SLOVENSKI STANDARD
SIST EN 208:2010

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Nadomešča:
SIST EN 208:1999
SIST EN 208:1999/A1:2003

Osebno varovanje oči - Varovala za zaščito oči pri nastavljanju laserjev in laserskih sistemov (očala za nastavitev laserjev)

Personal eye-protection - Eye-protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)

Persönlicher Augenschutz - Augenschutzgeräte für Justierarbeiten an Lasern und Laseraufbauten (Laser-Justierbrillen)

Protection individuelle de l'oeil - Lunettes de protection pour les travaux de réglage sur les lasers et sur les systèmes laser (lunettes de réglage laser)

Ta slovenski standard je istoveten z: **EN 208:2009**

ICS:

13.340.20 Varovalna oprema za glavo Head protective equipment

SIST EN 208:2010 **en,fr,de**

EUROPEAN STANDARD

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English Version

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This European Standard was approved by CEN on 21 November 2009.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 208:2009) has been prepared by Technical Committee CEN/TC 85 “Eye protective equipment”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 208:1998.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

The significant technical changes between this European Standard and the previous edition are detailed in Annex C.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard applies to laser adjustment filters and eye-protectors. These are filters and eye-protectors for use in adjustment work on lasers and laser systems as defined in EN 60825-1:2007 where hazardous radiation occurs in the visible spectral range of 400 nm to 700 nm. Filters specified in this European Standard reduce this radiation to values defined for lasers of class 2 (≤ 1 mW for CW (continuous wave) lasers).

This European Standard defines the requirements, test methods and marking. A guide is given in Annex B with regard to selection and use.

EN 207 applies to eye-protection against accidental exposure to laser radiation.

NOTE Before selecting eye protection according to this European Standard a risk assessment should first be undertaken (see Annex B).

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 166:2001, *Personal eye-protection — Specifications*

EN 167:2001, *Personal eye-protection — Optical test methods*

EN 168:2001, *Personal eye-protection — Non-optical test methods*

EN 207:2009, *Personal eye-protection equipment — Filters and eye-protectors against laser radiation (laser eye-protectors)*

ISO 11664-1:2007, *Colorimetry — Part 1: CIE standard colorimetric observers*

ISO 11664-2:2007, *Colorimetry — Part 2: CIE standard illuminants*

3 Requirements

3.1 Spectral transmittance of filters and frames

When tested according to 4.2, the spectral transmittance values of the filters and the frames for the laser wavelength shall be as given in Table 1.

Table 1 — Scale numbers, spectral transmittance and maximum laser power

Scale number	Spectral transmittance		CW and pulse lasers with a pulse duration of $\geq 2 \times 10^{-4}$ s	Pulse lasers with a pulse duration of $> 10^{-9}$ s to 2×10^{-4} s
	Filter	Frame	Maximum laser power W	Maximum pulse energy J
RB 1	$10^{-2} < \tau(\lambda) \leq 10^{-1}$	$\tau(\lambda) \leq 10^{-1}$	0,01	2×10^{-6}
RB 2	$10^{-3} < \tau(\lambda) \leq 10^{-2}$	$\tau(\lambda) \leq 10^{-2}$	0,1	2×10^{-5}
RB 3	$10^{-4} < \tau(\lambda) \leq 10^{-3}$	$\tau(\lambda) \leq 10^{-3}$	1	2×10^{-4}
RB 4	$10^{-5} < \tau(\lambda) \leq 10^{-4}$	$\tau(\lambda) \leq 10^{-4}$	10	2×10^{-3}
RB 5	$10^{-6} < \tau(\lambda) \leq 10^{-5}$	$\tau(\lambda) \leq 10^{-5}$	100	2×10^{-2}

3.2 Luminous transmittance of filters

When tested in accordance with 4.3, the luminous transmittance of the filter relative to the D65 standard illuminant (see ISO 11664-2:2007) shall be at least 20 %. However, luminous transmittance lower than 20 % can be accepted provided that the manufacturer supplies information related to the increase of the intensity of illumination at the relevant workplace in accordance with Clause 5.

