



SLOVENSKI STANDARD
SIST EN 12254:1999+A2:2008
01-maj-2008

Zaslони pri delu z laserji - Varovalne zahteve in preskušanje

Screens for laser working places - Safety requirements and testing

Abschirmungen an Laserarbeitsplätzen - Sicherheitstechnische Anforderungen und Prüfung

Ecrans pour postes de travail au laser - Exigences et essais de sécurité

Ta slovenski standard je istoveten z: EN 12254:1998+A2:2008

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English Version

Screens for laser working places - Safety requirements and testing

Ecrans pour postes de travail au laser - Exigences et essais de sécurité

Abschirmungen an Laserarbeitsplätzen - Sicherheitstechnische Anforderungen und Prüfung

This European Standard was approved by CEN on 16 October 1998, includes Amendment 1 approved by CEN on 1 August 2002 and Amendment 2 approved by CEN on 26 December 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

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Foreword

This document (EN 12254:1998+A2:2008) 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of an identical text or by endorsement, at the latest by July 2008, and conflicting national standards shall be withdrawn at the latest by July 2008.

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 Annexes ZA and ZB which are integral parts of this document.

This document supersedes EN 12254:1998.

This document includes Amendment 1, approved by CEN on 2002-08-01 and Amendment 2, approved by CEN on 2007-12-26.

The start and finish of text introduced or altered by amendment is indicated in the text by tags $\boxed{A_1}$ $\boxed{A_1}$ and $\boxed{A_2}$ $\boxed{A_2}$.

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 standard specifies specific functional requirements and a product labelling system applicable to a range of temporary and permanent passive guards (in the following called screens) for protection against laser radiation. This standard includes test methods for testing functional performance and also the specification of the user documentation to be supplied with the product. The screens are designed to protect the user from uncontrolled emission of direct and/or diffuse radiation for a defined exposure to lasers, based on the necessary functional requirements for any particular application being determined by risk assessment principles.

This standard applies to supervised screens for installations in working places at which laser radiation up to a maximum mean power of 100 W or single pulse energy of 30 J occurs within the spectral range between 180 nm (0,18 μm) and 10^6 nm (1000 μm).

This standard applies to the protection against laser radiation only. This standard does not apply to other hazards including hazards from secondary radiation that can arise during, for example, material processing.

This standard gives guidance on how to select such screens.

The following are not considered to be within the scope of the standard:

- laser enclosures and housings that are supplied as part of the laser product or are supplied to be fitted to a laser system to form a laser product (according to IEC 60 825-1:1998);
- any screen whose protective properties are limited to a restricted range of angles of incidence (e.g. some interference filters)

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2 Normative references

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This European Standard incorporates by dated or undated reference provisions by other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent revisions to or amendments of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 165:1995, *Personal eye-protection - Vocabulary*.

EN 166:1995, *Personal eye-protection - Specifications*.

EN 168:1995, *Personal eye-protection - Non-optical test methods*.

EN 169:1992, *Personal eye-protection - Filters for welding and related techniques - Transmittance requirements and recommended utilisation*

EN 1598:1997, *Health and safety in welding and allied processes - Transparent welding curtains, strips and screens for arc welding processes*

IEC 60825-1:1998, *Safety of laser products - Part 1: Equipment classification, requirements and user's guide*

IEC 60050-845:1987, *International electrotechnical vocabulary - Chapter 845: Lighting*

IEC 60 825-4:1997, *Safety of laser products - Part 4: Laser guards*

ISO 1184:1983, *Plastics - Determination of tensile properties of films*.

3 Definitions

For the purposes of this standard the definitions and terminology of IEC 60 825-1:1998, EN 165:1995, IEC 60825-4:1997 and IEC 60050-845:1987 apply.

4 Requirements

4.1 Spectral transmittance

The relationship between spectral transmittance at the laser wavelength and stability to laser radiation is based on the maximum permissible exposure (MPE) shown in IEC 60 825-1:1998. To simplify product specification, tests are conducted for laser test conditions described in table 1. The laser test conditions are referred to by the symbols D, I, R and M.

