Welding Health and Safety
Respiratory Protection

3M Occupational Health and Environmental Safety Division
Welding Health and Safety

- This training material has been prepared by 3M for the purpose of helping you understand applicable OSHA standards, or other safety regulations, workplace hazards, and safe workplace practices.

- It is the responsibility of both the employer and employees to comply with safety rules and regulations and to use all safety equipment in accordance with product user instructions, limitations, and warnings. Questions regarding proper use should be directed to the employer or the equipment manufacturer. For 3M products call 3M Technical Service 1-800-243-4630.

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Overview

- Regulations
- Respiratory Hazards and Health Effects
- Types of Respirators
- Assigned Protection Factors (APF’s)
- OSHA Respiratory Protection Standard
  - Requirements
  - Fit Testing
  - Care and Storage
Respiratory Protection Regulations

- **Occupational Safety and Health Administration (OSHA)**
  - Develops and enforces mandatory job safety and health standards
    - Only allows for the use of NIOSH approved respirators

- **National Institute for Occupational Safety and Health (NIOSH)**
  - Responsible for testing and approving respirator systems
  - Approves respirators as complete systems.
    - OSHA violation to alter any respirator or use parts that are not made by the original manufacturer.
OSHA’s Respiratory Protection Standard

- When effective engineering controls are not feasible, or while they are being instituted appropriate respirators shall be used.

- Employer Requirements:
  - “A respirator shall be provided to each employee when such equipment is necessary to protect the health of such employee.
  - The employer shall provide the respirators which are applicable and suitable for the purpose intended.
  - The employer shall be responsible for the establishment and maintenance of a respiratory protection program, which shall include the requirements outlined in paragraph (c) of this section.
  - The program shall cover each employee required by this section to use a respirator.”
Employer Payment For Personal Protective Equipment (PPE) Rule

- Requirement of OSHA’s PPE Standard 29 CFR 1910.132
- Requires employers to pay for required PPE
- Includes most PPE (welding helmets, respirators, leathers, gloves)
- Excluded PPE:
  - Ordinary prescription safety eyewear
  - Non-specialty safety-toe protective footwear
  - Clothing for protection from routine weather conditions (coats, gloves, raincoats, sunglasses and sunscreen)
  - Replacement PPE lost or intentionally damaged by employees
- Employers may allow use of employee-owned PPE, but are not required to reimburse employees
Respiratory Hazards

Particles
- Organisms
- Dusts
- Fibers
- Mists
- Fumes

Oxygen Deficiency

Gases

Vapors
Some Common Respiratory Hazards Associated with Welding

<table>
<thead>
<tr>
<th>PARTICLES</th>
<th>GASES/VAPORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>Argon</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>Copper</td>
<td>Fluorides</td>
</tr>
<tr>
<td>Hexavalent chromium</td>
<td>Helium</td>
</tr>
<tr>
<td>Iron oxide</td>
<td>Hydrogen chloride</td>
</tr>
<tr>
<td>Lead</td>
<td>Hydrogen fluoride</td>
</tr>
<tr>
<td>Manganese</td>
<td>Hydrogen sulfide</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Nitrogen dioxide</td>
</tr>
<tr>
<td>Nickel</td>
<td>Nitrogen oxide</td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td>Ozone</td>
</tr>
<tr>
<td>Vanadium oxide</td>
<td>Phosphine/Phosgene</td>
</tr>
<tr>
<td>Zinc</td>
<td>Sulphur dioxide</td>
</tr>
</tbody>
</table>
Contaminants Generated By

Welding Fume Generation

Grinding and Polishing

Arc Radiation and Chemical Interactions
Factors Effecting Respiratory Exposures in Welding

- Type of Welding
  - Electrode and Base metals
  - Flux vs. Shielding gas
- Work Position
- Ventilation (area/local)
- Voltage/Amperage
- Coatings on Metal
What is a Welding Fume?

- Welding fumes are **particles** generated by the vaporization of metal near the arc
- Sources include welding rods (primary), base metal and coatings
- Metal vapors quickly condense, oxidize and form feathery aggregate particles (not a gas or vapor!)
- NIOSH approved respirators with particle filters can efficiently filter these welding fume particles.

