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SAFETY TRAINING: Respiratory Protection

OSHA 29 CFR 1910.134

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Respiratory Protection

• Respirators protect workers by preventing exposures to harmful airborne chemical and biological agents.

• However, a respirator that is not used properly will fail to provide adequate protection, and may even cause certain hazardous conditions.

DANGER

Respiratory Protection Required in This Area

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Respiratory Protection

• This training program is intended to teach you the basic information you need to know in order to use a respirator correctly and safely.

• This training course will be supplemented with hands-on training using the specific respirator selected for you to use.

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM
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Respiratory Protection

- A respirator is one type of control often selected when ventilation controls such as local exhaust or enclosure are not feasible or sufficient.
- Respirators are designed to protect the respiratory system from inhalation of atmospheric hazards by either:
  - removing contaminants from the air before they are inhaled, or
  - supplying an independent source of "clean" air.

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Respiratory Protection

- Properties of hazardous substances:
  - Gases
  - Vapors
  - Particles

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Respiratory Protection

- Gases
  - One of the three basic phases of matter (along with liquids and solids)
  - Gases (like liquids) are fluids
    - Ability to flow
    - Viscosity, but does not resist deformation
  - Unconstrained gases (unlike liquids) do not occupy a fixed volume, but expand to fill their space

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM
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Respiratory Protection

• Vapors
  – A vapor is the gaseous state of a substance which under ordinary conditions exists as a liquid or solid.
  – Temperature and pressure changes can convert solids and liquids into vapors

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Respiratory Protection

• Particles
  – A particle is a very small speck of solid or liquid matter.
  – Several types of air contaminants are particles, such as:
    • Smoke
    • Mist
    • Fume
    • Dust
    • Infectious agents

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Respiratory Protection

• Particles: Smoke and Mist
  – Smoke is a suspension in air of small particles resulting from incomplete combustion of a fuel.
  – Mist is a collection of liquid droplets suspended in air
    • A mist can be formed when spraying or splashing a liquid.
    • It can also be formed when a vapor condenses into liquid droplets in the air, as with fog.
• Particles: Fumes
  – A fume is a solid particle that has condensed from the vapor state.
  – Example: Metal in welding or cutting processes can vaporize, then condense into tiny particles, or metal fumes.


• Particles: Dust
  – Dust refers to dry particles that are often the product of disintegration, scouring, crushing, or grinding of larger solid material
  – Some dusts can travel limited distances on air currents.


• Particles: Infectious Agents
  – Infectious agent particles include certain types of bacteria, viruses, prions, protozoa, fungi, etc.
  – These are often generated as aerosole: solid or liquid droplets suspended in a gas such as air
  – Like dusts, aerosols can travel limited distances on air currents.
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Particles: Infectious Agents

- Laboratory procedures that can generate infectious agent aerosols:
  - Pipetting; blowing out pipettes
  - Removing stoppers
  - Breaking culture containers
  - Intranasal inoculation of animals
  - Flaming inoculating needles, loops or slides
  - Inserting a heated loop into a culture
  - Streaking inoculums
  - Harvesting infected materials
  - Storing liquids
  - Freeze-drying specimens
  - Animal cage cleaning and bedding change
  - Careless glove removal

Training Source: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Particles: Infectious Agents

- Laboratory devices can generate infectious agent aerosols, especially when used incorrectly:
  - Vortexers and blenders
  - Bottles, flasks, and stoppers
  - Cell sorters
  - Centrifuges
  - French press
  - Homogenizers
  - Needles and syringes
  - Pipettes
  - Pressurized vessels
  - Shakers
  - Sonicators
  - Vacuum and aspirating equipment

Training Source: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Oxygen Deficiency Hazard

- Normal oxygen levels in air is 20.8%
  - Oxygen can rapidly deplete in confined spaces or other poorly-ventilated atmospheres.
- Symptoms of hypoxia occur at approximately 16% oxygen
  - Oxygen-deficient environments require an atmosphere-supplying respirator such as a Self-Contained Breathing Apparatus (SCBA)

Training Source: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM
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• Why is it important to understand the different states of atmospheric hazards?
  – The type of respirator and filtering media you select is determined based on the type of contaminant in your work environment.

