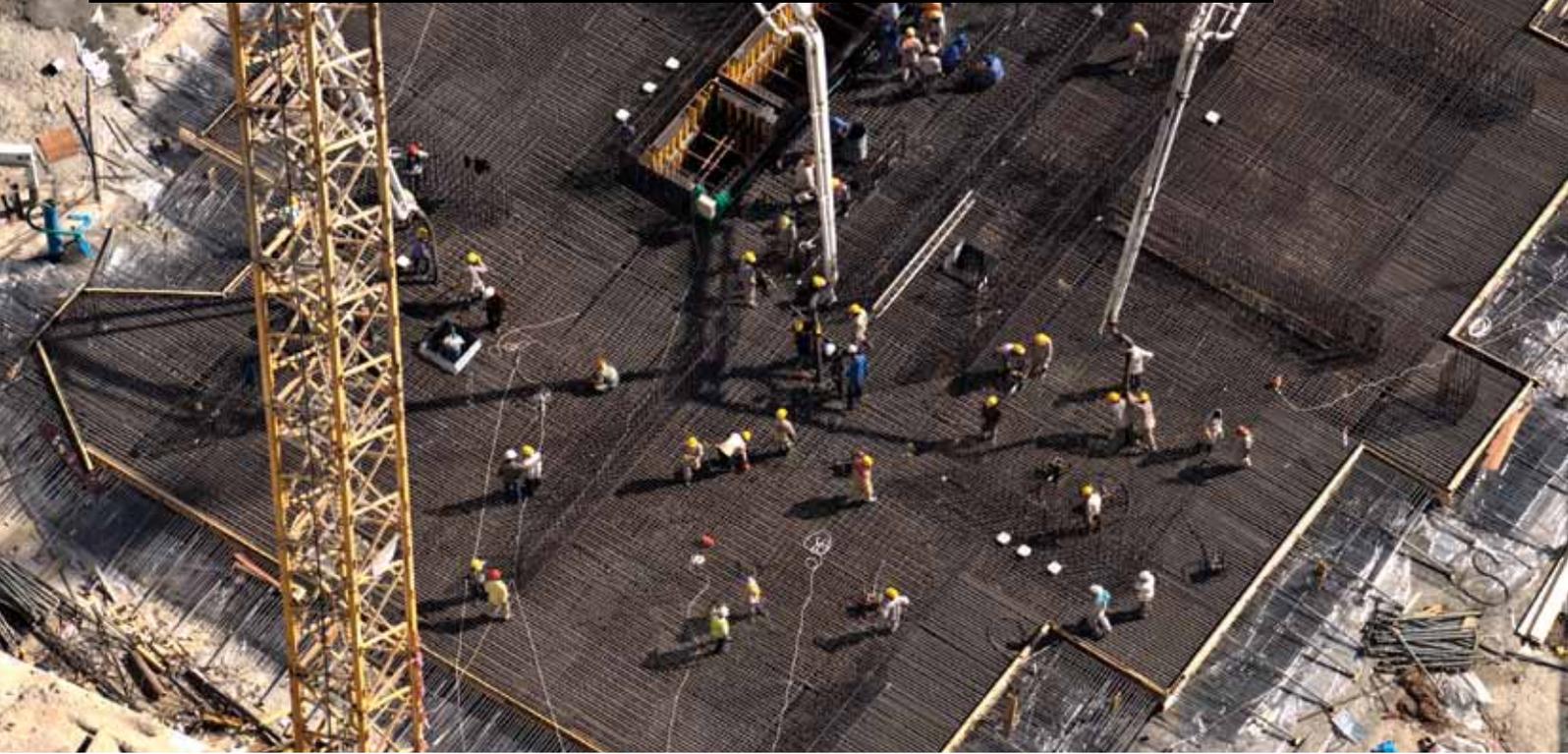


# FACING UP TO SAFETY

LOOKING AT PPE OPTIONS FOR ABOVE THE NECK PROTECTION



**H**istorical occupational eye and face and head injury statistics necessitate the need for proper protection of employees where work hazards may exist. Controlling a hazard at its source is the best way to protect workers. When engineering, however, work practise and administrative controls are not feasible or do not provide sufficient protection, employers must provide the appropriate personal protective equipment (PPE) to employees.

