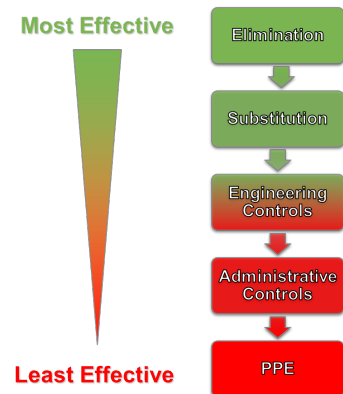




## Chapter 5: Personal Protective Equipment (PPE)

Eliminating hazards or using engineering and administrative controls may not always be feasible on hazardous waste sites. **Personal Protective Equipment (PPE) is required by OSHA and the EPA for all contractors working on Superfund sites when other controls cannot provide adequate protection.** PPE shields or isolates the wearer from the chemical, physical, radiological, and biological hazards at hazardous waste sites. Careful selection and use of PPE can protect the respiratory system, skin, eyes, ears, hands, feet, and head.



### Chapter Objectives:

After completing this module, you will be able to:

1. Identify if the proper PPE has been selected for the hazard.
2. Properly Don and Doff your PPE.
3. Inspect, clean and store your PPE.
4. Describe the four ensemble levels that may be used when doing hazardous waste work.
5. Explain the difference between a qualitative and a quantitative fit test.



## Case Study

Two workers were removing paint from a small process room. Methylene chloride was applied to the walls using brushes and rags. The workers wore coveralls, vinyl gloves, and full-face respirators with organic vapor cartridges. After an hour in the room, the workers felt eye and throat irritation but continued to work. After two hours, one of the workers was dizzy and both workers left the area. What happened?

The high levels of methylene chloride in the room used up the charcoal in the organic vapor cartridges. After 45 minutes, the workers had begun to breathe in large amounts of the chemical, but ignored the warning signs of exposure until they became too sick to keep working. The employer did not implement an adequate respiratory protection program; a change out schedule was not used to make sure that the cartridge life was not exceeded. The employer did not provide appropriate gloves and clothing to prevent the absorption of methylene chloride and skin absorption added to the inhalation exposure. The workers were not trained to recognize the signs of exposure to the chemicals that they were using.



## Section I – Personal Protective Equipment (PPE) Program

**A written personal protective equipment (PPE) program is required by OSHA [1926.65(g)(5)]** as part of the employer’s safety and health program and site-specific safety and health plan [1926.65(b)(1)]. Selected PPE must be capable of protecting employees from known and potential hazards. The PPE program must address:

1. selection, based upon site-specific hazards;
2. use and limitations;
3. work task duration;
4. maintenance and storage;
5. decontamination and disposal;
6. training and proper fitting;
7. putting on and taking off equipment;
8. inspection procedures;
9. evaluation of the effectiveness of the PPE program; and
10. limitations during temperature extremes, heat stress, and other appropriate medical considerations.

The preliminary site evaluation should provide enough information to select the appropriate PPE. **When information on hazards is inadequate, OSHA mandates a high level of skin and respirator protection (called Level B; see page 33), along with the use of special equipment to monitor the air [(1926.65(c)(5)(i) and (iii)].**



OSHA addresses PPE in 29CFR1926 Subpart E and 29CFR1910 Subpart I.

Standard Title	Construction Standard	General Industry Standard
General requirements	1926.95	1910.132
Foot protection	1926.96	1910.136
Head protection	1926.100	1910.135
Hearing protection	1926.101	1910.95
Eye and face protection	1926.102	1910.133
Respiratory Protection	1926.103	1910.134
Safety belts, lifelines and lanyards	1926.104	
Hand Protection		1910.138

## ***Respiratory Protection***

**Respiratory protection is required at hazardous work sites when engineering or administrative controls cannot provide adequate protection.** This section outlines the types of respiratory protection and their use and limitations.

Respirators can provide protection from chemical and particulate (dusts, fumes, mists, fibers) exposures (including some radioactive and biological materials) and oxygen deficient atmospheres. The respiratory protection standards for general industry (29CFR1910.134) and construction (29CFR1926.103) are identical.

**OSHA's respiratory protection standards require employers to develop a site-specific written respiratory protection program if workers are required to wear respirators.** When voluntary use of respirators is permitted employers are required to have a written program sufficient to control the potential hazards associated with the use of the respirator **[1910.134(c) or 1926.103(c)]**. If voluntary use is permitted, employers must provide users with the information contained in Appendix D of the respiratory protection standard.



**The respiratory protection program must be written, have a designated administrator, and address:**

- 1) Hazard evaluation**
  - a) Potential exposures
  
- 2) Respirator selection and use**
  - a) Type of respirator needed for each job
  - b) Type of filter or cartridge needed
  - c) User seal checks
  - d) Supplying Grade D air
  
- 3) Medical evaluation**
  - a) Before use and then as needed
  
- 4) Fit testing (tight-fitting respirators)**
  - a) Type of fit testing
  - b) Before use and at least annually
  
- 5) Training**
  - a) Before use, as needed, and at least annually
  
- 6) Storage, maintenance, repair, and care**
  
- 7) Program evaluation**
  - a) Identify the program administrator
  - b) How the program will be evaluated
  
- 8) Recordkeeping**



**Employers must provide medical evaluations to determine employees' ability to use a respirator before fit testing and use. Medical clearance to use a respirator is determined by a physician or other licensed health care professional (PLHCP).** The PLHCP uses a questionnaire and, if necessary, a follow-up medical examination, to determine if you are at risk for adverse health effects from the added stress of a respirator. If you answer "yes" to specific questions on the questionnaire, you must then get tests or a physical exam. The medical clearance is repeated if you have health problems, change the type of respirator you use, or the workplace changes. The PLHCP must be told what your job involves. Your employer keeps a copy of the medical clearance report with your other workplace records. The report must be limited to your ability to wear a respirator.

Medical conditions that could keep you from wearing a respirator include:

- lung disease
- claustrophobia (fear of small spaces)
- severe high blood pressure
- heart disease
- punctured eardrum

**Selecting the correct respirator for the hazard is the responsibility of the program administrator or other qualified personnel.** Choosing the wrong respirator may be life-threatening. All respirators must be approved by the National Institute for Occupational Safety and Health (NIOSH). Procedures for selecting respirators must be part of your employer's written program. To select the correct respirator a qualified person must first test the air and know:

- The percentage of oxygen in the air
- The hazardous substances workers may be exposed to
- The concentration of the substances in the air
- Permissible Exposure Limits (PELs) for the substances
- The likelihood of Immediately dangerous to life or health (IDLH) conditions
- If the contaminants are hazardous to skin and eyes



**Air monitoring and direct reading instruments are used to identify the substances in the air and determine their concentrations.**

**The concentration of the each hazardous substance must be compared to its PEL or another more protective occupational exposure limit.**

**Immediately dangerous to life or health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape. IDLH values are based on effects that might occur following a 30-minute exposure but workers should make every effort to exit the area immediately.**

**An atmosphere with less than 19.5% oxygen by volume is considered oxygen deficient and immediately dangerous to life and health.** The health effects experienced depend on duration of the oxygen deficiency, work rate, breathing rate, temperature, health, and age. Adverse health effects, such as reduced reaction times, may begin at 19.0% oxygen but not be immediately noticeable or recognized. These percentages are for measurements taken at sea level; adjustments must be made for higher elevations.

