



# Respiratory Protection

## Laborers-AGC Education and Training Fund

### Board of Trustees

#### Laborers' International Union of North America

Mike Quevedo, Jr.

Tony Dionisio

Edward M. Smith

Chuck Barnes

Armand E. Sabitoni

Raymond M. Pocino

Terence M. O'Sullivan, *Co-Chairman*

#### The Associated General Contractors of America

Edwin S. Hulihee

Fred L. Valentine

John F. Otto

Robert D. Siess

Lloyd D. Ferguson

Edward J. Hynds, Jr.

Robert B. Fay, Sr., *Co-Chairman*

James M. Warren, *Executive Director*

**LIUNA**  
**INNOVATION**  
**AT WORK**

37 Deerfield Road, Pomfret Center, Connecticut 06259  
(860) 974-0800 Fax (860) 974-1459

Copyright © 2000  
by  
Laborers-AGC Education and Training Fund

All rights reserved. The reproduction or use of this document in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, and including republication as or in connection with instructional or training seminars, and in any information storage and retrieval system, is forbidden without the written permission of Laborers-AGC Education and Training Fund. The information in this manual does not necessarily reflect the views or policies of the Laborers-AGC Education and Training Fund, nor does the mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

Printed in the United States of America



# RESPIRATORY PROTECTION

Section

**PREFACE**

Title

**HOW TO USE THIS MANUAL**

## MANUAL OBJECTIVE

The Respiratory Protection manual presents training information and other important aspects of what you, as a Laborer, must know to work safely, effectively, and efficiently with respirators. It will instruct you in both the technical and common-sense details of what you will encounter while working on the job site and using respiratory protection.

## HOW TO USE THIS MANUAL

This manual introduces you to the topics covered in the Occupational Safety and Health Administration's Respiratory Protection Standard 29 CFR 1910.134 and examines how this standard affects you on the job. Each **Section** covers a major component of the job. Concepts you will learn in each section are listed at the beginning as **Trainee Objectives**. At the end of each section, you will be expected to complete an **Assignment Sheet**. In addition, this manual contains a section on **Standard Operating Procedures**, which are hands-on exercises to help you become familiar with wearing and caring for a respirator. Together, the parts of this manual will prepare you to work with respiratory protection.

At the back of the manual, you will find a copy of 29 CFR 1910.134 in the **Regulations** section. The **Appendix** section contains additional information regarding respirators and respirator selection. Words that may be new to you are *italicized* in the text, and those words and their definitions are found in the **Glossary**.

## THANK YOU

Thank you for placing your trust in Laborers-AGC training manuals. We believe this manual will instruct you in the most significant, useful, and up-to-date technical information and safety aspects of your job.





# RESPIRATORY PROTECTION

Section	CONTENTS
Title	

Section	CONTENTS
Title	
<b>1 HAZARD RECOGNITION AND HEALTH EFFECTS</b> .....	1-1
<b>Trainee Objectives</b> .....	1-1
<b>Introduction</b> .....	1-3
<b>Airborne Contaminants</b> .....	1-3
Dusts .....	1-3
Fumes .....	1-3
Gases .....	1-4
Mists .....	1-4
Vapors .....	1-4
<b>Hazardous Atmospheres</b> .....	1-4
Oxygen-Deficient Atmosphere .....	1-4
Toxic Atmosphere .....	1-8
<b>Routes of Entry</b> .....	1-9
Inhalation .....	1-9
<b>Respiratory System</b> .....	1-9
Natural Defenses .....	1-9
Susceptibility of the Lungs .....	1-10
<b>Dose</b> .....	1-11
<b>Health Effects</b> .....	1-11
Prompt Effects .....	1-11
Delayed Effects .....	1-12
<b>Physical Warning Signs</b> .....	1-12
<b>Assignment Sheet</b> .....	1-13
<b>2 RESPIRATORS</b> .....	2-1
<b>Trainee Objectives</b> .....	2-1
<b>Introduction</b> .....	2-3
<b>Protection Factors</b> .....	2-3
<b>Exposure Guides</b> .....	2-5
Permissible Exposure Limits .....	2-6
Threshold Limit Values .....	2-6
Recommended Exposure Limits .....	2-6
Representing Exposure Limits .....	2-6
<b>Maximum Use Concentration</b> .....	2-8
<b>Air Purifying Respirators</b> .....	2-8
Negative Pressure Respirators .....	2-9
Limitations of APRs .....	2-13
<b>Filtering Devices</b> .....	2-15
Particulate Filters .....	2-15

# CONTENTS

---

Vapor and Gas Removing Cartridges and Canisters	2-21
Service Life	2-25
<b>Atmosphere Supplying Respirators</b>	2-26
Regulators	2-26
Supplied Air Respirators	2-27
Self-Contained Breathing Apparatus	2-29
<b>Assignment Sheet</b>	2-33
<b>3 RESPIRATOR PROGRAM REQUIREMENTS</b>	3-1
<b>Trainee Objectives</b>	3-1
<b>Introduction</b>	3-3
<b>Respirator Protection Program</b>	3-3
Respirator Program Administration	3-5
Voluntary Use of Respirators	3-5
<b>Respirator Selection</b>	3-6
Gather Information	3-6
Respirator Selection Process	3-6
General Use Conditions and Determination of Contaminants	3-7
Properties of Contaminants	3-7
Odor Threshold Data	3-7
Exposure Limits	3-8
IDLH Concentrations	3-8
Eye Irritation	3-8
Service Life Information	3-8
<b>Medical Evaluation</b>	3-8
Conducting the Medical Evaluation	3-9
Conditions of the Medical Evaluation	3-9
Written Report	3-9
<b>Fit Testing</b>	3-10
Fit Testing Protocols	3-10
Qualitative Fit Test	3-11
Quantitative Fit Test	3-12
<b>Respirator Use</b>	3-13
Facepiece Seal Conditions	3-13
User Seal Checks	3-14
Continued Respirator Effectiveness	3-15
IDLH Conditions	3-16
<b>Maintenance and Care</b>	3-16
Cleaning and Disinfecting	3-16
Storage	3-16
Inspection	3-17
Repair	3-17
<b>Breathing Air Quality</b>	3-17
<b>Training</b>	3-18
<b>Program Evaluation</b>	3-19

# CONTENTS

---

<b>Recordkeeping</b> .....	3-20
Fit Testing Records .....	3-20
Training Records .....	3-20
<b>Assignment Sheet</b> .....	3-21
<b>4 STANDARD OPERATING PROCEDRES</b> .....	4-1
<b>Standard Operating Procedure 1 - Half-Face APR</b> .....	4-3
<b>Standard Operating Procedure 2 - Full-Face APR</b> .....	4-5
<b>Standard Operating Procedure 3 - Qualitative Fit Test</b> .....	4-7
<b>Standard Operating Procedure 4 - SAR</b> .....	4-11
<b>Standard Operating Procedure 5 - SCBA</b> .....	4-17
<b>Standard Operating Procedure 6 - Refill SCBA Cylinder</b> .....	4-21
<b>REGULATIONS</b> .....	R-1
<b>29 CFR 1910.134</b> .....	R-3
<b>APPENDIXES</b> .....	A-1
<b>Appendix A - Respirator Decision Logic</b> .....	A-3
<b>Appendix B - Inspection Guidelines</b> .....	A-9
<b>Appendix C - Respirator Information</b> .....	A-12
<b>GLOSSARY</b> G-1	

# CONTENTS

---





# RESPIRATORY PROTECTION

Section

**1**

Title

**HAZARD RECOGNITION  
AND HEALTH EFFECTS**

## TRAINEE OBJECTIVES

After completing Section 1, you will be able to:

1. Define the following:

Delayed effects

Poor warning properties

Dose

Prompt effects

IDLH

Toxic atmosphere

2. List and define the five forms of airborne contaminants.
3. Identify the two hazardous atmospheres related to respirator use.
4. Identify when OSHA considers an atmosphere oxygen-deficient.
5. Indicate the most common route of entry for toxic chemicals to enter the body.
6. List the three natural defense systems to protect the body from toxic substances and foreign particles.
7. List the six physical warning signs of chemical exposure.



**INTRODUCTION**

If an employer requires you to wear a respirator it means that you are being exposed or have the potential to be exposed to a hazardous substance in the air. The goal of a respirator is to reduce your exposure to airborne contaminants to below the permissible exposure limit. However, by working in a hazardous atmosphere, you run the risk of being exposed to a hazardous substance. This section of the manual will make you aware of the hazards you may encounter and their effects on your health.

**AIRBORNE  
CONTAMINANTS**

Airborne contaminants create atmospheric hazards. Each contaminant has its own physical properties and behavior and can be either chemical or nonchemical. The forms that airborne contaminants take are as follows:

- Dusts
- Fumes
- Gases
- Mists
- Vapors

**Dusts**

Dusts are solid particles suspended in air. They are produced by crushing, grinding, sanding, sawing, or the impact of materials against each other. Dusts that are small enough to reach the lungs are called respirable dusts. When inhaled, they can build up in the lungs and reduce your ability to breath.

Microscopic dusts are dusts which are too small to be seen with your eyes. They do the most damage because they can be inhaled deeper into the lungs.

**Fumes**

Fumes are solid particles in the air that are generated when metals are heated. Fumes are respirable because of their small size. They get past the body's natural defenses and reach the deepest parts of the lungs. Once in the lungs, fumes pass easily into the bloodstream and can damage other parts of the body. For example, lead fumes can affect the liver, kidneys, and nervous system.

**Gases**

A gas is a state of matter that is formless at room temperature and expands to fill its container. (States of matter are gases, liquids, and solids.) Toxic gases can irritate the skin, throat, eyes, and lungs. Once inhaled, they can pass from the lungs into the blood stream and to other parts of the body. Toxic gases can damage organs or tissues as well as decrease the ability of the blood to carry oxygen.

**Mists**

Mists are small liquid droplets suspended in air. Many types of mists damage the body when they contact the skin and eyes and by being inhaled. They move easily from the lungs to the blood stream and to other parts of the body.

**Vapors**

Vapors are gaseous forms of materials that are usually solid or liquid at room temperature, such as gasoline and solvents. Vapors can affect the skin and cause *dermatitis* (rash). They can also be inhaled into the lungs or absorbed through the skin. Both routes allow vapors to pass into the blood stream. Some types of vapors damage the liver, kidneys, and blood.

**HAZARDOUS  
ATMOSPHERES**

The Occupational Safety and Health Administration (*OSHA*) divides hazardous atmospheres into three main categories:

- Oxygen-deficient/enriched
- Flammable/explosive
- Toxic

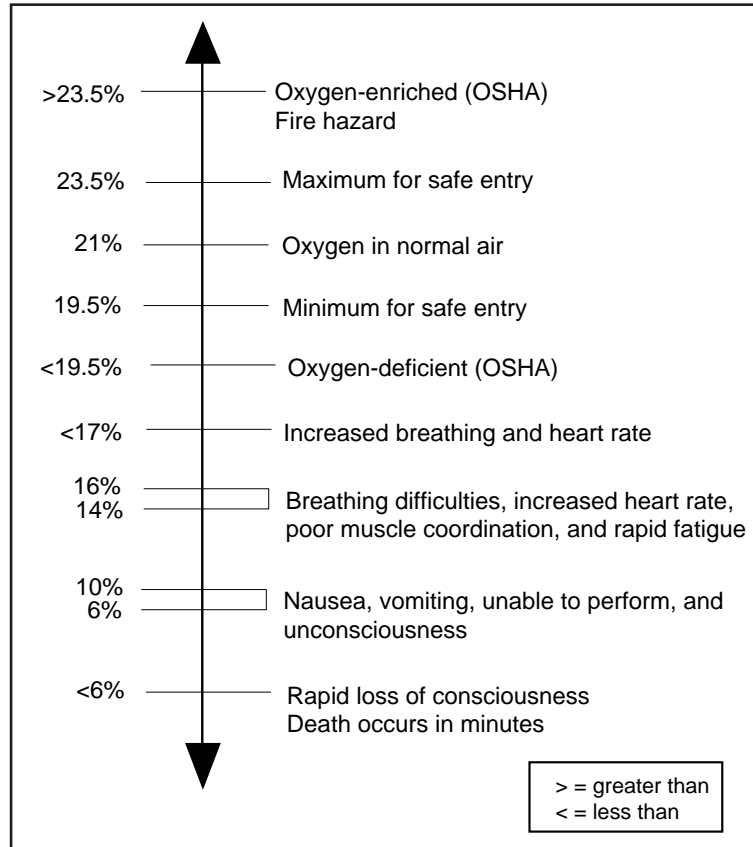
Only two types of hazardous atmospheres relate to respirator use—oxygen-deficient and toxic—and so only they will be discussed in this section.

**Oxygen-Deficient  
Atmosphere**

Normal breathing air has an oxygen content of approximately 21 percent by volume. *OSHA* defines an *oxygen-deficient atmosphere* as an atmosphere with oxygen content below 19.5 percent by volume. The decrease in oxygen level is the result of oxygen being consumed (used up) or displaced (pushed out) in an area.

As the oxygen level drops, signs of hypoxia will occur. Hypoxia is an oxygen deficiency in the body's tissues. Signs and symptoms of hypoxia change as the oxygen level decreases (Figure 1-1). The list below identifies specific signs and symptoms at different levels of oxygen concentration.

- Below 17 percent oxygen:
  - Deterioration of night vision - may not be noticeable
  - Increased breathing
  - Accelerated heart rate
  
- Between 14 and 16 percent:
  - Increased breathing
  - Intermittent breathing
  - Accelerated heart rate
  - Poor muscular coordination
  - Rapid fatigue
  
- Between 6 and 10 percent:
  - Nausea
  - Vomiting
  - Inability to perform
  - Unconsciousness
  
- Less than 6 percent:
  - Rapid loss of consciousness
  - Death occurs in minutes



**Figure 1-1.** As oxygen level decreases, the signs and symptoms of hypoxia change.

## Oxygen Consumption

Oxygen consumption is a result of the following situations:

- Combustion (fire)
- Chemical reaction
- Biological action (bacteria)

Oxygen must be present for combustion to occur. Therefore, any work involving burning uses up oxygen, such as welding, cutting, or brazing,

Some chemical reactions need oxygen to occur. Rusting is one example. Although rusting is a slow chemical reaction, over time it can significantly reduce the oxygen level in a space.

Oxygen consumption also occurs from bacterial action, such as when organic materials decompose or rot. Bacteria are living organisms that require oxygen.

Sewage treatment plants depend on bacteria to decompose raw sewage. Therefore, sewage tanks and sewer lines can have oxygen-deficient atmospheres. Garbage dumps, landfills, and swamps are other areas where decomposition is taking place. Manholes and excavations near these areas can have low oxygen levels.

### Oxygen Displacement

Oxygen displacement occurs when a gas is introduced into an area and pushes out the oxygen to make room for itself. For example, nitrogen is used to displace oxygen in an underground storage tank to prevent a fire during removal. A displacing gas may or may not be toxic.

### *Simple Asphyxiant*

A simple asphyxiating atmosphere is an atmosphere that contains a gas or gases that are nonreactive and nontoxic to the body. The danger with these gases is that they displace the oxygen. If enough oxygen is displaced, the atmosphere will not support life. For example, normal breathing air contains about 21 percent oxygen by volume. No one is harmed by breathing it. However, when 100 percent nitrogen is used to inert a confined space, it completely displaces the oxygen. The result to workers would be immediate collapse and death if the confined space were not adequately ventilated before worker entry. Other examples of simple asphyxiants that have claimed lives include carbon dioxide, argon, and helium.

### *Chemical Asphyxiant*

A chemical asphyxiant is a toxic gas that reduces or blocks the body's ability to carry or transfer oxygen. Some chemicals combine with the hemoglobin in red blood cells. (Hemoglobin is the part of the blood cell that carries the oxygen.)

For example, carbon monoxide binds more easily with hemoglobin than oxygen does. When carbon monoxide is present in the blood, it hinders the blood from picking up oxygen and carrying it to the cells of the body. The amount of oxygen carried to the body's cells and organs is reduced.

Other chemical asphyxiants interfere with processes that transfer oxygen from the lungs to the blood or from the blood to the cells. Examples of these asphyxiants include hydrogen sulfide and hydrogen cyanide, which prevent the body from getting enough oxygen to sustain life.

### **Toxic Atmosphere**

A chemical is considered toxic (poisonous) when it causes harmful health effects or interferes with the way the body works. Toxic atmospheres are characterized by the presence of these chemicals. OSHA defines a toxic atmosphere as any atmosphere having a chemical or biological agent in excess of its permissible exposure limit.

Toxic gases and vapors come from several sources:

- Biological or chemical processes - For example, decomposing organic material can create hydrogen sulfide, a deadly gas.
- Work activities - For example, welding releases nitrogen oxides, ozone, and carbon monoxide.

### **Poor Warning Properties**

Warning properties are characteristics that help identify the presence of a gas or vapor, such as color, odor, and taste. Some toxic gases and vapors are particularly dangerous because they have either poor warning properties or no warning properties at all. Carbon monoxide gas has no warning properties as it is both colorless and odorless.

### **Immediately Dangerous to Life and Health Atmosphere**

OSHA defines an immediately dangerous to life and health (*IDLH*) atmosphere as an atmosphere that has any of the following traits:

- Poses an immediate threat to life
- Would cause irreversible adverse health effects
- Would impair an individual's ability to escape from a dangerous atmosphere

**Note:** An oxygen-deficient atmosphere is also included in the definition of IDLH even though it does not involve chemicals.



**ROUTES OF ENTRY**

Chemicals can enter your body in four ways, and they are called routes of entry. The four routes of entry are:

1. Inhalation
2. Absorption
3. Ingestion
4. Injection

As only inhalation relates to respirators, it will be the only route of entry discussed in this manual.

**Inhalation**

Inhalation is the most common route of entry for toxic chemicals to enter your body. As noted earlier in this section, chemicals usually do more damage when inhaled because they pass quickly from the lungs to the blood stream. Also, since breathing is always occurring, there is a constant opportunity for exposure.

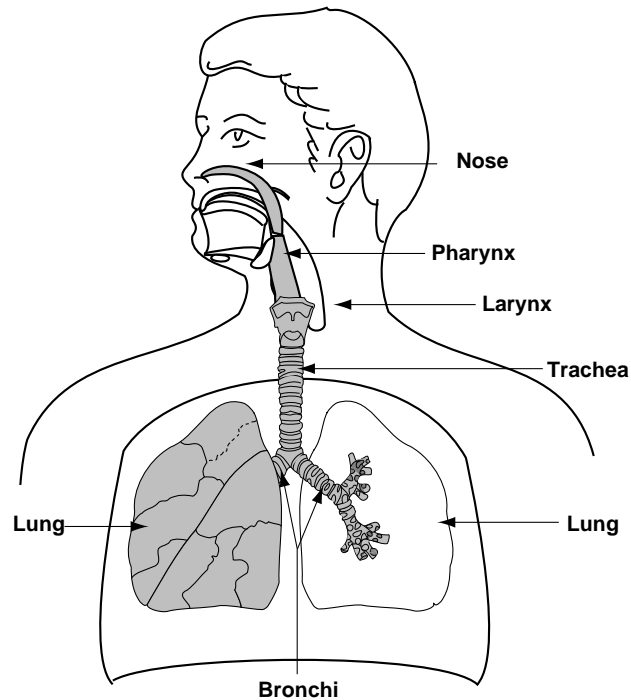
**RESPIRATORY SYSTEM**

The respiratory system consists of the lungs and airways leading to the lungs (Figure 1-2). It is in the lungs that the blood picks up oxygen and gets rid of carbon dioxide. About 15–17 times per minute, you inhale the surrounding air, along with whatever foreign particles happen to be floating in it. As your work rate increases, your breathing rate and depth of respiration increase. This increase in respiration means a greater amount of air and possibly toxic substances can get into your lungs.

**Natural Defenses**

The body has some natural defense systems to protect itself from toxic substances and foreign particles. These natural defense systems include:

- Coughing – Coughing expels the larger foreign particles and is one of the first signs of air passage irritation. It may occur at the time of an adverse exposure or be delayed. Delayed effects often occur first thing in the morning.
- Mucus production – The respiratory airways secrete mucus that helps to clear toxic particles, especially at night while you are lying down.
- Macrophage cell production – A macrophage is a large white blood cell that ingests (eats) foreign particles.



**Figure 1-2.** The respiratory system.

### **Susceptibility of the Lungs**

The structure of the lungs allows oxygen to be absorbed quickly. However, this means that some toxic chemicals can also enter the blood stream quickly. You may inhale a toxic gas that is absorbed so fast that you do not detect it until ill effects set in.

When you inhale particles, the size of the particles influences where they will be deposited in the respiratory system. Usually, the larger the particle, the closer to the mouth it is deposited. The smaller the particle the deeper into the lungs it is deposited.

Airborne contaminants deposited in the lungs can affect the lungs in different ways. The health effect depends on the type of contaminant as well as the substance.

Potential health effects include the following:

- Mists and dusts – Can damage lung tissue, cause tissue reaction or disease, or physically plug the lungs. For example silica dust can damage lung tissue, such as scarring, and cause plugging.