Source: Japuntich, Journal of the Intl. Soc. For Respiratory Prot. 1/84
Welding Fume is Not a Vapor

Welding fume is composed of particles, so welding respirators should always include particle filtration. Vapor filtration may be required in some cases.

This is vapor, not a fume! Vapor cartridges will not filter welding fumes.
What is an Exposure?

- **Exposure Depends On:**
  - Concentration of contaminants in the breathing zone
  - Exposure time
    - Number of minutes/hours a person is exposed

- **Exposure Limits**
  - PEL - Permissible Exposure Limit
    - Established by OSHA – enforced by regulation
  - TLV - Threshold Limit Values
    - Established by ACGIH as guidance (see ACGIH.org)
Respiratory Hazards

- **Common Short-Term Health Effects**
  - Coughing/Irritation
  - Difficulty breathing/asthma
  - Nausea
  - Drowsiness

- **Common Long-Term Health Effects**
  - Cancer
  - Silicosis
  - Birth defects
Some Respiratory Health Effects Linked to Welding Contaminants

- Irritation of the respiratory tract
- Metal Fume Fever
- Siderosis
- Systemic Toxicity
- Manganism
- Possible Lung Cancer

Source: Antonini, Critical Reviews in Toxicology - 33(1), 2003
Metal Fume Fever

- A set of flu-like symptoms that may be experienced following exposure to metal fumes. Symptoms may include:
  - Sweating, shivering, throat irritation, fatigue etc.
- Metals that may cause fume fever include:
  - Zinc (from galvanized metal), cadmium, copper and magnesium
- The on-set of symptoms is typically several hours after leaving work, subside after 24 to 48 hours
- No lasting health effects observed

Source: Antonini, Critical Reviews in Toxicology - 33(1), 2003
Siderosis (Welder’s Lung)

- A lung condition caused by long term over exposure to iron fume
- Usually benign but can rarely lead to pulmonary fibrosis following very high exposures

Source: Antonini, Critical Reviews in Toxicology - 33(1), 2003
Manganism

- Manganese is a metal used in steel to help promote hardness
- Over exposure to manganese may lead to Parkinson’s-like symptoms that may include:
  - Weakness / lethargy
  - Speech disturbances
  - Paralysis (mask-like face, tremors)
  - Psychological disturbance
- The health effects of exposure to manganese as a component of welding fume is currently under debate.

Source: Antonini, Critical Reviews in Toxicology - 33(1), 2003
Manganese is Found in Virtually all Steel Welding Electrodes and Wire

**Material Safety Data Sheet**

**For Welding Consumables and Related Products**


**SECTION I - IDENTIFICATION**

<table>
<thead>
<tr>
<th>Manufacturer/Supplier:</th>
<th>Product Type: Carbon Steel Electrode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Classification: AWS ER70S-3</td>
</tr>
</tbody>
</table>

**SECTION II - HAZARDOUS MATERIAL (†)**

<table>
<thead>
<tr>
<th>Ingredients:</th>
<th>CAS No.</th>
<th>Wt.%</th>
<th>TLV mg/m³</th>
<th>PEL mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon steel wire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total manganese</td>
<td>7439-96-5</td>
<td>1</td>
<td>0.2</td>
<td>1.0(c)</td>
</tr>
<tr>
<td>Total copper, including plated coating</td>
<td>7440-50-8</td>
<td>0.2(a)</td>
<td>0.1(a)</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>7439-89-6</td>
<td>bal.</td>
<td>10*</td>
<td>10*</td>
</tr>
</tbody>
</table>

**Additional Ingredients:**

- Manganese and/or manganese alloys and compounds (as Mn) | 7439-96-5 | 1 | 0.2 | 1.0(c) |
- Manganese and/or manganese oxides (as Mn) | 6596-74-9 | 5 | 10* |
- Limestone and/or calcium carbonate | 1317-65-3 | 0.5 | 10 | 15 |
- Quartz | 14808-60-7 | < 0.5 | 50,1** | 50,1** |