## A rationale for PPE

PPE is equipment worn by workers in order to minimise exposure to a variety of hazards. Examples of PPE above the neck include eye and face protection (face shields, spectacles, welding helmets, goggles), protective hearing protection (earplugs, muffs), hard hats and respirators.

Work related eye injuries that require medical treatment are one of the most frequent injuries in the workplace. Many injuries are treated in hospital emergency departments and result in one or more days of lost work.

Employers should conduct a hazard assessment of the entire workplace to determine if hazards are present, or likely to be present. Where such hazards are present, employers must communicate PPE selection decisions to each affected employee. The hazard assessment assures that potential workplace hazards necessitating PPE use have been identified and that the PPE selected is appropriate for those hazards. Additionally, all PPE should be of safe design and construction for the work to be performed.

As an example, protective hardhats should be worn in any work environment that presents a significant risk of head injury. There are various types of hard hats that are designed to protect workers from head injuries caused by the impact or penetration of

falling objects. They may also minimise the potential danger from high voltage shock or burns. Hard hats utilise a unique suspension system that dissipates the energy from an impact to minimise the direct force of an object against the skull.

## Head protection requirements

The US Occupational Safety and Health Administration (OSHA) publishes regulations for the workplace under the Code of Federal Regulations (CFR), 29 CFR 1910 *Occupational Safety and Health Standards, Subpart I, Personal Protective Equipment*. Head protection is specifically covered in section 1910.135.

Employers should ensure that each affected employee wears a protective helmet when working in areas where there is potential for injury to the head from falling objects. The employer should ensure that a protective helmet designed to reduce electrical shock

hazard is worn by employees near exposed electrical conductors which could contact the head.

Occupations for which head protection should be considered include carpenters, electricians, linemen, mechanics and repairers, plumbers and pipe fitters, assemblers, packers, wrappers, sawyers, welders, labourers, freight handlers, timber cutting and logging, stock handlers, and warehouse labourers.

OSHA regulations refer to the American National Standards Institute (ANSI) for their standard of performance criteria for industrial head protection. The most current published standard is ANSI/ISEA Z89.1-2009, 'American National Standard for Industrial Head Protection'.

## Head protection performance

The ANSI/ISEA standard differentiates protective headwear into specific types and classes. It groups helmets into two categories, Type 1 and Type 2 (based on location of impact force). Type 1 refers to hard hats that only provide protection from hits on top of the head and Type 2 describes hard hats that protect from blows to the top as well as the side of the head.

Three classes of electrical performance are specified by the ANSI/ISEA Z89.1 standard:

Class E (electrical) helmets are intended to decrease the impact of falling objects, but these helmets also lessen the risk of high voltage electrical conductors. They are tested at 20,000 volts of electrical charge. Class G (general) helmets are designed to decrease the impact of falling objects and to lessen the risk if exposed to low voltage electrical conductors. Helmets are tested at 2,200 volts of electrical charge. The voltages stated in classes E and G are not indications of the voltage at which the helmets protect the wearer. Class C (conductive) helmets also reduce the force of impact of falling objects, but do not protect against electrical contact.

The ANSI/ISEA Z89.1 standard also includes performance criteria for resistance to impact and penetration from hits on the top of the head, water absorption and flame resistance. Additional performance requirements

“hard hat manufacturers recommend replacing hard hats every five years. Replacement should be sooner if workers are exposed to extreme high temperatures, chemicals or sunlight”

for Type 2 helmets include resistance to side impacts. Detailed user instructions are required, and the following information should be stated inside the hardhat:

- *The manufacturer's name*
- *The standard, 'ANSI Z89.1-2009'*
- *The type designation*
- *The class designation (E, G or C)*
- *The approximate head size range*

Optional criteria may be stated on the label for hardhats that have passed performance tests for low temperature, reverse wearing and high visibility.

### High visibility

Helmets marked with a 'HV' indicate that the hard hat meets all testing requirements of the standard for high visibility colours. This includes tests for chromaticity and luminescence for fluorescent yellow-green, fluorescent orange-red and fluorescent red.