- Gases and vapors – Can cause an adverse reaction in the lung tissue. For example, hydrogen fluoride gas results in chemical burns in the lungs.
- Mists, gases, or vapors – Can be absorbed into the blood stream without affecting the lung tissue. Once in the blood, the contaminant can damage body organs or affect the ability of the blood to carry oxygen. For example, solvents absorbed into the blood can damage the central nervous system, liver, or kidneys.
- Fumes – Can produce prompt health effects in the lungs and delayed health effects in other parts of the body. For example, at high enough concentrations, cadmium oxide fumes can produce prompt health effect in the form of pulmonary edema (fluid build-up in the lungs). At lower concentrations, and after many years of exposure, cadmium oxide fumes can cause delayed health effects such as kidney damage and pulmonary emphysema.

**DOSE**

Dose is defined as the amount or concentration of a substance you receive from an exposure. The dose received determines the type and severity of the health effect. It is the most important factor in determining if you will have an adverse health effect from a chemical exposure.

**HEALTH EFFECTS**

The health effects resulting from an inhalation exposure can show up immediately and are called prompt effects or years later, in which case they are called delayed effects.

**Prompt Effects**

Prompt health effects occur shortly after exposure to a hazardous substance, such as within hours, days, or weeks. These effects can range from a simple skin rash or burning eyes to severe convulsions or death. Most prompt effects are temporary and will go away shortly after the exposure is removed. However, permanent damage can occur if exposures are high enough.

**Delayed Effects**

Delayed health effects occur a long time after exposure to a hazardous substance, such as months or years. They can be caused by exposures to fairly low concentrations of chemicals over a period of time, or after one exposure to a high concentration of a chemical. For example, lung cancer is a delayed effect caused by exposure to asbestos. It can take 20 to 30 years to be detected. Some chemicals can cause kidney or liver damage that will not show up on a medical test for years.

**PHYSICAL WARNING SIGNS**

The six physical warning signs of chemical exposure are:

1. Breathing difficulties – breathing faster or deeper, soreness, a lump in the throat
2. Dizziness, drowsiness, disorientation, difficulty concentrating
3. Burning sensation in the eyes or on the skin
4. Weakness, fatigue, lack of energy
5. Chills, upset stomach
6. Odors and/or a strange taste in the mouth

These physical warning signs are indications that you are being exposed to a toxic substance. You should be aware of and watch for them.

If you experience any of the physical warning signs, follow these steps:

1. Leave the work area.
2. Report the problem immediately to your supervisor.
3. Do not return to the area until the cause of the warning signs has been checked by qualified person.

---

**SECTION 1 - ASSIGNMENT SHEET**

1. Define the following:

Delayed effects

---

---

---

Dose

---

---

IDLH

---

Poor warning properties

---

---

Prompt effects

---

---

---

Toxic atmosphere

---

---

2. List and define the five forms of airborne contaminants.

---

---

---

3. Identify the two hazardous atmospheres related to respirator use.

---

---

4. Identify when OSHA considers an atmosphere to oxygen-deficient.

---

5. Indicate the most common route of entry for toxic chemicals to enter the body.

---

6. List the three natural defense systems to protect the body from toxic substances and foreign particles.

---

---

---

7. List the six physical warning signs of chemical exposure.

---

---

---

---

---

---

---

---

---

---



# RESPIRATORY PROTECTION

Section

**2**

Title

**RESPIRATORS**

## TRAINEE OBJECTIVES

After completing Section 2, you will be able to:

1. Define the following terms:

Maximum use concentration  
Protection factor

2. Write out the following acronyms.

APR            SAR            TLV  
PAPR          SCBA          TWA  
PEL            STEL

3. Identify which governmental agency approves respirators for use and assigns PFs.
4. Identify the trait all respirators have in common regarding respiratory protection.
5. State the goal of a respirator.
6. Explain how an APR cleans the air as a worker breathes.
7. List the limitations of an APR.
8. List the two limitations of a PAPR.
9. Identify the two basic types of filtering devices used with APRs.
10. List the three filter series for resistance to filter efficiency degradation.
11. List the three filter efficiency levels.

12. Describe how cartridges and canisters are used to protect workers.
13. Identify the two types of atmosphere supplying respirators and describe the difference in the air delivery system.
14. List the three types of regulators used by atmosphere supplying respirators.
15. List the limitations of an SAR.
16. List the limitations of an entry SCBA.



## INTRODUCTION

A respirator is a piece of *personal protective equipment (PPE)* that reduces exposures by limiting airborne contaminants from being inhaled. There are different types of respirators, all useful in specific situations. Respirators are composed of a facepiece that seals out contaminants and a device that provides clean air. Two types of respirators are used for obtaining clean air:

1. *Air purifying respirators* – A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing *ambient* air through the air-purifying element.
2. *Atmosphere supplying respirators* – A respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (*SARs*) and self-contained breathing apparatus (*SCBA*) units.

Only respirators approved by the National Institute of Occupational Safety and Health (*NIOSH*) can be used. *NIOSH* approval is indicated by the *NIOSH* logo and a *TC* number. *TC* stands for tested and certified. If a respirator does not have a *NIOSH* label it cannot be used for respiratory protection.

## PROTECTION FACTORS

Respirators differ in the amount of protection they afford. A paper dust mask is less protective than a firefighter's respirator with an air cylinder. How much difference is there? Industrial hygienists have developed a scoring system using *protection factors* to rank different types of respirators. Protection factor (*PF*) is the rating assigned to a respirator or a class of respirators that represents the level of protection it provides.

The key to understanding respirator protection is to realize all respirators leak to a certain degree. The amount of leakage depends on how well the facepiece seals to the face. A leak in the facepiece seal means contaminated air can enter the facepiece.

The act of inhaling creates a negative air pressure inside the facepiece, which causes a suction effect. This suction can draw in contaminated air through the leaks in the seal. These leaks compromise the protection given by the respirator and can lead to adverse health effects depending on the type and amount of air contaminant.

Respirators are tested for leakage by measuring the contaminant levels both outside and inside the respirator. Using the ratio of these two measurements, a PF is assigned. A PF is based on the assumption that the respirator is working properly, is worn correctly, and fits the wearer. Respirator PFs range from 5 to 10,000.

**The lower the PF, the lower the protection. The higher the PF, the higher the protection.** Figure 2-1 shows the calculation for determining the PF.

*The PF is calculated by dividing:*

$$\begin{aligned} \text{PF} &= \frac{\text{Concentration of airborne contaminant outside respirator}}{\text{Concentration inside the respirator}} \\ &= \frac{500 \text{ ppm (concentration outside the respirator)}}{50 \text{ ppm (concentration inside the respirator)}} \\ \text{PF} &= 10 \end{aligned}$$

**Figure 2-1.** Calculation for determining the protection factor.

NIOSH has assigned PFs to all respirators it has approved. The Occupational Safety and Health Administration (OSHA) has assigned PFs only to respirators regulated by the Toxic and Hazardous Substances regulations (Subpart Z in 29 *CFR* 1910 and 1926). If you are working with a hazardous substance that is not regulated by OSHA, you must use NIOSH's or other recognized PFs.

The goal of a respirator is to reduce the amount of airborne contaminant inside the respirator to below the OSHA *permissible exposure limit (PEL)*. Respirators

must be chosen to ensure that workers are never overexposed while wearing the respirator. The practical application of PF for the respirator wearer can be summed up as: How much of the outside contaminant level is reduced by the respirator? Examples follow:

- A respirator with a PF of 10 reduces a worker's exposure by 10 times or to 1/10 of the outside level. Therefore, if the contaminant level outside the respirator is 500 parts per million (*ppm*), the contamination inside the respirator is 50 ppm. If the PEL for the contaminant is below 50 ppm, the worker is overexposed. A PF of 10 means the respirator can only be used in exposures up to 10 times over the PEL.
- A respirator with a PF of 10,000 reduces the worker's exposure by 10,000 times. Concentration inside the respirator will be 1/10,000 of the outside level.

**Remember:** The lower the PF, the lower the protection. The higher the PF, the higher the protection.

## EXPOSURE GUIDES

When working around hazardous chemicals, exposure is an important consideration. Exposure guides are used to inform workers about warnings and exposure limits and to make decisions about worker exposure to chemicals.

When the the employer knows both the identity of a chemical and its air concentration at the work site, specific exposure guides can be applied. Three commonly used exposure guides that deal with concentration levels are:

1. Permissible exposure limit - set by OSHA
2. Threshold limit value - set by American Conference of Governmental Industrial Hygienists (*ACGIH*)
3. Recommended exposure limit - set by NIOSH

A product's *material safety data sheet (MSDS)* must list chemical exposure limits. The limits may also appear on the product's container label.

**Permissible Exposure Limits**

Permissible exposure limits (*PELs*) are legal guidelines for airborne concentrations of regulated substances. They set limits upon a worker's inhalation exposure or the amount of substance a worker can safely breathe. PELs are set by OSHA and are the only legally enforceable limits. This means that by law, employers must keep a worker's exposure below the PEL. PELs are meant to offer the minimum levels of protection. However, more protective limits are always allowed.

**Threshold Limit Values**

Threshold limit values (*TLVs*) are set by the ACGIH. They are based on the best available information from industrial experience, experimental human studies, and animal studies. The basis on which the values are established may differ from chemical to chemical. TLVs are only advisory and are not legally enforceable. A revised list of TLVs is published each year, which makes them more current than PELs.

**Recommended Exposure Limits**

Recommended exposure limits (*RELs*) are set by NIOSH. They are revised more frequently than OSHA PELs. As a result they tend to be more stringent because they are based on the most recent scientific data available. RELs can be found in the *NIOSH Pocket Guide to Chemical Hazards*.

**Representing Exposure Limits**

There are several ways to represent exposure limits.

- *Time weighted average (TWA)* - The average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week. The changes in exposures that occur during the work shift are averaged out.

**Note:** NIOSH's RELs are based on a 10-hour workday during a 40-hour workweek.

- *Short term exposure limit (STEL)* - The maximum concentration level of a substance to which workers can be exposed for a short period of time (usually 10 to 15 minutes) without suffering adverse health effects. At exposures above the STEL, workers can experience:
  - Chronic irreversible tissue damage.
  - Dizziness sufficient to increase the risk of accidents, impair self-rescue, or reduce work efficiency.
  - Irritation.

An exposure above the STEL should not occur more than four times per shift, and there should be at least 60 minutes between exposures. The daily TWA PEL must not be exceeded.

- *Ceiling limit (C)* - Exposure limit for a substance that should **never** be exceeded.
- *Immediately dangerous to life and health (IDLH)* - An exposure level in an environment likely to cause death or serious health effects with very short exposures.

The notation “skin” on OSHA PEL lists and in the ACGIH TLV publication is **not** an exposure guide. It only means that a chemical can be absorbed through the skin. There are no concentration guidelines for skin absorption so take steps to avoid skin contact with chemicals. Even when airborne exposure is below the PEL, REL, or TLV, you can still be overexposed to a chemical due to skin absorption.

## MAXIMUM USE CONCENTRATION

*Maximum use concentration (MUC)* is the highest concentration of a specific contaminant for which a cartridge or canister provides approved protection. Respirators cannot be used safely at concentrations above the MUC. Workers will be exposed above the PEL because of leakage into the respirator. Therefore, at **no** time shall a respirator be used in an environment that exceeds the MUC.

The MUC is calculated by multiplying PF times PEL. Figure 2-2 gives an example of calculating the MUC for nitric acid.

*Calculate the MUC of nitric acid:*

$$\text{MUC} = \text{PF} \times \text{PEL}$$

$$\text{PEL for nitric acid} = 2 \text{ ppm}$$

$$\text{PF of half-face respirator} = 10$$

$$\begin{aligned} \text{MUC} &= 2 \text{ ppm} \times 10 \\ &= 20 \text{ ppm} \end{aligned}$$

A half-face respirator cannot be used in atmospheres with a nitric acid concentration greater than 20 ppm.

**Figure 2-2.** Calculation for maximum use concentration.

## AIR PURIFYING RESPIRATORS

Air purifying respirators (*APRs*) clean the air you breathe by removing or filtering contaminants from the air before it enters your lungs. APRs have two components—the facepiece and the filtering device. When you inhale, contaminated air is pulled into the respirator through a filtering device attached to the facepiece. This device removes the contaminant from the air before the air enters the respirator through the inhalation valve. When you exhale, air from your lungs reverses the airflow through the facepiece. Air goes out through a separate valve called the exhalation valve.

## Negative Pressure Respirators

APRs are commonly called *negative pressure respirators*. The air pressure inside the facepiece is negative during inhalation with respect to the *ambient* air pressure outside the respirator. The reason is that an APR depends on lung power to pull the air through the filters. The suction created when you inhale creates a negative pressure inside the facepiece. During exhalation, air is blown out, and a positive pressure is created in the facepiece.

One problem with negative pressure respirators is that during inhalation, the negative pressure brings contaminants into the facepiece through any leaks in the seal.

**Note:** It is important to remember that negative pressure respirators **must** only be used when the oxygen level in the workplace is above 19.5 percent oxygen by volume.

The types of negative pressure APRs you will use are:

- *Filtering facepiece*
- Half-face APR
- Full-face APR
- *Powered air purifying respirator (PAPR)*

## Filtering Facepiece

A filtering facepiece is a negative pressure respirator in which the entire facepiece is composed of the filtering medium. It is also called a dust mask. Dust masks come in two types—disposable and reusable—with the disposable dust mask being the more common one. A dust mask can be used for work as long as it has been approved for use by NIOSH.

Disposable dust masks have the following limitations:

- They do not seal to the face well enough to provide a good fit.
- They cannot be used for gases, vapors, fumes, and fine dusts, which can pass right through the filtering medium.

A reusable dust mask can be reused as long as the wearer can breath through it with no resistance and the filtering facepiece is in a clean and sanitary condition.

Currently NIOSH has approved dust masks from many different manufacturers and has assigned dust masks a PF of 5 or 10, depending on the make and model.

#### Half-Face APRs

A half-face APR is made of rubber or silicone. It fits from the top of the nose to under the chin. Figure 2-3 shows a typical half-face APR.

#### **FIGURE 2-3 TO BE INSERTED HERE**

A half-face APR uses one or two filtering devices attached to the facepiece. The fit given by the respirator rates a fairly low PF. NIOSH assigns a half-face APR a PF of 10.

Half-face respirators are commonly used under the following conditions:

- Exposure levels are not high, and workers will be protected from overexposure with the respirator.
- The atmosphere is well monitored and characterized.
- The likelihood of exposure levels suddenly increasing is limited.

#### Full-Face APRs

A full-face APR is made of rubber or silicone. It covers the whole face, starting at the forehead, down over the temples and the eyes, and under the chin (Figure 2-4). The full-face APR has a higher PF than a half-face APR because it is easier to get a good seal across the forehead than across the nose. Also, the respirator is held more securely in place because it has a head harness instead of straps. The full-face APR uses the same types of filtering devices as the half-face APR, so it also carries the same limitations. It does protect the eyes, although it has a tendency to fog up.

#### **FIGURE 2-4 TO BE INSERTED AFTER THIS PARA.**



Some full-face APRs can use larger chin, chest, or back-mounted canister-type filters. These filters are larger, and have fewer filter limitations. There are several filters available in larger sizes for full-face APRs that are not available for half-face APRs. Even though full-face APRs protect more than half-face APRs, they still do not offer enough protection to be used under IDLH conditions.

### Powered Air Purifying Respirators

The powered air purifying respirator (*PAPR*) is an APR that uses a small, lightweight battery-operated blower to draw air through the filters and into the facepiece. It uses the same type of facepiece and filters as the full-face APR (Figure 2-5).

#### **FIGURE 2-5 TO BE INSERTED HERE**

The blower keeps a slight positive pressure inside the facepiece. This positive pressure reduces the likelihood of contaminants leaking into the respirator during inhalation. Any leaks from an imperfect seal tend to be outward.

Additionally, the blower offers the advantage of increased comfort for the user. Because the blower draws air into the facepiece, less work is required for inhalation. In addition, air is blown across the user's face and provides some degree of cooling.

Despite the fact that a PAPR seals the face in the same manner as the full-face negative pressure APR, the PFs assigned by government agencies vary. For example, OSHA assigns a PAPR a PF of 100 in the asbestos standard, while NIOSH assigns a PF of 50. The PF for a PAPR can vary even within the same agency. For example, OSHA assigns a PAPR a PF of 100 in the asbestos standard, but a PF of 50 in the lead standard.

---

*PAPR Limitations*

The PAPR has two limitations:

1. Weak batteries cause the fan motor to slow down, thus delivering less air to the facepiece. The batteries are designed to last a full shift, and then require a full charge. PAPR units come with a small flow meter that enables you to test the air flow, and thus, the battery charge.
2. Under heavy work conditions, you can use more air than the PAPR provides, creating a negative pressure in the facepiece. This condition is called *overbreathing* a PAPR. When overbreathing occurs, the PAPR functions just like a negative pressure full-face respirator.

*Hoods and Helmets*

Some PAPRs have loose-fitting *hoods* and *helmets* instead of facepieces. While these hoods are comfortable, they provide less protection. NIOSH assigns a PF of only 25 for loose-fitting PAPRs. They are not widely used.

**Limitations of APRs**

All APRs, including PAPRs, have limitations in the following areas:

- Cartridge life
- Cartridge efficiency
- Oxygen limitations
- Unknown chemicals or chemical concentrations
- IDLH concentrations
- Humidity
- Usage
- Eye protection

## Cartridge Life

The cartridge or canister life is limited in its ability to remove chemical contaminants. When the saturation point is reached, *breakthrough* occurs (chemicals begin to pass through the filter).

APRs cannot be used for chemicals with poor warning properties because of the potential for breakthrough and serious exposure.

---

	<p>Some cartridges and canisters have <i>end-of-service-life indicators (ESLI)</i> that change color when a filter is used up. However, few indicators have been successfully developed, and most are for specific chemicals only.</p>
Cartridge Efficiency	<p>There are many types of organic solvents, but only one type of organic solvent filter. Studies show that while this filter is very efficient for some solvents, it allows other solvents to pass through quickly. For example, the organic vapor filter lasts 143 minutes in an atmosphere with a concentration of 1,000 ppm of 1-nitropropane. But at 1,000 ppm of ethyl chloride, the filter only lasts 5.6 minutes. Therefore, the APR and filter are not used for solvents that have rapid breakthrough. It is important to note that not all solvents have been tested.</p>
Oxygen Limitations	<p>APRs can only be used when the oxygen level is between 19.5 and 23.5 percent by volume. Normal breathing air contains about 21 percent oxygen by volume. It can be less in confined areas with other chemicals present.</p>
Unknown Chemicals or Levels	<p>Because the protection offered by the APR is limited, it cannot be used for unknown chemicals or concentration levels.</p>
IDLH Concentrations	<p>Under no circumstances shall an APR be used in an IDLH atmosphere. For most chemicals, the MUC is lower than the IDLH level. However, there are exceptions in which the IDLH is lower than the MUC. The respirator cannot be used if the concentration approaches the IDLH level.</p>
Humidity	<p>Studies have shown that breakthrough occurs more quickly under conditions of high humidity.</p>
Usage	<p>The useful life of a cartridge or canister is limited once the cartridge package is opened. Usually filters are discarded after each use.</p>
Eye Protection	<p>In addition to the cartridge-related limitations, the half-face APR also has the disadvantage of having no eye protection. Therefore, goggles or face shields must be worn.</p>

**FILTERING DEVICES**

Filtering devices provide breathable air by removing contaminants from the air as it is drawn into the respirator. They are used with APRs and include two types:

1. Particulate filters
2. Vapor and gas removing canisters and cartridges

**Particulate Filters**

Particulate filters are made of a fibrous material that captures contaminant particles before they reach the wearer's lungs. The particles are pulled through the filter as the wearer inhales, where they become trapped by the fibers.

Particulate filters are not designed to be 100% efficient in removing particulates from the air. It would be too hard to inhale. The reason is that as contaminated air is drawn through the filter, the particles captured by the fibers plug the holes between the fibers. As more holes are plugged, breathing resistance increases. This is called filter loading. To prevent this situation, particulate filters are manufactured to provide the highest possible filter efficiency while keeping the resistance to breathing low.

Particulate filters protect against dusts, fumes, and mists. Typical examples on construction and environmental remediation sites include welding fumes, oil mists, silica, asphalt fumes, lead and asbestos.

