
British Standard Specification for

Sun glare eye protectors for general use

Protection individuelle de l'œil — Filtres solaires d'usage général — Spécifications

Augenschutzgeräte gegen Sonnenstrahlung

Foreword

This British Standard has been prepared under the direction of the Personal Safety Equipment Standards Committee. It supersedes BS 2724 : 1956, which is withdrawn.

At present no corresponding international standard exists but discussions, in which the United Kingdom is an active participant, are taking place within technical committees of both the European Committee for Standardization (CEN/TC85) and the International Organization for Standardization (ISO/TC94). This standard is based in large part on the current draft document prepared by CEN/TC85 and will be withdrawn when the CEN standard is published.

Requirements for transmittance limits in the ultraviolet and blue spectral regions have been set to reflect the current concern in the United Kingdom for potential hazards. Opinion in other countries is not yet in accord on this issue and the limits are more restrictive in this standard than may be required in specifications being prepared by ISO and CEN.

This revision introduces the concept of shade numbers (as in the CEN standard) for the description of levels of light transmission rather than using density designations as in BS 2724 : 1956. It includes requirements for other types of filters which are now available (photochromic, gradient and polarizing) and takes account of the need to ensure that the recognition of signal lights should not be prevented by the use of the filters specified in this standard. In common with certain other standards in preparation within CEN, a requirement for the level of light diffusion due to scattered light arising from the surface or the body of the material of the lens has also been included. Recommendations for the use of sun glare eye protectors, sometimes referred to as sunglasses, are given in appendix A. This revision details specific information to be made available to purchasers of sunglasses.

Assessed capability. Users of this British Standard are advised to consider the desirability of assessment and registration of a supplier's quality systems against the appropriate Part of BS 5750 by a third party certification body.

Compliance with a British Standard does not of itself confer immunity from legal obligations; in particular attention is drawn to the Protection of Eyes Regulations 1974 (SI 1974 No. 1681).

Contents

	Page
Foreword	Inside front cover
Committees responsible	Back cover
Specification	
1 Scope	2
2 Definitions and explanation of terms	2
3 Transmittance	2
4 Refraction properties	3
5 Quality of filter material and surface	4
6 Stability	4
7 Frames	4
8 Mechanical strength of break resistant, robust and impact resistant sunglasses	4
9 Information and labelling	5
Appendices	
A Recommendations for the use of sun glare eye protection	6
B Methods for determination of transmittance for all sun glare filters, the axis of polarization of polarized filters and fatigue of photochromic filters	6
C Methods for determination of refractive, astigmatic and prismatic powers	11
D Methods for determination of quality of material and surface	13
E Methods for determination of filter material stability and mechanical strength	14
Tables	
1 Shade numbers and transmittance values of filters	3
2 Permissible refraction tolerances of filters	4
3 Refraction requirements for mounted filters	4
4 Classification and uses of sunglasses	7
5 Factors required for determining the relative visual attenuation coefficients and luminous transmittance	10
6 Spectral irradiance for the infra-red spectral range	12
Figures	
1 Spectral transmittance of heat absorbing filter	7
2 Outline of apparatus used for the determination of the axis of polarization	9
3 Target for use when determining the refractive properties of filters	11
4 Outline of apparatus used to assess the surface quality of filters	13
5 Outline of apparatus used for the measurement of scattered light in filters	15
6 Illustration of the method used for assessing strength of frame and bridge of sunglasses	16

Specification

1 Scope

This British Standard specifies requirements for unmounted filters and filters mounted in frames used for attenuating natural solar radiation. Requirements for frame design, construction and performance are also specified. This standard does not apply to filters with corrective effect.

Compliance of filters with this standard does not necessarily indicate that they are suitable for use with artificial daylight sources, e.g. solaria.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions and explanation of terms

For the purposes of this British Standard the following definitions and explanation of terms apply.

2.1 gradient filter. A filter in which the luminous transmittance changes progressively in the vertical meridian, when the filter is mounted, over some or all of the filter.

2.2 photochromic filter. A filter that reversibly alters its luminous transmittance under the influence of sunlight.

NOTE. The alteration is not instantaneous but is a function of a time constant, dependent principally on temperature and the material of the filter.

2.3 polarizing filter. A filter in which the transmittance is dependent on the amount and orientation of the polarization of the incident radiation.

