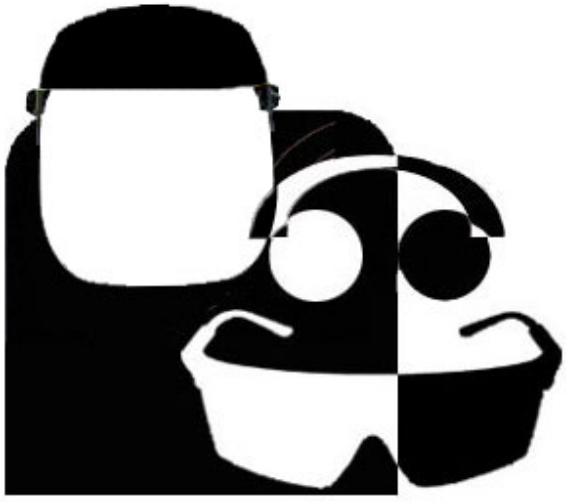
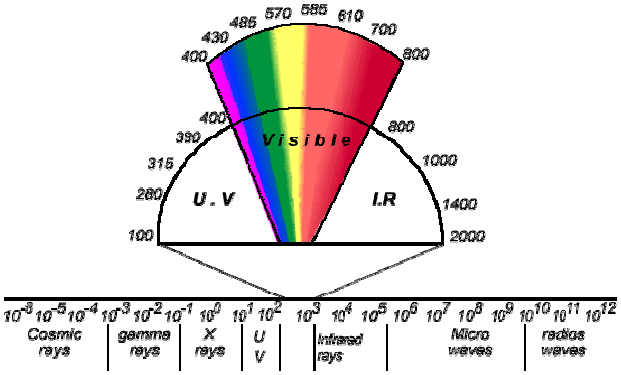
Eye & Face Protection



Training Guide

What is Light?



Know UV

UVA is lower in energy but penetrates more deeply than UVB.
UVB is a high-energy ray that causes the most damage to eyes.
UVC is the most powerful form of all.

Absorption Chart

Material	% of UV B Absorbed	% of UV A Absorbed
Clear glass	79%	20%
Clear Plastic	100%	90%
UV-coated plastic	100%	100%
Polycarbonate	100%	99%
Transitions Plus	100%	99.5%

Types of Eye & face Protection

Spectacles: (plano and prescription) These protective eyeglasses have safety frames constructed of metal or plastic and impact-resistant lenses. Side shields are available on some models.
Goggles: These are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area immediately surrounding the eyes and provide protection from impact, dust and splashes. Some goggles will fit over corrective lenses. Available in
Non-ventilation: Protects against gases, smoke, fluids, flying particles and debris
Direct ventilation: Provides protection from chips and flying particles
Indirect ventilation: Chemical and anti-splash protection
Face shields: These transparent sheets of plastic extend from the eyebrows to below the chin and across the entire width of the employee's head. Some are polarized for glare protection. Face shields protect against nuisance dusts and potential splashes or sprays of hazardous liquids but will not provide adequate protection against impact hazards. Face shields used in combination with goggles or safety spectacles will provide additional protection against impact hazards.
Welding helmets and handshields: Constructed of vulcanized fiber or fiberglass and fitted with a filtered lens, welding shields protect eyes from burns caused by infrared or intense radiant light. They also protect both the eyes and face from flying sparks, metal spatter and slag chips produced during welding, brazing, soldering and cutting operations. OSHA requires filter lenses to have a shade number appropriate to protect against the specific hazards of the work being performed in order to protect against harmful light radiation.
Full facepiece respirators: Designed to provide eye, face and respiratory protection. Protects the wearer's eyes and face against irritating gases, vapors and flying particles.

Lens Materials

Glass: Glass lenses have become less common in recent years due to the danger of shattering and their relatively high weight compared to CR-39 plastic lenses.

CR-39: Plastic lenses made from CR-39 monomer is used for casting plastic lenses for prescription eyewear, sunglasses and other plastic products requiring high abrasion resistance and high quality optical properties.

