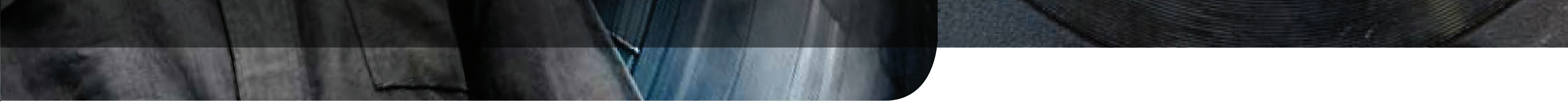


Frequently Asked Questions about Hexavalent Chromium and Manganese

Hexavalent Chromium(CrVI) is a form of the metal chromium that rarely occurs naturally and is most commonly produced by industrial processes. It has the ability to gain electrons from other elements (a strong oxidizer) which means it can react easily with them. Because of its ability to react with other elements, it can produce hard coatings, which is why it is used in paints for boats, cars and airplanes. Hexavalent chromium fume (a small metal particle) can also be generated when performing "hot work" such as welding on stainless steel or melting chromium metal. In these situations the chromium is not originally hexavalent, but the high temperatures involved in the process result in oxidation that converts the chromium to the hexavalent state. These properties are also what make it a health hazard. Hexavalent Chromium is often referred to as Hex Chrom, Hex Chrome, Chromium 6, Hexa Chrom, Cr(VI), or HexChrome.

Manganese is a grey-white metal resembling iron. Manganese is used extensively to produce a variety of important alloys and to desulfurize and deoxidize steel. Manganese is also in many welding rods and filler metals to promote hardness. Manganese oxide fume is formed when manganese metal is heated and reacts with oxygen in the air such as occurs during welding.

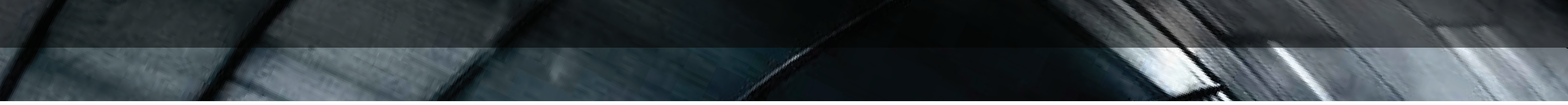
One of the more recent ailments identified by the National Institutes of Health (www.nih.gov) that can afflict welders is manganism, also known as welder's disease. Overexposure to manganese fume has been linked to weakness/lethargy, speech and psychological disturbances, paralysis, and tremors.

To help reduce the risk of adverse health effects caused by exposures to airborne materials such as Cr(VI) and manganese, the United States Occupational Safety and Health Administration (OSHA) has established permissible exposure limits (PELs) which are law. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) sets threshold limit values (TLVs®) which are airborne exposure limit guidelines., TLVs® are often used by industrial hygienists because they are evaluated on a more frequent basis than OSHA PELs.

Standards, Regulations and Enforcement Cr(VI)

On February 28th, 2006 (OSHA) published the final Hexavalent Chromium (CrVI) Standard. There are three versions of the standard: General Industry (1910.1026), Construction (1910.1126), and Shipyards (1515.1026). The requirements of each standard are very similar.

All CrVI inhalation exposure is covered by these rules, with the exception of exposures from Portland Cement and application of regulated pesticides, e.g. treatment of wood with pesticides (exposures resulting from sawing or sanding treated wood are covered). The OSHA PEL for all industries is 5 micrograms per cubic meter of air (5 µg/m3), reduced from 52 µg/m3, a difference of an order of magnitude. The PEL is a time weighted average (TWA) meaning it is a concentration limit for a conventional 8-hour workday and 40-hour workweek. The action level, or the level where many of the requirements of the standard such as medical surveillance may be required, is 2.5 µg/m3. There is no short term exposure limit (STEL).



