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Osebno varovanje oļ i - Ultravijoliļ ni filtri - Zahteve za prepustnost in priporoļ ena uporaba

Personal eye-protection - Ultraviolet filters - Transmittance requirements and recommended use

Persönlicher Augenschutz - Ultraviolettschutzfilter - Transmissionsanforderungen und empfohlene Anwendung

Protection individuelle de l'oeil - Filtres pour l'ultraviolet - Exigences relatives au facteur de transmission et utilisation recommandée

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Personal eye-protection - Ultraviolet filters - Transmittance requirements and recommended use

Protection individuelle de l'oeil - Filtres pour l'ultraviolet - Exigences relatives au facteur de transmission et utilisation recommandée

Persönlicher Augenschutz - Ultraviolettschutzfilter - Transmissionsanforderungen und empfohlene Anwendung

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Foreword

This document (EN 170:2002) 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of an identical text or by endorsement, at the latest by April 2003, and conflicting national standards shall be withdrawn at the latest by April 2003.

This document supersedes EN 170:1992.

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.

In this European Standard, Annex A is normative and Annexes B and C 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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1 Scope

This European Standard specifies the scale numbers and transmittance requirements for filters for protection against ultraviolet radiation.

The other applicable requirements for these types of filters and the frames/mountings to which they are intended to be fitted are given in EN 166.

Guidance on the selection and use of these filters are given in annex B.

NOTE The protective filters specified in this standard are not suitable for the direct viewing of bright light sources like Xenon high-pressure arc lamps or for the direct or indirect observation of an electric welding arc. For this purpose a welding filter as specified in EN 169 and with a scale number appropriate to the source being observed should by used.

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 (including amendments).

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

EN 166, *Personal eye-protection – Specifications*.

EN 167, *Personal eye-protection – Optical test methods*.

ISO/CIE 10526:1999, *CIE Standard illuminants for colorimetry*.

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

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3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 165:1995 apply.

4 Designation and identification

The complete table of numbering of filters is given in EN 166.

The marking of oculars and frame is described in EN 166.

The scale number of ultraviolet filters comprises the code number 2 and the shade number corresponding to the filter, from 1,2 to 5 (see Table 1).

5 Requirements

5.1 General

The requirements of EN 166 apply to ultraviolet filters. Only those requirements that are different from or supplement the EN 166 specifications are given in this European standard.

5.2 Transmittance requirements

The definitions of transmittances are given in EN 165.

The determination of luminous transmittance is described in EN 167.

The transmittance requirements for filters used for protection against ultraviolet radiation are given in Table 1.

Table 1 – Transmittance requirements

Scale number	Maximum spectral transmittance in the ultraviolet $\tau(\lambda)$		Luminous transmittance τ_v		Transmittance in the infrared spectral range
	313 nm %	365 nm %	maximum %	minimum %	
2-1,2	0,0003	10	100	74,4	no specification
2-1,4	0,0003	9	74,4	58,1	
2-1,7	0,0003	7	58,1	43,2	
2-2	0,0003	5	43,2	29,1	
2-2,5	0,0003	3	29,1	17,8	
2-3	0,0003	2	17,8	8,5	
2-4	0,0003	0,8	8,5	3,2	
2-5	0,0003	0,3	3,2	1,2	

Minimum and maximum values of luminous transmittance may be exceeded by taking into account the limits of relative uncertainty given in EN 167.

Additional requirements:

a) for 210 nm ≤ λ ≤ 313 nm the spectral transmittance shall not exceed the value specified for 313 nm;

b) for 313 nm < λ ≤ 365 nm the spectral transmittance shall not exceed the value specified for 365 nm;

c) for 365 nm < λ ≤ 405 nm the spectral transmittance shall not exceed the luminous transmittance;

NOTE Luminous transmittance values are based on the spectral distribution of CIE illuminant A and on the CIE (1931) standard observer (2°) (see ISO/CIE 10526:1999 and ISO/CIE 10527:1991).

5.3 Ocular with enhanced colour recognition (optional)

Between 500 nm and 650 nm the spectral transmittance shall be not less than 0,2 τ_v.

The relative visual attenuation quotient *Q*, for signal lights red, yellow, green and blue shall be not less than 0,8.

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Annex A
(normative)

Relative visual attenuation quotient for signal light recognition

A.1 Definition of relative visual attenuation quotient for signal light recognition

This quotient Q is defined as:

$$Q = \frac{\tau_{sign}}{\tau_v}$$

where

τ_v is the luminous transmittance of the filter for CIE standard illuminant D 65. See ISO/CIE 10526:1999

τ_{sign} is the luminous transmittance of the filter for the spectral power distribution of the traffic signal light.