**An assigned protection factor (APF) indicates the level of respiratory protection that a respirator can be expected to provide to employees when used as part of an effective respiratory protection program.** OSHA, NIOSH, and ANSI have published assigned protection factors for each type of respirator. We will be referring to the OSHA APFs throughout this manual but some organizations and government installations use other APFs. A lower APF means the respirator does not provide as much protection. For example, a full facepiece air-purifying respirator has an OSHA APF of 50 and an SCBA in positive pressure mode has an APF of 10,000. The full facepiece air-purifying respirator will let more contaminant into your facepiece and provide less protection than the SCBA will.

## OSHA Assigned Protection Factors<sup>1</sup>

Type of respirator <sup>2,3</sup>	Quarter mask	Half mask	Full facepiece	Helmet / hood	Loose-fitting facepiece
Air-Purifying Respirator	5	<sup>4</sup> 10	50		
Powered Air-Purifying Respirator (PAPR)		50	1,000	<sup>5</sup> 25/1,000	25
Supplied-Air Respirator (SAR) or Airline Respirator <ul style="list-style-type: none"> <li>• Demand mode</li> <li>• Continuous flow mode</li> <li>• Pressure-demand or other positive-pressure mode</li> </ul>		10 50 50	50 1,000 <sup>6</sup> 1,000	<sup>5</sup> 25/1,000	25
Self-Contained Breathing Apparatus (SCBA) <ul style="list-style-type: none"> <li>• Demand mode</li> <li>• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)</li> </ul>		10	50 10,000	50 10,000	

<sup>1</sup> 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 immediately dangerous to life or health atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> This APF category includes filtering facepieces and half masks with elastomeric facepieces.

<sup>5</sup> 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 Workplace Protection Factor or Simulated Workplace Protection Factor 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.

<sup>6</sup> A SAR in the positive pressure/pressure demand mode with an escape bottle has an assigned protection factor of up to 10,000 when used in the escape mode.





**Maximum use concentration (MUC) is a respirator's APF multiplied by the OSHA PEL (or another exposure limit) for a chemical.** The MUC is for a specific chemical and type of respirator and does not take into account the filter or cartridge. Air-purifying respirators cannot be used at IDLH concentrations even when the MUC is greater than the IDLH concentration. In this situation, you must use a respirator, such as a SCBA, specifically listed for IDLH conditions.

**Use the following formula to calculate maximum use concentration:**

$$\text{MUC} = \text{Respirator's APF} \times \text{OSHA PEL}$$

**Here is an example:**

You were given a half-face air-purifying respirator for work on a site with naphthalene. The OSHA PEL for naphthalene is 10 ppm. What is the maximum use concentration (MUC) in this scenario?

$$\text{MUC} = \text{APF of } 10 \times 10 \text{ ppm}$$

**MUC = 100 ppm** naphthalene with a half-face air-purifying respirator

If naphthalene concentrations may exceed 100 ppm then your employer must provide you with respirator with a higher APF.

***An MUC is the maximum amount of a hazardous substance a worker can be exposed to wearing a particular respirator.***



If you know the concentration at your worksite, you can also use a respirator's assigned protection factor to figure out the maximum concentration of a chemical you're likely to be exposed to while wearing that respirator. You need to make sure that the concentration inside your respirator is below the OSHA PEL for the chemical. Use the following formula to do this.

$$\frac{\text{concentration of chemical in the work area}}{\text{Respirator's APF}} = \text{Concentration of chemical in the respirator}$$

**Here is an example:**

The OSHA PEL for o-xylene is 100 ppm. You are working in an atmosphere where the concentration of o-xylene is 800 ppm. Which of the two respirators below would you rather have to protect you against the chemical?

A half-face air-purifying respirator with an assigned protection factor of 10?

$$\frac{800 \text{ ppm}}{\text{APF of 10}} = 80 \text{ ppm maximum concentration inside your respirator}$$

**Less Protective**

A full facepiece air-purifying respirator with an assigned protection factor of 50?

$$\frac{800 \text{ ppm}}{\text{APF of 50}} = 16 \text{ ppm maximum concentration inside your respirator}$$

**More Protective**

A properly fitted full facepiece air-purifying respirator protects your eyes and provides five times more protection than a half-face air-purifying respirator.



There are two main types of respirators, each with several subtypes:

1. **Air-purifying respirators (APRs)** remove contaminants from the air before it is inhaled.
2. **Atmosphere-supplying respirators** (also known as air-supplying respirators) supply clean breathing air from a source independent of the work area.



SCBA: full-face, positive-pressure, pressure demand  
30 minute unit.

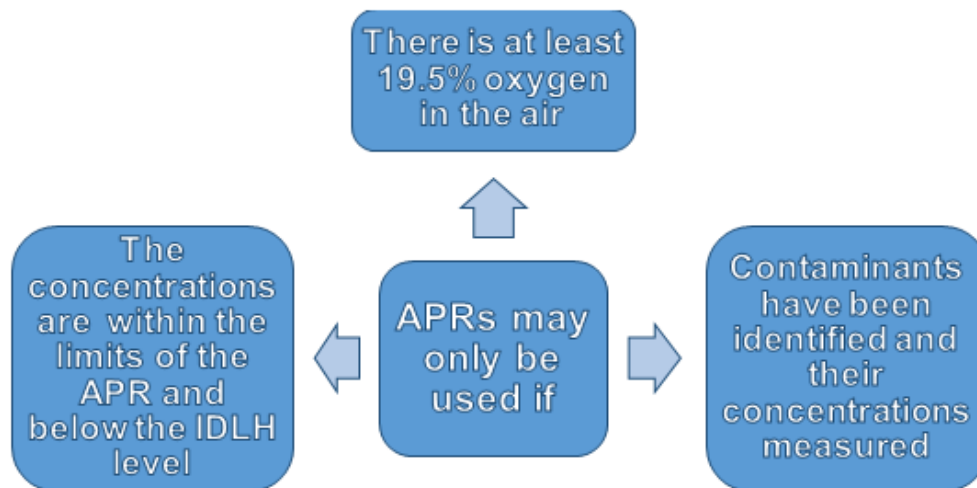
**Supplied-air respirators (SARs) or airline respirators** supply air through an airline from a tank or compressor to the wearer.

**Self-contained breathing apparatus (SCBA)** supplies the air from a tank on the wearer's back.



## ***Air-Purifying Respirators***

**Air-purifying respirators (APRs) can provide protection from particulates (dusts) and some toxic chemicals. They work by filtering air before it is inhaled.** APRs include half mask filtering facepieces, half mask elastomerics, full facepiece elastomerics, and powered-air purifying respirators (PAPRs). Elastomeric means a polymer plastic that stretches. Most APRs consist of a facepiece with one or two filtering cartridges through which the air enters, an exhalation (out) valve near the chin, and two straps. The most widely used on hazardous waste sites are full facepiece elastomeric APRs. Respirators and masks that are not approved by NIOSH should **never** be used for respiratory protection on a hazardous waste site or other jobs.



