CANADIAN STANDARDS ASSOCIATION

Z94.3.1-09

Selection, use, and care of protective eyewear

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Selection, use, and care of protective eyewear

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Selection, use, and care of protective eyewear

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 for the job and fitted to the wearer.
Note: *CAN/CSA-Z94.3 requires that prescription safety eyewear be fitted by a qualified professional (e.g., a licensed ophthalmic practitioner).*

The first choice in preventing eye injuries is to design work procedures and equipment so that workers are not exposed to eye hazards. However, the total elimination of eye hazards from the workplace is often not possible, and other measures must be taken to control residual hazards so that they do not result in injuries to workers and others in the work zone. One such control measure is the wearing of personal protective equipment (such as protective eyewear). It is well recognized that 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.

Any well-designed eye and face protection program should be part of an effective occupational health and safety management system. Specifications for such a management system can be found in CAN/CSA-Z1000, *Occupational Health and Safety Management*. This Standard is based on the Plan–Do–Check–Act model of safety management, and it lays out the basis for proper management of personal protective equipment as a necessary strategy for injury and illness prevention.

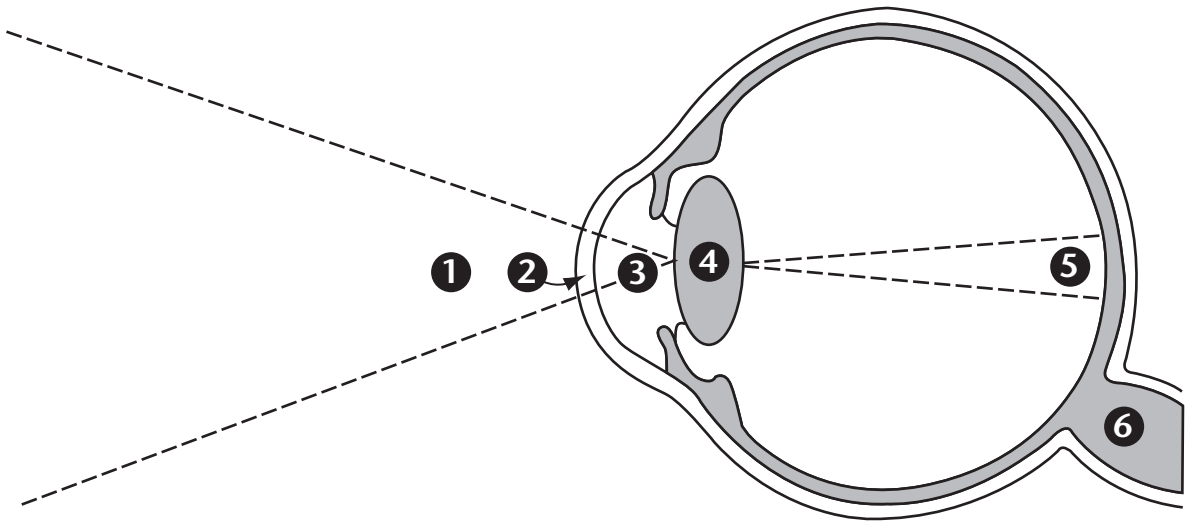
Notes:

(1) As a first step to selection of proper eye protection, a hazard assessment/risk analysis of the workplace should be done to identify the hazard type(s).

(2) Refer to Section 11 of this user guide for hazards and recommended protectors.

(3) Refer to provincial/federal occupational health and safety legislation.

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

BE CAREFUL, NOT ALL EYEWEAR IS SAFETY EYEWEAR.
There is a misconception that *impact resistance* implies compliance with the CSA Standard.

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

Prescription Safety Eye Protectors

Use of prescription safety eyewear is recommended practice for workers who require corrective lenses and are exposed to eye hazards on a regular basis.

"Over-the-glasses" protectors (oversized protectors designed to be worn over non-safety spectacles) should only be used for workers and visitors who require protection occasionally (those not normally exposed to eye hazards).

