NEW ZEALAND

EDICT OF GOVERNMENT

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AS-NZS 1067 (2003) (English): Sunglasses and fashion spectacles [By Authority of Australian Consumer Protection Notices No.13 of 2003 and No. 4 of 2005]

We will sell to no man,
we will not deny or defer to any man either justice or right.

Magna Carta—Tūtohinga Nui

Kore rawa e hoko ki te tangata, e kore e whakakāhoretia,
e tautuku rānei te tangata ki te ture, tika ranei.

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AS/NZS 1067:2003
(Incorporating Amendment No. 1)

STANDARDS NEW ZEALAND
PAEREWA AOTEAROA

Sunglasses and fashion spectacles

STANDARDS Australia

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CS-053, Sunglasses. It was approved on behalf of the Council of Standards Australia on 31 March 2003 and on behalf of the Council of Standards New Zealand on 18 March 2003.
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The following are represented on Committee CS-053:

Australian Association of Certification Bodies
Australian Chamber of Commerce and Industry
Australian Competition and Consumer Commission
Australian Institute of Sport
Australian Radiation Protection and Nuclear Safety Agency
Australian Retailers Association
Cancer Society of New Zealand
Consumers Federation of Australia
Department of Defence (Australia)
Guild of Dispensing Opticians (Australia)
New Zealand Association of Optometrists
Office of Consumer and Business Affairs, South Australia
Optical Distributors and Manufacturers Association of Australia
Optometrists Association, Australia
Queensland University of Technology
Royal Australian and New Zealand College of Ophthalmologists
Sunglass Association of Australia
The Treasury, Consumer Affairs Division
University of Auckland
University of New South Wales
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AS/NZS 1067:2003
(Incorporating Amendment No. 1)

Australian/New Zealand Standard™

Sunglasses and fashion spectacles

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AS 1067.1—1990 and AS 1067.2—1990 jointly revised, amalgamated and redesignated as AS/NZS 1067:2003.
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PREFACE

This Standard was prepared by Standards Australia/Standards New Zealand Committee CS-053, Sunglasses to supersede AS 1067.1—1990, *Sunglasses and fashion spectacles*, Part 1: *Safety requirements* and AS 1067.2—1990 and *Sunglasses and fashion spectacles*, Part 2: *Performance requirements*.

This Standard incorporates Amendment No. 1 (June 2009). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This Standard was first published in 1971 at which time it was the first national standard for sunglasses in the world. It addressed in novel ways the problems of protection against ultraviolet radiation and the distortion of colours by coloured sunglass lenses, as well as setting requirements for optical performance.

Since then a number of other national standards for sunglasses have been published which address the same safety and health issues defined by AS 1067 but take different approaches to setting requirements for sunglasses.

While it is acknowledged that the previous Australian sunglasses Standard was particularly well accepted nationally and internationally, revision of the Standard became a necessity to comply with elements of the World Trade Organization (WTO) Agreement on Technical Barriers to Trade (commonly referred to as the TBT Code).

Currently, there is no international Standard for sunglasses but the European Standard EN 1836, *Personal eye protection—Sunglasses and sunglare filters for general use* has significant international acceptance.

For this reason, this Australian/New Zealand Standard for sunglasses is modelled on the European Standard. The test methods are the same as those of the European Standard, however this Standard sets some different requirements to avoid lowering the standards set by AS 1067—1990 and reducing the level of protection provided. This recognizes the special circumstances of this region, especially its climatic conditions.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to figures are deemed to be requirements of this Standard.

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FOREWORD

Committee CS-053 considered it important that, where protection of the eyes against sunglare is required, the consumer would be able to select the correct type of sunglasses, depending on their intended use. Provision has therefore been made in this Standard for appropriate marking and labelling of sunglasses and fashion spectacles to provide consumers with the necessary information.

The scope of this Standard is unchanged from previous editions, and includes requirements for sunglass lenses, frames and minimum requirements for customer information. The Standard contains specific requirements for refractive properties and optical qualities of lenses and the assessment of robustness and lens retention.

The Standard covers children's sunglasses. It does not cover toy sunglasses that are clearly identified as such, ski goggles, spectacles for special purposes such as protection in solaria, and eye protection against sources of radiation other than the sun.

Appendices describing test methods for the determination of spectral transmittance and coloration limits, and suitable methods of test for performance characteristics are included in the Standard.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Sunglasses and fashion spectacles

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

A1 This Standard specifies minimum requirements for sunglasses and fashion spectacles and sunglass lenses of nominal plano power—excluding (any) prescription lenses—intended for protection against solar radiation for general use, and social and domestic purposes, including road use and driving.

NOTE: Information on the use of sunglasses lenses is provided in Appendix A.

This Standard applies to the following:

(a) Spectacles comprising tinted lenses of nominal zero power mounted in a spectacle frame.

(b) Individual tinted lenses of nominal zero power intended for use in sunglasses.

(c) Rimless sunshields and one piece visors.

(d) Clip-on and slip-on type sunglasses.

(e) Children's sunglasses.

A1 (f) Fashion spectacles.

This Standard does not apply to the following:

(i) Safety glasses and safety goggles intended to provide protection against optical radiation. AS/NZS 1337 and AS/NZS 1338 apply to safety glasses and safety goggles.

(ii) Eyewear for protection against radiation in solaria. AS/NZS 2635 applies to these lenses.

(iii) Ski goggles.

(iv) Glasses for use as toys and clearly and legibly labelled as toys.

1.2 OBJECTIVE

The objective of this Standard is to provide regulatory authorities, manufacturers, importers, distributors and retailers with a comprehensive set of requirements for sunglasses and fashion spectacles in order to minimize safety risks associated with use of inappropriate protective eyewear intended to provide protection against solar radiation.

1.3 REFERENCED DOCUMENTS

AS/NZS

1337 Eye protectors for industrial applications

1338 Filters for eye protectors (series)

2211 Laser safety (series)

2635 Solaria for cosmetic purposes

ISO/CIE
85 CIE spectral distribution of solar radiation

10526 CIE standard illuminants for colorimetry

10527 CIE standard colorimetric observers

EN
165 Personal eye protection—Vocabulary

1.4 DEFINITIONS

For the purposes of this Standard, the definitions below apply.

1.4.1 Absorptance (absorption)

Ratio of absorbed radiant or luminous flux to incident radiant or luminous flux. Absorptance is 1 minus transmittance minus reflectance.

NOTE: Some manufacturers use the term 'absorption' and specify the value of the absorption as the difference 1 minus the luminous transmittance. Luminous flux is a quantity derived from radiant flux by weighting the radiation by the spectral sensitivity of the eye. Radiant flux is power emitted, transferred or received in the form of radiation.

1.4.2 Afocal lens

A lens with zero optical power, that is, one in which incident rays entering parallel emerge parallel.

1.4.3 Air mass (1 and 2)

The amount of air that solar radiation must pass through to reach the earth's surface, and is a product of the air density and the distance traversed through the atmosphere. Air mass is expressed as the ratio of the path through the atmosphere to the path when the sun is directly overhead (air mass 1). Air mass 2 is when the path length is twice as long and the sun is at an angle of 30° above the horizon.

1.4.4 Corresponding points

Points on the surfaces of a pair of lenses, one on each lens, which have the same location when one lens is placed on top of the other without rotation of the lenses.

1.4.5 Fashion spectacles

Glasses having tinted lenses of nominal zero power which absorb some ultraviolet radiation but do not substantially reduce sunglare and are worn primarily for reasons of fashion.

1.4.6 Goggle

An eye protector fitting the contour of the face and held in position by an adjustable headband.

1.4.7 Infra red radiation

Optical radiation for which the wavelengths are longer than those for visible radiation.

1.4.8 Lens power

The ability of a lens to change the direction of rays of light passing through it.

NOTE: Lens power is specified as the reciprocal of the focal length of the lens when the medium surrounding the lens is air. For spectacle lenses the focal length is specified as the distance between the back surface of the lens and the point at which the lens brings parallel light rays to a focus. The unit of lens power is m^{-1}. This unit of lens power is sometimes called the dioptre.

A lens has positive power if the lens converges light rays to a point (the focal point). It has negative power if the light rays are diverged after passing through the lens in which case the focal point is found by extrapolating the diverging rays backwards.

If a lens has the same power in all meridians on its surface it is known as a spherical lens. If it has a power in one meridian which diminishes progressively to zero on the meridian at right angles to the first meridian, it is known as a cylindrical lens. If the power in the second meridian is not zero but is different from the power in the first meridian, the lens is known as a sphero-cylindrical lens.

1.4.9 Luminous density

Logarithm to the base 10 of the reciprocal of the luminous transmittance.

1.4.10 Luminous transmittance

Ratio of the transmitted luminous flux to the incident luminous flux. Luminous transmittance is usually specified with respect to one of the internationally accepted standard illuminants. (Symbol: τ_V)

1.4.11 Optical radiation

Electromagnetic radiation at wavelengths between the region of transition to X-rays (wavelength about 1 nm) and the region of transition to radio waves (wavelength about 1 mm).

1.4.12 Photochromic sunglass lens

Lens that reversibly alters its luminous transmittance under the influence of sunlight.

This alteration is not instantaneous, but is a function of a temperature and material dependent time constant. In this way, the luminous transmittance of the lens adjusts itself within certain limits to the ambient radiant flux.

1.4.13 Polarizing sunglass lens

Lens for which transmittance is dependent on the polarization of the radiation.

NOTE: Polarizing sunglass lenses have a preferred plane of polarization. The plane of polarization is determined by the transmission direction of the magnetic vector of the transmitted electromagnetic wave.

1.4.14 Prismatic power

The amount of deviation of a ray of light passing through a prism or lens. It is usually expressed as the amount of deviation in centimetres over a distance of 1 metre with the unit of centimetre per metre. One centimetre per metre of deviation is sometimes called a prism dioptre.

1.4.15 Reference points of afocal lenses

Representative measurement points for sunglass lenses. (See Appendix L for the method of determining reference points of lenses.)

1.4.16 Relative visual attenuation quotient for signal light detection

The luminous transmittance of the sunglass lens for the spectral power distribution of the traffic signal light divided by the luminous transmittance of the sunglass lens (for CIE Standard Illuminant D65).

1.4.17 Signal light transmittance

The mean of the spectral transmittance between 380 nm and 780 nm weighted with the spectral visibility function for the average human eye for daylight vision and the relative spectral energy distribution of the traffic signal. (Symbol: τ_{SIG}).

1.4.18 Solar blue-light transmittance

The mean of the spectral transmittance between 400 nm and 500 nm weighted with the solar radiation $E_s(\lambda)$ at sea level for air mass 2 and the blue-light hazard function $B(\lambda)$. (Symbol: τ_{SB}).

1.4.19 Solar infrared transmittance

Transmittance obtained by integration between the limits 780 nm and 2 000 nm based on the solar spectral distribution of radiation $E_S(\lambda)$ at sea level for air mass 2. (Symbol: τ_{SIR}).

1.4.20 Solar UV transmittance

Mean of the spectral transmittance between 280 nm and 400 nm weighted with the solar radiation E_S (λ) at sea level for air mass 2 and the relative spectral effectiveness function for UV radiation $S(\lambda)$. (Symbol: τ_{SUV}).

1.4.21 Solar UVA transmittance

Mean of the spectral transmittance between 315 nm and 400 nm weighted with the solar radiation $E_S(\lambda)$ at sea level for air mass 2 and the relative spectral effectiveness function for UV radiation $S(\lambda)$. (Symbol: τ_{SUVA}).

1.4.22 Solar UVB transmittance

The solar UVB transmittance is the mean of the spectral transmittance between 280 nm and 315 nm weighted with the solar radiation $E_S(\lambda)$ at sea level for air mass 2 and the relative spectral effectiveness function for UV radiation $S(\lambda)$. (Symbol: τ_{SUVB}).

1.4.23 Spectral transmittance

Ratio of transmitted radiant flux to the incident radiant flux for a given wavelength of monochromatic radiation.

1.4.24 Standard illuminant

Spectral distributions of sources of illumination that are internationally accepted for the purpose of calculating specifications for colour and luminous transmittance. The Standard Illuminants are defined by the Commission Internationale de L'Éclairage (CIE). There are two principal Standard Illuminants. Standard Illuminant A represents incandescent light and Standard Illuminant D65 represents daylight.

1.4.25 Visible radiation

Optical radiation capable of causing a direct visual sensation. There are no precise limits for the spectral range of visible radiations but the lower limit is generally taken as between 360 nm and 400 nm and the upper limit between 800 nm and 830 nm.

1.4.26 UV radiation

Optical radiation for which the wavelengths are shorter than those for visible radiation. Ultraviolet is commonly sub-divided into UV-A from 315 nm to 400 nm, UV-B from 280 nm to 315 nm and UV-C from 100 nm to 280 nm. UV-C is totally absorbed by the earth's atmosphere.

1.5 NOTATION

The following quantity symbols are used in the equations of this Standard.