The effective dates for implementing interim control measures, including respiratory protection were as follows:

- Employers with more than 20 employees – November 27, 2006
- Employers with less than 20 employees – May 30, 2007

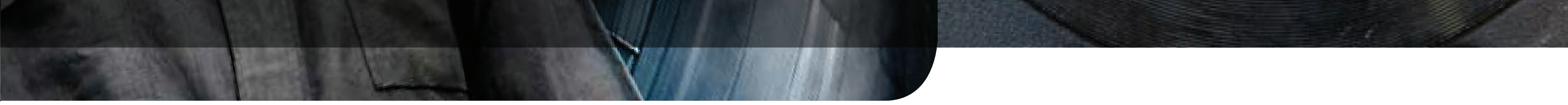
Feasible engineering controls to effectively reduce hexavalent chromium exposures to acceptable levels needed to be in place by May 31, 2010. Where engineering controls are not feasible other controls, such as administrative controls and/or personal protective equipment (PPE) must be implemented.

OSHA has implemented a new National Emphasis Program (NEP) to identify and reduce or eliminate the health hazards associated with occupational exposure to hexavalent chromium and other toxic substances commonly found in conjunction with hexavalent chromium. This NEP, which became effective February 23, 2010 targets industries where overexposures to hexavalent chromium are known to occur. A copy of this instructional manual can be found at: www.osha.gov/OshDoc/Directive_pdf/CPL_02-02-076.pdf

Manganese

The current OSHA PEL for manganese is 5 milligrams per cubic meter of air (5 mg/m^3). This PEL is a ceiling limit which means the exposure shall at no time exceed the exposure limit given for that substance. OSHA has had the same exposure limit for manganese since 1971.

The ACGIH TLV for manganese is a TWA limit of 0.1 mg/m^3. The 2012 edition of the ACGIH TLVs® and BEIs® includes a proposed revision to the manganese TLV®. This Notice of Intended Change (NIC) includes revising the current TLV-TWA for total manganese to 0.1 mg/m^3 for the inhalable fraction, and 0.02 mg/m^3 for the respirable fraction. The ACGIH's proposals should be considered trial values, and will remain on the NIC for approximately one year. If ACGIH neither finds nor receives any substantive data that changes its scientific opinion regarding an NIC TLV®, then the value is recommended for adoption by ACGIH. If they find or receive substantive data that changes its scientific opinion regarding the NIC TLV®, the recommendation could change to be either retained or withdrawn from the NIC. The respirable fraction is the smallest size fraction typically sampled, thus representing fume particles. This would most likely be the limit used for evaluating welding exposures.



Respiratory Protection for Cr(VI) and Manganese Exposure

In many cases, changes in manufacturing processes and engineering controls alone can't reduce exposure levels to below the occupational exposure limits (OELs). In such cases, it may be appropriate to use respiratory protection. For any particular application, an array of respirator types that provide an appropriate level of protection are available. The cost of these respirators may vary from around $1 for a basic negative-pressure, disposable, filtering facepiece to $1,000 or more for a powered or supplied-air system. Respirators should be selected based on results from air sampling and the necessary assigned protection factor (APF) as established within OSHA 29 CFR 1910.134. OSHA requires employers to implement a written respiratory protection program when respiratory protection is used. Elements of the written program include respirator selection, use, care and maintenance, medical evaluation, training, and fit testing.

Respirator Selection for Hexavalent Chromium Exposures

The table below shows suggested respiratory protection for hexavalent chromium up to the maximum use concentrations based on the OSHA APFs and PEL of 5 µg/m^3.

Exposure	Respiratory Protection
≤ 50 ug/m^3	Half Facepiece with N, R, or P class particulate filter (includes filtering facepiece respirator) Any other respirator with an APF ≥ 10
≤ 125 ug/m^3	Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece, Hood/Helmet, or Loose Fitting Facepiece Continuous flow supplied-air system with Full Facepiece, Hood/Helmet or Loose Fitting Facepiece
≤ 250 ug/m^3	Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece or Hood/Helmet Continuous flow supplied-air system with Full Facepiece or Hood/Helmet
≤ 5000 ug/m^3	PAPR with HEPA Filter and Full Facepiece or Hood/Helmet Continuous flow supplied-air system with Full Facepiece or Hood/Helmet(1)

(1) Manufacturer must provide evidence that hood/helmet respirator systems meet APF of 1,000

Respirator Selection for Manganese Oxide Fume Exposures

The table below shows suggested respiratory protection for manganese up to the maximum use concentrations based on the OSHA APFs and ACGIH TLV of 0.02 mg/m^3 for respirable fraction.