4 How to Recognize CSA-compliant Protective Eyewear

Plano (Non-Prescription) Eye and Face Protector	Prescription Safety Eye and Face Protector	Non-Safety (Dress) Eyewear
Frame:	Frame:	Frame:
Certification mark on frame and/or temple and on packaging (example: CSA mark or other accredited agency's mark) or declaration by manufacturer that product complies with CAN/CSA-Z94.3.	Certification mark on frame and/or temple (example: CSA mark or other accredited agency's mark) or declaration by manufacturer's label "CSA Z94.3" on temple.	No marking with reference to safety assurance.
Lenses:	Lenses:	Lenses:
Manufacturer's mark or monogram.	Manufacturer's mark or monogram.	Some marking on lenses, but usually just indicates brand name.
Side Protection (sideshields):	Side Protection (sideshields):	Side Protection (sideshields):
Sideshields are permanently attached, either integral or part of a continuous formed front that extends to provide the coverage required by the CSA Standard.	Sideshields are permanently attached or are an integral part of the eyewear design.	None **Note:** *Some sunwear have sideshields, but they do not meet the CSA Standard for safety.*

Note: *"Plano (Non-Prescription) Eye & Face Protector" may also include powered general-use magnifying protective safety eyewear.*
See Clauses 13.1–13.4, 15.2.3, and 15.4.2 of CAN/CSA-Z94.3.

5 Contact Lenses

Can contact lenses be worn in a hazardous workplace environment?

Be aware that contact lenses themselves **do not** provide eye protection in the industrial sense.

In any environment where industrial eye protection is required, contact lenses should not be worn, except under special medical circumstances (in consultation with a qualified medical professional). If individual medical circumstances require that contact lenses be worn in such environments, eye protection must also be used.

6 Laser Protective Eyewear

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

When is laser protective eyewear needed?

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

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 or 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).

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.

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 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
Trivex	• More impact resistant than CR39 Plastic • Less impact resistant than Polycarbonate • UV radiation absorption properties

8 Prescription Safety Eye Protectors

Prescription safety eyewear compliant with CAN/CSA-Z94.3 should be selected. These protectors incorporate lenses and frames that have been tested against the performance requirements in the Standard and have lenses that have been ground and assembled by a qualified dispensing laboratory.

Prescription eyewear frames should be selected to ensure proper fit on the face of the wearer. CSA recommends that you consult a qualified professional in both the selection and the fitting of frames.

Any modifications to safety eyewear frames (including side protection), in order to ensure proper fit, should be made by a qualified professional in a manner that results in optimal coverage for the wearer.

The following combinations of spectacle lens materials, surface treatments, and minimum thicknesses in mm are considered to meet the requirements for impact resistance for prescription lenses.

Material	SRC Coated		ARC	SRC and ARC	Tints Solid/ Gradient
	1 Side	2 Sides			
Glass	—	—	N/A	—	N/A
CR39	3.0	3.0	N/A	N/A	3.0
Polycarbonate	2.0	2.0	—	2.0	2.0
Trivex	2.5	2.5	—	2.5	2.5
Photochromic					
Glass	—	—	N/A	—	N/A
CR39	3.0	3.0	N/A	N/A	3.0
Polycarbonate	2.0	2.0	—	2.0	2.0
Polarized					
Glass	—	—	N/A	—	N/A
CR39	3.0	3.0	N/A	N/A	3.0
Polycarbonate	2.0	2.0	—	2.0	2.0

Legend:

Glass: Crown glass that has been either chemically hardened or heat treated.
SRC: Scratch Resistant Coating
ARC: Anti-Reflective Coating
Tint: Any color of tint, including solid or gradient BUT NOT including pre-tinted (through and through) materials. Pre-tinted materials fall under material type.
N/A: Not applicable due to the inability of the material type to meet the minimum impact requirements, regardless of minimum thickness.
—: Not available in this form.

9 Lens Colours

Do not be fooled by the colour of the lenses

Note: *A risk analysis/hazard assessment, identifying the type of exposure, is necessary in order to determine the type of protective lens required.*

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 (e.g., sunglasses) • 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)
Photochromic	• 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
Polarized	• Lenses with polarization block "reflected" glare	• Outdoor use for reflected glare light • May mask liquid crystal optical displays

(Continued)

Lens Colour	Properties	Applications and Limitations
Filter lenses **Note:** *Refer to a welding specialist or the manufacturer for specific advice on the use and application of welding eyewear and 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 protection required • The manufacturer should be consulted for specific uses and limitations

