SAUDI BINLADIN GROUP
OPERATION & MAINTENANCE

SBG O&M Personal Protective Equipment

INTRODUCTION

PPE is designed to protect against safety and/or health hazards. Hard hats, safety glasses, and safety boots, for instance, are designed to prevent or reduce the severity of injury if an accident occurs. Other PPE, such as hearing and respiratory protection, is designed to prevent illnesses and unwanted health effects. It is important to remember that PPE only provides protection. It reduces the risk but does not eliminate the hazard. This manual on particular kinds of PPE will enable users to

· assess hazards and select a suitable control method
· locate and interpret legislation related to PPE
· effectively use and maintain PPE.

Legal Requirements

While common to all trades, PPE varies according to individual, job, and site conditions. The *Occupational Health and Safety Act* makes employers and supervisors responsible for ensuring that required PPE is worn. This does not mean that the employer must provide PPE but only ensure that it is provided by someone. **SBG O&M** Workers, meanwhile, have a duty under the Act to wear or use PPE required by the employer. This addresses situations where the regulations may not require PPE but the employer has set additional health and safety standards, such as mandatory eye protection. The operations and maintenance regulation broadly requires that such protective clothing, equipment, or devices be worn "as are necessary to protect the worker against the hazards to which the worker may be exposed." It also requires that the worker be trained in the use and care of this equipment.

Control Strategies

Personal protective equipment should be the last resort in defence. Better alternatives lie in engineering controls that eliminate as much of the risk as possible. Engineering controls fall into five categories:

· substitution
· alternative work methods
· isolation
· enclosure
· ventilation.

Substitution
This control substitutes a less toxic chemical that can do the same job. A common example is the substitution of calcium silicate or fibreglass insulation for asbestos insulation. Substitution is an effective control as long as the substitute is less hazardous.

Alternative Work Methods
This simply means doing the job in a way which is less hazardous. For example, brushing or rolling paint produces much lower vapour levels than spray painting. Similarly, wet removal of asbestos releases up to 100 times less dust than dry removal. The change should be checked to ensure that it is safer.

Isolation
Isolation isolates the worker from the hazard. In a quarry, for example, the operator of a crusher can be isolated from dust by a filtered, air-conditioned cab.

Enclosure
A substance or procedure may be enclosed to contain toxic emissions. It may be as simple as putting a lid on an open solvent tank or enclosing asbestos removal projects with polyethylene sheeting (Figure 1). Enclosures have also been built around compressors to reduce the noise level. Enclosures must not restrict access when maintenance is required.

Ventilation
A common engineering control is to dilute the contaminant in the air by using general ventilation. Local ventilation is better because it removes the contaminant. General ventilation may employ fans to move large volumes of air and increase air exchange. This is not suitable, however, for highly toxic materials. Local ventilation captures and removes contaminants at their source. At a shop bench, a fume hood can be constructed to remove dusts and fumes. On sites, portable fume extractors (Figure 2) can be used. Remember: many filtering systems can only remove fumes—not gases or vapours.

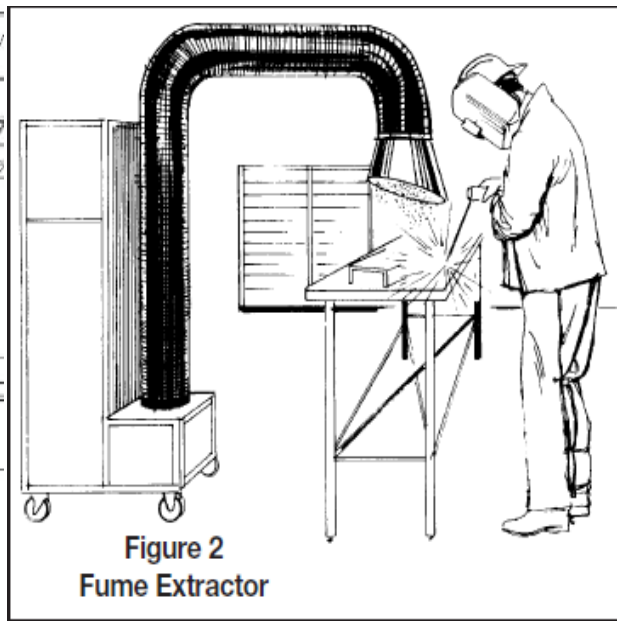


Figure 2
Fume Extractor

Fig 1 Enclosure

Personal Protective Equipment

When it is not possible to apply any of the five engineering controls, personal protective equipment may be the last resort. Regulations often refer to Canadian Standards Association (CSA) or other equipment standards as a convenient way to identify equipment which meets requirements and is acceptable. CSA certified equipment can be identified by the CSA logo. For instance, there are CSA standards for

- Head Protection - CSAZ94.1M1992
- Eye Protection - CSAZ94.3-07
- Foot Protection - CSAZ195-M1992

For respiratory protection, National Institute for Occupational Safety and Health (NIOSH) standards and approvals are usually referenced throughout North America. For life jackets, Transport Canada certification is the standard reference.

See the following chapters on particular kinds of PPE**H**

HIGH-VISIBILITY CLOTHING

The operations and maintenance regulation (O. Reg. 213/91) requires that any worker who may be endangered by vehicular traffic on a project must wear a garment that provides a high level of visibility. There are two distinct features to high-visibility clothing.

Background Material

This is the fabric from which the garment is made. It must be fluorescent orange or bright orange in colour and afford increased daytime visibility to the wearer. Fluorescent orange provides a higher level of daytime visibility and is recommended.

Retroreflective Stripes or Bands

The stripes or bands must be fluorescent and retroreflective and be arranged on the garment with two vertical stripes down the front and forming an X on the back. The stripes must be yellow and 50 mm wide. Retroreflective stripes are to afford the worker both lowlight and night-time visibility.

For night-time work, additional stripes or bands are required on the arms and legs. One way to meet this requirement is to dress workers in fluorescent orange coveralls with retroreflective bands or stripes attached.

Risk Assessment
Before selecting high-visibility garments, assess the risks to be controlled. Workers who require greater visibility, such as roadway operations and maintenance workers, should wear clothing that is highly conspicuous under the conditions expected. For further recommendations on high-visibility clothing, consult CSA's standard Z96-02.

