Respiratory Protection

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OSHAcademy Course 756 Study Guide

Respiratory Protection

Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 756.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Introduction

In H.G. Wells' classic novel, The War of the Worlds, invading Martians wreak havoc among helpless humans until a common form of bacteria does them in. Most likely, the bacteria was in the air along with gases, smoke, and dust raised along the Martians' path of destruction.

During a normal day, the air we breathe is mostly oxygen and nitrogen — although it still contains trace amounts of harmful gases, smoke, vapors, and dust produced by us and Mother Nature. Fortunately, our lungs have a series of mechanical and biological barriers that keep such contaminants from harming us. But healthy lungs aren't invincible. With repeated overexposure to toxins, these protective barriers break down, resulting in irritation, discomfort, or disease. Unfortunately, we may not even be aware of the damage until it's too late to recover.

Breathing in the Workplace

Black lung, farmer's lung, asbestosis, silicosis — You've probably heard of these work-related respiratory diseases and know of their consequences. These are just a few of the medical conditions that result when workers breathe contaminated air. However, protecting workers can be difficult because:

- there are so many types of contaminants; and
- there is no single method for controlling them in all workplaces.

If you're a business owner or manager who wants basic information about protecting your employees from respiratory hazards, this course will get you started. The course summarizes respiratory hazards, how to evaluate the hazards, and how to control them. And, it describes what employers should know before their employees use respirators.

You'll learn about the basic types of respirators and what you need to do to develop an effective respiratory protection program – the essential requirement of OSHA's respiratory protection standard, 1910.134. This standard specifies what you must do to ensure that your employees use respirators safely and responsibly.

Module 1: About Respiratory Hazards

Respiratory hazards include harmful substances and below-normal concentrations of oxygen in the air we breathe. What makes a substance harmful depends on its toxicity, chemical state, physical form, concentration, and the period of time one is exposed. Examples include:

- particulates,
- gases and vapors, and
- biological organisms.

Harmful effects are wide ranging and may occur immediately (acute) or take years to develop (chronic).

Examples of Respiratory Hazards

Particulates: These are airborne particles such as dust, fibers, fumes, mists, soot, and smoke. Some are so small they can only be seen with an electron microscope. The diameter of a particulate is usually measured in micrometers (one micrometer equals 1/1,000 millimeter or 1/25,400 inch). Particles with diameters under 10 micrometers are more likely to enter the respiratory system.

Gas and vapors: Gases can spread freely in the air. Vapors are the gaseous states of substances that are liquids or solids at room temperature. Gases and vapors are classified by their chemical forms.

Biological organisms: These include bacteria, viruses, fungi, and other living organisms that can cause respiratory infections.

Oxygen-deficient atmosphere: Normal air has an oxygen concentration of 20.8 percent by volume. When the concentration drops below 19.5 percent, the air is oxygen deficient and considered immediately dangerous to life and health (IDLH). The harmful effects of oxygen deficiency include impaired thinking and coordination, unconsciousness, and death.

Protection from Respiratory Hazards

Protect yourself and your co-workers from respiratory hazards by doing the following:

- Identify the respiratory hazards in your workplace.
- Evaluate employees' exposures to each hazard.

- Use the evaluation information to eliminate the hazards or to lower employees' exposures to safe levels.

This three-step process, summarized below, is called a hazard analysis or hazard evaluation.

Identify the Respiratory Hazards in your Workplace

- Consider the sources of respiratory hazards such as production processes, work tasks, raw materials, and end products. Each could expose employees to a respiratory hazard. What raw materials are used in a production process? What are the intermediate products and the byproducts of each process? Do employees use equipment or handle substances that could expose them to respiratory hazards?
- Review safety data sheets (SDS) and chemical inventories to identify chemicals that may expose employees to respiratory hazards.
- Talk to employees. Do they have safety or health concerns about certain products, materials, or machines? Have they reported signs or symptoms of respiratory conditions?

Evaluate Employees' Exposures to Each Hazard

After you have identified respiratory hazards, evaluate employees' exposures to determine whether they are exposed to unsafe levels. Evaluate exposures by measuring them or estimate them with data from previous exposure measurements. Three examples:

- Measure the exposures of individual employees by sampling their breathing air. The procedure – called personal exposure monitoring – is the most accurate way to evaluate exposure levels.
- Sample the air at specific locations – called area monitoring – to estimate exposures affecting groups of employees. This method is useful when employees move about and may not always be near a hazard's source.
- Use representative exposure data from industry studies, trade associations, or product manufacturers to estimate exposures affecting groups of employees. You must be able to show that the data are based on conditions similar to those that exist in your workplace.

Immediately dangerous to life and health (IDLH) refers to an atmospheric concentration of a toxic, corrosive, or asphyxiant substance that poses an immediate threat to life, causes irreversible health effects, or interferes with one's ability to escape from a dangerous

atmosphere. If employees may be exposed to such substances and you are unable to evaluate their exposures, you must consider the exposure immediately dangerous to life and health.

About Exposure Monitoring

Exposure monitoring is the testing of air samples to determine the concentration of contaminants in a work environment. Test data from the samples are averaged over a period of time, usually eight hours, and referred to as a time-weighted average (TWA).