**Half-mask respirators and disposable filtering facepiece respirators have an APF of 10** so they only provide one-fifth the respiratory protection of full facepiece APRs. Unlike full facepiece respirators, **half-mask APRs do not provide eye protection.** Half mask filtering facepieces consist of a filtering medium that makes up the entire facepiece and, in some cases, an exhalation valve. Filtering facepiece respirators do not provide protection from gases or vapors but are permitted for particles as long as they provide sufficient protection for the concentration present. Remember, APRs must not be used when the oxygen content is less than 19.5%



**Half-Mask Air-Purifying Respirator.**



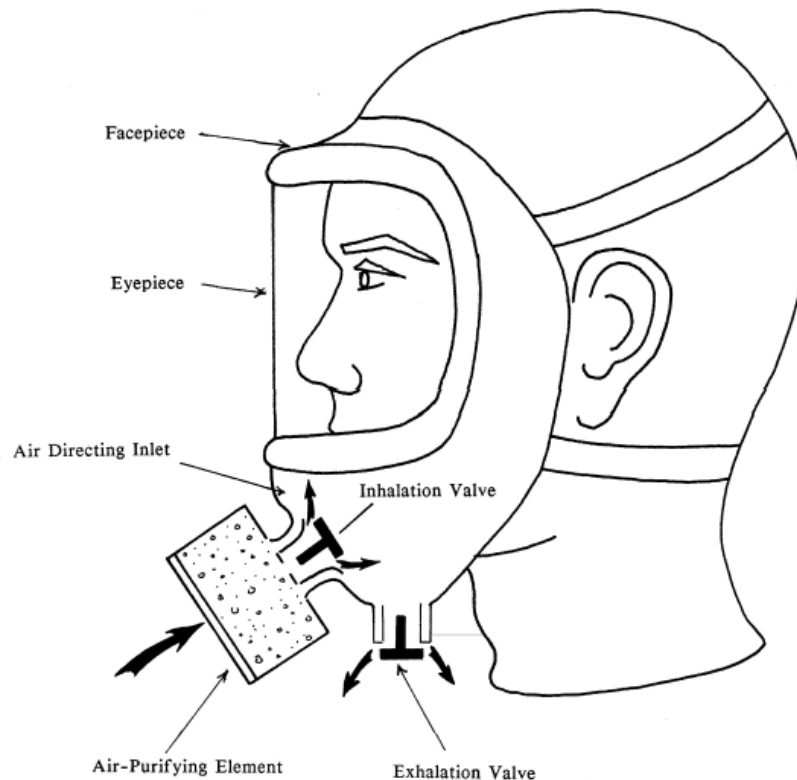
**Filtering Facepiece Air-Purifying Respirator**



**Full facepiece APRs have an APF of 50 and provide eye protection. They protect against dusts and some toxic chemicals by filtering air before it is inhaled.**

Air enters through the cartridge(s), which is selected to remove dusts, particles, chemicals, or some combination of these, and exits through a valve. Note the proper placement of the straps or headbands.

Workers who wear glasses will need a special kit to prevent the temples (side pieces) of the glasses from letting air leak in around the sides of the mask.



**Typical Full Facepiece Air-Purifying Respirator**



**Another type of APR is the powered air-purifying respirator (PAPR), which uses a blower to force air through the filters or cartridges and into the mask.** PAPRs consist of a hood or helmet, facepiece, filter or cartridge, power source, and a blower. APF for PAPRs are 50 with a half mask, 1,000 with a full facepiece, 25 with a helmet, hood, or loose-fitting facepiece. PAPRs with a helmet or hood can be given an APF of 1,000 with evidence from the manufacturer. PAPRs can only be used in environments where there is enough oxygen. If an employee has medical condition that prevents the use of a negative pressure respirator then the employer must provide a PAPR [1910.134(e)(6)(ii)].





**Two types of air purifiers (cleaners) are used with APRs.**

1. Filters or air purifying elements remove dusts, particles, mists, and fumes (tiny metal particles) from air
2. Chemical cartridges use a filter, sorbent, or catalyst, or a combination of these to remove vapors and gases from air

**Procedures for selecting filters and cartridges must be part of your employer's written program.** Filters and cartridges are chosen based on the contaminants, the concentration of the contaminants, and, to a lesser extent, the size of the particles. For example, welding often produces both fumes and gases and may require a combination cartridge with both a filter and a chemical cartridge. In some instances, cartridges to protect you from a chemical are not available or have short service life and it is not possible or practical to use an APR.





**Filters, canisters, and cartridges are labeled and, as a secondary means of identification, color-coded.**

**Color Assigned to Canister, Cartridge, or Filter (ANSI Z88.7-2010)**

Contaminants	Color Assigned
Acid gases	White
<b>Organic vapors</b>	<b>Brown/Black<sup>7</sup></b>
Ammonia gas	Green
Ammonia & methylamine gas	Green
Carbon monoxide gas	Blue
<b>Acid gases &amp; organic vapors</b>	<b>Yellow</b>
Acid gases, ammonia, and organic vapors	Brown
Organic vapors, chlorine, chlorine dioxide, hydrogen chloride, hydrogen fluoride, sulfur dioxide, formaldehyde, hydrogen sulfide (escape only), ammonia, methylamine	Pale Brown (Tan)
Acid gases, ammonia, carbon monoxide, and organic vapors	Red
Other vapors and gases or combinations not listed above	Olive
<b>Any Particulates – High Efficiency (HE), for PAPRs only</b>	<b>Purple/Magenta</b>
<b>Any Particulates – P100</b>	<b>Purple/Magenta<sup>8</sup></b>
<b>Any Particulates – P95, P99, R95, R99, R100</b>	<b>Orange<sup>9</sup></b>
<b>Any Particulates free of oil – N95, N99, or N100</b>	<b>Teal<sup>10</sup></b>

7 Organic vapor cartridges may be brown following changes to ANSI Z88.7 in 2010.

8 Particulate filters housed within a container, and which do not have replaceable filter media, shall be color-coded as above. Particulate filters not housed within a container and which have a NIOSH filter class designation (N95, P95, etc.) on the filter do not need to be color-coded.

9 An orange stripe or indicator shall be used to identify P class particulate filters, except P100, in combination with any vapor or gas canister or cartridge if the filter is housed within a container and the NIOSH filter class designation is not visible on the filter.

10 A teal stripe indicator shall be used to identify N class particulate filters in combination with any vapor or gas canister or cartridge if the filter is housed within a container and the NIOSH filter class designation is not visible on the filter.



NIOSH has nine filter classes for non-powered respirators and they are based on three levels of filter efficiency and three levels of resistance to degradation from oil mist.