### Reverse wearing

Reverse wearing test requirements are provided for the types and classes. The ANSI/ISEA standard contains reverse wearing test criteria for the proper way to mount the helmet to a head form in reverse with the peak backward to ensure that all the other applicable performance criteria are met when the suspension is reversed per the manufacturer's instructions. Helmets marked with a 'reverse donning arrow' can be worn frontward or backward in accordance with the manufacturer's wearing instructions. They pass all testing requirements, whether worn frontward or backward.

### Lower temperature

A hard hat may be labelled as Lower Temperature (LT) if it meets all testing requirements of the standard when

preconditioned at a temperature of -30° C (-22° F), instead of the normal cold preconditioning which is conducted at -18° C (0° F).

OSHA does not specify the service life of a hard hat, and there is no standard expiration time. Hard hat life span may vary depending on the conditions of each work site. As a general guideline, most hard hat manufacturers recommend replacing hard hats every five years regardless of outside appearance.

If work is conducted under extreme conditions such as exposure to high temperatures, chemicals or sunlight, hard hats should be replaced sooner. In addition, some manufactures even recommend replacing the suspension in your hard hat every 12 months. It's important to review each work site to ensure that degradation of employees' hard hats is not being accelerated due to work conditions.

### Eye and face injuries

Most eye and face injuries result from small particles or objects striking or abrading the eye. Examples include metal slivers, wood chips, dust, and cement chips that are ejected by tools, windblown, or fall from above a worker.

Some of these objects, such as nails, staples, or slivers of wood or metal may penetrate the eyeball and result in a permanent loss of vision. Large objects may also strike the eye/face, or a worker may run into an object causing blunt force trauma to the eyeball or eye socket. Chemical burns to one or both eyes from splashes of industrial chemicals or cleaning products are common. Thermal burns to the eye occur as well. Among welders, their assistants, and nearby workers, UV radiation burns (welder's flash) routinely damages workers' eyes and surrounding tissue. ▶

Healthcare workers, laboratory staff, janitorial workers, animal handlers, and other workers may be at risk of acquiring infectious diseases via ocular exposure. Infectious diseases can be transmitted through the mucous membranes of the eye as a result of direct exposure (e.g. blood splashes, respiratory droplets) or from touching the eyes with contaminated fingers or other objects.

Workplace engineering controls should be used to reduce eye injuries and to protect against ocular infection exposures. PPE such as goggles, face shields, spectacles, or full face respirators must also be used when an eye hazard exists. The eye protection chosen for specific work situations depends upon the nature and extent of the hazard, the circumstances of exposure, other protective equipment used, and personal vision needs.

Eye protection should fit the individual employee or be adjustable in order to provide appropriate coverage. Selection of protective eyewear appropriate for a given task should be made based on a hazard assessment of each activity and should allow for sufficient peripheral vision.

## Eye and face protection

As with head protection, the US OSHA specifies eye and face protection requirements. These are contained under 29 CFR 1910 Occupational

*Safety and Health Standards, Subpart I, Personal Protective Equipment.* Eye and Face protection is specifically covered in sections 1910.132 and 1910.133.

OSHA regulations state that PPE for the eyes and face should be designed to prevent or lessen the severity of injuries to workers. The employer must assess the workplace and determine if hazards that necessitate the use of eye and face protection are present, or are likely to be present, before assigning PPE to workers.

The employer should ensure that appropriate eye or face protection is used when workers are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapours, or potentially injurious light radiation.

An employee must use eye protection that provides side protection when there is a potential hazard from flying objects. Those employees who wear prescription lenses while engaged in operations that involve eye hazards must wear eye protection that incorporates the prescription in its design, or use eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.

For work being performed where there is potential for injury from light radiation, the employer should ensure that employees use equipment with filter lenses that have a shade number appropriate for the various operations.

“be aware of the possibility of multiple and simultaneous hazard exposures and protect against the highest level of each hazard”

OSHA requires a hazard assessment in order to determine the risk of exposure to eye and face hazards, including those which may be encountered in an emergency. Employers should be aware of the possibility of multiple and simultaneous hazard exposures and be prepared to protect against the highest level of each hazard. The chart, left, provides guidance on hazard types and common tasks requiring protection.