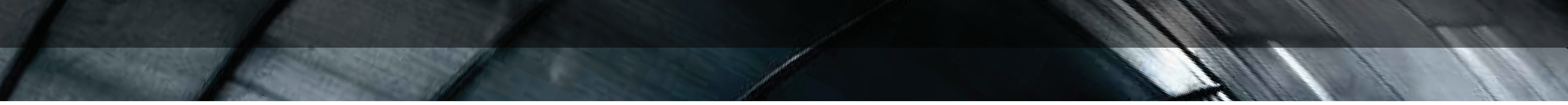
Exposure	Respiratory Protection
≤ 0.2 mg/m^3	Half Facepiece with N, R, or P class particulate filter (includes filtering facepiece respirator) Any other respirator with an APF ≥ 10
≤ 0.5 mg/m^3	Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece, Hood/Helmet, or Loose Fitting Facepiece Continuous flow supplied-air system with Full Facepiece, Hood/Helmet or Loose Fitting Facepiece
≤ 1 mg/m^3	Full Facepiece with N, R, or P class particulate filter PAPR with HEPA Filter and Full Facepiece or Hood/Helmet Continuous flow supplied-air system with Full Facepiece or Hood/Helmet
≤ 200 mg/m^3	PAPR with HEPA Filter and Full Facepiece or Hood/Helmet Continuous flow supplied-air system with Full Facepiece or Hood/Helmet(1)

(1) Manufacturer must provide evidence that hood/helmet respirator systems meet APF of 1,000

Summary

Cr(VI) and Manganese are found in many manufacturing processes. The proposed changes to manganese exposure levels may have an affect on various industries and industrial processes. As a precaution, review MSDS sheets for materials containing these substances in manufacturing processes. If there are questions regarding the air quality, it may be a good idea to discuss the option of air sampling with an industrial hygienist to better determine the levels of contaminants within a given process. If the air sampling results indicate exposure levels above the occupational exposure limit (either PEL or TLV, whichever the employer is using), changes to manufacturing processes, use of other engineering controls or PPE may be suitable choices to reduce employee exposures to acceptable levels.

Further questions regarding this article or selection of respiratory protection may be directed to 3M OH&ESD Technical Service at 1-800-243-4630.



How Auto-Darkening Filters Work

Before:

With the welding helmet in the safe, down position, you have a clear view through the welding filter. Both of your hands are free and the electrode can be precisely positioned.

During:

Within 0.1 milliseconds of the arc strike, the filter has switched to the dark state.

After:

The filter automatically returns to the clear state after welding is complete, allowing your immediate inspection of the weld pool, as well as preparation for the next weld.

Eye protection that helps increase your efficiency

The key to remember with 3M™ Speedglas™ Auto Darkening Welding Filters is consistency. They enable consistent, comfortable viewing and provide protection from ultraviolet and infrared (UV/IR) radiation. They consistently auto-switch from clear to dark, and back again, to help increase productivity while you weld.

Awkward made easier

Speedglas welding filters also help reduce neck-strain from "helmet nodding," while greatly increasing the accuracy of electrode placement. This, in turn, reduces the need for grinding and rework. In addition, you can get into tight, cramped spaces with your eye and face protection already in place. The filter's, clear optics make even extremely awkward welds easier.