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• Why is it important to understand the different states of atmospheric hazards?
  – Gases and vapors are absorbed using activated charcoal.
    ▪ Adsorption is a surface area bonding phenomenon
  – Dusts, mists, and fumes are absorbed using a filtering material.
    ▪ Absorption is a volume-based uptake of material

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• Understanding the Different States of Atmospheric Hazard
  – Many respirators have interchangeable media cartridges installed onto the facepiece for specific contaminants in the workplace.
  – A wrong filter can negate the benefits of using the respirator
  – Respirators may use a combination of activated charcoal and filtering media when particles and vapors/gases are anticipated.
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Respiratory Protection

- **WARNING!!**
  - An atmosphere-purifying respirator WILL NOT protect you in an oxygen deficient environment!
  - If the oxygen concentration is UNKNOWN, you MUST use a SCBA respirator to enter the atmosphere.
    - SCBA respirators must also be used if the concentration of a hazardous air contaminant is UNKNOWN, such as a hazardous chemical release or other emergency.

*Never assume entry into a hazardous atmosphere is safe!*

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Respiratory Protection

- **WARNING!!**
  - Respirator Use in Absence of Known Hazards
    - Example: Use by persons who have allergies and work outside with exposures to pollen and grasses
    - Use of a respirator by someone who doesn't understand limitations and use factors of the specific respirator could be dangerous, even in the absence of atmospheric hazards.

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

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Respiratory Protection

- **Respirator Use in Absence of Known Hazards**
  - Medical clearance to wear a respirator is required. There are certain medical conditions that could cause you to be physically unable to do your job while wearing a respirator.
  - Another potential problem unrelated to atmospheric hazards is surface contamination. If routinely used respirators are not cleaned and disinfected regularly, unhealthful conditions and infections could result.

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM
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Types of Respirators

- Each is designed based on the specific contaminant(s) encountered, the characteristics of the work environment, and the needs of the user.

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Air Purifying Respirator

- A commonly used type is the air-purifying respirator (APR).
- Tight-fitting facepieces or coverings produce a protective seal around the face of the user.
- Air is purified when it passes through a filtering media at the inlet cover of the facepiece.

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Air Purifying Respirator

- Tight fitting coverings or “facepieces” come primarily in two basic configurations:
  - Half-mask respirators cover the facial area from the bridge of the nose to just below the chin.
  - Full facepiece respirators cover the same facial area as the half-mask, but feature a supplemental seal around the perimeter of the face and a protective see-through shield.
Tight-Fitting Facepieces

Half-mask APR with twin cartridges

Full facepiece APR

The rarely-seen quarter-mask APR, which seals above the chin and below the mouth and has a single cartridge.

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Half-mask APRs

- Protection against gases, vapors, or particulates
- Cartridges contain a filtering and/or adsorbing media that removes contaminants from the air. The type of cartridge selected is based on anticipated contaminant(s) in the work environment.
- Cartridges attach to the respirator inlets, so air entering the facepiece is purified before it is inhaled by the respirator wearer.
- On the front of the mask is an exhalation outlet with a one-way valve that allows air to leave the facepiece.

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Full Facepiece APRs

- Full facepiece respirators are used when a higher level of respiratory protection is needed, or when protection of the eyes and face is important.
- Examples:
  - Hazardous waste bulking, in which there may be high atmospheric concentrations of vapors
  - Jobs involving chemicals that are irritating to the eyes
  - Pesticide or herbicide spraying, where overspray may contact the eyes
  - Research animal care, where allergens can affect the eyes as well as the respiratory system.
- Like the simpler half-face respirator, full facepieces have interchangeable cartridges that are selected on the basis of the anticipated respiratory hazard(s).
“Canister” Respirators

- Canisters are sometimes used instead of cartridges for gas and vapor respirators, because more sorbent material can fit in a canister.
- These tend to be heavier than cartridge-using APRs, and are not widely used at UK.

Disposable Filtering Facepiece Respirators

- This is another type of APR, which is used once and discarded.
- These are popular in healthcare settings and research laboratories.
- Filtering facepiece respirators are intended to protect against particles, although some models may contain an activated charcoal media to control odors or vapors. However, this type of respirator is not recommended if you have potential exposure to gases or vapors.

