APPENDIX: K

Z94.3.1-02

Protective Eyewear: A User's Guide

CANADIAN STANDARDS ASSOCIATION

CSA Special Publication

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Protective Eyewear: A User's Guide

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1-800-463-6727 • 416-747-4044

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1. Introduction

A recent survey found that three out of five workers suffering eye injuries wore no eye protection. Half of those who did use safety eyewear wore the wrong type.

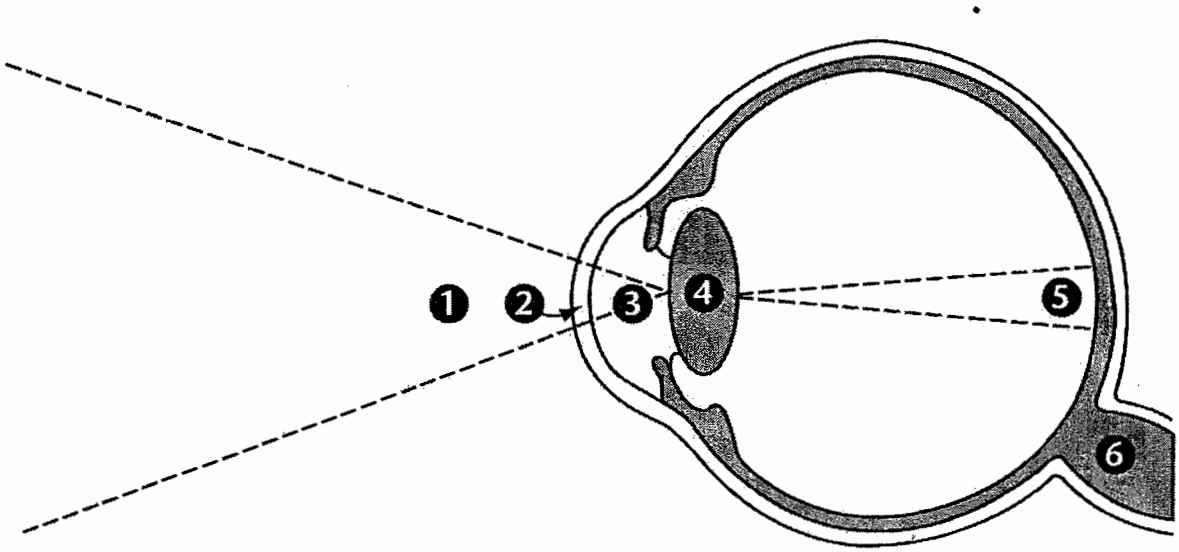
To be effective, eye protection must be properly selected and fitted.

The majority of eye injuries can be prevented by wearing appropriate protective eyewear and following basic safety rules.

The purpose of this user's guide is to provide advice for the proper selection of eye protection in relation to the specific hazardous activity involved; not all hazards have been identified in this guide.

Note: *A hazard assessment of the workplace must be done to identify the hazard type(s).*

2. How the Eye Works



1. Light strikes an object in your field of vision and is **REFLECTED** to your eyes.

2. Light passes through the **CORNEA** (transparent "front window" of the eye).

3. The **PUPIL** (the opening at the centre of the coloured **IRIS**) changes size to allow the correct amount of light through.

4. The **CRYSTALLINE LENS** focuses light rays onto the retina.

5. The **RETINA** (rear inner lining of the eye that contains light-sensitive cells) converts light into electrical signals.

6. The **OPTIC NERVE** carries these signals to the brain, which combines the images from each eye into a single picture.

3. Safety versus Non-Safety Eyewear

There is a misconception that the term *impact resistant* used in relation to non-safety or "dress" eyewear means that the eyewear meets safety standards.

In fact, different standards are used in the manufacture, fabrication, and testing of safety and non-safety "dress" eyewear.

Safety eyewear is covered in CSA Standard CAN/CSA-Z94.3-99, *Industrial Eye and Face Protectors*, whereas non-safety "dress" frames fall under an ophthalmic standard that has no relationship to protective safety eyewear.

- Safety eyewear must meet the CAN/CSA-Z94.3 standard for impact resistance, which requires testing with a 6.4 mm steel ball at a velocity of 46.5 m/second. Non-safety "dress" eyewear does not meet this standard.
- Safety eyewear frames must be manufactured so that the lens cannot be pushed through the back of the frame upon impact. Non-safety "dress" frames do not have this feature.
- Safety eyewear frames must be marked with the manufacturer's trademark. Non-safety "dress" eyewear is not marked. Plano (or non-prescription) must also be marked with the logo of the certifying agency (for example:).
- Safety lenses must be marked with the manufacturer's identification. Non-safety "dress" eyewear does not carry such a mark.
- Safety eyewear must have side protection, meet safety standard dimension requirements, and be tested as a complete protector. Non-safety "dress" eyewear does not meet these requirements.

4. How to Recognize Safety Eyewear

It's as simple as 1, 2, 3...

1. All safety eyewear must be marked with the manufacturer's identification on the frame or body of the product.

2. All safety eyewear must be marked with the manufacturer's identification on the lens.

   If the product is used for absorptive purposes, e.g., welding, the lens and the sideshield must also be marked with the "shade" (protective level) designation.