$B(\lambda)$	=	blue-light hazard function for the retina
$E_S(\lambda)$	=	solar irradiation
λ	=	wavelength
Q	=	relative visual attenuation quotient for signal light detection

$S_A(\lambda)$ = spectral distribution of radiation of Standard Illuminant A

$S_{D65}(\lambda)$ = spectral distribution of radiation of Standard Illuminant D65

$S(\lambda)$ = relative spectral effectiveness function for corneal damage

τ_0 = luminous transmittance of a photochromic lens in the faded state as reached at 23°C after specified conditioning

τ_1 = luminous transmittance of a photochromic lens in the darkened state as reached at 23°C after specified irradiation simulating mean outdoor conditions

τ_A = luminous transmittance of a photochromic lens in the darkened state as reached at 23°C after specified irradiation simulating reduced light conditions

τ_S = luminous transmittance of a photochromic lens in the darkened state as reached at 35°C after specification irradiation simulating outdoor condition at high temperature.

$\tau_F(\lambda)$ = spectral transmittance of the sunglass lens

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

τ_{SB} = solar blue-light transmittance

τ_{SIG} = relative transmittance of the sunglass lens for the spectral power distribution of the traffic signal light

τ_{SIR} = solar infrared transmittance

τ_{SUV} = solar UV transmittance

τ_{SUVA} = solar UVA transmittance

τ_{SUVB} = solar UVB transmittance

τ_V = luminous transmittance of the sunglass lens for the Standard Illuminant D65

τ_W = luminous transmittance of a photochromic lens in the darkened state as reached at 5°C after specified irradiation simulating outdoor conditions at low temperatures

$V(\lambda)$ = relative spectral visibility function of daylight vision.

See ISO/CIE 10527.

$WB(\lambda)$ = complete blue-light weighting function for retinal damage

$W(\lambda)$ = complete weighting function for corneal damage

1.6 EQUATIONS

1.6.1 Luminous transmittance (see Clause 1.4.10)

A1 The value of τ_V is calculated using Equation 1.6.1.

$$\tau_V = \frac{\int_{380\,\text{nm}}^{780\,\text{nm}} \tau_F(\lambda).S_{D65}(\lambda).V(\lambda).d\lambda}{\int_{380\,\text{nm}}^{780\,\text{nm}} S_{D65}(\lambda).V(\lambda).d\lambda} \qquad \ldots 1.6.1$$

NOTE: The product of the spectral distribution of radiation of daylight (CIE Standard illuminant D65) and relative spectral visibility function of daylight vision is compiled in Appendix C, Table C1 and may be interpolated where necessary.

1.6.2 Signal light transmittance (see Clause 1.4.17)

A1 The value of τ_{SIG} is calculated using Equation 1.6.2.

$$\tau_{SIG} = \frac{\int_{380\,nm}^{780\,nm} \tau_F(\lambda).S_A(\lambda).V(\lambda).\tau_S(\lambda).d\lambda}{\int_{380\,nm}^{780\,nm} S_A(\lambda).V(\lambda).\tau_S(\lambda).d\lambda} \qquad \ldots 1.6.2$$

NOTE: The products of the spectral distribution of radiation of the signal lights and relative spectral visibility function of daylight vision are compiled in Appendix C, Table C1 and may be interpolated where necessary.

1.6.3 Relative visual attenuation quotient for signal light detection (see Clause 1.4.16)

A1 Relative visual attenuation quotient for signal light detection is calculated using Equation 1.6.3.

$$Q = \frac{\tau_{SIG}}{\tau_V} \qquad \ldots 1.6.3$$

NOTE: Where Q is calculated for red, yellow, green and blue signals.

1.6.4 Solar blue-light transmittance (see Clause 1.4.18)

The complete blue light weighting function WB(λ) which is calculated using Equation 1.6.4(1).

$$WB(\lambda) = E_S(\lambda).B(\lambda) \qquad \ldots 1.6.4(1)$$

NOTE: The values of the functions of $E_S(\lambda)$ and $B(\lambda)$ are compiled in Appendix C, Table C2 and may be interpolated where necessary.

The value of τ_{SB} is calculated using Equations 1.6.4(2) or 1.6.4(3):

A1

$$\tau_{SB} = \frac{\int_{380\,nm}^{500\,nm} \tau_F(\lambda).E_S(\lambda).B(\lambda).d\lambda}{\int_{380\,nm}^{500\,nm} E_S(\lambda).B(\lambda).d\lambda} \qquad \ldots 1.6.4(2)$$

$$\tau_{SB} = \frac{\int_{380\,nm}^{500\,nm} \tau_F(\lambda).WB(\lambda).d\lambda}{\int_{380\,nm}^{500\,nm} WB(\lambda).d\lambda} \qquad \ldots 1.6.4(3)$$

1.6.5 Solar infrared transmittance (see Clause 1.4.19)

Solar infrared transmittance τ_{SIR} values are calculated using Equation 1.6.5 where values of $E_S(\lambda)$ are given in Appendix C, Table C3.

A1

$$\tau_{SIR} = \frac{\int_{780\,nm}^{2000\,nm} \tau_F(\lambda).E_S(\lambda).d\lambda}{\int_{780\,nm}^{2000\,nm} E_S(\lambda).d\lambda} \qquad \ldots 1.6.5$$

1.6.6 Solar UV transmittance (see Clause 1.4.20)

The complete weighting function W(λ) is calculated using Equation 1.6.6(1):

$$W(\lambda) = E_S(\lambda).S(\lambda) \qquad \ldots 1.6.6(1)$$

NOTE: The values of the functions of $E_S(\lambda)$ and $S(\lambda)$ are compiled in Appendix C, Table C2 and may be interpolated where necessary.

The value of Solar UV transmittance τ_{SUV} is calculated using Equation 1.6.6(2) or 1.6.6(3):

$$\tau_{SUV} = \frac{\int_{280nm}^{400nm} \tau_F(\lambda) . E_S(\lambda) . S(\lambda) . d\lambda}{\int_{280nm}^{400nm} E_S(\lambda) . S(\lambda) . d\lambda} \qquad \ldots 1.6.6(2)$$

$$\tau_{SUV} = \frac{\int_{280nm}^{400nm} \tau_F(\lambda) . W(\lambda) . d\lambda}{\int_{280nm}^{400nm} W(\lambda) . d\lambda} \qquad \ldots 1.6.6(3)$$

1.6.7 Solar UVA transmittance (see Clause 1.4.21)

The complete weighting function W(λ) is calculated using Equation 1.6.6(1)

The value of Solar UVA transmittance τ_{SUVA} is calculated using Equation 1.6.7(1) or 1.6.7(2):

$$\tau_{SUVA} = \frac{\int_{315nm}^{400nm} \tau_F(\lambda) . E_S(\lambda) . S(\lambda) . d\lambda}{\int_{315nm}^{400nm} E_S(\lambda) . S(\lambda) . d\lambda} \qquad \ldots 1.6.7(1)$$

$$\tau_{SUVA} = \frac{\int_{315nm}^{400nm} \tau_F(\lambda) . W(\lambda) . d\lambda}{\int_{315nm}^{400nm} W(\lambda) . d\lambda} \qquad \ldots 1.6.7(2)$$

1.6.8 Solar UVB transmittance (see Clause 1.4.22)

The complete weighting function W(λ) is calculated using Equation 1.6.6(1)

The value of Solar UVB transmittance τ_{SUVB} is calculated using Equation 1.6.8(1) or 1.6.8(2).

$$\tau_{SUVB} = \frac{\int_{280nm}^{315nm} \tau_F(\lambda) . E_S(\lambda) . S(\lambda) . d\lambda}{\int_{280nm}^{315nm} E_S(\lambda) . S(\lambda) . d\lambda} \qquad \ldots 1.6.8(1)$$

$$\tau_{SUVB} = \frac{\int_{280nm}^{315nm} \tau_F(\lambda) . W(\lambda) . d\lambda}{\int_{280nm}^{315nm} W(\lambda) . d\lambda} \qquad \ldots 1.6.8(2)$$

SECTION 2 REQUIREMENTS FOR SUNGLASS LENSES

2.1 TRANSMITTANCE REQUIREMENTS AND LENS CATEGORIES

2.1.1 Lens categories

Sunglass lenses shall be classified into five lens categories, where category 0 applies only to:

(a) Photochromic lenses in the faded state.

(b) Gradient lenses with a luminous transmittance greater than 80% at the reference point.

(c) Lenses that have a luminous transmittance greater than 80%, but where a specific protection against any part of the solar spectrum is claimed.

The range of the luminous transmittance of these five categories is given by the values in Table 1. The overlap of the luminous transmittance values shall be not more than ±2% (absolute) between the categories 0, 1, 2 and 3.

2.1.2 Transmittance requirements

Sunglass lenses in a given lens category shall meet the requirements set out in Table 1 when measured at the reference points of the lenses.

The requirements of Table 1 apply to all kinds of sunglass lenses including uniformly tinted, gradient density, polarizing and photochromic lenses.

Photochromic lenses shall meet the requirements in both the faded and darkened states.

A sunglass lens shall meet the requirements for ultraviolet radiation in Table 1 at all points within a circle 28 mm in diameter centred on the reference point.

2.1.3 Claims of luminous transmittance

If the supplier claims a luminous transmittance value for a sunglass lens, for categories 0 to 3, it shall be within ±3% absolute of the measured values and for Category 4 it shall be within ±30% relative to the measured value.

When stating the transmittance properties of photochromic lenses, at least two categories for transmittance values, τ_0 and τ_1 shall be used. These two values correspond to the faded state and to the darkened state of the lens respectively.

TABLE 1

TRANSMITTANCE REQUIREMENTS FOR SUNGLASS LENSES

<table>
<tr><th rowspan="3">Lens category</th><th colspan="7">Visible spectral range</th><th colspan="3">UV spectral range</th></tr>
<tr><th colspan="2">Range of luminous transmittance (τ_V)
%</th><th>Minimum spectral trans-mittance for wave-lengths</th><th colspan="4">Minimum relative visual attenuation for signal light detection (Q)</th><th colspan="2">Maximum value of spectral transmittance
($\tau_F(\lambda)$)</th><th>Maximum value of solar UVA transmittance
(τ_{SUVA})</th></tr>
<tr><th>from over</th><th>to</th><th>450 nm to 650 nm</th><th>red</th><th>yellow</th><th>green</th><th>blue</th><th>280 nm to 315 nm</th><th>Over 315 nm to 350 nm</th><th>315 nm to 400 nm</th></tr>
<tr><td>0</td><td>80.0</td><td>100</td><td rowspan="5">$0.20\tau_V$</td><td rowspan="4">0.80</td><td rowspan="4">0.80</td><td rowspan="4">0.60</td><td rowspan="4">0.70</td><td rowspan="5">$0.05\tau_V$</td><td rowspan="3">τ_V</td><td rowspan="3">τ_V</td></tr>
<tr><td>1</td><td>43.0</td><td>80.0</td></tr>
<tr><td>2</td><td>18.0</td><td>43.0</td></tr>
<tr><td>3</td><td>8.0</td><td>18.0</td><td rowspan="2">$0.50\tau_V$</td><td rowspan="2">$0.50\tau_V$</td></tr>
<tr><td>4</td><td>3.0</td><td>8.0</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
</table>

2.2 OTHER TRANSMITTANCE REQUIREMENTS

2.2.1 Uniformity of luminous transmittance of uniformly tinted sunglass lenses

The minimum luminous transmittance shall not be less than 85% of the maximum luminous transmittance at any point within a circle of 28 mm diameter centred on the reference point of the lens.

2.2.2 Transmittance matching for pairs of sunglass lenses of all types

The luminous transmittance at corresponding points within circles of 28 mm diameter centred on the reference points of a pair of lenses mounted in a frame or intended for assembly in a frame shall not differ by more than 15% of the value of the higher transmittance.

2.2.3 Uniformity of colour for pairs of sunglass lenses of all types

Pairs of lenses mounted in a spectacle frame shall appear to be of the same colour at corresponding points within circles of 28 mm diameter centred on the reference points. The hue of a uniformly tinted lens should appear constant from one area of the lens to another when the lens is inspected against a uniform white background by a person with normal colour vision.

2.3 SPECIAL TRANSMITTANCE REQUIREMENTS

2.3.1 Photochromic lenses

The categories of a photochromic lens shall be determined by its luminous transmittance in its faded state τ_0 and its luminous transmittance in its darkened state τ_1 achieved after 15 min irradiation according to Appendix B. In both states, the requirements specified in this section and Table 1 shall be met.

For photochromic lenses $\frac{\tau_0}{\tau_1}$ shall be ≥ 1.25.

2.3.2 Polarizing lenses

Where sunglasses are fitted with polarizing lenses, these shall be fitted in the frame so that the plane of polarization does not deviate from the horizontal direction by more than 5°. The misalignment between the plane of polarization of the left and right lenses shall not be greater than 6°.

The plane of polarization of uncut polarizing sunglass lenses shall be marked.

