



Factsheet sunglasses for general use

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Summary

When you are outdoors, you should protect your eyes against glare and the sun's ultraviolet (UV) rays. Excessive UV radiation can cause lasting damage to the cornea, conjunctiva, retina and eye lens. Children's eyes are particularly vulnerable to sunlight, as they have clearer lenses and UV rays penetrate more deeply, reaching the retina. You can prevent eye damage by wearing sunglasses.

To gain an overview of the optical quality of sunglasses available on the Swiss market, the FOPH requested ECS GmbH – the European Certification Service for eye protection products – to test the optical properties of sunglasses for conformity with the international and European standard for sunglasses for general use.

The test results showed that all 57 CE-marked sunglasses meet the requirements for 100% UV protection. With regard to optical requirements, no differences in quality were found between expensive and low-cost sunglasses.

When choosing and using sunglasses, the following recommendations should be helpful:

- Check the label to make sure the sunglasses bear the CE mark.
- Sunglasses should have a filter category of 2 or 3 – or category 4 for use in extreme conditions – and also offer side protection (see Table 1).
- Sunglasses should fit well and the lenses should extend up to your eyebrows and cover the width of your face.
- UV-blocking contact lenses should be used in combination with sunglasses.
- With corrective sunglass lenses, ask your optician whether 100% UV protection is guaranteed.
- Sunglasses should also be worn on cloudy days or under a parasol, as well as to reduce glare from reflective surfaces such as snow, sand, water, glass or metal.
- If you are a road user, make sure that all colours, especially traffic lights, can be clearly recognised through the lenses. Category 4 lenses (see Table 1) are not permitted for road use.
- Never look directly at the sun, even when wearing sunglasses.
- Sunglasses are not designed to provide protection against artificial high-energy light sources. In other words, sunglasses are not the same as the protective goggles which can be used, for example, during welding, at the solarium, or for cosmetic treatments.

- Worn-out or scratched sunglasses should be disposed of.
- Sunglasses should be used in combination with other sun protection measures, such as shade, wide-brimmed hats, suitable clothing and sunscreen.
- Protect children's eyes, which are particularly sensitive to UV rays. A hat is not enough to ensure adequate protection.

Health effects of UV radiation

The human eye is exquisitely sensitive to visible light. When dark-adapted, the retina can detect a few photons of blue-green light. The eye is even more vulnerable to UV and light damage than the skin. The cornea, lens and retina can be adversely affected by UV exposure [8].

Effects of UV radiation on the eye

The effects of UV radiation on the eye are dependent on the penetration depth, irradiation intensity, and duration and timing of exposure. UV radiation produces effects in the parts of the eye where it is absorbed (Figure 1). Exposure of the eyes to UV radiation at high intensity or over an extended period may give rise to painful inflammation of the retina or cornea, cataracts, retinopathy, or age-related macular degeneration.

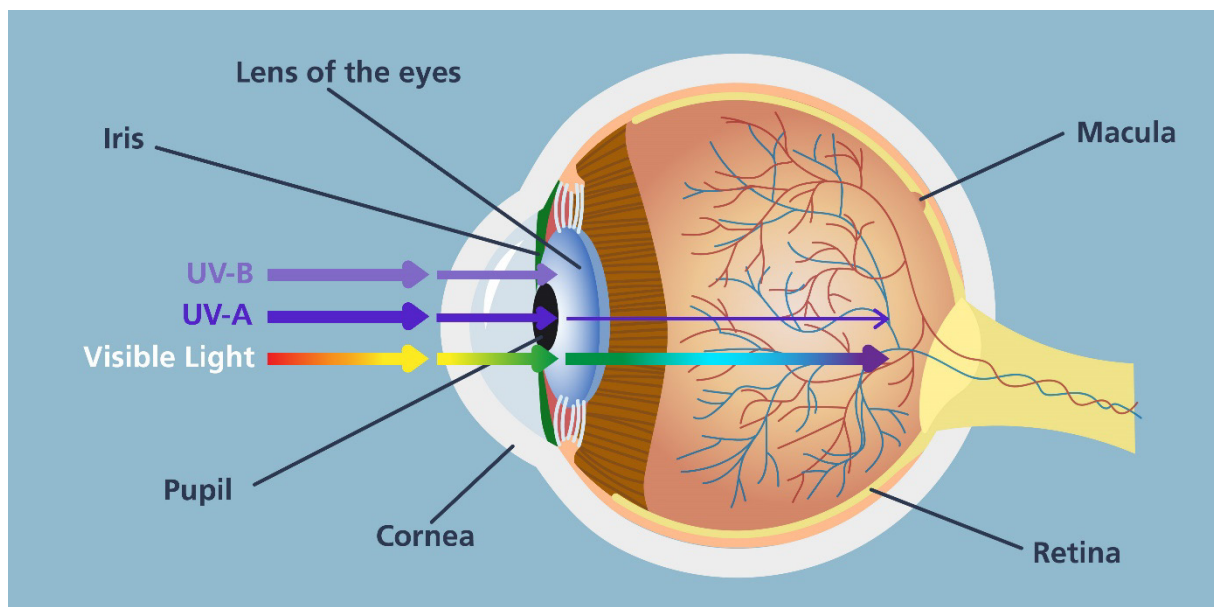


Figure 1 Schematic view of the anatomy of the eye, showing the penetration depth of visible light, UV-A and UV-B radiation (FOPH).