Polycarbonate: Polycarbonate is 10 times more impact resistant than any other lens material. It is also thinner and lighter than traditional plastic eyeglass lenses and blocks 99.9% of harmful UV radiation.

Acetate: (Zylonite) Acetate lenses cost effective and creative option for excellent chemical resistance and relatively lightweight. Good optical clarity and rigidity.

PETG: (Glycol Modified Polyethylene Terephthalate) A good chemical resistance that make them ideally suited for harsh industrial environments. PETG delivers impact strength and provides some of the advantages of Polycarbonate at lower cost.

High-Index: (Polyurethanes) Allows for thinner lenses. Refracts light in a different way than regular plastic lenses. Strength but not as shatter resistant as polycarbonate.

Lens Types

Ultraviolet Treatments: Ultraviolet treatment is applied to lenses to protect against harmful UV sunrays. Regular plastic eyeglass lenses block most UV light, but adding a UV-blocking dye boosts UV protection to 100 percent for added safety.

Hard Coatings: For safety glasses are permanently bonded to lens to extend lens life.

Anti Fog Coatings: Thermal varnish applied to lenses, provides resistance to fogging of lenses in absorbing humidity.

Scratch Resistant Coatings: No eyeglass lenses-not even glass lenses are scratch-proof. Scratch-resistant coating is applied to the front and back of lenses in the manufacturing process. Recommended to make lenses last longer. Easily cleaned and sanitized.

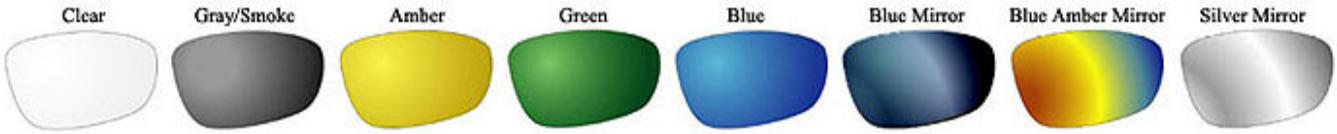
Anti Reflective Coatings: (AR coating or anti-glare coating) Anti-reflective coating is applied to reduce the amount of internal and external reflections on a lens which improves both your vision through your lenses and the appearance of your glasses.

Aspheric: An aspheric lens has flatter peripheral curvatures than a regular spherical lens. Reduces distortions that occur when looking away from the center of the lens, making vision much crisper. Also much lighter in weight than standard spherical lenses.

Photochromatic: Photochromatic/Transitions lens has a special chemical coating that makes them change to a dark tint in the sunlight and turn clear indoors. Also block 100 percent of the sun's UV rays without the need for an added UV lens treatment.

Polarized: Polarized lenses contain a polarized filter to reduce reflected glare, increase contrast, improve depth perception, and reduce eyestrain and fatigue, and improve visual acuity. Block 99.9% of harsh, reflective glare. Usually used to make sunglasses. Commonly in grey or brown tint but many other colors are available.

Tints



Clear: General purpose lenses that provides maximum visibility and protects against harmful levels of UV radiation.

Gray or Smoke: Protects eyes from excessive glare and harmful levels of UV radiation without distorting color perception, most popular sun wear shade.

Amber: Provides high absorption of blue in the spectrum, reducing the diffused reflected light from haze, thus enhancing object contrast and protects against harmful levels of UV radiation. Ideal for low light environments.

Green: Provides protection from excessive glare and harmful UV radiation; green tint provides attractive aesthetic alternative.

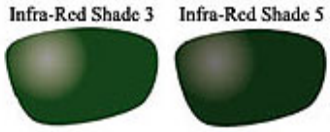
Blue: Is a contrast lens that is used to reduce glare from visible white light such as reflected from mist, fog, snow and water.

Blue Mirror: Mirrored surface reduces glare and reflects heat. Gray colored substrate behind the mirror also reduces glare without effecting color recognition. Recommended for outdoor use where excessive levels of UV are present especially around water, sand and snow.