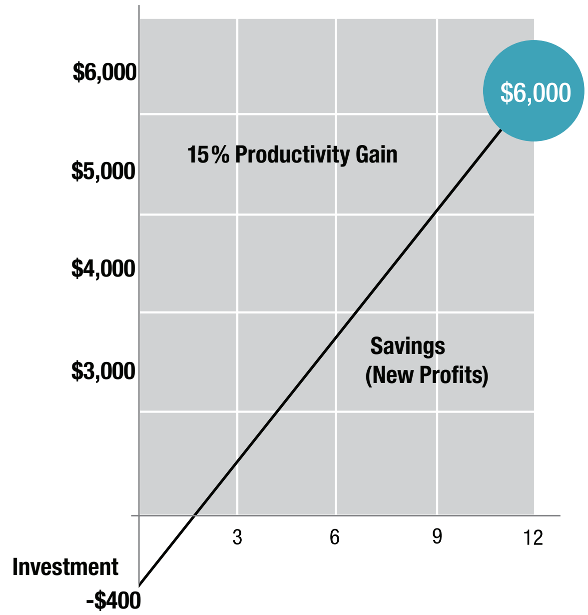
How fast does a 3M™ Speedglas™ Welding Helmet pay for itself?

If profitability is defined in terms of protection, one day is enough. But while "protection" sometimes can be difficult to measure, efficiency and weld quality are much easier to gauge. Studies show that you can increase efficiency substantially when using Speedglas auto-darkening welding filters. Not only can you work faster when you can see clearly, but you move more efficiently, placing electrodes more precisely.

Most "bad weld starts" can be reduced and fewer bad welds mean less grinding and higher overall quality levels.

For example:

Productivity gains are, of course, dependent on the application. If you do lots of tack welds, you will have much greater productivity gains than a welder doing long seam welds. With that said, this example uses a conservative 15% gain in productivity. If cost for salary is $20 per hour, the welding helmet will pay for itself in approximately two months. In one year the productivity gain could be up to $6000 in savings (also known as new profits). Note: Dollar amounts are approximate and may vary.