OSHA has established permissible exposure limits (PEL) for specific air contaminates. Exposures must not exceed the eight-hour PEL-TWA in any eight-hour work shift.

Permissible exposure limits are listed in OSHA Standard 1910.1000, Table Z-1 Limits for Air Contaminants, Table Z-2 Toxic and Hazardous Substances, and Table Z-3, Mineral Dusts.

A trained specialist, such as an industrial hygienist, can help you evaluate employee exposures, interpret the results, and suggest how to lower exposures to safe levels.

Controlling Exposure to Respiratory Hazards

To eliminate or reduce the chance of getting hurt in the workplace, OSHA requires employers to use a prioritized set of hazard control strategies called the Hierarchy of Controls. The highest priority strategies attempt to eliminate, replace or use engineering to manage the hazard, itself. The lower level strategies work to reduce exposure by controlling worker behaviors. Let's take a look at these strategies.

Elimination and Substitution

If employees are exposed to respiratory hazards at unsafe levels, you'll need to determine how to protect them from overexposure. You might try to:

- Completely eliminate the hazard by using another production process or materials that are not hazardous.
- Substitute or replace a hazardous substance with a less hazardous substance that does not require as much protection.

For instance, when performing abrasive blasting, the worker might replace blasting sand, which contains silica, with abrasive media such as glass beads, corn cob, or air and dry ice.

Engineering Controls

Water helps to reduce exposure to silica dust.

If you can't eliminate or replace a respiratory hazard, use engineering controls to lower exposures to safe levels. Such controls "engineer" or physically change the work environment, so the air is safe to breathe. Examples of engineering controls include:

- isolating a production process so that the employees are not exposed;
- installing an exhaust hood to remove air contaminants;
- using wet methods (water) to reduce exposure to airborne dust;
- integrating dust collection systems into cutting and grinding equipment.

Administrative Controls and Respiratory Protection

Administrative controls establish programs and policies that require employees to use processes, procedures, and practices to help to limit exposure to hazardous substances. As you can see, the primary strategy is to control behaviors to limit exposure. Some examples of administrative controls related to respiratory protection include:

- requiring employees to use respirators when working with asbestos;
- conducting hands-on training on the use of respirators;
- establishing rules for care and maintenance of respirators;
- mandating medical exams for all employees who will use respirators.

Employees must use respirators for protection from respiratory hazards when engineering controls are not feasible or will not reduce their exposures to safe levels.

Assigned Protection Factor and Maximum Use Concentration

Assigned Protection Factor (APF) means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when you implement a continuing, effective respiratory protection program.

For higher-risk exposure situations (i.e., a higher concentration of infectious particles), choosing a respirator with a higher APF provides a higher level of protection for the wearer. The APFs for

different types of respirators are presented in Table 1 of the OSHA Respiratory Protection Standard 1910.134. (See table below).

Table I: Assigned Protection Factors [5]

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

Maximum Use Concentration

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

- Be sure to select respirators for employees that maintain their exposure to the hazardous substance at or below the MUC.
- DO NOT apply MUCs to conditions that are immediately dangerous to life or health (IDLH); instead, they must use respirators listed for IDLH conditions discussed later in the course.
- When the MUC exceeds the IDLH level for a hazardous substance or the performance limits of the cartridge or canister, then set the maximum MUC at that lower limit.

For more information see OSHA Publication 3352, Assigned Protection Factors for the Revised Respiratory Protection Standard.

Module 1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Dusts, fibers, fumes, mists, soot, and smoke are all examples of _____.**

    a. gases
    b. particulates
    c. vapors
    d. biological organisms

2. **When the concentration of oxygen drops below _____, the air is oxygen deficient and considered immediately dangerous to life and health (IDLH).**

    a. 15.3 percent
    b. 18.4 percent
    c. 19.5 percent
    d. 20.5 percent

3. **Which of the following is the most accurate way to evaluate exposure levels?**

    a. Time average monitoring
    b. Area monitoring
    c. Periodic monitoring
    d. Personal exposure monitoring

4. **Integrating dust collection systems into cutting and grinding equipment is an example of which hazard control methods?**

    a. engineering controls
    b. administrative controls
    c. personal protective equipment
    d. elimination

5. **Which of the following is defined as the level of respiratory protection that a respirator is expected to provide to employees?**

    a. Maximum Use Concentration (MUC)
    b. Personal Exposure Level (PEL)
    c. Assigned Protection Factor (APF)
    d. Immediately Detrimental to Life and Health (IDLF)

Module 2: Respirator Basics

The purpose of a respirator is to prevent the inhalation of harmful airborne substances and/or an oxygen-deficient atmosphere. A respirator is designed as an enclosure that covers the nose and mouth or the entire face or head.

Respirators are available in many types, models, and sizes from several manufacturers for a variety of applications. Different types of respirators are designed to provide different levels of protection and to protect against different hazards.

The type of respirator to be used depends on several considerations:

- professional judgment,
- the type of airborne contaminant, its concentration, and potential to cause a health effect in exposed personnel, and
- applicable regulations.

When information regarding the exposure is limited, the decision should rely more heavily on professional judgment and more protective respirators may be selected for use.

