भारतीय मानक
Indian Standard

IS 8521 (Part 1) : 2022
ISO 16321-1 : 2021

(*Superseding* IS 5983 : 1980)

व्यावसायिक उपयोग के लिए आंख और चेहरे की सुरक्षा

भाग 1 सामान्य आवश्यकताएं

(पहला पुनरीक्षण)

Eye and Face Protection for Occupational Use

Part 1 General Requirements

(First Revision)

ICS 13.340.20

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NATIONAL FOREWORD

This Indian Standard (Part 1) (First Revision) which is identical with ISO 16321-1 : 2021 'Eye and face protection for occupational use — Part 1: General requirements' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on recommendation of the Occupational Safety and Health Sectional Committee and approval of the Chemical Division Council.

IS 8521 (part 1) was originally published in 1971 under the title 'Specification for industrial safety saceshields: Part 1 With plastics visor'. This specification covered the face shields (with plastics visor) that could be used in woodworking operations against chips and sawdust; in metal machining operations against flying particles; in buffing, polishing and grinding operations where particles may strike the face; in spot welding; and in the handling of corrosive materials. The standard is being revised in order to align it with the latest version of ISO 16321-1 : 2021.

This revision is also superseding IS 5983 : 1980 'Specification for eye-protectors' which covered the specification for eye-protectors that could be used in operations where small particles flying at high velocity, molten metal, chemical splashes, dust, gases, optical radiations (ultra-violet, infra-red and glare from intense visible light) pose hazards which are likely to impair vision or damage the eye.

The revised standard specifies general requirements for eye and face protectors which are intended to provide protection for the eyes and faces of persons against one or more common occupational hazards.

This Indian Standard is published in two parts. The other part in this series is:

Part 2 Additional requirements for mesh protectors

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminologies and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'this document' appear referring to this standard, they should be read as 'this Indian Standard'.

b) Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards where the standard atmospheric conditions to be observed are stipulated which are not applicable to tropical/subtropical countries. The applicable standard atmospheric conditions for Indian conditions are 27 ± 2°C and 65 ± 5 percent relative humidity and shall be observed while using this standard.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 16321-3 : 2021 Eye and face protection for occupational use — Part 3: Additional requirements for mesh protectors	IS 8521 (Part 2) : 2021 Eye and face protection for occupational use: Part 2 Additional requirements for mesh protectors	Identical
ISO 18526-1 : 2020 Eye and face protection — Test methods — Part 1: Geometrical optical properties	IS 7524 (Part 1) : 2021 Eye and face protection — Test methods: Part 1 Geometrical optical properties	Identical
ISO 18526-2 : 2020 Eye and face protection — Test methods — Part 2: Physical optical properties	IS 7524 (Part 2) : 2021 Eye and face protection — Test methods: Part 2 Physical optical properties	Identical

(*Continued on third cover*)

Introduction

The family of documents comprised of the ISO 16321 series, the ISO 18526 series and the ISO 18527 series was developed in response to the worldwide stakeholders' demand for minimum requirements and test methods for eye and face protectors traded internationally. ISO 4007 gives the terms and definitions for all the various product types. The test methods are given in the ISO 18526 series, while the requirements for occupational eye and face protectors are given in the ISO 16321 series. Eye protectors for specific sports are mostly dealt with by the ISO 18527 series. A guidance document, ISO 19734, for the selection, use and maintenance of eye and face protectors is under preparation.

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Indian Standard

EYE AND FACE PROTECTION FOR OCCUPATIONAL USE

PART 1 GENERAL REQUIREMENTS

(First Revision)

1 Scope

This document specifies general requirements for eye and face protectors. These protectors are intended to provide protection for the eyes and faces of persons against one or more common occupational hazards such as impacts from flying particles and fragments, optical radiation, dusts, splashing liquids, molten metals, heat, flame, hot solids, harmful gases, vapours and aerosols.

Additional requirements for eye and face protectors used during welding and related techniques and for mesh protectors are given in ISO 16321-2 and ISO 16321-3, respectively.

This document applies to:

— all plano as well as corrective and prescription lensed protectors and components;

— those eye and face protectors used for occupational-type tasks that are performed similarly to an occupation, e.g. "do-it-yourself";

— those eye and face protectors used in educational establishments.

This document does not apply to:

— protectors specifically intended for protection against only solar radiation and used in non-occupational environments for which the ISO 12312 series applies;

— protectors for medically prescribed applications (not occupational), e.g. eye protection for severe dry eye, tints prescribed for medical conditions;

— patient eye protectors during diagnosis or treatment (e.g. ISO/TR 22463);

— protectors for use during medical or e.g. aesthetic applications, e.g. intense light sources (ILS) for which the ISO 12609 series applies;

— protectors specifically intended for sports for which the ISO 18527 series applies;

— laser protectors;

— face protectors intended for live-working to protect against short-circuit electric arcs for which IEC 62819 applies;

— protectors intended to protect against ionizing radiation, e.g. X-rays, for which IEC 61331-3 applies.

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

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

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

ISO 16034:2002, *Ophthalmic optics — Specifications for single-vision ready-to-wear near- vision spectacles*

ISO 16321-2:2021, *Eye and face protection for occupational use — Part 2: Additional requirements for protectors used during welding and related techniques*

ISO 16321-3:2021, *Eye and face protection for occupational use — Part 3: Additional requirements for mesh protectors*

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, *Eye and face protection — Test methods — Part 4: Headforms*

ISO 21987:2017, *Ophthalmic optics — Mounted spectacle lenses*

ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*

3 Terms and definitions

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

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 http://www.electropedia.org/

4 General requirements for protectors

4.1 Ambient temperatures

Protectors[1)] described in this document are intended for use at normal ambient temperatures (23 ± 5) °C. In order to ensure that critical aspects of protection are not compromised due to temperatures towards the extremes of the normal range of occupational environments from (−5 ± 2) °C to (+55 ± 2) °C, physical and mechanical requirements at extremes of temperature are included (sometimes optionally) in this document. These physical and mechanical requirements can also be provided by manufacturers for validation of claims for protection at temperatures below (−5 ± 2) °C and/or above (+55 ± 2) °C.

4.2 Physiological compatibility

Protectors shall be designed and manufactured in such a way that, when used under the conditions and for the purposes intended, they will not compromise the health or safety of the wearer. The risks posed by substances leaking or evaporating from the protector that can come into prolonged contact with the wearer, shall be reduced by the manufacturer to within the limits of any applicable regulatory requirement.

1) For the purposes of this document, "protector" is used as a general term for eye and/or face protectors such as, but not limited to, spectacles, goggles, face shields and eye shields.

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 are known to 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 protector that, when the protector is used under the conditions and for the purposes intended, 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 with food, 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 Specific national regulations with regard to restriction of certain chemical substances need to be observed, for example release of nickel.

4.3 Construction and adjustment

Areas of the protector that may, during intended use, come into contact with the wearer shall be free from projections, sharp edges or other features likely to cause discomfort or injury during use.

Any part of the protector that can be adjusted or removed by the wearer for the purpose of replacement (in accordance with the instructions given in the information to be supplied by the manufacturer) shall facilitate adjustment, removal and attachment without the use of tools.

Any adjustment system incorporated in the protector shall maintain the intended fit for the foreseeable conditions of use.

The test shall be carried out by physical inspection in accordance with ISO 18526-3:2020, 6.1.

4.4 Cleaning and/or disinfection

The protectors shall be cleaned only once in accordance with the cleaning and/or disinfection procedures in the information to be supplied by the manufacturer before being subjected to testing.

4.5 Headform(s)

Unless the manufacturer specifies the headform(s) in accordance with ISO 18526-4 that is/are compatible with the protector, the test methods where (a) headform(s) is/are required shall use the headform 1-M in accordance with ISO 18526-4 as the default.

4.6 Mandatory and optional requirements

In this document both optional and mandatory requirements are described. Depending on the intended use and/or the manufacturer's claimed specification, some requirements marked as optional become mandatory.

5 Geometrical optical requirements for protectors

5.1 Field of view

Protectors, in the as-worn position, shall have a minimum unobstructed field of view in front of each eye of 30° temporally and nasally in the horizontal meridian, and 30° superiorly and inferiorly in the vertical meridian, when measured at the centre at the corneal apex of the headform in accordance with ISO 18526-3:2020, 6.2.

Protectors used for driving shall have a minimum unobstructed field of view in front of each eye of 60° temporally and 30° nasally in the horizontal meridian and 30° superiorly and inferiorly in the vertical meridian, when measured at the centre at the corneal apex of the headform in accordance with ISO 18526-3:2020, 6.2.

5.2 Refractive power and prismatic power for plano lenses

5.2.1 Spherical and cylindrical power

Plano lenses shall be tested at the reference points in the as-worn position in accordance with ISO 18526-1:2020, 6.1.

The spherical power and cylindrical power shall not exceed the tolerances given in Table 1.

Table 1 — Spherical power, cylindrical power and prismatic power tolerances

Products	**Spherical power** Mean value of the focal powers (F_1, F_2) in the two principal meridians $(F_1 + F_2)/2$ dioptres (D)	**Cylindrical power** Absolute difference between the focal powers (F_1, F_2) in the two principal meridians $\lvert F_1 - F_2 \rvert$ dioptres (D)	**Additional requirements for mounted plano lenses, one-piece and visor covering both eyes** Maximum difference between the measured spherical powers of the right and left lenses (F_R, F_L) $\lvert F_R - F_L \rvert$ dioptres (D)	**Prismatic power of unmounted plano lenses (in any direction)** prism dioptres (Δ)
flat automatic welding filters, flat passive welding filters, cover, or backing plates for welding filters	±0,06	≤0,06	≤0,09	≤0,12
eye shields, face shields, spectacles, goggles	±0,12	≤0,12	≤0,18	≤0,25

5.2.2 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 lens shall be further assessed in accordance with ISO 18526-1:2020, 6.3. The plano lens shall be free from irregular distortions likely to impair vision.

5.2.3 Prismatic power for unmounted plano lenses covering one eye

Unmounted plano lenses shall be tested at the reference point in the as-worn position in accordance with ISO 18526-1:2020, 6.1.

The prismatic power shall not exceed the values given in Table 1.

5.2.4 Prism imbalance of complete eye protectors or plano lenses covering both eyes

Complete eye protectors or plano lenses covering both eyes shall be tested in the as-worn position in accordance with ISO 18526-1:2020, 6.2. Depending on the interpupillary distance (PD) of the specified headforms, the respective diaphragm LB_2 shall be used.

The prism imbalance shall not exceed the values given in Table 2.

Table 2 — Prism imbalance

Products	Horizontal		Vertical prism dioptres (Δ)
	Base out prism dioptres (Δ)	Base in prism dioptres (Δ)	
flat automatic welding filters, flat passive welding filters, cover, or back plates for welding filters	0,75	0,25	0,25
eye shields, face shields, spectacles, goggles	1,00	0,25	0,25

5.3 Mounted prescription lenses

5.3.1 Optical

The back vertex power, the direction of the cylinder axis, the addition power or the variation power, and the prism imbalance shall satisfy the requirements of ISO 21987:2017, 5.3.

5.3.2 Positioning

The positioning of multifocal lenses, of position-specific single-vision lenses and of power-variation lenses shall satisfy the requirements of ISO 21987:2017, 5.5.

5.4 Single-vision ready-to-wear near-vision lenses (lenses with positive spherical power)

The optical power range, the optical power, the design reference points and prismatic power shall satisfy the requirements of ISO 16034:2002, 4.2, 4.3, and 4.4.