Table 1 — Duration of test applicable to screens for laser working places

Test condition (Corresponding laser designation)	Pulse duration, in seconds	Number of pulses
D (Continuous wave (CW) laser)	100	1
I (Pulsed laser)	10^{-6} to 10^{-2}	1000
R (Giant-pulsed laser)	10^{-9} to 10^{-6}	1000
M (Mode-coupled pulsed laser)	$\leq 10^{-9}$	100 000

NOTE: The listed pulse durations are values of typical lasers. A laser with a pulse length in this range of values is recommended for testing. Total exposure time for each test should be about 100 s.

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4.2 Stability to laser radiation

The screens shall not lose their protective properties and shall stay within the scale number under effect of laser radiation with the power and energy density as specified in table 2 including induced transmission (reversible bleaching).

4.3 Stability to UV radiation

The requirements of 4.1 to 4.2 shall be met after exposure for 50 h as specified in clause 6 of EN 168:1995. The spectral transmittance at the laser wavelengths shall not exceed the maximum permissible spectral transmittance of the corresponding scale number.

4.4 Stability at elevated temperature

The requirements of 4.1 to 4.2 shall be met after the screens have been stored for 5 h in a climatic cabinet at a temperature of $(55 \pm 2)^\circ\text{C}$ and a relative humidity of at least 95 %, and then stored for at least 2 h at room temperature $(23 \pm 5)^\circ\text{C}$.

A1 *deleted text* A1

4.5 Mechanical strength

Flexible screens shall withstand for 10 s a tensile stress of 15 N/mm² when tested according to 5.5.1. After this test, no sample shall be torn.

Inflexible screens shall be robust in accordance with 7.1.4.2 of EN 166:1995.

4.6 Resistance to ignition

Flexible screens shall satisfy the requirements of 3.4 of EN 1598:1997 when tested in accordance with 4.4 of EN 1598:1997.

Inflexible screens shall meet requirements according to 7.1.7 of EN 166:1995.

5 Testing

The testing schedule in table 3 applies to type testing of flexible and inflexible screens. At least 18 samples are required for testing. If testing for several wavelengths (wavelength ranges) or testing conditions according to tables 1 and 3 has to be done, more samples can be necessary.

5.1 Spectral transmittance

The spectral transmittance shall be determined at normal incidence.

5.2 Stability to laser radiation

Testing shall be done with laser radiation of the specific wavelength(s) and the power and energy densities as indicated in table 2. Spectral transmittance at the laser wavelength shall be measured during irradiation.

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A1) Table 2 — Scale numbers of screens for laser working places (maximum spectral transmittance and resistance to laser radiation)

Scale number	Maximum spectral transmittance at the laser wavelength $\tau(\lambda)$	Mean power (E) and single pulse energy density (H) for testing protective properties and resistance to laser radiation in the wavelength range											
		180 nm to 315 nm			> 315 nm to 1050 nm	> 1050 nm to 1400 nm	> 315 nm to 1400 nm	> 1400 nm to 10^6 nm					
		For test condition/pulse duration in s (see Table 1)									D	I, R	M
		D	I, R	M	D	D	I, R	M	D	I, R	M		
		> 0,25	> 10^{-9} to 0,25	$\leq 10^{-9}$	> $5 \cdot 10^{-3}$	> $2 \cdot 10^{-3}$	> 10^{-9} to 0,01	$\leq 10^{-9}$	> 0,1	> 10^{-9} to 0,1	$\leq 10^{-9}$		
		E_D W/m ²	$H_{I,R}$ J/m ²	E_M W/m ²	E_D W/m ²	E_D W/m ²	$H_{I,R}$ J/m ²	H_M J/m ²	E_D W/m ²	$H_{I,R}$ J/m ²	E_M W/m ²		
A1	10^{-1}	0,01	$3 \cdot 10^2$	$3 \cdot 10^{11}$	10	$2,5 \cdot 10^2$	0,05	0,0015	10^4	10^3	10^{12}		
A2	10^{-2}	0,1	$3 \cdot 10^3$	$3 \cdot 10^{12}$	10^2	$2,5 \cdot 10^3$	0,5	0,015	10^5	10^4	10^{13}		
A3	10^{-3}	1	$3 \cdot 10^4$	$3 \cdot 10^{13}$	10^3	$2,5 \cdot 10^4$	5	0,15	10^6	10^5	10^{14}		
A4	10^{-4}	10	$3 \cdot 10^5$	$3 \cdot 10^{14}$	10^4	$2,5 \cdot 10^5$	50	1,5	10^7	10^6	10^{15}		
A5	10^{-5}	10^2	$3 \cdot 10^6$	$3 \cdot 10^{15}$	10^5	$2,5 \cdot 10^6$	$5 \cdot 10^2$	15	10^8	10^7	10^{16}		
A6	10^{-6}	10^3	$3 \cdot 10^7$	$3 \cdot 10^{16}$	10^6	$2,5 \cdot 10^7$	$5 \cdot 10^3$	$1,5 \cdot 10^2$	10^9	10^8	10^{17}		
A7	10^{-7}	10^4	$3 \cdot 10^8$	$3 \cdot 10^{17}$	10^7	$2,5 \cdot 10^8$	$5 \cdot 10^4$	$1,5 \cdot 10^3$	10^{10}	10^9	10^{18}		
A8	10^{-8}	10^5	$3 \cdot 10^9$	$3 \cdot 10^{18}$	10^8	$2,5 \cdot 10^9$	$5 \cdot 10^5$	$1,5 \cdot 10^4$	10^{11}	10^{10}	10^{19}		
A9	10^{-9}	10^6	$3 \cdot 10^{10}$	$3 \cdot 10^{19}$	10^9	$2,5 \cdot 10^{10}$	$5 \cdot 10^6$	$1,5 \cdot 10^5$	10^{12}	10^{11}	10^{20}		
A10	10^{-10}	10^7	$3 \cdot 10^{11}$	$3 \cdot 10^{20}$	10^{10}	$2,5 \cdot 10^{11}$	$5 \cdot 10^7$	$1,5 \cdot 10^6$	10^{13}	10^{12}	10^{21}		

