

3M Occupational Health and Environmental Safety Division  
Products for Welder Safety



# Keeping Welders Smart about Safety

A Guide to Understanding Welding Hazards and Safety Equipment



# As a welding professional, you could be exposed to a variety of health and safety hazards.

Help protect yourself with safety equipment designed for welding hazards and your comfort.

There are many potential health hazards related to welding and other metalworking applications. Some of the more common hazards include:

- Respiratory exposure to welding fumes, vapors and grinding particles
- Eye and face impacts
- Foreign-object eye injuries
- Arc radiation burns
- Noise-induced hearing loss
- Heat stress

**3M offers a complete line of safety products that can help enhance safety and keep workers comfortable in most welding applications.**

## Toxic Fumes and Gases

Studies show that full-time welders are at increased risk of bronchitis, airway irritation, lung function changes, pulmonary infections (pneumonia), and lung cancer<sup>1</sup>. Recent studies suggest a possible link between welding fume and nerve disorders<sup>1</sup>. Respiratory hazards in welding can be divided into two main categories:

### Welding Fume

The primary airborne contaminant found in arc welding is welding fume. Welding fume is a complex mixture of very small particles of metal oxides. The specific components depend on the composition of the welding electrode (stick, wire or filler rod), base metal, surface coatings and the type of shielding gas or flux.

### Gases and Vapors

When electrode coatings, fluxes, shielding gases and surface coatings are burned or exposed to ultraviolet arc rays, they can generate potentially harmful gases, such as carbon monoxide, ozone, nitrogen oxides, gaseous fluoride and phosgene.



Whenever feasible, local and area ventilation systems should be used to remove harmful fumes and gases. However, in many cases engineering controls alone cannot reduce exposure levels adequately. In these situations, it may be appropriate to use respirators. For most welding applications, an array of respirator options exist that offer specific benefits and limitations. A summary of the most common respirator categories for welding is presented in Table 1.

1. Health Effects of Welding. Antonini (Health Effects Laboratory Division, NIOSH), Critical Reviews in Toxicology, 2003.

### NEW

On November 15, 2007, the Occupational Safety and Health Administration (OSHA) issued a new paragraph to the existing standard 29 CFR 1910.132, Personal Protective Equipment. The new paragraph, (h) *Employer Payment for Personal Protective Equipment (PPE)*, mandates that employers provide required PPE at no cost to employees. For further information regarding this standard, please go to [www.3M.com/OccSafety](http://www.3M.com/OccSafety) and look for 'Regulations'.

**WARNING! See warnings on back cover.**



**TABLE 1:**

Respiratory Protection Options for Various Welding Applications	Maintenance-Free 	Elastomeric Half-Facepiece 	Powered Air Loose-Fitting 	Supplied Air Elastomeric With Dual Airline 	Supplied Air Loose-Fitting 
<b>APF<sup>2</sup></b>	<b>10</b>	<b>10</b>	<b>25/1000<sup>3</sup></b>	<b>50</b>	<b>25/1000<sup>3</sup></b>
<b>Particles</b>					
General Dust	■	■	■	■	■
<b>Metal Fume</b>					
Steel/Manganese Alloys	■	■	■	■	■
Stainless Steel/Chromium Alloys	■	■	■	■	■
Aluminum	■	■	■	■	■
Galvanized Steel	■	■	■	■	■
Cadmium		■ <sup>4</sup>	■	■	■
Lead		■ <sup>4</sup>	■	■	■
<b>Gases</b>					
Ozone	■ <sup>5</sup>	■ <sup>5</sup>		■	■
Byproducts of Combustion of Coatings		■ <sup>6</sup>		■	■
Carbon Monoxide				■	■
Carbon Dioxide				■	■
Phosgene				■	■
Oxides of Nitrogen				■	■

2. Assigned Protection Factor (APF) is the level of protection a class of respirator is expected to provide when selected and used properly under real-world conditions. APFs for each respirator class are listed in the table shown. To determine the maximum concentration of a substance in which a respirator can be used, multiply its APF by the exposure limit of the substance. APF ratings assume compliance with all required elements of a Respiratory Protection Program.

3. APF = 25 for headgear classified as Loose-fitting. APF = 1000 for headgear classified as Helmets (neck sealing). No fit testing required.