## Hazard assessment

OSHA regulations refer to ANSI for their standard of performance criteria for eye and face protection. The most current published standard is ANSI/SEA Z87.1-2010, 'American National Standard for Occupational and Educational Personal Eye and Face Protectors'.

## Protection performance

The comprehensive ANSI/SEA Z87.1 standard focuses on the hazard, rather than on the protector type, to encourage safety personnel and users to identify and evaluate specific hazards in their workplace such as Impact, Optical Radiation, Splash, Dust, and Fine Dust Particles. The standard also specifies product markings to allow the user to easily identify these performance attributes for a given eye and/or face protective device. Selection of the appropriate eye and face protective devices should therefore always be based on the hazard.

ANSI/SEA Z87.1 standard sets minimum performance criteria for markings and tests such as impact resistance, penetration resistance, ignition, lens thickness, prismatic deviation, haze, luminous transmittance or corrosion. All protectors should bear markings in specified locations as appropriate for their designated performance.

Hazard Assessment

Hazard type	Examples of Hazard	Common Related Tasks
Impact	Flying objects such as large chips, fragments, particles, sand, and dirt	Chipping, grinding, machining, masonry work, wood working, sawing, drilling, chiseling, powered fastening, riveting, and sanding
Heat	Anything emitting extreme heat	Furnace operations, pouring, casting, hot dipping, and welding
Chemicals	Splash, fumes, vapours, and irritating mists	Acid and chemical handling, degreasing, plating, and working with blood
Dust	Harmful dust	Woodworking, buffing, and general dusty conditions
Optical Radiation	Radiant energy, glare, and intense light	Welding, torch-cutting, brazing, soldering, and laser work

In the standard, eye protectors are either non-impact or impact rated devices. ANSI/ISEA Z87.1 requires that frames used for a general purpose protector are marked as Z87. Those frames used for an impact rated protector are marked with Z87+ (the lenses would also have a + symbol). Detachable sideshields are marked both marked with Z87+. If the sideshield is permanent, they need not be marked. Impact rated protectors must meet the established high mass and high velocity tests, and defined, continuous lateral coverage. Compliant prescription products should be marked with Z87-2+.

### Testing and marking

The following high impact tests apply to lenses, as well as to the frames or product housing:

A lens retention test is conducted via a high mass impact. A pointed 500gm (1.1 lb) projectile is dropped 50 inches onto the complete protector mounted on a headform. No pieces can break

free from the inside of the protector, the lens cannot fracture, and the lens must remain in the frame or product housing. This test is a good measure of the product's strength, simulating a blow such as from a tool that slips from the work surface or when the lens collides with stationary objects.

A high velocity test is conducted, at six specified impact points, where the projectile is a ¼ inch steel ball travelling at specific speeds depending upon the type of protector. For spectacles, the velocity is 150 ft/sec or 102 mph. The pass/fail criteria are the same as for the high mass test, plus no contact with the eye of the headform is permitted through deflection of the lens. This is meant to simulate particles that would be encountered in grinding, chipping, machining or other such operations.

ANSI/ISEA Z87.1-2010 requires a coverage area, where the frame front encircling one lens should cover in plane view an area of not less than 40mm in width and 33mm in height (elliptical) in front of each eye, centered on the geometrical center of the lens.

Frames designed for small head sizes should cover in plain view an area of not less than 34mm in width and 28mm in height (elliptical) in front of each eye, centered on the geometrical center of the lens. Frames designed for small head sizes are marked with an 'H'. If the frame cannot be marked (e.g. a rimless frame), then the lens must be marked with an 'H'.

Impact rated protectors must provide continuous lateral coverage from the vertical plane of the lenses tangential to a point not less than 10mm (0.394-inch) posterior to the corneal plane and not less than 10mm (0.394-inch) in height [or 8mm (0.315-inch) for small head sizes] above and not less than 10mm (0.394-inch) in height [or 8mm (0.315-inch) for small head sizes] below the horizontal plane.