FOOT PROTECTION

Ankle injuries represent 50% of all foot injuries in Ontario operations and maintenance. Properly worn, a CSA-certified Grade 1 workboot meets the requirements of the current operations and maintenance regulation (O. Reg. 213/91) and helps protect against ankle and other injuries. One of three CSA grades, Grade 1 offers the highest protection and is the only one allowed in operations and maintenance. In a Grade 1 boot, a steel toe protects against falling objects while a steel insole prevents punctures to the bottom of the foot. Grade 1 boots can be identified by

· a green triangular patch imprinted with the CSA logo on the outside of the boot and
· a green label indicating Grade 1 protection on the inside of the boot.

Grade 1 boots are also available with metatarsal and dielectric protection. A white label with the Greek letter Omega in orange indicates protection against electric shock under dry conditions.

Selection and Fit

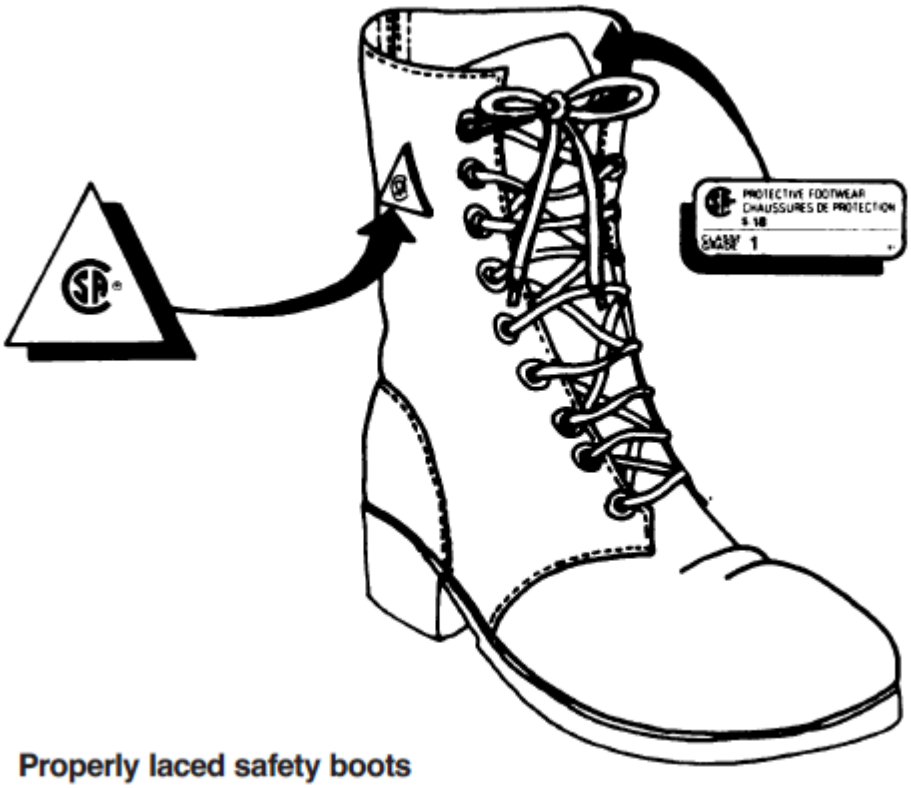
Grade 1 boots are available in various styles and sole materials for different types of work. For example, Grade 1 rubber boots may be better suited than leather boots for sewer and watermain or concrete work. Boots should provide ample “toe room” (toes about ½ inch back from the front of steel box toe cap when standing with boots laced). When fitting boots, allow for heavy work socks. If extra sock liners or special arch supports are to be worn in the boots, insert these when fitting boots.

Care and Use

Lacing boots military style permits rapid removal. In an emergency, the surface lace points can be cut, quickly releasing the boot. In winter, feet can be kept warm by wearing a pair of light socks covered by a pair of wool socks. Feet should be checked periodically for frostbite. Use high-cut (260 mm or 9 in) or medium-cut (150 mm or
6 in) CSA Grade 1 work boots. The higher cut helps support the ankle and provides protection from cuts or punctures to the ankle.

Greek Omega Label

Figure 21



Properly laced safety boots with CSA labels

HAND/SKIN PROTECTION

In operation and maintenance exposed hands and skin are susceptible to physical, chemical, and radiation hazards. Personal hand/skin protection is often the only practical means of preventing injury from

· physical hazards—sharp or jagged edges on materials and tools; heat; vibration
· corrosive or toxic chemicals
· ultraviolet radiation.

Physical Hazards

For physical hazards such as sharp edges, splinters, and heat, leather gloves are the preferred protection. Cotton or other materials do not stand up well and are recommended only for light-duty jobs. Vibration transferred from tools and equipment can affect hands and arms. One result may be hand/arm vibration syndrome (HAVS). This disease causes the following changes in fingers and hands:

· circulation problems such as whitening or bluish discoloration, especially after exposure to cold
· sensory problems such as numbness and tingling
· musculoskeletal problems such as difficulty with fine motor movements—for instance, picking up small objects. Workers who use vibrating tools such as jackhammers, grinders, riveters, and compactors on a daily basis may develop HAVS. Preventing this disease requires cooperation between employers and workers.

Employers

· Provide power tools with built-in vibration-reducing components.
· Review exposure times and allow rest breaks away from vibrating tools.
· Ensure proper tool maintenance (worn grinding wheels or tool bearings can lead to higher vibration levels).
· Train exposed workers in prevention techniques.
· Provide anti-vibration gloves.

Workers

· Wear appropriate clothing in cooler weather to maintain core body temperature.
· Wear gloves whenever possible.
· Wear anti-vibration gloves when using power tools and equipment.
· Avoid smoking (smoking contributes to circulatory problems).
· Report any poorly functioning tools immediately.

Chemical Hazards

For protection against chemical hazards, the material safety data sheet (MSDS) for the product being used should identify whether gloves are needed and what they should be made of. MSDSs must be available on site for all controlled products being used.