4. OSHA regulations for these contaminants require the use of NIOSH class 100 particle filters (e.g. P100).

5. 3M recommended for applications where ozone and nuisance level organic vapors may be present. 3M recommended for ozone protection up to 10 times the OSHA PEL or applicable government occupational exposure limits, whichever is lower. Not NIOSH approved for use against ozone. 3M recommended for relief from nuisance levels of organic vapors. Nuisance level organic vapors refer to concentrations not exceeding the OSHA PEL, or applicable government occupational exposure limits, whichever is lower. Do not use when concentrations of contaminants are immediately dangerous to life and health or are unknown.

6. The combustion of metal coatings during welding can produce a wide range of particle and vapor contaminants. Seek the advice of a Certified Industrial Hygienist or other qualified professional when selecting a respirator cartridge for these situations.

**WARNING! See warnings on back cover.**

# Choose the Respirator with the Features you Need

3M has a wide selection of respirators specifically designed for welding applications. Choose maintenance-free, reusable, or powered or supplied air systems with features that help make welders feel comfortable and help provide the protection they need.



**Cool Flow™ Exhalation Valve**  
Patented one-way valve for easy exhalation and cool, dry comfort.



**Adjustable Noseclip**  
Adjusts easily for greater comfort plus less eyewear fogging.



**Carbon Filter Material**  
Carbon layers remove many nuisance level odors for greater wearer comfort.



**Adjustable Buckle Straps**  
A single tug helps provide a comfortable, secure fit.



**Welding Web**  
Unique filter media and protective layers are designed to be flame resistant as demonstrated per ASTM D2859-96. (Not a substitute for a faceshield.)



**Cake-Resistant Filter Media**  
Specially designed filter layers for welding applications provide longer respirator life and easier breathing.



**Faceseal**  
Soft and secure, conforms closely to face for long-lasting comfort.

	Cool Flow™ Exhalation Valve	Adjustable Noseclip	Carbon Filter Material	Adjustable Buckle Straps	Welding Web	Cake-Resistant Filter Media	Faceseal
<b>NON-OIL APPLICATIONS</b>	 8515/N95	✓	✓				
	 8212/N95	✓	✓	✓	✓	✓	✓
	 8512/N95	✓	✓		✓	✓	
	 8214/N95	✓	✓	✓ OV/OZ	✓	✓	✓
	 8514/N95	✓	✓	✓ OV/OZ	✓	✓	✓
 6000 Series				✓			✓
 7500 Series-Silicone	✓			✓			✓
<b>OIL-PROOF APPLICATIONS</b>	 2071/P95				✓	✓	
	 2091/P100				✓	✓	
	 2097/P100			✓ OV/OZ	✓	✓	
	 7093C/P100			✓	✓	✓	

95 – At least 95% efficient

100 – At least 99.97% efficient

OZ – 3M recommended for ozone protection up to 10X OSHA PEL. Not NIOSH approved for ozone.

OV – 3M recommended for nuisance level organic vapor relief. Nuisance levels are less than OSHA PEL.

**WARNING! See warnings on back cover.**

# Arc Radiation and Eye/Face Impact Hazards



According to the U.S. Bureau of Labor Statistics report, *Nonfatal Occupational Injuries And Illnesses Requiring Days Away From Work - 2006*, welders, cutters, solderers, and brazers have the highest rate of lost-time eye injuries, at a staggering 55 incidents per 10,000 full-time workers. The report shows that welders are approximately 14 times more likely to sustain an eye injury than the average worker.

**Arc-eye** occurs when the surface of the eye is exposed to excessive ultraviolet (UV) radiation—usually when an arc is accidentally struck while the welding helmet is in the up position or the eyes are otherwise unprotected. Long-term over-exposure to arc radiation is linked to retinal burns, cataracts and skin cancer.

**Foreign body eye injuries** occur when material such as dust, grinding swarf or weld spatter gets into the eye. When a particle(s) penetrates the outer layer of the eye and enters the eye it is called a penetrating foreign body. These particles or objects are usually traveling at high speed and are commonly made of metal. A penetrating eye injury can be extremely serious, leading to blindness if not detected and treated promptly.

**Speedglas™ Welding Helmets and Auto-Darkening Filters (ADFs)** from 3M help reduce these and other injuries by allowing welders to keep their helmets down between welds. There are also ergonomic and possible productivity benefits due to welders not having to constantly raise and lower their shield to inspect their work.