For polarizing lenses the ratio of the luminous transmittance values parallel and perpendicular to the plane of polarization shall be greater than 8:1 for lens categories 2, 3, 4 and greater than 4:1 for category 1 when measured in accordance with Appendix B.

2.3.3 Gradient lenses

The lens category of gradient lenses shall be determined by the luminous transmittance value at the reference point.

A1 All parts of a gradient density lens within a circle of 28 mm diameter centred on the reference point shall comply with the minimum spectral transmittance and relative visual attenuation for signal light detection requirements set out in Table 1.

2.4 CLAIMED TRANSMITTANCE PROPERTIES

2.4.1 General

When specific transmittance values are claimed, these claims shall be in accordance with Clause 2.1.3 and the measurements of those transmittance values shall be in accordance with Appendix B.

2.4.2 Blue-light absorption/transmittance

2.4.2.1 *Blue-light absorption*

When it is claimed that a lens has x% blue-light absorption, the solar-blue-light transmittance τ_{SB} of the filter shall not exceed $(100.5 - x)$%.

2.4.2.2 *Blue-light transmittance*

A1 When it is claimed that a lens has less than x% blue-light transmittance, the solar blue-light transmittance τ_{SB} of the lens shall not exceed $(x + 0.5)$%.

2.4.3 UV absorption/transmittance

2.4.3.1 *UV absorption*

When it is claimed that a lens has x% UV absorption, the solar UV transmittance of the lens τ_{SUV} shall not exceed $(100.5 - x)$%.

2.4.3.2 *UV transmittance*

When it is claimed that a lens has less than x% UV transmittance, the solar UV transmittance of the lens τ_{SUV} shall not exceed $(x + 0.5)$%.

2.4.3.3 *UVA absorption*

When it is claimed that a lens has x% UVA absorption, the solar UVA transmittance of the lens τ_{SUVA} shall not exceed $(100.5 - x)$%.

2.4.3.4 *UVA transmittance*

When it is claimed that a lens has less than x% UVA transmittance, the solar UVA transmittance of the lens τ_{SUVA} shall not exceed $(x + 0.5)$%.

2.4.3.5 *UVB absorption*

When it is claimed that a lens has x% UVB absorption, the solar UVB transmittance of the lens τ_{SUVB} shall not exceed $(100.5 - x)$%.

2.4.3.6 *UVB transmittance*

When it is claimed that a lens has less than x% UVB transmittance, the solar UVB transmittance of the lens τ_{SUVB} shall not exceed $(x + 0.5)$%.

2.5 OPTICAL POWER OF LENSES

2.5.1 Spherical and cylindrical power

When tested in accordance with Appendix D, the spherical and cylindrical power values shall not exceed those set out in Table 2. The values shall not be exceeded for all positions of the measuring field specified in the method.

2.5.2 Local aberrations in spherical and cylindrical power

When the view of the image in the method of Appendix D cannot be clearly focussed or small area distortions are seen in the lens under test within a circle 20 mm diameter centred on the reference point, the lens shall also be tested in accordance with Appendix E. The spherical and cylindrical power values measured shall not exceed those set out in Table 2.

NOTE: Small area distortions are most easily viewed by inspection of a regular grid of lines through the lens.

2.5.3 Prismatic power—Individual unmounted lenses

When tested in accordance with Appendix D, the prismatic power values shall not exceed those set out in Table 3, Column 1.

2.5.4 Prismatic power difference—Assembled sunglasses

When tested in accordance with Appendix F, the prismatic power values shall not exceed those set out in Table 3, Column 2.

TABLE 2

SPHERICAL AND CYLINDRICAL POWER VALUES OF LENSES

Spherical power Mean value of the optical power values in the two principal meridians m^{-1}	Cylindrical power Absolute difference of the optical power values in the two principal meridians m^{-1}
$(D_1 + D_2)/2$	$\|D_1 - D_2\|$
±0.09	0.09

TABLE 3

PRISMATIC POWER VALUES OF INDIVIDUAL LENSES AND ASSEMBLED SUNGLASSES

Prismatic power in individual unmounted lenses (edged or uncut) at the reference point	Difference in prismatic powers at the reference points in assembled sunglasses, cm/m		
	Horizontal		Vertical
cm/m	Base out	Base in	
0.25	1.00	0.25	0.25

2.6 SCATTERED LIGHT

When tested as described in light diffusion test of Appendix G at the reference point, the reduced luminous factor of a lens shall not exceed 0.65 $cd.m^{-2}/lx$.

2.7 MATERIAL AND SURFACE QUALITY

When inspected by the naked eye in accordance with the method described in Appendix H, sunglass lenses shall have no material or machining defects within an area of 28 mm diameter centred on the reference point of the lens that could impair vision, e.g. bubbles, scratches, inclusions, dull spots, pitting, mould marks, notches, reinforced points, specks, beads, water specks, pocking, gas inclusions, splintering, cracks, polishing defects or undulations. Single defects outside this area and within 5 mm of frame edges are permissible.

2.8 RESISTANCE TO RADIATION

Following irradiation as specified in Appendix I, the relative change in the luminous transmittance shall be less than ±5% for lenses of category 0, less than ±10% for lenses of category 1 and less than ±20% for lenses of all other categories.

After irradiation—

(a) the scattered light shall not exceed the limit value of 0.65 $cd.m^{-2}/lx$; and

(b) for photochromic filters, $\frac{\tau_0}{\tau_1}$ shall be ≥ 1.25.

2.9 IGNITION

When tested as described in Appendix J, sunglass lenses shall not ignite or continue to glow after removal of the steel rod.

SECTION 3 REQUIREMENTS FOR ASSEMBLED SUNGLASSES

3.1 GENERAL CONSTRUCTION

Sunglasses shall be free from projections, sharp edges or other defects which are likely to cause injury during intended use.

3.2 EYE COVERAGE AND FIELD OF VIEW

3.2.1 Eye coverage

3.2.1.1 *General*

In order to provide a minimum field of view and area of UV protection, the following provisions shall apply to assembled sunglasses with Category 2, 3 and 4 lenses including one-piece visors, clip-ons and slip-ons.

3.2.1.2 *Assembled sunglasses*

The lenses of assembled sunglasses that are not labelled as children's sunglasses shall cover two ellipses of horizontal diameter of 40 mm and a vertical diameter of 28 mm, the centres of which are separated by 64 mm and symmetrically placed on either side of the centre of the nose bridge of the frame.

3.2.1.3 *Children's sunglasses*

The lenses of assembled sunglasses which are labelled as children's sunglasses shall cover two ellipses of horizontal diameter of 34 mm and a vertical diameter of 24 mm, the centres of which are separated by 54 mm and symmetrically placed on either side of the centre of the nose bridge of the frame.

3.2.1.4 *Clip-ons and slip-ons*

Clips-ons and slip-ons shall meet the requirements of Clauses 3.2.1.2 and 3.2.1.3 unless they are designed for and sold as an accessory to be used with a particular spectacle frame fitted with prescription lenses.

3.2.2 Field of view

The view through lenses shall not be obstructed or obscured by labels, decorations or markings within the area of the two ellipses defined in Clause 3.2.1 other than for those intended to be removed before use. This assessment shall be made viewing from the eye side of the lens.

3.3 DIMENSIONAL TOLERANCE

The shape and size of a pair of lenses assembled in one frame shall not differ by more than ±0.5 mm in any meridian, except where the difference is intended as a design feature.

3.4 MECHANICAL REQUIREMENTS

3.4.1 Security of the lenses in the frame

A1 The lenses of sunglasses and fashion spectacles shall be firmly and securely fitted to the frame. When the assemblies are tested in accordance with Appendix K, the lens mounting shall hold the lenses firmly and securely in position and neither the lens nor the frame shall break. After restoring the original geometry, flaking or peeling of any coating material applied to the frame shall not be regarded as a failure of the test.

Clip-on and slip-on type sunglasses are exempt from the requirements of this Clause.

3.4.2 Impact resistant sunglasses and fashion spectacles

Sunglasses and fashion spectacles which are claimed to be impact-resistant shall also comply with the dimensional requirements for safety spectacles and the low impact requirements in AS/NZS 1337.

3.5 IGNITION

When sunglasses are tested in accordance with Appendix J, there shall be no continued combustion after withdrawal of the test rod.

3.6 MATERIALS FOR THE MANUFACTURE OF ASSEMBLED SUNGLASSES

The manufacturer shall not use frame materials that cause irritation, toxic reaction, or other harm during wear in contact with skin in normal state of health.

NOTE: Reactions may be generated by excessive pressure, chemical irritation or allergy. Rare or idiosyncratic reactions may occur to any material and may indicate the need for the individual to avoid particular types of frames.

SECTION 4 MARKING AND LABELLING

4.1 INFORMATION TO BE SUPPLIED

4.1.1 All assembled sunglasses and individual sunglass lenses

The following information shall be supplied with every pair of assembled sunglasses and with individual sunglass lenses:

(a) Identification of manufacturer or supplier.

A1 (b) Lens category number and description in accordance with Table 4. For photochromic lenses, both lens categories shall be named and described.

(c) Number of this Standard, AS/NZS 1067.

4.1.2 Category 1 lenses

Sunglasses fitted with Category 1 lenses shall be marked or labelled 'NOT SUITABLE FOR DRIVING AT NIGHT'.

4.1.3 Category 4 lenses

Sunglasses fitted with Category 4 lenses shall be marked or labelled 'MUST NOT BE USED WHEN DRIVING' and the symbol shown Figure 1 shall be included in the label. The minimum height of the symbol shall be 5 mm.

4.1.4 Photochromic lenses

Sunglasses fitted with photochromic lenses shall be marked or labelled 'PHOTOCHROMIC LENSES' and shall carry the words 'NOT SUITABLE FOR DRIVING AT NIGHT' unless the lenses reach category 0 in the dark when tested in accordance with Appendix B.

FIGURE 1 SYMBOL 'MUST NOT BE USED WHEN DRIVING'

4.1.5 Category 0 to 3 lenses

A1 Lenses that do not meet requirements for minimum relative visual attenuation for signal light detection Q in Table 1 or the minimum spectral transmittance for wavelengths in the region 450 to 650 nm shall be marked 'MUST NOT BE USED WHEN DRIVING' and the symbol shown in Figure 1 shall be used. The minimum height of the symbol shall be 5 mm.

A1
4.1.6 Driving warnings

Where the warning 'NOT SUITABLE FOR DRIVING AT NIGHT' is required under Clause 4.1.2 or Clause 4.1.4 and the warning 'MUST NOT BE USED WHEN DRIVING' is required under Clause 4.1.3 or Clause 4.1.5, the single warning 'MUST NOT BE USED WHEN DRIVING' and the symbol shown in Figure 1 shall be sufficient.

4.2 METHODS OF MARKING AND LABELLING

4.2.1 Form of labelling

The information required shall be supplied in the form of an indelible marking on the sunglass frame, a removable label affixed to the lens, or a removable label securely attached or tied to the frame, or any combination of these means.

4.2.2 Durability

The method of labelling shall be such that it is not easily removed or lost when the sunglasses are tried on by prospective purchasers.

4.2.3 Legibility

The information shall be clearly legible and unobscured by other stickers and labels such as price labels.

4.3 TRANSMITTANCE CLAIMS

Any claim of specific transmittance values shall be in accordance with the specifications given in Clause 2.4.

4.4 IMPACT RESISTANCE

Any claim of impact resistance shall be in accordance with the specifications given in Clauses 3.4.2.

TABLE 4

LENS CATEGORIES AND DESCRIPTIONS

Lens category	Description	Additional required information	Required symbol
0	Fashion spectacles—not sunglasses Very low sunglare reduction Some UV protection	None	None
1	Fashion spectacles—not sunglasses Limited sunglare reduction Some UV protection	NOT SUITABLE FOR DRIVING AT NIGHT	None
2	Sunglasses Medium sunglare reduction Good UV protection	None	None
3	Sunglasses High sunglare reduction Good UV protection	None	None
4	Sunglasses—special purpose Very high sunglare reduction Good UV protection	MUST NOT BE USED WHEN DRIVING	Figure 1 (min height 5 mm)

APPENDIX A
USE OF SUNGLASS LENSES
(Informative)

A1 ADVANTAGES OF SUNGLASSES

The main purposes of sunglasses are to improve visual perception under bright sunny conditions and to reduce discomfort that may be associated with very high levels of sunlight. They also provide protection against solar ultraviolet radiation.

Solar ultraviolet radiation can cause an inflammation of the anterior surfaces of the eye. Long term exposure of the eyes to ultraviolet radiation over a period of years may also be a factor in causing cataract. Long term exposure to near ultraviolet radiation in the wavelength band 315 to 400 nm may be a factor in causing degenerations of the retina of the eye.

Wrap around sunglasses and sunglasses with side shields provide additional protection from ultraviolet radiation by reducing radiation reaching the eyes from the side.

A2 INAPPROPRIATE USE OF SUNGLASSES

A2.1 Artificial sources

Sunglasses conforming to this Standard are not intended to provide adequate protection against ultraviolet radiation from artificial sources such as welding arcs or lasers and sources used in solaria. Eye protection conforming to AS/NZS 1338.2 or AS/NZS 2211 or AS/NZS 2635 should be worn when exposed to artificial sources of ultraviolet radiation.

