BRITISH STANDARD

BS EN 208:1999
Incorporating Amendment No. 1

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

The European Standard EN 208:1998, with the incorporation of amendment A1:2002, has the status of a British Standard

ICS 13.340.20

BSI British Standards

National foreword

This British Standard is the English language version of EN 208:1998, including amendment A1:2002. It supersedes BS EN 208:1994 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] ⟨A1]. Tags indicating changes to CEN text carry the number of the amendment. For example, text altered by CEN amendment A1 is indicated by [A1] ⟨A1].

The UK participation in its preparation was entrusted by Technical Committee PH/2, Eye protection, to Subcommittee PH/2/3, Eye protection against lasers, which has the responsibility to:

— aid enquirers to understand the text;
— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Descriptors: accident prevention, eyes, safety devices, eyesglasses, radiation protection, laser radiation, specifications, transmittance, maximal value, tests, marking

English version

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

(includes amendment A1:2002)

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)
(inclut l'amendement A1:2002)

Persönlicher Augenschutz —
Augenschutzgeräte für Justierarbeiten an Lasern und Laseraufbauten (Laser-Justierbrillen)
(enthält Änderung A1:2002)

This European Standard was approved by CEN on 24 August 1998. Amendment A1 was approved by CEN on 30 May 2002.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 208:1998 + A1:2002 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 85, Eye protective equipment, the Secretariat of which is held by AFNOR.

This European Standard supersedes EN 208:1993.

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 March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.

This European Standard 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 standard.

Annex A, Annex B and Annex ZA are informative.

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

Foreword to amendment A1

This amendment EN 208:1998/A1:2002 to the EN 208:1998 has been prepared by Technical Committee CEN/TC 85, Eye protective equipment, the Secretariat of which is held by AFNOR.

This amendment to the European Standard EN 208:1998 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2003, and conflicting national standards shall be withdrawn at the latest by February 2003.

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).

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

Contents

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 60825-1:1994 [i.e. LED (light emitting diode) radiation is included] where hazardous radiation occurs in the visible spectral range of 400 nm to 700 nm. Filters specified in this standard reduce this radiation to values defined for lasers of class 2 [≤ 1 mW for CW (continuous wave) lasers]. In this case aversion responses including the blink reflex contribute to eye-protection.

This standard defines 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 laser radiation where aversion responses, including the blink reflex are not stipulated, and laser radiation outside the visible spectral range.

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

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions 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 166:1995, *Personal eye-protection — Specifications*.

EN 167:1995, *Personal eye-protection — Optical test methods*.

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

EN 207:1998, *Personal eye-protection — Filters and eye-protectors against laser radiation (laser eye-protectors)*.

EN 60825-1:1994, *Safety of laser products, equipment classification, requirements and user's guide*.

ISO/CIE 10526:1991, *CIE standard colorimetric illuminants*.

ISO/CIE 10527:1991, *CIE standard colorimetric observers*.

3 Requirements

3.1 Spectral transmittance of filters and frames

The spectral transmittance values of the filters and the frames for the laser wavelength shall be as given in Table 1.

3.2 Luminous transmittance of filters

When assessed in accordance with **4.2**, the luminous transmittance of the filter relative to the D65 standard illuminant (see ISO/CIE 10526:1991) shall be at least 20 %, unless it is recommended in the information supplied by the manufacturer to increase accordingly the intensity of illumination at the relevant work place.

3.3 Stability of filters and frames to laser radiation

When tested according to **4.3**, 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) given in Table 2 for a period of at least 10 s and for 100 pulses. They 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 is not considered negative if the protective effect is still ensured.

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

Scale number	Spectral transmittance		CW lasers 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
R1	$10^{-2} < \tau(\lambda) \leq 10^{-1}$	$\tau(\lambda) \leq 10^{-1}$	0,01	2×10^{-6}
R2	$10^{-3} < \tau(\lambda) \leq 10^{-2}$	$\tau(\lambda) \leq 10^{-2}$	0,1	2×10^{-5}
R3	$10^{-4} < \tau(\lambda) \leq 10^{-3}$	$\tau(\lambda) \leq 10^{-3}$	1	2×10^{-4}
R4	$10^{-5} < \tau(\lambda) \leq 10^{-4}$	$\tau(\lambda) \leq 10^{-4}$	10	2×10^{-3}
R5	$10^{-6} < \tau(\lambda) \leq 10^{-5}$	$\tau(\lambda) \leq 10^{-5}$	100	2×10^{-2}

Table 2 — Power density and energy density for testing

Scale number	Power density E W/m^2	Energy density H J/m^2
R1	1×10^4	2
R2	1×10^5	20
R3	1×10^6	200
R4	1×10^7	2 000
R5	1×10^8	20 000

3.4 Refractive values of filters and eye-protectors

When assessed in accordance with **4.4**, 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 166:1995.