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Lung Cancer

- Studies estimate approximately 30 - 40%* increased risk for welders
- Much of this risk is due to high rates of smoking and asbestos exposure among welders
- Suspected link to chromium and nickel exposure from stainless steel
- Possible link to radioactive thorium contained in certain tungsten electrodes used in TIG welding

* Antonini, Critical Reviews in Toxicology - 33(1), 2003
Hexavalent Chromium (Cr\textsuperscript{+6})

- OSHA standard published Feb 28, 2006 requires effected employers to measure worker exposures to Cr+6 and establish control measures accordingly.
  - OSHA PEL for Cr+6 reduced to 5 µg/m\textsuperscript{3} (from 52 µg/m\textsuperscript{3})
    - Action level 2.5 µg/m\textsuperscript{3} – triggers certain requirements such as medical surveillance
  - By May 31, 2010 – Employers must have engineering controls in place where feasible

- Over exposure to Hexavalent Chromium (Cr\textsuperscript{+6}) may result in:
  - Lung cancer
  - Irritation or damage to the nose, throat, and lung (respiratory tract)
  - Irritation or damage to the eyes and skin

Source: OSHA, Federal Register: February 28, 2006 (Volume 71, Number 39)
Hexavalent Chromium (Cr\(^{+6}\))

- Most impacted industries and applications:
  - Electroplating
  - Welding
  - Grinding
  - Painting
  - Producers of chromates
  - Paint and coating production
  - Wood preserving
  - Chromium metal production
  - Steel mills
  - Iron foundries
  - Steel foundries
  - Construction using Portland Cement

Source: OSHA, Federal Register: February 28, 2006 (Volume 71, Number 39)
What Types of Welding Produce Cr\(^{+6}\)?

- Welding processes using flux shielding produce a higher ratio of Cr\(^{+6}\) to Cr\(^{+3}\) than methods using inert shielding gas
  - Flux-Core & Stick (SMAW): 47-62% of total Cr in fume is Cr\(^{+6}\)
  - MIG/TIG: 4% of total Cr in fume is Cr\(^{+6}\)

Source: Larry Verdier et al, Shaw Environmental, AIHCE Expo, 2005
Thoriated Tungsten Electrodes

- Thorium emits alpha radiation
- No risk from skin contact
- Inhalation of particles increases risk of cancers of the lung, bone and pancreas
- Potential exposure from inhalation of particles while grinding
Shielding and Fuel Gas Effects

**Shielding:**
- Argon
- Carbon Dioxide
- Helium

**Fuel:**
- Acetylene
- Propane
- Butane

- Primary hazard is displacement of available oxygen (simple asphyxiants) when welding in confined spaces
- Carbon Dioxide (CO₂) can cause narcosis at high concentrations headache, dizziness, nausea, drunkenness
Hazardous Byproduct Gas Effects

- **Fluorides**
  - From fluxes and electrode coatings
  - Irritation of eyes, nose and throat

- **Carbon Monoxide**
  - From arc UV light interaction with carbon dioxide
  - Binds to blood preventing transport of oxygen in body

- **Ozone**
  - From arc UV light interaction with oxygen in the air
  - Deep lung irritant causing coughing and fluid build up

- **Phosgene**
  - From UV interaction with chlorinated solvents (e.g. metal cleaners like trichloroethylene) vapors
  - Deep lung irritant causing coughing and fluid build up
Hazardous Byproducts from Coated Materials Include

- Polyurethane coatings may generate some hydrogen cyanide and some toluene diisocyanate
- Epoxy resins may generate aldehydes and carbon monoxide
- PVC generates hydrogen chloride
- Other coatings can result in other potentially toxic exposures
Respiratory Protection
What is a Respirator?

- Equipment worn by a person to help protect them from breathing airborne hazards
  - “Dust Masks”
  - Facepieces
  - Hoods
  - Helmets
Fundamental philosophy of Respiratory Protection Equipment

- Respirators are intended to reduce a worker’s inhalation exposure to air contaminants from a level that is considered hazardous to a level that is considered acceptable.