Each facility's written policies and training programs should specify whom to contact for questions or additional information.

Respirator Types

To understand how respirators can be used to protect employees, it is important to understand what a respirator is and what it is not. A respirator protects against respiratory hazards by removing specific air contaminants from the ambient (surrounding) air or by supplying breathable air from a safe source.

- **Air-purifying respirators.** Respirators that remove contaminants from the ambient air are called air-purifying respirators. Particulate respirators are a type of air-purifying respirator. The part of a respirator that forms a protective barrier between the user's respiratory tract and air contaminants is called an inlet covering. Most inlet coverings are classified as either tight-fitting or loose-fitting.

- **Tight-fitting respirator.** A tight-fitting respirator has an inlet covering, also called a face piece or mask, designed to form a seal with the face of the wearer. It is available in three types: quarter mask, half mask, and full face piece.

- **Loose-fitting respirator.** A loose-fitting respirator has an inlet covering that typically covers the user's head and may extend over the shoulders. It is designed to form a partial seal with the face. These include loose-fitting face pieces, as well as hoods, helmets, blouses, or full suits, all of which cover the head completely.

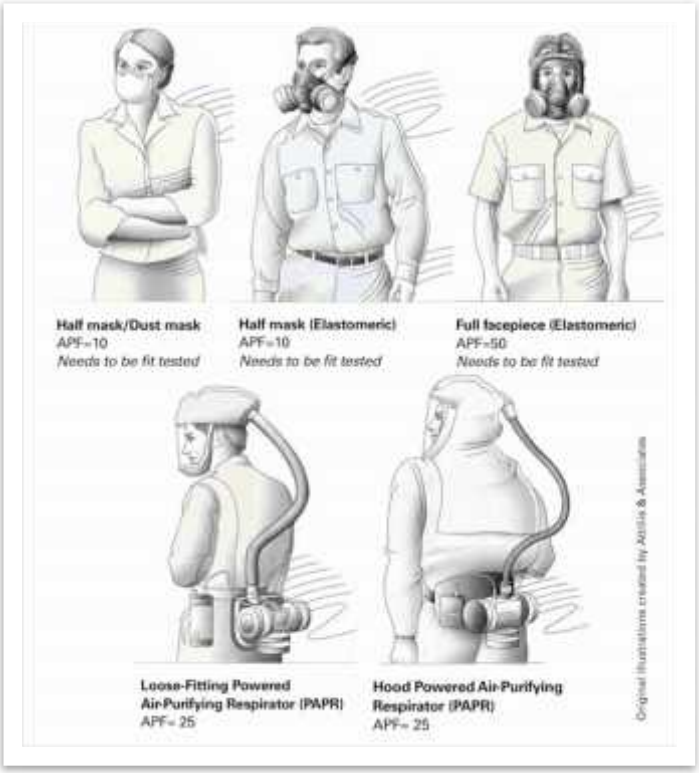
- **Atmosphere-supplying respirators.** Respirators that supply air from a safe source other than the ambient air are called atmosphere-supplying respirators. There are two types of atmosphere-supplying respirators: Supplied-Air Respirators (SARs) and Self-Contained Breathing Apparatus (SCBA).

Air-Purifying Respirators (APR)

The air-purifying respirator, or "APR," has an air-purifying filter, cartridge, or canister that removes specific air contaminants, such as particulates, gases, and vapors, or both from the air.

Selecting an appropriate filter, cartridge, or canister can be complicated because there are many types, and none protect against all contaminants. That's why it's necessary to identify each respiratory hazard in your workplace before you select a respirator.

Air-purifying respirators are available in non-powered and powered types.



Air-Purifying Respirators

Non-Powered Air-Purifying Respirator (APR)

When using a non-powered air-purifying respirator, the user operates it simply by breathing. This type of respirator has a blower that forces ambient air through one or more filters attached to an inlet covering. Both non-powered and powered APRs must be fit tested.

There are basically three types of non-powered APRs:

- Half mask/Dust mask
- Half mask (Elastomeric)
- Full face piece (Elastomeric)

Key Features

- elastic face piece covers entire face
- inspiratory effort of wearer draws ambient air through filter(s) before air is inhaled
- provides increased protection when used with filters, cartridges, or canisters that remove specific contaminants

Advantages

- comparatively light weight
- does not restrict mobility
- provides both respiratory and eye protection

Disadvantages

- Does not supply oxygen (cannot be used in low oxygen environments).
- May only be used when air contaminant level is below the concentration limits of the filter(s).
- Fit testing required.
- Some contaminated air can leak into facepiece.
- Communication can be difficult.

Powered Air-Purifying Respirator (PAPR)

This type of respirator has a blower that forces ambient air through one or more filters attached to an inlet covering. The powered type is easier to breathe through than the non-powered type but needs a fully charged battery to work properly.

Key Features

- Battery powered blower forces contaminated ambient air through air-purifying filters.
- Purified air is delivered under positive-pressure to facepiece mask, helmet, or hood.
- Worn when disposable and reusable half mask negative-pressure air-purifying respirators do not provide adequate protection.