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 cm/m	Base in cm/m	cm/m
±0,09	±0,09	0,75	0,25	0,25

NOTE The requirements of the national standards apply to laser radiation protection filters with a corrective effect up until such times as corresponding European Standards have been prepared.

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 assessed in accordance with **4.5.1**.

Except for a marginal area 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 *Scattered light*

The reduced luminous coefficient l^* of a filter, determined in accordance with **4.5.2**, shall not be greater than:

$l^* = 0{,}50$ (cd/m^2)/lx

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

3.6.1 *Stability to ultraviolet radiation*

When exposed to ultraviolet radiation in accordance with **4.6**, 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**, **3.3**, **3.4** and **3.5**. The relative change in the luminous transmittance shall be ≤ ±10 %:

$$\left|\frac{\Delta\tau_v}{\tau_v}\right| \leq 10\ \%$$

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 at elevated temperature*

After the filters and eye-protectors have been stored for 5 h in a climatic cabinet at a temperature of (55 ± 2) °C and a relative humidity of at least 95 %, and then stored for at least 2 h at room temperature, they shall satisfy the requirements of **3.1**, **3.2**, **3.3**, **3.4** and **3.5**. The relative change in the luminous transmittance shall be ≤ ±5 %:

$$\left|\frac{\Delta\tau_v}{\tau_v}\right| \leq 5\ \%$$

3.7 Resistance of filters and frames to ignition

When tested in accordance with **4.7**, 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 **4.8**.

3.9 Construction of filters

Filters shall be constructed so that when tested in accordance with **4.3** and **4.9** 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 Frames

[A1] **3.10.1** Filters shall not be interchangeable in the frame.

3.10.2 The frame shall be designed so that no laser radiation can penetrate from the side unintentionally. 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 degree (°).

The upward limit β_u of the protected range shall be:

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

The downward limit β_l of the protected range shall be:

$$\beta_l = -70 + 10^{-5} \times (\alpha - 22)^2 + 2{,}3 \times 10^{-6} \times (\alpha - 22)^4$$ [A1]

3.11 Mechanical strength of eye-protectors

3.11.1 *Basic requirement*

Filters for protection against laser radiation shall be of at least 1,4 mm thickness or satisfy the static bending requirement as specified in **7.1.4.1** of EN 166:1995.

The frames of the eye-protectors shall satisfy the requirements of **7.1.4.2** or **7.2.2** of EN 166:1995.

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** of EN 166:1995 shall be met.

4 Test

The testing schedule in Table 4 shall be applied to type testing of filters, frames and complete eye-protectors for laser adjustment work. The sequence of testing 1 to 9 may be changed. The sequence of testing 13 to 16 may be changed. At least 16 filters or 8 complete eye-protectors are required for testing. If testing for several wavelengths (wavelength ranges) or testing conditions according to **4.3** and/or several optional requirements has to be done, more than 16 samples may be necessary.

4.1 Spectral transmittance [A1] *Text deleted* [A1]

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 [A1] 700 nm [A1] shall be measured at angles of incidence between 0° and 30° with polarized radiation [A1] and an orientation of the polarization direction giving the highest value of the spectral transmittance. The spectral transmittance 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. [A1]

4.2 Luminous transmittance of filters

The luminous transmittance shall be determined for normal incidence, relative to the D65 standard illuminant (see ISO/CIE 10526:1991 and ISO/CIE 10527:1991).

