

Australian/New Zealand Standard™

Personal eye protection

Part 1: Eye and face protectors for occupational applications



AS/NZS 1337.1:2010

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee SF-006, Eye and Face Protection. It was approved on behalf of the Council of Standards Australia on 29 March 2010 and on behalf of the Council of Standards New Zealand on 9 April 2010.
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Australian/New Zealand Standard™

Personal eye protection

Part 1: Eye and face protectors for occupational applications

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-006, Eye and Face Protection, to supersede part of AS/NZS 1337:1992, *Eye protectors for industrial applications*. It has been renumbered as AS/NZS 1337.1, as it is Part 1 of a series pertaining to personal eye protection, some of which have already been published.

This Standard incorporates Amendment No. 1 (April 2012). 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.

The objective of this Standard is to provide tests and requirements for eye and face protectors to be used occupationally.

The objective of this revision is to align the Standard more closely with other published Standards including CEN Standards pending the development of equivalent ISO Standards. It is planned to eventually adopt an ISO Standard as a Joint Australian/New Zealand Standard.

Accordingly, the Committee has decided to retain both the 'drop-ball' (Appendix K) and the 'ballistic' (Appendix L) methods for determining low impact resistance in order to maintain consistency with existing CEN Standards. The use of the term 'ocular/s' to replace the term 'lens/es' is to come in line with international terminology and refers to the use of non prescription products. The term 'lens/es' (used in AS/NZS 1337.6) refers to prescription spectacle products.

It is noted that the ISO/TC 94 SC 6 Committee on Eye and Face Protection is developing requirements for 'resistance to ageing' including resistance to thermal exposure, ultraviolet radiation and corrosion. Over time, Committee SF-006 expects to introduce similar requirements in a future edition of this Standard.

Members of Committee SF-006 have actively participated in ISO/TC 94 SC 6 and are aware that issues of eye coverage, protection area and field of view that are not adequately covered in this Standard are also under consideration in ISO. They are not, as yet, developed to a useable stage. They will be considered in a future revision of the Standard.

The data for the spectral energy distribution of incandescent traffic signals for the calculation of relative visual attenuation for signal light detection (Q) are from actual measurements on modern traffic signals that comply with ISO/CIE 16508:1999, *Road traffic lights—Photometric properties of 200 mm roundel signals*. The calculation is the same as in AS/NZS 1067:2003, *Sunglasses and fashion spectacles*, but the data are different as the AS/NZS 1067:2003 data represent older technology. The same data has been provided to ISO TC 94 SC 6 and will be used in the preparation of the ISO sunglass standard, in the first instance. Modern traffic signalling practice is moving rapidly to light emitting diode technology. Data is also provided for modern LED signals also complying with ISO/CIE 16508:1999. In this edition of the Standard the incandescent data are to be used but in future revisions of applicable standards (AS/NZS and ISO standards) it is intended that the LED data will become used. These data are provided at this stage to allow manufacturers to prepare for the changes. The minimum requirements for the Q values are consistent with EN 167, *Personal eye-protection—Optical test methods*. The minimum spectral transmittance lower wavelength limit has been set at 470 nm. AS/NZS 1067:2003 has 450 nm and EN 167 and EN 1836, *Personal eye-protection—Sunglasses and sunglare filters for general use and filters for direct observation of the sun*, have 500 nm. There is an agreement at ISO/TC 94 SC 6 for 475 nm in the sunglass standard.

Appendices for testing and calculation of transmittance and coloration have been drafted with reference to AS/NZS 1067:2003 in order to maintain consistency of methods and values.

It should be recognized that complete protection for the eye cannot be provided solely by the use of eye protectors or other personal protective equipment (ppe). Relevant factors for a particular application should be considered in the choice of the correct ppe to provide the maximum possible protection. AS/NZS 1336, *Recommended practices for occupational eye protection*, should be consulted for the appropriate measures to be taken into account.

The material and optical requirements described in this Standard maintain uniformity (where appropriate) with the following Standards:

AS

1609 Eye protectors for motor cyclists and racing car drivers

AS/NZS ISO

21987 Ophthalmic optics—Mounted spectacle lenses

The term ‘normative’ has been used in this Standard to define the application of the appendix to which it applies. A ‘normative’ appendix is an integral part of a Standard.

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Australian/New Zealand Standard

Personal eye protection

Part 1: Eye and face protectors for occupational applications

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies minimum requirements for non-prescription eye and face protectors and associated oculars. They are designed to provide protection for the eyes and faces of persons against common occupational hazards such as flying particles and fragments, dusts, splashing materials and molten metals, harmful gases, vapours and aerosols. Requirements for optical qualities and low, medium, high and very high impact resistance are given and appendices describing appropriate test methods are included in this Standard.

Requirements for prescription-eye protectors against low and medium impact are given in AS/NZS 1337.6. Requirements for eye protectors against laser radiation are given in AS/NZS 1337, Parts 4 and 5.

The aim of this Standard is to assist in the provision of safe, efficient and comfortable vision in the occupational situation, including consideration of the need for protection against sunglare and optical radiation in the natural environment.

NOTE: The Standard does not apply to filter oculars for protection against optical radiations generated by industrial processes, which are dealt with in AS/NZS 1338.

1.2 APPLICATION

Oculars for eye and face protectors shall comply with the requirements of Section 2.

Assembled eye protectors shall comply with the requirements of Section 3, and if intended for use in welding and allied operations, with Section 5.

NOTE: Where eye and face protection is incorporated in protective equipment, such as a hood or respirator, the relevant requirements of this Standard apply to the components affording eye and face protection.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1152	Specifications for test sieves
AS/NZS	
1337	Personal eye protection
1337.0(Int)	Part 0: Eye and face protectors—Vocabulary
1337.4	Part 4: Filters and eye-protectors against laser radiation (laser eye-protectors)
1337.5	Part 5: Eye-protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)
1337.6	Part 6: Prescription eye protectors against low and medium impact

AS/NZS

1338 Filters for eye protectors

1338.1 Part 1: Filters for protection against radiation generated in welding and allied operations

1338.2 Part 2: Filters for protection against ultraviolet radiation

1338.3 Part 3: Filters for protection against infra-red radiation

1680 Interior and workplace lighting

1680.1 Part 1: General principles and recommendations

1680.2.4 Part 2.4: Industrial tasks and processes

ISO

11664 Colorimetry

11664-1 Part 1: CIE standard colorimetric observers

11664-2 Part 2: CIE standard illuminants

ISO/CIE

85 Solar spectral irradiance

1.4 DEFINITIONS

For the purpose of this Standard, the definitions of AS/NZS 1337.0(Int) apply as well as the following:

1.4.1 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.