Blue Amber and/or Yellow Amber Mirror: Mirrored surface serves to both reduce surface glare and reflect heat. The substrate is a yellow-orange material that blocks blue-light and enhances the contrast for colored objects. These lenses are recommended for outdoor use where excessive levels of UV are present.

Indoor/Outdoor: A light silver mirror coating over a clear substrate to reduce glare and visible light transmission and protects against harmful levels of UV radiation. Ideal when moving from bright to dark environments.

Shades



Infra-Red: Protect the eyes from harmful forms of spectral emissions inherent in metal working and welding operations:
Special absorptive quality protects against excessive UV, which can cause welder's flash, as well as excessive infra-red radiant energy.

Transmittance Requirements for General-Purpose Filters for Protection from Ultraviolet, Visible and Infrared Radiation

Shade Number	Luminous Transmittance			Maximum Effective Far-Ultraviolet Average Transmittance	Maximum Infrared Average Transmittance
	Maximum %	Nominal %	Minimum %		
CLEAR	100	----	85	----	----
1.5	67	61.45	55	0.1	25
1.7	55	50.1	43	0.1	20
2.0	43	37.3	29	0.1	15
2.5	29	22.8	18.0	0.1	12
3.0	18.0	13.9	8.50	0.07	9.0
4	8.50	5.18	3.16	0.04	5.0
5	3.16	1.93	1.18	0.02	2.5
6	1.18	0.72	0.44	0.01	1.5
7	0.44	0.27	0.164	0.007	1.3
8	0.164	0.100	0.061	0.004	1.0
9	0.061	0.037	0.023	0.002	0.8
10	0.023	0.0139	0.0085	0.001	0.6
11	0.0085	0.0052	0.0032	0.0007	0.5
12	0.0032	0.0019	0.0012	0.0004	0.5
13	0.0012	0.00072	0.00044	0.0002	0.4
14	0.00044	0.00027	0.00016	0.0001	0.3

Filter Lenses for Protection Against Radiant Energy

Operations	Electrode size in 1/32" (0.8mm)	Arc current	Minimum protective shade
Shielded metal arc welding	< 3 3 - 5 5 - 8 > 8	< 60 60 - 160 160 - 250 250 - 550	7 8 10 11
Gas metal arc welding and flux cored arc welding		< 60 60 - 160 160 - 250 250 - 500	7 10 10 10
Gas tungsten arc welding		< 50 50 - 150 150 - 500	8 8 10
Air carbon	(light)	< 500	10
Arc cutting	(heavy)	500 - 1,000	11
Plasma arc welding		< 20 20 - 100 100 - 400 400 - 800	6 8 10 11
Plasma arc cutting	(light) (medium) (heavy)	< 300 300 - 400 400 - 800	8 9 10
Torch brazing			3
Torch soldering			2
Carbon arc welding			14

Filter Lenses for Protection Against Radiant Energy

Operations	Plate thickness inches	Plate thickness mm	Minimum protective shade
Gas welding: Light	< 1/8	< 3.2	4
Gas welding: Medium	1/8 - 1/2	3.2 - 12.7	5
Gas welding: Heavy	> 1/2	> 12.7	6
Oxygen cutting: Light	< 1	< 25	3
Oxygen cutting: Medium	1 - 6	25 - 150	4
Oxygen cutting: Heavy	> 6	> 150	5

Construction Industry Requirements for Filter Lens Shade Numbers for Protection Against Radiant Energy

Welding Operation	**Shade Number**
Shielded metal-arc welding 1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes	10
Gas-shielded arc welding (nonferrous) 1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes	11
Gas-shielded arc welding (ferrous) 1/16-, 3/32-, 1/8-, 5/32-inch diameter electrodes	12
Shielded metal-arc welding 3/16-, 7/32-, 1/4-inch diameter electrodes	12
5/16-, 3/8-inch diameter electrodes	14
Atomic hydrogen welding	10 - 14
Carbon-arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1 to 6 inches	4 or 5
Heavy cutting, more than 6 inches	5 or 6
Gas welding (light), up to 1/8-inch	4 or 5
Gas welding (medium), 1/8- to 1/2-inch	5 or 6
Gas welding (heavy), more than 1/2-inch	6 or 8

Frame Materials

PLASTIC

Nylon: Nylon is a virtually unbreakable, hypoallergenic material. Neither shrinks nor stretches to edge the lenses for the exact size.

