



## INTRODUCTION

U.S. government agencies estimate that there are about 2,000 eye injuries each day in American workplaces. Most injuries are caused by not wearing eye protection or wearing the wrong kind of eye protection needed for the job. Additionally, nearly 70 percent of eye injuries are caused by flying particles.

## NATURE OF THE HAZARD

The major eye and face hazards during welding and cutting include arc and heat rays, flying metal, slag from chipping, dirt, and particles from grinding. Because these hazards are so common in welding and cutting environments, proper selection and consistent use of eye and face protection are vital to avoid injury and blindness.

Note: This fact sheet does not address eye protection for welding operations involving lasers.

## HOW TO AVOID EYE AND FACE INJURIES

- Select the proper protection for the job - including other work going on nearby. Eye and face protectors for welding and related tasks, such as grinding and chipping, should comply with the requirements of ANSI Z87.1. Look for labels or markings indicating

compliance. Depending on the specific work task, appropriate eye/face protection may include safety glasses with side protection (side shields or wrap-around frames), goggles, face shields, welding helmets, curtains, or combinations of the above.

- Always wear safety glasses with top and side protection under your welding helmet.
- Keep eye and face protectors in place whenever the hazards are present. Not using them is the main cause of eye injury.
- Use the correct shade of filter in your welding helmet or goggles.
- Be sure eye protection devices are not damaged or missing parts, and be sure they fit properly.
- Whenever radiation or flying particles and spatter are a hazard, welding helmets should be selected that protect the face, forehead, neck, and ears. Additional protection may be needed for overhead welding, where spatter and rays can bounce back from nearby surfaces, and where hazards are created by nearby workers.
- Where feasible, welding areas should be isolated from other work areas by

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partitions or curtains designed to absorb harmful welding rays.

### **SELECTING PROTECTIVE EYEWEAR FOR ARC PROCESSES**

For all types of electric arc processes, a welding helmet complying with ANSI Z87.1, equipped with the correct shade filter, is required. See the chart at the end of this Fact Sheet for shade selection. In recent years welders have been able to choose between traditional “fixed-shade” welding filters and the newer “auto-darkening” filters. Following are some safety considerations for each type of filter.

#### **SAFETY CONSIDERATIONS FOR FIXED-SHADE FILTERS**

- Fixed-shade filters provide reliable protection as long as they are worn and in the down position.
- Welders must raise the helmet to see whenever there is no arc, to start a new weld, or to inspect a completed weld. This increases the possibility of eye and face injuries from flying metal fragments and “arc flash” or “welder’s eye”, where the surface of the eyeball is burned by arc or heat rays. These limitations can also cause welders to keep their helmet up until the arc is started, further increasing the chances of arc flash.
- Increased potential for neck injury or muscle strain from continual “snapping” or “nodding” the helmet up or down.
- Inability to see the precise location of the arc start accurately causing out-of-position starts.
- No light or dark shaded areas when looking through the filter.

### **SAFETY CONSIDERATIONS FOR AUTO-DARKENING FILTERS (ADFs)**

- ADFs allow continuous visibility of the work piece and arc zone before, during, and after striking an arc, and without raising the helmet.
- The need for “snapping” or “nodding” the helmet up or down is eliminated, reducing strain and possible neck injury.
- Keeping the helmet down more means less chance for eye injuries from flying particles or arc rays--particularly when welding in groups or near other workers.
- Higher accuracy in starting welds.
- ADFs include a special filter that blocks harmful radiation even if the main switching element fails.
- Blocked light sensors, dead batteries, improper sensitivity settings, or using ADFs in very cold temperatures can prevent switching to the dark shade when an arc is struck, resulting in temporary “blind spots,” similar to the effects of a camera flash.

### **SELECTING PROTECTIVE EYEWEAR FOR OXY-FUEL PROCESSES**

- Always wear safety glasses with side shields or goggles with the correct filter shade.
- Choose goggles/safety glasses appropriate for the work area—dust, dirt, and some airborne vapors require specific goggle types—see ANSI Z87.1 for the complete details.

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- If goggles are used, they should be vented to prevent fogging.
- When full-face protection is needed, such as when working overhead or during cutting, use of a full-face shield or helmet over safety glasses of the correct filter shade is recommended.
- Be sure the selected glasses or goggles meet the impact, heat, and filtering requirements specified in ANSI Z87.1— look for a label on the carton and product stating compliance.

## SUMMARY

- Always choose welding helmets and eyewear that meets the requirements of ANSI Z87.1 to ensure proper vision protection. Filter lens and ADFs should be marked with the manufacturers name or logo, the desired shade number (or shade range for variable ADFs), and “Z87.1.”
- Maintain welding helmets and eyewear in good condition—inspect them regularly and replace parts as needed.
- Clean eyewear as needed according to the manufacturer’s recommendations, and after use by others.
- Always read, understand, and follow the manufacturer’s instructions.