5.5 Enhanced optical performance (optional requirement)

Enhanced optical performances for protectors with plano lenses may be claimed by the manufacturer if they fulfil the requirements given in both Tables 3 and 4.

Table 3 — Enhanced optical performances — Spherical power and cylindrical power

Spherical power	Cylindrical power	Additional requirements for mounted plano lenses and one-piece lenses and visors that cover both eyes
Mean value of the focal powers (F_1, F_2) in the two principal meridians	Absolute difference between the focal powers (F_1, F_2) in the two principal meridians	Maximum difference between the measured spherical powers of the right and left lenses (F_R, F_L)
$(F_1 + F_2)/2$	$\lvert F_1 - F_2 \rvert$	$\lvert F_R - F_L \rvert$
dioptres (D)	dioptres (D)	dioptres (D)
±0,06	≤0,06	≤0,09

Table 4 — Enhanced optical performance — Prismatic power and prism imbalance

Unmounted plano lens covering one eye	Mounted plano lenses, unmounted and mounted one-piece lenses and visors that cover both eyes		
	Prism imbalance		
Prismatic power prism dioptres	Base out prism dioptres	Base in prism dioptres	Vertical prism dioptres
(Δ)	(Δ)	(Δ)	(Δ)
0,12	0,75	0,25	0,25

6 Physical optical requirements for protectors

6.1 Detection of signal lights

Detection of signal lights is a mandatory requirement for sunglare filters for occupational use, but an optional requirement for other protectors.

Between 475 nm and 650 nm, the spectral transmittance shall be not less than $0{,}20\tau_v$ and the relative visual attenuation coefficient, Q, for red, yellow, green and blue signal lights shall be not less than 0,80 when tested in accordance with ISO 18526-2:2020, Clause 11.

6.2 Luminous transmittance of lenses without deliberate filter action

The transmittance of lenses without deliberate filtering action (i.e. without declared scale numbers) shall have a luminous transmittance, $\tau_{v,A}$, not less than 80 % when tested in accordance with ISO 18526-2:2020, 7.1, or ISO 18526-2:2020, 7.3.

For face shields with a lens thickness of more than 2,0 mm and for multiple glazed eye protectors, the luminous transmittance shall be not less than 75 %.

6.3 Specific requirements for different types of filter

6.3.1 Ultraviolet protective filters

6.3.1.1 General

Ultraviolet protective filters (UV filters) are intended to protect against the UV radiation that is emitted by radiators (lamps and lamp systems) exhibiting a high amount of short wavelength radiation. If greater reduction of glare in the visible spectrum is also required, this is taken into account with separate scale numbers (see also 6.3.1.2).

UV filters shall be tested in accordance with ISO 18526-2:2020, Clauses 6, 7.1, 7.3 and Clause 8, and classified in accordance with Table 5.

6.3.1.2 Luminous and spectral transmittance and scale numbers

The luminous transmittance, as shown in Table 5, is based on the spectral distribution for CIE standard illuminant A (see ISO 11664-2) and the CIE 1931 standard colorimetric observer (2°) (see ISO/CIE 11664-1). The scale number for the UV filter is determined by the value of its luminous transmittance in accordance with Table 5.

Table 5 — Transmittance requirements for UV filters, code letter U

Scale number	Maximum spectral transmittance in the UV spectral range $\tau(\lambda)$			Luminous transmittance $\tau_{v,A}$
	200 nm ≤ λ ≤ 313 nm %	313 nm < λ ≤ 365 nm %	365 nm < λ ≤ 400 nm %	380 nm ≤ λ ≤ 780 nm %
U1,2	0,000 3	0,1	$\tau_{v,A}$	$100 > \tau_{v,A} \geq 74,4$
U1,4				$74,4 > \tau_{v,A} \geq 58,1$
U1,7				$58,1 > \tau_{v,A} \geq 43,2$
U2				$43,2 > \tau_{v,A} \geq 29,1$
U2,5				$29,1 > \tau_{v,A} \geq 17,8$
U3				$17,8 > \tau_{v,A} \geq 8,5$
U4				$8,5 > \tau_{v,A} \geq 3,2$
U5				$3,2 > \tau_{v,A} \geq 1,2$
NOTE UV filters protect the wearer against ultraviolet radiation whilst permitting any visual task to be performed safely and accurately. In particular it is necessary to take care that the colour of the filter permits any necessary perception of colour such as the detection of signal lights, markings and indicators and the evaluation of colour matches. UV filters that do not conform to these criteria could lead to difficulties for users. For further information about the selection of the correct protector, a guidance document (ISO 19734) for the selection, use and maintenance of eye and face protectors is in preparation.				

6.3.1.3 Marking of UV filters

UV filters that meet the transmittance requirements given in Table 5 shall be marked by code letter U. Filters that meet additionally the optional requirement for the detection of signal lights in accordance with 6.1 shall be marked by code letter UL.

6.3.2 Infrared protective filters

6.3.2.1 General

Infrared protective filters (IR filters) are intended to protect against the wavelengths of radiation from artificial sources that are longer than visible. If greater reduction of glare in the visible spectrum is also required, this is taken into account with separate scale numbers (see also 6.3.2.2).

IR filters shall be tested in accordance with ISO 18526-2:2020, Clauses 6, 7.1, 7.3 and Clause 10, and classified in accordance with Table 6.

6.3.2.2 Luminous and spectral transmittance and scale numbers

The scale number for the IR filter is defined based on the value of the luminous transmittance in Table 6.

The luminous transmittance, as shown in Table 6, is based on the spectral distribution of a black body radiator at 1 900 K and the spectral luminous efficiency of the CIE 1931 standard colorimetric observer (see ISO/CIE 11664-1).

Table 6 — Transmittance requirements for IR filters, code letter R

Scale number	Luminous transmittance $\tau_{v,1\,900\,K}$ 380 nm ≤ λ ≤ 780 nm %	Near IR transmittance τ_{NIR} 780 nm ≤ λ ≤ 3 000 nm **Maximum** %
R1,2	$100 > \tau_{v,1\,900\,K} \geq 74{,}4$	1,5
R1,4	$74{,}4 > \tau_{v,1\,900\,K} \geq 58{,}1$	1,4
R1,7	$58{,}1 > \tau_{v,1\,900\,K} \geq 43{,}2$	1,3
R2	$43{,}2 > \tau_{v,1\,900\,K} \geq 29{,}1$	1,2
R2,5	$29{,}1 > \tau_{v,1\,900\,K} \geq 17{,}8$	1,1
R3	$17{,}8 > \tau_{v,1\,900\,K} \geq 8{,}5$	0,82
R4	$8{,}5 > \tau_{v,1\,900\,K} \geq 3{,}2$	0,62
R5	$3{,}2 > \tau_{v,1\,900\,K} \geq 1{,}2$	0,51
R6	$1{,}2 > \tau_{v,1\,900\,K} \geq 0{,}44$	0,33
R7	$0{,}44 > \tau_{v,1\,900\,K} \geq 0{,}16$	0,23
R8	$0{,}16 > \tau_{v,1\,900\,K} \geq 0{,}061$	0,16
R9	$0{,}061 > \tau_{v,1\,900\,K} \geq 0{,}023$	0,11
R10	$0{,}023 > \tau_{v,1\,900\,K} \geq 0{,}008\,5$	0,083

The spectral transmittance requirements are those given in Table 6 and the following:

a) at 313 nm, the spectral transmittance shall not exceed 10 % of the measured value of the luminous transmittance of the IR filter;

b) for 210 nm < λ ≤ 313 nm, the spectral transmittance shall not exceed the measured value at 313 nm.

6.3.2.3 Enhanced infrared reflection (optional requirement)

Filters that are claimed to have enhanced infrared reflection shall have a mean spectral reflectance greater than 60 % within the wavelength range 780 nm to 2 500 nm when measured in accordance with ISO 18526-2:2020, Clause 12, with the geometry specified in ISO 18526-2:2020, 12.2.1 for flat lenses or 12.2.2 for curved lenses.

6.3.2.4 Marking of IR filters

IR filters that meet the transmittance requirements given in Table 6 shall be marked by code letter R. The code letter R refers to IR filters that can affect perception of colour and do not have enhanced reflectance in the infrared spectral range. The code letters RL refer to IR filters that comply with 6.1 and do not prevent the detection of signal lights. The code letters RR refer to IR filters that comply with 6.3.2.3 having enhanced infrared reflection, and the code letters RRL refer to IR filters that allow the detection of signal lights and provide enhanced infrared reflection, see Table 7.

Table 7 — Overview of code letters for IR filters

Code letter	Detection of signal lights	Enhanced infrared reflectance
R	No	No
RL	Yes	No
RR	No	Yes
RRL	Yes	Yes

NOTE IR filters protect the wearer against infrared radiation whilst permitting any visual task to be performed safely and accurately, including the optional perception of safety signals. It is necessary in particular to take care that the colour of the IR filters is compatible with good perception of colour, especially for accurate evaluation of melting furnace temperatures. IR filters that do not conform to these criteria could lead to difficulties for users. For further information about the selection of the correct protector guidance document, ISO 19734, for the selection, use and maintenance of eye and face protectors is in preparation.

6.3.3 Sunglare filters for occupational use

6.3.3.1 General

Sunglare filters are intended to reduce solar glare to a comfortable level and solar ultraviolet radiation to a safe level.

Sunglare filters shall be tested in accordance with ISO 18526-2:2020, Clauses 6, 7 and 8. The UV requirements and the optional IR requirements in Table 8 shall be met as appropriate.

6.3.3.2 Luminous and spectral transmittance and scale numbers

The determination of the luminous transmittance of the sunglare filters shall be based on the spectral energy distribution of CIE standard illuminant D65 in accordance with ISO 11664-2 and spectral luminous efficiency of the CIE 1931 standard colorimetric observer in accordance with ISO/CIE 11664-1.

The scale numbers of for sunglare filters are defined based on the value of the luminous transmittance in Table 8.

Table 8 — Transmittance requirements for sunglare filters for occupational use, code letter G

Scale number	Wavelength range from 280 nm to 400 nm			Visible spectral range	Optional infrared spectral range
	Maximum solar UV-B transmittance τ_{SUVB} 280 nm ≤ λ ≤ 315 nm (%)	Maximum solar UV-A transmittance $\tau_{SUVA\ 380}$ 315 nm < λ ≤ 380 nm (%)	Maximum mean 380 nm to 400 nm transmittance $\tau_{m380\text{-}400}$ 380 nm < λ ≤ 400 nm (%)	Luminous transmittance $\tau_{v,D65}$ 380 nm ≤ λ ≤ 780 nm (%)	Maximum solar IR transmittance τ_{SIR} 780 nm ≤ λ ≤ 2 000 nm (%)
G0	0,03 $\tau_{v,D65}$	0,5 $\tau_{v,D65}$	0,75 $\tau_{v,D65}$	$100 > \tau_{v,D65} \geq 80$	$\tau_{v,D65}$
G1	0,03 $\tau_{v,D65}$	0,5 $\tau_{v,D65}$	0,75 $\tau_{v,D65}$	$80 > \tau_{v,D65} \geq 43$	$\tau_{v,D65}$
G2	0,03 $\tau_{v,D65}$	0,25 $\tau_{v,D65}$	0,5 $\tau_{v,D65}$	$43 > \tau_{v,D65} \geq 18$	$\tau_{v,D65}$
G3	0,03 $\tau_{v,D65}$	0,25 $\tau_{v,D65}$	0,5 $\tau_{v,D65}$	$18 > \tau_{v,D65} \geq 8$	$\tau_{v,D65}$
G4	0,03 $\tau_{v,D65}$	0,5 % absolute or 0,125 $\tau_{v,D65}$, whichever is greater	0,5 % absolute or 0,125 $\tau_{v,D65}$, whichever is greater	$8 > \tau_{v,D65} \geq 3$	$\tau_{v,D65}$

NOTE Some national requirements can stipulate a different requirement for long wavelength limit of UV-A.