Recommended guide for shade numbers according to ANSI Z49.1 -2012

<table>
<tr><th rowspan="2">Welding process</th><th colspan="25">Current in amperes
A</th></tr>
<tr><th>1.5</th><th>6</th><th>10</th><th>20</th><th>30</th><th>40</th><th>60</th><th>70</th><th>100</th><th>125</th><th>150</th><th>175</th><th>200</th><th>225</th><th>250</th><th>300</th><th>350</th><th>400</th><th>450</th><th>500</th><th>600</th><th>700</th><th>800</th><th>900</th><th>1000</th></tr>
<tr><td>Shielded Metal Arc</td><td colspan="6"></td><td colspan="5">10</td><td colspan="3">12</td><td colspan="6">14</td><td colspan="5"></td></tr>
<tr><td>Gas Metal Arc Welding</td><td colspan="6"></td><td colspan="5">11</td><td colspan="3">12</td><td colspan="5">14</td><td colspan="6"></td></tr>
<tr><td>Gas Tungsten Arc Welding</td><td colspan="6">10</td><td colspan="4">12</td><td colspan="9">14</td><td colspan="6"></td></tr>
<tr><td>Air Carbon Arc Cutting</td><td colspan="19">12</td><td colspan="6">14</td></tr>
<tr><td>Plasma Arc Welding</td><td colspan="3">6-8</td><td colspan="5">10</td><td colspan="9">12</td><td colspan="5">14</td><td colspan="3"></td></tr>
<tr><td>Plasma Arc Cutting</td><td colspan="15">9</td><td colspan="2">12</td><td colspan="5">14</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Carbon Arc Welding</td><td colspan="25">14</td></tr>
<tr><td>1.5</td><td>6</td><td>10</td><td>15</td><td>30</td><td>40</td><td>60</td><td>70</td><td>100</td><td>125</td><td>150</td><td>175</td><td>200</td><td>225</td><td>250</td><td>300</td><td>350</td><td>400</td><td>450</td><td>500</td><td>600</td><td>700</td><td>800</td><td>900</td><td>1000</td></tr>
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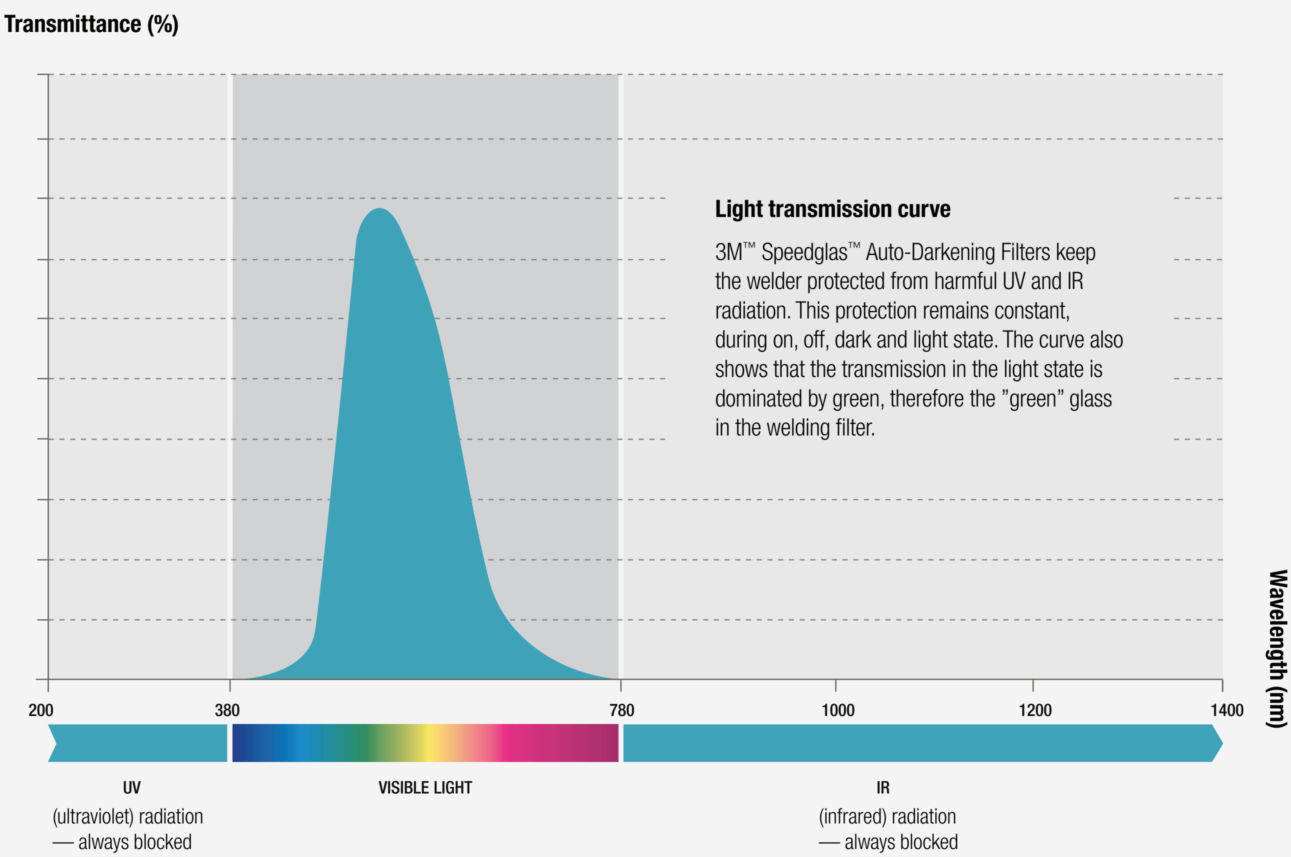
The table recommends best dark shade of welding filter for various working applications.
According to the conditions of use, the next greater or the next smaller scale number can be used.



Light transmission curve

3M™ Speedglas™ Auto-Darkening Filters keep the welder protected from harmful UV and IR radiation. This protection remains constant, during on, off, dark and light state. The curve also shows that the transmission in the light state is dominated by green, therefore the "green" glass in the welding filter.

Changes to the ANSI Z87.1-2010 Standard for Eye and Face Protective Devices*

The ANSI/ISEA Z87.1-2010, replaces the Z87.1-2003 standard. As of the date of this summary, the Occupational Safety and Health Administration (OSHA) has not incorporated the 2010 standard into the eye and face protection regulation (29 CFR 1910.133). OSHA accepts the three latest ANSI standards (1989, 2003 and 2010).

