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Eye and face protection for occupational use —

Part 2: Additional requirements for protectors used during welding and related techniques

Protection des yeux et du visage à usage professionnel — Partie 2: Exigences complémentaires relatives aux protecteurs utilisés pour le soudage et les techniques connexes

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This first edition of ISO 16321-2 cancels and replaces ISO 4850:1979.

A list of all parts in the ISO 16321 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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.

Eye and face protection for occupational use —

Part 2: Additional requirements for protectors used during welding and related techniques

1 Scope

This document specifies additional material, design, performance and marking requirements for eye and face protectors designed to provide protection for the eyes and faces of persons against occupational hazards, such as optical radiation, impacts from flying particles and fragments, and hot solids during welding and related techniques. The other applicable requirements for welding protectors are given in ISO 16321-1.

This document also applies to welding protectors used in educational establishments.

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

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 16321-1:2021, *Eye and face protection for occupational use — Part 1: General requirements*

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*

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 Requirements

4.1 General

Only those requirements that are different from or supplement the ISO 16321-1 specifications are given in this document.

The following requirements from ISO 16321-1:2021 shall be met:

— 4.2 to 4.6: General requirements for protectors;

— 5.2: Refractive power and prismatic deviation;

— 6.1: Detection of signal lights, optional;

— 6.4: Uniformity of luminous transmittance (not for automatic welding filters);

— 7.2: Headbands and harnesses;

— 7.3: Quality of material and surface of lenses, visors and filters;

— 7.4: Basic Impact Level (for welding helmets, hand shields, frames or mountings);

— 7.7: Resistance to corrosion, where applicable;

— 7.8: Resistance to ignition;

— 7.9: Penetration of vents and gaps, where applicable;

— 7.10: High-speed impact resistance, Impact Level C, D, E, optional;

— 7.11: High mass impact, Impact Level HM, optional.

The additional requirements given in this document shall be met.

Welding protectors[1)] described in this document are intended for use at temperatures from −5 °C to +55 °C. Physical and mechanical requirements are generally specified 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, optical, physical and mechanical requirements at the extremes of temperature are included (sometimes optionally) in this document. These 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 Field of view

Welding protectors, in the as-worn position, shall have a minimum unobstructed field of view in front of each eye of 8° temporally and 15° nasally in the horizontal meridian, and 24° total in the vertical meridian, when measured at the corneal apex of the headform according to ISO 18526-3:2020, 6.2.

The field of view of peripheral awareness welding filters shall begin no less than 45° temporally from the straight ahead position of gaze. This requirement shall be measured in accordance with ISO 18526-3:2020, 6.2, by using the appropriate headform.

4.3 Requirements for welding filters

4.3.1 Transmittance requirements and scale numbers

4.3.1.1 General

Welding filters are intended to protect against radiation generated by various welding processes, which emit a significant amount of radiation in the UV, visible and IR spectral range. Requirements therefore

1) For the purposes of this document, “welding protector” is used as a synonym for welding helmets, welding hand shields, welding goggles, welding spectacles and the associated frames and mountings including welding filters.

exist in the UV and IR and for glare in the visible spectral range that are taken into account by requiring specific scale numbers.

Welding filters shall be tested in accordance with ISO 18526-2:2020, Clauses 6, 7.1, 7.3, Clauses 8 and 10, and classified according to Table 1.

For the determination of luminous transmittance of welding filters, the luminous transmittance values are based on the spectral distribution for CIE standard illuminant A (see ISO 11664-2) and the CIE (1931) standard observer (2°) (see ISO/CIE 11664-1).

4.3.1.2 Transmittance requirements and scale numbers

The scale numbers of welding filters are defined based on the value of the luminous transmittance in Table 1.

The spectral transmittance requirements are given in Table 1 and the blue-light transmittance, τ_B, shall be less than the luminous transmittance, $\tau_{v,A}$.