Table 8: Glove Selection Chart

Chemical Name	Glove Selection
Acetone	Butyl Rubber
Cellosolve	PVA, PVC, Neoprene
Cellosolve Acetate	PVA, PVC
Cyclohexane	NBR, Viton®
Hexane	Neoprene, NBR, PVA
Methyl Alcohol	Neoprene, Rubber, NBR
Methyl Chloroform	PVA, Viton
Methylene Chloride	PVA, Viton
Methyl Ethyl Ketone	Butyl Rubber
Methyl Isobutyl Ketone	Butyl Rubber, PVA
Mineral Spirits	Neoprene
Naphtha	NBR, PVA
Perchloroethylene	NBR, PVA, Viton
Stoddard Solvent	PVA, NBR, Rubber
Toluene	PVA, Viton
Turpentine	PVA, NBR
Trichloroethylene	PVA, Viton
1, 1, 1 Trichloroethane	PVA, Viton
1, 1, 2 Trichloroethane	PVA, Viton
Xylene	PVA, Viton

PVA – Polyvinyl Alcohol
PVC – Polyvinyl Chloride
NBR – Nitrite Butyl Rubber
Viton® – Dupont tradename product

Table 8 identifies glove materials to be worn for protection against chemicals that may injure the skin. This information can be used when the MSDS does not specify the type of glove to be worn.
CAUTION: Common glove materials have limited protective properties and do not protect against all hazards. Some solvents, degreasers, and other liquids can penetrate and/or dissolve rubber, neoprene, or PVC.

Ultraviolet Radiation

In recent years there has been growing concern over the health risks of exposure to the sun's ultraviolet (UV) radiation. Operations and maintenance workers are particularly at risk because they often work outdoors. Long-term health risks of UV exposure include skin cancer. Every year there has been an alarming increase in the incidence of skin cancer. Sunlight is the main source of UV radiation known to damage the skin and cause skin cancer. Exposure to the sun's UV radiation is widely recognized as a *highly preventable* cause of skin cancer. Melanoma is the least common but most dangerous type of skin cancer. The incidence of melanoma in men is rising faster than all other cancers. According to the Canadian Dermatology Association (CDA), the mortality rate from malignant melanoma is increasing, particularly in middle-aged males. Melanomas most often appear on the upper back, head, and neck. The CDA also notes that there is generally a lag time of 10 to 30 years for the clinical appearance of skin cancer to occur. Consequently, it is critical for young workers to beware of the cumulative effect of unprotected sun exposure. The more time they spend unprotected in the sun, the higher the risk of developing skin cancer. Although most operations and maintenance workers generally cover up their arms, legs, and torso on site, their faces and necks are still exposed to the sun's harmful rays. In addition, areas like the tips of the ears and the lips are often overlooked when it comes to sun protection. The type of skin cancer that develops on the ear or the lip has a high chance of spreading to other parts of the body and causing death. Melanoma may also occur on the sun exposed parts of the head and neck. In fact the majority of skin cancers (2 out of 3) occur on the head and neck, followed by the forearm and back of the hand. Workers too often leave these critical areas exposed to the harmful effects of UV radiation. Individual risk factors for developing skin cancer include

- fair skin that burns easily
- blistering sunburns in childhood and adolescence
- family history of melanoma
- many freckles and moles.

In addition to the harmful effects of the sun's direct rays, some workers may be exposed to indirect UV radiation. Workers can receive additional radiation if they are on or near a surface that reflects sunlight. Reflective surfaces such as concrete, water, unpainted corrugated steel, building glass, and aluminum can increase the amount of ultraviolet radiation to which a worker is exposed. Another source of indirect UV radiation is from the hard hat itself. UV rays can reflect off the hard hat onto a worker's face, magnifying the amount of UV exposure. Although all operations and maintenance workers are at risk, those who don't have ready access to shade and/or work at heights are at a higher risk for UV overexposure. These trades include

- concrete finishing workers
- roofers
- rod workers
- formworkers on high-rise and residential sites
- road workers
- traffic signallers
- ironworkers.

In addition, working at sites with southern exposure decreases the daytime shade available and increases UV exposure. Remember—even on cloudy or hazy days, UV radiation can penetrate the atmosphere and burn your skin.

What Workers Can Do

- Apply a broad-spectrum sunscreen with a sun protection factor (SPF) of 15 or greater to all exposed skin areas. Be sure to cover your ears and the back of your neck. Apply sunscreen 20 to 30 minutes before you go out in the sun. Reapply sunscreen every 2 hours.
- Use an SPF 15 or higher sunscreen lip balm and reapply every two hours. Skin cancers can develop on lips.
- You may add UV protection to the back of your neck by using fabric to block the sun's rays. Neck protectors that clip onto your hardhat are available.
- Wear UV-absorbent safety glasses (CSA-approved polycarbonate glasses incorporate this feature).
- Wear clothing that covers as much of the skin as possible. Tightly woven material will offer greater protection as a physical block to UV rays.
- If you sweat heavily, you may need to reapply sunscreen more often. Additionally, when clothing is wet, it loses some of its ability to block out the sun's rays. Ensure you have additional dry clothing if necessary.
- Try to find a shaded area for your breaks and lunch.
- Wear a wide-brim hard hat designed to protect your face and neck from the sun. Adding a glare guard under the peak of your hard hat will help reduce reflective UV rays.
- Examine your skin regularly for any unusual changes. The most important warning sign for skin cancer is a spot on the skin that is changing in size, shape, or colour. The danger signs include any wound or skin patch that doesn't heal properly or scales. Be particularly attentive to any mole that grows or becomes irregular in shape, especially if it is multicoloured. If anything looks unusual, see your doctor as soon as possible. **Skin cancers detected early can almost always be cured.**

What Employers Can Do

- Supply workers with a broad-spectrum sunscreen with an SPF of 15 or higher.
- Ensure adequate shaded areas for workers on breaks and lunch.
- If possible, rotate workers to shaded areas of the jobsite.
- Educate workers on the hazards of UV radiation.
- Ensure that workers use UV-absorbent safety glasses.

The majority of skin cancers are preventable. Taking basic precautions can significantly reduce the health effects of chronic sun exposure.