10 Coating Types Available

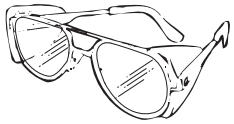
Note: *It should be noted that not all protective eyewear include these coatings.*

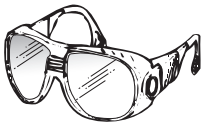
Coating Type	Applications and Properties
Anti-Scratch	• Most are factory applied but some can be applied afterwards • Lenses with anti-scratch coatings are not scratch proof. Lenses with anti-scratch coatings can get scratched. The amount of care and handling determines how long lenses will last
Anti-Fog	• 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

11 Classification of Protective Eyewear

Examples of Class 1 — Spectacles

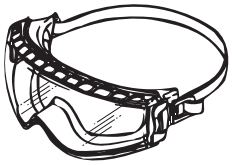
Class 1A
Spectacles with side protection





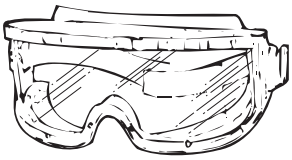
Class 1B
Spectacles with side and radiation protection

Examples of Class 2 — Goggles



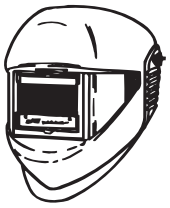
Class 2A
Direct ventilated goggles

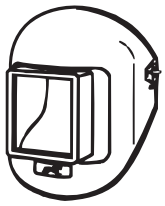
Class 2B
Non-ventilated goggles



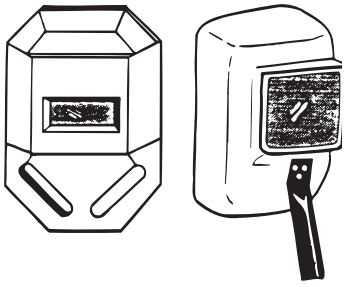
Class 2C
Direct/non-ventilated with radiation protection

Examples of Classes 3 and 4 — Welding Helmets and Hand Shields





Class 3
Welding helmets



Class 4
Welding hand shields

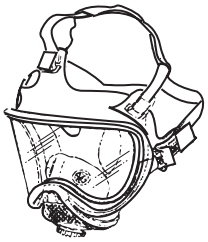
Examples of Class 5 — Non-rigid Helmets (Hoods)

Class 5A Non-rigid helmet (hood) with impact-resistant window
Class 5B Non-rigid helmet (hood) for dust, splash, and abrasive materials protection
Class 5C Non-rigid helmet (hood) with radiation protection
Class 5D Non-rigid helmet (hood) for high-heat applications

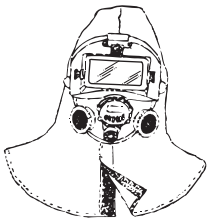
Examples of Class 6 — Face Shields

Class 6A Face shield for impact and splash protection
Class 6B Face shield for radiation protection
Class 6C Face shield for high-heat application

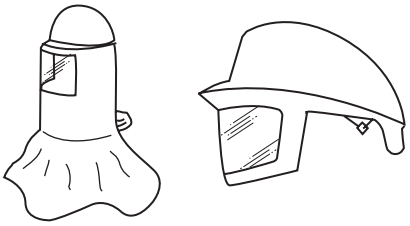
Examples of Class 7 — Respirator Facepieces



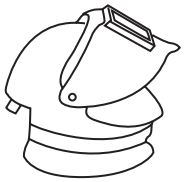
Class 7A



Class 7B



Class 7C



Class 7D

Class 7A Respirator facepiece for impact and splash protection
Class 7B Respirator facepiece for radiation protection
Class 7C Respirator facepiece with loose-fitting hoods or helmets
Class 7D Respirator facepiece with loose-fitting hoods/helmets for radiation protection