A2.2 Observation of the sun

Sunglasses complying with this Standard are not suitable and should not be used for direct observation of the sun, including during eclipses.

A2.3 Use of sunglasses in reduced light

Sunglasses reduce the ability to see at low light levels. The lower the luminous transmittance of a lens or lenses the more vision is impaired. Sunglasses with lens categories 1 to 4 should not be worn when driving at night or indoors whenever good vision is critically needed.

A2.4 Photochromic lenses

Photochromic sunglass lenses are not suitable for use in twilight or at night unless they reach a luminous transmittance of more than 80% when tested in accordance with this Standard.

A3 VARIABILITY OF PHOTOCHROMIC SUNGLASS LENSES

The luminous transmittance value of photochromic sunglass lenses depends quite considerably on the intensity of radiation, temperature, age of lenses and other parameters. Thus luminous transmittance values in actual use may differ from those expressed by the lens category range.

A4 BLUE-LIGHT HAZARD

Visible radiation in the blue wavelength range 415 to 490 nm may cause retinal damage more readily than other wavelengths in the visible spectrum. However, solar radiation at ground level does not exceed accepted limits of safe exposure even under extreme illumination conditions (e.g. snow surfaces). The blue part of solar radiation is not considered a special risk under conditions of ordinary exposure to solar radiation at ground level. Therefore, this Standard contains no mandatory specifications in this respect.

Opinion is divided whether there could be a long-term risk. In order to allow a correct description of blue-light attenuation by sunglass lenses, a definition of the blue-light transmittance is included.

However, it should be noted that direct viewing of the sun is hazardous in part because of the high content of blue-light in the solar spectrum.

A5 INFRA-RED RISK

Solar radiation at ground level does not exceed currently accepted limits of safe exposure for infrared. Therefore this Standard contains no mandatory specifications for infrared transmission. However, in order to allow a correct description of the attenuation of infrared radiation by sunglass lenses, a definition of the infrared transmittance is included.

A6 UV RISK

The amount of solar ultraviolet radiation reaching the eye depends on geographical location, seasonal variation, ground reflectance and time of day in that order [1-4]. Diffuse sky radiation decreases with increasing altitude [5] and as a consequence corneal UV irradiation is nearly constant with increasing altitude, so there is no need for special consideration of solar UV exposure at high altitude [6].

The basis for the adopted UV transmittance limits is a calculation of the transmittance limits required to ensure that UV does are kept below recognised safety limits [7]. Exposure doses weighted by known biological response functions have been calculated for exceptional solar exposures [8]. Further margins of safety in addition to those explicit in the exceptional exposure experiences, are incorporated. The specification of spectral (instead of average or weighted) transmittance limits provides a further very large increase in the margin of safety [9].

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APPENDIX B

MEASUREMENT OF SPECTRAL TRANSMITTANCE AND CALCULATIONS OF LENS TRANSMITTANCES AND SIGNAL ATTENUATION QUOTIENTS

(Normative)

B1 SCOPE

This Appendix specifies methods for measuring the spectral transmittance of lenses for sunglasses and calculating transmittance and signal attenuation quotient values.

B2 PRINCIPLE

A spectrophotometer is used to measure the proportion of radiation transmitted by a lens in the ultraviolet and visible regions of the electromagnetic spectrum. If infrared claims are being evaluated, then measurements are also made in the near infrared region.

B3 APPARATUS

The following apparatus is required:

(a) *Spectrophotometer* A spectrophotometer capable of providing a beam of radiation of angular divergence of less than ±5 degrees about the beam axis, with a cross-sectional dimension of 20 mm or less in the plane of the lens under test and a spectral half-band width of 10 nm or less at 550 nm. Stray radiation in the beam shall produce an error of less than 0.002 in the value of spectral transmittance being measured. The concave surface of the lens under test should be presented to a diverging beam and the convex surface to a converging beam.

NOTE: For routine quality control procedures, a spectrophotometer with less rigorous specification may be used provided the measured values are well within the transmittance requirements.

(b) *Lens support* The holder of the lens under test shall be constructed so that any part of the lens surface may be traversed by the beam within ±5 degrees of the normal to the surface at the test position. It shall enable the lens displacement in any plane to be measured and repeated to within ±0.5 mm

B4 CALIBRATION OF THE SPECTROPHOTOMETER

For all spectrophotometric testing, the wavelength scale shall be calibrated by either—

(a) spectral emission lines of an electrical discharge in mercury vapour, supplemented by the spectral emission lines of other elements; or

(b) absorption bands in a glass containing holmium oxide for the ultraviolet region and absorption bands in a glass containing rare-earth elements, known as didymium, for the visible and infrared wavelength regions.

The photometric scale shall be checked at regular intervals by means of calibrated neutral glass filters of optical quality and with spectral transmittance approximately equal to those of the luminous transmittance limits of Table 1.

Test methods for the determination of transmittance shall be used which have, at a confidence level of 95%, relative uncertainties less than or equal to those given in Table B1.

TABLE B1

RELATIVE UNCERTAINTY PERMISSIBLE FOR TRANSMITTANCE MEASUREMENTS AT A CONFIDENCE LEVEL OF 95%

Transmittance value %		Relative uncertainty %
From	To over	
≤100	>17.8	±5
≤17.8	>0.44	±10
≤0.44	>0.023	±15

B5 PROCEDURES

B5.1 Uniformly tinted lenses (non-polarizing)

Spectrophotometers may produce a beam of radiation that is partially linearly polarized. Such a beam will produce errors in the measured spectral transmittance of a polarizing lens unless special steps are taken to avoid such error. Each lens shall be tested before being measured to check whether there is an effect due to polarization in the lens. When no significant effect is seen, the measurement of spectral transmittance shall proceed. Where there is evidence of a linear polarizing effect in the lens, the method described in Paragraph B5.2 shall be used.

B5.2 Uniformly tinted lenses (polarizing)

When a significant polarizing effect is noted, spectral transmittance shall be measured twice at mutually perpendicular orientations of the lens. The arithmetic mean of the two values of spectral transmittance so obtained is the spectral transmittance for unpolarized light. It is the value that shall be used for subsequent calculations.

B5.3 Gradient density tinted lenses (non-polarizing)

At the position of the test lens, the spectrophotometer beam shall have cross-sectional dimensions not exceeding 4 mm × 8 mm. The lens shall be cut to shape or mounted in a frame and orientated in the spectrophotometer with the meridians of constant density parallel to the longer dimension of the spectrophotometer beam. The lens shall be positioned so that the centre of the beam passes through the reference point of the lens or the points 14 mm above or below the reference point, as appropriate. If an uncut lens is tested, the centre of the beam shall pass through the intended reference point or the points 14 mm above or below the intended reference point, as appropriate.

B5.4 Gradient density tinted lenses (polarizing)

For polarizing gradient density lenses, the spectrophotometer beam shall be square with sides not exceeding 8 mm or circular with a diameter not exceeding 8 mm. The lens shall be positioned in the spectrophotometer beam so that the centre of the beam passes through the reference point of the lens. Spectral transmittance shall be measured twice at mutually perpendicular orientations of the lens. The arithmetic mean of the two values of spectral transmittance so obtained is the spectral transmittance for unpolarized light. This shall be repeated 14 mm above and below the reference point.

B5.5 Photochromic lenses

B5.5.1 *Conditioning*

Unless the manufacturer specifies a different procedure to reach the faded state in the information supplied with the product, photochromic lenses shall be conditioned by the following procedure:

(a) Store samples in the dark at 65 ±5°C for 2 ±0.2 hours. Then store in the dark at 23 ±5°C for at least 12 hours.

NOTE: Most photochromic materials respond to normal room lighting and all measurements should therefore be made in absence of extraneous light.

CAUTION: CARE SHOULD BE TAKEN TO ENSURE THAT THE RADIATION USED FOR THE MEASUREMENTS DOES NOT CAUSE DARKENING OR BLEACHING OF THE SAMPLE.

(b) In order to test the variability of the transmittance, a source simulating daylight shall be used. It should approximate as closely as possible to the spectral distribution of solar radiation for air mass m = 2* at an illuminance of 50 000 ± 3 000 lx, corresponding to the values given in Table B2.

See also ISO/CIE 85:1989, Table 6 for the spectral distribution of solar radiation.

(c) At present two methods are used to achieve this radiation distribution. Both methods are given in Paragraphs B5.5.2 and B.5.5.3 as examples.

The surface temperature of the lens shall be maintained within ±1°C of the required temperature (see Table B2).

NOTE: Conditioning may be carried out in a liquid bath. However, since immersion of the specimen reduces the reflectivity of the surface thereby increasing the measured transmittance relative to the transmittance values that would be measured in air, the transmittance values determined using liquid immersion need correction to yield the equivalent air values. Calibration of the equipment may be checked using a test sample with a refractive index deviating by not more than ±0.01 from the refractive index of the sample.

If a liquid bath is used, samples should be immersed in the liquid for the least possible time to avoid modification of the photochromic performance due to reaction of the lens with the liquid.

Table B2 gives the measurement conditions for the different luminous transmittance values that can be specified for photochromic lenses.

TABLE B2

MEASUREMENT CONDITIONS FOR THE DIFFERENT LUMINOUS TRANSMITTANCE VALUES

Luminous transmittance value (see Clause 1.5)	Surface temperature of the test specimen °C	Illuminance at the surface of the sample lx
τ_0	23 ±1	0 (light state)
τ_1	23 ±1	50 000 ±3 000
τ_w	5 ±1	50 000 ±3 000
τ_s	35 ±1	50 000 ±3 000
τ_a	23 ±1	15 000 ±750

NOTE: These measurement conditions are also recommended for additional data, such as time constant for example.

* P. Moon, *Journal of the Franklin Institute* Vol. 230 1940, pp 583-617

B5.5.2 *Method to approximate the spectral distribution for solar radiation for air mass* m = *2 using 1 lamp*

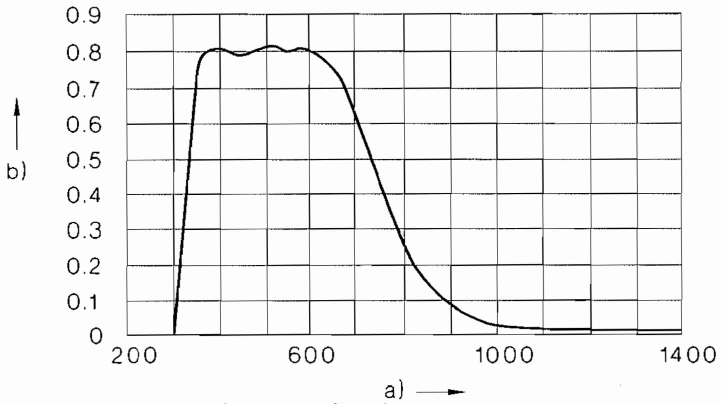
Use an ozone free high-pressure xenon arc lamp, a heat absorbing filter and a band-pass filter as specified in Figure B1. The transmittance curve can be achieved using, for example, a heat absorbing filter (Schott KG 2*) with a thickness of 3 mm or a Pittsburg 2043*, 2 mm thick and a clear white crown glass, e.g. B 270* with a thickness of 5 mm. The use of mirrors or lenses in the optical system for irradiation of photochromic samples may change the spectral distribution of the xenon lamp.

NOTE: A commercial apparatus for simulation for solar radiation is the ORIEL Air mass 2†.

B5.5.3 *Method to approximate the spectral distribution of solar radiation for air mass* m = *2 using 2 lamps*

In order to approximate as closely as possible the spectral distribution for solar radiation for air mass $m = 2$, use two ozone free high-pressure xenon arc lamps. The radiation of the two lamps is superimposed by the means of a semi-transparent mirror. If different filtering is used in front of the two lamps, the solar spectrum can be approximated more closely than with one lamp.

The principle could be expanded by the use of more than two lamps in order to approximate the solar spectrum even better in the relevant spectral ranges.



a) wavelength
b) spectral transmittance

WAVELENGTH IN NANOMETRES

FIGURE B1 SPECTRAL TRANSMITTANCE OF THE COMBINATION OF THE HEAT ABSORBING FILTER AND THE CUT-OFF FILTER FOR THE MEASUREMENT OF PHOTOCHROMIC LENSES

* Schott KG 2, Pittsburg 2043 and B270 are examples of suitable products available commercially. This information is given for the convenience of users of this Standard and does not constitute an endorsement of these products.

† ORIEL Air mass 2 is an example of a suitable product available commercially. This information is given for the convenience of users of this Standard and does not constitute an endorsement of this product.

B6 CALCULATIONS

B6.1 Luminous transmittance

The spectral distribution of Standard Illuminant D65 and the standard spectral values of the colorimetric 2° standard observer CIE 1931 according to ISO/CIE 10526 shall be used to determine the luminous transmittance τ_V. The equation for calculation is 1.6.1 and the necessary values are found in Table C1. Linear interpolation of these values for steps smaller than 10 nm is permissible.

