1 500) lx at (23 ± 1) °C for 15 min;

c) filters are then stored in the dark at (23 ± 1) °C for 60 min.

A.3 Photochromic sunglass filters

The luminous transmittance of photochromic sunglass filters depends primarily on the amount of radiation on the filters and the temperature. The specific conditions of use may result in luminous transmittances that differ from those expressed by the filter categories quoted. These are in particular:

a) decreased transmittance, $\tau_{v\,w,}$ in low temperatures, e.g. in winter;

b) increased transmittance, $\tau_{v\,s}$, in high temperatures, e.g. in high summer, the tropics;

c) increased transmittance, $\tau_{v\,a}$, in reduced light levels, e.g. when driving.

A.4 Solar blue-light risk

If solar radiation on the ground is evaluated using current limit values, even under extreme illuminance conditions except for snow surfaces, a risk from acute exposure to the blue part of the spectrum is not

to be expected. Therefore, this document contains no mandatory specifications in this respect. Opinion is divided whether there could be a long-term risk. In order to allow a correct description of blue-light attenuation by sunglass filters, a definition of the solar blue-light transmittance is included in ISO 4007 and claims of blue-light protection may be made according to 5.3.5.1.

A.5 Infrared risk

If solar radiation on the ground is evaluated using current limit values, even under extreme illuminance conditions, no risk by the infrared part of the radiation is to be expected. Hence this document contains no mandatory specifications in this respect. Prolonged exposure in desert environments may, however, pose some risk according to some scientists. In order to allow a correct description of solar infrared attenuation by sunglass filters, a definition of the solar infrared transmittance is included in ISO 4007.

A.6 UV (ultraviolet) risk

Humans have a natural aversion response to bright light that limits outdoor exposure when one is not wearing sunglasses. This aversion response, which results in squinting, limits ocular exposure greatly. Sunglasses without side shields may permit exposure of the eye to UV reflected from the environment. This is of biological significance due to the Coroneo effect[32]. The analytic characterization of ultraviolet skylight[21], as adapted for calculating corneal irradiance[22], show that the largest influence on ocular exposure in temperate regions is the seasonal variation of solar irradiance as adjusted by ground reflectance and the time from solar noon[23]. Diffuse sky radiation decreases with increasing altitude[26][24] and corneal irradiance varies significantly with lid opening and ground cover[27]. The adopted transmittance limits are based on calculations of the biologically weighted exposure doses. The ultraviolet transmittance limits for sunglasses will restrict these doses to below the recognized safe limit even for exceptional daily exposure except over snow[23][18].Further margins of safety to account for tropical conditions or walking over snowfields in late spring have been incorporated. This has been done by adding additional safety factors to those implicit in the exceptional exposure experiences at mid-latitudes over normal terrain.

A.7 Road use and driving

This document specifies the requirements for filters for road use and driving in normal conditions, where category 4 sunglasses are considered unsuitable for road use and driving. Nevertheless, in extremely high luminance conditions, such as desert and snowfields under full sunlight, the use of category 4 filters may be recommended.

Annex B
(informative)

Electro-optical sunglare filters

B.1 Generic description of electro-optical sunglare filters/electro-optical sunglass filters and guidance on selection

The term electro-optical sunglare filter/sunglass filter describes an electronically controlled optical filter that changes its transmittance from a faded state (high transmittance) to a darkened state (low transmittance) depending on the amount of light incident on the system. Below is a generic description of some functions of a typical electro-optical filter (see Figure B.1). There are several variants of electro-optical filters available and this description may not be representative for all.

B.2 Power control

Generally, an electro-optical sunglare filter may be powered by a battery and/or photovoltaic cell and/or any other means. The photonics unit, comprising a power supply, the light detector and the electronic units, may be integrated into the front surface and/or any other part of the sunglass frame. It may be powered as the user puts it on his head and/or by manual and/or remote-control actions.

B.3 Light detection

The amount of light from the sun is continuously monitored by the light detection unit. The transmittance of the filter is adjusted, within the designed filter category range, either proportional to the amount of light incident on the detector, when a threshold incident light level is exceeded or by manual selection.