Optional testing is available for dust and mist, as well as for optical radiation UV (ultraviolet), visible light and IR (infrared) filters. These tests are not mandatory, but if a manufacturer wants to claim this specific performance the protectors must be tested and marked accordingly.

Markings requirements for the optional testing described above are as follows. Splash and droplet protectors should be marked D3-splash and droplet, D4-dust and D5-fine dust. Welding lenses should be marked W followed by shade number.

Classifications and marking requirements are stated for lenses to indicate their radiation filtration properties and the hazards for which they are intended to provide protection. The shade/scale numbers indicate levels of protection based on the intensity of the hazard.

Ultraviolet (UV) protectors should be marked U followed by scale number. Infrared (Heat) IR protectors should be marked R followed by scale number. A Visible Light filter (such as a grey lens for sun protection) should be marked L followed by a scale number. Examples of markings are:

- *Welding Filters W and Shade number, i.e. W10*
- *UV Filters U and Scale number, i.e. U6*
- *IR Filters R and Scale number, i.e. R4*
- *Visible Light (Glare) Filters L and Scale number, i.e. L2.5*



## Certification

In addition to identifying the appropriate protective device, many organisations in their purchasing specifications require independent certification. Third party certification is designed to ensure that product testing is conducted in accordance with the most current product performance standard in a consistent manner by a laboratory accredited to test to that particular standard.

An independent, non profit organisation, the Safety Equipment Institute (SEI), has been certifying safety spectacles, goggles, face shields and welding helmets using ANSI Z 87.1, and hard hats using ANSI/ISEA Z89.1 as the basis for compliance testing for more than 30 years.

SEI's certification programme allows the manufacturer to use the SEI mark only when:

- *The independent testing laboratory determines that the product models have successfully undergone performance tests and meet the specified product performance standard*
- *The quality assurance auditor completes an extensive audit of the manufacturer's operations and determines that the manufacturer complies with SEI quality assurance requirements*

The quality audit, conducted at the manufacturing facility, is an important facet of SEI certification. Certification is not based on a one-time test; it is comprehensive and ongoing. After the initial audit, the SEI auditor conducts

audits annually and selects products for annual compliance testing. If products not meeting the standards should be found, SEI can require a recall.

Manufacturers' operations usually include proprietary information normally protected closely from outsiders. 'Opening the doors' requires serious consideration by the manufacturer. Participation in a third party certification programme demonstrates a manufacturer's integrity and responsibility by showing a willingness to provide auditors the access to their facilities. The SEI programme provides independent confirmation of in-house testing and quality assurance programmes.

Organisations such as SEI publish lists of certified products to assist safety directors and purchasers find certified products. Certified head and eye and face protection may be found at: [www.SEInet.org](http://www.SEInet.org). ■

Author



Patricia Gleason  
and SEI

*The Safety  
Equipment  
Institute (SEI)  
is a non-profit  
organisation*

*whose sole purpose is to test and certify a broad range of safety and protective equipment. SEI's certification programme assists government agencies in ensuring employers have confidence in the safety products they provide their workers for protection from potential workplace hazards.*

*For the past 32 years, SEI has operated certification programmes for safety and protective equipment used by industrial, fire service, and construction workers.*

*Patricia Gleason currently serves as President of the SEI. She brings more than 25 years of management experience serving non-profit, safety related organisations, and her area of expertise is in conformity assessment in the field of personal protective equipment and safety products.*

*In this position, Ms Gleason serves as a member of the American National Standards Institute (ANSI) Board of Directors, the ANSI Accreditation Committee, and is the Chairman of the ANSI Conformity Assessment Policy Committee. She is a member of the Board of Directors of the American National Accreditation Board (ANAB) and served on the US delegation for ISO Working Group 29, which was charged with the revision of ISO 17065, the standard governing the accreditation of third party certification organisations.*

*Ms Gleason also serves on technical committees for the American Society for Testing and Materials (ASTM), the National Fire Protection Association and the National Institute of Justice (NIJ) to provide expertise on certification and conformity assessment issues.*

[www.osedirectory.com/health-and-safety.php](http://www.osedirectory.com/health-and-safety.php)

**“third party certification is designed to ensure that product testing is conducted in accordance with the most current product performance standard in a consistent manner”**