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

Order of testing	Requirement	According to clause	Filter/frame number				
			1 to 3	4 to 6	7 to 16	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	Frames	**3.10**	+	+			
6	Scattered 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 at elevated temperature	**3.6.2**	+				
13	Material and surface defects	**3.5.1**	+	+			
14	Scattered light	**3.5.2**	+	+			
15	Luminous transmittance	**3.2**	+	+			
16	Refractive values	**3.4**	+				
17	Spectral transmittance	**3.1**	+	+			
18	Mechanical strength	**3.11**			+		
19	Stability 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**			filters/frames 7 to 9		
21	Optional requirements as given in EN 166:1995	according to applicable clause of EN 166: 1995					depends on requirement /test procedure

Explanation of the symbols: + testing to be carried out on the indicated specimen; empty field: no testing specified.

4.3 Stability of filters and frames to laser radiation

The test method shall be as specified in EN 207. For this, the power densities and energy densities given in Table 2 shall be used for the particular scale numbers. The test period shall be 10 s with the stated power densities and 100 pulses with the stated energy densities.

All laser adjustment filters shall be tested in accordance with the test condition for CW lasers. If no CW laser is available for a specific wavelength, a pulse laser at a minimum pulse repetition frequency of 5 Hz may be used.

The frame shall be exposed to radiation at the point of least wall thickness for each of the materials used (with the exception of headbands).

〈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_{63} 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 formula:

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

where the constants are in the case of filters consisting of

glass or containing glass

— $a_0 = 0{,}769$, $a_1 = 18{,}29$, $a_2 = 0{,}477\ 8$;

plastics

— $a_0 = 1$, $a_1 = 5{,}66$, $a_2 = 0{,}449\ 8$.

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. 〈A1〉

4.4 Refractive value of filters and eye-protectors

The test shall be carried out in accordance with Clause **3** of EN 167:1995.

4.5 Quality of material and surface of filters

4.5.1 *Material and surface defects*

The test shall be carried out in accordance with Clauses **4** and **5** of EN 167:1995.

NOTE Thin layered filters should be very carefully examined, as the protection could be affected if the vacuum-metallized layer was damaged (e.g. by scratches and holes).

4.5.2 *Scattered light*

The test shall be carried out in accordance with Clause **4** of EN 167:1995.

4.6 Stability to UV radiation

The test shall be carried out in accordance with Clause **6** of EN 168:1995, with the lamp running at a power of 450 W and an exposure time of (50 ± 0,2) h.

4.7 Resistance of filters and frames to ignition

The test shall be carried out in accordance with Clause **7** of EN 168:1995.

4.8 Field of vision

The test shall be carried out in accordance with **4.8** of EN 207:1998.

4.9 Construction of filters

The test shall be carried out by means of visual inspection.

4.10 Frames

[A1] **4.10.1** It shall be tested by means of visual inspection whether the filters are interchangeable.

4.10.2 The test shall be carried out using the method given in **4.8**. The zero values of the angles α and β are reached when the axis A, B and C of the test apparatus are perpendicular to each other. [A1]

4.11 Mechanical strength

The test shall be carried out in accordance with Clause **4** of EN 168:1995.

5 Information supplied by the manufacturer

The information shall be in the language(s) of the country in which the eye-protector is sold.

The information provided, e.g. on a sticker, in the case, or on a label, shall contain at least the following data:

a) the eye-protector only affords protection against laser radiation:

up to 0,01 W and up to 2×10^{-6} J for scale number R1;

up to 0,1 W and up to 2×10^{-5} J for scale number R2;

up to 1 W and up to 2×10^{-4} J for scale number R3;

up to 10 W and up to 2×10^{-3} J for scale number R4;

up to 100 W and up to 2×10^{-2} J for scale number R5;

b) the eye-protector is not intended to be used for looking directly into the beam;

c) that it only offers protection against occasional radiation exposure where there is no suppression or reduction (medical treatment, sickness...) of the blink reflex; consequently, repeated exposures to radiation shall be avoided;

d) details regarding an appropriate cleaning method;

e) a warning that damaged eye-protection and eye-protection with scratched oculars has to be replaced;

f) the luminous transmittance shall be given. If the luminous transmittance is less than 20 %, it shall be indicated and the user shall be recommended to increase the intensity of illumination at the workplace;

g) in the case of tinted filters a warning to the user to check if the recognition of warning lights or warning signals is impaired;

h) the instructions for use shall also contain a note to the effect that eye-protectors and filters which are damaged or have undergone a colour change are not to be used any more;

j) the symbols given in the designation shall be explained;

k) it shall be pointed out that hazards may arise because of accidental reflection of laser radiation, e.g. by reflection from reflective parts (including eye-protectors), tilting or maladjustment of optical components. All personnel working in these areas shall wear eye-protectors.