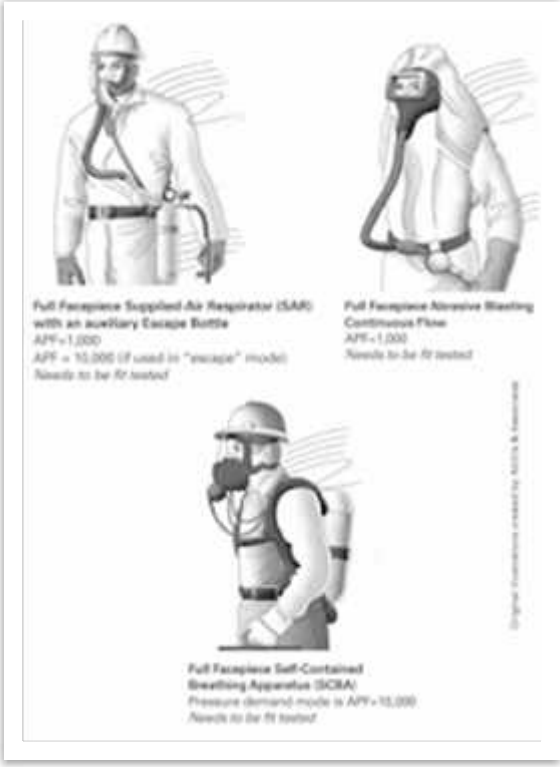
Advantages

- Provides greater protection than non-powered negative-pressure air-purifying respirators.
- More comfortable to wear and to breathe compared to non-powered negative-pressure air-purifying respirators.
- Air delivery to facepiece mask, helmet, or hood ensures that leakage of contaminated air is usually outward.
- Fit testing is not required.
- Various chemical cartridges or canisters are available to eliminate chemicals including organic vapors and acid gases.
- Provides both respiratory and eye protection.

Disadvantages

- bulky and noisy
- battery dependent
- not a true positive-pressure device (i.e., some leakage of contaminated air into facepiece mask, helmet, or hood can occur)
- communication can be difficult

Atmosphere-Supplying Respirators



Atmosphere-supplying respirators are used to provide breathing air from a source independent of the ambient atmosphere. Respirators that supply breathing air are generally used in highly hazardous work environments. It is critical that such respirator systems provide breathing air of optimal quality and that the equipment operates reliably.

The two types of atmosphere-supplying respirators are:

- **Supplied-air respirators (SARs)** (also known as airline respirators), receive air from a connecting hose. The source of air is either a pressurized cylinder or an air compressor. Because the employee does not carry the air on his or her back when using a SAR, breathing air can be provided over a longer time period than is the case with an SCBA.
- **Self-contained breathing apparatus (SCBA)** units: Air is supplied from a tank (a cylinder of compressed air or oxygen). For this type of respirator, the source of the breathing air is designed to be transported by or with the equipment user.

Supplied-Air Respirator

Key Features

- Compressed air is delivered from a stationary source (located away from contaminated area) to a half or full facepiece mask via a hose.
- Worn when negative-pressure and powered air-purifying respirators do not provide adequate protection.

Advantages

- Provides high level respiratory protection.
- Provides positive pressure to mask so almost all leakage is outward.
- Less bulky and can be used for longer periods than self-contained breathing apparatus.

- May be easier for hospital personnel to use.
- Provides both respiratory and eye protection.

Disadvantages

- Length of air hose may limit mobility.
- Air hose may be a trip hazard.
- Clean source of breathing air is required.
- Fit testing is required.
- Immediately operable emergency escape respirator, escape hood, or escape mask is required.
- Communication can be difficult.

Self-Contained Breathing Apparatus (SCBA)

SCBAs have a full facepiece with an Assigned Protection Factor (APF) of 10,000. Fit testing is required.

Key Features

- Provides very pure, dry compressed air to full facepiece mask via a hose.
- Air is exhaled to the environment.
- By law, this type of respirator must be worn whenever entering environments immediately dangerous to life and health (IDLH) or when information is inadequate to rule out IDLH atmosphere.

Advantages

- Provides highest level of respiratory protection.
- Several different types are available depending on need.
- Offers improved mobility over Supplied-Air Respirators.
- Provides both respiratory and eye protection.

Disadvantages

- They are heavy to wear.
- Limited oxygen supply limits the duration of use.
- Fit testing is required.
- Communication can be difficult.

Are Dust Masks Respirators?

One important distinction that must be made when discussing respirator use is the difference between respirators and facemasks. Facemasks include surgical masks, which are fluid resistant, and procedure or isolation masks which are not fluid resistant. While some people may call both respirators and facemasks "masks," this is incorrect as they are very different in their design, performance, and purpose.

Only dust masks certified by NIOSH are considered respirators and are covered under 1910.134 rules. A NIOSH-certified dust mask – called a filtering facepiece – is a tight-fitting, negative pressure, particulate respirator. The particulate filter is the facepiece. Dust masks that don't have NIOSH certification are not respirators. The image at the right is an example of a filtering facepiece.