1.4.2 Browguard

A face-shield or eye-shield ocular holder usually designed for protection to the forehead, often secured by a head harness.

1.4.3 Clip-ons

A pair of protective oculars or a one-piece ocular designed to clip on over the front of spectacles.

1.4.4 Double-glazed oculars

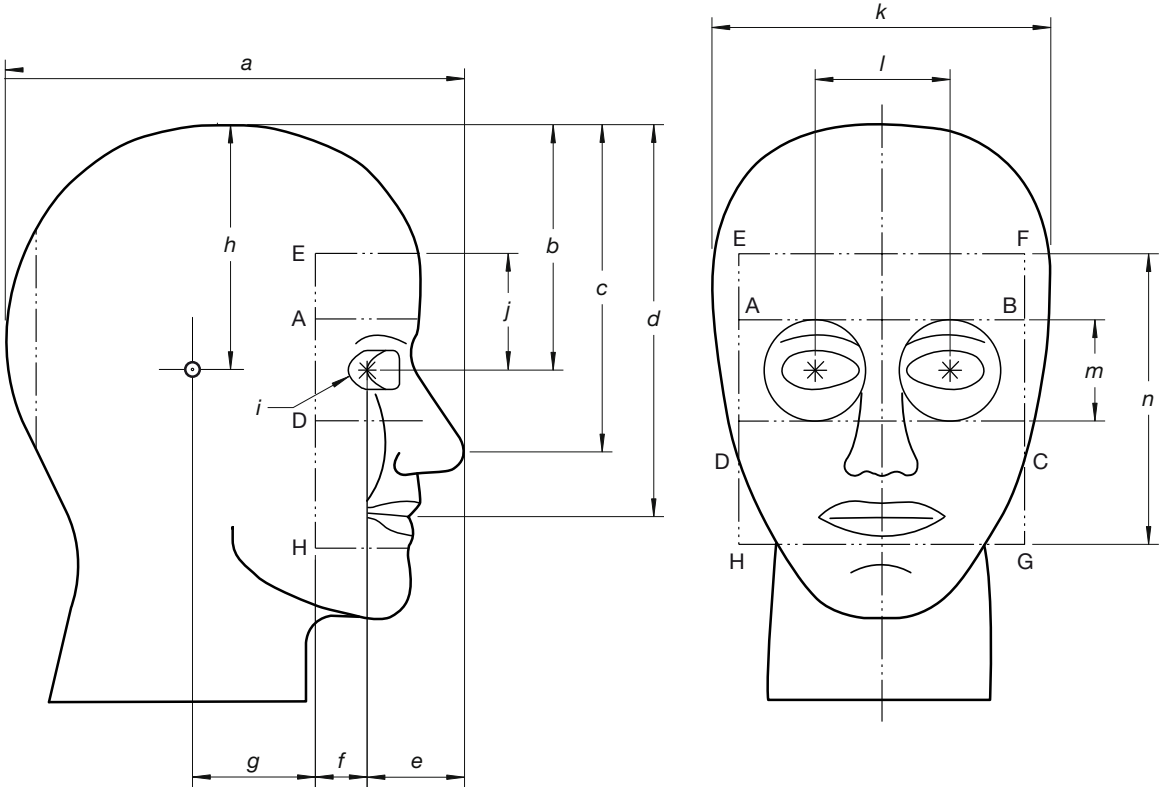
Oculars consisting of two or more components separated by an air gap and with the normal line of sight passing through all the components.

1.4.5 Eye-shield

See 'eye-guard' in AS/NZS 1337.0(Int).

1.4.6 Headform

A headform with nose, ears and defined orbit area or 'standard anatomical head' suitable for use as a test support for eye protectors. Typical dimensions of medium-sized and small-sized standard anatomical heads are given in Figure 1.



Dimension	Head size mm	
	Medium	Small
a	218	206
b	111	110
c	144	131
d	178	166
e	45	42
f	18	18
g	60	53
h	111	110
Radius i	10	10
j	56	48
k	156	146
l	64	54
m	52	48
n	134	118

FIGURE 1 TYPICAL DIMENSIONS OF AN ANATOMICAL HEAD

1.4.7 Hood

A device that completely covers the head, neck and a portion of the shoulders, and which includes eye protection.

1.4.8 Luminous transmittance

See 'luminous transmittance' in AS/NZS 1337.0(Int).

1.4.9 Mesh (for eye protectors)

Lattice of material enclosing open areas, the material providing protection.

NOTE: A metal mesh may be woven or perforated, a plastic mesh may be moulded, woven or perforated.

1.4.10 Prescription insert

A device to carry prescription lenses, that is intended to be attached on the inside of the eye protector between the eyes of the wearer and the protective ocular.

1.4.11 Prismatic power

See 'prismatic variation' in AS/NZS 1337.0(Int).

1.4.12 Untinted ocular

An ocular with a luminous transmittance of 80% or more. An untinted ocular may be clear or coloured.

1.4.13 Wide-vision spectacles

Safety spectacles with an ocular or oculars and of wrap-around design or with permanently attached sideshields. Wrap-around designs follow the contours of the front and side surrounding the wearer's eyes.

1.4.14 Wire-mesh screen

A device that consists of woven metal gauze supported in front of the face and incorporates a transparent ocular in front of the eyes.

1.4.15 Wrap-around design

A design of wide-vision spectacles that is intended to follow the contours of the front and side of the area of the face surrounding wearer's eyes.

SECTION 2 REQUIREMENTS FOR OCULARS

2.1 SCOPE OF SECTION

This Section specifies requirements for the materials, optical properties and impact strength of oculars, whether or not fitted to a frame, for eye and face protectors for occupational applications.

2.2 GENERAL REQUIREMENTS FOR OCULARS

2.2.1 Finish

Oculars shall be free from projections, sharp edges or other features likely to cause discomfort or injury during use.

2.2.2 Materials

Oculars shall be made of organic materials (plastics), inorganic materials (glass), or any suitable combination of these materials.

Oculars shall not include any substance in such quantities or in such a manner that would be hazardous to the health of the wearer when the ocular is subject to normal use and reasonably foreseeable abuse.

NOTE: The purpose of this requirement is to prevent the use of substances with properties not specifically covered by this Standard but which would nonetheless be injurious to the health of the wearer.