**Labels**

All respirators have labels identifying their approval for use. Particulate filters are approved under 42 CFR 84 and all other respirators under 30 CFR 11. Part 84 labels are different from Part 11 labels in following two ways:

1. Sequence of approval numbers:

Part 84 – TC-84A-XXXX

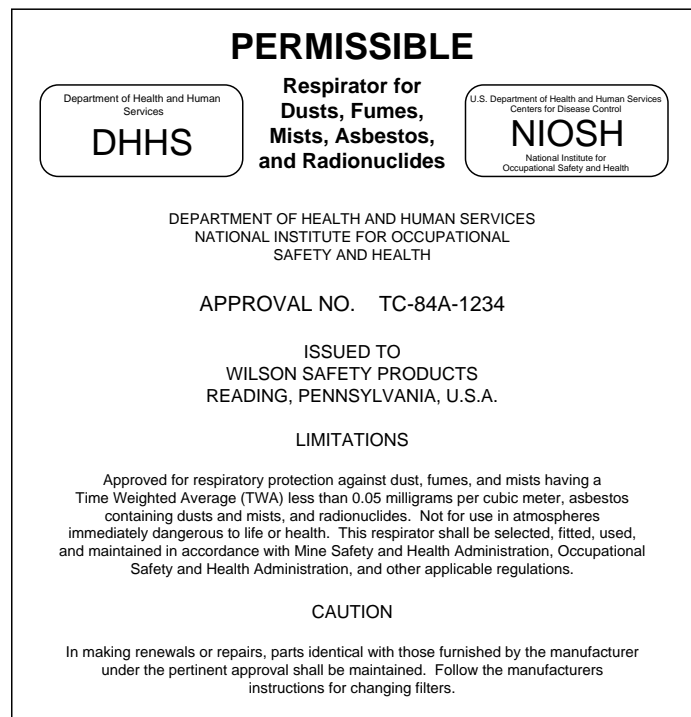
Part 11 – TC-21C-XXX

2. Approving agencies:

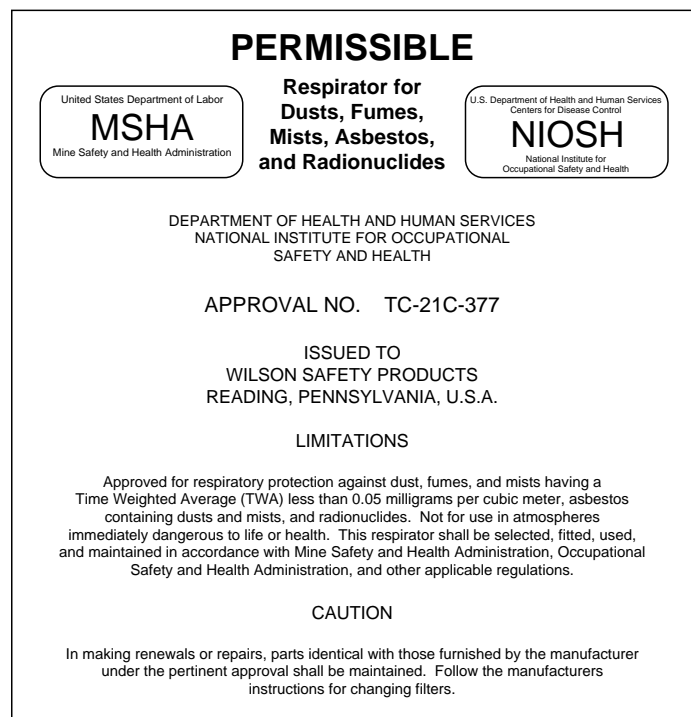
Part 84 – NIOSH and the Department of Health and Human Services (DHHS). See Figure 2-6.

Part 11 – NIOSH and Mine Safety and Health Administration (MSHA). See Figure 2-7.

Labels are found on the respirator box, cartridge box, or the backpack of an SCBA.



**Figure 2-6.** Part 84 label



**Figure 2-7.** Part 11 label.

---

Particulate Filter  
Classes

NIOSH regulation Part 84 created nine classes of particulate filters, made up of:

- Three filter series for resistance to filter efficiency degradation
- Three filter efficiency levels

*Filter Series*

The three filter series define different degrees of resistance to filter efficiency degradation. They are labeled as N, R, and P.

**N series filters** have the following characteristics:

- Used for solid or water-based particulates.
- **Not** resistant to oil. Cannot be used in an atmosphere containing oil or for oil-based particulates.
- Can be used for more than one work shift if there are no problems with hygiene, damage, or breathing.

**R series filters** have the following characteristics:

- Used for solid or liquid particles.
- Resistant to oil but not oil proof.
- Can be used for an extended time in an oil-free atmosphere.
- Has limited use time in an environment containing oil (one 8-hour shift or a combined total of 8 hours.)

**P series filters** have the following characteristics:

- Used for solid or liquid particles, both oil-based and non-oil based.
- Is considered oil proof. Can be used as long as a worker has no breathing problems.

**Note:** NIOSH has issued an update to its selection guide. It was originally assumed the P-series filters would not degrade from oil exposure, and filters would only need to be changed when breathing resistance,

hygiene concerns, or filter damaged occurred. However, a recent NIOSH study indicates the P-series of particulate filters may lose efficiency with long term exposure to oil.

NIOSH is recommending that whenever there is oil exposure to the P-filters, they should be replaced after each shift. There have been no changes to the selection logic for the N and R series filters.

An easy way to remember the filter series is:

- N is **N**ot resistant to oil
- R is **R**esistant to oil
- P is oil **P**roof

### *Filter Efficiency Levels*

There are three filter efficiency levels for each of the three filter series. The minimum efficiency levels are 95%, 99%, and 99.97%. These efficiency levels are identified by the following designations:

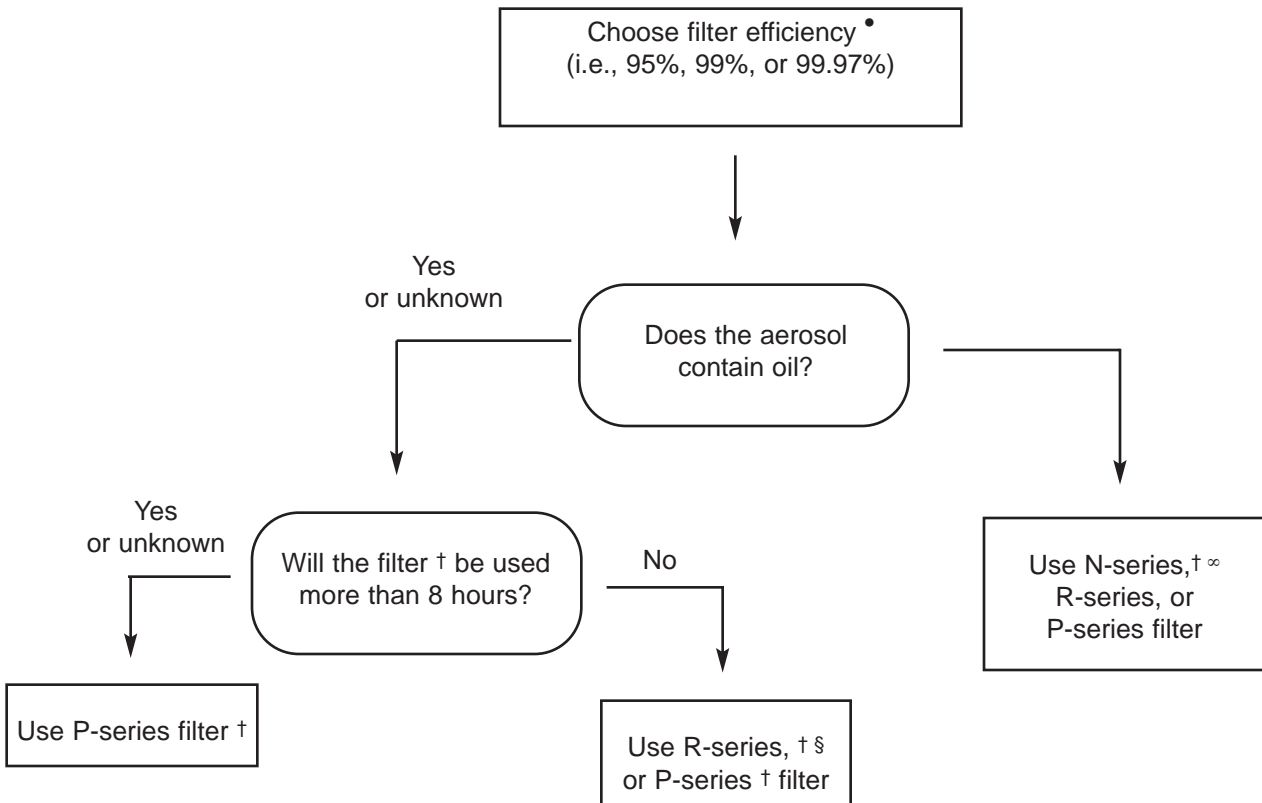
- Filters with N95, R95, and P95 designations are certified as having a minimum efficiency of 95%. The series of 95% efficiency filters replaces the old dust/fume and dust/fume/mist filters.
- Filters with N99, R99, and P99 designations are certified as having a minimum efficiency of 99%.
- Filters with N100, R100, and P100 designations are certified as having a minimum efficiency of 99.97%. These filters replace the *high efficiency particulate air (HEPA) filters* under the old certification standard. Unlike the old HEPAs, both the N100 and R100 have the following limitations:
  - N100 - no oil exposure
  - R100 - oil exposure for one shift only

The P100 filter is the only filter that will keep the familiar magenta color.

Table 2-1 summarizes the nine classes of particulate filters. Figure 2-8 illustrates the decision process for choosing the appropriate filter.

<b>Table 2-1.</b> Nine Classes of Particulate Filters.			
<b>Filter Series</b>	<b>Filter Efficiency Level</b>	<b>Filter Classes</b>	<b>Service Time</b>
N-Series	99.97%	N100	Non-specific
	99%	N99	Non-specific
	95%	N95	Non-specific
R-Series	99.97%	R100	One Shift
	99%	R99	One Shift
	95%	R95	One Shift
P-Series	99.97%	P100	Non-specific
	99%	P99	Non-specific
	95%	P95	Non-specific





- The higher the filter efficiency, the lower the filter leakage.

† Limited by considerations of hygiene, damage, and breathing resistance.

∞ High (200 mg) filter loading in the certification test is intended to address the potential for filter efficiency degradation by solid or water-based (i.e., non-oil) aerosols in the workplace. Accordingly, there is no recommended service time in most workplace settings. However, in dirty workplaces (high aerosol concentrations), service time should only be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that demonstrates (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

§ No specific service time limit when oil aerosols are not present. In the presence of oil aerosols, service time may be extended beyond 8 hours of use (continuous or intermittent) by demonstrating (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

**Figure 2-8.**  
Flow Chart for Selecting Part 84 Particulate Filters.

### Vapor and Gas Removing Cartridges and Canisters

Vapor and gas removing cartridges and canisters are used with APRs to protect workers from exposures to air contaminated with toxic vapors and gases. Cartridges or canisters are designed for either one specific type of gas or vapor, or one specific combination of a gas and vapor. Examples are carbon monoxide, ammonia gas, or combinations of gases and vapors, such as acid gases or organic vapors. This is unlike No particulate filters, which are effective for nearly all types of particles.

### Sorbent

A *sorbent* is a granular material in a respirator cartridge or canister that absorbs specific contaminants from the air as the air is inhaled. This provides protection to the wearer from the toxic effects of the gas or vapor. Materials used as sorbents include:

- Activated charcoal
- Silica gel
- Mixtures of specific chemicals that will absorb a contaminant

### Cartridges and Canisters

Sorbents are packaged into either *cartridges* or *canisters*. The only difference between a cartridge and a canister is the amount of sorbent they contain. Cartridges are designed to be used singly or in pairs on APRs. The amount of sorbent contained in a cartridge is small, making their service life short in duration. This limitation restricts the use of cartridges to low concentrations of gases and vapors.

Canisters contain larger amounts of sorbent material than cartridges. Therefore, they can be used in situations where the workplace air concentration requires a longer canister life. Canisters are designed as chin, front, or back-mounted devices. When a canister is used with a facepiece, the respirator is called a gas mask.

### *Cartridge/Canister Use*

As mentioned earlier, a cartridge or canister protects against a specific gas or vapor. However, some cartridges and canisters are manufactured to protect against gases/vapors and particulates. They do this by combining particulate filters with sorbent materials. When a particulate filter is combined with a canister or

cartridge, the filter is located on the inlet side of the cartridge. It is either built into the cartridge itself or held to the outside of the cartridge by a snap-on cover.

Both canisters and cartridges are available for the following specific gases and vapors:

- Ammonia
- Organic vapors
- Pesticides
- Vinyl chloride
- Hydrogen fluoride
- Hydrogen sulfide
- Formaldehyde
- Acid gases (e.g., chlorine, hydrogen chloride)

Only cartridges are available for these additional substances:

- Paints, lacquers, and enamels
- Mercury
- Chlorine dioxide

Likewise, only canisters are available for these substances:

- Chlorine
- Sulfur dioxide
- Carbon monoxide
- Ethylene oxide
- Hydrogen cyanide
- Hydrogen chloride

A color coding scheme identifies the contaminants that a gas and vapor canister or cartridge protects against. The color coding is assigned to either individual contaminants or combinations of contaminants as shown in Table 2-2.

To determine if there is a cartridge problem for a specific chemical, refer to the *NIOSH Pocket Guide to Chemical Hazards*. Respirator recommendations are listed for the majority of chemicals listed in the guide. If there is a cartridge problem, NIOSH will not recommend APRs be used. Table 2-3 lists some of the chemicals that cannot be safely protected against by APRs.

**Table 2-2.** Cartridges and canisters are color-coded for specific contaminants.

Atmospheric Contaminant	Assigned Color
Acid Gases	White
Organic Vapors	Black
Ammonia Gas	Green
Carbon Monoxide Gas	Blue
Acid Gases and Organic Vapors	Yellow
Acid Gases, Ammonia, and Organic Vapors	Brown
Acid Gases, Ammonia, Carbon Monoxide, and Organic Vapors	Red
Other Vapors and Gases not listed above	Olive
Radioactive Materials (except Tritium and Noble Gases)	Purple (magenta)
Dusts, Fumes, and Mists (other than radioactive materials)	Orange

**Table 2-3.** APRs do not protect against the following chemicals:

Acrolein	Methylene bisphenyl isocyanate
Aniline	Nickel carbonyl
Arsine	Nitro compounds
Bromide	Nitrobenzene
Carbon monoxide	Nitrogen oxides
Dimethylaniline	Nitroglycerin
Dimethyl sulfate	Nitromethane
Hydrogen cyanide	Ozone
Hydrogen fluoride	Phosgene
Hydrogen selenide	Phosphine
Hydrogen sulfide	Phosphorous trichloride
Methanol	Stibine
Methyl bromide	Sulfur chloride
Methyl chloride	Toluene diisocyanate

## Breakthrough

Initially a gas and vapor sorbent is 100 percent efficient in absorbing a contaminant. However, as the sorbent is used up, its efficiency decreases. When the sorbent is exhausted, the contaminant passes completely through the sorbent and into the facepiece, where it is inhaled by the wearer. This loss of capturing efficiency is called *breakthrough*. It is opposite to particulate filters, which become more efficient as particles collect in the filter.

Many chemicals have warning properties, such as odor, taste, or throat irritation. If you experience any of these warning properties, breakthrough has occurred. Follow these steps:

1. Leave the work area immediately
2. Go to a location with fresh air
3. Notify your supervisor or site safety and health officer
4. Replace the cartridge or canister

Gas and vapor canisters/cartridges have short useful service lives. Therefore, it is recommended you discard your canisters/cartridges at least daily, even if no odor, taste, or irritation is detected. However, if you notice that breakthrough has occurred, change the filters immediately, even if it has been less than one shift. Table 2-4 lists general MUCs for chemical cartridges that have hazardous breakthrough problems.

**Table 2-4.** MUCs for chemical cartridges with hazardous breakthrough problems are listed below.

Type of Cartridge	MUC
Organic vapors	1,000 ppm
Acid gases	1,000 ppm
Sulfur dioxide	50 ppm
Chlorine	10 ppm
Hydrochloric acid	50 ppm
Ammonia	300 ppm
Methylamine	100 ppm

Service life is the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer. For the particulate filter, service life ends when breathing resistance increases due to filter loading. For a gas and vapor removing cartridge or canister, service life ends when the sorbent is used up and breakthrough occurs.

Traditionally, the time to change a cartridge or canister was when breathing became more difficult due to filter loading, or when breakthrough occurred and a contaminant was smelled or sensed in some way. However, OSHA no longer allows the use of breakthrough to determine when to change a cartridge or canister. Instead, OSHA requires one of the following methods be used:

- Respirators must be equipped with an end-of-service-life indicator (*ESLI*) that has been certified by NIOSH for the substance.
- A regular change schedule must be instituted to ensure that cartridges or canisters are replaced before the end of their service life.

#### End of Service Life Indicators

An ESLI is a device on a gas and vapor removing cartridge or canister that changes color as the sorbent is used up. It provides you with a warning that the filter cartridge or canister has reached the end of its service life and needs to be changed. For example, certain respirators used for metallic mercury vapor have an ESLI that changes from orange to brown as the cartridge loses its effectiveness. At present, only a few NIOSH-approved respirators have ESLIs.

#### Change Schedule

If a canister or cartridge does not have an ESLI, your employer is required to implement a change schedule. The change schedule must be based on objective information that ensures canisters and cartridges are changed before the end of their service lives. Employers cannot use breakthrough as a way of determining that a canister or cartridge is used up.

Breakthrough data is not widely available for many contaminants. Even so, change schedules for respirators without ESLIs must be established and implemented.

The respirator program administrator (RPA) should be notified if problems routinely occur despite using the recommended filter cartridge and canister change schedule.

## **ATMOSPHERE SUPPLYING RESPIRATORS**

Atmosphere supplying respirators come in two types. They are:

1. *Supplied air respirator (SAR)*
2. *Self-contained breathing apparatus (SCBA).*

Both types of respirators supply clean breathable air to the wearer rather than filtering contaminated air. The difference between the two respirator types is the air delivery system. The SAR receives air through a hose connected to a compressor or air cylinders, which is not designed to be worn by the respirator user. The SCBA receives air from a compressed air tank or cylinder carried by the user. In both cases the air is under pressure and a regulator must be used. A regulator reduces the air pressure to a safe breathing level and also controls the air flow into the respirator.

## **Regulators**

There are three types of regulators:

1. Demand flow
2. Pressure demand
3. Continuous flow

## **Demand Flow Regulators**

A demand flow regulator uses the suction force of inhalation to open the regulator valve and let air flow into the respirator. In other words, when you “demand” the air, you get it. When you exhale, the flow of air into the facepiece stops.

The advantage of the demand flow regulator is the air supply is not wasted, so the breathing time provided by an air cylinder is maximized.

The disadvantage is the regulator depends on negative air conditions during inhalation. Because of this, the NIOSH PF for demand type atmosphere supplying respirators is only 50 when used with a full facepiece. A respirator with a demand flow regulator is **not** recommended for many applications, including hazardous waste work and IDLH environments.

#### Pressure Demand Regulators

Pressure demand regulators are similar to demand flow regulators in that airflow into the facepiece occurs mainly during inhalation. However, there is also a constant flow of air into the facepiece that keeps it pressurized. So, negative pressure conditions never exist, even during inhalation. Because positive pressure conditions exist at all times, leakage is minimized.

The pressure demand regulator is used most often in hazardous waste operations, confined space entry, and IDLH environments.

#### Continuous Flow Regulator

Continuous flow airline respirators maintain air flow at all times, rather than only on demand. In place of a demand or pressure demand regulator, an air-flow control valve controls the air flow into the respirator. Continuous flow respirators are known as Type C or Type CE respirators. Usually they are used in abrasive blasting applications.

#### Supplied Air Respirators

A *supplied air respirator (SAR)* supplies air to a facepiece through a length of hose (Figure 2-9). The hose is connected to either a compressed air cylinder or a compressor that is equipped with a filtering system to purify the air. The air supply is used to pressurize the respirator to achieve a high PF. NIOSH assigns an SAR with a pressure demand regulator a PF of 1,000. The pressure demand SAR is being used more and more for hazardous waste decontamination, confined space entry, and asbestos removal.

**INSERT FIGURE 2-9 AFTER THIS PARAGRAPH**



Continuous flow respirators are usually SARs, and the PF varies. When used with a hood or helmet, NIOSH assigns continuous flow respirators a PF of 25. When used with a tight-fitting facepiece, NIOSH assigns a PF of 50.

Some manufacturers have shown that their continuous flow respirators can offer protection greater than a PF of 25 or 50. OSHA has assigned a PF of 1000 for some continuous flow abrasive blasting respirators when the manufacturer has proven that the respirator affords the greater protection.

### Limitations

An SAR has the following limitations:

- The air line impairs movement for the wearer. According to OSHA regulations, the hose cannot exceed a length of 300 feet or manufacturer's specifications. In addition, you must carefully retrace your steps when coming off the job.
- The air line can be damaged. Rough or sharp surfaces can puncture the line. Chemicals on the ground can deteriorate the hose. Falling materials, vehicles, and heavy equipment can also damage the air line.
- The location of the air compressor. The compressor must be located away from potential chemical or contamination hazards. All filters and alarms must be working properly and the system must be maintained according to the manufacturer's recommendations.

Because of limitations, SARs are often used with an escape SCBA, which is an air cylinder with a 5 to 10 minute air supply. When an escape SCBA is provided, NIOSH assigns the pressure demand SAR a PF of 10,000. Escape SCBAs are required for pressure demand SARs used in IDLH atmospheres.

**Self-Contained Breathing Apparatus**

A *self-contained breathing apparatus (SCBA)* consists of a facepiece and regulator mechanism connected to a cylinder of compressed air that is carried by the user (Figure 2-10). SCBAs are commonly used when airborne concentrations are very high or unknown. Pressure demand SCBAs have a PF of 10,000 and no air line problems.

**INSERT FIGURE 2-10 HERE**

There are different types of SCBAs, and each has its own set of limitations. SCBAs include:

- Closed-circuit or rebreathers
- Open-circuit SCBAs
  - Entry
  - Escape

**Open-Circuit and Closed-Circuit SCBAs**

An open-circuit SCBA uses a cylinder of breathing quality air, a regulator, and a facepiece. Exhaled air goes through an exhalation valve directly to the outside air. Open-circuit tanks usually are rated at 30 to 60 minutes.

Closed-circuit SCBAs are called rebreathers because the exhaled air goes back into the system to be recycled. A closed-circuit system consists of a scrubber device to remove exhaled carbon dioxide, a tank of pure oxygen, and a breathing bag to blend the mixture. The closed-circuit unit supplies enough breathing air for up to four hours.