## Speedglas 9000 Series Helmet Assemblies



## Super Light (SL)



### Auto-Darkening Filter options include:

- Various Shades and Viewing Area Dimensions • MIG, Stick, TIG • Solar Panel
- Various Sensitivity Adjustments and Delay Settings • Membrane-Covered Control Buttons



### 3M™ ClearVisor with Adflo™ System



### 3M™ Protective Eyewear

In light of welders' increased risk of eye injuries, OSHA requires welders to wear ANSI Z87.1-2003 compliant spectacles (safety glasses) in addition to any welding helmet. 3M's lightweight, protective eyewear can be comfortably worn with Speedglas and other welding helmets, and there are many configurations available for use in a wide range of conditions. All 3M protective eyewear features polycarbonate lenses, which absorb 99% of harmful UV\* from sunlight.

\*Not for protection from UV radiation from arc welding.

**⚠ WARNING! See warnings on back cover.**

# Top Impacts

Head impacts are among the most common injuries that occur in all industries. For this reason, industry standards have been established to help protect head impact injuries. 3M offers a line of hardhats that can be used in virtually all industrial applications. These hardhats meet the requirements of ANSI Z89.1-2003, Type I - Class C, E, and G. They are available with a slide or ratchet suspension for size adjustment.

In addition, 3M offers hardhat options specifically designed for welders:

- **Speedglas™ ProTop System** – Offers an exclusive pivot mechanism that “nests” the welding helmet down low over the hardhat, in a balanced, secured position. The lower center-of-gravity helps reduce neck strain.
- **Helmet Systems Headgear L-Series 700 and 900** – These hardhat/helmets can be used with 3M™ Powered or Supplied Air Respirator Systems. They are designed for welding operations which must have both respiratory protection and top impact protection (Z89.1-2003). Assigned protection factors of 25 and 1000 x PEL (depending on helmet). Some models meet ANSI Type I, II hardhat requirements.

3M recommends:

- **Speedglas™ Welding Helmets 9000 Series** assembled with certain hardhat models using a “Speedy Mounting Loop” Model 5000 manufactured by Fibre-Metal® (or Speedy-Loop).



**Speedglas™ ProTop System**

**3M™ Helmet L-905 with Welding Shield**



**Approved Hardhat**



**Speedy Mounting Loop**



**Speedglas Welding Helmet 9000 Series**



**CAUTION:** Assembling a welding helmet and hardhat using components from different manufacturers or brands will void ANSI compliance (Z89.1.2003) unless testing verifies that the assemblies remain compliant with the ANSI performance requirements. Please visit [www.3M.com/OccSafety](http://www.3M.com/OccSafety) or call 1-800-328-1667 to learn the configurations that successfully meet the impact test requirements of ANSI Z87.1-2003 and Z89.1-2003.

**WARNING! See warnings on back cover.**

## Noise Hazards

By themselves, certain welding processes may produce hazardous noise levels. Examples include high amperage AC and carbon/arc gouging. However, most metal fabrication operations involve noise hazards, if not from welding then from some related operation such as grinding, stamping or ventilation equipment. A variety of hearing protectors are available from 3M to help reduce hearing loss.

**3M™ Banded Hearing Protector 1310**



**3M™ Reusable Ear Plugs 1290**

## Heat Stress

Occupational heat stress exposure is a serious concern, especially in extreme summer heat. Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities have a potential for inducing heat stress in employees engaged in such operations. Occupational heat stress can result in costly down time and potentially life-threatening situations.

3M products that help reduce or control and evaluate the effects of heat stress include:

- **3M™ Vortex Cooling Assembly V-100 Series** – Used to cool air supplied to 3M™ High Pressure Supplied Air Respirator Systems that use 3M™ L-Series Headgear by up to 50°F (28°C). The assembly allows the user to adjust airflow and temperature for personal comfort.
- **Speedglas™ Adflo™ Powered Air Purifying Respirator Systems for Welders** – These systems do not allow for actual cooling of breathing air, but they do supply a continuous flow of fresh, filtered air over the welder's face, reducing stuffiness and fogging inside the helmet and greatly helping increase welder comfort.
- **3M™ WIBGET™ Heat Stress Monitor RSS-214** – This product can monitor certain environmental factors that may contribute to heat stress.