Age-dependent penetration

Children's eyes are highly sensitive, as they have less pigment and a more transparent lens than adults. Damage to the conjunctiva, cornea and retina from UV rays can occur particularly rapidly in children. In the adult eye, UV radiation in the 280–365 nm wavelength range is completely absorbed by the lens. One to two per cent of UV-A radiation in the 365–400 nm wavelength range penetrates as far as the retina. In the eyes of children and



adolescents, an additional narrow transmittance window exists around 320 nm. As a result, from birth onwards, some radiation in this wavelength range also reaches the retina. This window closes by the age of 30.

Eye colour

Light-coloured eyes are more sensitive than dark eyes, as the iris contains less pigment and UV rays can thus penetrate more easily. In people with brown eyes, the high melanin content provides more protection, but they also need to take adequate precautions.

Requirements for sunglasses




UV protection and glare protection

Sunglasses must provide protection against glare and UV radiation. Glare is reduced by a light-attenuating filter, whose strength is determined by the degree of tint. The darker the lenses, the greater the reduction of visible light and glare. Lenses are divided into five filter categories in accordance with the international standard ISO 12312-1:2022 (Table 1). The degree of UV protection depends on the UV radiation-absorbing properties of the material the lenses are made of, and not on the colour or tint of the lenses. Sunglasses bearing the CE mark and labelled as “100% UV” or “UV 400” filter out UV rays, thus protecting the cornea and retina from UV-A (315 nm to 380 or 400 nm) and UV-B (280 nm to 315 nm) radiation. As defined in the standard, sunglass lenses offer 100% UV protection if transmittance at wavelengths up to 380 nm is less than 0.05%.





Labelling

Sunglasses must be provided with a clear and legible label indicating the identity of the manufacturer or supplier, the filter category (Table 1), the category description and suitability for road use. Sunglasses not suitable for driving must be appropriately marked with the symbol of a crossed-out car. The label should also make reference to the international standard ISO 12312-1:2022.

Table 1. Glare protection and UV protection: Description of filter categories and associated symbols specified in ISO 12312-1:2022

	Category 0: Very limited glare reduction. Luminous transmittance >80%. Limited UV protection. Not suitable as sunglasses.
	Category 1: Limited glare reduction. Slightly tinted lenses, with luminous transmittance of 43–80%. Moderate UV protection. Not suitable as sunglasses.
	Category 2: Good glare protection. Moderately tinted lenses, with luminous transmittance of 18–43%. Good UV protection. Suitable as sunglasses for everyday use.



	<p>Category 3: High glare protection. Dark-tinted lenses, with luminous transmittance of 8–18%. Good UV protection. Suitable as sunglasses for everyday use and for holidays or sunny locations (e.g. in the mountains or at the beach).</p>
  	<p>Category 4: Very high glare protection. Very dark-tinted lenses, with luminous transmittance of 3–8%. Very high protection against extreme glare. Excellent side protection. Good UV protection. Suitable as special sunglasses for extreme sun glare (e.g. at sea, in desert, on high mountain, over snowfields).</p> <p>Not suitable for road use: These lenses are too dark to permit recognition of traffic light signals and are therefore prohibited for road use.</p>

Side protection

With sunglasses lacking side protection, the eyes may be exposed to reflected UV radiation. Protection from reflected sunlight is a requirement for category 4 filters and is recommended for sunglasses in all other categories so as to prevent the growth of conjunctival tissue on the cornea (pterygium) and clouding of the eye lens (cataract). Broad earpieces or side shields offer side protection, but they are not suitable for road use as they restrict the field of view.

Light conditions, polarisation, lens colouring, blue light, weather

Sunglasses are not recommended for driving at night, in twilight or in poor light conditions. Sunglasses not permitted for road use are marked with the symbol of a crossed-out car (see Table 1). Polarised lenses have a special coating which filters and absorbs reflected light, thus further reducing glare and alleviating eyestrain. Brown or grey-tinted lenses are ideal for visual clarity. Blue and red tints impair contrast sensitivity and visual acuity. As well as providing protection from UV radiation and glare, sunglasses can also reduce the amount of blue light reaching the retina. However, except in the case of snowfields, no risks are to be expected with acute exposure even to high-intensity blue light.