Polyamide: A type of nylon. Strong and lightweight. Easily tinted and wide range of colors.

Cellulose Acetate: (Zyl) Lightweight in nature. Easy to adjust and has a unique ability to slightly reduce in size to accommodate a lens.

Propionate: A nylon-based plastic that is hypoallergenic. Lightweight and has more transparency and gloss than other plastics.

Carbon Fiber Graphite: Consists of a carbon compound and a textile. Lightweight and high tensile strength.

PVC: PVC profiles can be clear or colored and can have a high gloss or matte finish. Fair heat resistance, good chemical resistance, excellent electrical insulation properties.

Polycarbonate: Polycarbonate resin is impact strength. Excellent thermal resistance and low temperature toughness.

TPU: Thermoplastic Polyurethane is high tensile strength, good low temperature flexibility and abrasion resistance.

TR90: TR90 is an ultra lightweight material featuring memory flex technology, lighter than polycarbonate and more flexible than nylon, chemical resistance and high stress crack resistance.

METAL

Nickel: Strong and generally bends without breaking which makes it suitable for endpieces and nose pad arms.

Titanium: Titanium is a silver-gray metal that's lightweight, durable, strong and corrosion-resistant. Some titanium frames are made from an alloy that is a combination of titanium and other metals, such as nickel or copper. In general, titanium alloy frames cost less than 100 percent titanium frames.

Stainless steel: Strong even in thin, low toxicity. Provides excellent resistance to corrosion, abrasion and heat.

Aluminum: Aluminium is used primarily by high-end eyewear designers because of the unique look it creates. Pure aluminum is actually soft and weak, but commercial aluminum with small amounts of silicon and iron is hard and strong.

Contacts and Prescription (Rx) Lenses

Employers must ensure that employees who wear prescription (Rx) lenses or contacts use PPE that incorporates the prescription or use eye protection that can be worn over prescription lenses.

- Workers who wear prescription glasses must also wear required eye protection
- Eye and face protection that fits comfortably over glasses is available
- Safety goggles and spectacles may incorporate prescription lenses
- Dust and chemicals present additional hazards to contacts wearers. OSHA recommends that workers have an extra pair of contacts or eyeglasses in case of contact failure or loss

What is the difference between plastic and polycarbonate?

The "standard plastic" lenses in safety glasses are often called "Hard Resin", "CR-39 plastic", or just "plastic" lenses.

CR-39® is actually a PPG Industries registered trade name for a DADC (diallyl diglycol carbonate) polymer that was introduced in 1941. The "CR" stands for Columbia Resin and CR-39 was the 39th batch or formula made by Columbia Laboratories in Ohio. This polymer is a polycarbonate but its starting materials are different from the resins used in safety glasses with "polycarbonate" lenses. The hard resin or CR-39 plastic is a thermoset plastic meaning it cannot be molded or bent when heated.

On the other hand, the polycarbonate polymers (e.g., Lexan®, a GE trade name) are thermoplastic which means that the lenses can be formed by melting polycarbonate pellets and injecting them into a mold.

Base Curve Lens

The base curve is the radius of the sphere measured from the back of the lens.
6 base tend to be more flat relative to your face while 9 base provide the maximum amount of wrap around your face.

Care

Safety glasses need maintenance.

- Clean your safety glasses daily. Follow the manufacturer's instructions. Avoid rough handling that can scratch lenses.
- Scratches impair vision and can weaken lenses.
- Store your safety glasses in a clean, dry place where they cannot fall or be stepped on. Keep them in a case when they are not being worn.
- Replace scratched, pitted, broken, bent or ill-fitting glasses. Damaged glasses interfere with vision and do not provide protection.
- Replace damaged parts only with identical parts from the original manufacturer to ensure the same safety rating.