Resistance to Oil			
Minimum Efficiency	N (not oil resistant)	R (oil resistant)	P (oil proof)
95%	N95	R95	P95
99%	N99	R99	P99
99.97%	P100	R100	R100

### How do you know when your cartridge or filter needs to be changed?

Your employer's written program must include a **change schedule for cartridges for gases and vapors [1910.134(d)(3)(iii)(B)(2)]**, unless the cartridge has an **end-of-service-life indicator (ESLI)**, which is a dot that changes color when the cartridge is no longer effective. **The frequency with which cartridges need to be changed depends on the chemicals, their concentrations and boiling points, the temperature and humidity of the air, and your rate of work or breathing.** Some cartridges will only last for minutes while others may be effective for many hours. It is considered a best practice to replace gas and vapor cartridges at the beginning of each shift and some substance-specific OSHA standards (e.g. benzene and formaldehyde) require this even if the end of the cartridge's service life has not been reached. Odor, taste, and irritation cannot be used in place of a change schedule or ESLI but **you must leave the work area and change your cartridges if you detect a taste or smell** in your respirator. You cannot rely on smell, taste, or irritation because they may not occur until you've already been exposed. If your sense of smell is weakened, you may be working with a useless cartridge and not even know it. When a particulate filter becomes "loaded" it becomes difficult to breathe through and must be changed. Cartridges and filters must also be changed when recommended by the manufacturer or when they become damaged or wet.



## ***Atmosphere-Supplying Respirators***

**Atmosphere-supplying respirators (also known as air-supplying respirators) include self-contained breathing apparatus (SCBA) and supplied-air respirators (SARs).<sup>11</sup>**

**Self-contained breathing apparatus (SCBA) supply clean breathing air from a tank carried on the wearer's back.** Full facepiece SCBAs operated in a positive pressure or pressure demand mode offer the best respiratory protection because the pressure in the facepiece prevents you from breathing contaminated air, even if you have a leak. The usefulness of SCBAs is limited by the amount of air that can be carried in the tank on the wearer's back.



There are several different brands of SCBAs on the market. **You must be fit tested and trained to use the specific make and model of SCBA your employer gives you.** Each SCBA will have different checkout procedures and manufacturer's instructions. **Do not attempt to use an SCBA without proper training.**

**Supplied-air respirators (SARs), also known as airline respirators, supply breathing air from a tank or compressor through an airline to the wearer's mask.** For the greatest protection, airline respirators should be used with a full facepiece and operated in a positive pressure/pressure demand mode.

Airline hoses must **never exceed 300 feet** from the air source to the wearer. Supplied-air respirator hoses are a problem when there is any moving equipment. The hose can get cut, run over, or tangled up in equipment. Often hoses are covered with plastic or duct tape to keep chemicals off of them.

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<sup>11</sup> In this manual, when we write "SCBA" we always mean a positive-pressure/pressure-demand full-facepiece (modern style) minimum 30-minute SCBA approved by NIOSH. When we write SAR we always mean a positive-pressure/pressure-demand full-facepiece (modern style) SAR with an escape bottle approved by NIOSH.

An escape bottle should always be used with airline SARs in case the hose is cut or damaged. Never go farther into a contaminated area than you can escape from in **five minutes**. Escape bottles, when properly filled, are rated to provide air for 5, 10, or 15 minutes of **normal breathing**.

Compressors used to supply breathing air must meet special requirements. These compressors must be equipped with in-line, air-purifying sorbent beds and filters that are maintained and replaced or refurbished per manufacturer's instructions. The compressor's exhaust must not contaminate the air it supplies. To avoid contamination of the supplied air, locate compressor air intakes in a contaminant-free area. **Compressed breathing air must meet or exceed the following criteria for Grade D breathing** as described in ANSI/CGA G-7.1-1989:

- **Oxygen content of 19.5 - 23.5%;**
- **Hydrocarbon (condensed) content of 5 mg/m<sup>3</sup> or less;**
- **CO content of 10 ppm or less;**
- **CO<sub>2</sub> content of 1,000 ppm or less; and**
- **Lack of noticeable odor.**

Procedures for protecting hoses and ensuring clean air must be part of your employer's written program.

Sometimes workers need to go into areas that are immediately dangerous to life or health (IDLH). SCBA and SARs with escape bottle are the most protective forms of respiratory protection and the only types allowed in IDLH conditions. **Whenever SCBAs or SARs are used in these areas, there must be a trained worker outside who is in constant contact with the workers inside.** Provisions must be made for rescue.

After receiving medical clearance

Prior to use

Following changes in respirator make, model, or size

Following changes in physical characteristics affecting fit

Annually



**Positive pressure SCBAs or SARs with an escape bottle must be used when:**

- Oxygen content of the air is less than 19.5%;
- Contaminants and/or its concentration are unknown;
- Concentration of the contaminant is IDLH or above the concentration safely handled by a less protective respirator; and
- There is an emergency including any of the above conditions.

**Respirators must fit properly, be worn correctly, cleaned, stored, and maintained to provide the level of respiratory protection indicated by the assigned protection factor.**

A tight-fitting respirator will protect you only if it seals against your face. Faces come in different sizes; so do respirators. The purpose of fit testing is to find the manufacturer/size combination that offers you the best protection. OSHA's respiratory protection standard requires that **users of tight-fitting respirators be fit-tested:**

Weight loss or gain, scars, dentures, dental work, or facial injury can change the way the respirator seals to your face and require another fit test.

Facial hair prevents the respirator from sealing to your face and **wearing or fit testing a tight-fitting respirator is not allowed when facial hair may interfere with the face-to-facepiece seal.**

Section 1910.134(g)(1)(i) of the OSHA General Industry Standards states:

“The employer shall not permit respirators with tight-fitting face-pieces to be worn by employees who have (A) facial hair that comes between the sealing surfaces of the face-piece and the face . . . or (B) any condition that interferes with the face-to-facepiece seal.”

OSHA says there cannot be any facial hair between the skin and the facepiece when you use a respirator that relies upon a good face-to-face-piece seal. This includes any tight-fitting (as opposed to helmet or loose-fitting hood) positive pressure respirators.



Even a heavy stubble can prevent a good face-to-face-piece seal. Studies clearly show that facial hair will reduce the protection provided by respirators, particularly negative-pressure respirators. Twelve out of 14 studies reviewed showed that leakage increased 20 to 1,000 times when respirator wearers had facial hair (Stobbe, 1988). Rules about facial hair must be part of your employer's written program.

**Workers must be fit tested with the same make, model, style, and size of respirator that will be used. Fit testing can be either qualitative (subjective) or quantitative (objective measurement with a computer), depending on the respirator.** Procedures for annual fit tests and routine seal checks must be part of your employer's written program.



**Qualitative** and **Quantitative** fit testing are used to find the size and model of respirator you should wear and demonstrate that your face-to-facepiece seal is adequate. These tests must be repeated at least annually to ensure a proper fit and your employer must keep a record of the tests.



## Qualitative (Taste/Smell) Testing

**Purpose:** Determine whether the seal between the respirator's facepiece and the wearer's face is adequate.

**Method:** While wearing a respirator you are exposed to a test substance which is an irritant (smoke), has a strong odor (banana oil), or has a sweet or bitter taste (saccharine or Bitrex). If you smell, taste, or detect the substance then your respirator does not fit well and will not protect you.

**Requirements:** These qualitative methods are OSHA-approved and can be used to fit test tight-fitting respirators as required by 1910.134. These tests can only be used for APRs with an APF of 10 or less and tight-fitting atmosphere-supplying respirators and PAPRs.

**Disadvantages:** Qualitative fit testing depends on your senses; passing or failing is subjective and determined by the respirator user. Having a poor sense of smell or taste or not following the method may cause you to believe you are protected when you aren't.