Respirator Selection

Properly selected and used, respirators protect workers from hazards but don't eliminate hazards. If the respirator fails or is inappropriate for a particular task, the user risks exposure. A respirator can stress a worker's heart and lungs and present other physical and psychological challenges such as:

- Breathing through a tight-fitting air-purifying respirator, for example, is harder than breathing ambient air.
- An atmosphere-supplying self-contained breathing apparatus (SCBA) can increase the user's heart rate because of its weight.
- Those with lung diseases or asthma or who have trouble breathing should never use a respirator without the approval of a professionally licensed-health care provider (PLHCP).

- Those who have vision problems or who are claustrophobic may also be unable to use some respirators.

Effective respiratory protection ensures that workers are medically able to use respirators, that their respirators fit properly, and that they know how to use and care for their respirators.

Care and Maintenance of Respirators

Employees must clean and inspect their own respirators in accordance with the provisions of the respiratory protection program. Here are some important things to remember:

- Maintenance involves a thorough visual inspection for cleanliness and defects.
- Worn or deteriorated parts must be replaced prior to use.
- No components are to be replaced or repairs made beyond those recommended by the manufacturer.
- Repairs to regulators or alarms of atmosphere-supplying respirators are to be conducted by the manufacturer.

Cleaning

Cleaning and sanitizing respirators is necessary to prevent skin irritation and dermatitis. Contaminant build-up on the respirator facepiece seal or within the respirator can reduce the protection because the contaminant is in the breathing zone or has compromised the seal. Contamination can also contribute to the deterioration of the respirator's materials. Also, follow these cleaning best practices:

- Respirators must be cleaned and disinfected as often as necessary to remain sanitary.
- Respirators used by more than one employee must be cleaned and disinfected before being used by a different individual.
- Respirators maintained for escape-only use, as well as respirators used in fit testing and training, must be cleaned and disinfected after each use.

The program administrator should maintain an adequate supply of the appropriate cleaning and disinfecting agents at the cleaning station.

Storing Respirators

After inspection, cleaning, and necessary repair, store respirators so that they are not damaged, contaminated, or exposed to dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. Follow these procedures to store respirators properly:

- Store filter cartridges separately from clean respirator face pieces to prevent contamination of the interior of the respirator facepiece from hazardous particulate matter (e.g., lead, asbestos, cadmium, silica) that may have accumulated on the filter cartridge.
- Store the facepiece and the exhalation valve in a manner that will prevent deformation. To do that, position each respirator so it retains its natural configuration. Synthetic materials and even rubber will warp if stored in an unnatural shape, thus affecting the fitting characteristics of the facepiece.
- Respirators should be packed or stored so the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

Module 2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Which type of respirator removes contaminants from the ambient air?**

    a. Air-purifying respirator
    b. Supplied-air respirator
    c. Self-contained breathing apparatus (SCBA)
    d. Atmosphere-supplying respirators

2. **Which type of respirator supplies air from a safe source other than the ambient air?**

    a. Air-purifying respirator
    b. N95 facepiece
    c. Dust mask
    d. Atmosphere-supplying respirator

3. **Which type of respirator is easier to breathe through but needs a fully charged battery to work properly?**

    a. Powered Air-purifying respirator
    b. Non-powered air-purifying respirator
    c. Atmosphere-supplying respirator
    d. Supplied-air respirator

4. **What is the part of a respirator that forms a protective barrier between the user's respiratory tract and air contaminants?**

    a. Barrier seal
    b. Face seal
    c. Cartridge filter
    d. Inlet covering

5. Filter cartridges must be _____ respirator facepieces that have been cleaned.

a. stored separately from
b. color coordinated with
c. maintained inside
d. sufficient to be identified with

Module 3: The Respiratory Protection Program

One of the primary responsibilities of the employer under the respiratory protection program is to develop and implement a written plan that describes in detail worksite-specific procedures and practices for required respirator use. A suitably trained program administrator should administer the written plan. Also, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator.

Essential Elements of a Respiratory Protection Program

Employers can't just hand out respirators and expect to protect their employees. If employers evaluate your workplace, find respiratory hazards, and determine respirators are necessary to protect employees, employers must have a respiratory protection program.

An effective program ensures employees are medically able to use respirators, their respirators fit properly, and they know how to use and care for them. It must include a written plan that contains the following elements:

- procedures for selecting respirators for use in the workplace;
- medical evaluations for those persons required to use respirators;
- fit testing procedures for tight-fitting respirators;
- use of respirators in routine and reasonably foreseeable emergency escape situations;
- procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, and otherwise maintaining respirators;
- procedures to ensure adequate air quality, quantity, and flow of breathing air for self-contained breathing apparatus (SCBA);
- training employees in the respiratory hazards to which they are potentially exposed;
- training employees on the proper use of respirators, including putting on and removing them, any limitations on their use, and maintenance procedures; and
- procedures for regularly evaluating the effectiveness of the program.

Respiratory Program Administrator Duties

The person responsible for managing the respiratory protection program has many important duties. The program administrator should:

- ensure the program is understood and followed by all affected employees;

- ensure all employees (including new hires) receive appropriate training, fit testing, and medical evaluations as required;
- ensure the availability of appropriate respirators, sufficient supplies (e.g., filters, chemical cartridges, canisters, cleaning and disinfecting solutions) and spare parts;
- ensure respirators are properly cleaned, maintained, and stored according to the respiratory protection program;
- monitor users to ensure they use respirators according to their certifications;
- obtain new equipment and maintain non-individually-assigned equipment that is ready to be re-issued;
- properly maintain emergency escape self-contained breathing apparatus;
- interview employees who use respirators to assess their views on program effectiveness and to identify and correct any problems;
- conduct evaluations of the respiratory protection program as necessary, and update written programs as needed; and
- maintain records required by the program.