B6.2 Infrared transmittance

The infrared transmittance τ_{SIR} shall be calculated from the spectral transmittance values using the solar spectral irradiance as given in Table C3 and Equation 1.6.5.

B6.3 Ultraviolet transmittance

B6.3.1 *General*

When calculating solar ultraviolet transmittances, the wavelength step shall not exceed 5 nm and the weighting functions of Table C2 shall be used.

B6.3.2 *Solar UV*

When calculating solar UV transmittance τ_{SUV} Equation 1.6.6(2) or 1.6.6(3) shall be used.

B6.3.3 *Solar UVA*

When calculating solar UVA transmittance τ_{SUVA} Equation 1.6.7(1) or 1.6.7(2) shall be used.

B6.3.4 *Solar UVB*

When calculating solar UVB transmittance τ_{SUVB} Equation 1.6.8(1) or 1.6.8(2) shall be used.

B6.4 Recognition of signal lights

When calculating the Q values from the spectral measurements, the values in Table C1 shall be used with Equations 1.6.2 and 1.6.3. Linear interpolation of these values for steps smaller than 10 nm is permissible.

B7 Uniformity of luminous transmittance

A 5 mm maximum diameter field shall be used for the measurement. The measurement shall be executed with a light bundle parallel to the visual axis in the measurement area specified around the reference point.

APPENDIX C
SPECTRAL FUNCTIONS
(Normative)

C1 SCOPE

This Appendix contains the spectral functions for the calculations of luminous transmittance, relative visual attenuation quotients, solar UV transmittance values, blue light transmittance values, and infrared transmittance.

A1

TABLE C1
SPECTRAL DISTRIBUTION DATA

Wavelength (λ)	$S_A(\lambda).V(\lambda).\tau_S(\lambda)$				$S_{D65}(\lambda).V(\lambda)$
nm	red	yellow	green	blue*	
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

A1

(continued)

TABLE C1 (*continued*)

Wavelength (λ) nm	$S_A(\lambda).V(\lambda).\tau_S(\lambda)$ red	yellow	green	blue*	$S_{D65}(\lambda).V(\lambda)$
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	100.00	100	100	100	100

* For blue flashing light the spectral distribution for 3200 K is used instead of Standard Illuminant A.
Source: ISO/CIE 10526 and ISO/CIE 10527.

TABLE C2

SPECTRAL FUNCTIONS FOR THE CALCULATION OF SOLAR UV TRANSMITTANCE VALUES AND BLUE-LIGHT TRANSMITTANCE

Wavelength λ nm	Solar irradiation at sea level Air mass 2 $E_S(\lambda)$ 10^6 W.m^{-3}	Relative spectral effectiveness function $S(\lambda)$	Weighting function $W(\lambda)=E_S(\lambda).S(\lambda)$	Blue-light hazard function $B(\lambda)$	Blue-light Weighting function $WB(\lambda)=E_S(\lambda).B(\lambda)$
280	0	0.88	0		
285	0	0.77	0		
290	0	0.64	0		
295	2.09×10^{-4}	0.54	0.00011		
300	8.10×10^{-2}	0.30	0.0243		
305	1.91	0.060	0.115		
310	11.0	0.015	0.165		
315	30.0	0.003	0.090		
320	54.0	0.0010	0.054		
325	79.2	0.00050	0.040		

(*continued*)

TABLE C2 *(continued)*

Wavelength λ nm	Solar irradiation at sea level Air mass 2 $E_S(\lambda)$ 10^6 W.m^{-3}	Relative spectral effectiveness function $S(\lambda)$	Weighting function $W(\lambda)=E_S(\lambda).S(\lambda)$	Blue-light hazard function $B(\lambda)$	Blue-light Weighting function $WB(\lambda)=E_S(\lambda).B(\lambda)$
330	101	0.00041	0.041		
335	128	0.00034	0.044		
340	151	0.00028	0.042		
345	170	0.00024	0.041		
350	188	0.00020	0.038		
355	210	0.00016	0.034		
360	233	0.00013	0.030		
365	253	0.00011	0.028		
370	279	0.000093	0.026		
375	306	0.000077	0.024		
380	336	0.000064	0.022	0.006	2
385	365	5.3×10^{-5}	0.019	0.012	4
390	397	4.4×10^{-5}	0.017	0.025	10
395	432	3.6×10^{-5}	0.016	0.05	22
400	470	3.0×10^{-5}	0.014	0.10	47
405	562			0.20	112
410	672			0.40	269
415	705			0.80	564
420	733			0.90	660
425	760			0.95	722
430	787			0.98	771
435	849			1.00	849
440	911			1.00	911
445	959			0.97	930
450	1006			0.94	946
455	1037			0.90	933
460	1080			0.80	864
465	1109			0.70	776
470	1138			0.62	706
475	1161			0.55	639
480	1183			0.45	532
485	1197			0.34	479
490	1210			0.22	266
495	1213			0.16	194
500	1215			0.10	122

TABLE C3

SPECTRAL DISTRIBUTION OF SOLAR IRRADIANCE IN THE INFRARED SPECTRUM FOR THE CALCULATION OF THE SOLAR INFRARED TRANSMITTANCE*

Wavelength λ nm	Solar spectral irradiance at sea level Air mass 2 $E_S(\lambda)$ 10^6 W.m^{-3}	Wavelength λ nm	Solar spectral irradiance $E_S(\lambda)$ 10^6 W.m^{-3}	Wavelength λ nm	Solar spectral irradiance $E_S(\lambda)$ 10^6 W.m^{-3}
780	907	1200	373	1620	194
790	923	1210	402	1630	189
800	857	1220	431	1640	173
810	698	1230	420	1650	163
820	801	1240	387	1660	159
830	863	1250	328	1670	145
840	858	1260	311	1680	139
850	839	1270	381	1690	132
860	813	1280	382	1700	124
870	798	1290	346	1710	115
880	614	1300	264	1720	105
890	517	1310	208	1730	97.1
900	480	1320	168	1740	80.2
910	375	1330	115	1750	58.9
920	258	1340	58.1	1760	38.8
930	169	1350	18.1	1770	18.4
940	278	1360	0.66	1780	5.70
950	487	1370	0	1790	0.92
960	584	1380	0	1800	0
970	633	1390	0	1810	0
980	645	1400	0	1820	0
990	643	1410	1.91	1830	0
1000	630	1420	3.72	1840	0
1010	620	1430	7.53	1850	0
1020	610	1440	13.7	1860	0
1030	601	1450	23.8	1870	0
1040	592	1460	30.8	1880	0
1050	551	1470	45.1	1890	0
1060	526	1480	83.7	1900	0
1070	519	1490	128	1910	0.705
1080	512	1500	157	1920	2.34
1090	514	1510	187	1930	3.68

(*continued*)

TABLE C3 *(continued)*

Wavelength λ nm	Solar spectral irradiance at sea level Air mass 2 $E_S(\lambda)$ 10^6 W.m^{-3}	Wavelength λ nm	Solar spectral irradiance $E_S(\lambda)$ 10^6 W.m^{-3}	Wavelength λ nm	Solar spectral irradiance $E_S(\lambda)$ 10^6 W.m^{-3}
1100	252	1520	209	1940	5.30
1110	126	1530	217	1950	17.7
1120	69.9	1540	226	1960	31.7
1130	98.3	1550	221	1970	37.7
1140	164	1560	217	1980	22.6
1150	216	1570	213	1990	1.58
1160	271	1580	209	2000	2.66
1170	328	1590	205		
1180	346	1600	202		
1190	344	1610	198		

* P. MOON, *Journal of Franklin Institute*. Vol. 230. No. 5. 1940. pp. 583–617 and EN 165:1995

APPENDIX D

TEST FOR SPHERICAL, CYLINDRICAL AND PRISMATIC POWERS

(Normative)

D1 SCOPE

This Appendix describes the test methods to determine conformity to the requirements for spherical and cylindrical power for individual lenses and assembled sunglasses that are specified in Clause 2.5.1 and prismatic power of individual lenses that are specified in Clause 2.5.3.

D2 PRINCIPLE

For spherical and cylindrical power an optical system is focused on a target and is refocussed when the lens under test is interposed. The change needed to refocus is calibrated in terms of lens power in m^{-1}.

D3 APPARATUS

The apparatus comprises:

(a) A telescope with an objective aperture of nominal 20 mm diameter and a magnification between 10× and 30×, fitted with an adjustable eyepiece incorporating a reticule.

(b) A target which is a black plate incorporating the pattern shown in Figure C1, which is illuminated by a light source of adjustable intensity using a condenser, if necessary, to focus the light on the target.

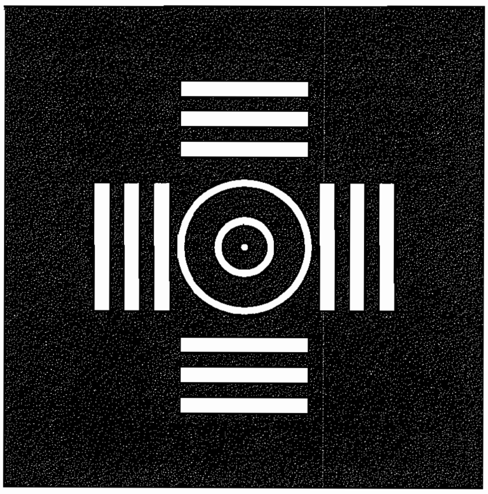


FIGURE D1 TELESCOPE TARGET

The larger annulus of the target has an outer diameter of 23.0 ±0.1 mm with a width of 0.6 ±0.1 mm. The smaller annulus has an outer diameter of 12.2 ±0.1 mm with a width of 0.6 ±0.1 mm. The central aperture has a diameter of 0.6 ±0.1 mm. The bars are nominally 20 mm long and 2 mm wide with a nominal 2 mm separation.

A filter with a maximum transmittance in the green part of the spectrum may be used to reduce chromatic aberrations.

Lenses with positive and negative spherical powers of 0.06 ±0.01 m^{-1}, 0.12 ±0.01 m^{-1} and 0.25 ±0.01 m^{-1} are required as calibration lenses.

The illuminated target is placed on the optical axis of the telescope with the target 4.60 ±0.02 m from the telescope objective.

The observer focuses the telescope eyepiece on the reticule and then focuses the telescope on the target. The telescope is then aligned to obtain an image of the target centred on the reticule. This sets the zero point of the focusing and prism scale of the telescope.

The focusing adjustment of the telescope is calibrated with the calibration lenses so power may be measured with a precision of 0.01 m^{-1} or better. Any other equivalent calibration method may be used.

D4 PROCEDURE

D4.1 Spherical and cylindrical power

D4.1.1 *General*

The procedure shall be as follows:

(a) Position an individual sunglass lens normal to the telescope axis immediately in front of the telescope objective.

(b) Position an assembled sunglass with its front normal to the measurement direction and immediately in front of the telescope objective. Pairs of lenses intended for assembly into a sunglass shall be tested by being positioned immediately in front of the telescope objective at the tilt intended in the assembled sunglasses.

(c) Take measurements with the telescope's measuring field midpoint within a 10 mm radius circle around the reference point(s).

D4.1.2 *Sunglasses without cylindrical power*

Adjust the telescope until the whole of the image of the target is sharply focussed. The spherical power of the lens shall then read from the scale of the telescope.

D4.1.3 *Sunglasses with cylindrical power*

The target, or the sunglass lens, shall be rotated to align the principal meridians of the lens with the bars of the target. The telescope shall be focused firstly on one set of bars (measurement D_1) and then on the perpendicular bars (measurement D_2). The spherical power shall be the mean, $(D_1 + D_2)/2$, and the cylindrical power is the absolute difference, $|D_1 - D_2|$, of the two measurements.

D4.2 Prismatic power—single lenses

When the telescope is focussed on the target as in Paragraph C4.1.2 or focussed on one of the set of bars as in Paragraph C4.1.3, observe the displacement of the target with respect to the intersection of the reticule lines. If the intersection of the reticule lines falls outside the larger annulus, the prismatic power exceeds 0.25 cm/m.

D5 REPORTING OF RESULTS

The following shall be reported—

(a) Whether each lens or assembled sunglass passes or fails the requirements of Table 2.

(b) Whether each lens passes or fails the requirements of Column 1 of Table 3.

(c) The reasons for failure and the values of any parameter that does not comply.

APPENDIX E

DETERMINATION OF LOCAL ABERRATIONS IN SPHERICAL AND CYLINDRICAL POWER

(Normative)

E1 SCOPE

This Appendix describes the test method to determine the conformity of sunglasses to the requirements for local variations of spherical and cylindrical power that are specified in Clause 2.5.2.

E2 PRINCIPLE

The deviation caused to a laser beam by local changes in optical power is measured and expressed in terms of lens power in m^{-1}.

E3 APPARATUS

The apparatus comprises:

(a) A laser and optics providing a parallel light beam of nominal diameter 5 mm (representing a typical diameter of the eye-pupil).