This summary of the revision of this eye and face protection standard focuses on the key changes to the standard; it does not represent any official or legal interpretation of the standard or even serve as a complete summary of the revision. If questions occur, the revised standard itself should be reviewed and relied on, rather than this summary.

The key changes to the eye and face protection standard include:

A focus on the hazard, rather than on the protector type, to encourage safety personnel and users to evaluate and identify specific hazards in their workplace such as Impact, Optical Radiation, Splash, Dust, and Fine Dust Particles. Therefore, under the revised standard, selection of the appropriate eye and face protective devices should be based on the hazard.

Performance Markings

Users will now be able to match the hazard they need protection from by identifying marks located on the protectors, spectacles, goggles, faceshields and welding helmets.

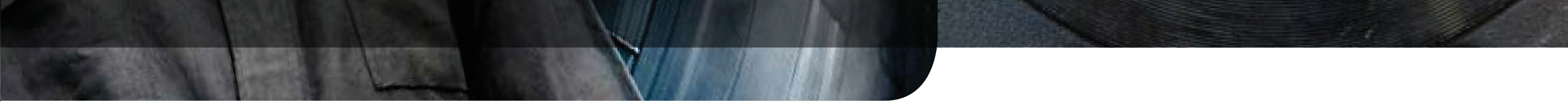
The standard includes performance requirements for dust and mist, as well as for UV (ultra violet), visible light and IR (infra red) filters. Testing is optional, however if a manufacture wants to claim any specific performance the protectors must be tested and marked according to requirement listed in Table 4a of the standard.

- Welding lenses shall be marked W followed by shade number.
- UV protectors shall be marked U followed by scale number.
- IR protectors shall be marked R followed by scale number.
- Visible Light filters shall be marked L followed by a scale number.
- Special purpose lenses (less than 85% transmission) shall be marked S.
- Variable tints lens (photochromic) shall be marked with a V.

There are also specific performance and marking requirements for devices claiming to provide protection from splash/droplet, dust or fine dust hazards. The Splash/Droplet Test is intended to determine the capability of the goggle to keep liquid splashes or sprays from reaching the wearer's eyes.

The Dust Test is intended to determine the capability of the goggle to keep large dust particles from reaching the wearer's eye. (Dust with particle size > 5 um) The Fine Dust Test is intended to determine the capability of the goggle to keep fine dust particles from reaching the wearer's eye. (Dust with particle size< 5 um).

* Safety prescription spectacle protective devices may have different requirements in some cases.



Changes to the ANSI Z87.1-2010 Standard

The frame/shroud or lens of these protector types shall be marked as follows:

- D3-Splash and droplet
- D4-Dust
- D5-Fine dust.

Impact Rating Markings

All protectors must demonstrate entry-level impact protection via the drop ball test. Both the high mass impact test and the high velocity impact test must be completed on any impact-rated protector. Impact- rated protectors shall include a permanent marking identifying the manufacturer and indicate “Z87+” on both the front and at least one of the temples. Frames that are intended for use as Not Rated for Impact can be marked “Z87” (no “+”). Example: “3M+W3” for an impact rated protector with a shade 3.0 welding filter.

New headform for product testing

The 2010 revision of the standard adopts the European (CE) small & medium headform sizes for testing to harmonize with existing international test methods.

Minimum Frontal Coverage Area:

It is important that the protective eyewear cover the soft tissue that surrounds the eye to minimize exposure to flying particles. The coverage area requires the eyewire and lens shall cover in plane view an area of not less than 40 mm in width and 33 mm in height (elliptical) in front of each eye, centered on the geometrical center of the lens.

Frames designed for small head sizes shall cover in plane view an area of not less than 34 mm (1.34 in.) in width and 28 mm (1.10 in.) in height (elliptical), centered on the geometrical center of the lens. Frames designed for small head sizes shall be tested on the 54 mm (2.13 in.) papillary distance (PD) headform. Frames that are tested using the small headform shall be marked on the frame with the letter “H.”