6.3.3.3 Marking of sunglare filters

Sunglare filters that meet the mandatory transmittance requirements given in Table 8 shall be marked by code letter G. Sunglare filters of shade numbers 0, 1, 2 or 3 that comply with the requirements of 6.1, detection of signal lights, shall be marked with GL0, GL1, GL2 or GL3. Sunglare filters of scale number GL0, GL1, GL2 or GL3 are suitable for road use and driving.

Sunglare filters of shade number GL4 comply with the requirements of 6.1 but are not suitable for road use and driving.

Photochromic filters shall be identified and labelled with their shade numbers corresponding to their faded state $\tau_{v,0}$ and darkened state $\tau_{v,1}$, e.g. GL0-2.

Sunglare filters that meet the optional infrared transmittance requirements shall be marked with the code letter GR or GLR respectively.

6.3.3.4 Additional transmittance requirement

6.3.3.4.1 Photochromic filters

The scale numbers of the faded and darkened states are determined by $\tau_{v,0}$ and $\tau_{v,1}$, respectively in accordance with ISO 18526-2:2020, 16.3.2 and 16.3.3.

The requirements of 6.1 shall be met in both the faded and darkened states.

The photochromic response *PR* shall be:

$$PR = \frac{\tau_{v,0}}{\tau_{v,1}} \geq 1{,}25$$

6.3.3.4.2 Polarizing filters

Where sunglare filters are fitted with polarizing filters, these shall be fitted in the frame so that, when tested in accordance with ISO 18526-2:2020, 15.1, the direction of the intended horizontal orientation of the filter does not deviate from the horizontal direction by more than ±5°; additionally, any misalignment between the planes of transmission of the left and right filters shall not be greater than 6°.

When tested in accordance with ISO 18526-2:2020, 15.2, the polarizing efficiency, *P*, shall be ≥78 % for filter categories GL2, GL3, G4 or GL4 and ≥60 % for filter category GL1.

NOTE 1 Filters of category GL0 do not have any useful polarizing effect.

NOTE 2 These values are equivalent to ratios of the transmittance values parallel and perpendicular to the plane of transmission of approximately 8:1 and 4:1 respectively.

6.3.3.4.3 Gradient-tinted sunglare filters

The luminous transmittance is measured at the reference point to determine the scale number of the filter.

Gradient-tinted sunglare filters shall meet the solar and spectral transmittance requirements from Table 8 and the detection of signal lights requirements from 6.1 (for filter number GL0 to GL3) within a (10 ± 1) mm radius circle centred on the reference point, and defined by the luminous transmittance at the reference point. If additional claims from 6.3.3.5 are made by the manufacturer, these requirements shall apply within a (10 ± 1) mm radius circle centred on the reference point.

6.3.3.5 Claimed transmittance properties

6.3.3.5.1 General

In the case where specific transmittance values are claimed, these claims shall be in accordance with 6.3.3.5.2 and 6.3.3.5.3.

6.3.3.5.2 Solar blue-light absorption/transmittance

a) **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 sunglare filter, measured in accordance with ISO 18526-2:2020, 9.1, shall not exceed (100,5 − x) %.

b) **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 sunglare filter, measured in accordance with ISO 18526-2:2020, 9.1, shall not exceed (x + 0,5) %.

For the calculation of the solar blue-light transmittance, the values of ISO 18526-2:2020, Table D.1, shall be used.

6.3.3.5.3 Solar UV absorption/transmittance

Requirements for the maximum transmittance of sunglare filters in the UV-A and UV-B shall be as given in Table 8 as appropriate. In cases where it is claimed that a sunglare filter reaches a certain percentage of UV absorption or UV transmittance better than the requirement in Table 8, the corresponding requirements shall apply.

For the calculation of the values of UV absorption/transmittance the values of ISO 18526-2:2020, Table D.1, shall be used.

a) **Solar UV absorption** — In the case where it is claimed that a sunglare filter has x % UV absorption, the solar UV transmittance of the filter τ_{SUV}, measured in accordance with ISO 18526-2:2020, 8.3, shall not exceed (100,5 − x) %.

b) **Solar UV transmittance** — In the case where it is claimed that a sunglare filter has less than x % UV transmittance, the solar UV transmittance of the filter τ_{SUV}, measured in accordance with ISO 18526-2:2020, 8.3, shall not exceed (x + 0,5) %.

c) **Solar UV-A absorption** — In the case where it is claimed that a sunglare filter has x % UV-A absorption, the solar UV-A transmittance of the filter $\tau_{SUVA\ 380}$, measured in accordance with ISO 18526-2:2020, 8.4, shall not exceed (100,5 − x) %.

d) **Solar UV-A transmittance** — In the case where it is claimed that a sunglare filter has less than x % UV-A transmittance, the solar UV-A transmittance of the filter $\tau_{SUVA\ 380}$, measured in accordance with ISO 18526-2:2020, 8.4, shall not exceed (x + 0,5) %.

e) **Solar UV-B absorption** — In the case where it is claimed that a sunglare filter has x % UV-B absorption, the solar UV-B transmittance of the filter τ_{SUVB}, measured in accordance with ISO 18526-2:2020, 8.5, shall not exceed (100,5 − x) %.

f) **Solar UV-B transmittance** — In the case where it is claimed that a sunglare filter has less than x % UV-B transmittance, the solar UV-B transmittance of the filter τ_{SUVB}, measured in accordance with ISO 18526-2:2020, 8.5, shall not exceed (x + 0,5) %.

6.3.4 Filters for use in glass blowing

Filters specifically designed for use in glass blowing applications are intended to reduce discomfort glare. Since some of these filters do not meet the UV or IR requirements as listed in Tables 5 and 6, they shall be used in conjunction with filters that do meet the UV and IR requirements.

Filters for use in glass blowing shall be assessed for spectral transmittance in accordance with ISO 18526-2:2020, Clause 6.

Filters for use in glass blowing, identified by a marking of code letter SF, can be used in accordance with Table 9.

Table 9 — Filters for use in glass blowing

Filter type, commonly used name	Description	Application	Requirements	Scale number
Didymium, Didymium-like	multi-absorption band filter with an absorption band that covers the Sodium 589 nm emission line in combination with an IR filter	glasswork with soda lime glass (soft glass), where temperatures below 1 000 °C occur	$\tau(589\ \text{nm}) \leq 0{,}01\ \%$ $\tau_{NIR} < 8\ \%$	SF1

6.4 Uniformity of luminous transmittance and transmittance matching

For lenses with deliberate filtering action, unless otherwise specified:

a) the relative variations of the luminous transmittance around the reference point(s), ΔF_R and ΔF_L, shall be measured in accordance with ISO 18526-2:2020, 7.4, as applicable. ΔF_R and ΔF_L (as appropriate) shall not exceed the values given in Table 10.

b) the relative difference of the luminous transmittance ΔP between the right and left eye reference points shall be measured in accordance with ISO 18526-2:2020, 7.5. ΔP shall not exceed the values given in Table 10.

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

Table 10 — Variations in mean luminous transmittance for filters

luminous transmittance 380 nm ≤ λ ≤ 780 nm %	Maximum value of ΔF_R and ΔF_L %	Maximum value of ΔP %
$100 > \tau_v \geq 17{,}8$	10	15
$17{,}8 > \tau_v \geq 0{,}44$	20	15
$0{,}44 > \tau_v \geq 0{,}023$	30	20
$0{,}023 > \tau_v \geq 0{,}001\ 2$	40	20
$0{,}001\ 2 > \tau_v \geq 0{,}000\ 023$	60	20

6.5 Scattered light

With the exception of welding filters, for which narrow angle scatter is tested, the percentage value of wide angle scatter shall not exceed 3,0 %, when measured in accordance with ISO 18526-2:2020, 14.1.

6.6 Frame transmittance

When the lenses of protectors are claimed to provide protection against optical radiation, the frame or housings shall provide at least the same scale number of protection, for the area to be protected in accordance with 7.1 against optical radiation, as that given by a filter of any scale number declared usable with the protector by the manufacturer or supplier.

The following requirements shall be satisfied when the transmittances are measured in accordance with ISO 18526-2:2020, Clauses 6, 7.1, 7.3 and Clauses 8 to 10:

a) the luminous transmittance of the frame shall not exceed the value corresponding to the darkest filter stated to be usable by the manufacturer;

b) the spectral requirements corresponding to the luminous transmittance of the darkest filter stated to be usable by the manufacturer shall be satisfied.

Sunglare filters with the scale number G4 or GL4 shall provide temporal shielding in accordance with ISO 12312-1:2013, 11.2.

In the case of holes or gaps in the protector, e.g. vents, it shall not be possible to see the area to be protected, when viewed from outside at any angle within the boundary of the range defined. Positions outside these areas do not need to be assessed.

6.7 Anti-reflective coated lenses (optional requirement)

In the case where lenses are claimed to have an anti-reflective coating, the luminous reflectance ρ_v is measured from the eye-side in accordance with ISO 8980–4:2006, 5.1 to 5.4 and shall be less than 2,5 %.

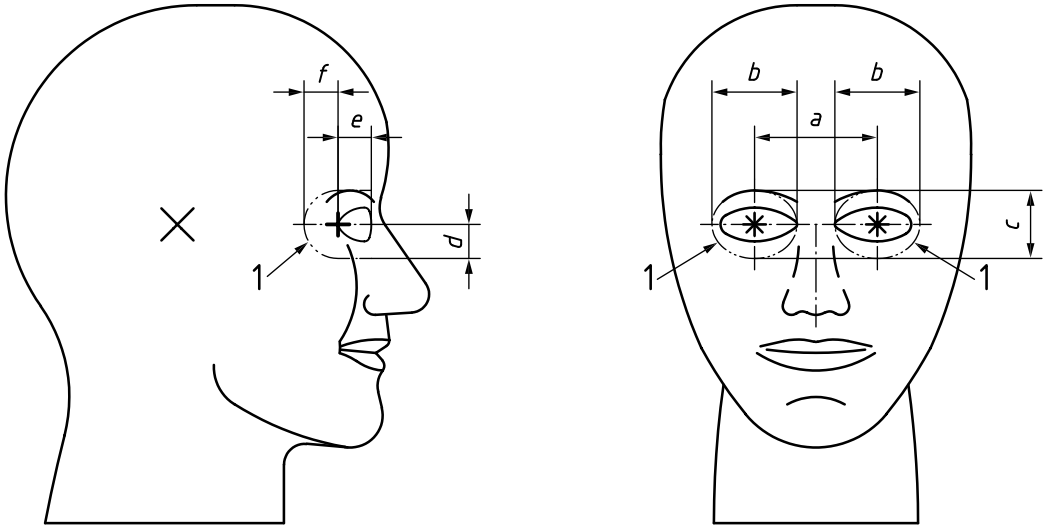
7 Physical and mechanical requirements for protectors

7.1 Area to be protected

7.1.1 General

Figures 1 to 4 and Tables 11 to 14 describe the minimum areas to be protected.

The dimensions of the headforms are defined in ISO 18526-4.