Rebreathers work in the following manner.

1. The air for breathing is mixed in a flexible breathing bag. As the wearer inhales and deflates the bag, oxygen flows into the bag from the oxygen tank. The oxygen tank can contain either compressed or liquid oxygen.
2. The exhaled air goes through a filter known as an alkaline scrubber, which removes the carbon dioxide from the exhaled breath.

3. The scrubbed air then mixes with the oxygen in the bag, so that a breathing quality mixture is available for the next inhalation.

One problem with rebreathers is they typically use demand regulators. For this reason NIOSH assigns them a PF of 50. However, a few companies make rebreathers with pressure demand regulators that can be used on job sites where a higher PF is needed.

#### Entry SCBA

The typical entry SCBA is a pressure demand, open-circuit SCBA with a cylinder. It provides enough air for 30 to 60 minutes and weighs about 25 or 30 pounds.

Pressure-demand, open-circuit entry SCBAs are the work-horse respirators used on most jobs when hazards are severe or unknown. They provide excellent protection to the wearer.

#### *Limitations*

The chief limitations of the entry SCBA is its weight and limited air supply. These limitations greatly affect the work schedule because the work day must be divided into many smaller segments. In addition, some workers may feel uncomfortable and confined in the respirator.

#### Escape SCBA

Escape SCBAs are small air cylinders capable of providing 5 to 15 minutes of breathable air. They are only used for emergency evacuation and do not provide enough air for entry to do work.

An escape SCBA may be attached to an SAR, thus providing breathing air during an emergency. Other escape SCBAs come with hoods and are used in emergencies by workers wearing non-SCBA respirators (i.e., mines and industrial settings).



---

**SECTION 2 - ASSIGNMENT SHEET**

1. Define the following terms:

Maximum use concentration \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Protection factor \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. Write out the following abbreviations:

APR \_\_\_\_\_

PAPR \_\_\_\_\_

PEL \_\_\_\_\_

SAR \_\_\_\_\_

SCBA \_\_\_\_\_

STEL \_\_\_\_\_

TLV \_\_\_\_\_

TWA \_\_\_\_\_

3. Identify which governmental agency approves respirators for use and assigns PFs.

\_\_\_\_\_

4. Identify the trait all respirators have in common regarding respiratory protection.

\_\_\_\_\_

\_\_\_\_\_



8. List the two limitations of a PAPR.

---

---

---

---

9. Identify the two basic types of filtering devices used with APRs.

---

---

10. List the three filter series for resistance to filter efficiency degradation.

---

---

---

11. List the three filter efficiency levels.

---

---

---

12. Describe how cartridges and canisters are used to protect workers.

---

---

---

---

- 13. Identify the two types of atmosphere supplying respirators and describe the difference in the air delivery system.

---

---

---

---

- 14. List the three types of regulators used by atmosphere supplying respirators.

---

---

---

---

- 15. List the limitations of an SAR.

---

---

---

---

---

---

---

---

- 16. List the limitations of an entry SCBA.

---

---

---

---





# RESPIRATORY PROTECTION

Section

**3**

Title

**RESPIRATOR PROGRAM  
REQUIREMENTS**

## TRAINEE OBJECTIVES

After completing Section 3, you will be able to:

1. Define the following terms:

Qualitative fit test  
Quantitative fit test  
Service life

2. Write out the following acronyms.

ESLI          QLFT          RPA  
IDLH          QNFT

3. Identify OSHA's requirement for reducing exposure level to below the PEL.
4. List the nine required topics of a respiratory protection program.
5. Identify where information on voluntary respirator use is found.
6. Identify who receives a copy of the PLHCP written opinion.
7. State how often a fit test must be given.
8. List the conditions that prevent a good face-to-facepiece seal.
9. Identify the two common procedures used to check a facepiece seal.
10. Explain when workers should leave the work area.
11. State when a respirator must be inspected.
12. List the topics in which the employer must ensure that workers can demonstrate knowledge.



**INTRODUCTION**

This manual has been put together to help you understand and comply with the Occupational Safety and Health Administration (*OSHA*) Standards 29 *CFR* 1910.134 (General Industry) and 29 *CFR* 1926.103 (Construction) for respirator usage (Appendix C).

Before respirators are used, several steps must be taken to control any potential hazardous airborne exposure.

1. The concentration of the contaminant must be measured using air sampling techniques. Air sampling provides information about whether the airborne level of exposure is hazardous to unprotected workers.
2. The sampling results must be compared to exposure limits. This determines if the contaminant levels in the workplace are hazardous to workers. Examples of exposure limits include OSHA's permissible exposure limit (*PEL*) or the American Conference of Governmental Industrial Hygienists (*ACGIH*) threshold limit values (*TLV*).

If contaminant levels exceed the *PEL*, OSHA requires that *engineering controls* and *administrative controls* be used first to reduce contaminant levels to below the *PEL*. Respirators should only be used:

- After it has been shown that engineering and administrative controls are unable to reduce exposures to below the *PEL*.
- When engineering and administrative controls are infeasible.
- While engineering controls are being instituted.

**RESPIRATORY PROTECTION PROGRAM**

OSHA requires employers to have a written respiratory protection program whenever:

- Respirators are necessary to protect the health of workers.
- The employer requires the use of respirators.

The respiratory protection program must cover certain required work site-specific procedures for respirator use. Also it must be updated when there are changes in workplace conditions that affect respirator use.

The respiratory protection program includes the following requirements:

1. Procedures for selecting respirators for use in the workplace.
2. Medical evaluations of employees who are required to use respirators.
3. Fit testing procedures for tight-fitting respirators.
4. Procedures for proper use of respirators in routine situations and reasonably foreseeable emergencies.
5. Procedures and schedules for cleaning, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.
6. Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere supplying respirators.
7. Employee training in the respiratory hazards to which they are potentially exposed during routine and emergency situations.
8. Employee training in the proper use of respirators, including:
  - *Donning and doffing*
  - Limitations
  - Maintenance
9. Procedures for regularly evaluating the effectiveness of the program.

**Respirator Program Administration**

The employer must designate a respirator program administrator (*RPA*) to oversee the respiratory protection program and to conduct the required evaluations of program effectiveness. To fulfill these duties, the RPA must have the training or experience that matches the complexity of the program.

As part of the administration of the program, the RPA is responsible for ensuring the following:

- Appropriate care is taken to properly select, use, and maintain the respirators.
- The nature of the air contaminant and its exposure concentration is considered in properly selecting a respirator.
- Workers are trained in the proper use and care of the respirators that are provided.
- Workers are medically fit to wear the respirator.

**Voluntary Use of Respirators**

Voluntary use of a respirator means that a worker chooses to wear a respirator when the employer does not require it. Even when respirator use is voluntary, the employer has several obligations. They are listed below:

1. Determine that the voluntary use of respirators will not create a hazard.
2. Provide workers who voluntarily use respirators with the information in 29 CFR 1910.134, Appendix D.
3. Establish and implement an abbreviated written respiratory protection program. This abbreviated program must include:
  - Provisions for initial medical screening of the voluntary respirator user.
  - The means and training so the user can properly clean, store, and maintain the respirator.

There is one exception regarding a written respiratory protection program for voluntary use. Employers are not required to include those workers whose voluntary use only includes *filtering facepieces* (dust masks).

## **RESPIRATOR SELECTION**

Employers are responsible for selecting the appropriate respirators for their employees. To do this the employer must:

1. Gather information
2. Apply information to respirator selection process
3. Choose the respirator based on the selection process

### **Gather Information**

It is impossible to choose a respirator without knowing the hazards on the work site and the workers' potential exposure levels. The employer can use two methods for identifying the hazards and their airborne levels:

1. Personal air monitoring devices.
2. Past exposure levels encountered on similar jobs.

It is very important that some actual or educated estimate of exposure levels is known before selecting a respirator. In the absence of such information, OSHA requires that the job's exposure level be considered *immediately dangerous to life and health (IDLH)*.

In addition to airborne hazards and their exposure levels, the employer must gather other types of information:

- General use conditions and determination of contaminants
- Properties of the contaminants
- Odor threshold data
- Exposure limits
- IDLH concentrations
- Eye irritation potential
- *Service life* information

### **Respirator Selection Process**

Once the criteria information is gathered and evaluated, the employer applies it to a respirator selection process. The selection process uses a sequence of questions to identify the recommended class of respirators for the airborne contaminants. One example of this process is

the Respirator Decision Logic from the National Institute of Occupational Safety and Health (*NIOSH*) located in the Appendix A of this manual.

**General Use  
Conditions and  
Determination of  
Contaminants**

General use conditions include the following:

- Descriptions of the job tasks to be performed
- Duration and frequency of the tasks to be performed
- Work location
- Physical demands of the work to be performed
- Respirator comfort

Determination of contaminants includes the following:

- Identity of the substances present in the air.
- Actual measured exposure level of the contaminant on the job.
- If possible, an estimate of the highest level of exposure that workers are likely to encounter.

**Properties of the  
Contaminants**

Information is needed on the physical, chemical, and toxic properties of the contaminant. This information includes:

- Form in which the substance is found on the job site, such as dust, mist, fume, gas or vapor.
- Chemical properties, such as organic vapor, pesticide, metal, acid gas.
- Toxicological properties of the substance as they pertain to adverse health effects (e.g., *carcinogen*) and warning properties.

**Odor Threshold Data**

Information on odor threshold is essential to determine whether a contaminant has warning properties at or below the exposure limit that would allow an *air purifying respirator (APR)* to be selected. If the odor threshold exceeds the exposure limits, the contaminant is considered to have *poor warning properties*. Therefore, an APR would not be recommended for use unless it had an *end-of-service-life indicator (ESLI)*.

Odor threshold data would be obtained from industrial hygienists or other experts such as NIOSH or OSHA.

**Exposure Limits**

Several organizations require, recommend, or publish exposure limits. They are listed below:

- OSHA - *Permissible exposure limit (PEL)*
- NIOSH - *Recommended exposure limit (REL)*
- ACGIH - *Threshold limit value (TLV)*

Exposure limit information is necessary to calculate *maximum use concentrations (MUCs)* for the types or classes of respirators using their assigned *protection factors (PFs)*. The *NIOSH Pocket Guide to Chemical Hazards* is an excellent source of information for many chemicals and their exposure limits.

**IDLH Concentrations**

Contaminant concentrations that are IDLH are life threatening and call for the most protective respirators for the wearer. The *NIOSH Pocket Guide to Chemical Hazards* provides IDLH concentrations for many chemicals found in the workplace. The IDLH concentration for a substance must be compared to the actual concentration measurement of the substance on the job.

**Eye Irritation**

Some contaminants have the potential to cause eye irritation. In these situations, a full facepiece, hood, or helmet should be selected instead of a half mask to provide eye protection.

**Service Life Information**

Service life refers to the length of time a filter *cartridge* or *canister* will provide protection to the wearer. This information is necessary to determine a *filter* change schedule for the chosen respirator.

**MEDICAL EVALUATION**

Wearing a respirator may place a physiological burden on the wearer. Therefore, OSHA requires that an employer provide a medical evaluation to determine if a worker can wear a respirator. The evaluation must be done before a worker is fit tested or required to use a respirator.



**Conducting the Medical Evaluation**

An employer must select a *physician or other licensed health care professional (PLHCP)* to conduct the medical evaluation. The PLHCP must use one of the following:

- The mandatory medical questionnaire (20 CFR 1910.134, Appendix C).

or

- An initial medical examination that obtains the same information as the medical questionnaire.

Prior to giving the medical questionnaire, the PLHCP must be given the following information:

- Type and weight of the respirator to be used by the worker.
- Frequency and duration of respirator use.
- Expected physical work effort.
- Additional protective clothing and equipment worn.
- Temperature and humidity extremes that may be encountered.
- Copy of the employer's written respiratory protection program.
- Copy of the 29 CFR 1910.134 standard.

**Conditions of the Medical Evaluation**

The medical evaluation must comply with these conditions:

- Be administered confidentially during normal working hours or at a time and place convenient for the worker.
- Be understandable to the worker. Also, the worker must have the opportunity to discuss the questionnaire and results with the PLHCP.

**Written Report**

Upon completion of the initial evaluation (and follow-up exam if necessary), the PLHCP must make a medical determination regarding the worker's ability to use a respirator. The PLHCP must give a written report to the

employer regarding the worker's ability to use a respirator and a copy of the written report to the worker. The written report must include the following:

- Any limitations on respirator use
- Need for further medical evaluations
- Statement that the PLHCP has given the worker a copy of the written report provided to the employer

## **FIT TESTING**

*A qualitative fit test (QLFT) or quantitative fit test (QNFT) must be performed on all negative or positive pressure tight-fitting respirator before a worker is required to wear it. The worker must be fit tested on the same make, model, size, and style of respirator that will be used in the workplace.*

*A fit test must be conducted at least annually and whenever changes in the worker's physical condition could affect the respirator fit. Such conditions include, but are not limited to:*

- Cosmetic surgery
- Dental changes
- Facial scarring
- Obvious changes in body weight

Fit testing atmosphere supplying respirators and powered air purifying respirators (*PAPR*) shall be accomplished by performing the fit tests in negative pressure mode.

## **Fit Testing Protocols**

OSHA has provided specific procedures for performing QLFTs and QNFTs. By following these procedures for each fit test, the test results will be consistent from one test to another. For a QLFT, the worker is tested using a testing agent to ensure that the respirator is fitting properly. For a QNFT, a machine is used to make sure that the respirator fits correctly.

**Qualitative Fit Test**

A QLFT is a pass/fail fit test used to check respirator fit that relies on the user's response to a test agent. It involves introducing a harmless odorous or irritating test agent into the breathing zone of the user. If the user does not detect the test agent, the respirator fits properly.

Four test agents are approved by OSHA for conducting a QLFT:

1. Banana oil (isoamyl acetate or isopentyl acetate)
2. Irritant smoke (stannic oxychloride or titanium tetrachloride)
3. Saccharin (sodium saccharin) solution
4. Bitrex™ (denatonium benzoate) solution

Before a test agent is used, OSHA requires an odor and taste threshold screening be conducted. The screening determines if the user can smell or taste the test agent at low concentrations. If the user can smell or taste the testing agent, he or she can be fit tested with it.

Qualitative fit testing addresses the following issues:

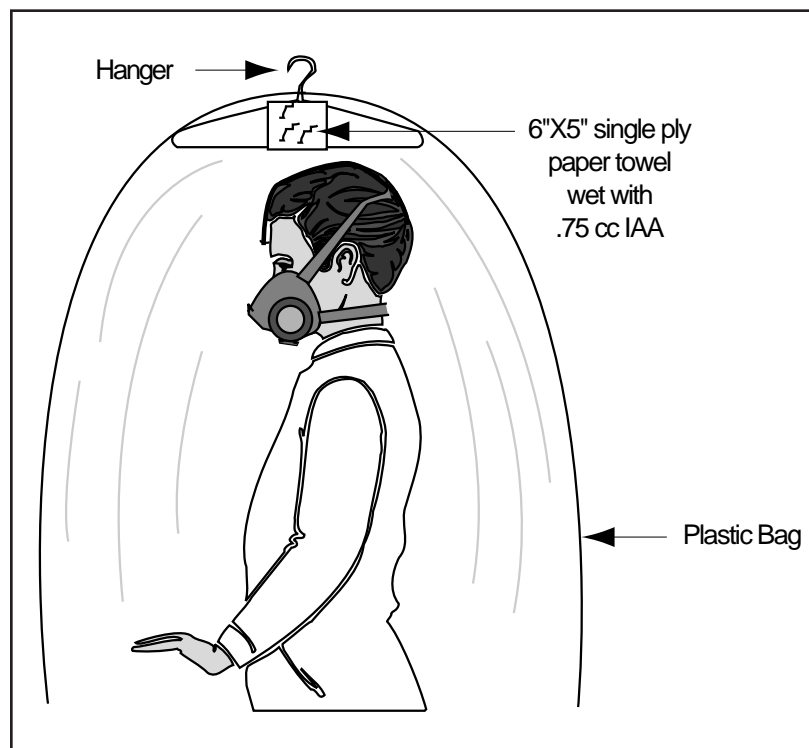
- Choosing the respirator needed.
- Determining comfort level. Comfort is important when respirators are used for long periods of time.
- Establishing a facepiece-to-face seal with a particular respirator.
- Identifying facial complications that affect the fit, such as dentures, facial surgery, or dental/oral surgery.

A QLFT is simple and inexpensive, which makes it the most common type of fit testing done for respirators. However, a QLFT relies upon a user's subjective response to the testing agent. In other words, the user must inform the tester if he/she can smell or taste the substance. Because of the subjectivity of the QLFT, a respirator should never be assigned a PF higher than 10 when using this type of test.

**Note:** Before performing any test, make sure the correct respirator cartridge for the testing agent has been installed.

### Isoamyl Acetate Protocols

Isoamyl acetate (*IAA*) is also known as banana oil. This test requires the respirator be fitted with organic vapor cartridges or offer protection against organic vapors. The wearer stands inside a fit test chamber for while taking this test (Figure 3-1).



**Figure 3-1.** The fit test chamber is only used with isoamyl acetate (*IAA*).

In some individuals, exposure to *IAA* may cause the following health effects:

- Olfactory fatigue - the sense of smell is dulled
- Feelings of lightheadedness and drunkenness

---

Irritant Smoke Test	Irritant smoke is very irritating to the eyes, nose, and throat and usually causes coughing. The worker being tested must keep his or her eyes closed during the fit test when wearing a half facepiece. This test requires the respirator be fitted with a <i>high efficiency particulate air (HEPA) filter</i> or P100 particulate filter.
Saccharin Test	The saccharin test uses a saccharin aerosol. If saccharin leaks into the facepiece, the worker will have a sweet taste on the lips and tongue. Workers must take a taste test before using this testing agent because some people cannot taste saccharin. A small nebulizer is used to create a saccharin aerosol inside the test chamber. This test uses a particulate filter.
Bitrex Test	The Bitrex test is a Bitrex aerosol that has a citrus or orange flavor. The fit testing protocol for Bitrex is identical to the saccharin protocol.
<b>Quantitative Fit Test</b>	<p data-bbox="621 915 1469 1100">A <i>quantitative fit test (QNFT)</i> is a more sophisticated fit test. It measures the actual amount of leakage into the respirator. A variety of methods are available for performing a QNFT, and each one uses a different technology. The quantitative fit test protocols are:</p> <ul data-bbox="621 1146 1469 1709" style="list-style-type: none"><li data-bbox="621 1146 1469 1289">• Generated aerosol – An aerosol is generated and dispersed in a room. Air monitoring instruments are used to measure both the concentration in the room and the concentration inside the actual facepiece.</li><li data-bbox="621 1335 1469 1446">• Ambient aerosol condensation nuclei counter – The amount of natural dusts in the air is measured and compared to the amount of dust inside the facepiece.</li><li data-bbox="621 1493 1469 1709">• Controlled negative pressure - Air pressure inside the facepiece is kept constant. As air leaks into the facepiece, air is exhausted to maintain the constant inside air pressure. Therefore, the exhausted air is equivalent to the amount of leakage and can be measured to determine leakage.</li></ul>

**RESPIRATOR USE**

The employer is required to establish and implement procedures for the proper use of respirators. These procedures are listed below:

- Prohibiting conditions that may result in facepiece seal leakage.
- Preventing workers from removing respirators in hazardous environments.
- Taking actions to ensure continued effective respirator operation throughout the work shift.
- Establishing procedures for the use of respirators in IDLH atmospheres.

**Facepiece Seal Conditions**

OSHA does not permit respirators to be worn when conditions prevent a good seal. These conditions include the following:

- Facial hair that crosses the sealing surface (stubble beard growth, beard, mustache, or sideburns)
- Skull cap that projects under the facepiece
- Temple pieces on glasses
- Absence of one or both dentures
- Facial scars or deformities that hinder a good seal

The need for a good seal is the reason facial hair is prohibited for workers who must wear respirators. Facial hair prevents the facepiece from sealing against the face and results in a high rate of leakage.

Eyeglasses pose another facepiece seal problem. The temple bars on eyeglasses prevent a respirator from sealing against the side of the head. However to go without eyeglasses creates vision-related problems, such as tripping hazards. Respirator manufacturers make fittings that hold lenses in place in the facepiece without temple bars. OSHA requires that this type of fitting be made available at the employer's expense to workers who wear glasses.

**User Seal Checks**

A respirator must be adjusted each time you put it on to ensure the best possible seal. To do this, conduct a user seal check. You can use either of the two methods listed:

1. Positive pressure seal check and negative pressure seal check
2. Manufacturer's recommended user seal check

User seal checks are **not** substitutes for qualitative or quantitative fit tests.

**Positive Pressure User Seal Check**

To perform a positive pressure user seal check, follow these steps:

1. Cover the exhalation valve of the respirator.
2. Exhale gently for about 10 seconds. Do **not** exhale too hard or push the mask into the face because the check will be inaccurate.

If the respirator fits, a slight pressure should build up inside the facepiece. If air leaks out, the respirator does not fit properly, and the seal is inadequate. Figure 3-2 illustrates a positive pressure seal check.

This test is done on a atmosphere supplying respirator by covering the inlet and exhalation valve with your hands and exhaling (Figure 3-3).

**INSERT FIGURE 3-2**

**INSERT FIGURE 3-3**

**Negative Pressure User Seal Check**

To perform a negative pressure user seal check, follow these steps:

1. Cover the filter openings with the palms of your hands.
2. Inhale gently and hold your breath for about 10 seconds. Do **not** push the respirator into the face too hard, or the check will be inaccurate.