3.3 Resistance of filters and frames to laser radiation

When tested according to 4.4, the filters and frames shall meet the requirements of 3.1 and shall not lose their protective effect under the influence of laser radiation of the power (E) or energy density (H) as specified in Table 2 for a period of at least 5 s and for 50 pulses in case of pulsed lasers. The values of energy density (H) for testing the resistance against laser radiation for pulsed lasers should be multiplied with the factor $N^{-1/4}$, where N is the number of pulses in 5 s, if the pulse durations is between 10^{-9} and 2×10^{-4} s and the pulse series is fast (frequency > 0,1 s^{-1}). The eye-protector shall not show any induced transmission (reversible bleaching). No splinters shall come away from the side of the filter facing the eye under the influence of the laser radiation. Any melting or other damage of the surface during the course of irradiation is not considered negative if the protective effect is still maintained.

Table 2 — Power density and energy density for testing

Scale number	Power density E W/m^2	Energy density H J/m^2
RB 1	1×10^4	2
RB 2	1×10^5	20
RB 3	1×10^6	200
RB 4	1×10^7	2 000
RB 5	1×10^8	20 000

3.4 Refractive values of filters and eye-protectors

When tested in accordance with 4.5, the maximum refractive values of filters and eye-protectors with no corrective effect shall be as given in Table 3. They apply for the range specified in EN 166.

Table 3 — Maximum refractive values of filters and eye-protectors with no corrective effect

Spherical power	Astigmatic power	Prismatic power difference		
		horizontal		vertical
		base out	base in	
m^{-1}	m^{-1}	cm/m	cm/m	cm/m
± 0,09	0,09	0,75	0,25	0,25

3.5 Quality of material and surface of filters

3.5.1 Material and surface defects

The material and surface defects of filters shall be tested in accordance with 4.6.1.

Except for a marginal area of 5 mm wide, filters shall be free from any material or surface defects likely to impair the intended use, such as bubbles, scratches, inclusions, dull spots, mould marks, scoring or other defects originating from the manufacturing process. No holes are allowed anywhere in the filters.

3.5.2 Diffusion of light

The reduced luminous coefficient l^* of a filter, determined in accordance with 4.6.2, shall not be greater than

$$l^* = 0{,}50 \ \frac{\text{cd} / \text{m}^2}{\text{lx}} \qquad (1)$$

3.6 Stability of filters and eye-protectors to ultraviolet radiation and to elevated temperature

3.6.1 Stability to ultraviolet radiation

When exposed to ultraviolet radiation in accordance with 4.7.1, the properties of filters and eye-protectors shall not change to such an extent that they can no longer satisfy the requirements of 3.1, 3.2, 3.4 and 3.5. The relative change in the luminous transmittance shall not exceed 10 %.

$$\left|\frac{\Delta \tau_v}{\tau_v}\right| \leq 10\ \% \qquad (2)$$

The spectral transmittance for the laser wavelengths shall, however, in no case exceed the maximum spectral transmittance corresponding to the indicated scale number (see Table 1).

3.6.2 Stability to elevated temperature

After exposure to elevated temperature in accordance to 4.7.2, filters and eye-protectors shall satisfy the requirements of 3.1, 3.2, 3.4 and 3.5. The relative change in the luminous transmittance shall not exceed 5 %.

$$\left|\frac{\Delta \tau_v}{\tau_v}\right| \leq 5\ \% \qquad (3)$$

The spectral transmittance for the laser wavelengths shall, however, in no case exceed the maximum spectral transmittance corresponding to the indicated scale number (see Table 1).

3.7 Resistance of filters and frames to ignition by contact with hot surfaces

When tested in accordance with 4.8, the filters and frames shall not ignite or continue to glow.

3.8 Field of vision of eye-protectors

Eye-protectors shall have a clear field of vision of at least 40° in the vertical and horizontal directions for each eye when measured in accordance with 4.9.

3.9 Construction of filters

Filters shall be constructed so that when tested in accordance with 4.4 followed by a visual inspection no splinters are detached from the side of the filter facing the eye. If the filters consist of several individual filters, they shall be assembled in such a way that they cannot be interchanged.

3.10 Construction of frames

3.10.1 Filters shall not be interchangeable in the frame. An exception is possible if the protection to laser radiation is determined only by the filter(s) and no part of the frame lies inside the protected range as defined below. In such a case the marking of the eye-protector shall be on the filter(s) and there is no requirement for the frame to satisfy 3.3 on resistance to laser radiation.

3.10.2 The frame shall be designed so that no laser radiation can penetrate from the side. This requirement is met if for the horizontal angle range α from - 50° (nasal side) to + 90° (temporal side) the vertical angle β range is protected within the following limit angles in degrees (°).