Key

1 eye protection zones

✳ corneal apices and pupil centres

+ lateral canthus

✕ resting point of the sides

a–*f* As defined in Table 11.

Figure 1 — Eye protection zone — Minimum area to be protected (basic impact level)

Table 11 — Dimensions of eye protection zone (basic impact level) for individual headforms based on interpupillary distance and corneal apex position

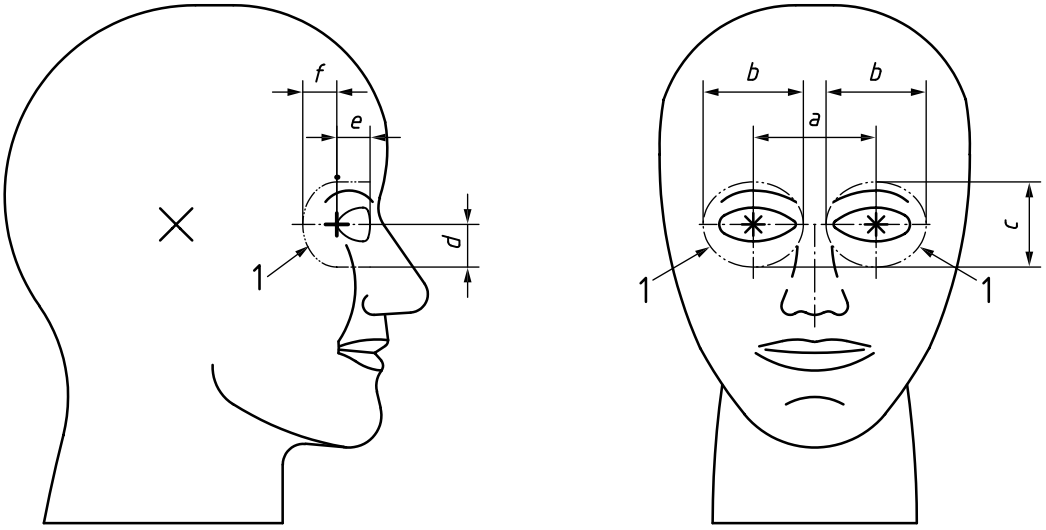
Tolerance on dimensions ±0,5 mm

Dimensions in millimetres

Dimensions see Figure 1	Headform						
	1-C12	1-S	1-M	1-L	2-S	2-M	2-L
a[a]	58	60	64	68	63	64	70
b	24	36	40	42	33	35	40
c	20	25	28	29	23	24	28
d	10	13	14	15	11	12	14
e	8	9	12	13	7	8	9
f	10 mm around lateral canthus location				10 mm around lateral canthus location		

[a] Dimension *a* is the same as dimension *D* in ISO 18526-4:2020, Table 2 and Table 3.

NOTE There are no dimensions available for headforms 2-C12.



Key

1 orbital protection zones

✳ corneal apices and pupil centres

+ lateral canthus

╳ resting point of the sides

a–*f* As defined in Table 12.

Figure 2 — Orbital protection zone (OPZ) — Minimum area to be protected [impact level C (45 m/s)]

Table 12 — Dimensions of orbital protection zone (impact level C) for individual headforms based on interpupillary distance and corneal apex position

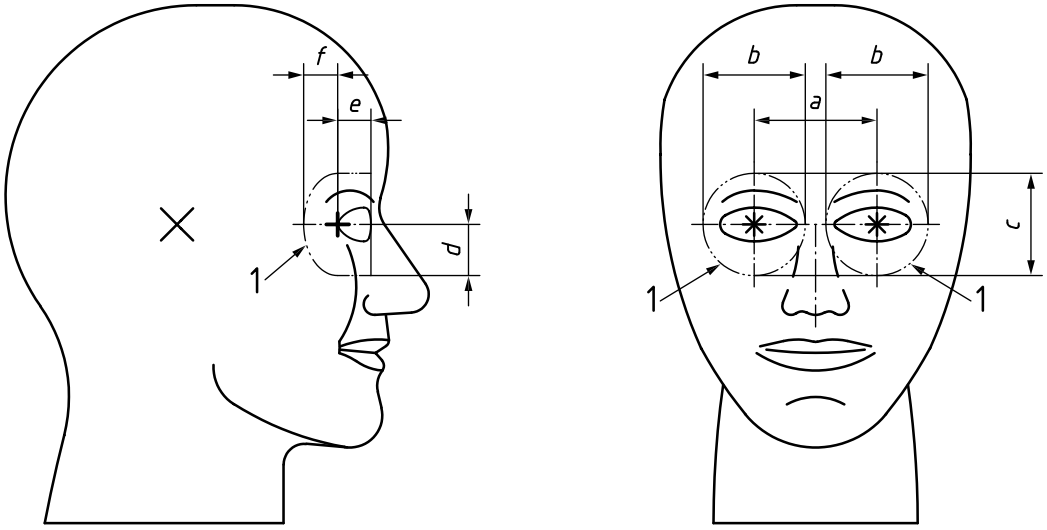
Tolerance on dimensions ±0,5 mm

Dimensions in millimetres

Dimensions see Figure 2	Headform						
	1-C12	1-S	1-M	1-L	2-S	2-M	2-L
a[a]	58	60	64	68	63	64	70
b	32	36	40	42	33	35	40
c	26	30	33	35	27	29	33
d	13	15	17	17	14	14	16
e	8	9	12	13	7	8	9
f	10 mm around lateral canthus location				10 mm around lateral canthus location		

[a] Dimension *a* is the same as dimension *D* in ISO 18526-4:2020, Table 2 and Table 3.

NOTE There are no dimensions available for headforms 2-C12.



Key

1 extended orbital protection zones

✳ corneal apices and pupil centres

+ lateral canthus

✕ resting point of the sides

a–*f* As defined in Table 13.

NOTE This protection can be given by cup goggles with individual lenses for each eye; the whole width of the face can be protected by a box goggle with a one-piece lens covering both eyes.

Figure 3 — Extended orbital protection zone (EOZ) — Minimum area to be protected [(impact level D (80 m/s)]

Table 13 — Dimensions of extended orbital protection zone (impact level D) for individual headforms based on interpupillary distance and corneal apex position

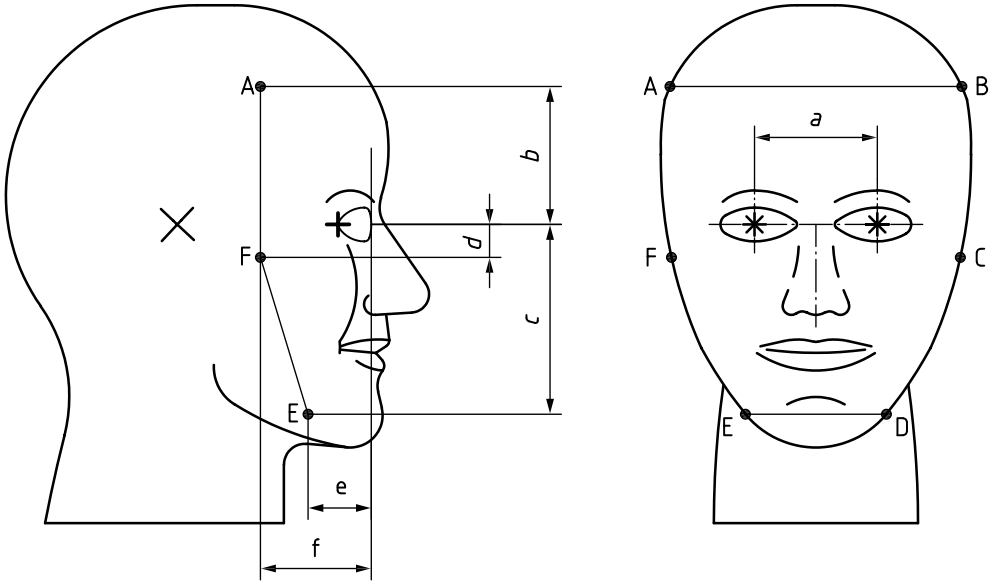
Tolerance on dimensions ±0,5 mm

Dimensions in millimetres

Dimensions see Figure 3	Headform						
	1-C12	1-S	1-M	1-L	2-S	2-M	2-L
a[a]	58	60	64	68	63	64	70
b and *c*	41	47	52	55	43	45	51
d	21	23	26	27	21	23	26
e	8	9	12	13	7	8	9
f	10 mm around lateral canthus location				10 mm around lateral canthus location		

[a] Dimension *a* is the same as dimension *D* in ISO 18526-4:2020, Table 2 and Table 3.

NOTE There are no dimensions available for headforms 2-C12.



Key

ABCDEF face protection zone

✳ corneal apices and pupil centres

+ lateral canthus

× resting point of the sides

a–*f* As defined in Table 14.

Figure 4 — Face protection zone (FPZ) — Minimum area to be protected [(impact level E (120 m/s)]

Table 14 — Dimensions of face protection zone (impact level E) for individual headforms based on interpupillary distance and corneal apex position

Tolerance on dimensions ±0,5 mm

Dimensions in millimetres

Dimensions see Figure 4	Headform						
	1-C12	1-S	1-M	1-L	2-S	2-M	2-L
a[a]	58	60	64	68	63	64	70
b	41	50	56	59	46	49	55
c	55	100	111	119	95	102	110
d	15	15	17	17	14	14	16
e	14	14	20	23	12	16	19
f	45	27	30	31	25	26	27

[a] Dimension *a* is the same as dimension *D* in ISO 18526-4:2020, Table 2 and Table 3.

NOTE There are no dimensions available for headforms 2-C12.

7.1.2 Area to be protected by eye protectors

The eye protector (combined lens and/or frame) shall cover the minimum area to be protected for the Basic impact level defined in Figure 1 and Table 11 on the headform(s) in accordance with ISO 18526-4 and specified by the manufacturer. The area is bounded by:

a) an ellipse of major and minor axes *b* and *c* respectively, centred on the corneal apex of each eye of the headform, projected horizontally from the front;

b) contiguous lateral coverage with no openings with any dimension greater than 1,5 mm, tangential from the vertical plane of each lens, to a distance *e* posterior to the corneal plane and a minimum height of *c*, centred on the corneal apex.

The protection from frontal and lateral direction shall be assessed in accordance with ISO 18526-3:2020, 6.3 and 6.4.

If an impact level C or D is claimed, depending on the impact velocity in accordance with 7.10, the minimum area to be protected for eye protectors shall protect, by means of the lens and/or frame, the orbital or extended orbital protection zone (shown in Figures 2 or 3).

If the protection against droplets or streams of liquids is claimed in accordance with 7.15 or 7.16 respectively, the minimum area to be protected for spectacles, goggles and eye shields shall protect, by means of the lens and/or frame, the extended orbital protection zone (shown in Figure 3).

7.1.3 Area to be protected by face protectors

Face protectors, with impact protection up to impact level E, shall protect, by means of the lens, brow guard and/or frame, the minimum area to be protected as defined by the face protection zone of the headform(s) in accordance with ISO 18526-4 that is/are specified by the manufacturer; this is contained by ABCDEF, as described in Figure 4 and Table 14.The protection from frontal and lateral direction shall be assessed in accordance with ISO 18526-3:2020, 6.3 and 6.4.

7.1.4 Lateral protection

If protection against high speed particles is claimed in accordance with the requirements of 7.10, the protectors shall pass the lateral region coverage according Figures 2 to 4 and Tables 12 to 14 and shall be assessed in accordance with ISO 18526-3:2020, 6.4.

