

Personal Protective Equipment (PPE) Requirements: Eye & Face Protection

Introduction

According to Prevent Blindness America, eye injuries in the workplace are very common. More than 2,000 people injure their eyes at work each day and about one in ten injuries requires one or more missed workdays. It is estimated that using the correct eye protection could lessen the severity or even prevent 90% of eye injuries.

Personal Protective Equipment (PPE) Requirements

General personal protective equipment (PPE) requirements are addressed in Title 29 Code of Federal Regulations (CFR) [1910.132](#) – Occupational Safety and Health Standards:

"Protective equipment including personal protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices, and protective shields and barriers shall be provided, used and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact." (29 CFR 1910.132(a))

Eye and face protection requirements are outlined in 29 CFR [1910.133](#):

- Employers must ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors or potentially injurious light radiation
- Employers must ensure that each affected employee uses eye protection that provides side protection when there is a hazard from flying objects
- Employers must ensure that each affected employee who wears prescription lenses while engaged in operations that involve eye hazards wears eye protection that incorporates the prescription in its design, or wears eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses
- Employers must ensure that each affected employee uses equipment with filter lenses that have a shade number appropriate for the work being performed for protection from injurious light radiation

Criteria for Protective Eye & Face Devices

On Sept. 9, 2009, OSHA issued a Final Rule concerning 29 CFR (Part 1910 and others) that revised the personal protective equipment (PPE) requirements for eye and face protective devices, head protection and foot protection. The Final Rule incorporated the latest versions of national consensus and industry standards. Additionally, OSHA also announced its use of "direct final rule" to ensure that when standards change, the law is automatically updated. Therefore, employers must comply with this Final Rule by using and providing for employees eyewear that are constructed in accordance with any of the last three American National Standards Institute (ANSI) national consensus standards or their proven equivalent:

- ANSI Z87.1-2003, American National Standard for Occupational and Educational Personal Eye and Face Protection Devices
- ANSI Z87.1-2010, American National Standard for Occupational and Educational Personal Eye and Face Protection Devices

- ANSI Z87.1-2015, American National Standard for Occupational and Educational Personal Eye and Face Protection Devices

NOTE: Even though "direct final rule" applies, the process to actually incorporate ANSI Z87.1-2010 and 2015 into the federal law may take some time.

History of ANSI Z87.1

The first "standard" for head and eye protection dates back to 1922 with the first edition of the Z2 standard by the War and Navy Department and the National Bureau of Standards.

In 1968, the eye and face protection standard was published with the Z87 designation, Z87.1-1968. Since then Z87.1 has been revised five times—1979, 1989, 2003, 2010 and 2015. Through these revisions, the purpose of this Standard has remained the same—to provide minimum requirements for eye and face protective devices including selection, use and maintenance of the devices.

ANSI Z87.1 Key Changes

The 2003 edition and its predecessors are organized by the type of device. Each type of device has a "chapter" in the standard that describes the device, the required testing and optical properties and also establishes product marking PPE requirements.

The 2010 standard focuses on the hazards and is organized by the nature of the hazard—impact, optical radiation, droplet and splash, dust and fine dust and mist. This was a dramatic shift away from product configuration requirements toward a hazard-based focus structure. This focus encourages users to evaluate the specific hazards that they are exposed to and to select appropriate protection based on that evaluation. Because of this change, required product markings were changed. Users will have to match the hazard that they need protection from with the marking on the device.