HEAD PROTECTION

Standards

Requirements for head protection are specified in the current edition of the operations and maintenance regulation (O. Reg. 213/91). Under this regulation, hard hats are mandatory for all operations and maintenance workers on the job in Ontario. The hard hat must protect the wearer's head against impact and against small flying or falling objects, and must be able to withstand an electrical contact equal to 20,000 volts phase to ground. At the present time, the Ministry of Labour (MOL) considers the following classes of hard hats to be in compliance with the regulation.

Class B
– manufactured and tested in accordance with CSA Standard Z94.1-1977

Class B
– manufactured and tested in accordance with ANSI Z89.1-1986

Type I, Class E
– manufactured and tested in accordance with ANSI Z89.1-1997.

Class E
– manufactured and tested in accordance with CSA Standard Z94.1-1992

Type II, Class E

- manufactured and tested in accordance with ANSI Z89.1-1997.

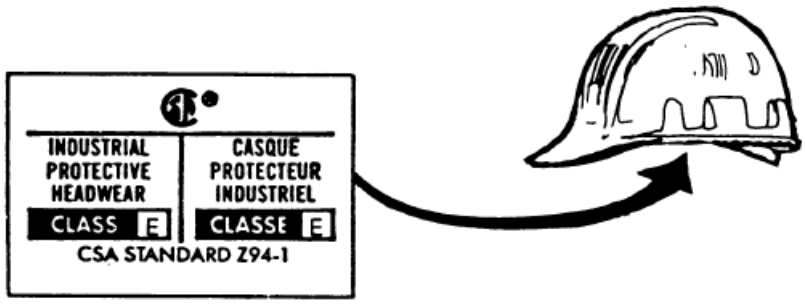
"Type" and "Class" of hard hat can be identified by the CSA or ANSI label. Some manufacturers also stamp the CSA or ANSI classification into the shell of the hard hat under the brim.

Styles

New Class E hard hats come in three basic styles:

1) standard design with front brim, rain gutter, and attachment points for accessories such as hearing protection
2) standard design with front brim and attachment points for accessories but without a rain gutter
3) full-brim design with attachment points for accessories and brim that extends completely around the hat for greater protection from the sun.

Figure 20



CSA label, stamped into the shell, indicating Class E hard hat

ND / SKIN PROTECTION

Eye protection

Introduction

Eye protection is not the total answer to preventing eye injuries. Education regarding proper tools, work procedures, hazard awareness, and the limitations of eye protection is also very important. Like any other manufactured product, eye protection has material, engineering, and design limitations. But proper eye protection, selected to match the specific operations and maintenance hazard, combined with safe work procedures, can help to minimize the number and severity of eye injuries. When we consider that one out of every two operations and maintenance workers may suffer a serious eye injury during their career, the importance of wearing proper eye protection cannot be over-emphasized. In the hazardous environment of the operations and maintenance industry, wearing proper eye protection should be considered a labourmanagement policy, not a matter of individual preference.

Classes of Eye Protectors

Before outlining the type(s) of eye protectors recommended for a particular work hazard, it is necessary to explain the various types of eye protectors available. Eye protectors are designed to provide protection against three types of hazards — impact, splash, and radiation (visible and invisible light rays) — and, for purposes of this manual, are grouped into seven classifications based on the CSA Standard Z94.3-07, *Industrial Eye and Face Protectors.*The seven basic classes of eye protectors are: spectacles, goggles, welding helmets, welding hand shields, hoods, face shields, and respirator facepieces.

Class 1 – Spectacles (Figure 3)

CSA Standard Z94.3-07 requires that Class 1 spectacles incorporate side protection. Most side shields are permanently attached to the eyewear, but some may be detachable.

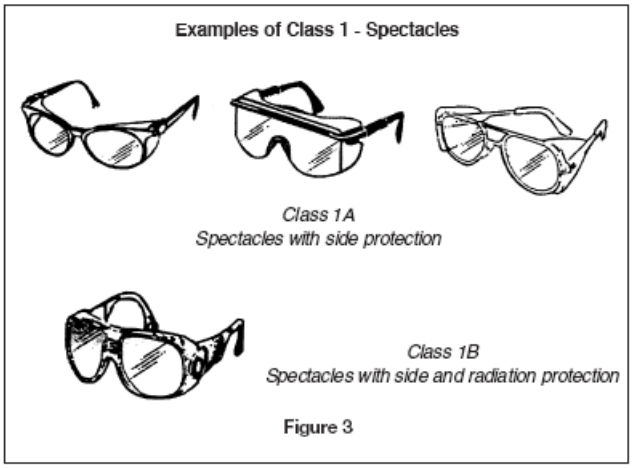


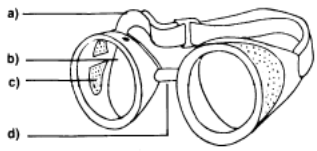
Figure 3

Class 2 – Goggles

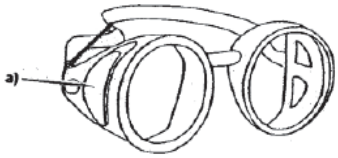
There are two types of goggles — eyecup and cover. Both must meet the CSA Z94.3-07 Standard.

Eyecup goggles (Figure 4) completely cover the eye socket to give all-round protection. They have adjustable or elasticized headbands and are equipped with ventilation ports to allow passage of air and prevent fogging. Some have direct ventilation ports which prevent the direct passage of large particles, but do not exclude dust or liquids. Others have indirect ventilation ports which prevent the passage of particles, dust, and liquids. There are also models available with an adjustable chain bridge.

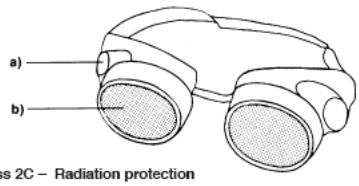
Figure 4 – Eyecup Goggles



Class 2A – Direct ventilated goggles for impact protection
Eyecup goggles with direct ventilation openings or ports. These openings exclude direct passage of large particles. They do not exclude dust and splash. a) headband; b) lens; c) direct ventilation port; d) bridge.