2.2.3 Dimensions of oculars and visors

Unfitted oculars shall comply with the following dimensional requirements, except those intended to be used in protectors designed to fit small heads, which shall meet the requirements of Clause 2.2.4:

- (a) *Eye cup goggles*—Each ocular in eye cup goggles shall have a box length of not less than 50 mm and a box depth of not less than 40 mm. Glass oculars other than filter oculars or cover oculars shall be not less than 3 mm thick. See Figures 2 and 3.
- (b) *Eye-shield*—The transparent visor of a half-face type of eye-shield shall be of sufficient area to contain a rectangle 120 mm horizontally and 70 mm vertically, (when fitted to a nominated mounting, including binding where applicable), symmetrically located about the vertical centre-line. See Figure 4.
- (c) *Face-shield*—The transparent visor of a face-shield shall be of sufficient area to contain a rectangle 120 mm horizontally and 150 mm vertically, (when fitted to a nominated mounting, including chin guard or binding where applicable), symmetrically located about the vertical centre-line.
- (d) *Safety clip-ons*—Each ocular of a safety clip-on shall have a box length of not less than 42 mm box depth of not less than 32 mm.
- (e) *Spectacle eye protector*—Shaped oculars in spectacle eye protector shall have a box length of not less than 42 mm and a box depth of not less than 32 mm. Tempered glass oculars shall be not less than 3 mm thick.
- (f) *Wide-vision goggle*—The ocular or oculars of wide-vision goggle shall have minimum dimensions such that they wholly contain a rectangle 120 mm × 50 mm symmetrically located about the vertical centre-line in the horizontal plane of the ocular and in the as-worn position. Shaping to fit the nose area may intrude into the rectangle.

- (g) *Wide-vision spectacles*—The oculars of wide-vision spectacles shall have a box length of not less than 42 mm and a box depth of not less than 35 mm.
- (h) *Wire-mesh screens*—The transparent ocular of a wire-mesh screen shall be of sufficient area to contain a rectangle 120 mm horizontally and 100 mm vertically, symmetrically located about the vertical centre-line.

A1

2.2.4 Dimensions of oculars and visors for small heads

Unfitted oculars intended to be used in protectors designed to fit small heads shall comply with the following dimensional requirements:

- (a) *Eyecup goggles*—Each ocular in eyecup goggles shall have a box length of not less than 50 mm and a box depth of not less than 40 mm. Glass oculars other than filter oculars or cover oculars shall be not less than 3 mm thick. See Figures 2 and 3.
- (b) *Eye-shield*—The transparent visor of a half-face type of eye-shield shall be of sufficient area to contain a rectangle 100 mm horizontally and 60 mm vertically, (when fitted to a nominated mounting, including binding where applicable), symmetrically located about the vertical centre-line. See Figure 4.
- (c) *Face-shield*—The transparent visor of a face-shield shall be of sufficient area to contain a rectangle 100 mm horizontally and 125 mm vertically, (when fitted to a nominated mounting, including chin guard or binding where applicable), symmetrically located about the vertical centre-line.
- (d) *Safety clip-ons*—Each ocular of a safety clip-on shall have a box length of not less than 42 mm box depth of not less than 32 mm.
- (e) *Spectacle eye protector*—Shaped oculars in spectacle eye protector shall have a box length of not less than 42 mm and a box depth of not less than 32 mm. Tempered glass oculars shall be not less than 3 mm thick.
- (f) *Wide-vision goggle*—The ocular or oculars of wide-vision goggle shall have minimum dimensions such that they wholly contain a rectangle 100 mm × 42 mm symmetrically located about the vertical centre-line in the horizontal plane of the ocular and in the as-worn position. Shaping to fit the nose area may intrude into the rectangle.
- (g) *Wide-vision spectacles*—The oculars of wide-vision spectacles shall have a box length of not less than 35 mm and a box depth of not less than 30 mm.
- (h) *Wire-mesh screens*—The transparent ocular of a wire-mesh screen shall be of sufficient area to contain a rectangle 100 mm horizontally and 85 mm vertically, symmetrically located about the vertical centre-line.

2.3 MATERIAL REQUIREMENTS

2.3.1 Visual quality

On visual inspection of the viewing area (see Clause 2.3.2), oculars shall be reasonably free of pits, scratches, greyness, watermarks, bubbles, striae, local aberrations and inclusions which could impair vision or prevent the use of the oculars for their intended purpose. Lighting conditions for inspection of oculars are set out in Appendix J. Other visual inspection shall be carried out under good illumination against a suitable background with the unaided eye, although spectacles may be worn if required.

NOTES:

- 1 Suitable lighting conditions for inspection purposes are recommended in AS/NZS 1680.1 and AS/NZS 1680.2.4.
- 2 The defects described in this Clause cannot be completely quantified. Where the presence, size or frequency of any of these are considered to be of concern, arrangements should be made between the purchaser and the manufacturer. This may be achieved by the provision of acceptable type samples or methods of test. Where defects are present and the product is submitted for acceptance, the manufacturer should be able to demonstrate fitness for purpose.

2.3.2 Viewing area

The viewing area of oculars is determined as follows:

- | | |
|----|---|
| A1 | <p>(a) <i>For spectacles and goggle with separate oculars for each eye</i>—the area contained to within 3 mm from the edge.</p> <p>(b) <i>For visors</i>—the area contained in a rectangle 120 mm horizontally and 50 mm vertically, except for visors specified in Clause 2.2.4, symmetrically located about the vertical centre-line, and in the horizontal plane of the ocular in the as-worn position.</p> <p>(c) <i>For single ocular wide-vision goggles</i>—the area contained to within 10 mm of the edge excluding markings and an area 10 mm either side of this vertical centre-line, on the horizontal plane of the ocular and in the as-worn position.</p> |
| A1 | <p>(d) <i>For visors meeting the requirements of Clause 2.2.4</i>—the area contained in a rectangle 100 mm horizontally and 42 mm vertically, symmetrically located about the vertical centre-line, and in the horizontal plane of the ocular in the as-worn position.</p> |

2.4 OPTICAL PROPERTIES OF OCULARS**2.4.1 Position of measurement**

The refractive properties of oculars as specified in Clause 2.4.7, shall be determined at the following point(s) on an ocular:

- | | |
|----|--|
| A1 | <p>(a) <i>Individual oculars</i>—For an individual ocular, which is not mounted in a frame, measurement shall be made at the reference point (see Figure 2).</p> <p>(b) <i>Pairs of oculars</i>—For pairs of oculars mounted or integrally moulded in a frame, or intended for mounting in a particular frame, measurement shall be made for each ocular at a point on the horizontal mid box line 32 mm (for a medium-sized headform) (see Figure 3(a)) or 27 mm (for a small-sized headform) from the centre-line of the frame (see Figure 3(b)).</p> <p>(c) <i>One-piece ocular and visor types</i>—For one-piece ocular and visor types mounted or integrally moulded in a frame, or intended for mounting in a particular frame, measurement shall be made at points 32 mm (for a medium-sized headform) (see Figure 4(a)) or 27 mm (for a small-sized headform) on either side of the centre-line and which lie in the horizontal plane that would bisect the eyes when the visor is worn (see Figure 4(b)).</p> |
|----|--|

2.4.2 Direction of measurement

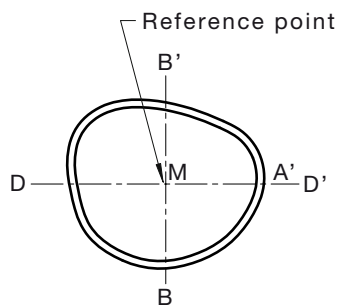
The direction of measurement shall be as follows:

- (a) *Individual oculars*—For individual oculars where the as-worn position is not yet known, measurement shall be made along a direction perpendicular to the ocular, i.e. perpendicular to the tangent to the ocular curve at the reference point.