Some of the test substances can irritate the eyes or cause coughing. NIOSH recommends against fit testing with irritant smoke because of the associated health risks.

Fit testing is often done in an "ideal" environment that does not reflect real working conditions. Test conditions will not show how a respirator will fit in extreme temperatures or during hard physical work.



## Quantitative (Computer) Testing

**Purpose:** Measures the effectiveness of a respirator in keeping contaminants from entering the facepiece during a fit test. Quantitative fit tests provide a fit factor to indicate whether the seal between the respirator's facepiece and the wearer's face is adequate. Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in room air to its concentration inside the respirator when worn.

**Method:** A probe is added to the respirator facepiece or between the filter and the facepiece. Then an instrument is used to measure particles or air pressure inside and outside the mask. The most common method measures the number of particles in the room and in the respirator mask, compares the two numbers, and calculates a fit factor. The test is repeated while you complete 8 activities (speaking, moving your head, deep breathing, running in place, etc.) that may affect fit. These activities are performed for one minute each except for grimacing (smiling or frowning) which is done for 15 seconds. Grimacing breaks the face to facepiece seal and checks to see if the respirator reseals to the face afterward. The test provides an average fit factor for the 7 one-minute activities.

**Requirements:** Quantitative fit testing is required by OSHA for all negative pressure respirators with an APF greater than 10 and is a good practice for all respirators. The quantitative fit test must indicate a fit factor of at least 100 for half mask respirators and at least 500 for full facepiece respirators or else the respirator cannot be used.

**Disadvantages:** The equipment is more expensive to purchase than the equipment required for qualitative fit testing.





## ***Respirator User Seal Checks***

**Both positive-pressure and negative-pressure user seal checks must be done each time you put on a respirator.** These quick checks ensure that the respirator is properly seated on and sealed to your face but do not replace initial or annual fit-testing.

### **Positive-Pressure (Exhale) User Seal Check**

Method: Cover the exhalation (out) valve with your hand and blow out gently. The facepiece should expand but not break the seal. Adjust the respirator to eliminate leaks if necessary, and repeat the process. For a positive pressure respirator, after the air supply is attached, simply hold your breath. You should not hear any air leaking from the mask.



**Positive Pressure Check**

### **Negative-Pressure (Inhale) User Seal Check**

Method: For an APR, place your hands or latex gloves over cartridges and inhale. For an SCBA or SAR, disconnect the hose at the regulator, cover the end of the hose and inhale. Hold your breath for 10 seconds and check to see that no outside air leaks into the face-piece. Adjust the respirator to eliminate leaks if necessary, and repeat the process.



**Negative Pressure Check**

Positive-pressure and negative-pressure user seal checks can be done quickly and easily in the field.



**Respirators should be inspected before and after each use and, if not used, at least monthly.** Most construction workers are responsible for doing this themselves. Even if someone else is assigned to inspect your respirator, it is a good idea to check for yourself. Procedures for inspecting, maintaining, and storing respirators must be part of your employer's written program. Your employer's policy may include more frequent inspections.

**Inspection for all respirators should include:**

1. Check the condition of the face-piece and all of its parts
2. Check the headbands to make sure that they can be tightened to provide a good fit

**Inspection for SCBAs and SARs should include:**

1. Check the hoses and the points where the hose attaches to the face-piece and to the air tank
2. Check the head and tank harnesses for cracks, tears, or other defects
3. Check the regulator according to the manufacturer's directions
4. Check the air tanks or compressor for damage
5. Report defects or unusual conditions immediately

**Employers must provide each user with a respirator that is clean, sanitary and in good working order. Employers must ensure that respirators are cleaned and disinfected using the procedures in 1910.134 Appendix B-2 or equivalent procedures recommended by the respirator manufacturer.**



**It is a good practice to clean and disinfect respirators after every use. OSHA states that respirators must be cleaned and disinfected:**

- as often as necessary to maintain sanitary conditions when used by one person;
- before being worn by different individuals when issued to more than one employee; and
- after each use for respirators used for emergencies, fit testing, or training.

**Cleaning and disinfecting for all respirators should include:**

1. Inspect each piece
2. Wash/disinfect the respirator components following the manufacturer's instructions
3. Hand-drying with a clean, lint-free cloth or air-drying
4. Reinspect the pieces as they are put back together
5. Store away from dust, sunlight, heat, extreme cold, high humidity, and chemicals

**Cleaning and disinfecting for SCBAs and SARs should include:**

1. Remove the air tank or hoses
2. Inspect each piece
3. Wash/disinfect the face-piece, hose, and harness following the manufacturer's instructions with disinfectant soap and water
4. Hand-drying with a clean, lint-free cloth or air -drying
5. Do not submerge SCBAs in water
6. Follow the manufacturer's specialized instructions

**If you find something wrong with your respirator, do not try to fix it yourself. Find out who is authorized to do repairs in your site-specific respiratory protection program.**



## ***Summary: Respirator Protection***

Respirators prevent toxic materials from entering your body through your lungs. When respirators are required, your employer must have a **written respiratory protection program**. You must complete a respirator medical evaluation (questionnaire) and/or exam and **receive medical clearance** from a physician or other licensed health care professional before your fit test.

**Selecting the right respirator and filter or cartridge can be a matter of life or death.** Special considerations in use of respirators include facial hair, eyeglasses, communication, and use in IDLH atmospheres (such as low oxygen or chlorine leaks).

A respirator that filters the air is an **air-purifying respirator** or **APR**. These may be filtering facepiece respirators or elastomeric (rubber) respirators with cartridges or filters. Elastomeric respirators have a facepiece, straps, an exhalation (out) valve, and one or two filters or cartridges where the air enters. Filters remove dusts and particulates, cartridges remove vapors and gases, and some hazards require filters and cartridges to be used together. Your employer must have a change schedule unless the cartridge has an end of service life indicator (ESLI). An APR can only be used if there is enough oxygen in the air.

Situations where you must **not** use an air-purifying respirator (APR) include:

- not enough oxygen (less than 19.5%);
- the chemicals or concentrations of chemicals are not known
- levels of hazardous substances in the air are above the maximum use concentration for the respirator and chemical;
- atmosphere is immediately dangerous to life and health (IDLH); and
- skin hazards where you must wear a fully encapsulating suit.

**Atmosphere-supplying respirators include self-contained breathing apparatus (SCBA) and supplied-air respirators (SARs).**



**SCBA** are the type of respirator firefighters use most often. They can be used in areas with low oxygen, high levels of chemicals, very toxic chemicals, or fires. SCBA have a facepiece, a 30-60 minute tank of air, a pressure gauge, a low-pressure alarm, a regulator, and a safety or bypass valve for use during regulator failure.

**SARs, also known as airline respirators,** have a long hose that supplies air. The long hose must be protected from chemicals and cuts. **If SARs are used in IDLH** situations or for unknown concentrations, a small bottle of air for escape must also be worn.

A tight-fitting respirator is only as good as its fit. You need a fit test before you wear a tight-fitting respirator and at least once a year after that. The two kinds of fit tests are **qualitative** (yes or no) or **quantitative** (computer and instrument provide a number to indicate how good the fit is). Before each use, you must also do positive- and negative-pressure user seal checks.