Lateral (Side Coverage)

The standard now requires lateral coverage for impact rated protectors. This inclusion is consistent with other international product standards. Lateral (side) coverage usually in the form of a fixed or detachable shield will not be allowed to have any openings larger in diameter than 1.5 mm (0.060 in). Coverage will be lateral from the vertical plane of the lenses tangential to a point not less than 10mm posterior to the corneal plane and not less than 10mm in height (8mm for the small head form) above/below the horizontal plane.

Sideshields

All impact rated protectors must have side protection (permanent, detachable or integrated). While most sideshields are specifically designed for each individual protector, any use of aftermarket sideshields shall be tested on representative frames for which the product is specified to fit. Sideshields shall include a permanent marking identifying the manufacturer and indicate "Z87+".

After Market Components

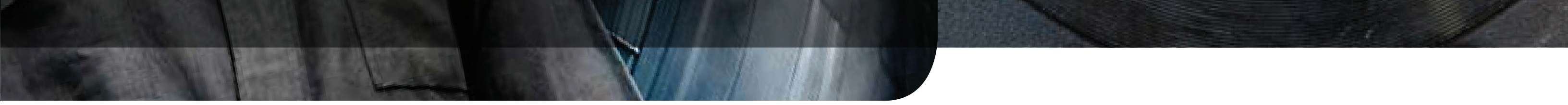
Non-original equipment manufacturers of devices (i.e. sideshields and lenses) that are represented as an "accessory" to protectors must now perform testing to assure that the "accessory" does not compromise the integrity of the Z87 protector. This test requirement assures that replacement parts claimed as compatible with various frames, meet the standard in all combinations.

Ignition Test

The flammability test was replaced with an ignition test which uses a hot steel rod contacting the protector to determine if the protector will ignite. The flammability test was eliminated since it was not representative of realistic use as it measured resistance to material igniting from contact with hot metal rather than the unlikely event that the device will be in flames.

Selection Chart

A pull-out selection chart has been added to aid users in identifying and selecting the types of eye and face protectors that are available, their capabilities and limitation for the hazard source operations listed. Selection includes recommended protectors for various types of work activities that can expose the worker to impact, heat, chemical, dust or optical radiation hazards.



Assigned Protection Factors Information

On August 24, 2006 the Occupational Safety and Health Administration amended its regulation for respiratory protection (29 CFR 1910.134) by adding definitions and requirements for Assigned Protection Factors (APFs) and Maximum Use Concentrations (MUCs). The revisions also supersede many of the APF requirements established in substance specific standards. This final rule became effective November 22, 2006. The final rule defines APFs and MUCs as:

Assigned Protection Factor (APF) means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section [meaning 29 CFR 1910.134].

Maximum Use Concentration (MUC) means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance.

The MUC can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the required OSHA permissible exposure limit, short-term exposure limit, or ceiling limit. When no OSHA exposure limit is available for a hazardous substance, an employer must determine a MUC on the basis of relevant available information and informed professional judgment. Table 1 of 29 CFR 1910.134 lists the APFs the employer must use beginning November 22, 2006. Footnote 4 of table 1 states: "The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1000 or greater to receive an APF of 1000. This level of performance can best be demonstrated by performing a workplace protection factor (WPF) or simulated workplace protection factor (SWPF) study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25."

The definitions of WPF and SWPF are provided in the Federal Register August 24, 2006, Vol. 71 Number 164.

Type of Respirator 1,2	Quarter Mask	Half Mask	Full Facepiece	Helmet/ Hood	Loose-Fitting Facepiece
1. Air-Purifying Respirator	5	10[3]	50	—	—
2. Powered Air-Purifying Respirator (PAPR)	—	50	1,000	25/1,000[4]	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	—	10	50	—	—
• Continuous flow mode	—	50	1,000	25/1,000[4]	25
• Pressure-demand or other positive-pressure mode	—	50	1,000	—	—
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	—	10	50	50	—
• Pressure-demand or other positive-pressure mode	—	—	10,000		—

1.Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

2.The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

3.This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

4.The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

5.These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).