These are given by the equations:

$$\tau_v = \frac{\int_{380\ nm}^{780\ nm} \tau_F(\lambda) \cdot V(\lambda) \cdot S_{D65\lambda}(\lambda) \cdot d\lambda}{\int_{380\ nm}^{780\ nm} V(\lambda) \cdot S_{D65\lambda}(\lambda) \cdot d\lambda}$$

$$\tau_{sign} = \frac{\int_{380\ nm}^{780\ nm} \tau_F(\lambda) \cdot \tau_s(\lambda) \cdot V(\lambda) \cdot S_{A\lambda}(\lambda) \cdot d\lambda}{\int_{380\ nm}^{780\ nm} \tau_s(\lambda) \cdot V(\lambda) \cdot S_{A\lambda}(\lambda) \cdot d\lambda}$$

where

$S_{A\lambda}(\lambda)$ is the spectral distribution of radiation of CIE standard illuminant *A* (or 3200 K light source for blue signal light). See: ISO/CIE 10526:1999

$S_{D65\lambda}(\lambda)$ is the spectral distribution of radiation of CIE standard illuminant D65. See ISO/CIE 10526:1999

$V(\lambda)$ is the spectral luminous efficiency for daylight vision. See ISO/CIE 10 527:1991

$\tau_S(\lambda)$ is the spectral transmittance of the traffic signal lens;

$\tau_F(\lambda)$ is the spectral transmittance of the filter.

The spectral values of the products of the spectral distributions ($S_{A\lambda}(\lambda)$, $S_{D65\lambda}(\lambda)$), of the illuminants, the spectral luminous efficiency $V(\lambda)$ of the eye and the spectral transmittance $\tau(\lambda)$ of the traffic signal lenses are given in A.2.

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A.2 Spectral functions for the calculation of luminous transmittance and relative visual attenuation quotients

Table A.1 :Product of the spectral distribution of radiation of the signal lights and standard illuminant D65 as specified in ISO/CIE 10526:1999 and the spectral luminous efficiency of the average human eye for daylight vision as specified in ISO/CIE 10527:1991

Wavelength λ	$S_A(\lambda)\ V(\lambda)\ \tau_S(\lambda)$				$S_{D65}(\lambda)\ V(\lambda)$
nm	red	yellow	green	blue[a]	
380	0	0	0	0,0001	0
390	0	0	0	0,0008	0,0005
400	0	0	0,0014	0,0042	0,0031
410	0	0	0,0047	0,0194	0,0104
420	0	0	0,0171	0,0887	0,0354
430	0	0	0,0569	0,3528	0,0952
440	0	0	0,1284	0,8671	0,2283
450	0	0	0,2522	1,5961	0,4207
460	0	0	0,4852	2,6380	0,6688
470	0	0	0,9021	4,0405	0,9894
480	0	0	1,6718	5,9025	1,5245
490	0	0	2,9976	7,8862	2,1415
500	0	0	5,3553	10,1566	3,3438
510	0	0	9,0832	13,0560	5,1311
520	0	0,1817	13,0180	12,8363	7,0412
530	0	0,9515	14,9085	9,6637	8,7851
540	0	3,2794	14,7624	7,2061	9,4248
550	0	7,5187	12,4687	5,7806	9,7922
560	0	10,7342	9,4061	3,2543	9,4156
570	0	12,0536	6,3281	1,3975	8,6754
580	0,4289	12,2634	3,8967	0,8489	7,8870
590	6,6289	11,6601	2,1640	1,0155	6,3540
600	18,2382	10,5217	1,1276	1,0020	5,3740
610	20,3826	8,9654	0,6194	0,6396	4,2648
620	17,6544	7,2549	0,2965	0,3253	3,1619
630	13,2919	5,3532	0,0481	0,3358	2,0889
640	9,3843	3,7352	0	0,9695	1,3861
650	6,0698	2,4064	0	2,2454	0,8100
660	3,6464	1,4418	0	1,3599	0,4629
670	2,0058	0,7892	0	0,6308	0,2492
680	1,1149	0,4376	0	1,2166	0,1260
690	0,5590	0,2191	0	1,1493	0,0541
700	0,2902	0,1137	0	0,7120	0,0278
710	0,1533	0,0601	0	0,3918	0,0148
720	0,0742	0,0290	0	0,2055	0,0058
730	0,0386	0,0152	0	0,1049	0,0033
740	0,0232	0,0089	0	0,0516	0,0014
750	0,0077	0,0030	0	0,0254	0,0006
760	0,0045	0,0017	0	0,0129	0,0004
770	0,0022	0,0009	0	0,0065	0
780	0,0010	0,0004	0	0,0033	0
Sum	100	100	100	100	100

[a] For blue flashing light the spectral distribution for 3200 K is used instead of standard illuminant A.

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Annex B
(informative)

Guidance on selection and use

B.1 For the personal protection of the operator the filter must be mounted in a suitable eye protector. Eye protector types are described in EN 166.

B.2 For protection against ultraviolet radiation, filters should be selected from those classified in Table B.1. These filters can have a yellowish tinge which can modify colour perception.

B.3 For processes in which colour recognition is important, the use of UV filters with enhanced colour recognition is recommended.

B.4 Filters according to this standard are not suitable for direct viewing of bright light sources like Xenon high-pressure arc lamps or welding arcs. For this purpose welding filter according to EN 169 should be used.

B.5 The guidelines given in Table B.1 (typical applications) are not applicable to persons with photophobia or to those under medical treatment that can increase the sensitivity of the eyes to optical radiation.

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