7.2 Headbands and harnesses

The requirement of this subclause do not apply to spectacles unless they incorporate a headband or harness. Harnesses and headbands can be adjustable or self-adjusting to allow correct positioning of the protector.

Headbands and harnesses shall be capable of holding the protector in the correct position when fitted in accordance with the information to be supplied by the manufacturer and the protector shall remain secure and comfortable, without undue pressure or slip, when tested in accordance with ISO 18526-3:2020, 6.5.

7.3 Quality of material and surface of mounted and unmounted lenses, visors and filters

In a circular area 30 mm diameter centred on the reference point(s) but excluding a marginal area 5 mm wide around the edge of the lens, visor or filter if this overlaps with the circular area, lenses, visors or filters shall be free from defects likely to impair vision in use (such as bubbles, scratches, inclusions, dull spots, pitting, mould marks, scouring, grains, pocking, scaling and undulation) when examined in accordance with ISO 18526-3:2020, 6.6.

7.4 Basic impact level of complete protectors

7.4.1 Complete protectors

Unless higher levels of impact protection at extremes of temperatures (7.10.2 and 7.11.2) are claimed, this clause defines the minimum mechanical strength of complete protectors and their lenses or filter assemblies.

Unless the manufacturer specifies more extreme temperatures, the test for the Basic impact level shall be carried out under the following conditions:

— with the lenses or protectors heated to a temperature of (55 ± 2) °C;

— with the lenses or protectors cooled to a temperature of (−5 ± 2) °C.

Where a more extreme temperature is specified by the manufacturer, the appropriate temperature with accuracy of ±2 °C shall be substituted for the relevant test condition.

Complete protectors shall meet the requirements for the Basic impact level when tested in accordance with ISO 18526-3:2020, 7.3.1, using a steel ball with a diameter of $\left(25{,}40^{+0{,}05}_{0}\right)$ mm, weighing $\left(66{,}8^{+0{,}5}_{0}\right)$ g and a drop height of $\left(1{,}27^{+0{,}03}_{0}\right)$ m.

There are four impact points defined with respect to the headform rather than the protector. The ball is aimed at these impact points with the protector in the as-worn position.

The four impact points are defined as follows:

a) the left eye, frontal;

b) the right eye, frontal;

c) the left eye, lateral;

d) the right eye, lateral.

Frontal impact: The ball is directed perpendicular to the frontal plane through the two corneal vertices (denoted by ✳ in Figures 1 to 4) to anywhere within an area of (10 ± 1) mm radius centred on the corneal vertex. This is carried out for the right and the left eyes.

Lateral impact (if appropriate): The ball is directed along a line through or parallel to that through the two lateral canthi (the location of the edge of the bony orbit and represented as ✚ in Figures 1 to 4) to anywhere within an area of (10 ± 1) mm radius centred on the lateral canthus. This is carried out for the right and the left eyes.

The headform may be moved horizontally and vertically to select any single impact point lying within this (10 ± 1) mm of the specified impact centres.

New protectors may be used for each individual impact. In the case of failure after multiple impacts on the same test sample, one new test sample for each individual impact point shall be used.

7.4.2 Failure criteria

After testing for protection from frontal and lateral impact in accordance with ISO 18526-3:2020, 7.3.1, at (−5 ± 2) °C and (+55 ± 2) °C, the following defects of the lens, filter, protector housing or frame shall not be allowed when inspected in accordance with ISO 18526-3:2020, 6.1:

a) cracking through the entire thickness into two or more pieces;

b) the protector separates into two or more pieces;

c) the lens or filter has become dislodged from its normal position;

d) material becomes detached from the surface opposite to that impacted;

e) the ball passes through the protector; or

f) an indication that there has been contact of the ball or the protector with the eye of the test headform.

7.4.3 Protectors with inserts to carry prescription lenses

For a protector provided with a prescription insert behind the protector lens, the following defects shall not be allowed when inspected in accordance with ISO 18526-3:2020, 6.1:

— when mounted with nominal 2 mm thick afocal uncoated hard resin lenses (allyl diglycol carbonate) for the purposes of the test, either lens cracks through the entire thickness or physically separates into two or more pieces; or

— if contact is made with the eye of the test headform by the ball, frame, lens or any part of fragment of these.

7.5 Resistance to thermal exposure

When tested in accordance with ISO 18526-3:2020, 6.7, no deformation of any part of the protector shall be observed using an oven temperature of (55 ± 2) °C for $\left(120^{+5}_{0}\right)$ min.

The test shall be verified by physical inspection in accordance with ISO 18526-3:2020, 6.1.

7.6 Resistance to UV radiation

After exposure in accordance with ISO 18526-3:2020, 6.8.3:

a) the relative change of luminous transmittance shall not be greater than the values in Table 15;

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

c) any applicable UV and/or IR requirements for the initial τ_v shall continue to be satisfied.

d) all claimed transmittance requirements shall continue to be met, if applicable.

e) for photochromic filters, the permissible relative change as described in Table 15 shall be measured in the faded state.

f) for photochromic filters, the photochromic response $\tau_{v,0}/\tau_{v,1}$ shall be ≥1,25.

Table 15 — Permissible relative change in luminous transmittance following the resistance to UV radiation test

Initial luminous transmittance τ_v (380 nm ≤ λ ≤ 780 nm) %	**Permissible relative change in luminous transmittance for lenses without deliberate filtering effect, UV protective, IR protective and sunglare filters**[a] %
100 > τ_v ≥ 17,8	±5
17,8 > τ_v ≥ 0,44	±10
0,44 > τ_v ≥ 0,023	±15
0,023 > τ_v ≥ 0,001 2	±20
0,001 2 > τ_v ≥ 0,000 023	±30

[a] Calculated relative to the initial value.

7.7 Resistance to corrosion

Following the resistance to corrosion test in accordance with ISO 18526-3:2020, 6.9, the intended use of all exposed metal parts of the protector shall not be affected. No metallic part that would come into direct contact with the user during intended use shall show signs of corrosion. The test shall be verified by physical inspection in accordance with ISO 18526-3:2020 6.1.

7.8 Resistance to ignition

All exterior parts of protectors that are exposed (excluding headbands) when worn shall be tested in accordance with ISO 18526-3:2020, 6.10, and shall not ignite or continue to glow after removal of the heated rod.

7.9 Penetration of vents and gaps

When eye protectors have provision for ventilation or gaps between components, the openings shall prevent the entry of a rigid rod $1{,}5\ ^{+0{,}02}_{0}$ mm in diameter when tested in accordance with ISO 18526-3:2020, 7.5.

7.10 High-speed impact resistance, impact level C, D, E (optional requirement)

7.10.1 Protection at normal ambient temperatures

Protectors intended to provide protection against high-speed particles shall withstand the impact of a steel ball with a diameter[2)] of $6\,\text{mm}^{\ 0}_{-0{,}25}\,\mu\text{m}$ and 0,86 g minimum mass (see ISO 3290-1:2014, Table 2) aimed at both the corneal apex along the visual axis and at the outer canthus of the headform in accordance with ISO 18526-4 along a perpendicular to the visual axis, at one of the velocities given in Table 16. Protectors offering protection against high-speed particles shall provide lateral protection by a wraparound design or permanently attached side shields. Permanently attached means not removable without the use of special tools or destroying the frame.

Table 16 — Impact velocities for assessment of high-speed impact

	Impact velocity of the ball		
	$\left(45^{+1,5}_{0}\right)$ m/s	$\left(80^{+2,0}_{0}\right)$ m/s	$\left(120^{+3,0}_{0}\right)$ m/s
Impact level	**C**	**D**	**E**
Minimum area to be protected	Orbital protection zone (OPZ)	Extended orbital protection zone (EOZ)	Face protection zone (FPZ)

NOTE Depending on the possible hazards of certain applications, the choice of the appropriate type of protector could be restricted according to the guidance document (ISO 19734) for the selection, use and maintenance of eye and face protectors, which is in preparation.

The test shall be done in accordance with ISO 18526-3:2020, 7.3.2.1, conducted at an ambient temperature of (23 + 5) °C.

There are four impact points, and these are defined with respect to the headform rather than the protector. The ball is aimed at these impact points with the protector in the as-worn position.

The four impact points are defined as follows:

a) the left eye, frontal;

b) the right eye, frontal;

2) Laboratories need only to verify the diameter to within a tolerance of ±0,05 mm.

c) the left eye, lateral;

d) the right eye, lateral.

Frontal impact: The ball is directed perpendicular to the vertical plane through the two corneal vertices (denoted by ✳ in Figures 2 to 4) to anywhere within an area of (10 ± 1) mm radius centred on the corneal vertex. This is carried out for the right and the left eyes.

Lateral impact: The ball is along directed a line through or parallel to that through the two lateral canthi (the location of the edge of the bony orbit and represented as + in Figures 2 to 4) to anywhere within an area of (10 ± 1) mm radius centred on the lateral canthus. This is carried out for the right and the left eyes.

The headform may be moved horizontally and vertically to select any single impact point lying within this (10 ± 1) mm of the specified impact centres.

If the material and/or the thickness of the face protector covering the area to be protected vary, additional impact points (40 ± 1) mm below the frontal impact points a) and b) shall be performed.

New protectors may be used for each individual impact at the manufacturer's request. In the case of failure after multiple impacts on the same test sample, one new test sample for each individual impact point shall be used.

After testing for protection from frontal and lateral impact in accordance with ISO 18526-3:2020, 7.3.2.1 at (23 + 5) °C, the following defects of the lens, filter, protector housing or frame shall not be allowed when inspected in accordance with ISO 18526-3:2020, 6.1:

a) cracking through the entire thickness into two or more pieces;

b) the protector separates into two or more pieces;

c) the lens or filter has become dislodged from its normal position;

d) material becomes detached from the surface opposite to that impacted;

e) the ball passes through the protector; or

f) an indication that there has been contact of the ball or the protector with the eye of the test headform.

For a protector provided with a prescription insert behind the protector lens the following defects shall not be allowed when inspected in accordance with ISO 18526-3:2020, 6.1:

— when mounted with nominal 2 mm plano untempered glass lenses for the purposes of the test, either lens cracks through the entire thickness or physically separates into two or more pieces; or

— if contact is made with the eye of the test headform by the ball, frame, lens or any part of fragment of these.

7.10.2 Protection at extremes of temperature

The requirements of 7.10.1 shall be met when the specified impact is carried out under the following conditions in accordance with ISO 18526-3:2020, 7.3.2.2:

a) with the protector heated to a temperature of (55 ± 2) °C;

b) with the protector cooled to a temperature of (–5 ± 2) °C.

Where a more extreme temperature is specified by the manufacturer, the appropriate temperature with an accuracy of ±2 °C shall be substituted for the relevant test condition.

If requirements for 7.10.2 are met, it is not necessary to also test the protector at ambient temperature (23 ± 5) °C.

7.11 High mass impact, impact level HM (optional requirement)

7.11.1 Protection at normal ambient temperatures

Protectors intended to provide protection against high mass objects moving at moderate speeds shall withstand the impact of a pointed steel projectile weighing $\left(500^{+50}_{0}\right)$ g and a diameter of (25,40 ± 0,05) mm, having an angle of (30 ± 1)° between the sides of conical tip with a $\left(3{,}0^{+0{,}3}_{0}\right)$ mm spherical radius dropped from a height of $\left(1{,}27^{+0{,}03}_{0}\right)$ m onto its outer surface.

The two impact points are defined as follows:

a) the left eye, frontal;

b) the right eye, frontal.