- (b) *Pairs of oculars, one-piece ocular and visor types*—For pairs of oculars, one-piece ocular and visor types mounted or integrally moulded in a frame or intended for mounting in a particular frame, measurements shall be made at the reference point with the eye protector in the as-worn position nominated by the manufacturer. (See Figure 5.)

NOTES:

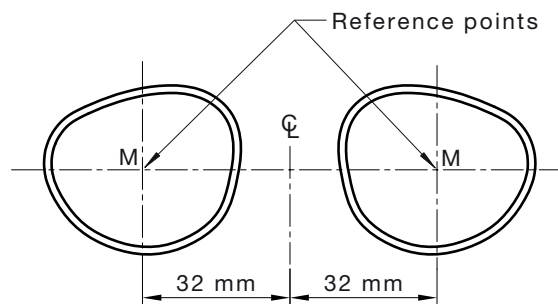
- 1 Prismatic effects and power effects can be introduced when an ocular is tilted with respect to the line of sight. The intention of the above requirements is to ensure that measurements of power and prismatic effect are made on a line coincident with or close to the line of sight. It is especially important that the refractive properties be measured on or near the line of sight for wrap-around or excessively curved eye protectors.
- 2 Manufacturers should note that individual oculars may comply with the refractive requirements when measured at the geometric centre on a line perpendicular to the ocular, but may not comply with the requirements when mounted in the frame of exaggerated wrap-around design. See Figure 5.



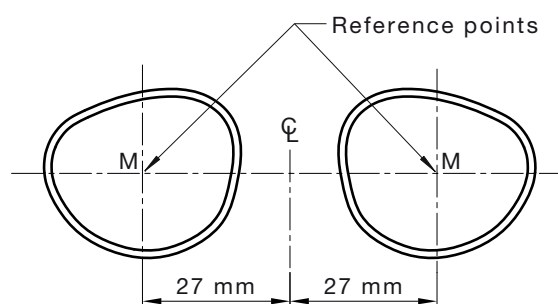
Legend:

- DD' = datum line
 AA' = datum length of lens
 BB' = mid-datum depth of lens
 (measured through M)

FIGURE 2 REFERENCE POINTS FOR INDIVIDUAL OCULAR

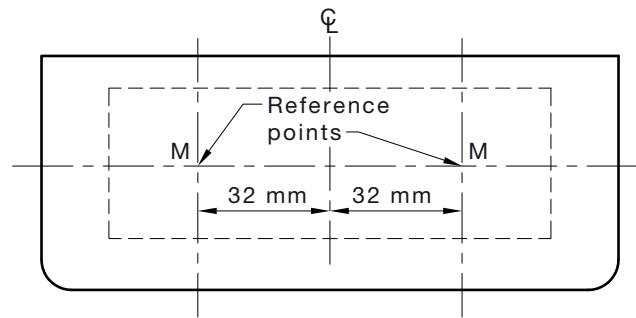


(a)

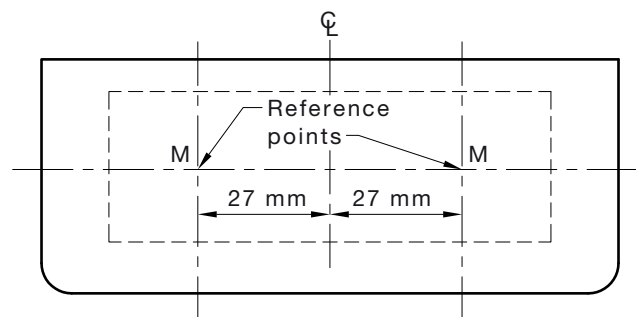


(b)

FIGURE 3 REFERENCE POINTS FOR OCULAR PAIR

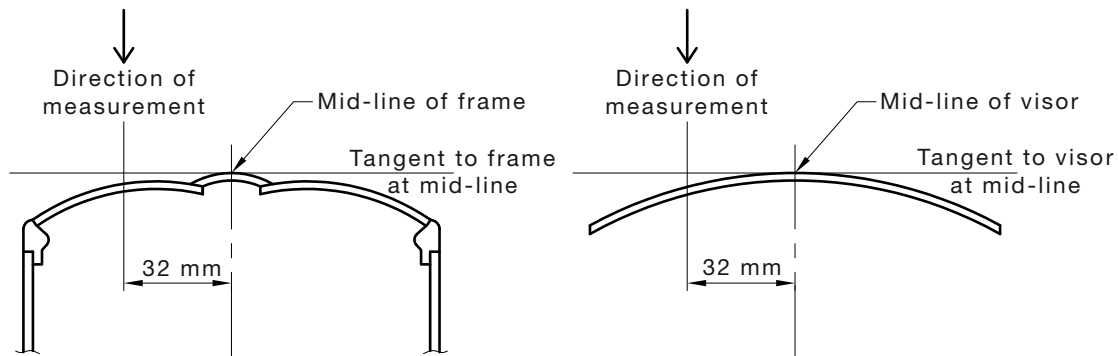


(a)

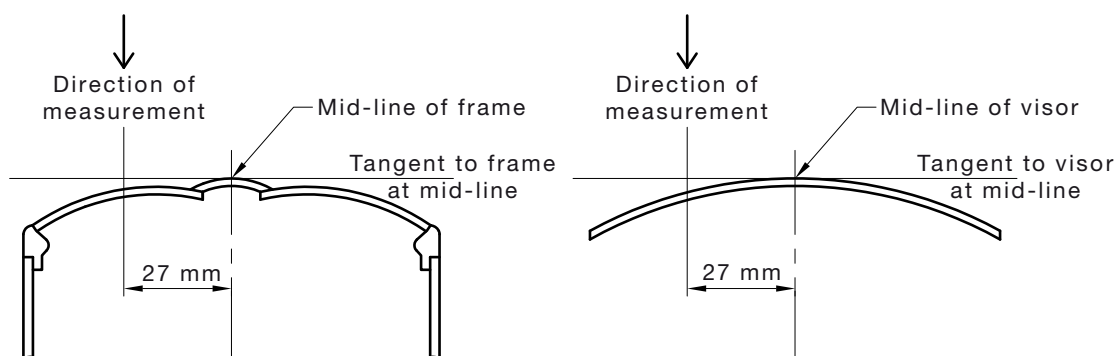


(b)

FIGURE 4 REFERENCE POINTS FOR VISOR



(a)



(b)

FIGURE 5 GEOMETRY FOR MEASUREMENTS OF REFRACTIVE AND PRISMATIC POWER

2.4.3 Transmittance properties

Oculars and filters that are intended to provide protection against optical radiation generated by industrial processes shall comply with the transmittance requirements of the relevant Part of AS/NZS 1338, and Section 5 of this Standard.