Respirators do not work well or reliably unless they are properly **cleaned, inspected, and stored**. Respirators must be inspected before and after each use or monthly if not used routinely.

**Important abbreviations related to respiratory protection include:**

<b>APR</b>	air-purifying respirator
<b>APF</b>	assigned protection factor
<b>FF</b>	fit factor
<b>IDLH</b>	immediately dangerous to life or health
<b>MUC</b>	maximum use concentration
<b>PAPR</b>	powered air-purifying respirator
<b>PLHCP</b>	physician or other licensed health care professional
<b>SAR</b>	supplied-air respirator
<b>SCBA</b>	self-contained breathing apparatus



## Section II – Chemical Protective Clothing (CPC)

After other controls have been used to the extent feasible, PPE provides an important barrier between chemicals or other hazards and your body. Although it cannot eliminate exposures, PPE can reduce exposures when properly selected and worn.

**Chemical protective clothing (CPC) is a type of PPE and protects employees from chemical and physical hazards.** CPC is an important part of a hazardous waste site worker's protective equipment.

Chemical protective clothing includes suits, foot covers, boots, gloves, and hoods that are made of special materials. These materials are chemical-resistant, which means they act as a barrier to keep chemicals from coming in contact with your skin. It is critical to select CPC that is designed to protect against the specific chemicals on your site. Otherwise, you might not be protected, even when you think you are.

**CPC, and other PPE, must be selected based on potential exposures** and explained in the safety and health plan. For example, totally-encapsulating suits may be required for moving leaking drums, whereas non-encapsulating suits may be okay for operating a remote (robot) drum handler. The level of protection provided must be reevaluated as additional site information is gained.





**Suits, respirators, gloves, and chemical protective steel-toed boots are always worn together in an ensemble, or combination. PPE ensembles are selected based on the respiratory and skin risks of the job. OSHA describes PPE ensembles as Level A, Level B, Level C, and Level D, in Appendix B of the HAZWOPER standard (29CFR1926.65).**

PPE Ensemble Level	Respiratory Risk	Skin Risk
A	High	High
B	High	Moderate
C	Moderate	Moderate
D	Low / None	Low / None

**Chemical protective suits are of two general types, totally-encapsulating or nonencapsulating.**

1. Totally-encapsulating chemical-protective (TECP) suit: Provides head-to-toe coverage to protect the wearer from chemicals. These “moon suits” have special seams and zippers to prevent chemicals from leaking into the suit. They are gas/vapor-tight and have exhalation valves. TECPs are used when the highest levels of skin and respiratory protection are needed. These suits have a face shield that is part of the hood.
2. Non-encapsulating chemical-protective (NECP) suit: Provides good protection from chemicals and may or may not have face shields. These suits are not totally-encapsulating, are not vapor tight, and do not have exhalation valves. They provide less skin protection than vapor tight suits. These suits are used when less skin protection is needed. The hood can either be part of the suit or detached.

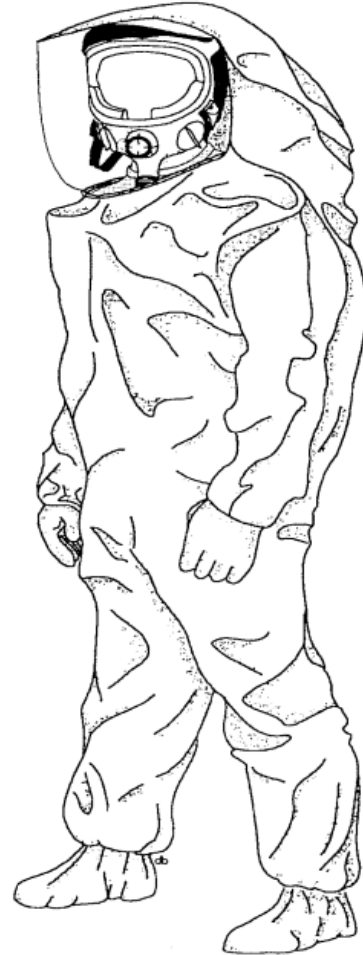
Disposable suits, which provide limited protection from chemicals, can be used alone or in conjunction with these chemical-protective suits.



**Level A provides the highest level of skin, respiratory, and eye protection that can be worn by a hazardous waste site worker.**

**The following constitute Level A equipment and may be used as appropriate:**

1. NIOSH-approved positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator (SAR) with escape SCBA.
2. Totally-encapsulating chemical-protective (TECP) suit.
3. Built-in outer chemical-resistant gloves and separate inner chemical-resistant gloves.
4. Chemical-resistant boots with steel toe and shank.
5. Disposable protective suit, gloves, and boots (worn outside the Level A suit to protect the expensive suit).\*
6. Coveralls.\*
7. Hard hat (under suit).\*
8. Long underwear (to absorb sweat).\*



**\* Optional depending on conditions**

**Note:** With SAR, the suit must be properly equipped with a pass-through air-line connection, called an air-line egress.

**Level A should be worn when:**

1. The identified substances require the **highest level of protection for the skin, eyes, and respiratory system;**
2. There is potential for splash, hand or foot, immersion, or other **skin contact** with substances that may harm or be absorbed through the skin; or
3. Working in confined, poorly ventilated areas, and the chemicals present or their concentrations are **unknown**.

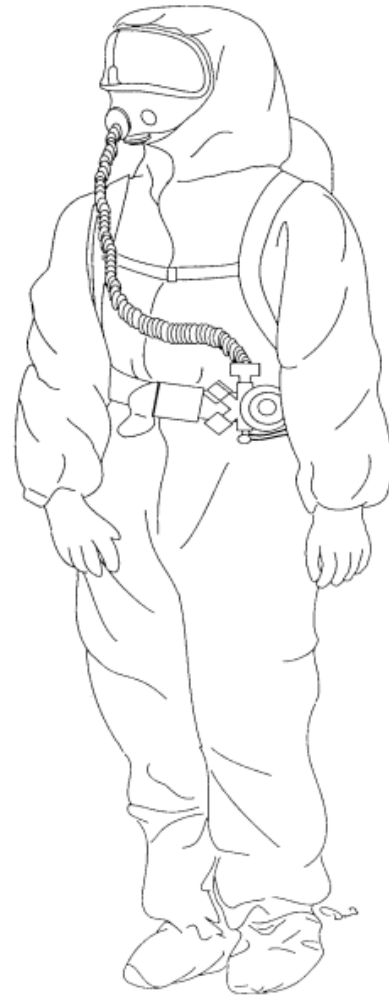




**Level B provides the highest level of respiratory protection, but a lesser degree of skin and eye protection than Level A. Level B is the minimum acceptable level for initial entry.**

**The following constitute Level B equipment and may be used as appropriate:**

1. NIOSH-approved positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator (SAR) with escape SCBA.
2. Non-encapsulating chemical-protective (NECP) suit. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls) - **not vapor-tight.**
3. Inner and outer chemical-resistant gloves.
4. Chemical-resistant boots (outer) with steel toe and shank.
5. Boot covers: outer, chemical-resistant (disposable).
6. Disposable protective suit or coveralls and gloves (worn outside the Level B suit to protect the expensive suit and gloves).\*
7. Hard hat.\*
8. Face shield. \*
9. Long underwear (to absorb sweat).\*



A Level B suit that covers the SCBA would reduce equipment contamination

**\* Optional depending on conditions**



**Level B should be worn when:**

1. The type and concentration of substances in the air have been identified and require a high level of respiratory protection, but less skin protection.
2. The atmosphere contains less than 19.5 percent oxygen; or
3. Incompletely identified vapors or gases are present but not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

**Note:** This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.



**Level C provides less respiratory protection than Levels A and B and less skin protection than A.** It may or may not provide the same skin protection as Level B, depending on the type of suit worn.