(b) A carriage to move the test lens continuously on a spiral path with a pitch of 1 mm nominal and in a plane perpendicular to the laser beam without rotating the lens.

(c) A position sensing photodiode (quadrant photodiode) to measure the deflection of the laser beam. The photodiode shall have a minimum active sensitive area 1.9 cm × 1.9 cm and shall be capable of being positioned between 50 cm and 250 cm from the lens under test so that a refractive quantity of up to 2 m^{-1} can be measured.

NOTE: A PIN SC25 is a suitable photodiode.

(d) Circuitry for the photodiode and a method of recording the output (e.g. storage oscilloscope or x-y recorder).

Calibrated lenses may be used to calibrate the system. Displacement caused by a known lens is measured to provide a conversion to spherical and cylindrical power.

E4 PROCEDURE

The laser beam is directed at the centre of the photodiode. The lens under test is then moved in a spiral fashion so that the laser beam passes though each part of the circle 28 mm diameter centred on the reference point. Afocal lenses will cause no deflection of the beam. Spherical powered lenses will produce an equal deviation in all locations equidistant from the centre of the lens. Sphero-cylindrical lenses will produce different deviations, but these will be regular in nature. Irregularities of power will produce an irregular deviation.

The deviation is recorded and converted to a local value of refractive power:

$$F = (u - v)/(u.w)$$

where

F = refractive power at the measurement point

u = distance from reference point to point where laser beam meets the lens

v = distance from centre of photodiode to point where beam falls on the photodiode

w = distance from lens under test to photodiode.

E5 REPORTING OF RESULTS

The following shall be reported:

(a) Whether each lens or assembled sunglass passes or fails the requirements of Table 2.

(b) The reasons for failure, the value of any parameter that does not comply and the location on the lens where the failure was identified.

APPENDIX F

DETERMINATION OF THE DIFFERENCE IN PRISMATIC POWER FOR PAIRS OF LENSES OR ASSEMBLED SUNGLASSES

(Normative)

F1 SCOPE

This Appendix describes the test methods to determine the conformity of pairs of lenses and assembled sunglasses to the requirements for prismatic power that are specified in Clause 2.5.4.

F2 PRINCIPLE

The displacement of a light beam is measured and converted to a prismatic power. The apparatus used enables both lenses of an assembled sunglass to be measured at the same time and for the assessment to be made with the assembled sunglass in the 'as-worn' position

F3 APPARATUS

The components and arrangement of the apparatus are shown in Figure F1.

F4 PROCEDURE

The procedure shall be as follows:

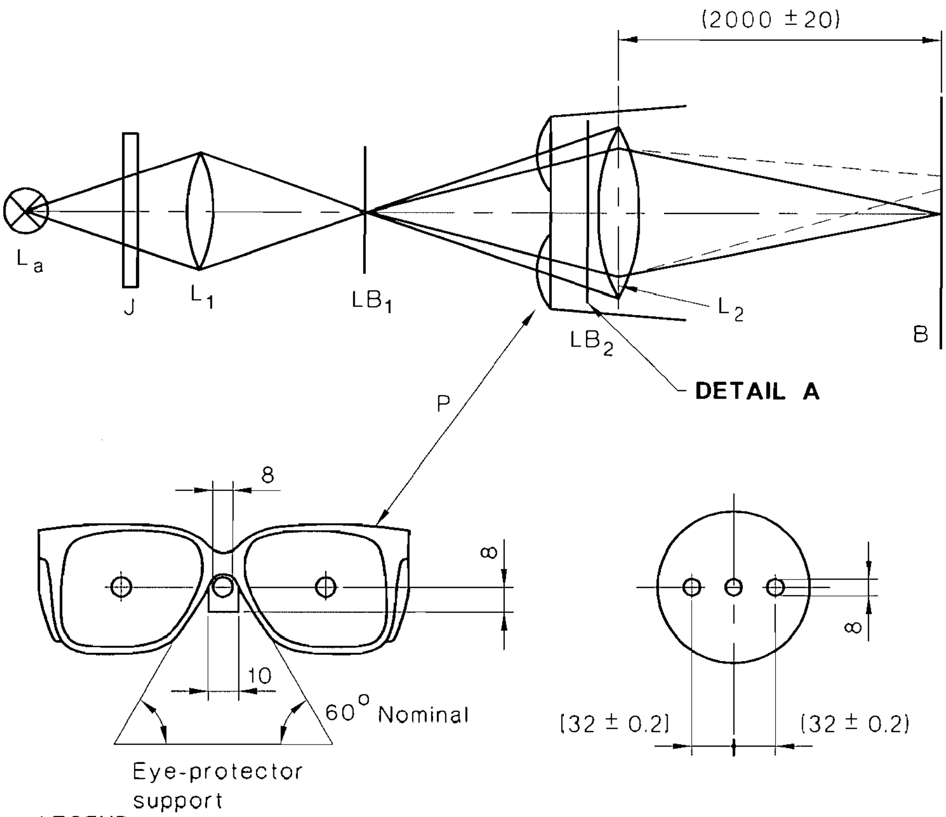
(a) The diaphragm LB_1, illuminated by the light source, is adjusted in such a way that it produces an image in the plane B when the lenses or sunglass (P) is not in position.

(b) The sunglass is placed in front of the lens L_2 in the 'as-worn' position.

(c) Measure the vertical and horizontal distances between the two displaced images arising from the two lenses of the sunglasses.

These distances in centimetres are divided by two to give the horizontal and vertical prismatic differences in cm/m.

If the two light paths corresponding to the lenses cross, the prismatic power is 'base in' and if the light paths do not cross, it is 'base out'.



LEGEND:

L_a light source, for example, small filament lamp, laser with wavelength of (600 ±70) nm, etc.
J interference filter with peak transmittance in the green part of the spectrum (required only if a filament lamp is used as the light source)
L_1 achromatic lens, focal length between 20 and 50 mm
LB_1 diaphragm, diameter of aperture 1 mm nominal
P lenses or sunglass
LB_2 diaphragm as shown in detail A
L_2 achromatic lens, 1000 mm nominal focal length and 75 mm nominal diameter
B image plane

DIMENSIONS IN MILLIMETRES (nominal unless toleranced)

FIGURE F1 ARRANGEMENT OF APPARATUS FOR MEASUREMENT OF DIFFERENCE IN PRISMATIC POWER

F5 REPORTING OF RESULTS

The following shall be reported:

(a) Whether the assembled sunglass or pair of sunglass lenses pass or fail the requirements of Clause 2.5.4.

(b) The reasons for failure and the values of any parameter that does not comply.

APPENDIX G
LIGHT DIFFUSION TEST
(Normative)

G1 SCOPE

This Appendix sets out the method for determining light diffusion of sunglass lenses.

G2 PRINCIPLE

The luminance (L_s) of an illuminated sunglass lens is a measure of its light diffusion and is proportional to the illuminance (E) on the lens. The ratio $\ell^* = L_s/E$ is the luminance factor which is expressed in the units:

$$\frac{\text{cd.m}^{-2}}{\text{lx}}$$

However, this ratio has to be expressed in a form ℓ^* that is independent of the luminous transmittance τ_V of the lens, such that:

$$\ell^* = \frac{L_S}{\tau_V . E} \quad \text{. . . G1}$$

This quantity is known as the reduced luminance factor and is expressed in the same units as the luminance factor.

NOTE: Most sunglass lenses have diffusion properties which are symmetrical about the optical axis. For these sunglass lenses, the mean value of the reduced luminance factor is constant within an angle limited by the two cones shown in Figure G1.

G3 TEST METHODS

G3.1 General

Two reference test methods are specified which use the same measurement principle. Either may be used.

The results obtained with the two methods may be considered to be equivalent; whichever method is used, the relative measurement uncertainty for the reduced luminance factor shall not be greater than 25%.

G3.2 Primary method

G3.2.1 *Apparatus*

The arrangement is shown in Figure G2. The spherical mirror H_1 forms an image of light L of identical dimensions at diaphragm LB. The concave mirror H_3 forms an image of diaphragm LB in the plane of diaphragms B_L and B_R. The achromatic lens A is positioned immediately behind the diaphragm so that a reduced image of the test sample in position P appears on diffusing screen MS. The image of iris diaphragm IB_1 is formed at the same time as IB_2.

The arrangement collects all the light originating from the lens between angles $\alpha = 1.5°$ and $\alpha + \Delta\alpha = 2°$ in relation to the optical axis. The diameters of the annular diaphragm circles shall be measured to an uncertainty not exceeding 0.01 mm in order that the solid angle ω may be determined accurately; any deviation from the nominal diameters shall be taken into account by calculation.

G3.2.2 *Procedure*

The procedure shall be as follows:

(a) Place the sunglass lens in the parallel beam at position P, then put diaphragm B_L in place. The flux φ_{1L} falling onto the photodetector corresponds to the undiffused light transmitted by the sample.

(b) Replace Diaphragm B_L by annular diaphragm B_R; flux φ_{1R} falling onto the photodetector corresponds to the total diffused light originating from the filter and from the apparatus.

(c) Place the test sample at position P′. The flux φ_{2R} which then falls onto the photodetector corresponds to the scattered light coming from the apparatus only.

The difference $\varphi_{1R} - \varphi_{2R}$ corresponds to the light diffused by the lens. The mean reduced luminance factor ℓ^* for the solid angle ω is calculated from the measured fluxes by means of the equation:

$$\ell^* = \frac{1}{\omega} \times \frac{\varphi_{1R} - \varphi_{2R}}{\varphi_{1L}} \quad \text{. . . G2}$$

where

φ_{1R} = luminance flux with the annular diaphragm without the test sample

φ_{2R} = luminance flux with the annular diaphragm with the test sample

φ_{1L} = luminous flux with the circular diaphragm

ω = Solid angle defined by the annular diaphragm

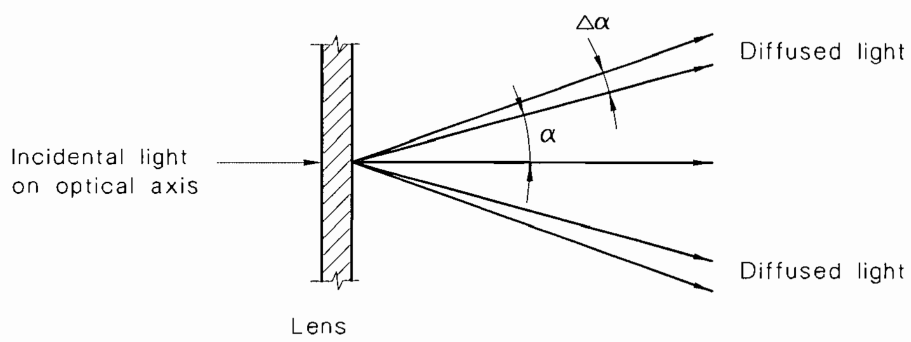
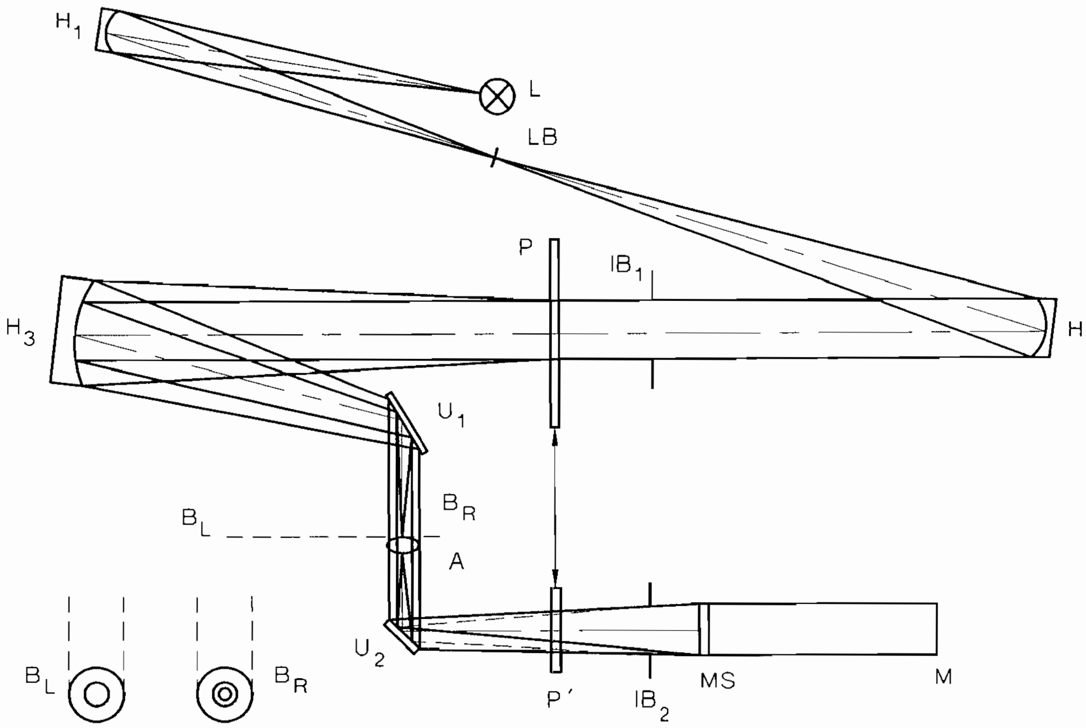