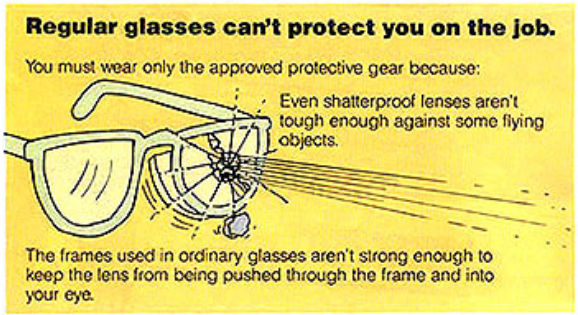
Don't just wear safety glasses at work

Most of us know to wear safety glasses at work. In many cases it's mandatory. We get to work and donning the PPE is part of the daily routine.

Here's a tip though… Of the 2.5 million eye injuries that happen each year in the US, 50% occur at home.

The fact of the matter is that the reason why safety eyewear makes sense at work also applies at home. So why aren't we wearing eyewear when we are working around the house?

Don't be a statistic! Don't be safe at work and stupid at home. Wear safety glasses at home whenever you are using power tools or doing work that might potentially result in an eye injury.



Polycarbonate Compatibility Data-Harmful Chemicals

The following chemicals are known to harm UNCOATED polycarbonate. Duration of exposure and concentration have a direct effect on the severity of harm.

ACETALDEHYDE
ACETIC ACID
ACETIC ANHYDRIDE
ACETIMIDE
ACETONE
ACETYL CHLORIDE
ACETYLENE
ACRYLONITRILE
AMINES
AMMONIA
AMONIUM HYDROXIDE
AMYL ACETATE
ANILINE
ANTIFREEZE
ASPHALT
BARIUM HYDROXIDE
BARIUM NITRATE
BARIUM SULFATE
BENZALDEHYDE
BENZENE
BENZOL
BRAKE FLUID
BUTADENE
BUTANE
BUTYL ACETATE
BUTYL AMINE
BUTYLENE
BUTYL PYTHALATE
BUTYRIC ACID
CALCIUM BISULFATE
CALCIUM BISULFITE
CALCIUM HYDROXIDE
CALCIUM HYPOCHLORITE
CARBON DISULFIDE
CARBON TETRACHLORIDE
CASTER OIL
CAUSTIC SODA SOLUTION
CHLOROBENZENE
CHLOROFORM
CHLOROACETIC ACID
CHROMIC ACID 50%
CINNAMON OIL
COPPER CYANIDE
COPPER NITRATE
CRESOL
CRESYLIC ACID
CYCLOHEXANONE
DIACETONE ALCOHOL
DICHLOROBENZENE
DICHLOROETHANE
DIETHYL ETHER
DIETHYLAMINE
DIMETHYL ANILINE
DIMETHYL FORMAMIDE
DIOXANE
ETHYL BENZOATE
ETHYLINE BROMIDE
ETHYL ACETATE
ETHYL ALCOHOL
ETHYL AMINE
ETHYL CHLORIDE
ETHYLENE CHLOROHYDRIN
ETHYLENE CHLORIDE
ETHYLENE CHLROHYDRIN
ETHYLENE CHLORIDE
EHTYLEN DICHLORIDE
FERROUS CHLORIDE
FREON
FURFURAL
GASOLINE
HEXANE
HYDRAZINE
HYDROFLUORIC ACID
HYDROXIDE
ISOPROPYL ACETATE
ISOPROPYL ETHER
KEROSENE
KETONES
LACQUER THINNER
LACQUERS
LITHIUM HYDROXIDE
MERCURY
METHYL ACETATE
METHYL ALCOHOL
METHYL BUTYL KETONE
METHYL CELLOSOLVE
METHYL CHLORIDE
METHYL DICHLORIDE
METHYL ETHYL KETONE
METHYL ISOBUTYL KETONE
METHYL ISOPROPYL KETONE
METHYLENE CHLORIDE
MONOCHLOROACETIC ACID
MORPHOLINE
NICKEL NITRATE
NITRIC ACID
NITROBENZENE
NITROMETHANE
PERCHLOROETHYLENE
PHENOL
PICRIC ACID
PHOSPHORIC ACID ANHYDRIDE
POTASSIUM HYDROXIDE
PYRIDINE
SODIUM HYDROXIDE
SODIUM SULFIDE
SODIUM THIOSULFATE
SODIUM SULFIDE
SODIUM THIOSULFATE
STYRENE
SULFURIC ACID
TETRACHLORETHYLENE
TETRAHYDROFURAN
TOLUENE
TRICHLOROETHANE
TURPENTINE
UREA
VARNISH
XYLENE