If the respirator fits correctly, the facepiece should collapse slightly inward. If the respirator does not fit correctly, the facepiece will not collapse, and you will feel an air leak (Figure 3-4).

This test is done on a atmosphere supplying respirator by covering the inlet with the hand and inhaling (Figure 3-5).

**INSERT FIGURE 3-4**

**INSERT FIGURE 3-5**

**Continued Respirator Effectiveness**

OSHA requires the employer to monitor the workplace for changes that may affect the effectiveness of the respirators. Examples include changes in work area conditions or in worker exposure or stress. When such changes occur, the employer shall reevaluate the continued effectiveness of the respirator.

If you experience any trouble with your respirator, leave the area and fix the problem. Specifically, leave the work area for any of the following conditions:

- To wash your face and respirator to prevent eye or skin irritation.
- If you detect vapor or gas breakthrough.
- If you experience increased breathing resistance.
- If you detect a leak in the facepiece seal.
- To replace the respirator or the filter, cartridge, or canister.



**IDLH Conditions**

OSHA requires that additional standby worker(s) be located outside an IDLH atmosphere when a worker(s) has entered that area. The purpose of the standby worker is to assist co-workers in case of an emergency. The standby person must:

- Be trained and equipped to provide effective emergency response.
- Maintain either visual, voice, or signal line of communication with the worker(s) in the IDLH atmosphere.

**MAINTENANCE AND CARE**

The employer must provide for the following regarding the respirators used by workers:

- Cleaning and disinfecting
- Storage
- Inspection
- Repair

**Cleaning and Disinfecting**

It is the employer's responsibility to provide a clean and disinfected respirator to the user. A respirator issued for the exclusive use of one worker must be cleaned and disinfected by that worker to maintain the respirator in a sanitary condition. However, if a respirator is issued to more than one worker, for emergency use, or for fit testing, it must be cleaned and disinfected after each use.

**Storage**

For a respirator to remain in good condition and proper working order, it must be stored correctly to protect it from the following:

- Chemicals
- Contamination
- Damage
- Dust
- Excessive moisture
- Extreme temperatures
- Sunlight

In addition, a respirator shall be packed and stored to prevent the facepiece and exhalation valve from being deformed.

**Inspection**

All respirators must be inspected before each use and during cleaning. Atmosphere supplying respirators and respirators used for emergency purposes must be inspected monthly or according to manufacturer specifications. All written inspection records for emergency use respirators must be kept.

Air cylinders must be maintained in a fully charged state. They must be recharged when the pressure falls below 90 percent of manufacturer's recommended pressure.

Check the following items when conducting a respirator inspection:

- Function
- Connections, including tightness
- Condition of parts, especially rubber parts, for flexibility and deterioration

**Repair**

The following list outlines OSHA's requirements regarding respirator repairs:

- Repairs must be performed by a trained individual.
- Only the manufacturer's NIOSH-approved parts designed for the specific respirator shall be used.
- Repairs performed on the regulator, alarms, or admission valves of an atmosphere supplying respirator shall be performed by the manufacturer or a technician trained by the manufacturer.

**BREATHING AIR QUALITY**

Breathing air used in atmosphere supplying respirators must meet at least the requirements for Grade D breathing air as described in the *ANSI/Compressed Gas Association Commodity specifications for Air, G-7.1-1989*. Grade D air has the following limits:

- Oxygen content - 19.5 to 23.5 percent (similar to normal breathing air)
- Hydrocarbons - No greater than 5  $mg/m^3$  of air
- Carbon monoxide - No greater than 10 *ppm*
- Carbon dioxide - No greater than 1,000 *ppm*

Additionally, several issues related to breathing air and air cylinders are addressed in 29 CFR 1910.134 (i):

- Air cylinders must be tested and meet minimum standards to ensure they can be safely pressurized.
- Air line couplings must be incompatible with outlets for other gases. This incompatibility prevents injury caused by the accidental use of other gases.
- Compressors used for supplied air systems must have built-in safety devices. These include:
  - Air purifying filters.
  - Alarms for compressor failure.
  - Alarms for overheating or high carbon monoxide levels.
  - Reserve air systems to provide back-up air in the case of compressor failure.
- Compressed oxygen shall **not** be used in open circuit atmosphere supplying respirators.

**Note:** Compressors used for pneumatic tools must not be used for supplied air systems. The air contains carbon monoxide, making it unbreathable and dangerous.

## TRAINING

The respiratory protection standard requires that the employer provide effective training to workers who are required to use respirators. Training must be:

- Given to workers before they begin using respirators
- Understandable to the worker
- Comprehensive enough that it covers all required items
- Provided annually or more often if necessary

Workers who voluntarily wear a respirator shall be given the information located in 29 CFR 1910.134 appendix D. This information can be given written or verbally.

An employer must ensure that workers can demonstrate knowledge in the following topics:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator.
- Limitations and capabilities of the respirator.
- How to use the respirator in an emergency situation.
- How to inspect, don, doff, use, and seal check the respirator.
- Procedures for maintaining and storing the respirator.
- How to recognize medical signs and symptoms that may limit or prevent the effective use of the respirator.

Retraining shall be done every year, or sooner, for the following reasons:

- Changes in the workplace or type of respirator render the old training ineffective.
- A worker does not retain information from the initial course.
- Any other situation occurs in which retraining appears necessary to ensure safe respirator use.

## **PROGRAM EVALUATION**

The employer is required to evaluate the written respiratory protection program as necessary to ensure it is being properly implemented and is effective. The evaluation shall include consulting workers who use respirators for their views on program effectiveness as well as problems.

**RECORDKEEPING**

The employer has to establish and retain written information regarding the following:

- Exposure assessments
- Medical evaluations
- Respirator inspections
- Written respirator program

**Fit Testing Records**

Qualitative and quantitative fit testing records must also be kept. They must be retained until the worker's next fit test. These records shall contain the following information:

- Name of the worker tested
- Type of fit test performed
- Make, model style, and size of the respirator tested
- Test date
- Test results -
  - Pass/fail results of qualitative fit tests
  - Fit factor and strip chart recording
  - Other recordings of the test results for QNFTs

**Training Records**

Written documentation of worker respirator training and respirator program evaluation results shall also be maintained.



---

**SECTION 3 - ASSIGNMENT SHEET**

1. Define the following terms:

Qualitative fit test

---

---

Quantitative fit test

---

---

Service life

---

---

2. Write out the following acronyms:

ESLI \_\_\_\_\_

IDLH \_\_\_\_\_

QLFT \_\_\_\_\_

QNFT \_\_\_\_\_

RPA \_\_\_\_\_

3. Identify OSHA's requirement for reducing exposure level to below the PEL.

---

---

4. List the nine required topics of a respiratory protection program.

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

5. Identify where information on voluntary respirator use is found.

---

---

6. Identify who receives a copy of the PLHCP written opinion.

---

---

7. State how often a fit test must be given.

---

---



8. List the conditions that prevent a good face-to-facepiece seal.

---

---

---

---

---

---

9. Identify the two common procedures used to check a facepiece seal.

---

---

10. Explain when workers should leave the work area.

---

---

---

---

---

---

---

---

11. State when a respirator must be inspected.

---

---

12. List the topics in which the employer must ensure that workers can demonstrate knowledge.

---

---

---

---

---



# RESPIRATORY PROTECTION

Section

**4**

Title

**STANDARD OPERATING  
PROCEDURES**

## Standard Operating Procedures

1. Inspect a half-face APR.  
Don a half-face APR.  
Perform a negative pressure user seal check with a half-face APR.  
Perform a positive pressure user seal check with a half-face APR.  
Clean, sanitize and maintain a half-face APR.
2. Inspect a full-face APR.  
Don a full-face APR.  
Perform a negative pressure user seal check with a full-face APR.  
Perform a positive pressure user seal check with a full-face APR.
3. Clean, sanitize, and maintain a full-face APR.
4. Complete an irritant smoke or isoamyl acetate qualitative fit test.
5. Inspect an SAR.  
Store an SAR.  
Don a facepiece.  
Perform user seal checks.  
Don a supplied air respirator.
6. Inspect an SCBA.  
Store an SCBA.  
Don the SCBA.  
Don the facepiece.  
Perform user seal checks.
7. Refill a 2216 psi SCBA cylinder with a cascade charging system.



---

**STANDARD OPERATING PROCEDURE 1****Half-Face APR**

- A. Inspect the half-face APR. Check all parts for signs of dirt, wear, tears, and integrity. Ensure all parts can and will work properly by checking the following respirator parts or components.
1. General appearance (no deformities)
  2. Harness and strap assemblies
  3. Facepiece seal area
  4. Nose cup
  5. Inhalation valves
  6. Exhalation valve, valve seats and cover
  7. Filter or cartridge holder and gaskets
  8. Filter(s) or cartridge(s)
- B. Don a half-face APR.
1. Inspect the respirator.
  2. Install proper filter(s) or cartridge(s).
  3. Loosen the harness assembly completely.
  4. Hang the facepiece around the neck using the neck strap (if available).
  5. Raise the facepiece upward and open exposing the chin and nose cup.
  6. Place chin in the chin cup and pull the harness over the top of the head.  
Make sure there is no hair or other obstructions between the face and facepiece.
  7. Tighten the bottom two harness straps (not too tight).
  8. Tighten the top strap slightly.
  9. Adjust facepiece if needed.
- C. Perform user seal checks with the half-face APR.

**Negative pressure user seal check:**

1. Inspect the respirator.
2. Don the respirator.
3. Cover the filter or cartridge inlet openings. You can use the palms of your hands, duct tape, plastic wrap, or surgeon's gloves.
4. Inhale so the facepiece collapses inward. Hold for ten seconds.
5. If the facepiece stays collapsed, continue with step 7.
6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
7. Uncover the filter or cartridge inlets.

**Positive pressure user seal check:**

1. Inspect the respirator.
2. Don the respirator.
3. Cover the exhalation outlet. You can use the palm of your hand, duct tape, plastic wrap, or surgeon's gloves.
4. Exhale so the facepiece is enlarged slightly. Hold for ten seconds.
5. If the facepiece stays enlarged, continue with step 7.
6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
7. Uncover the exhalation outlet.

**D. Clean, sanitize, and maintain a half-face APR.**

1. Remove and properly discard filters and/or cartridges.
2. Immerse the respirator in a warm (about 120°F/49°C) solution of germicidal or disinfecting detergent.
3. Scrub the respirator body and parts gently with a cloth or soft brush.
4. Rinse in clean, warm (about 120°F/49°C) water.
5. Shake gently to remove excess water. It may be necessary to tip the respirator in several directions.
6. Wipe the respirator with a soft, clean cloth (if available) or allow to air dry away from direct heat or sunlight.
7. Inspect the respirator.
8. Replace all damaged or missing parts according to the manufacturer's instructions.
9. Loosen harness straps.
10. Place respirator in a clean bag, box, or appropriate storage area. The storage area should be in a cool, dry place. Do not place any weight on the respirator.

---

**STANDARD OPERATING PROCEDURE 2****Full-Face APR**

- A. Inspect a full-face APR. Check for signs of wear and dirt, as well as integrity. Check the following parts to ensure they work properly.
1. Overall general appearance (no deformities).
  2. Harness assembly and connections.
  3. Lens and lens gasket.
  4. Facepiece seal area.
  5. Inner nose cup (if applicable).
  6. Inhalation valves and their seating surfaces.
  7. Exhalation valves and their seating surfaces.
  8. Filter or cartridge holder and gaskets.
  9. Filter(s) or cartridge(s).
- B. Don a full-face APR.
1. Inspect the respirator.
  2. Install proper filter(s) or cartridge(s).
  3. Loosen the harness assembly completely.
  4. Hang the facepiece around the neck using the neck strap (if available).
  5. Raise the facepiece upward and open to expose the chin and nose cup.
  6. Place chin in the chin cup and pull the harness over the top of the head. Make sure no hair or other obstructions are between the face and facepiece.
  7. Tighten the bottom harness straps. Do not overtighten.
  8. Tighten the middle two harness straps.
  9. Tighten the top strap slightly.
  10. Adjust the facepiece if needed. It should be centered on the face.
- C. Perform user seal checks with a full-face APR.

**Negative pressure user seal check:**

1. Inspect the respirator.
2. Don the respirator.
3. Cover the filter or cartridge inlet openings. You can use the palms of your hands, duct tape, plastic wrap, or surgeon's gloves.
4. Inhale so the facepiece collapses inward. Hold for ten seconds.
5. If the facepiece stays collapsed, go to step 7.
6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
7. Uncover the filter or cartridge inlets.

**Positive pressure user seal check:**

1. Inspect the respirator.
2. Don the respirator.
3. Cover the exhalation outlet. You can use the palm of your hand, duct tape, plastic wrap, or surgeon's gloves.
4. Exhale so that the facepiece is enlarged slightly. Hold for 10 seconds.
5. If the facepiece stays enlarged, go to step 7.
6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
7. Uncover the exhalation outlet.

**D. Clean, sanitize, and maintain a full-face APR using the following steps.**

1. Remove and properly discard filters and/or cartridges.
2. Immerse the respirator in a warm (about 120°F/49°C) solution of germicidal or disinfecting detergent.
3. Scrub respirator body and parts gently with a cloth or soft brush.
4. Rinse in clean, warm (about 120°F/49°C) water.
5. Shake gently to remove excess water. It may be necessary to tip the respirator several directions.
6. Wipe the lens and respirator with a soft, clean cloth (if available) or allow to air dry away from direct heat or sunlight.
7. Inspect the respirator.
8. Replace all damaged or missing parts according to the manufacturer's instructions.
9. Loosen harness straps.
10. Place respirator in a clean bag, box, or appropriate storage area. The storage area should be in a cool, dry place. Do not place any weight on the respirator.



---

**STANDARD OPERATING PROCEDURE 3****Qualitative Fit Test**

- A. Complete an irritant smoke or isoamyl acetate qualitative fit test using the following steps:

**Irritant smoke:**

1. Smell a weak concentration of the test agent.
2. Inspect the respirator.
3. Don the respirator.
4. Perform a negative pressure user seal check.
5. Perform a positive pressure user seal check.
6. Wear the respirator for at least 5 minutes.
7. Close your eyes if wearing a half-face APR.
8. Breathe normally.
9. Breathe deeply. Breaths must be deep and regular.
10. Turn head from side to side.
11. Nod head up and down.
12. Read the rainbow passage.
13. Bend over or jog in place.
14. Breathe normally.
15. If the test agent is detected, leave the test chamber and readjust the mask. Repeat steps 4 through 15.
16. If the test agent is still detected, select another size or make of respirator. Repeat steps 2 through 15.
17. Clean, sanitize, and maintain the respirator.

**Isoamyl acetate (banana oil):**

1. Read the following instructions that will be typed on a card and placed on the table in front of the two test jars (1 and 2).

“The purpose of this test is to determine if you can smell isoamyl acetate at a low concentration. The two jars in front of you contain water. One of these jars also contains a small amount of isoamyl acetate. Be sure the covers are on tight, then shake each jar for two seconds. Unscrew the lid of each jar, one at a time, and sniff at the mouth of the jar. Indicate to the test conductor which jar contains isoamyl acetate.”

2. Make sure each of the covers are on tight and shake each jar for two seconds.
3. Unscrew the lid of each jar one at a time and sniff at the mouth of the jar.

4. Indicate to the person conducting the test which jar contains the banana oil.
5. The IAA QLFT cannot be used if you are unable to correctly identify the jar containing the odor test solution.
6. If you correctly identify the odor test solution, proceed to step 7.
7. Select the most comfortable respirator from the various sizes and manufacturers.
  - Hold each facepiece up to your face.
  - Eliminate those facepieces that obviously will not fit comfortably.

Normally, you will begin by looking at half facepieces. If a fit cannot be found, go to the full facepieces. (A small percentage of users will not be able to wear any half facepieces.) Each respirator represents a different size and shape, and if fitted properly, will provide adequate protection. The selection process shall be conducted in a room separate from the fit test chamber to prevent odor fatigue. A mirror shall be available to assist you in evaluating the fit and position of the respirator.

8. Inspect the chosen respirator. Make sure it is equipped with organic vapor cartridges. Don and wear the most comfortable facepiece for at least five minutes to assess comfort. Assess comfort by discussing and reviewing the following points with your instructor(s).
  - Chin properly placed
  - Positioning of mask on nose
  - Strap tension
  - Fit across nose bridge
  - Room for safety glasses
  - Distance from nose to chin
  - Room to talk
  - Tendency to slip
  - Cheeks filled out
  - Self-observation in mirror
  - Adequate time for assessment
9. If you are not familiar with using a particular respirator, your instructor(s) will help you inspect the respirator, don the facepiece several times, and adjust the straps so you set the proper tension on the straps.
10. After selecting, donning, and properly adjusting a respirator, “seat” the facepiece. Move your head from side to side and up and down. Take a few deep breaths.
11. Conduct either negative and positive pressure user seal checks or manufacturer seal checks.

12. Wear the respirator at least 5 minutes before starting the fit test.
13. Enter the fit test chamber and do the following:
  - Get a 6 x 5-inch piece of paper towel or other porous absorbent single-ply material.
  - Fold the material in half.
  - Wet three-quarters of the material with 1 cc of pure IAA from the instructor.
  - Hang the wet towel on the hook at the top of the fit test chamber.
14. Allow two minutes for the IAA test concentration to be reached before starting the fit testing exercises. Use this time to:
  - Read the test exercises that are taped to the inside of the test chamber.
  - Ask the instructor(s) questions or have the exercises demonstrated.
15. Perform the following test exercises for at least one minute each.

**Test exercises:**

- a. Normal breathing.
- b. Deep breathing. Be certain breaths are deep and regular.
- c. Turn your head from side to side. Inhale at each side. Be sure movement is complete. Do not bump the respirator on your shoulders. Inhale when your head is at either side.
- d. Nod head up and down. Be certain motions are complete and made about every second. Do not bump the respirator on your chest. Inhale when your head is in the full up position.
- e. Talking. Talk aloud and slowly for several minutes. Read the rainbow passage (shown below). Reading the passage results in a wide range of facial movements and satisfies this requirement.

“When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.”

- f. Bend over. Bend at the waist as if trying to touch your toes. Jogging in place can be substituted in those test environments that do not allow for bending at the waist. You can substitute jogging in place if the fit test chamber is too small for bending over.
  - g. Normal breathing. Same as test exercise “a.”
16. If at any time during the test, you detect the banana-like odor of IAA, quickly exit the test chamber and leave the test area to avoid olfactory fatigue.
  17. If you have detected the odor, return to the selection room and remove the respirator. Repeat the odor sensitivity test and select another respirator. If you cannot be fitted with the selection of half-mask respirators, include full facepiece models in your selection process. Return to the test by starting at step 8 above.
  18. If you complete the test without detecting the banana-like odor, break the face seal and take a breath before exiting the chamber. This demonstrates the efficiency of the respirator.
  19. Remove the saturated towel from the hook, leave the test chamber, and return the towel to the instructor(s).
  20. If you successfully passed this fit test, you may be assigned the use of the tested respirator in atmospheres up to 10 times the PEL. In other words, this IAA protocol may be used to assign a protection factor of 10 and no higher.
  21. After passing the fit test, assess the comfort of the respirator by using the steps outlined above. If it has become uncomfortable, another model of respirator shall be tried and tested.

---

**STANDARD OPERATING PROCEDURE 4****SAR**

- A. Inspect the SAR. Before an SAR can be used, it must be properly inspected to prevent malfunctions during use. The specific manufacturer's instructions shall always be followed. However, the following inspection criteria is a general guideline for proper inspection and donning of a pressure-demand SAR.

**Air source and airline inspection:**

1. Ensure breathing air source (high pressure air cylinders or air compressors) meets the requirements of the ANSI/Compressed Gas Association Specification G-7.1-1989 for Quality Verification Level (Grade) D Breathable Air.
2. Connect the pressure gauge to the air source. A multi-user manifold can be added to accommodate multiple users.
3. Operating air pressure from the high pressure gauge to the respirator regulator must range from 60 to 100 *psig*. This range ensures there is a consistent flow of 4 *cfm* to the facepiece for tight fitting facepieces and 6 *cfm* for loose fitting hoods.
4. Inspect the airline for cuts, severe abrasions, and chemical degradation.
5. Check to ensure all air line connection assemblies are in working order.

**Harness assembly inspection:**

1. Inspect straps for complete set.
2. Inspect straps for frayed or damaged straps.
3. Inspect buckles for mating ends.
4. Check buckle locking function.
6. Inspect the emergency-escape cylinder hold-down strap, check strap tightener and lock to assure that it is fully engaged.

**Cylinder inspection (emergency-escape):**

1. Check cylinder pressure. It should be 3000 *psig*.
2. Check hydrostatic test date to ensure it is current.
3. Inspect the cylinder gauge for condition of face, needle, and lens. Make sure the gauge face and gauge needle are visible and not bent.
4. Inspect cylinder for large dents or gouges in the metal. If cylinder is less than full, charge the cylinder before use or storage.
5. Check to ensure that cylinder is tightly fastened to harness.

**Facepiece inspection:**

1. Inspect facepiece head harness for damaged serrations and deteriorated rubber. Inspect rubber facepiece body for signs of deterioration or extreme distortion.
2. Inspect the lens for proper seal in rubber facepiece, retaining clamp properly in place, and absence of cracks or large scratches.
3. Inspect exhalation valve for visible deterioration or buildup of foreign materials. Exhalation valve should be clean and operating easily. The valve must move off the seat and return to its original location. If the valve and spring do not perform in this way, the entire exhalation assembly needs to be replaced.
4. Inspect the facepiece coupling for damage. Check to be sure the breathing hose and regulator will fit properly on facepiece.