The 2015 revision continues to focus on product performance and harmonization with global standards and fine-tunes the 2010 hazard-based product performance structure noted by the following key changes:

- Deleted minimum lens thickness from general requirements
- Deleted additional impact requirements for specific protector types from impact protector requirements
- Added automatic darkening welding filter devices to optical radiation protector requirements
- Added angular dependence of luminous transmittance test for automatic welding filter devices
- Added Illustrations to aid in refractive power, astigmatism and resolving power testing
- Added examples of protector markings (acceptable and unacceptable)
- Added minimum thickness requirements for prescription lenses
- Added refractive power, astigmatism and resolving power tolerances and prism and prism imbalance tolerances for "readers, full-facepiece respirators and loose-fitting respirators"
- Added "magnifiers" and "readers" to the marking requirements table
- Added information that is to be provided with welding protectors
- Hazard Assessment and Protector Selection expanded to include goggle ventilation and peripheral vision

The 2003 versions and predecessors had no defined minimum coverage requirement. The 2010 and 2015 versions have a minimum frontal requirement and for impact rated devices, a lateral coverage requirement:

- The frame front encircling one lens and lens must cover in plain view an area of not less than 40-millimeters (1.57-inches) in width and 33-millimeters (1.30 inches) in height (elliptical) in front of each eye
- Frames designed for small head sizes must cover in plain view an area of not less than 34-millimeters (1.34-inches) in width and 28-millimeters (1.10-inches) in height
- Impact rated protectors must provide continuous lateral coverage from the vertical plane of the lenses tangential to a point not less than 10-millimeters (0.394-inch) posterior to the corneal plane and not less than 10-millimeters (0.394-inch) in height [or 8-millimeters (0.315-inch) for small head sizes] above and not less than 10-millimeters (0.394-inch) in height [or 8-millimeters (0.315-inch) for small head sizes] below the horizontal plane

The 2003 version and its predecessors had no defined performance criteria for splash/droplet, dust or fine dust.

The 2010 and 2015 revisions have specific performance and marking requirements for devices claiming to provide protection from splash/droplet, dust or fine dust hazards.

The 2003 version and its predecessors use the "Alderson" head form for product testing. The 2010 and 2015 revisions adopt the European small and medium head form size for testing.

The 2010 version section on selection, use and maintenance has been revised to show recommended protectors for various types of work activities that can expose workers to impact, heat, chemical, dust or optical radiation hazards.

The 2015 eye and face selection guide has been expanded to include:

- Irritating mist added under CHEMICAL—liquids, acid and chemical handling, degreasing and plating, although there are currently no marking designations for eye protection to irritating mists exposure in the Z87.1-2015 standard
- OPTICAL RADIATION was expanded to include Infrared Radiation (IR); Arc Welding: Arc expanded to include process examples and welding respirator added as a possible protector; and Oxyfuel Gas Welding separated from Oxyfuel or Oxygen cutting
- Ultraviolet Radiation (UV) added
- Lasers added although there are currently no marking designations for eye protection to lasers in the Z87.1-2015 standard

Both the 2010 and 2015 versions address aftermarket components. All original equipment manufacturers and non-original equipment manufacturers aftermarket components not sold with the original device must be tested and assembled with the original complete device in the as-worn condition. For aftermarket side shields, the side shields must be tested on representative frames for which the product is specified to fit. Documentation listing all devices that the component or accessory has been tested and is approved for must be made available by the manufacturer. The entity claiming compliance of the component is responsible for testing the assembled device.

ANSI Z87.1 Markings

ANSI Z87.1-2003: Two levels of protection are described—basic and high impact. Removable lenses must be marked with the manufacturer's monogram and basic impact lenses require no additional mark, but high impact lenses require a "+". Non-removable lenses must be marked with the manufacturer's monogram and basic impact lenses must be marked "Z87" and high impact lenses must be marked "Z87+". If applicable the lenses must be marked with the appropriate shade and special purpose designation. Spectacles front, at least one temple and removable sideshield and goggles frame and lens housing or carrier must be marked with the manufacturer's monogram and "Z87 or Z87+". Non-removable lens products require only one marking – for

spectacles the marking may be placed on the frame or temples and for goggles the marking may be applied to any component including the lens.

ANSI Z87.1-2010 and 2015: Products are either non-impact or impact protectors. In addition to the manufacturer's monogram, Z87 marking and impact marking, manufacturers must add lens type (welding, UV filter, visible light filter, IR filter, variable tint and special purpose) and use (protection against splash droplet, dust and fine dust) markings when claims of impact rating, specific lens type and/or use are made.