2.4 relative visual attenuation coefficient. The relative visual attenuation coefficient Q is defined by the equation:

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

where

τ_{sign} is the luminous transmittance of the sun glare filter for the spectral power distribution of the signal light;

τ_v is the luminous transmittance of the sun glare filter for CIE Standard Illuminant D65.

These are given by the following equations:

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

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

where

λ is the wavelength of radiation;

$S_A(\lambda)$ is the spectral distribution of radiation of CIE Standard Illuminant A (or 3200 K light source for blue signal light);

$S_{D65}(\lambda)$ is the spectral distribution of radiation of CIE Standard Illuminant D65;

$V(\lambda)$ is the spectral luminous efficiency for photopic vision;

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

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

2.5 visual point. The point of intersection of the visual axis with the back surface of the filter when in the position of normal use.

3 Transmittance

3.1 General requirements

3.1.1 Shade numbers and transmittance values. Shade numbers and transmittance values of filters shall be as given in table 1. Transmittance values shall be determined in accordance with appendix B.

3.1.2 Spectral transmittance. The mean spectral transmittance for the wavelength range 380 nm to 500 nm shall not exceed $1.2 \tau_v$ when determined in accordance with B.4.

NOTE. Filters should have a mean spectral transmittance over this spectral range less than τ_v .

The spectral transmittance for the wavelength range 450 nm to 650 nm shall be not less than $0.2 \tau_v$ when determined in accordance with B.6.

3.1.3 Uniformity of luminous transmittance. Apart from a marginal zone 5 mm wide, the difference in luminous transmittance when determined in accordance with B.6 between any two points on the filter shall be not greater than 10 % of the higher value.

NOTE. For gradient filters this requirement applies in a section perpendicular to the gradient.

For mounted filters the difference between the luminous transmittance of the filters at the visual centre for the right and left eye shall not exceed 20 % of the higher value.

3.1.4 Recognition of signal lights and colours. Each tinted filter shall have a relative visual attenuation coefficient not less than 0.8 for each of the four signal colours specified when determined in accordance with B.5.

3.2 Additional requirements for special filters

3.2.1 Photochromic filters. When tested in accordance with B.6, photochromic filters shall be classified according to their luminous transmittance in the clear state, τ_0 , and in the darkened state, τ_1 , and their spectral transmittance values shall be as given in table 1 and 3.1.2 and enable the filters to comply with 3.1.3 and 3.1.4 in clear and dark states. The ratio of luminous transmittances τ_0/τ_1 shall be greater than 1.25.

Table 1. Shade numbers and transmittance values of filters

Transmittance class (recommended application)	Shade no.	UV range			Visible range
		UVB	UVA		Range of luminous transmittance
		280 nm to 315 nm	315 nm to 350 nm	315 nm to 380 nm	τ_v
		τ_{λ} maximum	τ_{λ} maximum	τ_{UVA}^* maximum	
Cosmetic spectacles	1.1				%
	1.4				100 to 80
	1.7	$0.1\tau_v$	τ_v	τ_v	80 to 58.1
	2.0				58.1 to 43.2 43.2 to 29.1
General purpose sunglasses	2.5				29.1 to 17.8
	3.1	$0.1\tau_v$	$0.25\tau_v$	$0.25\tau_v$	17.8 to 8.0
Special purpose sunglasses	3.1				17.8 to 8.0
	4.1	$0.01\tau_v$	$0.25\tau_v$	$0.25\tau_v$	8.0 to 3.0
*See B.3. NOTE 1. Appendix A gives further guidance on application. NOTE 2. Shade numbers are related to the luminous transmittance (τ_v) (geometrical mean value for each range) by the following equation: $\text{shade number} = 1 + 7/3 \log 1/\tau_v.$ NOTE 3. Shade numbers 1.1 to 2.0 may apply to certain photochromic sun glare filters in their clear condition and for the high luminous transmittance range of gradient filters. NOTE 4. Shade number 3.1 embraces both general and special purpose sun glare filters.					

When a representative sample of photochromic filter is tested in accordance with B.7, the relative change in luminous transmittance shall not exceed 5 % for the determined value for the clear state and 20 % for the determined value for the darkened state.

3.2.2 Polarizing filters. When tested in accordance with B.8, sunglasses fitted with polarizing filters shall not show a deviation from the vertical of greater than $\pm 5^\circ$ for the plane of polarization of the filters in the frame. The misalignment between the plane of polarization of the left and right filters shall be not greater than 6° .