NOTE: Exposure to acids or bases (either concentrated or at elevated temperatures) will attack lens coatings and may cause coating delamination

Safety glasses are required to be tested to ANSI Z87.1
Here is a list of the most important (not complete) tests that are required:

Test Performed	Description
High Mass Impact	Frame shall be capable of resisting impact from a pointed projectile weighing 500g (17.6 oz.) dropped from a height of 127 cm (50”)
High Velocity Impact	Spectacles shall be capable of resisting impact from a 6.35 mm (1/4”) diameter steel ball traveling at a velocity of 45.7 mps (150 fps) Goggles shall be capable of resisting impact from a 6.35 mm (1/4”) diameter steel ball traveling at a velocity of 76.2 mps (250 fps)
Drop-Ball Impact	Basic impact requirement for all devices: 1 inch diameter steel ball dropped at 127 cm (50”)
Coverage	Required lateral (side) coverage has been increased (taken from CSA Z94.03-02) No openings greater than 1.5 mm (0.06")
Penetration Test(Plastic lenses only)	Spectacles shall be capable of resisting penetration from a weighted projectile weighing 44.2 g (1.56 oz dropped from a height of 127 cm (50”)
Prismatic Power	The prismatic power shall not exceed 1/2 prism diopter in any direction. Vertical and horizontal prism imbalance shall not exceed 1/4 prism diopter....
Refractive Power and Astigmatism	The refractive power in any meridian shall not exceed 0.06 diopter The astigmatism shall not exceed 0.06 diopter
Haze	Lenses shall not exhibit more than 3% haze, when tested in accordance with....
Optical Quality	No stripe, bubbles, waves or other visible defects that would impair optical quality is allowed
Transmittance	Clear and filter plano lenses shall comply with table one of Z87.1 Special purpose lenses shall comply with Table 6 through 10
Cleanability	After cleaning the function of the spectacles shall not be impaired