6 Marking

The following elements shall be marked permanently on the filters or frames for identification:

a) maximum laser power in watts (W) and maximum pulse energy in joules (J);

b) wavelength or wavelength range (in nm) for which the eye-protector is specified;

c) scale number;

d) manufacturer's identification mark.

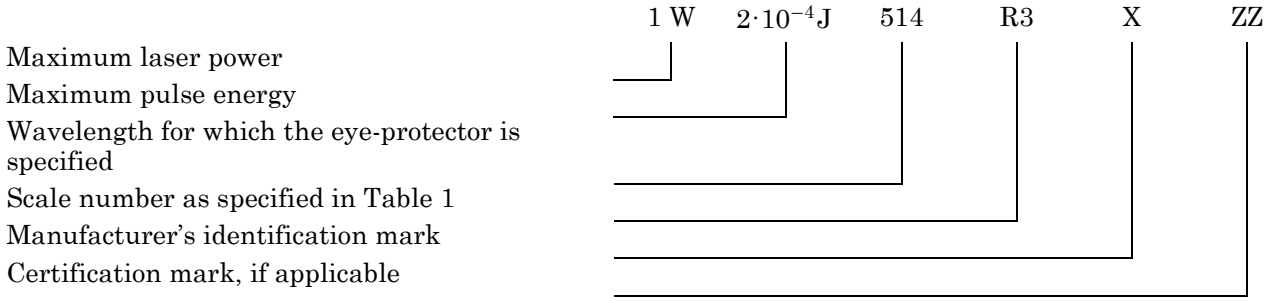
Only marks granted on a national or European level shall be used:

e) certification mark, if applicable;

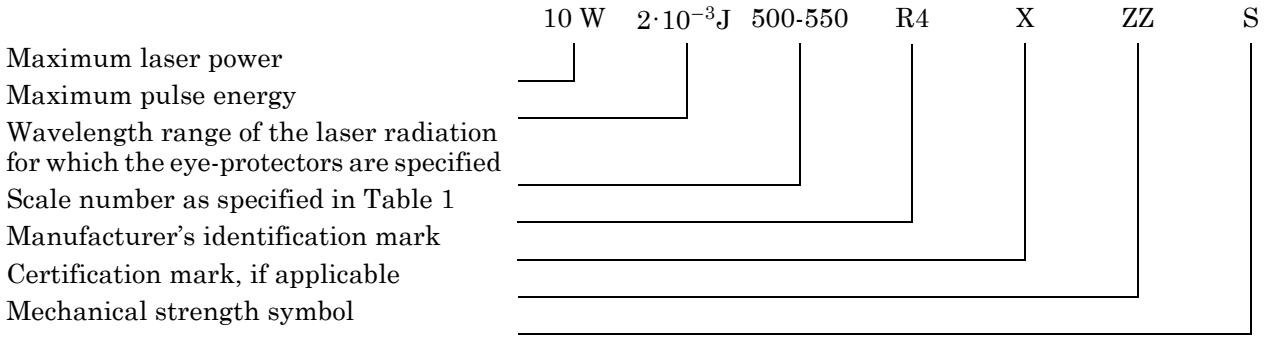
f) on the frame the words “adjustment eye-protectors” in the language(s) of the country in which the eye-protector will be sold;

g) if the eye-protector satisfies the mechanical strength requirements of **3.11**, one of the symbols specified in Clause **9** of EN 166:1995 shall be added.

EXAMPLE 1



EXAMPLE 2



Annex A (informative)
Basics

A.1 Class 2 lasers

The laser classes are defined in EN 60825-1:1994. The following definition is taken from **9.2** of EN 60825-1:1994.

Class 2 lasers are low-power devices which emit visible radiation (in the wavelength range 400 nm to 700 nm) and which are capable of operating either in the continuous wave or pulsed mode. For exposure periods of up to 0,25 s, the output power or energy of these devices is limited to the limiting values of accessible radiation (AEL) for class 1. The limit is 1 mW for a continuous wave laser and 2×10^{-7} J for a single pulse of pulsed lasers.