All other oculars and filters for use in occupational eye protectors shall, when tested in accordance with the method set out in Appendix A using the spectral functions given in Appendix B or any other validated method, comply with the optical transmittance requirements of Table 1 at the reference point of the oculars, as shown in Figures 2, 3 or 4 as applicable.

These oculars shall be classified into four ocular categories, where category 0 applies only to—

- (a) untinted oculars;
- (b) photochromic oculars in the faded state;
- (c) gradient oculars with a luminous transmittance greater than 80% at the reference point; and
- (d) oculars 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 four categories is given by the values in Table 1. The overlap of the luminous transmittance values shall be not more than $\pm 2\%$ (absolute) between the categories 0, 1, 2 and 3.

2.4.4 Transmittance requirements

2.4.4.1 General

Filters in a given ocular category shall meet the requirements set out in Table 1 when measured at the reference points of the oculars.

The requirements of Table 1 apply to all filters including untinted, uniformly tinted, gradient density, polarizing and photochromic.

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

2.4.4.2 Claims of luminous transmittance

If the supplier claims a luminous transmittance value for filters, for categories 0 to 3, it shall be within $\pm 3\%$ absolute of the measured values.

When stating the transmittance properties of photochromic filters, 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 ocular respectively.

TABLE 1
TRANSMITTANCE REQUIREMENTS FOR UNTINTED AND SUNGLARE OCULARS FOR EYE PROTECTOR

Ocular category	Visible spectral range							UV spectral range		
	Range of luminous transmittance (τ_V) %		Minimum spectral transmittance for wave-lengths 470 nm to 650 nm	Minimum relative visual attenuation for signal light detection (Q)				Maximum value of spectral transmittance ($\tau_F(\lambda)$)		Maximum value of solar UVA transmittance (τ_{SUA})
	from over	to		red	yellow	green	blue	280 nm to 315 nm	Over 315 nm to 350 nm	315 nm to 380 nm
0	80.0	100	0.20 τ_V	0.80	0.80	0.80	0.80	0.05 τ_V	τ_V	τ_V
1	43.0	80.0								
2	18.0	43.0						0.01 τ_V	0.50 τ_V	0.50 τ_V
3	8.0	18.0								
Outdoor untinted	80.0	100						0.01 τ_V	0.25 τ_V	0.25 τ_V

2.4.5 Other transmittance requirements

2.4.5.1 Uniformity of luminous transmittance of uniformly tinted filters

The minimum luminous transmittance shall not be less than 85% of the maximum luminous transmittance at any point within an area centred on the reference point of the filter of a 28 mm diameter circle (for eye-protectors) or a rectangle of 120 mm × 50 mm (for face-shields and eye-shields).

2.4.5.2 Transmittance matching for pairs of filters of all types

The luminous transmittance at corresponding points within circles of 28 mm diameter centred on the reference points of a pair of filters 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.

2.4.5.3 Uniformity of colour for pairs of filters of all types

Pairs of filters mounted in a 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 filter should appear constant from one area of the filter to another when the filter is inspected against a uniform white background by a person with normal colour vision.

2.4.6 Special transmittance requirements

2.4.6.1 Photochromic filters

The categories of a photochromic filter 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 A. In both states, the requirements specified in this Section and Table 1 shall be met.

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

2.4.6.2 Polarizing filters

When measured in accordance with Appendix C the plane of transmission shall not deviate from the horizontal direction by more than 5°. The misalignment between the plane of transmission of the left and right oculars shall not be greater than 6°.

The plane of transmission of uncut polarizing eye protector filters shall be marked.

For polarizing filters the ratio of the luminous transmittance values parallel and perpendicular to the plane of transmission shall be greater than 8:1 for filter categories 2 and greater than 4:1 for category 1 when measured in accordance with Appendix D.

2.4.6.3 Gradient filters

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

- | | |
|----|--|
| A1 | For all eye protectors intended to fit a medium-sized headform, all parts of a gradient density filter 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. |
| A1 | For eye protectors intended to fit a small-sized headform, all parts of a gradient density filter within a circle of 24 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. |

2.4.6.4 Outdoor use, untinted filters

Where a filter is claimed to be 'outdoor untinted' see Table 1.

2.4.7 Refractive power of oculars

2.4.7.1 Spherical and astigmatic power

When tested in accordance with Appendix E, the spherical and astigmatic powers 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.

2.4.7.2 Local aberrations in spherical and astigmatic power

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

2.4.7.3 Prismatic power—Individual oculars

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

2.4.7.4 Prismatic power difference—Pairs of oculars

When tested in accordance with Appendix G, the prismatic power difference shall not exceed those set out in Table 3, Columns 2–4.

TABLE 2
SPHERICAL AND ASTIGMATIC POWER
VALUES OF OCULARS

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
$(D_1 + D_2)/2$ ±0.09	$ D_1 - D_2 $ ±0.09

TABLE 3
PRISMATIC POWERS OF INDIVIDUAL OCULARS AND
ASSEMBLED EYE PROTECTORS

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

2.4.8 Scattered light

When tested for scattered light at the reference point as specified in Appendix H, the scattered light measured in the ocular shall not exceed 3%.

- A1 | If it is not possible to test for scattered light, as the ocular is too optically dense, e.g. higher shades of welding filters, the ocular shall be tested for light diffusion at the reference point as specified in Appendix I. The reduced luminous factor of the ocular shall not exceed $0.65 \text{ cd.m}^{-2}.\text{lx}^{-1}$.

2.4.9 Material and surface quality

When inspected by the naked eye in accordance with the method specified in Appendix J, oculars shall have no material or machining defects within an area of 28 mm diameter centred on the reference point of the ocular 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.

2.5 LOW IMPACT RESISTANCE

2.5.1 General

All oculars for low impact eye and face protectors shall be capable of withstanding the relevant test for low impact resistance specified in Appendix K. A different method for the determination of low impact resistance is specified in Appendix L. In case of dispute the method given in Appendix K is to be used.

Oculars for clip-ons, wide-vision goggles, eye-shields, face-shields and hoods, and oculars used as pairs in spectacles and goggles (including those with prescription inserts) shall be tested in the assembled state as specified in Appendix K, and Appendix L. In case of dispute the method specified in Appendix K shall be used.