B.4 Transmittance range

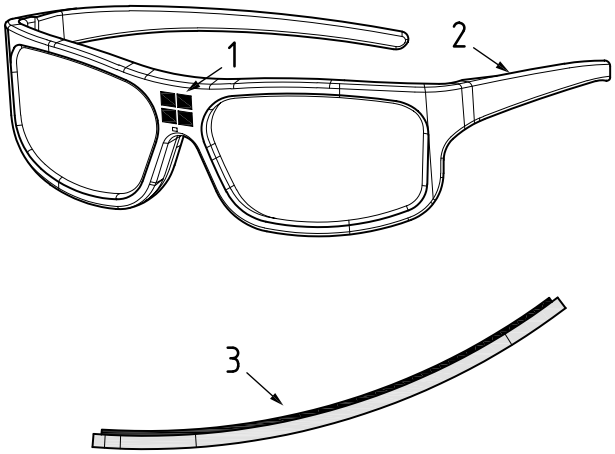
The transmittance range of an electro-optical sunglare filter corresponds typically (but not limited to) between a filter category 1 according to Table 1, representing the faded state, and a filter category 3, representing the darkened state. The transmittance may be adjusted over the continuous range or may switch from the faded to the darkened state and back again when a threshold value is reached. Please refer to the owner's manual for more specific information.

B.5 Guidance on selection

Early but limited experience with this new type of sunglass suggests that, depending on preference and activity, the user may select the product according to the recommendations of Table B.1.

Table B.1 — Recommended user information for electro-optical sunglare filters

Reaction time: <0,2 s	Activities such as driving a vehicle on land, at sea or in the air at velocities exceeding 60 km/h
Reaction time: >0,2 s	All other activities



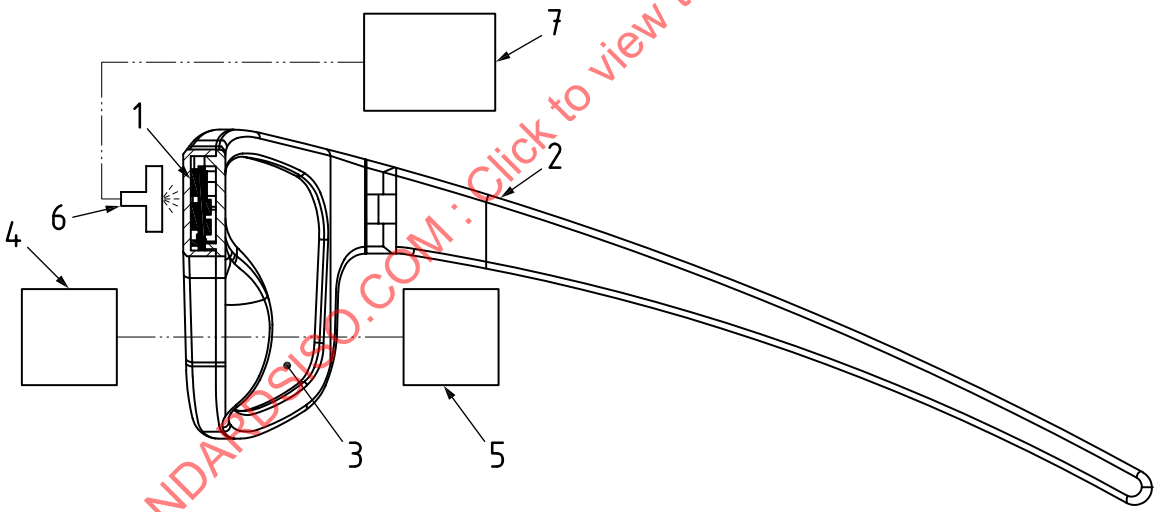
Key

1 photonics unit comprising power supply, light detector and electronics
2 side
3 electro-optical filter comprising the variable filter on a carrier lens

See References [45],[46],[47].

Figure B.1 — Electro-optical sunglare filter/electro-optical sunglass filter

B.6 Reaction time test method



Key

1 photonics unit comprising power supply, light detector and electronics
2 side
3 electro-optical filter comprising the variable filter on a carrier lens
4 light source
5 light detector and recording unit
6 trigger light source
7 AC-power supply

See References [47][48][49].

Figure B.2 — Reaction time test method in accordance with ISO 18526-2:2020, 17.11 and Annex E