A1)

A1) The diameter d_{63} of the laser beam during this test shall be $\geq 0,5$ mm for pulse durations < 1 ns.

The diameter d_{63} of the laser beam during this test shall be ≥ 2 mm in all other cases. A beam diameter d_{65} between 0,5 mm and 2,0 mm may be used if the irradiance $E(d)$ or radiant exposure $H(d)$ used at a diameter d is increased compared to the nominal value E_n or H_n , respectively by the factor given by the following equation:

$$E(d) / E_n = a_0 + a_1 \cdot e^{-d/a_2} \quad \text{or} \quad H(d) / H_n = a_0 + a_1 \cdot e^{-d/a_2}$$

where the constants are in the case of filters consisting of


— glass or containing glass

$$a_0 = 0,769, \quad a_1 = 18,29, \quad a_2 = 0,4778;$$

— plastics

$$a_0 = 1 \quad a_1 = 5,66, \quad a_2 = 0,4498.$$

In the case of rectangular beams, the dimensions specified apply to the shortest side of the rectangle.

NOTE The number of decimals of the coefficients was chosen to give a smooth transition at a 2 mm beam diameter. It should not be interpreted as a requirement for measurement accuracy. 

All screens shall be tested in accordance with the test condition D. If no continuous wave (CW) laser is available for a specific wavelength, a pulsed laser at a minimum pulse repetition frequency of 5 Hz may be used.

If additional protection against pulsed lasers is required, the screens shall be tested according to one or several of the test conditions I, R or M.

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Table 3 — Type examination test schedule for screens for protection against laser radiation

Order of testing	Requirement	According to clause	Screen/sample number				
			1-3	4-6	7-12	13-15	16-18, or more
1	Marking	6	+	+	+	+	+
2	Spectral transmittance at laser wavelength λ	4.1	+	+			3 samples per λ and test condition
3	Stability to UV radiation	4.3		+			
4	Stability at elevated temperature	4.4	+				
5	Spectral transmittance at laser wavelength λ	4.3, 4.4	+	+			
6	Mechanical strength	4.5					+
7	Stability to laser radiation and spectral transmittance at laser wavelength λ	4.2					3 samples per λ and test condition
8	Resistance to ignition	4.6				+	

5.3 Stability to UV radiation

Testing shall be done according to clause 6 of EN 168:1995.

5.4 Stability at elevated temperature

Testing shall be done according to clause 5 of EN 168:1995.

5.5 Mechanical strength

5.5.1 Flexible screens

5.5.1.1 Testing machine

The tensile testing machine shall be power-driven and capable of maintaining the appropriate rate of grip separation as specified in 5.5.1.3. The testing machine shall be equipped with the following devices.

— Grips for holding the test sample, one being fixed and the other movable.