Type of Mark	Description	Marking
Impact	Impact Rated Plano	Z87+
	Impact Rated Prescription	Z87-2+
Non-Impact	Plano	Z87
	Prescription	Z87-2
Lens Type	Clear	None
	Welding	W and Shade Number (Shades range from 1.3 to 14 – the higher the number the darker the lens)
	UV Filter	U and Scale Number (Scale ranges from 2 to 6 – the higher the number the highest protection from far and near UV)
	Visible Light Filter	L and Scale Number (Scale ranges from 1.3 to 10 – lower numbers providing greater light transmittance)
	IR Filter	R and Scale Number (Scale ranges from 1.3 to 10 – lower numbers
	Variable Tint	V
	Special Purpose	S (This is on virtually all non-clear lenses that don't have another distinction)
	Use	Splash/Droplet
Dust		D4
Fine Dust		D5

Definitions

Accessory – An item that is added to a complete device that may or may not affect the performance of that complete device.

Aftermarket Component – A component that may or may not be manufactured by the complete device manufacturer and is not supplied with the original complete device.

Complete device – A product with all its components in their configuration of intended use, subjected to testing for determination of compliance with the standard.

Component – A functional part of a complete device.

Cover Lens – An expendable lens used to protect another lens from surface damage and that is not intended to contribute to user protection. It is not a safety plate.

Faceshield* – A protector intended to shield the wearer's face, or portions thereof from certain hazards, as indicated by the faceshield's markings.

Filter lens – A lens that attenuates specific wavelengths of ultraviolet, visible and/or infrared radiation.

Frame – A structure, which holds the lens or lenses on the wearer.

Front – That part of a spectacle or goggle frame that is intended to contain the lens or lenses.

Goggle – A protector intended to fit the face surrounding the eyes in order to shield the eyes from certain hazards, depending upon the hazard type.

Inner Surface – The inward facing portions of any component of a complete device which have a direct line to the eye or lateral coverage area.

Lens – The transparent part of a protector through which the wearer sees.

Lens housing or carrier – That part of a goggle that mechanically houses a lens.

Magnifier – A mass produced lens (non-prescription) that incorporates plus refractive power throughout the entirety of the lens. This includes spectacle lenses but does not include magnifiers inserted into welding devices, which are considered accessories.

Non-Removable lens – A lens and holder that are homogeneous and continuous or a lens that cannot be removed from the frame/front without damage to the device.

Plano lens – A lens that does not incorporate a corrective prescription.

Protector – A complete device meeting, at a minimum the General Requirements of ANSI Z87.1.

Reader – A mass produced non-prescriptive spectacle that incorporates plus refractive power in a portion of the lens.

Removable lenses – Prescription or plano lenses fabricated to fit a single spectacle frame.

Replaceable lenses – Interchangeable lens/fronts designed for spectacle or goggle devices that are directly mounted to the frame or shell of the device.

Sideshield – A component of a spectacle that provides lateral protection.

Spectacle – A protector intended to shield the wearer's eyes from certain hazards, depending on the type of hazard.

Temple – That part of a spectacle frame commonly attached to the front and generally extending behind the ear of the wearer.

Ultraviolet radiation (UV) – Electromagnetic energy with wavelengths from 200 to 380 nanometers.

Welding Faceshield – A faceshield intended to provide optical radiation protection for limited welding applications.

Welding Goggle – A goggle intended to provide optical radiation protection for limited welding applications.

***Faceshield:** Although it would appear from the definition and the various included test procedures (droplet and splash, dust, and fine dust) that faceshields can be used as standalone devices, all references on the Selection Chart refer to "faceshields worn over goggles or spectacles". The droplet and splash test is intended to determine the capability of a faceshield to keep liquid splashes or sprays from reaching the wearer's eyes by observing the area of coverage of the faceshield.