NOTE In order to distinguish CW lasers from pulsed lasers from a time point of view, this standard has been simplified in comparison with EN 60825-1:1994. Figure A.1 shows a comparison between the EN 60825-1:1994 values and those of this standard.

Class 2 lasers are not intrinsically safe but eye-protection is normally afforded by aversion responses, including the blink reflex.

A.2 Beam reduction and time base

It is the function of the laser adjustment eye-protectors to reduce the power in the laser beam to class 2 values. In this way, the eye is protected for periods of up to 0,25 s (blink reflex).

A.3 Stability to laser radiation

A beam diameter of approximately 1 mm has been used as the basis for the requirement of stability to laser radiation as many typical lasers in the visible spectral range (e.g. argon lasers, He–Ne lasers, krypton lasers) are in this diameter range.

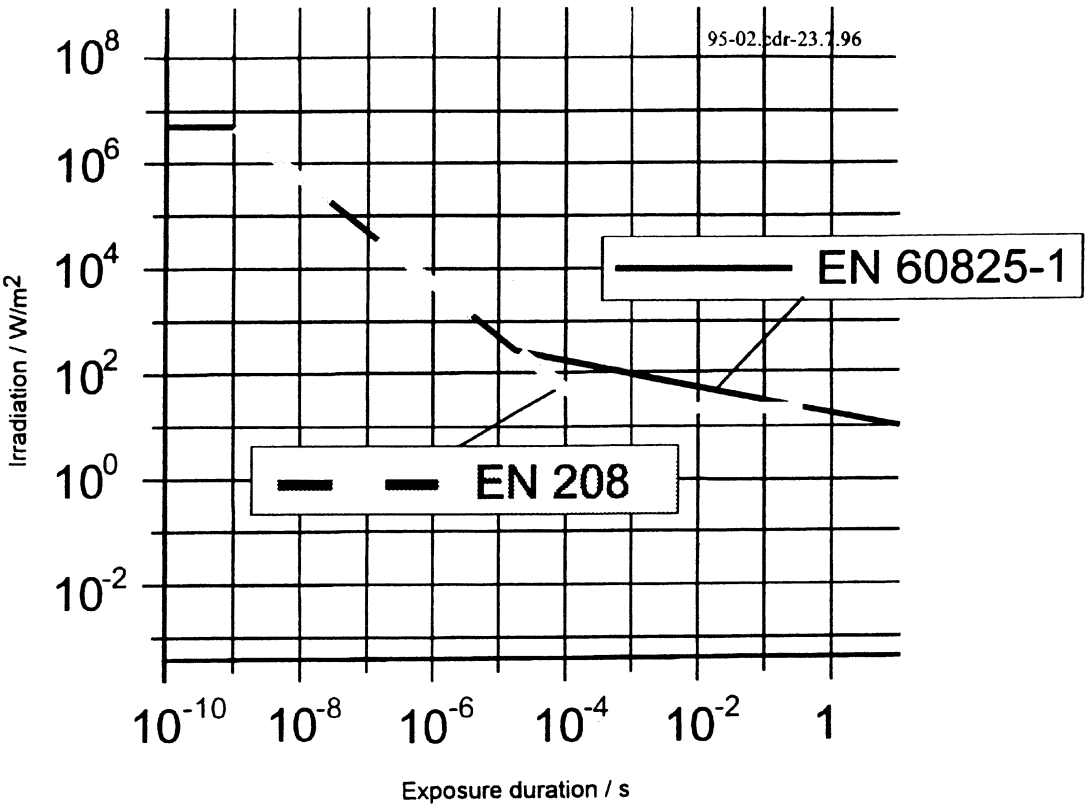


Figure A.1 — Comparison of the limit values of EN 60825-1:1994 with the simplified values of this standard

Annex B (informative)
Recommended use of laser adjustment eye-protectors

This annex gives recommendations as to the selection of laser radiation eye-protectors. Before selecting eye-protection a risk assessment must first be undertaken and the risk minimized by engineering and administrative controls. Control methods are outlined in EN 60825-1:1994 and applicable national regulations.