2.5.2 Performance criteria

When tested in accordance with Appendix K, an ocular shall be considered to have failed—

- (a) if it cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of the ocular material becomes detached from a part of the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular; or
- (d) if contact is made with either eye of the test headform by the ball, frame, ocular or any part or fragment of these.

These performance criteria are also applicable to the test method in Appendix L, if used.

2.6 MEDIUM IMPACT RESISTANCE

2.6.1 General

All oculars for medium impact eye and face protectors shall be capable of withstanding the test specified in Appendix M.

2.6.2 Performance criteria

When tested in accordance with Appendix M, an ocular shall be considered to have failed—

- (a) if it cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of the ocular material becomes detached from a part of the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular; or
- (d) if contact is made with either eye of the test headform by the ball, frame, ocular or any part or fragment of these.

2.7 HIGH IMPACT RESISTANCE

2.7.1 General

All oculars for high impact face protectors shall be capable of withstanding the test specified in Appendix N.

2.7.2 Performance criteria

When tested in accordance with Appendix N, an ocular shall be considered to have failed—

- (a) if it cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of the ocular material becomes detached from a part of the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular; or
- (d) if contact is made with either eye of the test headform by the ball, frame, ocular or any part or fragment of these.

2.8 EXTRA HIGH IMPACT RESISTANCE

2.8.1 General

All oculars for extra high impact face protectors shall be capable of withstanding the test specified in Appendix O.

2.8.2 Performance criteria

When tested in accordance with Appendix O, an ocular shall be considered to have failed—

- (a) if it cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of the ocular material becomes detached from a part of the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular; or
- (d) if contact is made with either eye of the test headform by the ball, frame, ocular or any part or fragment of these.

2.9 PENETRATION RESISTANCE

2.9.1 General

All plastics oculars for eye and face protectors shall be capable of withstanding the test described in Appendix P.

2.9.2 Performance criteria

When tested in accordance with Appendix P, an ocular shall be considered to have failed—

- (a) if it cracks through its entire thickness into two or more pieces;
- (b) if the point of the projectile pierces the surface of the ocular remote from that surface struck by the projectile; or
- (c) if contact is made with either eye of the test headform by the projectile, ocular or any part or fragment of these.

2.10 RESISTANCE TO IGNITION

2.10.1 General

Materials for oculars for wide-vision goggles, eye-shields and face-shields and hoods shall be capable of withstanding the test described in Appendix Q.

2.10.2 Performance criteria

When tested for resistance to ignition in accordance with Appendix Q no part of the ocular shall ignite or continue to glow after removal of the steel rod.

2.11 SPECIAL REQUIREMENTS

2.11.1 Protection against molten metals

When oculars designed to provide protection against molten metals are tested in accordance with Appendix R, there shall be no adherence of molten metal to the ocular and the integrity of the ocular shall be maintained.

2.11.2 Protection against hot solids

When oculars designed to provide protection against hot solids are tested in accordance with Appendix S, complete penetration shall not take place within a period of 5 s.

2.12 TESTING

- A1 | A minimum of three samples (pairs if applicable) of oculars shall be subjected to the appropriate tests listed in Table 4 and in the sequence described therein. Low and medium impact testing and penetration resistance testing shall be carried out on the same protector. Each impact test at the high and extra high impact levels shall be carried out on a protector that has not been previously impacted.

2.13 MARKING OF OCULARS AND REPLACEMENT OCULAR PACKAGING

2.13.1 Marking of oculars

The following information shall be etched or impressed into the oculars:

- A1 | (a) The manufacturer's name, trade name or mark. This shall not be in a form that is likely to cause confusion with any of the letters or numerals permitted in AS/NZS 1337.1, Table 7 or the 'R' required in AS/NZS 1337.6 to indicate prescription eye protectors.
- (b) The ocular marking appropriate to the type of protector (see Tables 1 and 7).

Where the design of the eye protector is such that the oculars are integral to the frame or front frame, the above information may be etched or impressed into the frame instead.

2.13.2 Marking of replacement ocular packaging

The outer package containing replacement oculars shall be clearly marked with the following information:

- (a) 'These oculars comply with AS/NZS 1337.1:2010, when correctly fitted to a 'brand' . . . , 'model number' . . . 'eye protector', by trained personnel according to the manufacturer's instructions', or equivalent wording.
- (b) The suitability of the ocular (see Table 5).

NOTE: Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

TABLE 4
SCHEDULE OF TESTS FOR OCULARS

Types of ocular	Material	Optical properties	Low impact properties	Medium impact resistance	High impact resistance	Extra high impact resistance	Penetration resistance (plastics oculars only)	Resistance to ignition	Molten metal resistance (see Note)	Hot solids resistance (See Note)
	(Clause 2.3)	(Clause 2.4)	(Clause 2.5)	(Clause 2.6)	(Clause 2.7)	(Clause 2.8)	(Clause 2.9)	(Clause 2.10)	(Clause 2.11.1)	(Clause 2.11.2)
Low impact paired or single	X	X	X	—	—	—	X	X	—	—
Medium impact	X	X	X	X	—	—	X	X	O	O
High impact	X	X	X	—	X	—	X	X	O	O
Extra high impact	X	X	X	—	—	X	X	X	O	O

LEGEND:

X = mandatory
O = optional
— = not required

SECTION 3 REQUIREMENTS FOR ASSEMBLED EYE AND FACE PROTECTORS

3.1 SCOPE OF SECTION

This Section specifies requirements for assembled eye and face protectors designed to provide protection against hazards such as flying particles and fragments, dusts, splashing materials and molten metals, harmful gases and vapours and aerosols.

3.2 GENERAL REQUIREMENTS

3.2.1 Finish

Eye and face protectors shall be free from projections, sharp edges or other features likely to cause discomfort or injury during use. Adjustable or interchangeable parts or components incorporated in eye and face protectors shall be simple to adjust, interchange or replace. Clip-ons shall be designed so that the retention system does not damage the oculars of the spectacles onto which they are fitted.

3.2.2 Materials

Materials used in the construction of eye and face protectors that come into contact with the skin should be non-irritant when subjected to perspiration and should not discolour the skin. The design of eye and face protectors (in particular, a dust goggle) shall be such as will reduce to a minimum the possibility of skin irritation due to abrasion. Materials of construction which are prone to absorption of moisture shall be readily replaceable.

Where provided, headbands or harnesses shall be of good quality durable materials, and shall have a minimum width of 10 mm for a goggle and 5 mm for spectacles.

3.2.3 Optical properties of oculars

Oculars of assembled eye and face protectors shall comply with Clauses 2.1 to 2.4 inclusive.