Remember: The eyewear you choose and wear is your first line of defense in preventing eye injury and blindness.

## INFORMATION SOURCES

American National Standards Institute (ANSI). *Safety in Welding, Cutting, and Allied Processes*, Z49.1, available from

American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 (phone: 800–443–9353, website: [www.aws.org](http://www.aws.org)).

American National Standards Institute (ANSI). *Practice for Occupational and Educational Eye and Face Protection* (ANSI Z87.1), available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

American Welding Society (AWS). *Lens Shade Selector*, AWS F2.2, available from American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 (phone: 800–443–9353, website: [www.aws.org](http://www.aws.org)).

Occupational Safety and Health Administration (OSHA). *Code of Federal Regulations*, Title 29 Labor, Parts 1910, available from U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250–7954 (phone: 800–321–6742, website: [www.osha.gov](http://www.osha.gov)).

National Fire Protection Association (NFPA). *Standard for Fire Prevention during Welding, Cutting, and Other Hot Work* (NFPA 51B), available from National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269–9101 (phone: 800–344–3555, website: [www.nfpa.org](http://www.nfpa.org)).

Bolton, Corinne. 1997. “Autodarkening Filters Light the way to Welder Comfort and Safety,” in *Welding Journal Special Report: Staying Safe On the Job*. May 1997.

Lyon, T. L. 2002. “Knowing the Dangers of Actinic Ultraviolet Emissions,” in *Welding Journal*. Vol. 81, No. 12, December 2002.

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Sliney, D. H. 1992. "A Safety Manager's Guide to the New Welding Eye Filters," in *Welding Journal*. Vol 71, No. 9, September 1992.

Sliney, D. H. and Freasier, B. C. *Evaluation of Optical Radiation Hazards*, Applied Optics, Vol 12, pp. 1-24, January 1973.

U.S. Department of Labor: Program Highlights Fact Sheet No. OSHA 92-03. "Eye Protection in the Workplace." This is one of a series of Fact Sheets highlighting U.S. Department of Labor programs.

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This chart provides minimum suggested protective lens shades and suggested comfort lens shades for a variety of commonly used welding and cutting processes. It is adapted from the 2001 Edition of ANSI F2.2.

## LENS SHADE SELECTOR

Shade numbers are given as a guide only and may be varied to suit individual needs.

Process	Electrode Size in. (mm)	Arc Current (Amperes)	Minimum Protective Shade	Suggested* Shade No. (Comfort)
<b>Shielded Metal Arc Welding (SMAW)</b>	Less than 3/32 (2.4)	Less than 60	7	-
	3/32-5/32 (2.4-4.0)	60-160	8	10
	5/32-1/4 (4.0-6.4)	160-250	10	12
	More than 1/4 (6.4)	250-550	11	14
<b>Gas Metal Arc Welding (GMAW) and Flux Cored Arc Welding (FCAW)</b>		Less than 60	7	-
		60-160	10	11
		160-250	10	12
		250-500	10	14
<b>Gas Tungsten Arc Welding (GTAW)</b>		Less than 50	8	10
		50-150	8	12
		150-500	10	14
<b>Air Carbon Arc Cutting (CAC-A)</b>	<b>(Light)</b>	Less than 500	10	12
	<b>(Heavy)</b>	500-1000	11	14
<b>Plasma Arc Welding (PAW)</b>		Less than 20	6	6 to 8
		20-100	8	10
		100-400	10	12
		400-800	11	14
<b>Plasma Arc Cutting (PAC)</b>		Less than 20	4	4
		20-40	5	5
		40-60	6	6
		60-80	8	8
		80-300	8	9
		300-400	9	12
		400-800	10	14
<b>Torch Brazing (TB)</b>		-	-	3 or 4
<b>Torch Soldering (TS)</b>		-	-	2
<b>Carbon Arc Welding (CAW)</b>		-	-	14

  

	Plate Thickness		Suggested* Shade No. (Comfort)	
	in.	mm		
<b>Oxyfuel Gas Welding (OFW)</b>	Light	Under 1/8	Under 3	4 or 5
	Medium	1/8 to 1/2	3 to 13	5 or 6
	Heavy	Over 1/2	Over 13	6 or 8
<b>Oxygen Cutting (OC)</b>	Light	Under 1	Under 25	3 or 4
	Medium	1 to 6	25 to 150	4 or 5
	Heavy	Over 6	Over 150	5 or 6

\*As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding, cutting, or brazing where the torch and/or the flux produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line of the visible light spectrum.

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