Disposable Filtering Facepiece Respirators

- These respirators are described based on their resistance to oil, and their collection efficiency with 0.3 micron test particles.
- Oil resistance is indicated by N, R, or P:
  - “N” means that the respirator is not resistant to oil
  - “R” is more resistant to oil
  - “P” is most resistant, and is often considered “oil-proof”
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**Respiratory Protection**

**Disposable Filtering Facepiece Respirators**
- Filtration efficiency is listed by the numerical percent of test particles (0.3 μm) that are filtered.
  - This number is listed after the N, R, or P.
- N-95 is the minimum level of efficiency that is acceptable for protection against hazardous particulates.
  - Respirators with greater filtration efficiency are available (e.g., N-97 and N-100, R-97 and R-100, P-97 and P-100).
  - An N-, R-, or P-100 filter is also called a High Efficiency Particulate Air (HEPA) filter because it is nearly 100% effective at filtering test particles.

**Training Source:** Central Welding Supply, Occupational Safety Division, www.centralwelding.com

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**Respiratory Protection**

**Disposable Filtering Facepiece Respirators**
- N-95 or higher disposable respirators are effective for hazard reduction when working with infectious agents.
  - Greater levels of protection might be required for specific agents or protocols.
- Eye and face protection can be worn with disposable filtering facepiece respirators.
  - E.g., goggles and/or face shield worn with disposable respirator in Biosafety Level 3 facilities.

**Training Source:** Central Welding Supply, Occupational Safety Division, www.centralwelding.com

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**Respiratory Protection**

**NIOSH Certified Respirators**
- All respirators used in the workplace must bear the certification of the National Institute for Occupational Safety and Health (NIOSH).
- NIOSH certification is for the intact respirator unit, with all parts in place, operational, and from the same manufacturer.
  - “Mixing and matching” parts from different brands of respirators invalidates the NIOSH certification.
  - Homemade and shop-made respirators or alterations are NOT approved.

**Training Source:** Central Welding Supply, Occupational Safety Division, www.centralwelding.com
NIOSH-Certified Respirators

• Some disposable masks are not “respirators” at all, since they are not NIOSH certified.
  – These are often recognizable by their use of thin paper rather than a rated filtering material, or a single strap. NIOSH-certified filtering facepiece respirators will always have two straps.
  – Paper masks and “surgical” masks have their uses, but they are not respirators!
  – Do not use these for tasks where a real respirator is needed, and do not expect these to provide any level of respiratory protection.

Powered Air-Purifying Respirator (PAPR)

• PAPRs are useful for work environments where traditional full facepiece respirators are not acceptable.
  – Example: if the work environment is hot with high humidity, then the face shield on a traditional full facepiece respirator may fog up rapidly, causing discomfort and obstructed vision.
• PAPRs utilize a battery powered blower motor to pull air through a purifying element (cartridge or canister), then push the air into the full facepiece.

• Air is circulated through the facepiece producing a cooling effect that improves comfort and reduces fogging.
  – Additionally the blower motor does the work of pulling air through the filtering media, resulting in less physical stress on the user.
• When maximum comfort and communication ability is needed, a loose-fitting covering or hood can be used with a PAPR blower motor and air purifying element.
How do I determine the protection level that a specific respirator type will provide?

- A respirator’s protective capacity is rated based on Assigned Protection Factors, or APF’s.
  - APFs are assigned by OSHA and legally enforceable
- The higher the concentration of airborne contaminants, the greater the need for a high APF.
- APF’s are numerical ratings that express the respirators anticipated protective ability against a given contaminant. The higher the APF, the greater the protection provided by the respirator.

**Example:** If the established occupational exposure limit for a particular chemical is 10 ppm (parts of the contaminant vapor per million parts of air), a full facepiece respirator, with an APF of 50, can safely be used in airborne concentrations of up to 500 ppm.

This is a copy of the official OSHA APF Table. Ref: 29 CFR 1910.134(d)(3)(ii)
Do I have to know about all respirator types, even if I will only use one certain type in my job?