**The following constitute Level C equipment and may be used as appropriate:**

1. NIOSH-approved air-purifying respirator (APR), full-face or half-mask.
2. Hooded chemical-resistant clothing (coveralls; two-piece chemical-splash suit; disposable chemical-resistant overalls).
3. Inner and outer chemical-resistant gloves.
4. Coveralls.\*
5. Chemical-resistant boots (outer) with steel toe and shank.\*
6. Boot covers: outer, chemical-resistant (disposable).\*
7. Hard hat.\*
8. Escape mask.\*
9. Face shield.\*

**\* Optional depending on conditions**

**Level C should be worn when:**

1. The types and concentrations of airborne substances are known and there is at least 19.5% oxygen in the air;
2. A sufficient APR is available and all criteria for use have been met; and
3. Direct contact with the hazardous substance will not harm the skin or be absorbed through the skin.





**Level D provides no respiratory protection and little or no skin protection.** It is for people who work outside of the hazardous waste area. Level D protection is typically worn by workers involved with support activities such as equipment supply, maintenance, or off-site vehicle operation. Level D is similar to “typical work clothes” except for chemical-resistant boots with steel shank.

**The following constitute Level D equipment and may be used as appropriate:**

1. Coveralls (work clothing).
2. Chemical-resistant boots or shoes with steel toe and shank.
3. Hard hat.\*
4. Gloves.\*
5. Outer, chemical-resistant boots (disposable).\*
6. Safety glasses or chemical splash goggles.\*
7. Face shield.\*
8. Escape mask.\*



**\* Optional depending on conditions**

**Level D should be worn when:**

1. The atmosphere contains no known hazards; and
2. The work will not involve getting chemicals on the skin or inhaling hazardous levels of any chemicals.



**Remember, CPC ensembles must be selected based on the level of respiratory and skin protection required.** Combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

<b>CPC Ensemble Level</b>	<b>Respirators</b>	<b>Skin Protection</b>	<b>Protection From</b>
<b>A</b>	SCBA or SAR	TECP suit, chemical-resistant gloves & boots	High respiratory and skin hazards and unknowns
<b>B</b>	SCBA or SAR	NECP suit, chemical-resistant gloves & boots	High or unknown respiratory and moderate skin hazards
<b>C</b>	APR or PAPR	NECP suit, chemical-resistant gloves	Moderate respiratory and skin hazards
<b>D</b>	None	Optional gloves	No respiratory hazards and minimal skin hazard



## CPC Selection Guidelines

**Chemical resistance:** Different materials are resistant to different chemicals. Even water can breakdown some materials. CPC must provide protection against the chemicals likely to be at the site. This is true for whole-body as well as hand and foot protection.

**Durability:** In addition to exposure to chemicals, CPC will be subject to stretching, contact with rough surfaces and sharp objects. CPC must be durable enough to be used without being torn, punctured, or abraded.

**Resistance to temperature extremes:** Heat and cold can often damage CPC. Clothing which will be worn in cold temperatures could crack or become ineffective against chemicals. Likewise, heat may destroy the chemical resistance of clothing or even melt it. Always check the manufacturer's information about temperature damage.

**Ability to be cleaned:** Clothing must either be decontaminated or disposed of after each use.

**Cost:** CPC is expensive, but buying less expensive, inferior products which do not adequately protect employees can be more expensive in the long run due to increased medical costs and lost work time.

**Flexibility:** Materials need to be flexible enough for the wearer to move and work safely. Overly rigid suits can result in unnecessary accidents from slips, trips, and falls. Gloves which are too rigid can make gripping difficult and lead to other hazards.

**Heat stress and thermal comfort:** CPC's contribution to workers' heat stress must be considered, monitored, controlled, and balanced against the need to provide protection from chemicals.

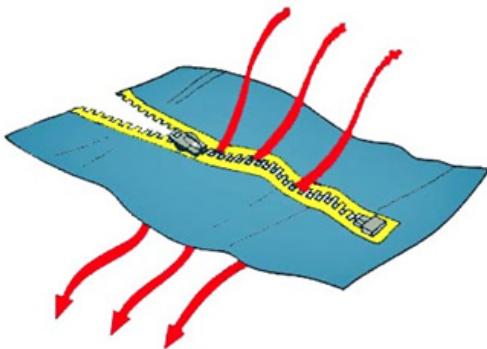
**Size:** CPC should be available in a variety of sizes to accommodate different sized workers. Suits that are too small will tear easily and provide no protection. Suits that are too large will make walking and working difficult. Safety boots that are too big will result in a tripping hazard and reduced comfort. Gloves that don't fit well make using equipment difficult and dangerous.



**Chemical protective clothing's ability to protect us depends on:**

- Contact time
- Concentration
- Presence of chemical mixtures
- Temperature
- Size of the contaminant molecules and pore size of the CPC material
- Physical state (solid, liquid, gas) of the chemical contaminants

**Penetration** is the movement of a chemical through openings in CPC. Zippers, stitched seams, abrasions, punctures, tears, or other openings in the CPC material can contribute to penetration.

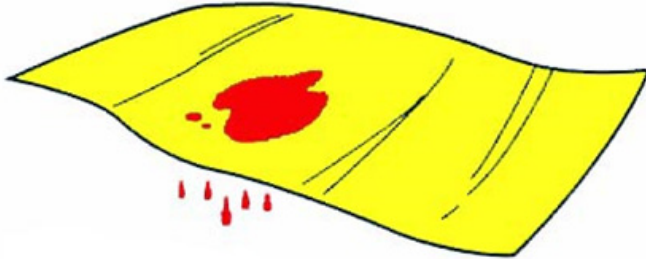


**Degradation** is the physical deterioration of the protective material and reduces chemical resistance. High temperature, sunlight, inappropriate storage environments, and chemical exposure can contribute to degradation.. Signs of degradation are not always visible and include discoloration, blistering, brittleness, softening, cracking, swelling, and shrinking.





**Permeation** is the movement of a chemical through a protective material on a molecular level (invisible). Breakthrough time is the amount of time required for a chemical to permeate, or pass through, a material.