Eye-protectors specified in this standard are used for adjustment work on lasers in a visible spectral range 400 nm to 700 nm where the path of the beam has to be seen. Eye-protectors specified in EN 207 generally do not allow this. However, eye-protectors specified in this standard are not suitable for looking directly into the laser beam. For better protection against hazards of this type, eye-protectors meeting the requirements of EN 207 should be used.

When eye-protectors as specified in this standard are used, the eye is only protected against damage from an accidental direct look at the beam, as in the case of class 2 lasers (1 mW for continuous wave lasers, see also Annex **A.1**), if the eyelid closes within 0,25 s (blink reflex). If this reflex is suppressed or delayed (medical treatment, sickness...) this protection is no longer ensured. In the event of longer exposure to the beam, the filters described in EN 207 shall be used.

B.1 Continuous wave lasers

Table B.1, column 2, summarizes the use, in conformity with the requirements, of laser adjustment eye-protectors in continuous wave lasers. The power and energy values given relate to the maximum laser beam diameter of 7 mm.

If the laser beam is considerably larger, then the selection can be based on the fraction of the power that would pass through a 7 mm aperture.

Table B.1 — Application of laser adjustment eye-protectors

Scale number	Maximum instantaneous laser power for continuous wave lasers for emission durations $\geq 2 \times 10^{-4}$ s W	Maximum laser energy for pulsed lasers for pulse durations from 10^{-9} s to $< 2 \times 10^{-4}$ s J
R1	0,01	2×10^{-6}
R2	0,1	2×10^{-5}
R3	1	2×10^{-4}
R4	10	2×10^{-3}
R5	100	2×10^{-2}

The use of a laser adjustment eye-protector of a higher scale number than is necessary according to Table B.1 reduces the brightness of the images of the laser spot used in adjustment work. It is therefore recommended that this table is used with discretion when selecting laser adjustment eye-protectors.

B.2 Pulsed lasers

For pulsed and quasi-continuous lasers, EN 60825-1:1994 requires that the class 1 limiting values are adhered to for periods <0,25 s (see also Annex **A.1**). Table B.1, column 3 summarizes the use in conformity with the requirements, of laser adjustment eye-protectors for pulsed lasers with a pulse duration greater than 2×10^{-4} s.

B.2.1 *Slow pulse series (frequency* <0,1 s^{-1}*)*

For the slow pulse sequences and pulse durations between 10^{-9} and 2×10^{-4} s, the filters given by column 3 of Table B.1 can be selected.

B.2.2 ***Fast pulse series (frequency*** >0,1 s^{-1}***)***

The exposure from any single pulse within a pulse train shall not exceed the permissible exposure for a single pulse multiplied by the correction factor C_5.

where

C_5 = $N^{-¼}$;

N = number of pulses in the pulse train during the expected exposure duration T.

If the pulse repetition frequency is υ, then the total number N of pulses within an exposure duration T, which in this standard is taken to be 10 s:

$N = \upsilon \times T = \upsilon \times 10$ s

The evaluation procedure for the scale number required is the following:

The pulse energy Q of the laser beam is multiplied by $N^{¼}$:

$Q' = Q \times N^{¼}$

Then, for Q', the necessary scale number is taken from column 3 of Table B.1.

Annex ZA (informative)
Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard 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 89/686/EEC.

WARNING. Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

The following clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II.

EU Directive 89/686/EEC, Annex II		Clauses of this standard
1.1	Design principles	**3.1**, **3.2**, **3.3**, **3.4**, **3.5**, **3.8**
1.2	Innocuousness of PPE	**3.3**, **3.4**, **3.5**, **3.6**, **3.7**, **3.8**
1.3	Comfort and efficiency	**3.2**, **3.5**, **3.6**, **3.7**, **3.8**, **3.11**
1.4	Information supplied by the manufacturer	**5**, **6**
2.3	PPE for the face, eyes and respiratory tracts	**3.8**
2.4	PPE subject to ageing	**3.6**
2.12	PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	**6**
3.1	Protection against mechanical impact	**3.11**
3.9.1	Non-ionizing radiation	**3.1**, **3.3**, **3.10**

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directives concerned and associated EFTA regulations.

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