Selecting Respirators

Respirator selection requires correctly matching the respirator with the type and degree of the hazard, and the user. The properly selected respirator must effectively reduce user exposure under all conditions, including reasonably foreseeable emergency escape situations. The program administrator should make a respirator available to each employee who is assigned a job that requires respiratory protection.

Proper respirator selection involves choosing a device that will protect the employee from the respiratory hazards to which he or she may be exposed, yet permits the employee to perform the job with the least amount of physical burden.

General Requirements: In choosing the appropriate respirator, you must consider the nature and extent of the hazard, work requirements and conditions, and the characteristics and limitations of the available respirators. Take the following information into account when choosing respirators:

- the nature of the hazard, and the physical and chemical properties of the air contaminant;

- concentrations of contaminants;
- relevant permissible exposure limit or other occupational exposure limit;
- the nature of the work operation or process;
- the length of time the respirator is used;
- work activities and physical/psychological stress;
- fit testing; and
- physical characteristics, functional capabilities, and limitations of respirators.

Respirator certification: All respirators selected must be certified by NIOSH and must be used according to the terms of that certification, which appears on the NIOSH certification label. Under certain circumstances, OSHA may permit the use of respirators not approved by NIOSH (i.e., where no NIOSH-approved respirator exists) where documentation exists to attest to the adequacy of the respirator's effectiveness against the contaminant(s) of concern. OSHA will examine those situations on a case-by-case basis.

Replacement: Make replacement respirators, cartridges, canisters, and filters available as required. All filters, cartridges, and canisters must be labeled with the appropriate NIOSH approval label. Do not remove or deface labels while the respirator is in use.

Checklist for Respirator Selection

Use this checklist during your respiratory protection program audits and inspections:

General Requirements

- Respiratory hazards in your workplace have been identified and evaluated.
- Employee exposures that have not been, or cannot be, evaluated must be considered IDLH.
- Respirators are NIOSH-certified and used under the conditions of certification.
- Respirators are selected based on the workplace hazards evaluated and workplace and user factors affecting respirator performance and reliability.
- Respirators are selected based on the APFs and calculated MUCs.
- Provide a sufficient number of respirator sizes and models for proper selection.

IDLH Atmospheres

- Full facepiece pressure demand SARs with auxiliary SCBA unit or full facepiece pressure demand SCBAs, with a minimum service life of 30 minutes, are provided.
- Respirators used for escape only must NIOSH-certified for the atmosphere in which they are used.
- Oxygen deficient atmospheres must be considered IDLH (d)(2)(B)(iii).

Non-IDLH Atmospheres

- Respirators selected are appropriate for the APFs and MUCs.
- Respirators selected are appropriate for the chemical nature and physical form of the contaminant.
- Air-purifying respirators used for protection against gases and vapors are equipped with End-of-Service-Life Indicators (ESLIs) or a change schedule has been implemented. The ESLI is a system that warns the user of the approach of the end of adequate respiratory protection; e.g., the sorbent is approaching saturation or is no longer effective.

- Air-purifying respirators used for protection against particulates are equipped with NIOSH-certified (High Efficiency Particulate Air) HEPA filters that are at least 99.97% efficient in removing particles of .3 micrometers in diameter. Equivalent filters (N100, R100, and P100) certified by NIOSH for particulates under Title 42 CFR part 84 may also be used.

Respirators for IDLH Atmospheres

The employer must provide the following respirators for employee use in IDLH atmospheres:

- full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or
- a combination of full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

Respirators provided only for escape from IDLH atmospheres must be NIOSH-certified for escape from the atmosphere in which they are used.

All oxygen-deficient atmospheres must 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 the standard (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

Respirators for Non-IDLH Atmospheres

The employer must provide a respirator adequate enough 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.

The respirator selected must be appropriate for the chemical state and physical form of the contaminant.

For protection against gases and vapors, the employer must provide an atmosphere-supplying respirator, or an air-purifying respirator, provided that:

- the respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or
- If there is no ESLI appropriate for conditions in the employer's workplace, the employer must implement 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 must 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.

For protection against particulates, the employer must provide:

- an atmosphere-supplying respirator; or

- 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
- 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.

Emergency Procedures

In areas where the wearer could be overcome by a toxic or oxygen-deficient atmosphere if the respirator fails, at least one additional person must be present. Communications (visual, voice, or signal line) must be maintained between both or all individuals present. Planning must be such that one individual will be unaffected by any likely incident, and have the proper rescue equipment to be able to assist the other(s) in case of emergency.

When self-contained breathing apparatus or hose masks with blowers are used in atmospheres immediately dangerous to life or health, standby persons must be present with suitable rescue equipment.

Persons using airline respirators in atmospheres immediately hazardous to life or health (IDLH) must be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres or other and equivalent provisions for the rescue of persons from hazardous atmospheres must be used. A standby person or persons with suitable self-contained breathing apparatus must be at the nearest fresh air base for emergency rescue.