Materials used to make most PPE and suits do not “breathe”, causing rapid heat and moisture build-up inside the PPE. **Wearing PPE makes it difficult for the body to cool itself and adds to heat stress. This leads to discomfort and possibly heat-related illnesses including:**

- Heat exhaustion
- Heat cramps
- Heat rash
- Heat stroke

**The safety and health plan should address preventing heat-related illnesses with procedures for:**

- Monitoring forecasts and weather conditions
- Acclimatizing workers to working in a hot work environment
- Implementing a work-rest schedule
- Providing water and shade and ensuring they are used
- Identifying and responding to heat-related illnesses





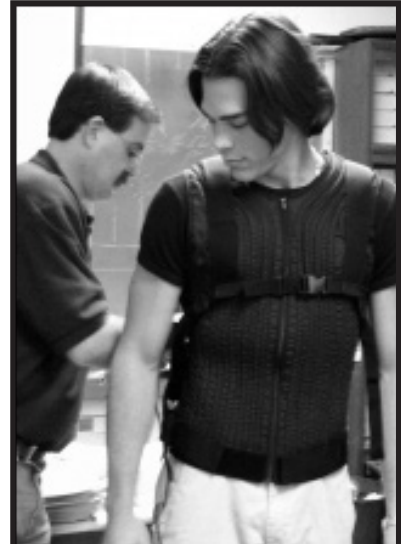
**Wearing cool suits and vests while wearing protective clothing keeps workers cool.**



Instructor with Cool Suit vest and a frozen H<sub>2</sub>O bottle



A closer view of the vest, bottle carrier (r), pump priming bulb (m), and battery pack (l)



Front view of the Cool Suit vest & sternum strap

It is important to **inspect** CPC for evidence of chemical or physical damage. Instructions for inspection, maintenance, and storage should be in the site safety and health plan.

**CPC should always be inspected when it is:**

1. Received from the distributor
2. Issued to workers
3. Put into storage
4. Taken out of storage
5. Used in training
6. Used for work or an emergency response
7. Received following maintenance or repair



**An inspection checklist should be developed for each item. CPC inspection checklists should consider:**

1. Weakness in zipper or valve seals
2. Cuts, holes, tears, swelling, and abrasions in seams of fabric
3. Signs of contamination such as discolorations or visible stickiness
4. Signs of malfunctioning exhaust valves
5. Improper storage

**Note:** CPC may be contaminated even though it does not appear discolored.

Proper **maintenance** and **storage** can prevent problems with CPC and prolong the life of the equipment. SOPs should describe storage before the CPC is issued to the wearer and also post-use storage. Check manufacturer's data, as most CPC has a shelf life.



### Chemical-protective clothing has limitations:

1. Fully encapsulating suits **make communication very difficult**. It is important to establish other ways to communicate. Learn the alarm and hand signals used on your site. Two-way radios, portable radios, or radios with a microphone and speaker combination attached to the full-face respirator are recommended. Remember, all radios must be intrinsically safe when working in a potentially explosive atmosphere.
2. Most suits **restrict movement and increase clumsiness**, especially when climbing, working in tight areas, or using hand tools.
3. PPE, especially TECPs, **increases heat stress and the risk of heat-related illnesses**. Heat stroke is a serious threat. Watch for signs of dizziness, nausea, and lack of perspiration, especially at temperatures over 70°F.
4. Disposable **boot covers may be slippery**. Use caution to prevent slips and falls.
5. Suit-to-boots and suit-to-glove **joints on Level B and Level C suits should be taped**. Fold the end of the tape back under to make a tab for easy removal (See image to the right). Use special care when removing tape as adhesive tape can damage the suit material.
6. **Goggles and eye/face protection may become clouded** due to moisture from breathing. When wearing Level A, you may want to keep a cloth inside the suit to wipe fog off the inside of the face shield.
7. **Kneeling can contaminate and tear the suit**.
8. **Seams are weak points**, especially in disposable suits. Be careful not to strain and split them. If this occurs, report the incident and follow the appropriate SOP.
9. **Use caution when suits are worn in potential fire areas. Most suits offer no fire protection** and may increase the possibility of injury because they melt. If fire occurs, get out of the area. Special fire retardant suits may be worn over your CPC, but this makes movement more difficult and greatly increases heat stress.





## ***Other Protective Clothing and Equipment***

The situation and potential exposures determine the PPE needed. For example, chemical-resistant gloves, face shield/goggles, and aprons can be used with Level D when there are no respiratory hazard present but some skin hazards exist.

A number of operations at hazardous waste sites result in a substantial noise exposure and require the use of hearing protection. When required, a hearing conservation program must be implemented (**29CFR1926.52 and 29CFR1910.95**). The employer must provide a selection of hearing protection for you to choose from (**29CFR1926.101 and 29CFR1910.95**).

## ***Summary: Chemical Protective Clothing***

**Personal protective equipment (PPE)** includes respirators, chemical-resistant suits, steel-toed boots, gloves, hard hats, and hearing protection. PPE is required by OSHA regulations and protects workers from:

- chemical contact with skin and eyes
- noise
- respiratory hazards
- sharp objects underfoot
- falling objects

Chemical protective clothing and other PPE expose wearers to **heat stress** because heat, moisture, and air do not move through them well, or at all. Heat stress can lead to symptoms including severe fatigue, nausea, chills, dizziness, confusion and heat-related illnesses including heat exhaustion, fainting, heat cramps, heat rash, and heat stroke. Anyone experiencing these symptoms or suspected of having these conditions should receive **immediate medical attention**.



Suits are made of many different kinds of **materials**, including butyl, neoprene, and polyethylene. No one material can stop all chemicals. All chemicals will eventually soak through the material (permeate), move through the seams (penetrate), or damage the material (degrade).

Suits, respirators, several pairs of gloves, and chemical protective steel-toed boots are always worn together in an **ensemble**. The PPE ensemble used must be selected based on the respiratory and skin hazards present or anticipated.

**Level A** is for gases, mists, or vapors that may burn the skin or spills of chemicals that can soak through the skin. It provides the most protection and includes:

- an SCBA (or supplied-air respirator with escape unit).
- a **gas-tight**, totally-encapsulating chemical-protective suit with gloves and foot coverings built in.

**Level B** is for high levels of gases or small spills of chemicals that can soak through the skin. It includes:

- an SCBA (or supplied-air with escape unit).
- a full-body chemical-protective suit that is not gas-tight
- gloves and boots

**Level C** is for known, low levels of gases, dusts, or spills of chemicals that cannot soak through the skin. It includes:

- an air-purifying respirator (APR).
- hooded, chemical-resistant clothing.
- gloves and boots.

PPE must be properly **cared for, maintained, inspected, and stored**. Wearers should know the uses and limitations of PPE. Written programs about selection, care, and use of PPE should be included in or referenced in the safety and health plan.



## Background Reading Material and Resources: Personal Protective Equipment

*Occupational Safety and Health Guidance Manual for Waste Sites*  
1989. (NIOSH # 85-115)

Chapter 8                      Personal Protective Equipment, p. 1-24  
Appendix D                  Decontamination of Levels A, B, C

EPA's *Standard Operating Safety Guides*, July 1988.

Part 5                          Site Entry—Levels of Protection, p. 1-14  
Part 7                          Decontamination, p. 9-11 and Annexes

*Hazardous Waste Operations and Emergency Response Standard*  
*Federal Register, Final Rule*. March 6, 1989. (29CFR1926.65)

Personal Protective Equipment  
Personal Protective Equipment Program  
Engineering Controls, Work Practices and Personal Protective Equipment for  
Employee Protection

*Ergonomic Criteria for the Selection of Chemical Protective Clothing*, J.O. Stull,  
Washington D.C., Workplace Health Fund, 1991



Notes:

A large rectangular area with rounded corners, containing 25 horizontal lines for writing notes.