NOTE. The CEN standard for sunglasses, which is currently in preparation, specifies $\pm 3^\circ$ for the maximum deviation from the vertical of the plane of polarization. It is probable that the CEN standard will retain this more stringent requirement. Users of this British Standard are advised therefore that it would be prudent to work towards the requirement of $\pm 3^\circ$.

The ratio of values of luminous transmittance determined with light polarized parallel and perpendicular to the plane of polarization of the filter shall be greater than 20:1.

3.2.3 Gradient filters. Shade numbers for gradient filters shall be determined by the highest and lowest values of transmittance within a distance 15 mm above and below the centre of the filter for non-mounted filters or the visual point for mounted filters.

3.2.4 Infra-red filters. If a filter is claimed to attenuate infra-red radiation associated with daylight, the mean infra-red transmittance shall not exceed τ_v when determined in accordance with B.9.

4 Refraction properties

4.1 Unmounted filters

When tested in accordance with appendix C, the values for refractive, astigmatic and prismatic powers for unmounted filters shall be as given in table 2.

When examined in accordance with D.1, class 1 unmounted filters shall show no local distortion effect to within 2 mm of the edge of the filter.

Table 2. Permissible refraction tolerances of filters

Class	Spherical power	Astigmatic power	Prismatic power
	Mean value of the refractive values in the two principal planes [$\frac{1}{2} \{D_1 + D_2\}$]	Difference of the refractive values in the two principal planes [$D_1 - D_2$]	
1	D ± 0.09	D 0.09	Δ 0.12
2	± 0.09	0.09	0.25

NOTE. The unit of power is the dioptre (symbol D).
The unit of prism power is the prism dioptre (symbol Δ).
(See BS 3521 : Parts 1 and 2.)

4.2 Mounted filters

When tested in accordance with appendix C, values for mounted filters shall be as given in table 2 and shall also be as given in table 3 for differences between prismatic power of each pair of mounted filters.

When examined in accordance with D.1, class 1 mounted filters shall show no local distortion effect within the full clear aperture of the filters.

Table 3. Refraction requirements for mounted filters

Class	Difference in prismatic power [$\Delta_1 - \Delta_2$] Prism dioptre (Δ)		
	Horizontal		Vertical
	Base out	Base in	
1	Δ 0.5	Δ 0.25	Δ 0.25
2	1.0	0.25	0.25

5 Quality of filter material and surface

5.1 Freedom from visible defects

When filters are examined in accordance with D.1, they shall be free, within an area 15 mm in radius about the visual point, from defects that affect their suitability for use, e.g. bubbles, striae, inclusions, scratches, digs, mould marks and distortion due to surface irregularity.

5.2 Light diffusion

When tested in accordance with D.2, the reduced luminance coefficient of unused filters shall not exceed $0.5 \text{ cd/m}^2 \cdot \text{lx}$.

6 Stability

6.1 Thermal stability

After treatment in accordance with E.2, filters shall not experience any change in their properties leading to them not being capable of complying with clauses 3 and 4. The relative change in luminous transmittance shall be less than 5 % for shade numbers 1.1 to 3.1 and less than 10 % for shade number 4.1.

6.2 Radiation stability

After exposure to radiation in accordance with E.3, the filter shall comply with clauses 3 and 4. The relative change in luminous transmittance shall be less than 5 % for shade numbers 1.1 to 3.1 and less than 10 % for shade number 4.1.

6.3 Flammability

When tested in accordance with E.4, plastics filters shall neither ignite nor continue to glow when removed from the oven.

7 Frames

7.1 Design and manufacture

Frames shall be free from obvious defects and shall be smoothly finished with no sharp edges or projections likely to cause discomfort or injury to the wearer.

7.2 Materials

All materials that come into contact with the wearer shall be not known to cause skin discoloration or irritation.

7.3 Flammability

When tested in accordance with E.4, frames shall neither ignite nor continue to glow when removed from the oven.

7.4 Security of filters

Filters shall be firmly and securely fitted to the frame. If the frame is fitted around the filters there shall be no gaps greater than 0.1 mm between the filter edge and the frame, unless they are a design feature.

8 Mechanical strength of break resistant, robust and impact resistant sunglasses

8.1 Break resistant sunglasses

When tested in accordance with either E.5.2.1 (unmounted filters) or E.5.2.2 (mounted filters), a filter shall not break through its thickness into two or more pieces and more than 30 mg of filter material shall not become detached from the side remote from that receiving the load or from the concave side, as appropriate.