Frontal impact: The steel projectile is directed perpendicular to the vertical plane through the two corneal vertices (denoted by ✳ in Figures 1 to 4) to anywhere within an area of (10 ± 1) mm radius centred on the corneal vertex. This is carried out for the right and the left eyes.

New protectors may be used for each individual impact at the manufacturer's request. In the case of failure after multiple impacts on the same test sample, one new test sample for each individual impact point shall be used.

After testing for protection from frontal impact in accordance with ISO 18526-3:2020, 7.3.3.1 at (23 ± 5) °C, the following defects of the lens, filter, protector housing or frame shall not be allowed when inspected in accordance with ISO 18526-3:2020, 6.1:

a) cracking through the entire thickness into two or more pieces;

b) the protector separates into two or more pieces;

c) the lens or filter has become dislodged from its normal position;

d) material becomes detached from the surface opposite to that impacted;

e) the point of the projectile pierces the lens or filter in its entire thickness and projects through the back surface; or

f) an indication that there has been contact of the projectile or the protector with the eye of the test headform.

For a protector provided with a prescription insert behind the protector lens the following defects shall not be allowed when inspected in accordance with ISO 18526-3:2020, 6.1:

— when mounted with nominal 2 mm thick afocal uncoated hard resin lenses (allyl diglycol carbonate) for the purposes of the test, either lens cracks through the entire thickness or physically separates into two or more pieces; or

— if contact is made with the eye of the test headform by the projectile, frame, lens or any part of fragment of these.

7.11.2 Protection at extremes of temperature

The requirements of 7.11.1 shall be met when the specified impact is carried out under the following conditions in accordance with ISO 18526-3:2020, 7.3.3.2:

a) with the protector heated to a temperature of (55 ± 2) °C;

b) with the protector cooled to a temperature of (−5 ± 2) °C;

Where a more extreme temperature is specified by the manufacturer, the appropriate temperature with an accuracy of ±2 °C shall be substituted for the relevant test condition.

If requirements for 7.11.2 are met, it is not necessary to also test the protector at ambient temperature (23 ± 5) °C.

7.12 Resistance to surface damage due to flying fine particles (optional requirement)

If the surface of the lens or filter (except welding filters) is claimed to be resistant to surface damage by flying fine particles, the resulting values for wide angle scatter shall not exceed 8 % when tested in accordance with ISO 18526-3:2020, 7.4, and ISO 18526-2:2020, 14.1.

7.13 Resistance to fogging of lenses or filters (optional requirement)

If the surface of the lens or filter is claimed to be fog resistant, then the time to fog shall be not less than 8 s when tested in accordance with ISO 18526-3:2020, 6.11. An initial fogging for ≤0,5 s shall not constitute a failure.

NOTE This is a test of a lens or filter alone. There is no accepted test for the resistance to fogging of assembled protectors under all conditions of use.

7.14 Protection against molten metals and hot solids (optional requirement)

Face protectors (with the exception of mesh protectors which are unsuitable) intended to provide protection against molten metals and hot solids shall be considered to be satisfactory if:

a) the area to be protected by the face protector covers the face protection zone in accordance with 7.1.3;

b) when tested and assessed in accordance with ISO 18526-3:2020, 7.6.1, the face protector prevents the adherence of molten metal to the portion of the face protector that affords protection to the area to be protected in Figure 4 and 7.1.3;

c) the face protector satisfies the requirements for one of the three impact levels given in 7.10.1;

d) complete penetration of lenses or filters within the area to be protected does not occur within 5 s when tested in accordance with ISO 18526-3:2020, 7.6.2;

e) complete penetration of all types of frames, housings, browguards, etc. does not occur within 7 s when tested in accordance with ISO 18526-3:2020, 7.6.2;

7.15 Protection against droplets (optional requirement)

When tested in accordance with ISO 18526-3:2020, 6.12, protectors (with the exception of mesh protectors which are unsuitable) intended for use against droplets shall be considered to be satisfactory if:

a) the minimum area to be protected by the protector covers the extended orbital protection zone in accordance with Figure 3 and 7.1.2.

b) no pink or crimson colouration appears in the lens or filter regions defined by the extended orbital protection zone. No account shall be taken of any such colouration up to a distance of 6 mm inside the edges of the protector.

7.16 Protection against streams of liquids (Optional requirement)

When tested in accordance with ISO 18526-3:2020, 6.13, protectors (with the exception of mesh protectors which are unsuitable) intended for use against streams of liquids shall be considered to be satisfactory if:

a) the minimum area to be protected by the protector covers the extended orbital protection zone in accordance with Figure 3 and 7.1.2;

b) the blotting paper covered by the lens or filter regions does not become wet.

7.17 Protection against large dust particles (optional requirement)

When tested in accordance with ISO 18526-3:2020, 6.14, protectors intended for use against large dust particles shall be considered to be satisfactory if the reflectance after the test is not less than 80 % of its value before the test.

7.18 Protection against gases and fine dust (optional requirement)

When tested in accordance with ISO 18526-3:2020, 6.15, protectors intended for use against gases and fine dust particles shall be considered to be satisfactory if no pink or crimson colouration appears in the area covered by the protector. No account shall be taken of any such colouration up to a distance of 6 mm inside the edges of the protector.

7.19 Protection against radiant heat (optional requirement)

Protectors that claim protection against radiant heat shall have head mounted or helmet mounted face shields with infrared protective filters and shall fulfil the requirement of Figure 4 and 7.1.3.

When tested in accordance with ISO 18526-3:2020, 6.16, the temperature measured on the headform behind the face shield shall not increase by more than 25 °C above the initial sensor temperature during the $3\,\text{min}^{+10}_{0}$ s exposure. The protector shall show no damage (e.g. melting, softening or dripping of material) after irradiation.

7.20 Chemical resistance (optional requirement)

Protectors intended to provide chemical resistance shall be tested against at least the chemicals listed in Table 17. A minimum of two protectors shall be tested for each chemical. After exposure in accordance with ISO 18526-3:2020, 6.17, followed by thorough rinsing in clean water and drying, the protectors shall continue to fulfil the following requirements:

a) there shall be no visible distortion of the protector when assessed in accordance with ISO 18526-3:2020, 6.6;

b) refractive power and prismatic power shall continue to comply with 5.2 and wide angle scatter shall continue to comply with 6.5;

c) one protector shall be assessed on one subject for aspects of practical performance. Continued operation of any incorporated mechanisms shall be assessed. When worn by a test person, security of fastenings and retention shall be assessed when tested in accordance with ISO 18526-3:2020, 6.5.

d) protection against high-speed particles in accordance with 7.10, at the appropriate impact level, assessed on two test samples (one frontal impact and one lateral impact);

e) resistance to ignition in accordance with 7.8 without further conditioning, cleaning or application of anti-fogging treatments, assessed on one test sample.

Where testing is carried out using chemicals in addition to those listed in Table 17, details shall be included in the information supplied with the protector and marking of the protector shall direct the user to this information.

Table 17 — Minimum list of chemicals for resistance testing of protectors

Chemical	Concentration (mass) %
Sulfuric acid (purity 96 %)	30 ± 2 (aqueous)
Sodium hydroxide (purity 99 %)	10 ± 1 (aqueous)
p-xylene (purity 99 %)	Undiluted
Butan-1-ol (purity 99 %)	Undiluted
n-heptane (purity 99 %)	Undiluted

7.21 Use in explosive atmospheres (optional requirement)

For protectors that are intended to be used in explosive atmospheres and if the principal ignition source is electrostatic, an evaluation based on requirements in accordance with ISO 80079-36:2016, Annex D, shall be carried out.

NOTE ISO 80079-36 is not specific to PPE but ignition due to electrostatic charges on the PPE can be evaluated by following this document.

8 Marking of protectors

8.1 General

When checked in accordance with ISO 18526-3:2020, Clause 8, all markings should be clear and sufficiently durable to remain legible throughout the intended lifetime of the protector.

The marking shall be fully visible when the complete protector is assembled. The marking shall not encroach into the minimum field of view. If the lenses or filters and frame front form a single unit, the complete marking shall be applied to at least one of the frame front or one of the lenses or filters.

Since the basic impact level is the default minimum mechanical strength level, no specific code letter is assigned for this marking.

For protectors that claim compliance with this document, the marking shall show only those aspects from those listed in Table 18 that have been proved by testing.

Table 18 — Code letters/code numbers for marking of protectors

Code letters/code numbers for marking of protectors	Requirements
16321	Basic use
1	Enhanced optical performance (marking optional)
3	Droplets
4	Large dust particles
5	Gas and fine dust particles
6	Streams of liquid
7	Radiant heat
9	Molten metals and hot solids
CH	Chemical resistance

Table 18 *(continued)*

Code letters/code numbers for marking of protectors	Requirements
K	Surface damage by fine particles
N	Resistance to fogging
C	Impact level C (45 m/s)
D	Impact level D (80 m/s)
E	Impact level E (120 m/s)
HM	Impact level HM
CT	Impact level C (45 m/s) at extremes of temperature
DT	Impact level D (80 m/s) at extremes of temperature
ET	Impact level E (120 m/s) at extremes of temperature
HMT	Impact level HM at extremes of temperature

8.2 Mandatory markings on lenses/filters

For lenses or filters the sequence of markings shall be:

a) manufacturer's identifying mark or manufacturer's trade mark;

b) filtering performance code letter (U, R, GL, GLR, SF, etc.), if applicable;

d) enhanced infrared absorption or reflection if applicable;

c) shade number(s), if applicable;

e) impact level;

Specific national or regional regulations with regard to marking should be observed.

Table 19 — Overview of filter markings

Filters	Code letter	Meet requirements for colour detection of signal lights	Infrared absorption	Enhanced IR reflectance	Shade number
UV filter	U	L (optional)	Not applicable	Not applicable	1,2 to 5 (see Table 5)
IR filter	R	L (optional)	Not needed	R	1,1 to 10 (see Table 6)
Sunglare filters for occupational use	G	L	R	Not applicable	0 to 3 (see Table 8)
		L (optional)			4 (see Table 8)

8.3 Mandatory markings on frames

For frames the sequence of markings shall be:

a) number of this document (i.e. 16321);

b) manufacturer's identifying mark or manufacturers trade mark;

c) filtering performance code letter (U, R, GL, SF, etc.), if 6.6 is applicable;

d) maximum shade number(s), if 6.6 is applicable;

e) impact level; if the impact level symbols are not equal for both the lens and the frame, then it is the lower level that shall be assigned to the complete protector;

f) applicable head size:

If the manufacturer wishes to indicate the size of the headform(s) (according to ISO 18526-4) that the protector will fit, the following symbols shall be added to the product marking:

— a single size is given by its respective symbol: 1-C12, 1-S, 1-M, 1-L, or 2-S, 2-M, 2-L

— multiple sizes are given by the symbols of the smallest and the largest size respectively, divided by a slash e.g. 1-M/1-L, 2-M/2-L

Specific national or regional regulations with regard to marking should be observed.

8.4 Optional markings on lenses/filters

For lenses or filters, where applicable and tested, the sequence of additional possible markings is:

a) model identification;

b) claim for enhanced optical performance;

c) extremes of temperature for mechanical tests;

d) resistance to surface damage;

e) resistance of lens/filter to fogging;

f) resistance to chemicals;

g) resistance to molten metals and hot solids;

h) protection against radiant heat.

NOTE Specific national or regional regulations with regard to marking might make these optional markings mandatory.