Table 1 — Transmittance requirements for welding filters

Scale number	Spectral transmittance $\tau(\lambda)$			Luminous transmittance $\tau_{v,A}$	IR-A transmittance τ_{IRA}	Near IR transmittance τ_{NIR}
	200 nm ≤ λ ≤ 313 nm Maximum %	313 nm ≤ λ ≤ 365 nm Maximum %	365 nm ≤ λ ≤ 400 nm Maximum %	380 nm ≤ λ ≤ 780 nm %	780 nm ≤ λ ≤ 1 400 nm Maximum %	780 nm ≤ λ ≤ 3 000 nm Maximum %
W1,2	0,000 3	50	$\tau_{v,A}$	$100 > \tau_{v,A} \geq 74,4$	30	30
W1,4	0,000 3	35		$74,4 > \tau_{v,A} \geq 58,1$	25	25
W1,7	0,000 3	22		$58,1 > \tau_{v,A} \geq 43,2$	20	20
W2	0,000 3	14		$43,2 > \tau_{v,A} \geq 29,1$	15	15
W2,5	0,000 3	6,4		$29,1 > \tau_{v,A} \geq 17,8$	12	12
W3	0,000 3	2,8		$17,8 > \tau_{v,A} \geq 8,5$	9	9
W4	0,000 3	0,95		$8,5 > \tau_{v,A} \geq 3,2$	5	5
W5	0,000 3	0,30		$3,2 > \tau_{v,A} \geq 1,2$	3,5	3,5
W6	0,000 3	0,10		$1,2 > \tau_{v,A} \geq 0,44$	1,5	1,5
W7	0,000 3	0,050		$0,44 > \tau_{v,A} \geq 0,16$	1	1
W8	0,000 3	0,025		$0,16 > \tau_{v,A} \geq 0,061$	1	1
W9	0,000 3	0,012		$0,061 > \tau_{v,A} \geq 0,023$	1	1
W10	0,000 3	0,006		$0,023 > \tau_{v,A} \geq 0,008\,5$	1	1
W11	0,000 3	0,003 2		$0,008\,5 > \tau_{v,A} \geq 0,003\,2$	1	1
W12	0,000 3	0,001 2		$0,003\,2 > \tau_{v,A} \geq 0,001\,2$	1	1
W13	0,000 3	0,000 44		$0,001\,2 > \tau_{v,A} \geq 0,000\,44$	1	1
W14	0,000 16	0,000 16		$0,000\,44 > \tau_{v,A} \geq 0,000\,16$	1	1
W15	0,000 061	0,000 061		$0,000\,16 > \tau_{v,A} \geq 0,000\,061$	1	1
W16	0,000 023	0,000 023		$0,000\,061 > \tau_{v,A} \geq 0,000\,023$	1	1

NOTE The measurement of spectral transmittance values between 2 800 nm and 3 000 nm might require the purging of the spectrophotometer with dry nitrogen to reduce the influence of water molecules in the air on the transmittance values.

4.3.1.3 Marking of welding filters

Welding filters that meet the transmittance requirements given in Table 1 shall be marked by the code letter W. The code letter W refers to welding filters that can affect detection of signal lights and do not have enhanced reflectance in the infrared spectral range.

The code letter WL refers to welding filters with minimally altered detection of signal lights.

NOTE Information on the appropriate scale numbers to use for specific welding and related applications are given in a guidance document, ISO 19734, for the selection, use and maintenance of eye and face protectors.

4.3.1.4 Additional requirements for peripheral awareness welding filters

The manufacturer shall identify the darkest welding filter that may be used with the welding protector that is fitted with peripheral awareness welding filters.

In addition to the mechanical and thermal requirements of the complete welding protector, peripheral awareness welding filters shall satisfy the following requirements when the transmittances are measured in accordance with ISO 18526-2:2020, Clause 6, using the relevant test methods in accordance with ISO 18526-2:2020, Clauses 7 to 10:

— The blue-light transmittance of a peripheral awareness welding filter, τ_B, shall be less than 5 000 times the luminous transmittance of the darkest filter identified by the manufacturer.