**3M™ WIBGET™ Heat Stress Monitor RSS-214**



**3M™ Vortex Cooling Assembly V-100 Series with L-Series Headgear and Supplied Air System**

**⚠ WARNING! See warnings on back cover.**

 <p><b>⚠️WARNING</b>  <b>Filtering Facepiece Respirators, Half and Full Facepiece Respirators (See pages 3-4.)</b></p> <p>These respirators help reduce exposure to certain airborne contaminants. <b>Misuse may result in sickness or death.</b> For proper use, see <i>User Instructions</i> in package, supervisor, or contact 3M OH&amp;ESD Technical Service at 1-800-243-4630. In Canada, call 1-800-267-4414.</p>	<p><b>⚠️WARNING</b>  <b>Head Protection Products (See page 6.)</b></p> <p>These hardhats provide limited protection only. <b>Misuse or failure to follow warnings and instructions may result in serious personal injury or death.</b> For proper use, see supervisor, read <i>User Instructions</i> and warnings on the package, or call 3M OH&amp;ESD Technical Service in the USA at 1-800-243-4630. In Canada, call 1-800-267-4414.</p> <p>Bumpcaps do not provide protection against impact from falling or glancing objects. They do not protect against electrical hazards. Bumpcaps do not meet the requirements of the American National Standard for Industrial Head Protection ANSI Z89.1-2003. When head protection is required, wear a protective hardhat or helmet that meets the requirements of ANSI Z89.1-2003.</p>
<p><b>⚠️WARNING</b>  <b>Heat Stress Monitor (See page 7.)</b></p> <p>This monitor helps to measure certain environmental factors that can contribute to heat stress. <b>Misuse may result in sickness or death.</b> For proper use, see supervisor or <i>User Instructions</i>, or call 3M in U.S.A., 1-800-243-4630. In Canada, call Technical Service at 1-800-267-4414.</p>	<p><b>⚠️WARNING</b>  <b>Eye and Face Protection Products (See pages 5.)</b></p> <p>These eye and face protection products help provide limited eye and face protection against flying particles. <b>Misuse or failure to follow warnings and instructions may result in serious personal injury, including blindness, or death.</b> For proper use, see supervisor, read <i>User Instructions</i> and warnings on the package, or call 3M OH&amp;ESD Technical Service in the USA at 1-800-243-4630. In Canada, call 1-800-267-4414.</p>
 <p><b>⚠️WARNING</b>  <b>Positive Pressure Respirators (See page 5.)</b></p> <p>These respirators help reduce exposure to certain airborne contaminants. Use of 3M™ Positive Pressure Respirators by untrained or unqualified persons, or use not in accordance with the <i>User Instructions</i> or operator's manual, may adversely affect product performance and <b>result in sickness or death.</b></p> <p>Positive pressure respirators are to be used only by qualified persons who are properly trained in their use and maintenance, and only in accordance with their operating and maintenance manuals. For proper use, each person using these products must first read and understand the operator's manual. See supervisor for assistance or call 3M Technical Service at 1-800-243-4630. In Canada, call 3M OH&amp;ESD at 1-800-267-4414.</p>	<p><b>⚠️WARNING</b>  <b>Welding Products (See page 5.)</b></p> <p>These welding safety products must be used only by qualified persons trained in their use and maintenance and only in strict accordance with and adherence to the detailed instructions and precautionary statements provided in the instruction manual which accompanies each product. <b>Failure to comply with these instructions could result in sickness, serious bodily injury or loss of life.</b></p> <p>For proper use of these products, read <i>User Instructions</i> and warnings on the package. Any questions concerning proper use should be directed to your supervisor, on-site training specialist, industrial hygienist or 3M Occupational Health and Environmental Safety Division (OH&amp;ESD) Technical Service in the U.S.A. at 1-800-243-4630. In Canada, call 1-800-267-4414.</p>
<p><b>⚠️WARNING</b>  <b>Hearing Protection Products (See page 7.)</b></p> <p>These hearing protection products help prevent hearing loss against certain noises. To provide proper protection, the hearing protector should be (1) suitable for the job, (2) fitted properly in/on the ear, (3) worn during all times of exposure to noise, and (4) replaced when damaged or otherwise necessary. Failure to fit and use proper hearing protectors according to these instructions will reduce their effectiveness. Failure to wear hearing protectors 100% of the time that you are exposed to hazardous noise may dramatically increase your risk of developing hearing loss. Keep ear plugs away from infants and small children. They may get caught in a child's windpipe. For more information, call 3M OH&amp;ESD Technical Service at 1-800-243-4630. In Canada, call 1-800-267-4414.</p>	

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**For More Information**

**In U.S.**

Technical Assistance 1-800-243-4630  
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