- No respirator provides the wearer with a zero exposure level.
Types of Respirators
Respirator Types

- **Negative Pressure**
  - Wearer breathes through cartridges and/or filters that filter the air

- **Powered and Supplied Air**
  - Clean air is delivered to the facepiece via:
    - Motor/blower drawing air through cartridges/filters
    - Compressed air source
Respirator Types

- **Tight-fitting**
  - Half
  - Full Face

- **Loose-fitting**
  - Hood
  - Helmet
  - Loose-fitting facepiece
Air Purifying Respirators

- Particles, gases or vapors pass through a filter
- Negative Pressure or Powered Air Purifying (PAPR)
Negative Pressure Respirators

- Filtering Facepiece
- Elastomeric
  - Half Facepiece
  - Full Facepiece
NIOSH Filter Categories (42 CFR Part 84)

<table>
<thead>
<tr>
<th>Minimum Filter Efficiency</th>
<th>Resistance to Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (No Oil)</td>
</tr>
<tr>
<td>95%</td>
<td>N95</td>
</tr>
<tr>
<td>99%</td>
<td>N99</td>
</tr>
<tr>
<td>100% (99.97%)</td>
<td>N100</td>
</tr>
</tbody>
</table>

- N-95 Class ½ facepiece respirators can help reduce exposure to welding fumes from steel, galvanized steel, stainless steel (CrVI) and aluminum where exposures are less than 10 times the exposure limit.

- OSHA substance-specific standards for lead and cadmium require 100 class filters when air purifying respirators are used.
Particulate Filter Change Schedule

Environments with no measurable amount of oil in the air
- **N, R, and P Series Filters**
  - When filter becomes dirty damaged or difficult to breathe through.

Environments with measurable amounts of oil are in the air
- **R Series**
  - Every shift (8 hours) or
  - When filter becomes dirty damaged or difficult to breathe through.
- **P Series**
  - According to manufacturer instructions or
    - E.g. 3M recommends 30 days or 40 hours use, whichever comes first
    - When filter becomes dirty damaged or difficult to breathe through.
- **HEPA filter in Powered Air Purifying Respirator (PAPR)**
  - Air flow rate drops below required level
Color Coding for Chemical Cartridges

- Organic Vapor: Black
- Acid Gases: White
- Organic Vapor / Acid Gases: Yellow
- Ammonia / Methylamine: Green
- Formaldehyde Organic Vapor: Olive/Black
- Multi-Gas and Vapor: Olive
- Mercury Vapor / Chlorine Gas: Orange
- P100 (filter): Magenta
Cartridge Change Out Schedules

- Odor, taste, or irritation not always reliable indicators of end of service life
- OSHA states a user must use one of the following methods to determine when to change a cartridge:
  - End of service life indicator (ESLI)
  - Estimated end of service life based on objective data

- End of service life software programs are available from cartridge manufacturers
  - In general, you need to know the following:
    - Chemical contaminant
    - Exposure level of worker
    - Cartridge parameters or cartridge model number
    - Temperature and humidity
    - Workrate of worker
Powered & Supplied Air Respirators

- Powered Air Purifying Respirator (PAPR)
  - Helmet, Face, and Belt Mounted

- Atmosphere Supplying
  - Airline Respirator (SAR)
    - Helmets, Hoods, and Elastomeric Facepiece
Facial Hair

- Will cause leakage at the facepiece-to-face seal (even beard stubble)
- OSHA States:
  - “No facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function”
- Hoods and loose-fitting headgear can accommodate limited facial hair including beards as long as they don’t violate the above OSHA requirement.
Powered Air Purifying Respirators (PAPR)

- Motorized blower delivers filtered clean air to headpiece under positive pressure
- Blower may be on belt, in helmet or on facepiece
- Headgear and hoods may accommodate limited facial hair including some beards
- Fanning effect, higher protection, comfort, many headgear options
Supplied Air Respirators

- Air from compressor or air tanks delivered to headpiece under positive pressure
- Air must be tested to assure it meets Grade D breathing air requirements.
- Air may be cooled or heated by 50 degrees – can help enhance productivity
- Many headgear and hoods options which may accommodate limited facial hair including some beards
Assigned Protection Factors (APF)
Assigned Protection Factor (APF)

- Each type of respirator has an Assigned Protection Factor (APF) that is assigned by OSHA.