**Breathing tube and connector inspection** (if applicable):

1. Inspect breathing tube for perforations, small cracks, or signs of wear. Pay close attention along the corrugations.
  2. Check the breathing tube for leaks. Block one end with your hand or a stopper. Stretch the breathing tube 10 to 12 inches (254 to 304.8 mm) beyond its original length. Close off the other end of the breathing tube with your hand or stopper. Release the tension on the breathing tube, air should compress in the tube. If tube does not compress, this indicates there is a leak.
  3. Inspect the connector to ensure good condition of threads and for presence and proper condition of rubber gasket seals.
- B. Store the SAR. If the above mentioned inspection criteria is not met, then the SAR unit should be set aside for repair by a certified technician.
1. Refill emergency-escape cylinder as necessary. Clean and inspect unit.
  2. Close cylinder valve.
  3. Loosen all straps completely and lay straight.
  4. Store facepiece properly to protect against dust, direct sunlight, extreme temperatures, excessive moisture, and damaging chemicals, or stored in a carrying case available from the manufacturer or suitable storage location so it can be easily reached.

- C. Don the facepiece.
1. Inspect the respirator.
  2. Loosen the harness assembly completely.
  3. Hang the facepiece around your neck by the neck strap (if available).
  4. Raise the facepiece upward and open to expose the chin and nose cup.
  5. Place your chin in the chin cup and pull the harness over the top of your head. Be sure no hair or other obstruction is between your face and the facepiece.
  6. Tighten the bottom harness straps by pulling them back, not out. Do not over tighten.
  7. Tighten the middle two harness straps by pulling them back, not out.
  8. Tighten the top strap slightly.
  9. Adjust the facepiece if needed. It should be centered on your face.
- D. Perform user seal checks. User seal checks must be done each time you don a facepiece.

**Negative pressure user seal check:**

1. Block off the breathing tube or cover the inlet connection and inhale. Hold your breathe for 10 seconds. The facepiece should collapse and remain collapsed against your face.
2. If the facepiece does not remain collapsed, or you notice any leakage, readjust the straps and test again.

**Positive pressure user seal check:**

1. To test the exhalation valve:
  - Take a deep breath with the breathing tube blocked or inlet connection covered.
  - Exhale. If the valve is stuck, you will feel a heavy rush of air around the facepiece. You may need a sharp exhalation at first to crack the valve.
2. If the valve does not release, do not use the facepiece.

- E. Don the SAR.
1. Check the pressure reading on the cylinder gauge. The needle should be on the full indicator. If it is not, replace the cylinder with a fully charged cylinder before using.
  2. Place the facepiece out of the way.
  3. Fasten the shoulder harness using the adjustable strap.
  4. Fasten the seat belt type buckle on the waist strap and pull the waist strap tight. Tuck in the waist strap so it is out of the way.
  5. Attach the breathing tube or mask-mounted regulator to the facepiece.
  6. Connect the air supply hose to the inlet of the regulator. Inhale. Air should start to flow from the regulator.
- F. Clean, maintain, and store a full-face atmosphere supplying respirator using the following steps:
1. Turn off the positive pressure.
  2. If needed, clean the apparatus with a brush and mild detergent.
  3. Rinse well and towel or air dry.
  4. Unscrew the breathing hose at the manifold end.
  5. Remove the cover on the facepiece by unscrewing the two screws and pulling off the cover.
  6. Remove the breathing valve by twisting the valve clockwise, disconnecting the bayonet coupling.
  7. Cover the inhalation side of the valve with your thumb and immerse the breathing valve in a warm (about 120°F/49°C) solution of germicidal or disinfecting detergent. Do **not** allow water into the inhalation side of the valve!
  8. Cover the inhalation side of the valve again. Immerse the breathing valve in clean warm water and rinse.
  9. Gently shake the valve to remove excess water. Wipe with a clean soft cloth or allow to air dry.



10. Immerse the facepiece in the warm germicidal or disinfecting solution.
11. Gently scrub with a cloth or soft brush.
12. Rinse in clean warm water.
13. Shake gently to remove excess water.
14. Wipe the lens and facepiece with a soft cloth or allow to air dry. Keep it away from direct heat or sunlight.
15. Inspect the air line respirator and facepiece.
16. Connect the breathing valve to the facepiece by pushing and turning counterclockwise to engage the bayonet coupling.
17. Lock the breathing valve in position with the cover, speech diaphragm, or radio attachment by tightening the locking screws.
18. Connect the breathing hose to the manifold.
19. Store the apparatus in its case or in a clean, dry, dust-free area.



---

**STANDARD OPERATING PROCEDURE 5****SCBA**

- A. Inspect the SCBA. Before an SCBA can be used, it must be properly inspected to prevent malfunctions during use. The specific manufacturer's instructions shall always be followed. However, the following inspection criteria is a general guideline for proper inspection of a pressure-demand SCBA.

**Back pack and harness assembly inspection:**

1. Inspect straps for complete set.
2. Inspect straps for frayed or damaged straps.
3. Inspect buckles for mating ends.
4. Check buckle locking function.
5. Inspect back plate for cracks and missing rivets or screws.
6. Inspect the cylinder hold-down strap. Check strap tightener and lock to ensure it is fully engaged.

**Cylinder inspection:**

1. Check cylinder pressure. It should be 2216 or 4500 psig.
2. Check hydrostatic test date to ensure it is current.
3. Inspect the cylinder gauge for condition of face, needle, and lens. Make sure that gauge face and gauge needle are visible and not bent.
4. Inspect cylinder for large dents or gouges in the metal. If cylinder is less than full, charge the cylinder before use or storage.
5. Check to ensure that cylinder is tightly fastened to back plate.

**Regulator and alarm inspection:**

1. Inspect the regulator pressure gauge. Be sure the gauge needle and face are visible through the lens. Make sure the gauge stem is not bent.
2. Check the gauge with the regulator pressurized to ensure it is working.
3. Compare the gauge pressure with the cylinder gauge. It should be within 220 psig for 2216 psig cylinders, 300 psig for 3000 cylinders, or 450 psig for 4500 psig cylinders.
4. Check the regulator outlet. Look for stripped or damaged threads.
5. Check to ensure the regulator outlet is not covered or obstructed. Open and close the bypass valve momentarily to ensure air flow through the by-pass system.

6. Cover the regulator outlet with palm of your hand or the cap provided. Open mainline valve fully and read regulator gauge. It should be within 220 psig for 2216 psig cylinders, 300 psig for 3000 psig cylinders, or 450 psig for 4500 psig cylinders. The alarm or bell should ring when the mainline valve is opened and the respirator is pressurized.
7. Close the cylinder valve. Watch the regulator gauge. If the regulator assembly is leak tight, the gauge needle will not move. If the needle drops more than 100 psig in a few seconds (10 to 15 seconds), do not use the SCBA unit until it has been serviced.
8. Slowly uncover the regulator outlet and watch the needle drop. Gauge should begin to show immediate loss of pressure as the air flows. Low-pressure alarm should sound between 520 and 480 psig for 2216 psig cylinders and at 1000 psig for a 4500 psig cylinder.

**Facepiece inspection:**

1. Inspect the facepiece head harness for damaged serrations and deteriorated rubber. Inspect the rubber facepiece body for signs of deterioration or extreme distortion.
2. Inspect the lens for proper seal in rubber facepiece, retaining clamp properly in place, and absence of cracks or large scratches.
3. Inspect exhalation valve for visible deterioration or build-up of foreign materials. Exhalation valve should be clean and operating easily. The valve must move off the seat and return to its original location. If the valve and spring do not perform in this way, the entire exhalation assembly needs to be replaced.
4. Inspect the facepiece coupling for damage. Check to be sure breathing hose or regulator will fit properly on facepiece.

**Breathing tube and connector inspection (if applicable):**

1. Inspect breathing tube for perforations, small cracks, or signs of wear. Pay close attention along the corrugations.
2. Check the breathing tube for leaks. Block one end with your hand or a stopper. Stretch the breathing tube 10 to 12 inches (254 to 304.8 mm) beyond its original length. Close off the other end of the breathing tube with your hand or stopper. Release the tension on the breathing tube, air should compress in the tube. If tube does not compress, it has a leak.

3. Inspect connector to ensure good condition of threads and for presence and proper condition of rubber gasket seals.
- B. Store the pressure demand SCBA. If the above mentioned inspection criteria is not met, then the SCBA unit should be set aside for repair by a certified technician.
1. Refill the cylinder as necessary. Clean and inspect the unit.
  2. Close cylinder valve.
  3. Tighten high-pressure hose connector on cylinder.
  4. Bleed pressure off of high-pressure hose and regulator.
  5. Close bypass valve.
  6. Close mainline valve.
  7. Loosen all straps completely and lay straight.
  8. Store facepiece properly to protect against dust, direct sunlight, extreme temperatures, excessive moisture, and damaging chemicals, or stored in a carrying case available from the manufacturer or suitable storage location so it can be easily reached.
- C. Don the SCBA.
1. Check the pressure reading on the cylinder gauge. The needle should be on the full indicator. If it is not, replace the cylinder with a fully charged cylinder before using.
  2. Place the facepiece out of the way.
  3. Put your arms through the shoulder pads.
  4. Bend forward slightly at the hips so the cylinder rests on your back.
  5. Attach the chest strap.
  6. Grasp the adjustable pull straps. Pull them out as you move into an upright position. Twist your body slightly to hike the harness up onto your shoulders, like a backpack.
  7. Fasten the seat belt type buckle on the waist strap over the adjustable pull straps. Pull the waist strap tight. Tuck in the waist and shoulder straps so they are out of the way.
  8. If you are using an SCBA with a belt mounted regulator, position the regulator so you can easily reach the main-line and by-pass valves as well as read the regulator pressure gauge.

- D. Don the facepiece.
1. Inspect the respirator.
  2. Loosen the harness assembly completely.
  3. Hang the facepiece around the neck by the neck strap (if available).
  4. Raise the facepiece upward and open to expose the chin and nose cup.
  5. Place your chin in the chin cup and pull the harness over the top of your head. Make sure no hair or other obstruction is between your face and the facepiece.
  6. Tighten the bottom harness straps by pulling them back, not out. Do not over tighten.
  7. Tighten the middle two harness straps by pulling them back, not out.
  8. Tighten the top strap slightly.
  9. Adjust the facepiece if needed. It should be centered on the face.
- E. Perform user seal checks. User seal checks must be done each time you don a facepiece.

**Negative pressure user seal check:**

1. Block off the breathing tube or cover the inlet connection and inhale. Hold your breathe for 10 seconds. The facepiece should collapse and remain collapsed against your face.
2. If the facepiece does not remain collapsed, or you notice any leakage, readjust the straps and test again.

**Positive pressure user seal check:**

1. To test the exhalation valve:
  - Take a deep breath with the breathing tube blocked or inlet connection covered.
  - Exhale. If the valve is stuck, you will feel a heavy rush of air around the facepiece. You may need a sharp exhalation at first to crack the valve.
2. If the valve does not release, do not use the facepiece.

---

**STANDARD OPERATING PROCEDURE 6****Refill SCBA Cylinder**

- A. Refill a 2216 psi SCBA cylinder with a cascade charging system using the following steps:
1. Check all connections to make sure there are no leaks.
  2. Inspect the cylinder for signs of excessive wear or abuse. Check the hydrostatic test date. Do not refill it if there is a doubt.
  3. Make sure the tanks are numbered properly (1, 2, 3, and 4, with 4 having the highest pressure).
  4. Attach the cascade system coupling to the cylinder. (The cylinder may be immersed in water. Follow the manufacturer's recommendations. Filling the tanks slowly will prevent overheating).
  5. Open the cylinder valve.
  6. Slowly open tank number 1 until the tank pressure and cylinder pressure equalize, (i.e., no rushing air can be heard).
  7. Close tank 1.
  8. If the cylinder pressure is not full, slowly open tank 2. (If the cylinder pressure reaches full, close tank 2 and go to step 21.) Listen until no air flow can be heard.
  9. Close tank 2.
  10. Slowly open tank 3. (Watch the cylinder gauge or pressure gauge.) If the pressure reaches full, close the tank and go to step 21. Listen until no air flow can be heard.
  11. Close tank 3.
  12. Slowly open tank 4. (Again, watch the cylinder gauge or pressure gauge. If the pressure reaches full, close the tank and go to step 21). Listen until no air flow can be heard.
  13. Close tank 4.
  14. If the cylinder pressure is still not full, you must replace tank 1 with a new tank. Make sure all fittings are tight.
  15. Number the new tank #4.
  16. Number tank 2 #1.
  17. Number tank 3 #2.
  18. Number tank 4 #3.
  19. Open tank #4 (new tank) until the cylinder pressure reads full.
  20. Close tank #4.
  21. Close the cylinder valve.
  22. Bleed the pressure from the lines with the bleed valve.
  23. If at any time the cylinder valve pressure and the pressure gauge on the cascade system do not equalize, remove all equipment from service and have repaired according to the manufacturer's recommendation.







# RESPIRATORY PROTECTION

Section

## Appendixes

Title

<b>APPENDIX A - RESPIRATOR DECISION LOGIC</b> .....	A-3
<b>APPENDIX B - INSPECTION GUIDELINES</b> .....	A-9
<b>APPENDIX C - RESPIRATOR INFORMATION</b> .....	A-12

# Appendix

---

---

**APPENDIX A  
RESPIRATOR DECISION LOGIC**

The questions listed below are summarized from the Respirator Decision Logic document. They should be followed in sequence, while using the criteria information that has been gathered to select the proper respirator.

- 1. Is the respirator to be used for firefighting?**
  - a. If yes, use a full facepiece SCBA operated in a pressure demand mode.
  - b. If no, go to step 2.
- 2. Will the respirator be used in an oxygen-deficient atmosphere?**
  - a. If yes, any type SCBA or SAR with escape SCBA can be used.
  - b. If no, go to step 3.
- 3. Will the respirator be used in emergency situations?**
  - a. If yes, use a full facepiece SCBA operated in a pressure demand mode or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.
  - b. If no, go to step 4.
- 4. Is the contaminant a carcinogen?**
  - a. If yes, use a full facepiece SCBA operated in pressure demand mode, or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.
  - b. If no, go to step 5.
- 5. Is the contaminant exposure level less than the OSHA PEL or NIOSH REL?**
  - a. If yes, a respirator is not required except for escape. Go to step 7.
  - b. If no, go to step 6.

**6. Is contaminant exposure level less than IDLH concentration?**

- a. If yes, go to step 7.
- b. If no, conditions are IDLH. Use a full facepiece SCBA operated in pressure demand mode or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.

**7. Is the contaminant an eye irritant?**

- a. If yes, a respirator with full facepiece, helmet, or hood is recommended. Go to step 8.
- b. If no, a half mask respirator may be used, depending on exposure concentration. Go to step 8.

**8. Determine the minimum PF that is required.**

Divide the measured exposure concentration of the contaminant by its OSHA or NIOSH exposure limit. For escape respirators, determine the potential for a hazardous condition to occur caused by an accident or equipment failure. Go to step 9.

- 9. If the contaminant is a particulate, go to step 10.  
If the contaminant is a gas or vapor, go to step 11.  
If the contaminant is a combination, go to step 12.**

**10. Particulate Respirators**

- 10.1 Is the particulate respirator to be used only for escape purposes?
  - a. If yes, use the table of NIOSH recommendations for escape respirators.
  - b. If no, the respirator will be used for normal work activities, go to step 10.2.
- 10.2 Determine the type of filter that should be used for the particulate contaminant. Go to step 10.3
- 10.3 Select a particulate respirator with a PF equal to or greater than the minimum PF calculated in step 8.

---

**11. Gas/Vapor Respirators**

- 11.1 Is the gas/vapor respirator to be used only for escape purposes?
  - a. If yes, use the table of NIOSH recommendations for escape respirators.
  - b. If no, the respirator will be used for normal work activities. Go to step 11.2.
- 11.2 Are the warning properties for the gas/vapor contaminant adequate at or below the exposure limit (PEL or REL)?
  - a. If yes, go to step 11.3.
  - b. If no, an APR equipped with an ESLI, an atmosphere supplying respirator, or an SCBA is recommended. Go to step 11.4.
- 11.3 An APR chemical cartridge/canister respirator is recommended. Go to step 11.4.
- 11.4 Select a gas/vapor respirator with a PF equal to or greater than the minimum PF calculated in step 8.

**12. Combination Particulate and Gas/Vapor Respirators**

- 12.1 Is the combination respirator to be used only for escape purposes?
  - a. If yes, use the table of NIOSH recommendations for escape respirators.
  - b. If no, the respirator will be used for normal work activities. Go to step 12.2.
- 12.2 Does the gas/vapor contaminant have adequate warning properties at or below the exposure limit (PEL or REL)?
  - a. If yes, go to step 12.3
  - b. If no, an APR equipped with an ESLI, an atmosphere supplying respirator, or a SCBA is recommended. Go to step 12.4.
- 12.3 Use an APR with chemical cartridge/canister that has a particulate pre-filter. Go to step 12.4.

- 12.4 Select a combination gas/vapor and particulate respirator with a PF equal to or greater than the minimum PF calculated in step 8.

The respirator decision flow chart is pictured in Figure 1. The chart helps the selector organize the information and keep track of the flow of questions in the sequence.