8.5 Optional markings on frames

For frames, where applicable and tested, the sequence of additional possible markings is:

a) model identification;

b) extremes of temperature for mechanical tests;

c) resistance to droplets;

d) resistance to streams of liquids;

e) resistance to large dust particles;

f) resistance to gas/fine dust;

g) resistance to chemicals;

h) resistance to molten metals and hot solids;

i) protection against radiant heat.

NOTE Specific national or regional regulations with regard to marking might make these optional markings mandatory.

8.6 Examples of markings

Face shield:

16321 XX CT 6 9					
16321	**XX**	**C**	**T**	**6**	**9**
document number	manufacturer's identification	Impact level C	at extremes of temperatures	resistance to streams of liquids	resistance to molten metal and hot solids

UV protective goggle:

16321 XX U2 D 3 CH						
16321	**XX**	**U**	**2**	**D**	**3**	**CH**
document number	manufacturer's identification	UV protective filter	scale number	Impact level D	protection against droplets	chemical resistance

9 Information to be supplied by the manufacturer

The manufacturer shall provide with each protector at least the following printed information which is to be assessed in accordance with ISO 18526-3:2020, Clause 9:

NOTE Specific national or regional regulations with regard to information to be supplied by the manufacturer might have additional and/or different mandatory requirements. For example, different wording of the warning statements but with the same intent may be permissible.

a) name and address of the manufacturer;

b) a reference to this document (i.e. ISO 16321-1:2021);

c) the protector model identification;

d) instructions for storage, use and maintenance;

e) specific instructions for cleaning and/or disinfection;

f) details of the field of use, ambient range of intended use, protection capabilities and performance characteristics;

g) the applicable headforms in accordance with ISO 18526-4, e.g. "This protector is appropriate for the headform 1-S." This information shall be in the form of either markings on the frame, see 8.5, or separate information on labels, packaging, hang tags, etc., that accompanies the protector at the point of sale.

h) for protectors with non-uniform spectral transmittance in the visible region, add a warning "Protector can affect the recognition of colours and / or signal light detection."

i) the following warning: "Protectors that have been subject to impact shall not be used and shall be discarded and replaced."

j) the following warning: "If the impact level symbols are not equal on both the lens/filter and the frame, then it is the lower level that shall be assigned to the complete protector."

k) the following warning: "The protections corresponding to the code numbers/letter 7, 9, CH are provided by the complete protector only if the respective symbols are equal on both the lens and the frame."

l) details of any aspects of performance that have been assessed at extremes of temperatures and the corresponding temperature limits;

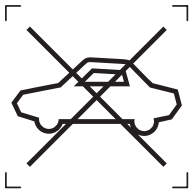
m) details of suitable accessories and spare parts; instructions for fitting shall be included with the original protector and/or with the spare part or accessory;

n) explanation of the meaning of the marking on the frame and the lens/filter;

o) how to recognize when the protector shall be repaired or replaced;

p) when the filter has a luminous transmittance of less 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 condition of dull light". The same warning applies to photochromic filters for which the luminous transmittance in the faded condition is less than 75 %.

q) if the requirement of field of view and/or transmittance for driving are not fulfilled the warning: "Not suitable for driving and road use" and/or the pictogram in accordance with ISO 7000, Reference No:2952A or 2952B, (see also Figure 5) shall be added.



a) ISO 7000-2952A

b) ISO 7000-2952B

Figure 5 — Symbol: "Not suitable for driving and road use"

10 Allocation of requirements, test samples and application

10.1 General test samples

Allocation of requirements and tests is given for unmounted and mounted lenses or filters in Table 20, and for frames and complete protectors in Table 21.

Test samples may be reused. If a reused test sample fails, a new test sample shall be used for that test.

Table 20 — Allocation of requirements, clauses and number of test samples for unmounted and mounted lenses or filters, where applicable

Requirements	Clause	Number of test samples							Comment
		Lenses without deliberate filter action	UV filters	IR filters	Sunglare filters for occupational use	Welding filters	Filters for use in glass blowing	Cover plates	
Physiological compatibility and construction and adjustment	4.2; 4.3	1	1	1	1	1	1	1	
Cleaning and/or disinfection	4.4	1	1	1	1	1	1	1	

Table 20 *(continued)*

Requirements	Clause	Number of test samples							Comment
		Lenses without deliber-ate filter action	UV filters	IR filters	Sunglare filters for occu-pational use	Welding filters	Filters for use in glass blowing	Cover plates	
Field of view	4.5; 5.1	1	1	1	1	1	1	1	For each claimed headform
Refractive power and prismatic power	5.2	6	6	6	6	6	6	6	3 left and 3 right lenses
Mounted prescription lenses	5.3	See 10.2	See 10.2	See 10.2	See 10.2				
Single-vision ready-to-wear near-vision lenses (lenses with positive spherical power)	5.4	See 10.2	See 10.2	See 10.2	See 10.2				
Enhanced optical performance	5.5	6	6	6	6	6	6	6	3 left and 3 right lenses
Luminous transmittance	6.2	6						6	3 left and 3 right lenses
Uniformity	6.4		6	6	6	6	6		3 left and 3 right lenses
Scattered light	6.5	6	6	6	6		6	6	3 left and 3 right lenses
Narrow angle scatter for welding filters	ISO 16321-2:2021, 4.3.2					6			
Anti-reflective coated lenses	6.7	6	6	6	6	6	6	6	3 left and 3 right lenses
Quality of material and surface	7.3	6	6	6	6	6	6	6	3 left and 3 right lenses
Minimum robustness for unmounted welding filters	ISO 16321-2:2021, 4.3.3					8			
Resistance to thermal exposure	7.5	3	3	3	3	3	3	3	samples from the optical testing shall be used
Resistance to UV radiation	7.6	3	3	3	3		3	3	samples from the optical testing shall be used
Resistance to UV radiation for welding filters	ISO 16321-2:2021, 4.3.4					3			
Resistance to ignition	7.8	2	2	2	2	2	2	2	samples can be used from mechanical testing
Marking of protectors	8.2 8.4	1	1	1	1		1	1	samples can be used from mechanical testing
Marking of welding protectors	ISO 16321-2:2021, 6.2; 6.4					1			
Marking of mesh protectors	ISO 16321-3:2021, 5.2; 5.4	1							
Information to be supplied by the manufacturer	Clause 9	1	1	1	1		1	1	
Information to be supplied by the manufacturer for welding protectors	ISO 16321-2:2021, Clause 7					1			

Table 20 *(continued)*

Requirements	Clause	Number of test samples							Comment
		Lenses without deliberate filter action	UV filters	IR filters	Sunglare filters for occupational use	Welding filters	Filters for use in glass blowing	Cover plates	
Information to be supplied by the manufacturer for mesh protectors	ISO 16321-3:2021, Clause 6	1							
Transmittance of ultraviolet protective filters	6.3.1		6						3 left and 3 right lenses
Transmittance of infrared protective filters	6.3.2			6					3 left and 3 right lenses
Transmittance of sunglare filters for occupational use	6.3.3; 6.1				6				3 left and 3 right lenses
Transmittance of welding filters	ISO 16321-2:2021, 4.3.1					6			3 left and 3 right lenses
Transmittance of automatic welding filters	ISO 16321-2:2021, 4.4.2					6			
Transmittance variation over time of automatic welding filters	ISO 16321-2:2021, 4.4.3					6			
Uniformity of luminous transmittance and transmittance matching for flat automatic welding filters	ISO 16321-2:2021, 4.4.4.2					6			
Angular dependence of luminous transmittance for flat automatic welding filters	ISO 16321-2:2021, 4.4.4.3					6			
Combined uniformity and angular dependence of luminous transmittance for curved automatic welding filters	ISO 16321-2:2021, 4.4.4.4					6			
Switching time and holding time of automatic welding filters	ISO 16321-2:2021, 4.4.5					6			
Manual control of dark shade number of automatic welding filters	ISO 16321-2:2021, 4.4.6					6			
Resistance to thermal exposure of automatic welding filters	ISO 16321-2:2021, 4.4.7					3			
Optical sensitivity of welding arc detection by automatic welding filters	ISO 16321-2:2021, 4.4.8					6			

Table 20 *(continued)*

Requirements	Clause	Number of test samples							Comment
		Lenses without deliberate filter action	UV filters	IR filters	Sunglare filters for occupational use	Welding filters	Filters for use in glass blowing	Cover plates	
Resistance to surface damage due to fine flying particles of automatic welding filters	ISO 16321-2:2021, 4.4.9					3			
Transmittance for glass blowing filters	6.3.4						6		3 left and 3 right lenses
Molten metals and hot solids	7.14	3	3	3	3	3	3		1 aluminium, 1 iron, 1 hot penetration
Resistance to surface damage due to flying fine particles	7.12	3	3	3	3	3	3		3 lenses
Resistance to fogging of lenses or filters	7.13	3	3	3	3	3	3		3 lenses
Chemical resistance	7.20	10	10	10	10	10	10		2 samples per chemical; samples can be used from mechanical testing
Number of apertures in mesh protectors	ISO 16321-3:2021, 4.3	3							
Contact with metal parts of mesh protectors	ISO 16321-3:2021, 4.4	3							
Reflection from mesh protectors	ISO 16321-3:2021, 4.5	3							
Luminous transmittance of mesh protectors	ISO 16321-3:2021, 4.2	3							

Table 21 — Allocation of requirements, clauses and number of samples for frames and complete protectors (if applicable)

Requirements	Clause	Application					Comment
		Protectors without deliberate filter action	Protectors with UV, IR protective and sun-glare filters	Welding protectors	Protectors for glass blowing	Mesh protectors	
Physiological compatibility and construction and adjustment	4.2; 4.3	1	1	1	1	1	
Headbands and harnesses	7.2	1	1	1	1	1	
Cleaning and/or disinfection	4.4	1	1	1	1	1	
Area to be protected	4.5; 7.1	1	1	1	1	1	For each claimed headform
Area to be protected for welding helmets	ISO 16321-2:2021, 5.2.1			1			For each claimed headform

Table 21 *(continued)*

Requirements	Clause	Application					Comment
		Protectors without deliberate filter action	Protectors with UV, IR protective and sun-glare filters	Welding protectors	Protectors for glass blowing	Mesh protectors	
Field of view	4.5; 5.1	1	1	1	1	1	For each claimed headform
Field of view for welding protectors	ISO 16321-2:2021, 4.2			1			For each claimed headform
Refractive power	5.2.1; 5.2.2	3	3	3	3		3 left and 3 right lenses
Prism imbalance	5.2.4	3	3	3	3		3 pairs of lenses
Mounted prescription lenses	5.3	See 10.2	See 10.2				
Single-vision ready-to-wear near-vision lenses (lenses with positive spherical power)	5.4	See 10.2	See 10.2				
Enhanced optical performance	5.5	3	3	3	3		3 left and 3 right lenses
Luminous transmittance	6.2	3					3 left and 3 right lenses
Uniformity	6.4		3	3	3		3 left and 3 right lenses
Scattered light	6.5	3	3		3		3 left and 3 right lenses
Narrow angle scatter for welding filters	ISO 16321-2:2021, 4.3.2			6			
Anti-reflective coated lenses	6.7	3	3	3	3		3 left and 3 right lenses
Quality of material and surface	7.3	6	6	6	6	6	
Basic impact level	7.4	8	8	8	8	8	4 at each temperature
Resistance to thermal exposure	7.5	3	3	3	3	3	samples from the optical testing shall be used
Resistance to UV radiation	7.6	2	2		2		2 left and 2 right Samples from the optical testing shall be used
Resistance to UV radiation for welding filters	ISO 16321-2:2021, 4.3.4			3			
Resistance to ignition	7.8	2	2	2	2	2	each component needs to be tested on ignition samples can be used from mechanical testing
Resistance to corrosion	7.7	2	2	2	2	2	For all metal parts
Lateral protection	4.5; 7.1.4	1	1	1	1	1	For each claimed headform
Penetration of vents and gaps	7.9	1	1	1	1	1	
Drop robustness for welding protectors	ISO 16321-2:2021, 5.2.3			3			at each temperature