- The APF is the level of protection a class of respirator is expected to provide when selected and used properly under real-world conditions.

- To determine the maximum concentration of a substance in which a respirator can be used, multiply the respirator’s APF by the exposure limit for the substance. For example:
  - Respirator: disposable 1/2 facepiece, APF = 10
  - Exposure: Hexavalent chromium (Cr+3) welding fume, PEL = 5 µg/m³
  - Maximum use concentration for above scenario: 10 x 5 µg/m³ = 50 µg/m³
APF’s of Respirator Headpiece Categories

- **Half facepiece (negative pressure)**
  - Covers mouth, nose, and under chin
  - APF = 10

- **Full facepiece (negative or positive pressure)**
  - Covers mouth, nose, eyes, and under chin
  - APF = 10 Qualitative Fit Test
  - APF = 50 Quantitative Fit Test
  - APF = 1,000 in positive pressure mode

- **Loose-fitting Headgear (positive pressure)**
  - Covers face and most of head
  - APF = 25

- **Hoods and helmets (positive pressure)**
  - Covers face, entire head and shoulders
  - APF = 25/1,000*

*The employer must have evidence provided by the respirator mfg. that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1000.
# Negative-Pressure Respirators for Welding Applications

<table>
<thead>
<tr>
<th>Description</th>
<th>APF</th>
<th>No maintenance</th>
<th>Low cost</th>
<th>Fits under most welding helmets</th>
<th>Light weight</th>
<th>Not compatible with facial hair</th>
<th>Fit-test required</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disposable Half Facepiece</strong></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elastomeric Half Facepiece</strong></td>
<td>10</td>
<td>Replaceable filters</td>
<td></td>
<td></td>
<td></td>
<td>Not compatible with facial hair</td>
<td>May not fit all welding helmets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More filter options</td>
<td></td>
<td></td>
<td></td>
<td>Fit-Test required</td>
<td></td>
</tr>
</tbody>
</table>
# Positive-Pressure Respirators for Welding Applications

<table>
<thead>
<tr>
<th>Description</th>
<th>APF</th>
<th>Benefits</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powered-Air (Loose-Fitting or Helmet)</td>
<td>25 or 1000*</td>
<td>Cooling effect</td>
<td>Increased weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No breathing resistance</td>
<td>Higher unit cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No fit testing</td>
<td>Increased maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hard Hat options</td>
<td>Increased user training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accommodates limited facial hair</td>
<td></td>
</tr>
<tr>
<td>Supplied-Air (Loose-Fitting or Helmet)</td>
<td>25 or 1000*</td>
<td>Chilled or heated air</td>
<td>Attachment to airline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No breathing resistance</td>
<td>Increased weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No filters to change</td>
<td>Higher cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No batteries to charge</td>
<td>Requires compressor</td>
</tr>
</tbody>
</table>

*Check respirator specifications. Depending on manufacturer’s test results APF may be 1,000 or 25.
OSHA Respiratory Protection Program
(29 CFR 1910.134)
Respiratory Protection Program

- **Employer** is **REQUIRED** to have a **written respiratory protection program** when respirators are being used by employees. The written program must include the following:
  - Procedures for selecting respirators in the workplace.
  - **Medical Evaluations** for employees required to wear respirators.
  - **Fit testing** procedures for tight-fitting respirators.
  - **Procedures for proper use** of respirators in routine and reasonably foreseeable emergency situations.
  - Procedures/schedules for **cleaning, disinfecting, storing, inspecting, repairing and maintenance** of respirators.
  - Procedures to ensure **adequate air quality**, quantity, and flow of breathing air for atmosphere-supplying respirators.
  - **Training** of employees in the respiratory hazards to which they are potentially exposed during routine & emergency situations.
  - **Training** in the **proper use** of respirators, including donning and removal, any limitations on their use, and their maintenance.
  - Procedures for **evaluating** the effectiveness of the program.
Medical Evaluation