- This is necessary only to the extent that knowledge of other respirator types helps you or your supervisor make the correct choice regarding the best type of respirator for your work environment.

Example:
- You initially select a half-mask respirator and then a new contaminant is introduced to the work environment, one that causes a need to protect the eyes and face.
- At that point, a general awareness of the protective capacity and general uses of full facepiece respirators will help you to realize that there is a better, more protective choice in respirators for your work environment.

I have asthma. Will this cause a problem when I am wearing a respirator?

- Possibly. In fact, there are a number of conditions that could cause potential adverse health effects for respirator wearers, including:
  - respiratory diseases
  - history of heart attack or stroke
  - claustrophobia
  - high blood pressure
- Each of these conditions may adversely affect the health of some employees who wear respirators.
I have asthma. Will this cause a problem when I am wearing a respirator?

- A physician or other licensed health care professional operating within the scope of his/her practice needs to medically evaluate employees to determine under what conditions they can safely wear respirators.
- Thus, it is necessary to ensure that you are physically capable of wearing a respirator.

How will I know if my respirator is fitting properly?

- Fit testing is an OSHA requirement, and is conducted to determine proper respirator fitting.
- Even the best designed and manufactured respirator will not protect the wearer if there is an improper match between facepiece and wearer or improper wearing practices by the user.

How will I know if my respirator is fitting properly?

- With different brands of a particular type of facepiece available, it is important to determine which one fits best.
- It is also important to know how to correctly wear your respirator.
- Choosing the correct respirator and knowing how to wear it are accomplished by fit testing.
How will I know if my respirator is fitting properly?

- It is important to remember that no single respirator type / model will fit everyone.
- Therefore, more than one brand of a given type of respirator should be purchased to take advantage of the different characteristics of each type, and to ensure a correct fit for everyone.
- Also, having more than one facepiece to choose from gives a better chance to find a respirator that is comfortable while providing good protection.

Quantitative Fit Testing (QNFT): the preferred method for determining proper fit

- QNFT is conducted using sophisticated equipment by trained personnel, in order to detect facepiece leakage.
- QNFT does not rely on subjective responses, and is highly sensitive and assures correct fit. This is especially important when working in highly hazardous atmospheres which can be immediately dangerous to life or health.

After the initial fit test, how do I know if my respirator continues to function correctly?

- To ensure that your respirator is functioning correctly and is safe to use, meticulous respirator MAINTENANCE is vital, and includes the following:
  - Inspection
  - Cleaning
  - Proper Storage
Respirator Maintenance

- Manufacturers' instructions for caring for your respirator should be followed to ensure correct function.
- Poorly maintained or malfunctioning respirators do not protect the wearer and can be more dangerous than not wearing a respirator at all.
- Maintenance guidelines may change due to the needs of your facility and how often you are using respirators and for what purpose.

Respirator Maintenance: Tailoring

- In a large respirator program in which respirators are used routinely, they should be exchanged daily for cleaning and inspection.
- However, in a small program involving only occasional respirator use, this period could be weekly or monthly.
- It is important to evaluate your specific needs regarding respirator use to determine the best maintenance program.

Respirator Maintenance: Inspection

- The facepiece of a routinely used respirator should be checked before and after each use for
  - Excessive dirt
  - Cracks, tears, holes, or distortion from improper storage
  - Inflexibility (stretch and massage to restore flexibility)
  - Cracked or badly scratched lenses in full facepieces
Respirator Maintenance: Inspection

- The facepiece of a routinely used respirator should be checked before and after each use for:
  - Incorrectly mounted full-facepiece lens or broken or missing mounting clips, and
  - Cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s) (if required).

Respirator Maintenance: Inspection

- The head straps or head harness of a routinely used respirator should be checked before & after each use for:
  - Breaks
  - Loss of elasticity
  - Broken/malfunctioning buckles and attachments, and
  - Excessively worn serrations on the head harness, which might permit slippage (full facepieces only).