— The maximum spectral transmittance in the ultraviolet and of the maximum near infrared transmittance, τ_{NIR}, of the peripheral awareness welding filters shall comply with the value given in Table 1 for the darkest welding filter identified by the manufacturer.

NOTE In situations when other welders are working beside and in situations where reflected light can be transmitted through the peripheral awareness welding filter, it can be preferable to cover these filters.

4.3.2 Narrow angle scatter (reduced luminance coefficient)

The reduced luminance coefficient l^* of welding filters shall not be greater than 1,0 $(cd \cdot m^{-2}) \cdot lx^{-1}$, when measured in accordance with ISO 18526-2:2020, 14.2.

For automatic welding filters, the reduced luminance coefficient shall be applied to the light state and to all nominal dark states. A higher value for automatic welding filters of up to 3,0 $(cd \cdot m^{-2}) \cdot lx^{-1}$ is allowed, but if the value is between 1,0 $(cd \cdot m^{-2}) \cdot lx^{-1}$ and 3,0 $(cd \cdot m^{-2}) \cdot lx^{-1}$, the symbol ISO 7000-1641 shall be marked on the product and the following note shall be given in the information to be supplied by the manufacturer:

INFORMATION — Scattered light can impair the contrast of the task during welding.

4.3.3 Minimum robustness for unmounted welding filters (Static Load Test)

Unless stated otherwise, the welding filter shall be tested according to ISO 18526-3:2020, 7.2.1, and subsequently examined by a trained observer.

During testing, the welding filter shall not fracture or deform as described below:

a) Fracture: A welding filter is considered to have fractured if:

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

— a trained observer can see either a piece of material that has become detached from the welding filter surface opposite that to which the force has been applied or a corresponding surface defect on this opposite surface.

b) Deformation: A welding filter is considered to have deformed if a mark appears on the contact indicating material on the opposite side to that contacted by the ball.

4.3.4 Resistance to UV radiation

After exposure according to ISO 18526-3:2020, 6.8.3:

a) the relative change of luminous transmittance shall not be greater than the values in Table 2;

b) the value of the reduced luminance coefficient of welding filters shall not exceed the values given in 4.3.2;

c) any applicable UV and/or IR requirements for the initial $\tau_{v,A}$ shall continue to be satisfied.

Table 2 — Permissible relative change in luminous transmittance following the resistance to ultraviolet radiation test

Initial luminous transmittance $\tau_{v,A}$ (380 nm ≤ λ ≤ 780 nm) %	Permissible relative change in luminous transmittance for welding filters[a] %
$100 > \tau_{v,A} \geq 17{,}8$	±5
$17{,}8 > \tau_{v,A} \geq 0{,}44$	±10
$0{,}44 > \tau_{v,A} \geq 0{,}023$	±15
$0{,}023 > \tau_{v,A} \geq 0{,}001\,2$	±20
$0{,}001\,2 > \tau_{v,A} \geq 0{,}000\,023$	±30

[a] Calculated relative to the initial value.

The requirements for resistance to ultraviolet radiation do not apply to automatic welding filters due to the use of protective cover plates.

4.4 Automatic welding filters

4.4.1 General

During a welding process or similar working processes, automatic welding filters attenuate the luminance from a welding arc to a safe non-hazardous level. Automatic welding filters are intended to protect against radiation generated by various welding processes since these emit a significant amount of radiation in the UV, visible and IR spectral range. Requirements therefore exist in the UV and IR and glare in the visible spectral range that are taken into account by requiring specific scale numbers.

Automatic welding filters attenuate the luminance and UV and IR irradiance generated in the welding process to non-hazardous levels. Automatic welding filters incorporates passive filters to reduce the UV and IR irradiance to safe levels even in the inactivated light state and a variable filter to reduce the luminance once the arc is struck. In this light state there is sufficient luminous transmittance to enable mobility, work organization and electrode placement. After the welding arc strikes and within a defined switching time, the luminous transmittance of the filter changes to the shade number that has been set (dark state).