ANSI Z87.1-2015

Eye and Face Protector Selection Guide

Hazard	Protectors	Limitations	Marking
IMPACT - Chipping, grinding, machining, masonry work, riveting, and sanding			
Flying fragments, objects, large chips, particles, sand, dirt, etc.	•Spectacles with side protection •Goggles with direct or indirect ventilation •Faceshield worn over spectacles or goggles •Welding helmet worn over spectacles or goggles •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators	Caution should be exercised in the use of metal frame protective devices in electrical hazard areas. Metal frame protective devices could potentially cause electrical shock and electrical burn through contact with, or thermal burns from exposure to the hazards of electrical energy, which include radiation from accidental arcs. To provide adequate protection, ensure goggles fit tightly to the face. Atmospheric conditions and the restricted ventilation of a protector can cause lenses to fog. Frequent cleaning may be required.	Impact rated: **+** (spectacle lens) **Z87+** (all other lens) **Z87+** (plano frame) **Z87-2+** (Rx frame)
HEAT - Furnace operations - pouring, casting, hot dipping, gas cutting, and welding			
Hot sparks	•Spectacles with side protection •Goggles with direct or indirect ventilation •Faceshield worn over spectacles or goggles •Loose-fitting respirator worn over spectacles •Full-facepiece respirators	Spectacles, cup and cover type goggles do not provide unlimited facial protection. Operations involving heat may also involve optical radiation. Protection from both hazards shall be provided.	NOTE: There are currently no marking designations for eye protection to heat or high-temperature exposure in the ANSI Z87.1-2015 standard.
Splash from molten metal	•Faceshield worn over goggles •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators		
High temperature exposure	•Screen faceshield over spectacles or goggles •Reflective faceshield over spectacles or goggles		
CHEMICAL – Liquids, acid and chemical handling, degreasing, and plating			
Splash, droplets and sprays	•Goggles with indirect ventilation (eyecup or cover type) •Faceshield worn over goggles) •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators	Atmospheric conditions and the restricted ventilation of a protector can cause lenses to fog. Frequent cleaning may be required. To provide adequate protection, ensure goggles fit tightly to the face.	Splash/droplet: **D3**
Irritating Mist	•Goggle with no ventilation (cover type) •Faceshield worn over goggles •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators		NOTE: There are currently no marking designations for eye protection to Irritating mists exposure in the ANSI Z87.1-2015 standard.
DUST - Woodworking, buffing, general dusty conditions			
Nuisance dust	•Goggles with direct or indirect ventilation (eyecup or cover type) •Full-facepiece respirators	Atmospheric conditions and the restricted ventilation of a protector can cause lenses to fog. Frequent cleaning may be required. To provide adequate protection, ensure goggles fit tightly to the face.	Dust: **D4**
Fine dust	•Goggles with indirect ventilation or no ventilation •Full-facepiece respirators	To provide adequate protection, ensure goggles fit tightly to the face.	Fine dust: **D5**

Hazard	Protectors	Limitations	Marking
OPTICAL RADIATION			
Infrared Radiation (IR)	•Spectacles with side protection •Goggles with direct or indirect ventilation •Faceshield worn over spectacles or goggles •Welding helmet worn over spectacles or goggles •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators	For proper fit of protector; there shall be no penetration of direct infrared spectra light in all non-lens areas. Side shields shall have filtering capability equal to or greater than the front lenses.	IR: **R** *scale number*
Visible Light (Glare)	•Spectacles with side protection •Goggles with direct or indirect ventilation •Faceshield worn over spectacles or goggles •Welding helmet worn over spectacles or goggles •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators	For proper fit of protector; there shall be no penetration of direct visible light in all non-lens areas. Side shields shall have filtering capability equal to or greater than the front lenses.	Visible: **L** *scale number*
Ultraviolet Radiation (UV)	•Spectacles with side protection •Goggles with direct or indirect ventilation •Faceshield worn over spectacles or goggles •Welding helmet worn over spectacles or goggles •Loose-fitting respirator worn over spectacles or goggles •Full-facepiece respirators	For proper fit of protector; there shall be no penetration of direct ultraviolet light in all non-lens areas. Side shields shall have filtering capability equal to or greater than the front lenses.	UV: **U** *scale number*
Lasers	Refer to ANSI Z136.1-2014 “Safe Use of Lasers”, for guidance in choosing the correct protective eyewear when working with lasers.		NOTE: There are currently no marking designations for eye protection to Lasers in the ANSI Z87.1-2015 standard.