FIGURE G1 DIFFUSION ANGLES



LEGEND:

L	High-pressure xenon lamp (for example XBO 150 W or CSX 150 W)
H_1	Spherical concave mirror; nominal focal length 150 mm; nominal diameter 40 mm
H_2	Spherical concave mirror; nominal focal length 300 mm; nominal diameter 40 mm
H_3	Spherical concave mirror; nominal focal length 300 mm; nominal diameter 70 mm
A	Achromatic lens; nominal focal length 200 mm; nominal diameter 30 mm
	U_1, U_2 Flat mirrors
B_R	Annular diaphragm; diameter of outer circle (21.0 ±0.1) mm, diameter of inner circle (15.75 ±0.10) mm. See note below.
B_L	Circular diaphragm; diameter of aperture (7.5 ±0.1) mm
M	Photomultiplier corrected according to curve V (λ) with diffusing screen MS
IB_1	Iris-diaphragm to adjust diameter of field of measurement
IB_2	Iris-diaphragm to eliminate edge effects from IB_1
LB	Circular diaphragm, diameter of aperture (1.0 ±0.1) mm
P, P'	Positions of test lens
MS	Diffusing screen

FIGURE G2 ARRANGEMENT OF APPARATUS FOR MEASUREMENT OF LIGHT DIFFUSION—PRIMARY METHOD

G3.3 Secondary method

G3.3.1 *Apparatus*

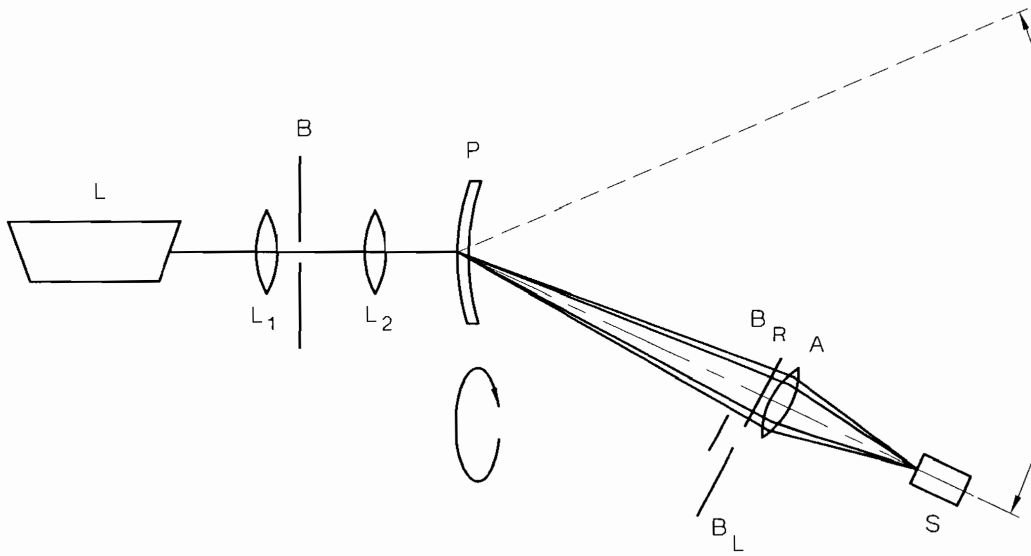
The test arrangement is shown in Figure G3.

The beam of the laser L shall be expanded using the two lenses L_1 and L_2 and is directed towards the measuring point of the lens P. Lens P shall be mounted in such a way that it can rotate around the axis of the beam.

The deviation of the beam shall be a function of the prismatic power at the measuring point. The annular or circular diaphragm, whichever is chosen, is at a distance of 400 ±2 mm from the centre of the sunglass lens. The lens A then produces the image of the centre of the sunglass lens on the photodetector S.

The part of the test arrangement, comprising the diaphragms, the lens and the photodetector, shall be designed to rotate about the vertical axis through the centre of the sunglass lens.

The detector part of the apparatus has to pivot in order to compensate for any prismatic power of the sunglass lens. The diameters of the annular diaphragm circles shall be measured to an uncertainty not exceeding 0.01 mm in order that the solid angle ω can be determined accurately; any deviation from the nominal diameters shall be taken into account by calculation.



LEGEND:

- L Laser with wavelength of 600 ±70) nm
  NOTE: Class 2 laser recommended, <1 mW. Diameter of beam between 0.6 mm and 1.0 mm
- L_1 10 mm nominal focal length lens
- L_2 30 mm nominal focal length lens
- B Circular diaphragm (a hole of 0.1 mm approximately produces a uniform light beam)
- P Ocular sample
- B_R Annular diaphragm, the diameter of the external circle being (28.0 ±0.1) mm and the inner circle 21.0 ±0.1 mm. See Note 2 below.
- B_L Circular diaphragm of 10 mm nominal diameter
- A Lens, 200 mm nominal focal length and 30 mm nominal diameter
- S Photoreceptor

NOTES:

1 The distance between the annular/circular diaphragm and the centre of the ocular shall be 400 ±2 mm.

2 The focal lengths of the lenses are only given as a guide. Other focal lengths may be used, for example, if a wider beam is desired or a smaller image of the sample is to be formed on the receptor.

FIGURE G3 ARRANGEMENT OF APPARATUS FOR MEASUREMENT OF LIGHT DIFFUSION—SECONDARY METHOD

G3.3.2 *Procedure*

G3.3.2.1 *Calibration of the apparatus*

The procedure shall be as follows:

(a) Set up the apparatus, the essential features of which are shown in Figure G3, without the sunglass lens in place.

(b) Put the annular diaphragm B_R in place.

(c) Rotate the detector part of the apparatus (consisting of a photodetector S, lens A and the annular diaphragm B_R) horizontally about P so as to align the light beam from the beam expander (consisting of a lens L_1 with a typical focal length of 10 mm, lens L_2 with a typical focal length of 30 mm and circular diaphragm B with a pinhole of sufficient size so as to provide a uniform beam) with the centre of the annular diaphragm B_R.

(d) Measure the flux φ_{IR} falling onto the photodetector S, corresponding to the total diffused light.

(e) Replace the annular diaphragm B_R by the circular diaphragm B_L.

(f) Measure the flux φ_{IR} falling onto the photodetector, corresponding to the total non-diffused light.

Obtain the reduced luminance factor for the apparatus, ℓ^*_a, for the solid angle ω using the following equation:

$$\ell^*_a = \frac{1}{\omega} \cdot \frac{\varphi_{IR}}{\varphi_{IL}} \quad \ldots \text{G3}$$

where

φ = luminous flux without the sunglass lens in the parallel beam and with the annular diaphragm B_R in place

φ_{IL} = luminous flux without the sunglass lens in the parallel beam and with circular diaphragm B_L in place

ω = solid angle defined by the annular diaphragm B_R.

G3.3.2.2 *Testing the lens*

The procedure shall be as follows:

(a) Place the lens in the parallel beam at position P as shown in Figure G3.

(b) Repeat G3.2 with the sunglass lens in place, and with the sunglass lens rotated about the axis of the beam to a position such that the prismatic deviation by the sunglass lens is horizontal.

(c) Rotate the detector part of the apparatus so that the light beam falls on the centre of B_R.

(d) Obtain the reduced luminance factor for the apparatus including the sunglass lens, ℓ^*_g, for the solid angle ω using the following equation:

$$\ell^*_g = \frac{1}{\omega} \times \frac{\varphi_{2R}}{\varphi_{2L}} \quad \ldots \text{G4}$$

where

φ_{2R} = luminous flux with the sunglass lens in the parallel beam and with the annular diaphragm B_R in place

φ_{2R} = luminous flux with the sunglass lens in the parallel beam and with circular diaphragm B_L in place

ω = solid angle defined by the annular diaphragm B_R.

Then calculate the reduced luminance factor ℓ^* of the sunglass lens using the following equation:

$$\ell^* = \ell^*_g - \ell^*_a \quad \ldots \text{G5}$$

APPENDIX H

ASSESSMENT OF QUALITY OF MATERIAL AND SURFACE

(Normative)

H1 SCOPE

This Appendix sets out the method for assessing the quality of the sunglass lens material and surface.

H2 PRINCIPLE

The assessment is conducted by visual inspection with the aid of a 'light box' or illuminated grid.

H3 PROCEDURE

H3.1 General

Observations should be made without the aid of any magnifying device but the observer should wear any necessary ophthalmic correction.

H3.2 Method A

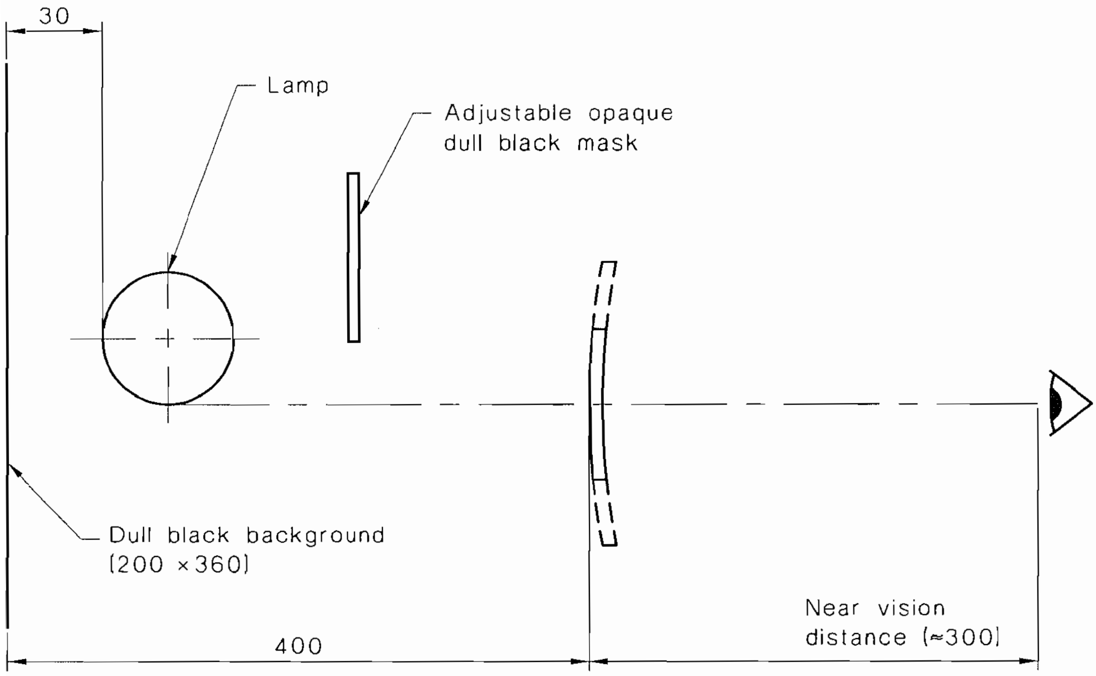
An illuminated grid used as a background shall be viewed through the lens held at various distances from the eye.

H3.3 Method B

The lens shall be illuminated by means of a fluorescent lamp mounted within a dull black chamber and with the amount of illumination adjusted by means of an adjustable opaque black mask. A suitable arrangement is shown in Figure H1.

H4 REPORTING OF RESULTS

Report whether the lens passes or fails the requirement of Clause 2.7 and if the lens fails, provide the reasons for failure.



DIMENSIONS IN MILLIMETRES (Nominal)

FIGURE H1 ARRANGEMENT OF APPARATUS FOR ASSESSMENT OF QUALITY OF MATERIAL AND SURFACE

APPENDIX I

TEST FOR RESISTANCE TO ULTRAVIOLET RADIATION

(Normative)

I1 SCOPE

This Appendix specifies the method of test of sunglass lenses for their resistance to ultraviolet radiation.

I2 PRINCIPLE

A sunglass lens not previously tested or used is exposed to UV radiation to determine its suitability to the outdoor environments.

I3 APPARATUS

A fused-silica envelope high-pressure xenon lamp is utilized to perform this test.

The power of the lamp shall be between 400 W and 500 W, with a preferred value of 450 W. An ozone free lamp shall be used.

NOTE: Examples of suitable lamps are XBO-450 OFR and CSX-450 OFR.

I4 PROCEDURE

New specimens shall be used for this test. The test equipment shall be operated within an environment of temperature 23 ±5°C.

Expose the external face of the sunglass lenses to radiation from a fused silica envelope high-pressure xenon lamp. The angle of incidence of the radiation on the specimen surface shall be essentially perpendicular. The distance from the axis of the lamp to the nearest point on the sample shall be 300 ±10 mm. The exposure time shall be as follows:

(d) Where the lamp is running at a power of 450 W, the exposure time shall be 25 ±0.1 hours.