3.2.4 Ventilation

Eye and face protectors which completely occlude the ocular area shall be provided with effective ventilation. The minor dimensions of openings of ventilated eye protectors shall not exceed 1.5 mm.

A1 | Eye and face protectors complying with any of the Clauses 3.3.4, 3.3.5 and 3.3.6, and marked in accordance with Table 5 are exempt from this requirement.

TABLE 5
MARKING OF PACKAGING FOR INDOOR OR OUTDOOR USE OCULARS

Type of ocular	Required marking
Untinted or laminated/double glazed	These oculars are intended for indoor use where no optical radiation hazards exist
Outdoor untinted	These oculars are intended for indoor and outdoor use where no optical radiation hazards exist other than solar radiation. They are intended to provide adequate protection against ultraviolet radiation from the sun, but are not intended to provide protection against sunglare
Outdoor tinted or photochromic	These oculars are intended for outdoor use where no optical radiation hazards exist other than solar radiation. They are intended to provide adequate protection against sunglare and ultraviolet radiation from the sun

3.2.5 Dimensional requirements for eye-shields and face-shields

The minimum vertical dimension from the upper to the lower edge of the exposed (viewing) area of the visor of an eye-shield shall be 70 mm, and for a face-shield the minimum vertical dimension from the lower edge of the browguard to the lower edge of the visor shall be 150 mm.

Faceshields, in addition to the dimensional requirements of Clause 2.2.3, shall cover the area as marked out by the rectangle EFGH in Figure 1. The headform size used for assessment shall be specified.

Eyeshields, in addition to the dimensional requirements of Clause 2.2.3, shall cover the areas as marked out by the rectangle EFCD in Figure 1. The headform size used for assessment shall be specified.

3.2.6 Assessment of lateral protection

In addition to the dimensional requirements of Clause 2.2.3, eye protectors claiming impact resistance greater than low impact resistance shall provide lateral protection.

This shall be evaluated by placing the eye protector on a headform as in Figure 1 in accordance with the manufacturer's instructions. A rod, 2 mm (nominal) diameter and 125 (± 5 mm) long, shall be held horizontally and used to probe the front and side planes of the assembly attempting to touch the impact point regions on the headform. The impact regions being a 20 mm wide area equidistant from the front reference point/s and a 10 mm radial end equidistant from the side reference point/s for each head form. (The side reference points are the junction point of dimensional reference line *f* and *b* in Figure 1.)

The lateral protection of the eye protector shall be deemed to be satisfactory if the eye protector prevents the tip of the rod from touching the impact regions of the headform.

3.2.7 Impact resistance

3.2.7.1 General

All eye and face protectors shall be capable of withstanding the relevant test for low impact strength described in Appendix K. A different method for determination of low impact resistance is given in Appendix L. In case of dispute the method in Appendix K shall be used.

Spectacle eye and face protectors, whether with or without side shields, are suitable for low impact protection only. In addition, face-shields, side shields, wide-vision goggle, wide-vision spectacles or hoods may be designed and constructed to comply with Clauses 3.3.1 and 3.3.2, as appropriate.

3.2.7.2 Performance criteria

When eye and face protectors and clip-ons are tested in accordance with Appendix K and L, as appropriate, they shall be considered to have failed—

- (a) for an ocular, ocular housing, frame or side shield—
 - (i) if the ocular, frame, housing, mounting or side shield cracks through its entire thickness into two or more pieces;
 - (ii) if more than 5 mg of ocular material becomes detached from the ocular surface remote from the surface struck by the ball;
 - (iii) if the ball passes through the ocular, frame, housing, mounting, or side shield;
 - (iv) if the ocular dislodges from the normal position with respect to the frame; or
 - (v) if any contact is made with either eye of the test headform by the ball, frame, side shield, ocular or any part or fragment of these.

- (b) for a clip-on or an eye protector with prescription inserts behind the eye protector ocular—
 - (i) if either of the 2 mm plano untempered glass oculars, over which they are mounted for the purpose of the test, cracks through its entire thickness or physically separates into two or more pieces; or
 - (ii) if contact is made with either eye of the test headform by the ball, frame, ocular or any part or fragment of these.

These performance criteria ((a) and (b)) are also applicable to the test method in Appendix L, if used.

3.2.8 Penetration resistance

3.2.8.1 General

Plastic oculars shall be capable of withstanding the test described in Appendix P.

3.2.8.2 Performance criteria

When eye protectors and clip-ons are tested in accordance with Appendix P, they shall be considered to have failed—

- (a) if the ocular or clip-on cracks through its entire thickness into two or more pieces;
- (b) if the projectile pierces the surface of the ocular or clip-on remote from that surface struck by the projectile; or
- (c) if contact is made with either eye of the test headform by the projectile, ocular or any part or fragment of these.

3.2.9 Resistance to ignition

3.2.9.1 General

Spectacle eye protector, headbands (textile or foam), and edgings of goggle type eye protectors, which do not extend more than 10 mm from the edge of the goggle are exempted from this requirement. Materials used in the construction of eye protectors shall be capable of withstanding the test described in Appendix Q.

3.2.9.2 Performance criteria

When tested in accordance with Appendix Q, no part of the eye-protector shall ignite or continue to glow after removal of the steel rod.

3.2.10 Thermal stability

Assembled eye and face protectors shall be stable at elevated temperatures, and when tested in accordance with Appendix T shall show no physical distortion. On completion of the 30 minute heating period of Paragraph T4(a)—

- (a) their optical properties shall not have deteriorated beyond the limits specified in Clause 2.4.7; and
- (b) their strength and resistance to penetration shall not have fallen below that required to pass the relevant tests described in Appendix K, L, M, N or O and P, as appropriate.

This strength requirement is also applicable if the test method in Appendix L is used.

3.2.11 Protection against corrosion

When tested in accordance with Appendix U, the metal components of eye and face protectors shall have a smooth surface free from corrosion that can be observed by inspection under conditions of adequate lighting.

NOTES:

- 1 Changes in colour of the components after testing should not be regarded as corrosion.
- 2 Suitable lighting conditions for inspection purposes are recommended in AS/NZS 1680.1.

3.3 SPECIAL PERFORMANCE REQUIREMENTS

3.3.1 Medium impact protectors

3.3.1.1 General

Medium impact protectors shall be wide-vision goggles, wide-vision spectacles, face-shields, eye-shields, hoods, welding hand-shields or welding helmets fitted with oculars complying with the requirements of Clause 2.6. They shall be capable of withstanding the test described in Appendix M.