3. All safety eyewear must meet the Occupational Health and Safety Standard specifications of CSA Standard CAN/CSA-Z94.3, *Industrial Eye and Face Protectors.*

Note: *CSA Standard CAN/CSA-Z94.3,* Industrial Eye and Face Protectors, *does not provide testing and certification requirements for prescription safety eyewear. However, all prescription safety eyewear must comply with Clause 14 of CSA Standard CAN/CSA-Z94.3.*

5. Contact Lenses

Can contact lenses be worn in a hazardous workplace environment?

Contact lenses themselves do not provide eye protection in the industrial sense.

Clause C2.1 of Appendix C, "Recommendations for Good Practice", in CSA Standard CAN/CSA-Z94.3 on eye and face protectors states that

> *In an environment where industrial eye protection is required, contact lenses should not be worn, except under special medical circumstances. If contact lenses must be worn, eye protection should be used.*

6. When is Laser Protective Eyewear Protection Needed?

Note: *Laser protection is not addressed in CSA Standard CAN/CSA-Z94.3,* Industrial Eye and Face Protectors.

Are you working around a laser beam or with a laser?

If so, the class of the laser will determine if laser safety eyewear protection is needed.

- Class I — Laser safety eyewear is not required; safe viewing occurs at all exposure levels.
- Class II — Laser safety eyewear is not required. Visible light lasers and natural reflex motions of the eye protect against damaging levels.
- Class IIIa/IIIb — Laser safety eyewear should be worn.
- Class IV — Laser safety eyewear must be worn for hazards from direct and scattered radiation.

What to know about the laser

- The type of laser safety eyewear correlates to the type of laser. For example, a carbon dioxide (CO_2) laser requires CO_2 laser safety eyewear.
- A laser typically operates at only one wavelength; therefore, laser safety eyewear must correspond to this wavelength.
- The power of the laser determines the class of the laser and the required optical density for a "continuous wave" laser.
- If the laser is "pulsed", you also need to know the energy pulse of the laser (joules), the pulse duration (seconds), and the rep rate (hertz).

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Factors to consider when choosing laser safety eyewear

- The **WAVELENGTH** of the eye must correspond to the wavelength of the laser.
- **O.D.** (optical density) must be sufficient to reduce the laser beam below the maximum permissible exposure levels.
- The **FACTOR OF TIME** if the filter is exposed to laser radiation; how long will the filter last?
- **VLT** (visual light transmission).
- **COMFORT** and **FIT.**

How does laser safety eyewear work?

- **ABSORPTION** — through the use of mineral glass or organic dyes.
- **REFLECTION** — through the use of holograms or dielectric coatings.

Your laser manufacturer should advise you about the type of laser safety eyewear that you require.

Or, contact a laser safety eyewear manufacturer who can assist you in determining your type of laser protection.

7. Lens Materials

Material	Properties
Glass	• High-density material resulting in heavy lenses • Loses impact resistance if scratched • Does not meet the impact criteria in CSA Standard CAN/CSA-Z94.3
Polycarbonate	• Most impact resistant of all lens materials • Lenses are coated to provide scratch resistance • Lightweight • Most lenses have built-in UV radiation absorbing properties
Plastic (CR39)	• Roughly one-half the weight of glass • Resistant to solvents and pitting • More coating and tinting options available

8. Lens Colours

Do not be fooled by the colour of the lenses

Lens Colour	Properties	Applications and Limitations
Clear	• Optically clear	• Good for low light conditions • For impact protection only • May offer UV protection
Tinted	• Tinted lenses come in a wide variety of colours • Tinted lenses can come tinted from the manufacturer or the tint may be applied • Tinted lenses reduce light transmission but do not contain any other absorbing properties	• Outdoor use for glare • Reduce light transmission but have no other absorbing properties • Amber lenses may enhance contrast in low light • May distort perception of colours (e.g., traffic signals)
Photochromatic	• These lenses darken when exposed to sunlight and lighten when indoors	• Outdoor use for glare • May not lighten fast enough for quick transition from light to dark environments

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Lens Colour	Properties	Applications and Limitations
Polarized	• Lenses with polarization block "reflected" glare	• Outdoor use for reflected glare light • May mask liquid crystal optical displays
Filter lenses	• Designed to filter out harmful UV and IR radiation • Available in shades 1.5 to 14	• Used for welding, cutting, soldering, etc. • Shade must be light enough to see work but dark enough to provide adequate protection (see selection chart)
Specialty lenses	• Specialty lenses come in a wide variety of colours and uses • The colour of the lens corresponds to the absorption/filter capabilities • A hazard assessment identifying the type of exposure is necessary in order to determine the type of protective lens required	• A hazard assessment identifying the type of exposure is necessary in order to determine the type of protection required • The manufacturer should be consulted for specific uses and limitations

9. Coating Types Available

Note: *It should be noted that not all protective eyewear include these coatings.*

Coating Type	Applications and Properties
Anti-Scratch	• Most are factory applied but some can be applied afterwards • Lenses with anti-scratch coatings are not scratch proof. Lenses with anti-scratch coatings can get scratched. The amount of care and handling determines how long lenses will last
Anti-Fog	• Usually factory applied or incorporated in the lens material • Anti-fog solutions, intended for application to the lens surface by the end user, are available but have limited performance relative to factory-applied products • In prescription lenses, there are anti-fog coatings that can be applied; however, they have a limited performance relative to factory-applied coatings
Anti-Reflective	• Factory or after-market applications are similar in function • Provides improved optical clarity
Ultraviolet	• This coating is usually applied to plastic lenses • Polycarbonate lenses have UV protection inherent in the material