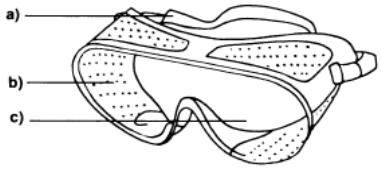
Class 2B – Non-ventilated and indirect ventilated goggles for impact, dust, and splash protection
Eyecup goggles with indirect ventilation ports to exclude direct passage of dust or liquids. These goggles are identical to class 2A except for the type of ventilation ports. a) indirect ventilation port



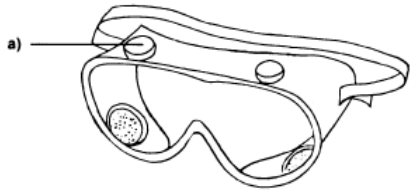
Class 2C – Radiation protection
Eyecup goggles for radiation protection with indirect ventilation ports not only to allow passage of air and prevent fogging, but also to exclude light. The lenses in these goggles are filter lenses. a) indirect ventilation port; b) filter lens.

Cover goggles (Figure 5, below) are designed to be worn over spectacles. They have adjustable or elasticized headbands and are equipped with direct or indirect ventilation ports to allow passage of air and prevent fogging.

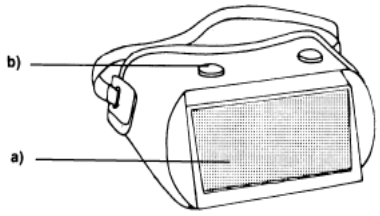
Figure 5 – Cover Goggles



Class 2A – Direct ventilated goggles for impact protection
Cover goggles with direct ventilation ports. (This type normally incorporates a soft-frame goggle.) As in class 2A eyecup goggles, these openings or ports exclude direct passage of large particles. They do not exclude dust and splash. a) headband; b) direct ventilation port; c) lens.



Class 2B – Non-ventilated and indirect ventilated goggles for impact, dust, and splash protection
Cover goggles for dust and splash with indirect ventilation ports to exclude direct passage of dust or liquid. a) indirect ventilation port.



Class 2C – Radiation Protection
Cover goggles for radiation protection. a) filter lens; b) indirect ventilation port.

YE PROTECTION

Class 3 – Welding Helmets (Figure 6)

This class provides radiation and impact protection for face and eyes. There are two types of welding helmets available — the stationary plate helmet and the lift-front or flip-up plate helmet. There are also special models incorporating earmuff sound arrestors and air purification systems. Special magnifying lens plates manufactured to fixed powers are available for workers requiring corrective lenses.

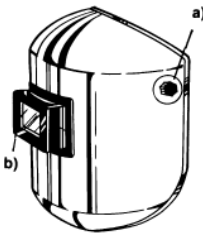


Figure 6 – Welding Helmets

Lift-front helmets or shields have three plates or lenses – a filter or shaded plate made of glass or plastic in the flip-up cover, along with a clear thin glass or plastic outer lens to keep it clean, and a clear, impact-resistant plastic or glass lens mounted in the helmet itself. a) hard hat attachment; b) flip-up lens holder.

Stationary plate helmets are similar to lift-front helmets except for the fact that they have a single filter lens plate, normally 51mm x 108mm (2" x 4-1/4") in size, or a larger plate 114mm x 113mm (4-1/2" x 5-1/4") in size which is more suitable for spectacle wearers.

The filter or shaded plate is the radiation barrier. Arc welding produces both visible light intensity and invisible ultraviolet and infra-red radiation. These ultraviolet rays are the same type of invisible rays that cause skin burning and eye damage from overexposure to the sun. However, ultraviolet rays from arc welding are considerably more severe because of the closeness of the eyes to the arc and lack of atmospheric protection. In arc welding, therefore, it is necessary to use a filter plate of the proper lens shade number to act as a barrier to these dangerous light rays and to reduce them to the required safe degree of intensity. For proper welding shade numbers, see Table 2.

In addition to common green filters, many special filters are also available. Some improve visibility by reducing yellow or red flare; others make the colour judgment of temperature easier. A special gold coating on the filter lens provides additional protection by reflecting radiation.

Class 4 – Welding Hand Shields (Figure 7)

Welding hand shields are designed to give radiation and impact protection for the face and eyes.

NOTE: With welding helmets and hand shields, the user is continually lifting and lowering the visor. To protect the eyes when the visor is lifted, Class 1 spectacles should be worn underneath.

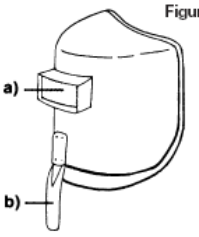


Figure 7 – Hand Shields

Hand-held shields or inspectors' shields are similar to Class 3 welding helmets except that there are no lift-front type models. a) stationary plate; b) handle.

Class 5 – Hoods (Figure 8)

Non-rigid helmets or hoods come with impact-resistant windows usually made of plastic. An air-supply system may also be incorporated. Hoods may be made of nonrigid material for use in confined spaces and of collapsible operations and maintenance for convenience in carrying and storing.

Hood types include:

5A with impact-resistant window
5B for dust, splash, and abrasive materials protection
5C with radiation protection
5D for high-heat applications.

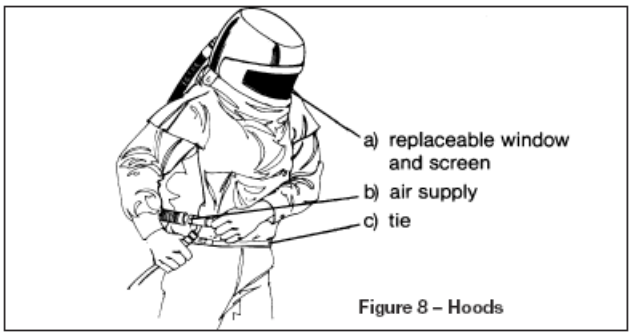


Figure 8 – Hoods

EYE PROTECTION

Class 6 – Face Shields (Figure 9)

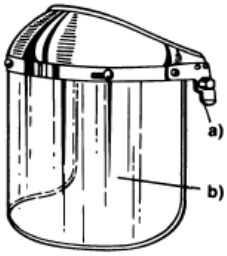
Face shields are just what the name implies—a device that includes a transparent window or visor to shield the face and eyes from impact, splash, heat, or glare. With face shields, as with welding helmets and hand shields, the user is continually lifting and lowering the visor. To protect the eyes when the visor is lifted, Class 1 spectacles should be worn underneath. Face shields may also be equipped with an adjustable spark deflector or brow guard that fits on the worker's hard hat. Shaded windows are also available to provide various degrees of glare reduction; however, they do not meet the requirements of CSA Standard Z94.3-07 *Industrial Eye and Face Protectors* for ultraviolet and total heat protection and should not be used in situations where any hazard is present from ultraviolet or infra-red radiation.