What OSHA Expects

OSHA's CPL 02-02-054 - Respiratory Protection Program Guidelines will give you insight into the OSHA inspection protocol for respiratory protection. Design your own audits with these strategies in mind.

OSHA enforcement inspectors will make sure you have a written program that describes how you will accomplish the following:

- select appropriate respirators for employees;
- conduct medical evaluations for employees who use respirators;
- fit-test employees who use tight-fitting respirators;

- ensure employees use respirators correctly during regular activities and during emergencies;
- ensure respirators are clean and properly maintained;
- ensure air-quality in atmosphere-supplying respirators;
- train employees to protect themselves from respiratory hazards; and
- evaluate your program's effectiveness.

Module 3 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Respirator selection requires correctly matching the respirator with the _____.**

    a. length of exposure with the cartridge
    b. nature and duration of exposure and severity
    c. type and degree of the hazard, and the user
    d. number of employees and workplace location

2. **With which of the following must all filters, cartridges, and canisters be labeled?**

    a. Approved OSHA sticker
    b. NIOSH approval label
    c. CDC respirator stamp
    d. IDLH Indicator

3. **Which of the following respirators is required for employee use in IDLH atmospheres?**

    a. Any air supplied respirator with NIOSH label
    b. A non-demand supplied-air respirator (SAR)
    c. A half-face demand air purifying respirator
    d. A full facepiece pressure demand SCBA

4. **Any atmosphere-supplying respirator may be used _____ if the oxygen concentration is maintained within the ranges specified by Table II of the OSHA standard.**

    a. within an IDLH environment
    b. with a face seal
    c. for 30 minutes if necessary
    d. if OSHA approves

5. **In areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, _____.**

   a. an extra oxygen tank must be immediately available
   b. more than one monitor must be close by
   c. at least one additional person must be present
   d. an air-purifying respirator may replace the respirator

Module 4: Medical Evaluations and Fit Testing

One of the primary components of the Respiratory Protection Program involves the requirement for employees to receive a medical evaluation to make sure they can use respirators.

The employer must 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.

The medical evaluation must obtain the information requested by the Respirator Medical Evaluation Questionnaire in 1910.134, Sections 1 and 2, Part A of Appendix C.

Follow-up Medical Examination

The employer must ensure that a follow-up medical examination is provided for an employee who gives a positive response (yes) to any question among questions 1 through 8 in Section 2 of the questionnaire or whose initial medical examination demonstrates the need for a follow-up medical examination. Here are the topics that are covered in the first 8 questions in the questionnaire:

1. smoking
2. conditions such as seizures, diabetes, allergies, claustrophobia, etc.
3. pulmonary or lung problems such as asbestosis, asthma, silicosis, etc.
4. symptoms of pulmonary or lung illness such as shortness of breath, coughing, etc.
5. cardiovascular or heart problems such as heart attack, angina, high blood pressure, etc.
6. cardiovascular or heart symptoms such as pain, tightness, irregular heartbeat, etc.
7. taking medication for lung problems, heart trouble, blood pressure, seizures, etc.
8. prior problems using respirators like eye irritation, allergies, anxiety, fatigue, etc.

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

Medical Determination

In determining the employee's ability to use a respirator, the employer must obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation must provide only the following information:

- 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;
- the need, if any, for follow-up medical evaluations; and
- a statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

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 must provide a PAPR if the PLHCP's medical evaluation finds that the employee can use it. If a subsequent medical evaluation finds the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

Additional Medical Evaluations

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

- an employee reports medical signs or symptoms that are related to their ability to use a respirator;
- a PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be re-evaluated;
- information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

- a change occurs in workplace conditions (e.g., physical work effort, protective clothing, or temperature) that may result in a substantial increase in the physiological burden placed on an employee.

Fit Testing

The primary purpose of fit testing is to identify the specific make, model, style, and size of respirator best suited for each employee. In addition, fit testing also reinforces respirator training by having wearers review the proper methods of donning and wearing the respirator. Employees must be medically evaluated and found eligible to wear the respirator selected for their use prior to fit testing.

Fit testing is required for all negative or positive pressure tight-fitting facepiece respirators using the protocols detailed in 1910.134, Appendix A. The OSHA respiratory protection standard requires fit testing be performed:

- before an employee first starts wearing a respirator in the work environment,
- whenever a different respirator facepiece is used, and
- at least annually thereafter.

Respirator Testing

Demonstrating and Selecting a Respirator Model: Prior to the actual fit test, the employee should:

- wear the respirator to be tested for at least five minutes prior to the start of the test;
- be given a description of the fit test and the exercises he or she will perform during the test;
- be shown how to put on a respirator, position it on the face, set strap tension, and determine an acceptable fit;
- be allowed to choose a respirator from a sufficient number of models and sizes so the employee can find an acceptable and correctly fitting respirator. When choosing the respirator, the employee should take into account;
    - the position of the mask on the face, nose, and cheeks;
    - room for eye protection; and
    - room to talk -- a user seal check must be conducted.

- be fit tested for each respirator that will be assigned.