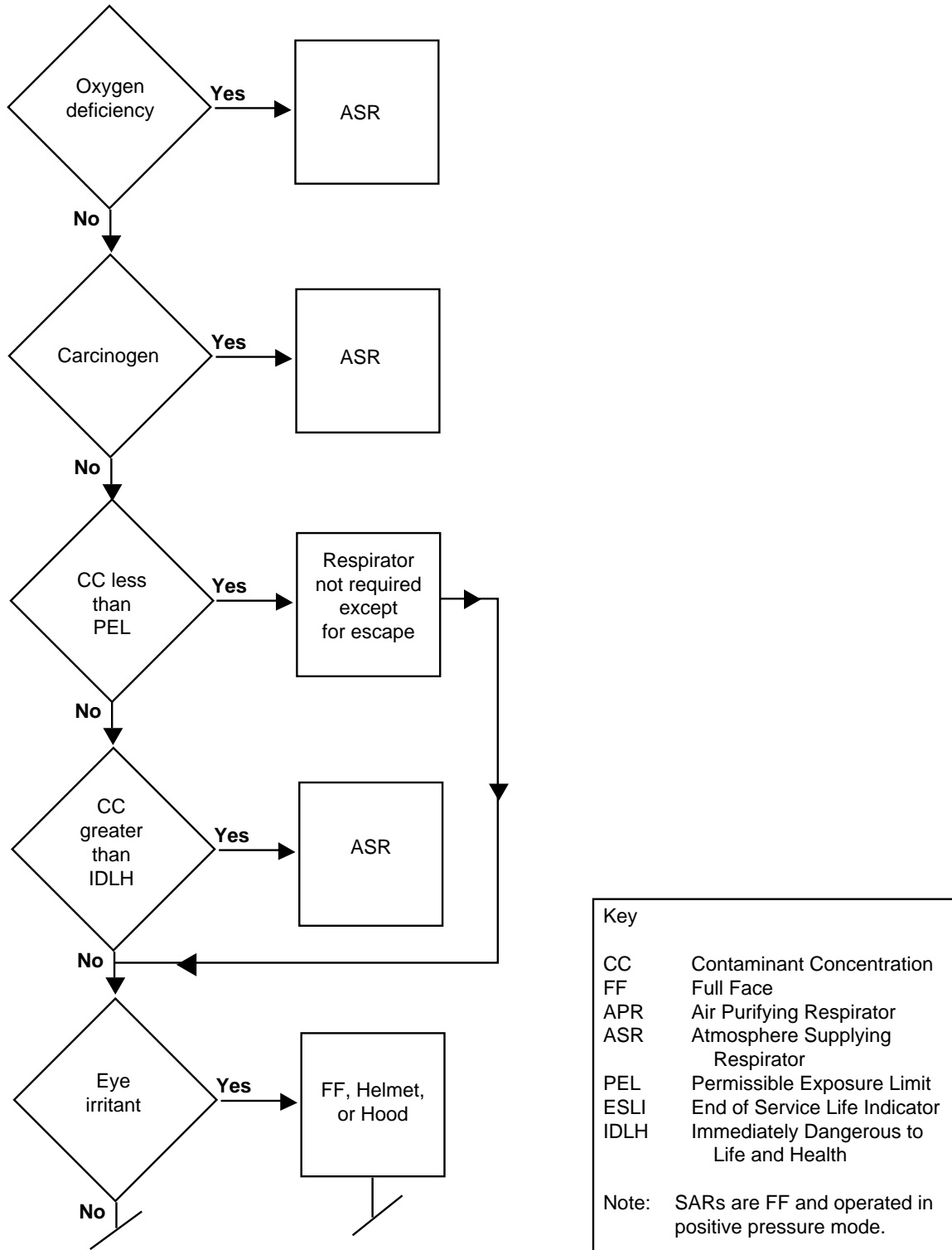


Figure 1. Respirator Decision Flow Chart

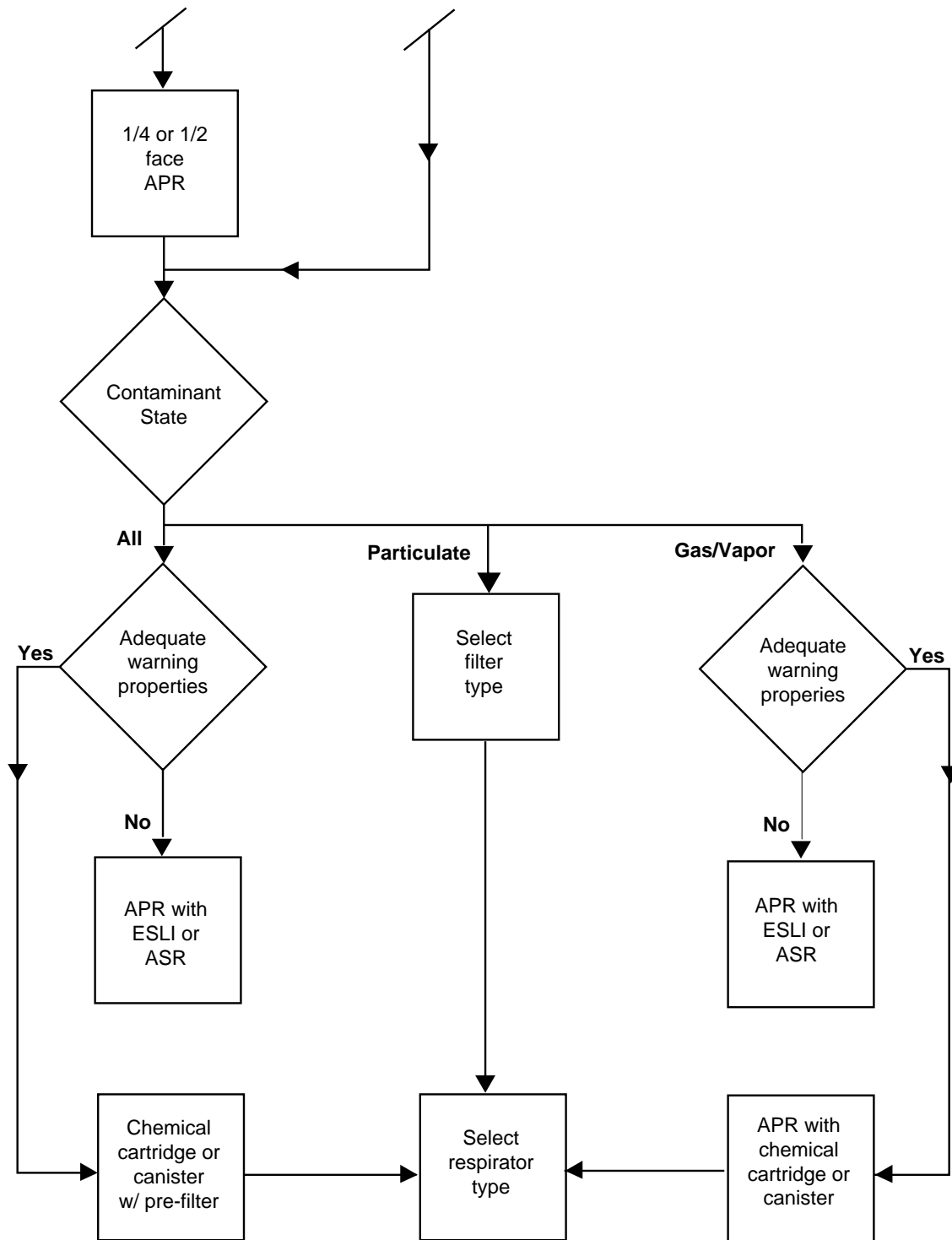


Figure 1. Respirator Decision Flow Chart (continued)



---

## APPENDIX B INSPECTION GUIDELINES

### SCBA Inspection Checkout

Before an SCBA can be used, it must be properly inspected to help prevent malfunctions during use. The specific manufacturer's instructions for the devices you use should always be followed. However the following checklist is a general guideline for proper inspection of a positive pressure, pressure-demand SCBA.

Prior to starting on the checklist, make sure of the following:

1. High pressure hose connector on the the cylinder fitting is tight.
2. By-pass valve is closed.
3. Mainline valve is closed.
4. Regulator outlet is not covered or obstructed.
5. Cylinder valve is closed.

### Checklist for Positive Pressure, Pressure-Demand SCBA

A. Backpack and harness assembly:

1. Visually inspect straps for complete set.
2. Visually inspect straps for frayed or damaged straps.
3. Visually inspect buckles for mating ends.
4. Physically check buckle locking function.
5. Visually inspect back plate for cracks and missing rivets or screws.
6. Visually inspect cylinder hold-down strap, physically check strap tightener and lock to assure that it is fully engaged.

B. Cylinder and cylinder valve assembly:

1. Physically check cylinder pressure. (Should be 2216 or 4500 psi.)
2. Physically check hydrostatic test date to assure it is current - monthly.
3. Visually inspect for large dents or gouges in the metal - monthly.
4. Physically check to ensure that it is tightly fastened to back plate.
5. If a fiberglass hoop-wrapped cylinder (4500 psi) is used, make sure it has a retrofitted steel cylinder neck ring.

---

C. Head and valve assembly:

1. Visually determine if the cylinder valve lock is present – monthly.
2. Visually inspect the cylinder gauge for condition of face, needle, and lens – monthly.
3. Open cylinder valve and listen or feel for leakage around packing. (If leakage is noted, do not use until repaired.) Note the functioning of the valve lock.

D. Regulator and high-pressure hose:

1. Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily indicate a faulty hose.)
2. Check to ensure that the regulator outlet is not covered or obstructed. Open and close by-pass valve momentarily to assure flow of air through the by-pass system.
3. Cover regulator outlet with palm of hand or cap provided. Open mainline valve and read regulator gauge. (The gauge must read at least 1,800 or 4,000 psi and not more than rated cylinder pressure.) The alarm or bell should ring when the mainline valve is opened, and the respirator is pressurized.
4. Close the cylinder valve and slowly bleed the emergency by-pass valve to allow air to flow slowly. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 520 and 480 psi or 25% of remaining air (1125 psi in a 4500 psi cylinder). This alarm is the second alarm or bell.
5. Cover regulator outlet with palm of hand or cap provided. Open mainline valve and read regulator gauge. (The gauge must read at least 1,800 or 4,000 psi and not more than rated cylinder pressure.) The alarm or bell should ring when the mainline valve is opened, and the respirator is pressurized. This is the third alarm or bell in a three-bell check.

---

**E. Facepiece and corrugated breathing tube:**

1. Visually inspect facepiece head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.
2. Visually inspect the lens for proper seal in rubber facepiece, retaining clamp properly in place, and absence of cracks or large scratches.
3. Visually inspect exhalation valve for visible deterioration or build-up of foreign materials.

**F. Breathing tube and connector:**

1. Stretch the breathing tube and visually inspect for deterioration and holes.
2. Visually inspect connector to assure good condition of threads and for presence and proper condition of rubber gasket seals.

If the above mentioned inspection criteria is not met, then the SCBA unit should be set aside for repair by a certified technician.

**Storage of Positive Pressure, Pressure-Demand SCBA Units**

1. Refill cylinder as necessary; clean and inspect unit.
2. Close cylinder valve.
3. Ensure high-pressure hose connector is tight on cylinder.
4. Bleed pressure off of high-pressure hose and regulator.
5. Close by-pass valve.
6. Close mainline valve.
7. Completely loosen all straps and lay straight.
8. Properly store the facepiece to protect it against dust, direct sunlight, extreme temperatures, excessive moisture, and damaging chemicals, or store in a carrying case (available from the manufacturer).

---

## APPENDIX C RESPIRATOR INFORMATION

### Protection Factors

Protection factor (PF) is a value assigned to a respirator based on its efficiency. If a respirator allows contaminants to leak around the face seal into the mask, it is less efficient.

The technical definition of PF is the concentration outside the respirator divided by the concentration that can get inside the respirator.

$$\text{PF} = \frac{\text{Concentration of contaminant outside the respirator}}{\text{Concentration inside the respirator}}$$

The practical definition of PF is how much of the outside contaminant level is reduced by the respirator.

- A respirator with a PF of 10 reduces exposure 10 times. The wearer is exposed to a concentration 1/10 of the outside concentration level.
- A respirator with a PF of 10,000 reduces exposure 10,000 times. The wearer is exposed to a concentration 1/10,000 of the outside concentration level.

A rule of thumb for protection factors is:

The lower the PF, the lower the protection.  
The higher the PF, the higher the protection.

### Maximum Use Concentrations

Using the PF and the OSHA Permissible Exposure Limit (PEL), you can determine the highest level at which a respirator can be safely used. This level is called the maximum use concentration (MUC). The MUC is the PF multiplied by the PEL.

$$\text{MUC} = \text{PF} \times \text{PEL}$$

Example: Calculate the MUC for nitric acid and half-face air purifying respirator (APR):

<b>OSHA PEL for nitric acid</b>	<b>=</b>	<b>2 ppm</b>
<b>PF of half-face APR</b>	<b>=</b>	<b>10</b>
<b>MUC</b>	<b>=</b>	<b>10 x 2</b>
<b>MUC</b>	<b>=</b>	<b>20 ppm</b>

A half-facepiece respirator cannot be used in nitric acid levels exceeding 20 ppm. At no time should a respirator be used in an environment that exceeds the MUC.

### **Respirator Selection**

The industrial hygienist selects the correct respirator based on the PF. If airborne chemical levels are high, there is a chance the respirator will not reduce the exposure enough. If this happens, the worker will be overexposed even wearing a respirator.

### **Example**

Workers are using half-facepiece respirators in an area where nitric acid levels are 50 ppm. Is this acceptable? No. The MUC for nitric acid and a half-face APR is 20 ppm.





# RESPIRATORY PROTECTION

Section

**Regulations**

Title

**29 CFR 1910.134**

<b>§1910.134</b>	<b>RESPIRATORY PROTECTION</b>	<b>R-3</b>
(a)	<b>Permissible practice</b>	<b>R-3</b>
(b)	<b>Definitions</b>	<b>R-3</b>
(c)	<b>Respiratory protection program</b>	<b>R-4</b>
(d)	<b>Selection of respirators</b>	<b>R-5</b>
(e)	<b>Medical evaluation</b>	<b>R-6</b>
(f)	<b>Fit testing</b>	<b>R-8</b>
(g)	<b>Use of respirators</b>	<b>R-9</b>
(h)	<b>Maintenance and care of respirators</b>	<b>R-10</b>
(i)	<b>Breathing air quality and use</b>	<b>R-11</b>
(j)	<b>Identification of filters, cartridges, and canisters</b>	<b>R-12</b>
(k)	<b>Training and information</b>	<b>R-12</b>
(l)	<b>Program evaluation</b>	<b>R-12</b>
(m)	<b>Recordkeeping</b>	<b>R-13</b>
(n)	<b>Dates</b>	<b>R-13</b>
(o)	<b>Appendices</b>	<b>R-13</b>
	<b>Appendix A to §1910.134: Fit Testing Procedures (Mandatory)</b>	<b>R-14</b>
	Part I. OSHA-Accepted Fit Test Protocols	<b>R-14</b>
	Part II. New Fit Test Protocols	<b>R-25</b>
	<b>Appendix B-1 to §1910.134: User Seal Check Procedures (Mandatory)</b>	<b>R-25</b>
	I. Facepiece Positive and/or Negative Pressure Checks	<b>R-25</b>
	II. Manufacturer's Recommended User Seal Check Procedures	<b>R-25</b>
	<b>Appendix B-2 to §1910.134: Respirator Cleaning Procedures (Mandatory)</b>	<b>R-26</b>
	I. Procedures for Cleaning Respirators	<b>R-26</b>
	<b>Appendix C to Sec. 1910.134: OSHA Respirator Medical Evaluation Questionnaire (Mandatory)</b>	<b>R-26</b>
	Part A. Section 1. (Mandatory)	<b>R-26</b>
	Part A. Section 2. (Mandatory)	<b>R-27</b>
	Part B.	<b>R-28</b>
	<b>Appendix D to Sec. 1910.134 (Mandatory) Information for Employees Using Respirators When Not Required Under the Standard</b>	<b>R-30</b>





**§1910.134 Respiratory Protection.**

This section applies to General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926).

**(a) Permissible practice.**

(1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the 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.

**(b) Definitions.**

The following definitions are important terms used in the respiratory protection standard in this section.

**Air-purifying respirator** means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

**Assigned protection factor (APF)**  
[Reserved]

**Atmosphere-supplying respirator** means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

**Canister or cartridge** means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

**Demand respirator** means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

**Emergency situation** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

**Employee exposure** means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

**End-of-service-life indicator (ESLI)** means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

**Escape-only respirator** means a respirator intended to be used only for emergency exit.

**Filter or air purifying element** means a component used in respirators to remove solid or liquid aerosols from the inspired air.

**Filtering facepiece (dust mask)** means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

**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 ambient air to its concentration inside the respirator when worn.

**Fit test** means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

**Helmet** means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

**High efficiency particulate air (HEPA) filter** means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

**Hood** means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

**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 from a dangerous atmosphere.

**Interior structural firefighting** means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)

**Loose-fitting facepiece** means a respiratory inlet covering that is designed to form a partial seal with the face.

**Maximum use concentration (MUC)**

[Reserved].

**Negative pressure respirator (tight fitting)** means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

**Oxygen deficient atmosphere** means an atmosphere with an oxygen content below 19.5% by volume.

**Physician or other licensed health care professional (PLHCP)** means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

**Positive pressure respirator** means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

**Powered air-purifying respirator (PAPR)** means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

**Pressure demand respirator** means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

**Qualitative fit test (QLFT)** means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

**Quantitative fit test (QNFT)** means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

**Respiratory inlet covering** means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

**Self-contained breathing apparatus (SCBA)** means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

**Service life** means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

**Supplied-air respirator (SAR) or airline respirator** means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

**This section** means this respiratory protection standard.

**Tight-fitting facepiece** means a respiratory inlet covering that forms a complete seal with the face.

**User seal check** means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

### (c) Respiratory protection program.

This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use.

The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator. The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

- (i) Procedures for selecting respirators for use in the workplace;
- (ii) Medical evaluations of employees required to use respirators;
- (iii) Fit testing procedures for tight-fitting respirators;
- (iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;
- (v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;
- (vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;
- (vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;
- (viii) Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and
- (ix) Procedures for regularly evaluating the effectiveness of the program.

(2) Where respirator use is not required:

- (i) An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section (“Information for Employees Using Respirators When Not Required Under the Standard”); and
- (ii) In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that

respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user.

Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

(3) The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

(4) The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

#### **(d) Selection of respirators.**

This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

##### **(1) General requirements.**

(i) The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

(ii) The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

(iii) The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant’s chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

(iv) The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

**(2) Respirators for IDLH atmospheres.**

(i) The employer shall provide the following respirators for employee use in IDLH atmospheres:

(A) A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

(B) A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

(ii) Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

(iii) All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

**(3) Respirators for atmospheres that are not IDLH.**

(i) The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

(A) Assigned Protection Factors (APFs)  
[Reserved]

(B) Maximum Use Concentration (MUC)  
[Reserved]

(ii) The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

(iii) For protection against gases and vapors, the employer shall provide:

(A) An atmosphere-supplying respirator, or

(B) An air-purifying respirator, provided that:

(1) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

(2) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis

for the canister and cartridge change schedule and the basis for reliance on the data.

(iv) For protection against particulates, the employer shall provide:

(A) An atmosphere-supplying respirator; or

(B) An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

(C) For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

TABLE I. -- Assigned Protection Factors [Reserved]

TABLE II

Altitude (ft.)	Oxygen deficient atmospheres (%O <sub>2</sub> ) for which the employer may rely on atmosphere-supplying respirators
Less than 3,001.....	16.0-19.5
3,001-4,000.....	16.4-19.5
4,001-5,000.....	17.1-19.5
5,001-6,000.....	17.8-19.5
6,001-7,000.....	18.5-19.5
7,001-8,000 <sup>1</sup> .....	19.3-19.5

<sup>1</sup>Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet.

**e) Medical evaluation.**

Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.

**(1) General.**

The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

**(2) Medical evaluation procedures.**

The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

(ii) The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

**(3) Follow-up medical examination.**

(i) The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

(ii) The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

**(4) Administration of the medical questionnaire and examinations.**

(i) The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

(ii) The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

**(5) Supplemental information for the PLHCP.**

(i) The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

(A) The type and weight of the respirator to be used by the employee;

(B) The duration and frequency of respirator use (including use for rescue and escape);

(C) The expected physical work effort;

(D) Additional protective clothing and equipment to be worn; and

(E) Temperature and humidity extremes that may be encountered.

(ii) Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

(iii) The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

**Note to Paragraph (e)(5)(iii):** When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

**(6) Medical determination.**

In determining the employee's ability to use a respirator, the employer shall:

(i) Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:

(A) Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

(B) The need, if any, for follow-up medical evaluations; and

(C) A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

(ii) If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

**(7) Additional medical evaluations.**

At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

- (i) An employee reports medical signs or symptoms that are related to ability to use a respirator;
- (ii) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;
- (iii) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or
- (iv) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

**(f) Fit testing.**

This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

(1) The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

(2) The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

(3) The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

(4) If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

(5) The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

(6) QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

(7) If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

(8) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

(i) Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

(ii) Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

(iii) Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

**(g) Use of respirators.**

This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

**(1) Facepiece seal protection.**

(i) The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

(A) Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

(B) Any condition that interferes with the face-to-facepiece seal or valve function.

(ii) If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

(iii) For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B-1 of this section.

**(2) Continuing respirator effectiveness.**

(i) Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

(ii) The employer shall ensure that employees leave the respirator use area:

(A) To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or

(B) If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or

(C) To replace the respirator or the filter, cartridge, or canister elements.

(iii) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.

**(3) Procedures for IDLH atmospheres.**

For all IDLH atmospheres, the employer shall ensure that:

(i) One employee or, when needed, more than one employee is located outside the IDLH atmosphere;

(ii) Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;

(iii) The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;

(iv) The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;

(v) The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;

(vi) Employee(s) located outside the IDLH atmospheres are equipped with:

(A) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either

(B) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or

(C) Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).

**(4) Procedures for interior structural firefighting.**

In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:

(i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

(ii) At least two employees are located outside the IDLH atmosphere; and

(iii) All employees engaged in interior structural firefighting use SCBAs.

**Note 1 to paragraph (g):** One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

**Note 2 to paragraph (g):** Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

#### **(h) Maintenance and care of respirators.**

This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

##### **(1) Cleaning and disinfecting.**

The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

(i) Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

(ii) Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

(iii) Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

(iv) Respirators used in fit testing and training shall be cleaned and disinfected after each use.

##### **(2) Storage.**

The employer shall ensure that respirators are stored as follows:

(i) All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

(ii) In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

(A) Kept accessible to the work area;

(B) Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

(C) Stored in accordance with any applicable manufacturer instructions.

##### **(3) Inspection.**

(i) The employer shall ensure that respirators are inspected as follows:

(A) All respirators used in routine situations shall be inspected before each use and during cleaning;

(B) All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

(C) Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

(ii) The employer shall ensure that respirator inspections include the following:

(A) A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and

(B) A check of elastomeric parts for pliability and signs of deterioration.

(iii) In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

(iv) For respirators maintained for emergency use, the employer shall:

(A) Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

(B) Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or



electronic files. This information shall be maintained until replaced following a subsequent certification.

**(4) Repairs.**

The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

(i) Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

(ii) Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

(iii) Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

**(i) Breathing air quality and use.**

This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

(1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

(i) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

(ii) Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

(A) Oxygen content (v/v) of 19.5-23.5%;

(B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

(C) Carbon monoxide (CO) content of 10 ppm or less;

(D) Carbon dioxide content of 1,000 ppm or less; and

(E) Lack of noticeable odor.

(2) The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

(3) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

(4) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

(i) Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 173 and part 178);

(ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

(iii) The moisture content in the cylinder does not exceed a dew point of -50 deg.F (-45.6 deg.C) at 1 atmosphere pressure.

(5) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

(i) Prevent entry of contaminated air into the air-supply system;

(ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 deg.C) below the ambient temperature;

(iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

(iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

(6) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

(7) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

(8) The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

(9) The employer shall use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

**(j) Identification of filters, cartridges, and canisters.**

The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

**(k) Training and information.**

This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

(1) The employer shall ensure that each employee can demonstrate knowledge of at least the following:

(i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

(ii) What the limitations and capabilities of the respirator are;

(iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

(iv) How to inspect, put on and remove, use, and check the seals of the respirator;

(v) What the procedures are for maintenance and storage of the respirator;

(vi) How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

(vii) The general requirements of this section.

(2) The training shall be conducted in a manner that is understandable to the employee.

(3) The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

(4) An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements

specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.

(5) Retraining shall be administered annually, and when the following situations occur:

(i) Changes in the workplace or the type of respirator render previous training obsolete;

(ii) Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or

(iii) Any other situation arises in which retraining appears necessary to ensure safe respirator use.

(6) The basic advisory information on respirators, as presented in Appendix D of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

**(l) Program evaluation.**

This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

(1) The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

(2) The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

(i) Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);

(ii) Appropriate respirator selection for the hazards to which the employee is exposed;

(iii) Proper respirator use under the workplace conditions the employee encounters; and

(iv) Proper respirator maintenance.

**(m) Recordkeeping.**

This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

**(1) Medical evaluation.**

Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.1020.