Class 6

This class includes

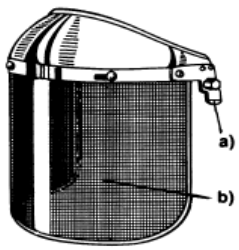
6A for impact and splash protection
6B for radiation protection
6C for high-heat applications.

Figure 9 – Face Shields



Class 6A
Face shield for impact, piercing, splash, head, and glare protection.
a) hard hat attachment; b) face shield (window).

Class 6B
Face shield for light non-piercing impact, splash, low heat, and glare protection. The major difference between 6A and 6B is the degree of thickness in the shield.



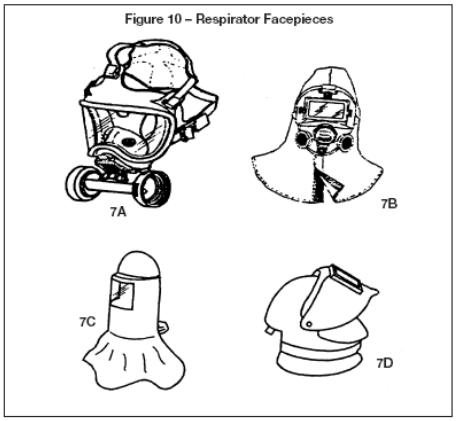
Class 6C
Face shield for light non-piercing impact and high heat protection only (usually wire screen windows). a) hard hat attachment; b) wire screen.

Class 7 – Respirator Facepieces (Figure 10)

This class includes

7A for impact and splash protection
7B for radiation protection
7C with loose-fitting hoods or helmets
7D with loose-fitting hoods or helmets for radiation protection.

Figure 10 – Respirator Facepieces



Hazards and Recommended Protectors

Reprinted from CSA Standard Z94.3-07 *Industrial Eye and Face Protectors*, Table 1 classifies the main eye hazards and outlines the types of protectors recommended for each. Each situation requires that all hazards be considered in selecting the appropriate protector or combination of protectors.

The practice of requiring all personnel to wear spectacles is strongly recommended. Spectacles should be worn underneath Classes 3, 4, 5, 6, or 7 protectors, where the hazard necessitates the use of spectacles.

The following classifications provide a general overview of eye protectors for each hazard group. For specific hazards, refer to Table 1. Note that the best eye protection results from a combination of different classes of eye protectors.

Group A: Flying Objects (Figure 11)

Minimum eye protection recommended:
Class 1 spectacles

Optimum eye protection recommended:
Goggles worn with face shields to provide eye and face protection.

Group B: Flying Particles, Dust, Wind, etc. (Figure 12)

Minimum eye protection recommended:
Class 1 spectacles

Optimum eye protection recommended:
Goggles (for dust and splash) worn with face shields to provide eye and face protection.

Group C: Heat, Glare, Sparks, and Splash from Molten Metal (Figure 13)

Minimum eye protection recommended:
Class 1 spectacles with filter lenses for radiation protection. Side shields must have filtering capability equal to or greater than the front lenses.

Optimum eye protection recommended:
Eyecup or cover goggles with filter lenses for radiation protection, worn with face shields to provide eye and face protection.

Table 1

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	Face shields Class 6			Non-rigid hoods Class 5			
			A	B	A	B	C			A	B	C	A	B	C	D
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				■				■				■		
E	Abrasive blasting materials	Sand blasting; shot blasting; shotcreting				■				■				■		
F	Glare, stray light (where 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: ***Shaded areas are recommendations for protectors.*** *Class 1 and Class 2 protectors shall be used in conjunction with recommendations for Class 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 in 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 flames or high-energy arcs.* Courtesy Canadian Standards Association

Table 2

Recommended Shade Numbers for Arc Welding and Cutting

Operation	Current in amperes (0.5 2.5 10 20 40 80 125 175 225 275 350 450 / 1.0 5.0 15 30 60 100 150 200 250 300 400 500)
SMAW (covered electrodes)	7 | 8 | 10 | 11
GMAW (MIG)	7 | 10 | 10 | 10
GTAW (TIG)	8 | 8 | 10
Air carbon arc cutting	10
Plasma arc cutting	8 | 9 | 10
Plasma arc welding	6 | 8 | 10 | 11

EYE PROTECTION

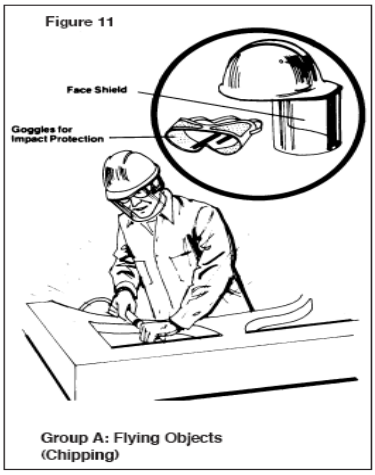
Notes:

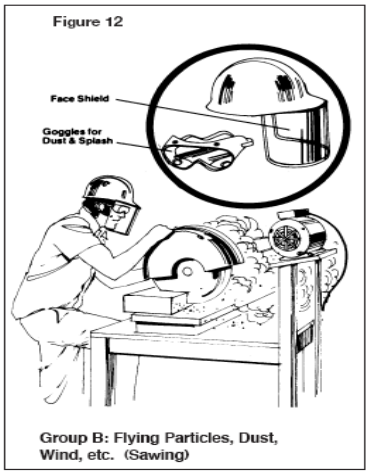
(1) For other welding processes (e.g., laser, electron beam welding), consult the manufacturer for eye protection recommendations.