12 Selection Guide

Hazards and Recommended Protectors																	
Hazard groups	Nature of hazard	Hazardous activities involving but not limited to	Spectacles Class 1		Goggles Class 2			Welding helmet Class 3	Welding hand shield Class 4	Non-rigid helmets (hoods) Class 5				Face shields Class 6		
			A	B	A	B	C			A	B	C	D	A	B	C
A	Flying objects	Chipping, scaling, stonework, drilling; grinding, buffing, polishing, etc.; hammer mills, crushing; heavy sawing, planing; wire and strip handling; hammering, unpacking, nailing; punch press, lathework, etc.	■		■	■				■	■			■		
B	Flying particles, dust, wind, etc.	Woodworking, sanding; light metal working and machining; exposure to dust and wind; resistance welding (no radiation exposure); sand, cement, aggregate handling; painting; concrete work, plastering; material batching and mixing	■		■	■				■	■			■		
C	Heat, sparks, and splash from molten materials	Babbiting, casting, pouring molten metal; brazing, soldering; spot welding, stud welding; hot-dipping operations		■			■					■	■		■	■
D	Acid splash; chemical burns	Acid and alkali handling; degreasing, pickling, and plating operations; glass breakage; chemical spray; liquid bitumen handling				■					■			■		

(Continued)

Hazards and Recommended Protectors (Continued)

Hazard groups	Nature of hazard	Hazardous activities involving but not limited to	Spectacles Class 1		Goggles Class 2			Welding helmet Class 3	Welding hand shield Class 4	Non-rigid helmet (hoods) Class 5				Face shields Class 6		
			A	B	A	B	C			A	B	C	D	A	B	C
E	Abrasive blasting materials	Sand blasting; shot blasting; shotcreting														
F	Glare, stray light (where slight reduction of visible radiation is required)	Reflection, bright sun, and lights; reflected welding flash; photographic copying														
G	Injurious optical radiation (where moderate reduction of optical radiation is required)	Torch cutting, welding, brazing, furnace work; metal pouring, spot welding, photographic copying														
H	Injurious optical radiation (where large reduction of optical radiation is required)	Electric arc welding; heavy gas cutting; plasma spraying and cutting; inert gas shielded arc welding; atomic hydrogen welding														

Note: *Highlighted areas are recommendations for protectors. Class 1 and Class 2 protectors shall be used in conjunction with recommendations for Classes 3, 4, 5, and 6 protectors. The possibility of multiple and simultaneous exposure to a variety of hazards shall be considered in assessing the needed protection. Adequate protection against the highest level of each of the hazards should be provided. This Table cannot encompass all of the various hazards that may be encountered. In each particular situation, thorough consideration should be given to the severity of all the hazards when selecting the appropriate protector or combination of protectors. The practice of wearing protective spectacles (Class 1B) with filter lenses under welding helmets or hand shields is strongly recommended, to ensure impact and flash protection to the wearer when the helmet or lift front is raised or the shield is not in use. Protectors that meet the requirements for ignition and flame resistance are not intended to provide protection in environments that expose the user to open flame or high-energy arcs.*

13 Care and Maintenance

Lens cleaning	• Always use water or lens cleaning fluid specific to your lens type. • By using a wet method of cleaning, you will "float" the dirt away rather than scratch it into your lens.
Replace worn parts	• Lenses and filters that are pitted or scratched should be replaced. • Pitted or scratched lenses and filters may impair vision and reduce impact resistance.
Protect your eyewear	• To prolong the life of your eye protectors, keep them in suitable cases or containers between periods of use.

14 Three Important Rules

1.Be Sure It Fits!

• Choose appropriate protective eyewear that fits firmly but not tightly, and that sits as close to the eyes as possible without the eyelashes hitting the lenses.

• Eyewear should never interfere with body movement.

• Do not wear someone else's equipment.

2.Maintain It Properly!

• Check equipment daily.

• Clean dirty lenses and frames; repair frames or replace lenses that are scratched, cracked, pitted, faded, etc., at once.

• Equipment should be clearly labelled with your name.

• Store equipment in a clean, dry area between periods of use.

• Do not alter or modify equipment.

3.Wear It!

• The best safety equipment in the world is no good unless you use it.

15 Summary

- Protecting your eyes from workplace hazards is easy to do.
- Wearing appropriate protective eyewear can save you from a serious eye injury.
- Take the time to identify the potential eye hazards at work.
- Prevent accidents and injuries by following all safety rules when using machinery, equipment, and tools.
- Above all, always wear the appropriate type of protective eyewear whenever you may be exposed to eye hazards.

REMEMBER: It only takes a single act of carelessness to injure your eyes. That is too great a risk to take with something as precious as your sight.

16 References

CSA Standard CAN/CSA-Z94.3-07, *Eye and Face Protectors.*

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