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Hazard	Protectors	Limitations	Marking
Arc Welding: Arc Process Examples: Shielded Metal Arc Welding (SMAW) Gas Metal Arc Welding (GMAW) Gas Tungsten Arc Welding (GTAW) Air Carbon Arc Welding (CAC-A) Carbon Arc Welding (CAW) Plasma Arc Welding (PAW) Plasma Arc Cutting (PAC) Viewing electric arc furnaces and boilers	•Welding helmet over spectacles or goggles •Handshield over spectacles or goggles •Welding Respirator TYPICAL FILTER LENSSHADE:10-14	Protection from optical radiation is directly related to filter lens density. Select the darkest shade that allows adequate task performance. For proper fit of protector; there shall be no penetration of direct visible light in all non-lens areas. Side shields shall have filtering capability equal to or greater than the front lenses. Welding helmets are intended to shield the eyes and face from optical radiation, heat, and impact. Welding helmets should not be used as a stand-alone protective devices and should be worn in conjunction with goggles or spectacles. Filter lens shade selection is to be made based on the welding process, arc current, electrode size and/or plate thickness. Use ANSI Z49.1:2012, Table 1, Guide for Shade Numbers, to select the proper filter lens shade for both protection and comfort (reduction in visible glare). Note: Filter lenses shall meet the requirements for shade designations in table 6 of ANSI Z87.1-2015	Welding: **W** *shade number* UV: **U** *scale number* Visible: **L** *scale number* IR: **R** *scale number* Variable tint: **V** Special purpose: **S**
Oxyfuel Gas Welding: Process Examples: Oxyfuel Gas Welding (OFW) Viewing gas-fired furnaces and boilers	•Welding goggles •Welding helmet over spectacles or goggles •Welding faceshield over spectacles or goggles TYPICAL FILTER LENS SHADE: 6 -8		
Oxyfuel or Oxygen Cutting	•Welding goggles •Welding helmet over spectacles or goggles •Welding faceshield over spectacles or goggles TYPICAL FILTER LENS SHADE:3-6		
Torch brazing	•Welding goggles •Welding helmet over spectacles or goggles •Welding faceshield over spectacles or goggles TYPICAL FILTER LENS SHADE: 3-4		
Torch soldering	•Spectacles •Welding faceshield over spectacles TYPICAL FILTER LENS SHADE: 2	Shade or special purpose lenses, as suitable. Note: Refer to definition of special purpose lenses in ANSI Z87.1-2015	
Glare	•Spectacles with or without side protection •Faceshield over spectacles or goggles		

European Standards Description

EN 166: 2002 Personal eye protection – specifications
EN 167: 2001 Personal eye protection – optical test methods
EN 168: 2001 Personal eye protection – non optical test methods
EN 169: 2002 Filters for welding and related techniques
EN 170: 2002 Specification for UV filters
EN 171: 2002 Specification for IR filters
EN 172: 2002 Specification for sunglare filters for industrial use
EN 174: 2001 Ski goggles for downhill skiing
EN 175: 1997 Eye and face protection during welding and allied processes
EN 379: 2003 Personal eye protection – Automatic welding filters

The EN166 standard is applicable to all types of personal eye protectors used against various dangers liable to damage the eye or to alter the vision, with the exception of radiation of nuclear origin, X rays, laser beams, infrared rays given out by sources at low temperatures. The specifications of this standard are not applicable to eye protectors for which separate and complete standards exist, such as anti-laser eye protector, all purpose solar spectacles, etc. The eye protectors fitted with corrective lenses are not excluded from the application field.

Application Chart

Standard	Symbol	Explanation
EN166	1	Optical Class
EN166	F	Low Energy Impact
EN166	B	Medium Energy Impact
EN166	9	Non adherence of molten metal and resistance to penetration of hot solids
EN166	3	Protection against liquid droplets/splashes
EN166	8	Protection against Short Circuit Electric Arc
EN169	3	Filters for personal eyes-protection equipment used in welding and similar operations, Scale number 3
EN169	5	Welding and braze welding of heavy metals. Welding with emitive fluxes (notably light alloys) Oxygen Cutting.
EN169	8	Filters for personal eyes-protection equipment used in welding and similar operations. Scale number 8
EN170	3-1, 2	For use with sources which emit predominantly Ultra Violet Radiation at wave lenghs shorter than 313 mm and when glare is not an important factor. This covers the UVC and most of the UVB bands. Low pressure mercury lamps such as germicidal lamps
EN171	4-5	Protection against infra red radiations. Typical application in terms of mean temperature sources up to 1390°C.

References:

Occupational Safety and Health Administration https://www.osha.gov
The National Institute for Occupational Safety and Health https://www.cdc.gov/niosh
American National Standards Institute https://www.ansi.org
The Safety Equipment Institute http://www.seinet.org
International Safety Equipment Association https://safetyequipment.org
European Committee for Standardization https://www.cen.eu
The European Union https://europa.eu
The British Standards Institution https://www.bsigroup.com