(2) For pulsed GMAW (MIG), use peak current for selecting the appropriate shade number.

(3) For underwater welding, the minimum shade number shown may not necessarily apply.

Courtesy Canadian Standards Association



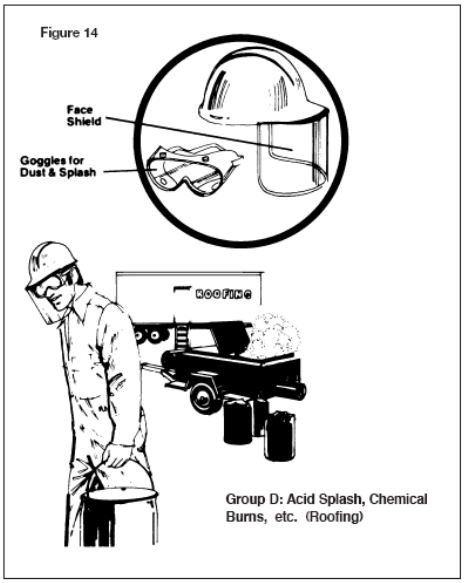


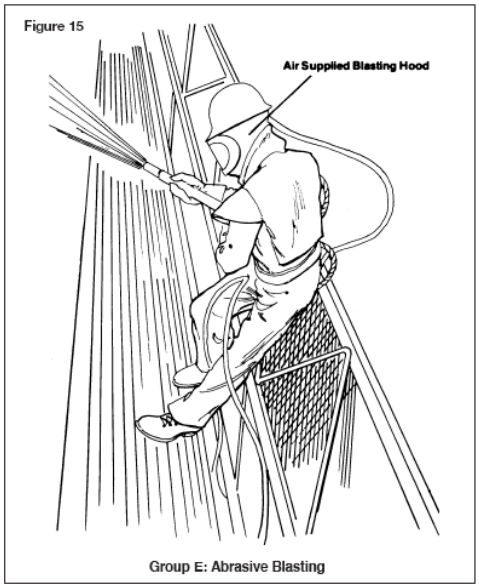
Group D: Acid Splash, Chemical Burns, etc. (Figure14)

Only eye protection recommended:

Eyecup or cover goggles (for dust and splash) worn with face shields to provide eye and face protection.

Hoods may also be required for certain hazardous activities such as chemical spraying.





Group E: Abrasive Blasting Materials (Figure 15)

Minimum eye protection recommended:
Eyecup or cover goggles for dust and splash.

Optimum eye protection recommended:
Hoods with an air line.

Group F: Glare, Stray Light (Figure 16)

These are situations where only slight reduction of visible light is required, e.g., against reflected welding flash. Stray light would result from passing by a welding operation and receiving a flash from the side without looking directly at the operation.

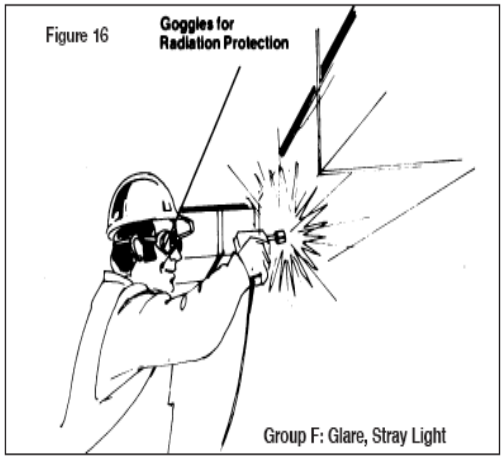
Minimum eye protection recommended:
Filter lenses for radiation protection. Side shields must have filtering capability equal to or greater than the front lenses.

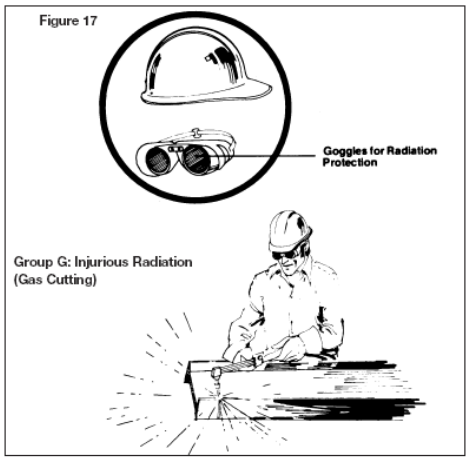
Optimum eye protection recommended:
Goggles with filter lenses for radiation protection.
See Table 2 for recommended shade numbers.

Group G: Injurious Radiation (Figure 17)

These are situations where only moderate reduction of visible light is required: for example, gas welding. Injurious radiation would result from looking directly at the welding operation.

Only eye protection recommended:
Goggles with filter lenses for radiation protection.



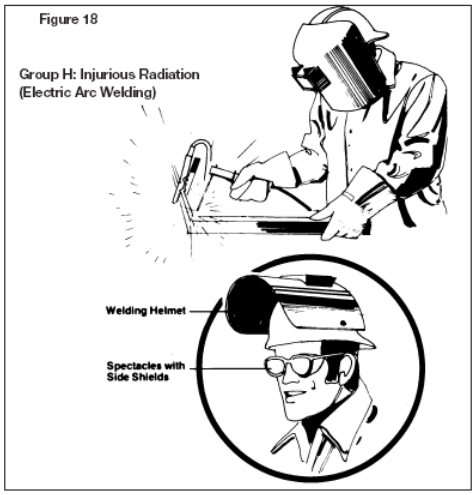


EYE PROTECTION

Note: The intensity of the flame and arc is lower in Group G than in Group H. For this reason, required filter shade numbers for this group are also lower. See Table 2.

Group H: Injurious Radiation (Figure 18)

These are situations where a large reduction in visible light is essential, e.g., in electric arc welding.
Only eye protection recommended:
Class 1 spectacles worn with full welding helmets or welding hand shields. These spectacles should incorporate suitable filter lenses if additional protection is required when the welding helmet is in the raised position: for example, when working near other welding operations. See Table 2.