Respirator Maintenance: Inspection

- The air-purifying elements of a routinely used respirator should be checked before and after each use for:
  - Incorrect cartridge, canister, or filter for the hazard
  - Incorrect installation, loose connections, missing or worn gaskets, or cross-threading in holder.
  - Expired shelf-life date on cartridge or canister
  - Cracks or dents in outside case of filter, cartridge, or canister, and
  - Evidence of prior use of adsorbent cartridge or canister, indicated by absence of sealing material, tape, foil, etc., over inlet.
Respirator Maintenance: Cleaning

- OSHA states that "routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to insure that proper protection is provided." and that emergency use respirators "shall be cleaned and disinfected after each use."

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

Respirator Maintenance: Cleaning

- If the respirator is dirty, it should be washed with detergent in warm water using a brush.
- If the respirator is not visibly soiled, it may still need to be disinfected using a solution of one part bleach to 10 parts water.

Place respirator in bleach solution for no less than 10 minutes, then rinse thoroughly in clean water (140°F maximum) to remove all traces of detergent or bleach. This is very important to prevent exposure that could lead to dermatitis.

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

Respirator Maintenance: Cleaning

- Alcohol-free cleaning pads can be used for cleaning non-disposable respirators that are not visibly soiled
- The use of rubbing alcohol should be avoided because alcohols will cause the rubber components of the facepiece to degrade.
Respirator Maintenance: Cleaning

- Drying of your respirator should be on a clean surface.
- Respirators may also be hung to dry, but care must be taken not to damage the facepiece or stretch/distort the head straps.
- Do not place the respirator back into an airtight container or storage bag until it is completely dry or mold growth could result.

Respirator Maintenance: Storage

- Storage of your respirator should be done in a clean, dry place free of hazards.
- The respirator should be able to dry where it is stored and respirator storage must protect against:
  - Dust
  - Sunlight
  - Heat
  - Extreme cold
  - Excessive moisture, and
  - Damaging chemicals.

Respirator Maintenance: Storage

- Clean, dry respirators should be placed in reusable plastic bags or other clean, sealable containers.
- They should be stored in a clean, dry location away from direct sunlight.
- They should be stored in a single layer with the facepiece and exhalation valve in a more or less normal position to prevent the rubber or plastic from taking a permanent distorted "set".
Can I wear a respirator if I have facial hair?

- A tight-fitting respirator must have a good seal around the face to ensure maximum protection. Facial hair that lies along the sealing area of the respirator, such as beards, sideburns, moustaches, or even a few days of stubble are **NOT permitted** when wearing a respirator.
- Facial hair between the wearer's skin and the sealing surfaces of the respirator will prevent a good seal. The wearer should be cleanly shaved when wearing a tight-fitting respirator.
- The only exception would be a small moustache that does not lie beneath the sealing surface of the respirator.

**TRAINING SOURCE:** CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

Can I wear a respirator if I have facial hair?

- Respirators with loose-fitting facepieces (such as the PAPR pictured below) are an option for personnel who cannot shave or maintain a tight face-facepiece seal.
- Consult UK OHS if you are interested in a loose-fitting respirator for a reason related to fit or comfort.

**TRAINING SOURCE:** CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM

Can I wear a respirator if I wear eye glasses?

- Ordinary eye glasses should not be used with tight-fitting full facepiece respirators. They can be worn under loose fitting PAPRs (see previous slide).
- Eye glasses with bars or straps that pass through the seal of the respirator will prevent a good seal.
- Special corrective lenses can be mounted inside a tight-fitting full facepiece respirator and are available from all manufacturers of full facepiece respirators.
- When wearing a half-mask respirator, glasses MAY be permitted because they do not pass through the seal.

**TRAINING SOURCE:** CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM
Can I wear a respirator if I wear contact lenses?

- There are several factors that limit the use of contact lenses while wearing any type of respiratory device, especially air-supplying respirators.
- With full facepiece respirators, incoming air directed toward the eye can cause discomfort from dirt, lint, or other debris lodging between the contact lens and the pupil.
- It is not recommended that contact lenses be worn while using a respirator and that other means be used such as special corrective lenses that are mounted inside a full facepiece respirator.

TRAINING SOURCE: CENTRAL WELDING SUPPLY, OCCUPATIONAL SAFETY DIVISION, WWW.CENTRALWELDING.COM