The upward limit β_u of the protected range shall be:

$$\beta_u = 55 - 0{,}001\,3\,(\alpha - 12)^2 - 1{,}3 \times 10^{-6}\,(\alpha - 12)^4 \qquad (4)$$

The downward limit β_l of the protected range shall be:

$$\beta_l = -70 + 10^{-5}\,(\alpha - 12)^2 + 2{,}3 \times 10^{-6}\,(\alpha - 22)^4 \qquad (5)$$

Testing shall be done in accordance with 4.10.

3.11 Mechanical strength of eye-protectors

3.11.1 Basic requirement

Filters for protection against laser radiation shall satisfy the requirement for minimum robustness as specified in 7.1.4.1 of EN 166:2001.

The frames of the eye-protectors shall satisfy the requirements of 7.1.4.2 or 7.2.2 of EN 166:2001.

3.11.2 Optional requirement

If the mechanical strength of filters and eye-protectors against laser radiation is to satisfy more stringent requirements, the requirements specified in 7.1.4.2 and 7.2.2 of EN 166:2001 shall be met.

4 Testing

4.1 General

The testing schedule in Table 4 shall be applied to testing of filters, frames and complete eye-protectors for laser adjustment work. The sequences of testing 1 to 9 and 13 to 16 may be changed. At least 16 filters or eight complete eye-protectors are required for testing. If testing for several wavelengths (wavelength ranges) or testing conditions according to 4.4 and/or several optional requirements has to be done, more than 16 samples may be necessary.

Table 4 — Test schedule for filters, frames and complete eye-protectors for laser adjustment work

Order of testing	Requirements	According to Clause	Number of filter/frame samples				
			3	3	10	Depends on specification/requirement	
1	Marking	6	+	+			
2	Material and surface defects	3.5.1	+	+			
3	Field of vision	3.8	1 frame				
4	Construction of filters	3.9	+	+			
5	Construction of frames	3.10	+	+			
6	Diffusion of light	3.5.2	+	+			
7	Luminous transmittance	3.2	+	+			
8	Refractive values	3.4	+	+			
9	Prismatic power difference	3.4	+	+			
10	Spectral transmittance at wavelength λ	3.1	+	+	3 filters/ frames per λ and test condition	3 filters/ frames per λ and test condition	
11	Stability to UV radiation	3.6.1		+			
12	Stability to elevated temperature	3.6.2	+				
13	Material and surface defects	3.5.1	+	+			
14	Diffusion of light	3.5.2	+	+			
15	Luminous transmittance	3.2	+	+			
16	Refractive values	3.4	+				

Table 4 (*continued*)

Order of testing	Requirements	According to Clause	Number of filter/frame samples				
			3	3	10	Depends on specification/requirement	
17	Spectral transmittance	3.1	+	+			
18	Mechanical strength	3.11			+		
19	Resistance to laser radiation and spectral transmittance at wavelength λ	3.3			3 filters/ frames per λ and test condition	3 filters/ frames per λ and test condition	
20	Ignition	3.7			3 filters/frames		
21	Optional requirements as given in EN 166	According to applicable clause of EN 166:2001					Depends on requirement/test procedure
Explanation of the symbols: + Testing to be carried out on the indicated specimen; Empty field No testing specified.							

4.2 Spectral transmittance of filters and frames

The spectral transmittance shall be determined for normal incidence. Filters with angular-dependent transmittance (such as interference layers) for the wavelength range from 400 nm to 700 nm shall be measured at angles of incidence between 0° and 30° with polarized radiation and an orientation of the polarization direction giving the highest value of the spectral transmittance. The spectral transmittance specification of Table 1 shall be met at 0°. At other angles the spectral transmittance shall be within the range specified or lower than the value given in Table 1.

Testing shall be done in accordance with EN 167:2001, Clause 6.

4.3 Luminous transmittance of filters

The luminous transmittance shall be determined for normal incidence, relative to the D65 standard illuminant (see ISO 11664-1:2007 and ISO 11664-2:2007).

The test shall be performed according to EN 167:2001, Clause 6.

4.4 Resistance of filters and frames to laser radiation

The test method shall be as specified in EN 207:2009, 4.4.

4.5 Refractive value of filters and eye-protectors

The test shall be carried out in accordance with EN 167:2001, Clause 3.