Table 21 *(continued)*

Requirements	Clause	Application					Comment
		Protectors without deliberate filter action	Protectors with UV, IR protective and sun-glare filters	Welding protectors	Protectors for glass blowing	Mesh protectors	
Electrical insulation of welding helmets and welding hand shields	ISO 16321-2:2021, 5.2.4			3			
Resistance to penetration by hot solid of welding helmets and welding hand shields	ISO 16321-2:2021, 5.2.5			3			
Marking of protectors	Clause 8	1	1		1		samples from impact level test can be used
Marking of welding protectors	ISO 16321-2:2021, Clause 6			1			
Marking of mesh protectors	ISO 16321-3:2021, Clause 5					1	
Information to be supplied by the manufacturer	Clause 9	1	1		1		
Information to be supplied by the manufacturer for welding protectors	ISO 16321-2:2021, Clause 7			1			
Information to be supplied by the manufacturer for mesh protectors	ISO 16321-3:2021, Clause 6					1	
Transmittance of ultraviolet protective filters	6.3.1		3				3 left and 3 right lenses
Transmittance of infrared protective filters	6.3.2		3				3 left and 3 right lenses
Transmittance of sunglare filters for occupational use	6.3.3; 6.1		3				3 left and 3 right lenses
Transmittance of welding filters	ISO 16321-2:2021, 4.3.1			6			3 left and 3 right lenses
Transmittance of automatic welding filters	ISO 16321-2:2021, 4.4.2			6			
Luminous transmittance variation over time for automatic welding filters	ISO 16321-2:2021, 4.4.3			6			
Uniformity of luminous transmittance and transmittance matching for flat automatic welding filters	ISO 16321-2:2021, 4.4.4.2			6			
Angular dependence of luminous transmittance for flat automatic welding filters	ISO 16321-2:2021, 4.4.4.3			6			

Table 21 *(continued)*

Requirements	Clause	Application					Comment
		Protectors without deliberate filter action	Protectors with UV, IR protective and sun-glare filters	Welding protectors	Protectors for glass blowing	Mesh protectors	
Combined uniformity and angular dependence of luminous transmittance for curved automatic welding filters	ISO 16321-2:2021, 4.4.4.4			6			
Switching time and holding time of automatic welding filters	ISO 16321-2:2021, 4.4.5			6			
Manual control of dark shade number for automatic welding filters	ISO 16321-2:2021, 4.4.6			6			
Resistance to thermal exposure for automatic welding filters	ISO 16321-2:2021, 4.4.7			3			
Optical sensitivity of welding detection by automatic welding filters	ISO 16321-2:2021, 4.4.8			6			
Transmittance for glass blowing filters	6.3.4				6		
Frame transmittance	6.6		3		3		
Non-filter area transmittance	ISO 16321-2:2021, 5.1.1			3			
Luminous reflectance of welding helmets and welding hand shields	ISO 16321-2:2021, 5.1.2			3			
Light tightness of welding protectors	ISO 16321-2:2021, 5.2.2			2			
High-speed impact resistance, impact level C,D,E	7.10.1	12	12	12	12	12	
High-speed impact resistance at extremes of temperatures, impact level CT,DT,ET	7.10.2	12	12	12	12	12	6 per temperature
High Mass impact, impact level HM	7.11.1	4	4	4	4	4	2 per impact point
High Mass impact at extremes of temperatures, impact level HMT	7.11.2	4	4	4	4	4	2 per temperature
Protection against molten metals and hot solids	7.14	3	3	3	3		1 aluminium, 1 iron, 1 hot penetration
Protection against droplets	7.15	2	2	2	2		
Protection against streams of liquids	7.16	2	2	2	2		

Table 21 *(continued)*

Requirements	Clause	Application					Comment
		Protectors without deliberate filter action	Protectors with UV, IR protective and sun-glare filters	Welding protectors	Protectors for glass blowing	Mesh protectors	
Protection against large dust particles	7.17	2	2		2		
Protection against gases and fine dust	7.18	2	2		2		
Protection against radiant heat	7.19	2	2	2	2		
Resistance to surface damage due to flying fine particles	7.12	2	2	2	2		3 lenses
Resistance to fogging of lenses or filters	7.13	2	2	2	2		3 lenses
Chemical resistance	7.20	10	10	10	10		2 per chemical
Use in explosive atmospheres	7.21	2	2	2	2	2	
Number of apertures in mesh protectors	ISO 16321-3:2021, 4.3					3	
Contact with metal parts of mesh protectors	ISO 16321-3:2021, 4.4					3	
Reflection from mesh protectors	ISO 16321-3:2021, 4.5					3	
Luminous transmittance of mesh protectors	ISO 16321-3:2021, 4.2					3	

10.2 Test samples for prescription lenses for eye protectors

In order that the mechanical and refractive power requirements of prescription lenses for eye protectors be satisfied, samples shall be chosen giving due consideration of the worst-case combinations of material, lens size, refractive power/thickness and lens design. The combinations specified below shall be included in the testing, namely

a) single-vision lenses,

b) multifocal (if applicable), and

c) power-variation[3)] lenses (if applicable).

10.2.1 Single-vision lenses

The single-vision lens worst cases are as follows:

a) highest plus sphere power;

b) highest (arithmetic) minus sphere power;

c) highest minus sphere/cylinder power combination;

d) minus 1,50 D sphere.

3) Power-variation lenses include progressive-power and degressive-power lenses.

10.2.2 Multifocal lenses

The surface discontinuity of discontinuity-based multifocal products represents a possible origin for failure of the material on impact. A distance plano near addition 2,00 D with the segment top 2,0 mm below boxed centre shall be included as part of the worst case.

10.2.3 Power-variation lenses

Power-variation lenses do not have characteristics that render them less impact resistant than single vision lenses. They shall be tested only for prescription compliance (see ISO 21987).

10.2.4 Information to be provided by the frame manufacturer

Manufacturers of protector frames intended for prescription use shall make available the specifications of the lenses for which the frames are suitable e.g. lens material, minimum thickness, power range, coatings, etc.

Annex A
(informative)

Summary of mechanical impact levels in eye and face protection for sunglass, occupational and sports use

Drop ball test						Ballistic test				
Sunglass										
Category	**Shape**	**Diameter** mm	**Mass** g	**Drop height** m		**Category**	**Shape**	**Diameter** mm	**Mass** g	**Velocity** m/s
Strength Level 1	ball	16	16	1,27		Strength Level 3	ball	6	0,86	45
Strength Level 2	ball	22	43	1,27						
Occupational										
Category	**Shape**	**Diameter** mm	**Mass** g	**Drop height** m		**Category**	**Shape**	**Diameter** mm	**Mass** g	**Velocity** m/s
Basic impact level	ball	25,4	66,8	1,27		Impact level C	ball	6	0,86	45
						Impact level D	ball	6	0,86	80
Impact level HM (High Mass)	cone		500	1,27		Impact level E	ball	6	0,86	120
Sports										
Category	**Shape**	**Diameter** mm	**Mass** g	**Drop height** m		**Category**	**Shape**	**Diameter** mm	**Mass** g	**Velocity** m/s
Strength Level 2	ball	22	43	1,27		Squash	yellow dot ball	40,0	24,0	40
Impact level HM (High Mass)	cone		500	1,27		Racquet-ball and Squash 57	ball	57,3	39,2	40

NOTE All quantities in this table are nominal. See the applicable product requirement standard for the specified tolerances.

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[1] ISO 3290-1:2014, *Rolling bearings — Balls — Part 1: Steel balls*

[2] ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*

[3] ISO 8980-1, *Ophthalmic optics — Uncut finished spectacle lenses — Part 1: Specifications for single-vision and multifocal lenses*

[4] ISO 8980-2, *Ophthalmic optics — Uncut finished spectacle lenses — Part 2: Specifications for power-variation lenses*

[5] ISO 10110-7, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 7: Surface imperfections*

[6] ISO 10110-18, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 18: Stress birefringence, bubbles and inclusions, homogeneity, and striae*

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

[8] ISO 12609-1, *Eyewear for protection against intense light sources used on humans and animals for cosmetic and medical applications — Part 1: Specification for products*

[9] ISO 12609-2, *Eyewear for protection against intense light sources used on humans and animals for cosmetic and medical applications — Part 2: Guidance for use*

[10] ISO 18527-1, *Eye and face protection for sports use — Part 1: Requirements for downhill skiing and snowboarding goggles*

[11] ISO 18527-2, *Eye and face protection for sports use — Part 2: Requirements for eye protectors for Squash and eye protectors for Racquetball and Squash 57*

[12] ISO 19011, *Guidelines for auditing management systems*

[13] ISO 19734, *Eye and face protection — Guidance on selection, use and maintenance*

[14] ISO/TR 22463, *Patient and client eye protectors for use during laser or intense light source (ILS) procedures — Guidance*

[15] IEC 60825-1, *Safety of laser products — Part 1: Equipment classification and requirements*

[16] IEC/TR 60825-14, *Safety of laser products — Part 14: A user's guide*

[17] IEC 62819[4)], *Live working — Eye, face and head protectors against the effects of electric arc — Test methods and performance requirements*

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[21] International Commission on Non-Ionizing Radiation Protection (ICNIRP)(2013) , ICNIRP guidelines on limits of exposure to incoherent visible and infrared radiation, *Health Phys*, **105**(1): 74–91

4) Under preparation (Stage at the time of publication IEC/CD 62819:2018).

National Annex A

(*National Foreword*)

A-1 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

The manufacturer's claim of meeting optional requirements for lenses/filters and frames shall be suitably marked on the product.

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(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 18526-3 : 2020 Eye and face protection — Test methods — Part 3: Physical and mechanical properties	IS 7524 (Part 3) : 2021 Eye and face protection — Test methods: Part 3 Physical and mechanical properties	Identical
ISO 18526-4 : 2020 Eye and face protection — Test methods — Part 4: Headforms	IS 7524 (Part 4) : 2021 Eye and face protection — Test methods: Part 4 Headforms	Identical

The technical committee has reviewed the provision of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this Standard:

International Standard	*Title*
ISO 4007	Personal protective equipment — Eye and face protection — Vocabulary
ISO 11664-1 : 2007	Colorimetry — Part 1: CIE standard colorimetric observers
ISO 11664-2 : 2007	Colorimetry — Part 2: CIE standard illuminants
ISO 12312-1 : 2013	Eye and face protection — Sunglasses and related eyewear — Part 1: Sunglasses for general use
ISO 16034 : 2002	Ophthalmic optics — Specifications for single-vision ready-to-wear near-vision spectacles
ISO 16321-2 : 2021	Eye and face protection for occupational use — Part 2: Additional requirements for protectors used during welding and related techniques
ISO 21987 : 2017	Ophthalmic optics — Mounted spectacle lenses
ISO 80079-36 : 2016	Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements

The standard also makes a reference to the BIS Certification Marking of the product. Details of which are given in National Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website- www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: CHD 08 (15534).

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