



Eye and Face Protection for Welding and Cutting Operations

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 radiation, 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. (See Safety and Health Fact Sheet No. 46)

HOW TO AVOID EYE AND FACE INJURIES

- Select the proper personal protective equipment (PPE) 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:

Z87+ - rated for a high-velocity impact

W – welding protection

U – UV protection

R – ultraviolet protection

L – visible light filter

- 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 or face shield.
- Always keep eye and face protectors in place whenever the hazards are present. See ANSI Z49.1 or the Lens Shade Selector found at the bottom of this Safety and Health Fact Sheet for 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 arc radiation, flying particles, or spatter are a hazard, welding helmets or appropriate face shields and safety eye glasses should be selected that provide

- proper face, forehead, neck, and ear protection. Additional protection may be needed for welding, where spatter and arc radiation 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 partitions or curtains designed to absorb harmful arc radiation.

SELECTING PROTECTIVE EYEWEAR FOR ARC PROCESSES

For all types of electric arc processes, a welding helmet complying with ANSI Z49.1 and ANSI Z87.1, equipped with the correct shade filter, is required. See the chart at the end of this Fact Sheet for shade selection. 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 radiation. 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 and face injuries from flying particles or arc radiation--particularly when welding in groups or near other workers. Safety glasses shall be worn under the helmet.
- 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.
- If goggles are used, they should be vented to prevent fogging.
- Whenever flying particles, or spatter are a hazard, welding helmets or appropriate face shields and safety eye glasses should be selected that provide proper face, forehead, neck, and ear protection. Additional protection may be needed for welding, where spatter can bounce back from nearby surfaces, and where hazards are created by nearby workers.
- 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

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, American National Standards Institute, <www.aws.org>.

ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*, American National Standards Institute, <www.ansi.org>.

AWS F2.2, *Lens Shade Selector (AWS F2.2)*, American Welding Society, <www.aws.org>.

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U.S. Department of Labor programs.

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)
Shielded Metal Arc Welding (SMAW)	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
Gas Metal Arc Welding (GMAW) and Flux Cored Arc Welding (FCAW)		Less than 60	7	-
		60-160	10	11
		160-250	10	12
		250-500	10	14
Gas Tungsten Arc Welding (GTAW)		Less than 50	8	10
		50-150	8	12
		150-500	10	14
Air Carbon Arc Cutting (CAC-A)	(Light)	Less than 500	10	12
	(Heavy)	500-1000	11	14
Plasma Arc Welding (PAW)		Less than 20	6	6 to 8
		20-100	8	10
		100-400	10	12
		400-800	11	14
Plasma Arc Cutting (PAC)		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
Torch Brazing (TB)		-	-	3 or 4
Torch Soldering (TS)		-	-	2
Carbon Arc Welding (CAW)		-	-	14

	Plate	Thickness	Suggested* Shade No. (Comfort)
	in.	mm	
Oxyfuel Gas Welding (OFW)			
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
Oxygen Cutting (OC)			
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.

American Welding Society
8669 NW 36 Street, #130
Miami, Florida 33166
E-mail: info@aws.org
<http://www.aws.org>

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