Declining UV protection

The UV protection provided by sunglasses deteriorates over time. UV resistance is guaranteed for two years. Protection will be reduced by scratched lenses. The current standard sunglasses aging test is designed to ensure safe use for a period of two years, with a maximum of two hours' use per day.

Combination with other UV protection measures

The protection effectiveness of sunglasses is strongly influenced by exposure conditions, head position, wearing position and geometry. Sunglasses do not totally block UV radiation and should be combined with additional protection means [1].

Radiation exposure and sunglasses

High doses of UV radiation can reach the eyes even when sunglasses are worn. Depending on the angle of incidence, direct radiation may circumvent the sunglasses, while reflected



radiation from ground surfaces and diffuse radiation from scattering by clouds and particles can also reach the eyes [1]. Ineffective use of sunglasses may even increase the UV radiation doses received due to dilatation of pupils or prolonged outdoor exposure with inadequate eye protection [1]. In addition, oblique rays entering the eye from the temporal side can reach the equatorial area of the lens [8]. The incidence of UV-induced conditions is significantly higher on the side of the nose than in other parts of the face exposed to direct sunlight [4]. This is due to light rays reflecting off the curved surface of the eye, which creates a focusing effect, producing hotspots on the side of the nose. The amount of UV radiation reaching the eyes from all angles can be reduced by using wrap-around sunglasses [2] and other sun protection measures.

UV contact lenses combined with sunglasses

Contact lenses should also have a UV filter. However, UV-blocking contact lenses do not offer adequate protection against UV radiation since they only cover part of the eye.

Sun and solar eclipse

Looking directly at the sun, even when wearing sunglasses, can cause permanent eye damage within a matter of seconds. To observe a solar eclipse, you should use specially designed glasses. If viewing through a telescope, camera or binoculars, a protective film or filter (available from specialist suppliers) must be fitted.

Testing of sunglasses

On behalf of the FOPH, 10 baby sunglasses, 17 children's sunglasses and 30 adult sunglasses were tested for their optical properties in accordance with the international and European standard "Eye and face protection — Sunglasses and related eyewear – Part 1: Sunglasses for general use" (EN ISO 12312-1:2022 + Amd1:2015) at an accredited laboratory, ECS GmbH, the European Certification Service for eye protection products.

Sunglasses are personal protective equipment (PPE), which must meet the basic health protection and safety requirements specified in the Swiss [Ordinance on the Safety of Personal Protective Equipment](#) (SR 930.115), which transposes the European [PPE Regulation](#) (EU) 2016/425 into national law. To determine the properties of the sunglasses, the international and European standard "Personal protective equipment — Test methods for sunglasses and related eyewear" (EN ISO 12311:2013) was applied. For testing, two sizes of reference test headforms were used, one roughly corresponding to the head of an adult male European, the other to that of a 12-year-old child.

The specimens were selected according to the following three criteria:

- From the range available for sale, the top-selling brands were selected.
- In each case, the most expensive and the cheapest models were tested.
- The baby and children's sunglasses were purchased online, the adult sunglasses at shopping centres and specialist retailers.

Excluded from testing were skiing goggles and sunglasses specifically designed for sports use, which have to comply with additional requirements (ISO 18527). Likewise not tested



were glasses offering protection from artificial light sources, and those used for solar observation or in occupational settings.

Tests were only performed for optical properties; no testing was performed for mechanical properties such as robustness, flammability or abrasion resistance.

Test results

The test results are shown in Table 2 below. The requirements are explained individually.

UV protection

All the sunglasses met the requirements for 100% UV protection; that is, transmittance at wavelengths up to 380 nm was less than 0.05%.

Table 2. Overview of requirements specified for baby, children's and adult sunglasses, and test results

Requirement	Baby glasses (n=10)	Children's glasses (n=17)	Adult glasses (n=30)
Manufacturer's information and labelling	6 compliant	13 compliant	13 compliant
Construction	10 compliant	17 compliant	30 compliant
Filter material and surface quality	10 compliant	16 compliant	30 compliant
Transmittance and filter categories	10 compliant	17 compliant	28 compliant
Uniformity of luminous transmittance	10 compliant	17 compliant	29 compliant
Road use	10 compliant	Colour detection requirements not met in 2 cases	30 compliant
Wide-angle scatter	10 compliant	17 compliant	30 compliant
Polarising filters	10 compliant	17 compliant	30 compliant
Refractive power	10 compliant	17 compliant	30 compliant
Resistance to solar radiation	10 compliant	17 compliant	26 compliant
Coverage area	10 compliant	17 compliant	30 compliant
Side protection with filter category 4	6 compliant	17 compliant	-

Manufacturer's information

None of the information leaflets included a warning that the sunglasses are not suitable for driving in twilight or at night. In one case, the information supplied related not to sunglasses, but to medical corrective lenses. The user information was frequently incomplete.