(e) Where the lamp is not running at 450 W, the exposure time shall be changed by an inverse proportion. For example, if the lamp is running at 400 W, the exposure time shall be 28.2 ±0.1 hours; if the lamp is running at 500 W, the exposure time shall be 22.5 ±0.1 hours.

I5 INSPECTION

Tests shall be carried out in accordance with Appendices B, G and H.

I6 REPORTING OF RESULTS

Report any lens not meeting the criteria described in Clause 2.8.

APPENDIX J

TEST FOR RESISTANCE TO IGNITION

(Normative)

J1 SCOPE

This Appendix specifies the method of test for resistance to ignition.

J2 PRINCIPLE

A heated steel rod is pressed against various surfaces of the sunglasses frame or sunglass lens.

J3 APPARATUS

J3.1 Steel rod

300 ±3 mm long and 6 mm nominal diameter with end faces which are flat and perpendicular to its longitudinal axis.

J3.2 Heat source

A heat source capable of generating at least 750°C shall be utilized.

J3.3 Thermocouple and temperature indicating device

A thermocouple and temperature indicating device at least capable of measuring within 500–750°C with an uncertainty of ±10°C.

J3.4 Timer

A timer capable of measuring an elapsed time at least 10 s with an uncertainty of ±0.1 s shall be used to carry out time measurements.

J4 PROCEDURE

The procedure shall be as follows:

(a) Heat one end of the steel rod over a length of at least 50 mm to a temperature of 650 ±20°C.

(b) Measure the temperature of the rod by means of the thermocouple attached at a distance of 20 ±1 mm from the heated end of the rod.

(c) Press the heated face of the rod (positioned vertically) against the surface of the test sample (the contact force being equal to the weight of the rod) for a period of 5.0 ±0.5 s, and then remove it.

(d) Carry out the test on all parts of the sunglasses.

J5 INSPECTION

Visual inspection shall be carried out during the test in order to establish whether the test samples ignite or continue to glow.

The tests shall be performed in an environment of temperature 23 ±5°C.

J6 REPORTING OF RESULTS

Report any sunglass that fails to meet the criteria of Clause 2.9 and Clause 3.5.

APPENDIX K

DETERMINATION OF ROBUSTNESS AND LENS RETENTION

(Normative)

K1 SCOPE

This Appendix sets out the method for determining the robustness and lens retention of sunglasses and fashion spectacles.

K2 PRINCIPLE

A spherical ball is dropped onto sunglasses and fashion spectacles to test their robustness and lens retention.

K3 APPARATUS

The following apparatus is required:

(a) *Support* A support or stand constructed of rigid material and conforming to the dimensions and contours of the medium-sized standard anatomical head. For the testing of children's sunglasses a smaller size anatomical head may be used.

(b) *Projectile* A spherical steel ball 16 mm in nominal diameter having a mass of 16 g.

K4 PROCEDURE

The procedure shall be as follows:

(a) Support the sunglasses or fashion spectacles on the headform or stand so that they are firmly held and make contact with the headform or stand in a manner corresponding as nearly as practicable to that in which the sunglasses or fashion spectacles are normally worn.

(b) Drop the ball from a free height of 1.27 m onto the centre of the outer surface of the lenses.

K5 REPORTING OF RESULTS

Report any sunglass that fails to meet the criteria of Clause 3.4.1.

APPENDIX L
DETERMINATION OF REFERENCE POINTS
(Normative)

L1 SCOPE

This Appendix specifies the method of determining the reference points of lenses both as-assembled in sunglasses and separately.

L2 PRINCIPLE

The reference points are set using the midlines of lenses and lens pairs and an assumed inter-pupillary distance of 64 mm, which is the mean adult value.

L3 APPARATUS

A rule of millimetre grid.

L4 METHODS

L4.1 Assembled sunglasses

The procedure shall be as follows:

(a) Using the rule of millimetre grid locate the tangents to the top and bottom of the lenses (see Figures L1 and L2).

(b) Mark the horizontal midline between these lines on the lenses. Locate the tangents to the outer limits to the lenses.

(c) Mark the vertical midline, mark points 32 mm each side of the vertical midline. These are the reference points.

L4.2 Single lenses

The process is the same for single lenses except that the left hand and right hand edges are used to establish the vertical midline and the reference point of the lens is set by the intersection of the horizontal and vertical midline. See Figure L3. The reference point of a single lens may be established for the purpose of predicting compliance with this Standard but the reference points in the assembled sunglasses may differ from that in the single lens. However, the difference in measurements made at the two points will rarely be significant.

L4.3 Uncut lenses

This method may also be used to establish a reference point for an uncut lens for the purpose of measurements to this standard and predicting compliance with this Standard. The reference points in the assembled sunglasses may differ from that in the uncut lens, especially when dealing gradient tinted lenses. For this reason, the manufacturer may specify a reference point as that intended to be the reference point in the assembled sunglasses.

L4.4 Children's sunglasses

The above procedures apply to children's sunglasses except that the 32 mm distance is replaced by 27 mm.

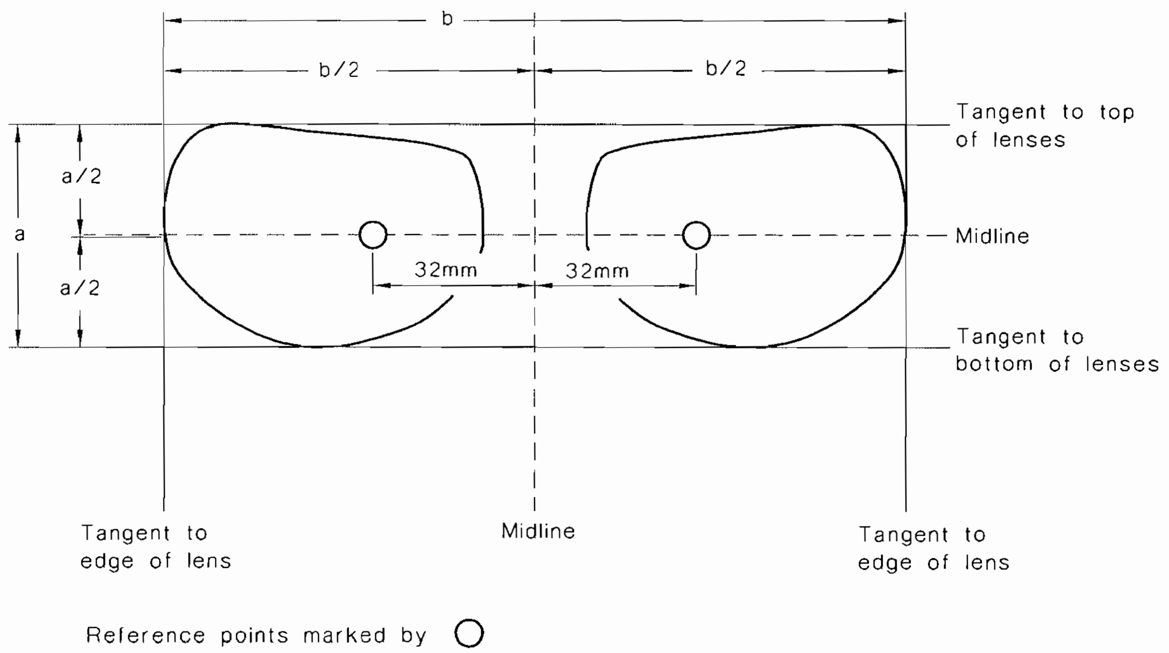


FIGURE L1 DETERMINATION OF THE REFERENCE POINTS OF PAIRS OF LENSES IN ASSEMBLED SUNGLASSES

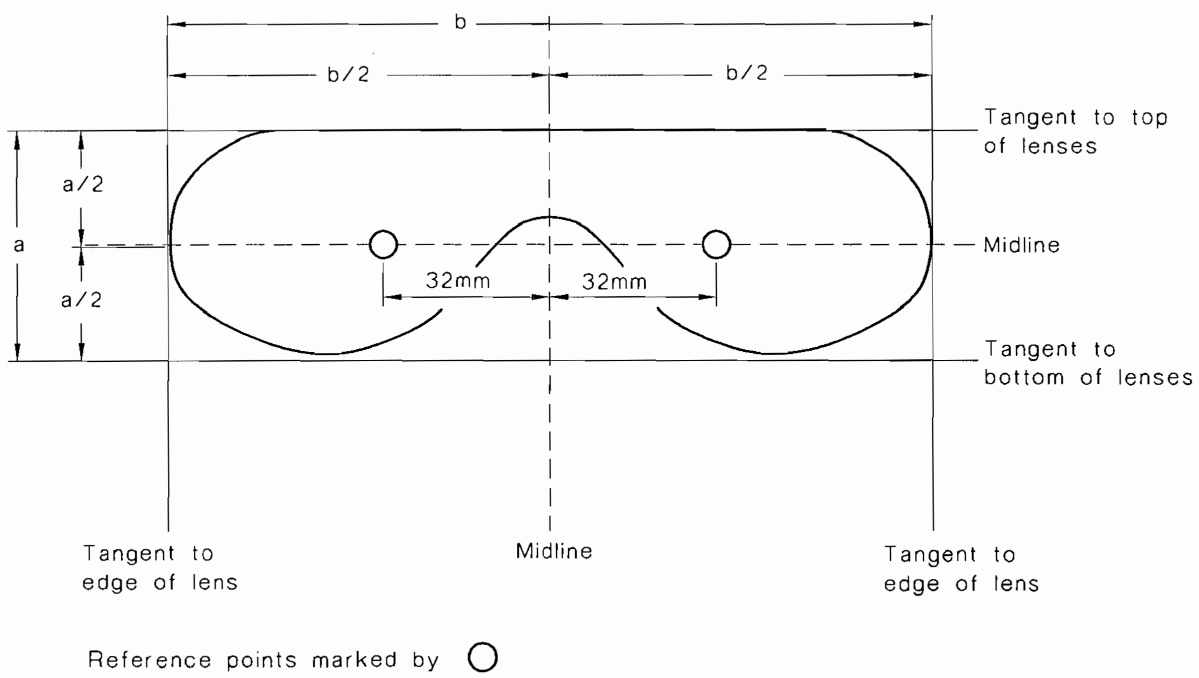


FIGURE L2 DETERMINATION OF THE REFERENCE POINTS OF A LENS IN A ONE PIECE FRONT OR VISOR TYPE SUNGLASS

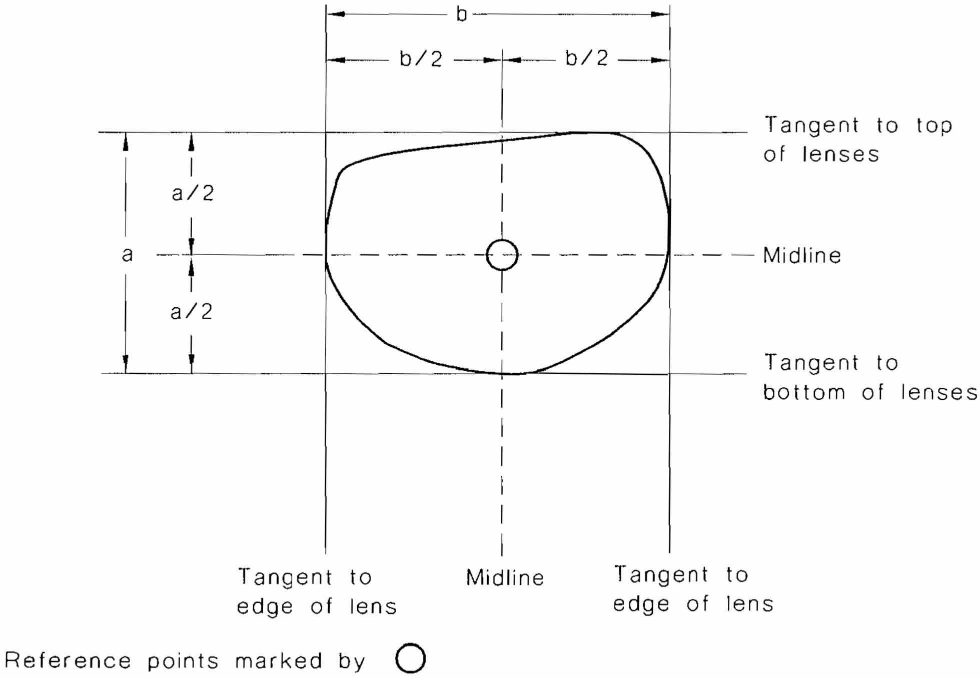


FIGURE L3 DETERMINATION OF THE REFERENCE POINTS OF A LENS IN SINGLE LENS OR UNCUT LENS

AMENDMENT CONTROL SHEET

AS/NZS 1067:2003

Amendment No. 1 (2009)

CORRECTION

SUMMARY: This Amendment applies to Clauses 1.1, 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.6.5, 2.3.3, 2.4.2.2, 3.4.1, 4.1.1 (Item (b)), 4.1.5, 4.1.6 (new) and Appendix C.

Published on 24 June 2009.

NOTES

NOTES

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