- Required for employees before being fit tested or required to use
- Mandatory questionnaire (Appendix C)
- Reviewed by physician or other licensed health care provider (PLHCP); follow-up examination if necessary
- Must obtain written recommendation
- Repeat if change in workplace or requested by employee, supervisor, program administrator, or PLHCP. Not required annually
Fit Testing

- **Purpose:** to determine the respirator style and size that will properly fit the wearer

- **Required:** Prior to initial use
  - Whenever a different make or size respirator is used
  - Annually thereafter
  - Change in employee’s physical condition affecting fit

- **Required:** All tight-fitting respirators
  - Includes tight-fitting positive pressure respirators

- **Not required for:** loose fitting respirators such as helmets and hoods

- **Must follow OSHA accepted protocol in mandatory appendix**
OSHA Required Fit Test Exercises

- One minute exercises designed to simulate movements encountered in the workplace
  - Normal breathing
  - Deep breathing
  - Turning head side to side
  - Moving head up and down
  - Talking
  - Bending Over/Jogging in Place
  - Normal Breathing
Use of Respirators

- **DO NOT** wear tight-fitting facepieces with:
  - Facial hair between the sealing surface and face or that interferes with valve function or any condition that interferes with facepiece seal or valve function

- **For all tight-fitting respirators, must perform a user seal check each time it is put on**
User Seal Checks for Filtering Facepiece Respirators

If you cannot achieve a proper seal, do not enter the contaminated area!

For non-valved respirators:
Place one or both hands completely over the respirator. Inhale and exhale sharply. If air leaks around your nose, readjust the nosepiece. If air leaks between the face and faceseal of the respirator, reposition it and readjust the nose clip for a more secure seal.

For valved respirators:
Place one or both hands completely over the respirator and inhale sharply. If air leaks around your nose, readjust the nosepiece. If air leaks between the face and faceseal of the respirator, reposition it and readjust the nose clip for a more secure seal.
User Seal Check for Elastomeric Respirators

Negative Pressure
- Cover cartridge
- Inhale
- Check for air leaks

Positive Pressure
- Cover cartridge
- Exhale
- Check for air leaks
Care of Respirators

- **Inspection**
  - Before each use and during cleaning
    - Face seal, Straps, Buckles, Valves, Hoses

- **Cleaning and Disinfecting**
  - Must use OSHA procedures in 1910.134 Appendix B-2 or
  - Procedures from the respirator manufacturer provided they are of equivalent effectiveness

- **Repairs**
  - Use only manufacture’s NIOSH approved parts for that specific respirator
  - According to manufacturer’s instructions by appropriately trained persons
Storage

- Protect the respirator from: physical damage, chemicals, dust, sunlight, extreme temperatures, excessive moisture
Respiratory Protection
Review Questions

1) Who is responsible for developing and implementing a respirator program?
   a) OSHA
   b) Employer
   c) NIOSH
   d) Employee

2) Employees must pay for and provide their own respirators and other PPE.
   a) True
   b) False
Respiratory Protection
Review Questions

3) What are the two main types of respiratory hazards encountered in welding environments?
   Particles (dusts and metal fumes), Gases

4) What type of respirator can help reduce exposures to welding fumes from steel, galvanized steel, stainless steel (CrVI) and aluminum where exposures are less than 10 times the exposure limit?
   a) ½ facepiece with N95 or higher particulate filter
   b) Powered Air Purifying Respirator (PAPR) with particulate filter
   c) Airline Respirator
   d) All of the above

5) True or False – A days growth of facial hair will not affect the performance of a ½ facepiece respirator.
Respiratory Protection
Review Questions

6) What are the main requirements of OSHA’s Respirator Standard
   a) Employer have a written program
   b) Medical evaluations
   c) Fit testing
   d) User seal check
   e) Procedure for caring for respirators
   f) All of the above

7) The purpose of fit testing a respirator prior to using it is to determine the style and size you selected can be properly fitted to your face.
   a) True
   b) False
Thank you!

Welding Health and Safety Topics

3M Occupational Health and Environmental Safety Division