Injuries Associated with Operations and maintenance Hazards

The cornea is the front layer of the eye and the first point at which light enters the eye; if light rays cannot pass through the cornea, vision is prevented. Injuries to the cornea that cause scarring, scratching, or inflammation can impair sight.

1. **Flying Objects**
   A piece of metal can pierce the cornea and eyeball and possibly cause the loss of an eye.
2. **Dust**
   Dust, sawdust, etc. can cause irritation resulting in a corneal ulcer which is a breakdown of corneal tissue causing a red, watery, or pussy eye.
3. **Heat**
   Heat can burn and severely damage the cornea.
4. **Acid Splash**
   Acid splash and chemicals can burn the cornea, conjunctiva (white coat on the eye), and eyelid and possibly cause loss of sight.
5. **Abrasive**
   Sand can cause a corneal abrasion which can result in loss of sight.

6. **Glare**
   Glare can make it difficult to see and can cause extreme fatigue to the eye.

7. **Radiation**
   Ultraviolet light from a welding arc can damage the cornea.

Correct eye protection, when matched to the hazard, can prevent or reduce the degree of any eye injury. However, once an eye injury has occurred, it is critical that the injury, no matter how small, be given immediate attention and first aid. Eye protection can only protect against injury if it is worn continuously on-site. It is often the time when a worker removes eye protection while working near or passing by other hazardous activities on the job that an eye injury results. When it is necessary to remove eye protection, do so only in a location that is completely away from hazardous work areas.

The inconvenience of wearing eye protection is far outweighed by the risk of being blinded in one or both eyes.

Purchase of Protective Spectacles
Protective spectacles are available with "plano" or nonprescription lenses and with prescription lenses.

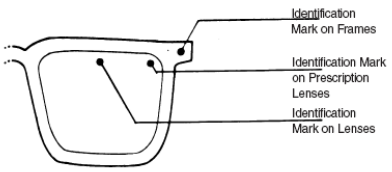
The polycarbonate materials used in safety glasses provide the best protection, while regular plastic CR-39 lenses in industrial thickness provide a substitute where poly carbonate is not available. Anti-scratch coatings are applied to the lens surface to extend useful lens life.

Glass lenses, even when thermally or chemically hardened, are not acceptable for the workplace. Current glass lenses do not meet the impact requirements of CSA Standard Z94.3-07.

When purchasing safety glasses, specify **industrial protection** lenses and frames. This term indicates that the eye protection meets specific test requirements.

Industrial protection safety glasses can be identified by the manufacturer's or supplier's logo or monogram which is located on the lens and frame (Figure 19).

Figure 19 – Where to Locate Identification Marks or Symbols



On non-prescription eye protectors, look also for the CSA logo.

This mark must appear on both the frame **and** the lens. It distinguishes industrial quality lenses and frames from streetwear lenses and frames.

EYE PROTECTION

The Canadian Standards Association (CSA) certification program for non-prescription (plano) industrial eye and face protection covers complete protectors only. It does not cover separate components such as lenses, frames, or shields.

In addition to the manufacturer's logo or I.D. mark which appears on the eye protector, the CSA logo will appear to indicate the eye protection meets the requirements of the CSA Z94.3-07 standard. Certification of industrial prescription safety glasses is not yet available.

Until such a program is available, the user should look for the manufacturer's or supplier's logo or I.D. mark on the frame and lens which indicates adherence to the American National Standards Institute (ANSI) Standard Z87.1-1989.

Fitting

Improper fit is the most common reason for resistance to wearing eye protection. A worker who wears nonprescription (plano) lenses and continues to complain about blurred vision after the fit has been checked by a competent person may require prescription lenses. Prescription lenses must be fitted by an optician or optometrist. Plano eye protection should be fitted individually by a trained person.

Here are some general guidelines to follow when fitting the various classes of eye protectors.

Class 1 – **Spectacles** require that the proper eye size, bridge size, and temple length be measured for each individual. The wearer should be able to lower his head without the spectacles slipping.

Class 2 – **Goggles** with adjustable headbands should fit snugly over the wearer's spectacles when worn.

Class 3 – **Welding helmets** are equipped with adjustable attachments to provide a comfortable fit over the head and face. Attachments are also available to fit on hard hats.

Class 4 – **Hand-held shields** require no adjustment.

Class 5 – **Hoods** Adjustments are located on the top inside of the hood. A tie is located around the neck to secure the hood and to prevent the entry of dust.

Class 6 – **Face shields** are equipped with adjustable attachments to provide a comfortable fit over the head and face. Attachments are also available to fit on hard hats.

Class 7 – **Respirator facepieces** should fit snugly without gaps to make an effective seal against airborne contaminants.

Care

Eye protectors in operations and maintenance are subjected to many damage-causing hazards. Therefore, care is very important.

1. Lenses should be inspected regularly for pitting and scratches that can impair visibility.
2. Scratched or pitted lenses and loose frames or temples should be replaced or repaired as soon as possible with components from the original manufacturer.
3. Lenses should be cleaned with clear water to remove abrasive dust—cleaning dry lenses can scratch the surface.
4. Anti-fog solutions can be used on glass or plastic lenses.
5. Frames should be handled with care and checked daily for cracks and scratches.
6. Eye protectors should never be thrown into tool boxes where they can become scratched or damaged.
7. Cases should be provided and used to protect spectacle lenses when not being worn.

Contact Lenses

In the operations and maintenance industry, contact lenses are not a substitute for protective eyewear. Dust and dirt can get behind the contact lenses causing sudden discomfort and impairment of vision.
Contact lenses are also difficult to keep clean when they have to be removed or inserted since there are seldom suitable washing-up facilities on a jobsite.
It is recommended that contact lenses not be worn on operations and maintenance sites.
However, in cases where contact lenses must be worn to correct certain eye defects, workers should obtain from their ophthalmologist or optometrist written permission indicating the necessity of wearing contact lenses in order to function safely at work. In these cases eye protection, preferably cover goggles, must be worn with the contact lenses.