3.3.1.2 Performance criteria

When the ocular or oculars, ocular housing and frame, including the side shields of wide-vision spectacles of medium impact eye protectors are tested in accordance with Appendix M, they shall be considered to have failed—

- (a) if the ocular, frame, housing or mounting or side shield cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of ocular material becomes detached from the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular, frame, housing, mounting, or side shield;
- (d) if the ocular dislodges from the normal position with respect to the frame;
- (e) if any contact is made with either eye of the test headform by the ball, frame, side shield ocular or any part or fragment of these; or
- (f) for eye protectors with prescription inserts behind the eye protector ocular—if either of the 2 mm plano untempered glass oculars, over which they are mounted for the purpose of the test, cracks through its entire thickness or physically separates into two or more pieces.

3.3.2 High impact protectors

3.3.2.1 General

High impact protectors shall be face-shields, hoods, welding hand-shields or welding helmets, fitted with oculars complying with the requirements of Clause 2.7. They shall be capable of withstanding the test described in Appendix N.

3.3.2.2 Performance criteria

When the ocular, oculars, ocular housing and frame are tested in accordance with Appendices K and L, they shall be considered to have failed—

- (a) if the ocular, frame, housing or mounting or side shield cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of ocular material becomes detached from the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular, frame, housing, mounting, or side shield;
- (d) if the ocular dislodges from the normal position with respect to the frame; or
- (e) if any contact is made with either eye of the test headform by the ball, frame, side shield ocular or any part or fragment of these.

3.3.3 Extra high impact protectors

3.3.3.1 General

High impact protectors shall be face-shields fitted with oculars complying with the requirements of Clause 2.8. They shall be capable of withstanding the test described in Appendix O.

3.3.3.2 Performance criteria

When the ocular, oculars, ocular housing and frame are tested in accordance with Appendix O, they shall be considered to have failed—

- (a) if the ocular, frame, housing or mounting or side shield cracks through its entire thickness into two or more pieces;
- (b) if more than 5 mg of ocular material becomes detached from the ocular surface remote from the surface struck by the ball;
- (c) if the ball passes through the ocular, frame, housing, mounting, or side shield;
- (d) if the ocular dislodges from the normal position with respect to the frame; or
- (e) if any contact is made with either eye of the test headform by the ball, frame, side shield ocular or any part or fragment of these.

3.3.4 Protection against splashes

When eye protectors designed for protection against splashing materials or liquids are tested in accordance with Appendix V, no coloration shall appear on the area enclosed by the goggle, and for a face-shield no coloration shall appear within 25 mm of the eye sockets.

3.3.5 Protection against dust

When eye protectors designed for protection against dust particles and aerosols are tested in accordance with Appendix W, they shall be deemed satisfactory if the luminous reflectance after the test is not less than 80% of that before the test.

3.3.6 Protection against gas

When eye protectors for protection against gas are tested in accordance with Appendix X, no staining shall appear on the area enclosed by the eye protector.

3.3.7 Protection against molten metal and hot solids

3.3.7.1 General

Eye and face protectors for protection against molten metal and hot solids shall be face-shields or wire-mesh screens complying with the requirements for medium impact protectors and the performance criteria set out in Clauses 3.3.2.2.

3.3.7.2 Performance criteria for molten metal test

When the eye and face protector is tested in accordance with Appendix R, there shall be no adherence of molten metal to the ocular and the integrity of the ocular shall be maintained. Where applicable, the woven gauze of a wire-mesh screen shall show no penetration of metal fragments.

3.3.7.3 Performance criteria for hot solids test

When the eye and face protector is tested in accordance with Appendix S, complete penetration of the ocular shall not occur within a period of 5 s.

3.3.8 Protection against high temperature

When the eye and face protector is tested in accordance with Appendix Y, the protector and its retention mechanism shall not show signs of visible charring, dripping, melting or deformation.

3.4 TESTING

- A1 | A minimum of three samples of eye and face protectors shall be subjected to the appropriate tests listed in Table 4 and in the sequence described therein. Low and medium impact testing and penetration resistance testing shall be carried out on the same protector. Each impact test at the high and extra high impact levels shall be carried out on a protector that has not been previously impacted.

3.5 MARKING OF ASSEMBLED EYE AND FACE PROTECTORS AND PACKAGING

3.5.1 Eye and face protectors

The following information shall be etched or impressed into the eye and face protectors:

- A1 | (a) The manufacturer's name, trade name or mark. This shall not be in a form that is likely to cause confusion with any of the letters or numerals permitted in AS/NZS 1337.1, Table 7 or the 'R' required in AS/NZS 1337.6 to indicate prescription eye protectors.
- (b) The appropriate ocular marking as given in Section 2 of this Standard and, where applicable, the appropriate marking as prescribed in AS/NZS 1338, Part 2 or Part 3.
- (c) The appropriate marking as given in Table 7.

Where the design of the protector is such that the oculars are integral to the frame or front frame, the above information may be etched or impressed into the frame instead.

3.5.2 Packaging

The following information shall be supplied with the eye and face protectors:

- (a) The type of protector as given in Table 7.
- (b) The appropriate marking as given in Table 8.
- A1 | (c) Where the protector is intended for a small size head then an indication of this.

The information should be marked on the packaging, however alternative methods such as swing tags or adhesive labels may be used, provided that the required marking is readily visible and secured to the protector as supplied.

NOTE: Manufacturers making a statement of compliance with this Australian/New Zealand Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

TABLE 6
SCHEDULE OF TESTS FOR EYE AND FACE PROTECTORS

Type of protector	Thermal stability (Clause 3.2.10)	Optical properties (Clause 3.2.3)	Low impact resistance (Clause 3.2.7)	Medium impact resistance (Clause 3.3.1)	High impact resistance (Clause 3.3.2)	Extra high impact resistance (Clause 3.3.3)	Penetration resistance (plastics oculars only) (Clause 3.2.8)	Resistance to ignition (Clause 3.2.9)	Corrosion resistance (Clause 3.2.11)	Splash resistance (Clause 3.3.4)	Dust resistance (Clause 3.3.5)	Gas resistance (Clause 3.3.6)	Molten metal and hot solids resistance (Clause 3.3.7)	High temperature (Clause 3.3.8)
Low impact	X	X	X	—	—	—	X	X	X	—	—	—	—	—
Medium impact	X	X	X	X	—	—	X	X	X	O	O	O	O	O
High impact	X	X	X	O	X	—	X	X	X	O	O	O	O	O
Extra high impact	X	X	X	O	O	X	X	X	X	O	O	O	O	O
Molten metal and hot solids	X	X	X	X	O	—	X	X	X	O	—	—	X	O
Splashproof	X	X	X	O	O	—	X	X	X	X	O	O	—	O
Dustproof	X	X	X	O	O	—	X	X	X	O	X	O	—	O
Gastight	X	X	X	O	O	—	X	X	X	O	O	X	—	O

LEGEND:
X = mandatory
O = optional
— = not required