**(2) Fit testing.**

(i) The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

- (A) The name or identification of the employee tested;
- (B) Type of fit test performed;
- (C) Specific make, model, style, and size of respirator tested;
- (D) Date of test; and
- (E) The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

(ii) Fit test records shall be retained for respirator users until the next fit test is administered.

(3) A written copy of the current respirator program shall be retained by the employer.

(4) Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

**(n) Dates.**

**(1) Effective date.**

This section is effective April 8, 1998. The obligations imposed by this section commence on the effective date unless otherwise noted in this paragraph. Compliance with obligations that do not commence on the effective date shall occur no later than the applicable start-up date.

**(2) Compliance dates.**

All obligations of this section commence on the effective date except as follows:

(i) The determination that respirator use is required (paragraph (a)) shall be completed no later than September 8, 1998.

(ii) Compliance with provisions of this section for all other provisions shall be completed no later than October 5, 1998.

(3) The provisions of 29 CFR 1910.134 and 29 CFR 1926.103, contained in the 29 CFR parts 1900 to 1910.99 and the 29 CFR part 1926 editions, revised as of July 1, 1997, are in effect and enforceable until October 5, 1998, or during any administrative or judicial stay of the provisions of this section.

**(4) Existing Respiratory Protection Programs.**

If, in the 12 month period preceding April 8, 1998, the employer has conducted annual respirator training, fit testing, respirator program evaluation, or medical evaluations, the employer may use the results of those activities to comply with the corresponding provisions of this section, providing that these activities were conducted in a manner that meets the requirements of this section.

**(o) Appendices.**

(1) Compliance with Appendix A, Appendix B-1, Appendix B-2, and Appendix C of this section is mandatory.

(2) Appendix D of this section is non-mandatory and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

**Appendix A to § 1910.134: Fit Testing Procedures (Mandatory)****Part I. OSHA-Accepted Fit Test Protocols****A. Fit Testing Procedures—General Requirements**

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit.

Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.

5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- (a) Position of the mask on the nose
- (b) Room for eye protection

- (c) Room to talk

- (d) Position of mask on face and cheeks

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

- (a) Chin properly placed;

- (b) Adequate strap tension, not overly tightened;

- (c) Fit across nose bridge;

- (d) Respirator of proper size to span distance from nose to chin;

- (e) Tendency of respirator to slip;

- (f) Self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B-1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in Appendix B-1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.

11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.

12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

13. The fit test shall be performed while the test subject is wearing any applicable safety

equipment that may be worn during actual respirator use which could interfere with respirator fit.

14. Test Exercises. (a) The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP protocol. The test subject shall perform exercises, in the test environment, in the following manner:

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

#### **Rainbow Passage**

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)

(7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as

shroud type QNFT or QLFT units that do not permit bending over at the waist.

(8) Normal breathing. Same as exercise (1).  
(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

### **B. Qualitative Fit Test (QLFT) Protocols**

#### **1. General**

(a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

#### **2. Isoamyl Acetate Protocol**

Note: This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

##### **(a) Odor Threshold Screening**

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

(1) Three 1 liter glass jars with metal lids are required.

(2) Odor-free water (e.g., distilled or spring water) at approximately 25 deg. C (77 deg. F) shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to

prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.

(7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

#### **(b) Isoamyl Acetate Fit Test**

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the

test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

### 3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

#### (a) Taste threshold screening.

The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten

squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

**Note to paragraph 3. (a):** If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

#### (b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to

spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A.14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

#### **4. Bitrex™ (denatonium benzoate) Solution Aerosol Qualitative Fit Test Protocol**

The Bitrex™ (denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical

Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

##### **(a) Taste Threshold Screening.**

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4 inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the



bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

#### **(b) Bitrex Solution Aerosol Fit Test Procedure.**

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in 4. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.

(11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

#### **5. Irritant Smoke (Stannic Chloride) Protocol**

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

##### **(a) General Requirements and Precautions**

(1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Only stannic chloride smoke tubes shall be used for this protocol.

(3) No form of test enclosure or hood for the test subject shall be used.

(4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

(5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of

the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

**(b) Sensitivity Screening Check**

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

(1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.

(3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

**(c) Irritant Smoke Fit Test Procedure**

(1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).

(2) The test subject shall be instructed to keep his/her eyes closed.

(3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.

(6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

(7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.

(8) If a response is produced during this second sensitivity check, then the fit test is passed.

**C. Quantitative Fit Test (QNFT) Protocols**

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

**1. General**

(a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

## 2. Generated Aerosol Quantitative Fit Testing Protocol

### (a) Apparatus.

(1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

(2) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.

(6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.

(7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.

(8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

### (b) Procedural Requirements.

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(A) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(B) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(C) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

(D) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$\text{Overall Fit Factor} = \frac{1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_7 + 1/ff_8}{\text{Number of exercises}}$$

Where ff1, ff2, ff3, etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

### 3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount TM ) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

**(a) Portacount Fit Test Requirements.**

(1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.

(2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.

(6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

**(b) Portacount Test Instrument.**

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.

(3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

**4. Controlled negative pressure (CNP) quantitative fit testing protocol.**

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

**(a) CNP Fit Test Requirements.**

(1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.

(2) The CNP system defaults selected for test pressure shall be set at -- 15 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

**(Note:** CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.)

(3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.

(4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.

(5) The test subject shall be trained to hold his or her breath for at least 20 seconds.

(6) The test subject shall don the test respirator without any assistance from the individual who conducts the CNP fit test.

(7) The QNFT protocol shall be followed according to section I.C. 1. of this appendix with an exception for the CNP test exercises.

**(b) CNP Test Exercises.**

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to

hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.

(4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.

(7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(8) Normal Breathing. The test subject shall remove and re-don the respirator within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

**(c) CNP Test Instrument.**

(1) The test instrument shall have an effective audio warning device when the test subject fails to hold his or her breath during the test. The test shall be terminated whenever the test subject failed to hold his or her breath. The test subject may be refitted and retested.

(2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

**Part II. New Fit Test Protocols**

A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.

B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or

2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.

C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

[63 FR 20098, April 23, 1998]

**Appendix B-1 to § 1910.134: User Seal Check Procedures (Mandatory)**

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

**I. Facepiece Positive and/or Negative Pressure Checks****A. Positive pressure check.**

Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

**B. Negative pressure check.**

Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

**II. Manufacturer's Recommended User Seal Check Procedures**

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the manufacturer's procedures are equally effective.

[63 FR 1152, Jan. 8, 1998]

**Appendix B-2 to § 1910.134: Respirator Cleaning Procedures (Mandatory)**

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B- 2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

**I. Procedures for Cleaning Respirators**

- A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure- demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
- B. Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
- C. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain.
- D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
  - 1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,
  - 2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,
  - 3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.
- E. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized.

Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

- F. Components should be hand-dried with a clean lint-free cloth or air-dried.
- G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.
- H. Test the respirator to ensure that all components work properly.

[63 FR 1152, Jan. 8, 1998]

**Appendix C to Sec. 1910.134: OSHA Respirator Medical Evaluation Questionnaire (Mandatory)**

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:  
Can you read (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

**Part A. Section 1. (Mandatory)**

The following information must be provided by every employee who has been selected to use any type of respirator (please print).

- 1. Today's date: \_\_\_\_\_
- 2. Your name: \_\_\_\_\_
- 3. Your age (to nearest year): \_\_\_\_\_
- 4. Sex (circle one): Male/Female
- 5. Your height: \_\_\_\_\_ ft. \_\_\_\_\_ in.
- 6. Your weight: \_\_\_\_\_ lbs.
- 7. Your job title: \_\_\_\_\_



8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code):  
\_\_\_\_\_

9. The best time to phone you at this number:  
\_\_\_\_\_

10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes/No

11. Check the type of respirator you will use (you can check more than one category):  
 a. \_\_\_\_\_ N, R, or P disposable respirator (filter-mask, non- cartridge type only).  
 b. \_\_\_\_\_ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).

12. Have you worn a respirator (circle one): Yes/No  
 If “yes,” what type(s): \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Part A. Section 2. (Mandatory)**

Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle “yes” or “no”).

- 1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: Yes/No
- 2. Have you ever had any of the following conditions?
  - a. Seizures (fits): Yes/No
  - b. Diabetes (sugar disease): Yes/No
  - c. Allergic reactions that interfere with your breathing: Yes/No
  - d. Claustrophobia (fear of closed-in places): Yes/No
  - e. Trouble smelling odors: Yes/No
- 3. Have you ever had any of the following pulmonary or lung problems?
  - a. Asbestosis: Yes/No
  - b. Asthma: Yes/No
  - c. Chronic bronchitis: Yes/No

- d. Emphysema: Yes/No
  - e. Pneumonia: Yes/No
  - f. Tuberculosis: Yes/No
  - g. Silicosis: Yes/No
  - h. Pneumothorax (collapsed lung): Yes/No
  - i. Lung cancer: Yes/No
  - j. Broken ribs: Yes/No
  - k. Any chest injuries or surgeries: Yes/No
  - l. Any other lung problem that you’ve been told about: Yes/No
4. Do you currently have any of the following symptoms of pulmonary or lung illness?
- a. Shortness of breath: Yes/No
  - b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes/No
  - c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes/No
  - d. Have to stop for breath when walking at your own pace on level ground: Yes/No
  - e. Shortness of breath when washing or dressing yourself: Yes/No
  - f. Shortness of breath that interferes with your job: Yes/No
  - g. Coughing that produces phlegm (thick sputum): Yes/No
  - h. Coughing that wakes you early in the morning: Yes/No
  - i. Coughing that occurs mostly when you are lying down: Yes/No
  - j. Coughing up blood in the last month: Yes/No
  - k. Wheezing: Yes/No
  - l. Wheezing that interferes with your job: Yes/No
  - m. Chest pain when you breathe deeply: Yes/No
  - n. Any other symptoms that you think may be related to lung problems: Yes/No
5. Have you ever had any of the following cardiovascular or heart problems?
- a. Heart attack: Yes/No
  - b. Stroke: Yes/No
  - c. Angina: Yes/No
  - d. Heart failure: Yes/No
  - e. Swelling in your legs or feet (not caused by walking): Yes/No
  - f. Heart arrhythmia (heart beating irregularly): Yes/No
  - g. High blood pressure: Yes/No
  - h. Any other heart problem that you’ve been told about: Yes/No

6. Have you ever had any of the following cardiovascular or heart symptoms?
- Frequent pain or tightness in your chest: Yes/No
  - Pain or tightness in your chest during physical activity: Yes/No
  - Pain or tightness in your chest that interferes with your job: Yes/No
  - In the past two years, have you noticed your heart skipping or missing a beat: Yes/No
  - Heartburn or indigestion that is not related to eating: Yes/ No
  - Any other symptoms that you think may be related to heart or circulation problems: Yes/No
7. Do you currently take medication for any of the following problems?
- Breathing or lung problems: Yes/No
  - Heart trouble: Yes/No
  - Blood pressure: Yes/No
  - Seizures (fits): Yes/No
8. If you've used a respirator, have you ever had any of the following problems? (If you've never used a respirator, check the following space and go to question 9):
- Eye irritation: Yes/No
  - Skin allergies or rashes: Yes/No
  - Anxiety: Yes/No
  - General weakness or fatigue: Yes/No
  - Any other problem that interferes with your use of a respirator: Yes/No
9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes/No

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you ever lost vision in either eye (temporarily or permanently): Yes/No

11. Do you currently have any of the following vision problems?
- Wear contact lenses: Yes/No
  - Wear glasses: Yes/No
  - Color blind: Yes/No
  - Any other eye or vision problem: Yes/No
12. Have you ever had an injury to your ears, including a broken ear drum: Yes/No
13. Do you currently have any of the following hearing problems?
- Difficulty hearing: Yes/No
  - Wear a hearing aid: Yes/No
  - Any other hearing or ear problem: Yes/No
14. Have you ever had a back injury: Yes/No
15. Do you currently have any of the following musculoskeletal problems?
- Weakness in any of your arms, hands, legs, or feet: Yes/No
  - Back pain: Yes/No
  - Difficulty fully moving your arms and legs: Yes/No
  - Pain or stiffness when you lean forward or backward at the waist: Yes/No
  - Difficulty fully moving your head up or down: Yes/No
  - Difficulty fully moving your head side to side: Yes/No
  - Difficulty bending at your knees: Yes/No
  - Difficulty squatting to the ground: Yes/No
  - Climbing a flight of stairs or a ladder carrying more than 25 lbs: Yes/No
  - Any other muscle or skeletal problem that interferes with using a respirator: Yes/No

### Part B

Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes/No
- If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes/No

2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes/No  
 If "yes," name the chemicals if you know them: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

3. Have you ever worked with any of the materials, or under any of the conditions, listed below:  
 a. Asbestos: Yes/No  
 b. Silica (e.g., in sandblasting): Yes/No  
 c. Tungsten/cobalt (e.g., grinding or welding this material): Yes/No  
 d. Beryllium: Yes/No  
 e. Aluminum: Yes/No  
 f. Coal (for example, mining): Yes/No  
 g. Iron: Yes/No  
 h. Tin: Yes/No  
 i. Dusty environments: Yes/No  
 j. Any other hazardous exposures: Yes/No  
 If "yes," describe these exposures: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

4. List any second jobs or side businesses you have: \_\_\_\_\_  
 \_\_\_\_\_

5. List your previous occupations: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

6. List your current and previous hobbies: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

7. Have you been in the military services? Yes/No  
 If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes/No

8. Have you ever worked on a HAZMAT team? Yes/No

9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other

medications for any reason (including over-the-counter medications): Yes/No  
 If "yes," name the medications if you know them: \_\_\_\_\_

10. Will you be using any of the following items with your respirator(s)?  
 a. HEPA Filters: Yes/No  
 b. Canisters (for example, gas masks): Yes/No  
 c. Cartridges: Yes/No

11. How often are you expected to use the respirator(s) (circle "yes" or "no" for all answers that apply to you)?:  
 a. Escape only (no rescue): Yes/No  
 b. Emergency rescue only: Yes/No  
 c. Less than 5 hours per week: Yes/No  
 d. Less than 2 hours per day: Yes/No  
 e. 2 to 4 hours per day: Yes/No  
 f. Over 4 hours per day: Yes/No

12. During the period you are using the respirator(s), is your work effort:  
 a. Light (less than 200 kcal per hour): Yes/No  
 If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.  
 Examples of a light work effort are sitting while writing, typing, drafting, or performing light assembly work; or standing while operating a drill press (1-3 lbs.) or controlling machines.

b. Moderate (200 to 350 kcal per hour): Yes/No  
 If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.  
 Examples of moderate work effort are sitting while nailing or filing; driving a truck or bus in urban traffic; standing while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; walking on a level surface about 2 mph or down a 5-degree grade about 3 mph; or pushing a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

c. Heavy (above 350 kcal per hour): Yes/No  
 If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.  
 Examples of heavy work are lifting a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; shoveling; standing while bricklaying or chipping castings; walking up an 8-degree

grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.).

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No  
If "yes," describe this protective clothing and/or equipment:

\_\_\_\_\_  
\_\_\_\_\_

14. Will you be working under hot conditions (temperature exceeding 77 deg. F): Yes/No

15. Will you be working under humid conditions: Yes/No

16. Describe the work you'll be doing while you're using your respirator(s):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s): Name of the first toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift \_\_\_\_\_

Duration of exposure per shift \_\_\_\_\_

Name of the second toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift: \_\_\_\_\_

Name of the third toxic substance: \_\_\_\_\_

\_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift: \_\_\_\_\_

The name of any other toxic substances that you'll be exposed to while using your respirator: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security): \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

**Appendix D to Sec. 1910.134 (Mandatory Information for Employees Using Respirators When Not Required Under the Standard**

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker.

Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, of if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning, and care, and warnings regarding the respirator's limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]





# RESPIRATORY PROTECTION

Section

## Glossary

Title

### A

**ACGIH** - American Conference of Governmental Industrial Hygienists

**Administrative controls** - Exposure control measures that reduce exposure to an acceptable limit by scheduling reduced work times in contaminated areas and establishing work practices.

**Air purifying respirator** - A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

**Ambient** - Surrounding

**ANSI** - American National Standards Institute

**APR** - Air purifying respirator

**APF** - Assigned protection factor

**Atmosphere supplying respirator** - A respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

### B

**Breakthrough** - The point at which chemicals begin to pass through a respirator filter because the filter's saturation point has been reached.

### C

**C** - Ceiling limit

**Canister** or **cartridge** - A container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

**Carcinogen** - Substance that causes cancer.

**Cartridge** - See canister

**Ceiling limit** - Exposure level for a substance that should never be exceeded.

**cfm** - Cubic feet per minute

**CFR** - Code of Federal Regulations

### D

**Demand respirator** - An atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

**Dermatitis** - Skin irritation with symptoms such as red, itchy skin, swelling, ulcers, and blisters.

**DHHS** - Department of Health and Human Services

**Doffing** - The act of removing PPE.

**Donning** - The act of putting on PPE.

## Glossary

---

### E

**Emergency situation** - Any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

**Employee exposure** - Exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

**End-of-service-life indicator** - A system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

**Engineering controls** - Exposure control measure that reduces or eliminates exposures by using mechanical means, such as ventilation systems, acoustical material, and clean air control booths. This measure doesn't eliminate the hazard.

**Escape-only respirator** - A respirator intended to be used only for emergency exit.

**ESLI** - End of service life indicator

### F

**Filter or air purifying element** - A component used in respirators to remove solid or liquid aerosols from the inspired air.

**Filtering facepiece (dust mask)** - A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

**Fit factor** - 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 ambient air to its concentration inside the respirator when worn.

**Fit test** - The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

### G

No entries

### H

**Helmet** - A rigid respiratory inlet covering that also provides head protection against impact and penetration.

**HEPA filter** - High efficiency particulate air filter

**High efficiency particulate air filter** - A filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

**Hood** - A respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

### I

**IAA** - Isoamyl acetate

**IDLH** - Immediately dangerous to life and health

**Immediately dangerous to life or health** - An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere. An exposure level in an environment likely to cause death or serious health effects with very short exposures.



### L

**Loose-fitting facepiece** - A respiratory inlet covering that is designed to form a partial seal with the face.

### M

**Material safety data sheet** - Written or printed material concerning a hazardous chemical - 29 CFR 1926.59(c).

**Maximum use concentration** - The highest concentration of a specific contaminant for which a cartridge or canister provides approved protection.

**mg/m<sup>3</sup>** - milligrams per cubic meter

**MSDS** - Material safety data sheet

**MSHA** - Mine Safety and Health Administration

**MUC** - Maximum use concentration

### N

**Negative pressure respirator (tight fitting)** - A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

**NIOSH** - National Institute of Occupational Safety and Health

### O

**OSHA** - Occupational Safety and Health Administration

**OSH Act** - Occupational Safety and Health Act

**Overbreathing** - The condition that occurs when, under heavy work conditions, a worker uses more air than a PAPR can provide, creating negative pressure in the mask.

**Oxygen-deficient atmosphere** - An atmosphere with an oxygen content below 19.5% by volume.

### P

**PAPR** - Powered air purifying respirator

**PEL** - Permissible exposure limit

**Permissible exposure limit** - Exposure guidelines for airborne concentrations of regulated substances that set limits upon a worker's inhalation exposure (the amount of substance a worker can safely breathe).

**Personal protective equipment** - Any protective clothing or device used to prevent contact with and exposure to chemical and nonchemical hazards in the work place.

**PF** - Protection factor

**Physician or other licensed health care professional** - An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

**PLHCP** - Physician or other licensed health care professional

**ppb** - parts per billion

**PPE** - Personal protective equipment

**ppm** - parts per million

**Poor warning properties** - Absence of odor, taste, or other trait which warns about a chemical's presence.

## Glossary

---

**Positive pressure respirator** - A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

**Powered air-purifying respirator** - An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

**psig** - Pressure per square inch gauge

**Pressure demand respirator** - A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

**Protection factor** - The rating assigned to a respirator or class of respirators that represents the level of protection it provides.

### Q

**QLFT** - Qualitative fit test

**QNFT** - Quantitative fit test

**Qualitative fit test** - A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

**Quantitative fit test** - An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

### R

**REL** - Recommended exposure level (NIOSH).

**Respiratory inlet covering** - The portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

**RPA** - Respirator program administrator

### S

**SAR** - Supplied air respirator

**SCBA** - Self-contained breathing apparatus

**Self-contained breathing apparatus** - An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

**Service life** - The period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

**Short term exposure limit** - Maximum concentration level of a substance to which workers can be exposed for a short period of time (usually 10 to 15 minutes) without suffering from adverse health effects.

**Site safety and health plan** - A site-specific plan that establishes the policies and procedures necessary to protect workers and the public from possible hazards at the site.

**Sorbent** - Granular material in a respirator cartridge or canister that absorbs specific contaminants from the air as the air is inhaled.

**Sorption** - To take up and hold, as by absorption or adsorption.

**Standard operating procedure** - Required procedures for performing the variety of work associated with activities at a hazardous waste site.

**STEL** - Short-term exposure limit

**Supplied-air respirator or airline respirator** - An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

**T**

**TC** - Tested and certified

**Tight-fitting facepiece** - A respiratory inlet covering that forms a complete seal with the face.

**Time weighted average** - Average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week.

**TLV** - Threshold limit values

**TWA** - Time weighted average

**U**

**User seal check** - An action conducted by the respirator user to determine if the respirator is properly seated to the face

**V, W, X, Y, Z**

**No entries**

# Glossary

---