Construction

Those parts of sunglasses, including the frame and – in the case of rimless or semi-rimless models – the edges of the filters, which may, during intended use, come into contact with the wearer must be smooth and without sharp protuberances. All the sunglasses met these requirements.

Filter material and surface quality

Sunglare filters must have no material or machining defects within an area of 30 mm diameter around the reference point that may impair vision, e.g. bubbles, scratches, inclusions, dull spots, pitting, mould marks, notches, reinforced areas, specks, beads, water specks, pocking, gas inclusions, splintering, cracks, polishing defects or undulations. In one of the children's sunglasses the surface quality was borderline.

Transmittance and filter categories

One of the adult sunglasses was labelled as filter category 2 but did not meet the requirements specified for either filter category 2 or 3. One other pair of adult sunglasses was labelled as filter category 3 but according to the measurements was filter category 2. It barely met the requirements, as the standard permits a 2% overlap of the transmittance values between these categories.

Uniformity of luminous transmittance

One of the adult sunglasses did not meet the requirements specified for uniformity of luminous transmittance.

Requirements for road use

Two of the children's sunglasses did not meet the requirements specified for red signal detection. The signal lights were not detectable in road use during the day. In one of these two cases, the fact that the sunglasses are not suitable for road use was declared, but this warning was buried in the manufacturer's information.

Testing of spherical, astigmatic and prismatic refractive power

There were no exceedances of limits which could give rise to eye problems such as headaches, stinging eyes, or sensation of pressure around the forehead or behind the eyes. All the sunglasses thus met the requirements ensuring clear and pleasant vision.

Resistance to solar radiation

The UV protection provided by sunglasses must still be ensured after 2 years, with a maximum of two hours' use per day. To determine UV protection after aging of sunglasses, the lens is exposed to a solar simulator for 50 hours. Four of the adult sunglasses did not meet the requirements specified for resistance to solar radiation.

Coverage area

All the sunglasses met the requirements specified for the minimum coverage area of the lens and frame.

Side protection with filter category 4



One of the baby sunglasses lacked side protection. For three other pairs of baby sunglasses, the glasses would need to be professionally fitted so as to ensure side protection. No adult category 4 sunglasses were tested.

Standards

Sunglasses must comply with the requirements specified in ISO 12312-1:2022 “Eye and face protection — Sunglasses and related eyewear – Part 1: Sunglasses for general use”. This standard was prepared by the Technical Committee ISO/TC 94 “Personal safety – Personal protective equipment”, in collaboration with the Technical Committee CEN/TC 85 “Eye-protective equipment”. The European standard was approved by the European Committee for Standardization (CEN) on 3 June 2022. All CEN members are obliged to adopt such standards at the national level. Since January 2023, this standard has also had the status of a national standard in Switzerland (SN EN ISO 12312-1:2022). The standard is applicable to sunglasses for general use, including road use, and contains information on, inter alia, terminology, the luminous transmittance and use of sunglass filters, and test methods.

For manufacturers, the use of these standards is voluntary. However, manufacturers are responsible for ensuring that their products comply with the conformity criteria.

Further information

Acute and chronic eye conditions: WHO: [Ultraviolet radiation \(who.int\)](https://www.who.int) – Effects on the eyes

General information on sun protection and advice on choosing sunglasses: Optik Schweiz – Verband für Optometrie und Optik: [Sonnenschutz – OPTIKSCHWEIZ der Fachverband für Augenoptik und Optometrie](#)

Occupational safety, occupational eye protection: Suva: [Augenschutz – Schutzbrillen | Kriterien bei der Auswahl \(suva.ch\)](#)

Structure and function of the eye: Kuratorium Gutes Sehen (KGS):
[▷ Das Auge: Aufbau & Funktion • Kuratorium Gutes Sehen e.V.](#)

General information on sun protection: Federal Office of Public Health FOPH: [Sonnenschutz \(admin.ch\)](#)

General advice on sun protection: Swiss Cancer League: [Sonnenschutz-Tipps | Krebsliga Schweiz](#)

Sunglasses: Federal Office for Radiation Protection BfS:
[BfS - UV eye protection](#)



Sunglasses – personal protective equipment (PPE): Health protection and safety requirements of the Swiss [Ordinance on the Safety of Personal Protective Equipment](#) (SR 930.115, available in German/French/Italian), and of the European [PPE Regulation](#) (EU) 2016/425

Recommended indirect viewing methods for solar eclipses: Australian Radiation Protection and Nuclear Safety Agency: [Solar eclipse and health | ARPANSA](#)

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