Retesting: If the employee finds the fit of the respirator to be unacceptable, he or she must be given a reasonable opportunity to select a different respirator and to be retested. Retesting is required whenever there are changes in an employee's physical condition that could affect respirators fit. Such conditions include, but are not limited to:

- facial scarring,
- dental changes (e.g., wearing new dentures),
- cosmetic surgery, or
- an obvious change in body weight.

Policies and Procedures for Using Respirators

Written procedures: It is important to develop standard procedures for respirator use. These should include all information and guidance necessary for their proper selection, use, and care. Also include possible emergency and routine uses of respirators.

Physical ability to use: Make sure employees are not assigned to tasks requiring respirators unless they are physically able to adequately perform the work and use the equipment. If there is any question or concern about using the respirator, a local physician must determine what health and physical conditions are pertinent. In such cases, periodically review the respirator user's medical status.

Face seal protection: To assure proper protection, check the facepiece fit using the manufacturer's facepiece fittings instructions, each time he or she puts on the respirator.

Do not wear respirators when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the facepiece, or temple pieces on glasses. Also, the absence of one or both dentures can seriously affect the fit of a facepiece. It's important to conduct periodic evaluation of worker compliance with this requirement.

Corrective glasses or goggles: Corrective glasses or goggles, or other personal protective equipment, must be worn in such a way that does not interfere with the seal of the facepiece to the face. In some cases, a full-facepiece respirator or powered air-purifying respirator (PAPR) may be more comfortable and less cumbersome than the combination of a half-mask and chemical goggles. OSHA's current standard on respiratory protection allows the use of contact lenses with respirators where the wearer has successfully worn such lenses before. However, wearing contact lenses in contaminated atmospheres is not permitted.

If corrective spectacles or goggles are required, they must not affect the fit of the facepiece.

Skin or Eye Irritation: Skin or eye irritation can result from wearing a respirator in hot, humid conditions as well as in contaminated environments. Irritation can cause considerable distress to employees, causing them to remove or adjust the respirator or to stop using the respirator at all. To prevent skin or eye irritation employees should leave the respirator use area to wash their faces and respirator facepieces as needed.

Vapor or Gas Breakthrough: Whenever the employee can detect vapor or gas breakthrough (by odor, taste, and/or irritation effects) or a change in breathing resistance or leakage of the facepiece, the employee must leave the respirator use area to replace the respirator or the filter, cartridge, or canister elements.

Impairments: Because respirators must be in good working condition to function, they should not be used if they have been impaired in any way. Impairments include a broken strap, loss of respirator shape, and a face seal that can no longer be maintained. Respirators that are not properly functioning must be replaced, repaired, or discarded.

Identification of Filters, Cartridges, and Canisters

The employer must 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. Replace those filters, cartridges, and canisters that have damaged color codes or labels. All cartridges are assigned a color designating the type of contaminant they filter as shown in the chart below:

RESPIRATOR CARTRIDGE COLOR CODING

Cartridge Color	Cartridge Use
WHITE WHITE with 1/2" GREEN stripe completely around bottom canister WHITE with 1/2" YELLOW stripe completely around bottom canister	Hydrogen Chloride, Sulfur Dioxide, Hydrogen Sulfide Hydrcyanic Acid Vapor Pure Chlorine
BLACK	Organic Vapors (OV)
YELLOW YELLOW with 1/2" BLUE stripe completely around bottom canister	Organic Vapors with Hydrogen Chloride, Sulfur Dioxide, Hydrogen Sulfide, or Hydrogen Fluoride Hydrcyanic Acid and Chloropicrin vapor
GREEN GREEN with 1/2" WHITE stripe completely around bottom canister	Ammonia, or Ammonia and Methylamine Ammonia and Acid Gases
CHARTREUSE	Formaldehyde
MAGENTA	Radioactive (Except Noble Gases & Tritium) Particulates (Dusts, Fumes, Fogs, Smoke, and in combination with any above gas or vapor)
BROWN	Multi-gas, or Multi-gas and OV, or Multi-gas and acid gas, or all
ORANGE	Mercury Vapor (Also used as a 1/2" stripe to represent gases not included in this table
BLUE	Carbon Monoxide
RED with 1/2" GRAY stripe completely around top canister	All the above contaminants in one canister

Where Respirator Use is not Required

An employer may provide respirators at the request of employees or permit employees to use their own respirators if the employer determines such respirator use will not in itself create a hazard.

If the employer determines any voluntary respirator use is permissible, the employer must provide the respirator users with the information contained in Appendix D of the standard.

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 the respirator and the respirator is cleaned, stored, and

maintained so 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 face pieces (dust masks).

Module 4 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **When is the employer required by OSHA to ensure a follow-up medical examination is provided for an employee?**

    a. When the employee does not complete or fails the initial examination
    b. When the employee answers “no” to question 9 in Section 1
    c. When the employee answers “yes” to questions 1-8 in Section 2
    d. When the employee has completed six months of work prior to using a respirator

2. **What must the employer do if the PLHCP finds a medical condition that may place the employee's health at risk using a negative pressure respirator?**

    a. Provide a PAPR if the PLHCP says the employee can use it
    b. Provide a NIOSH-approved full-face respirator
    c. Provide an air-purifying respirator with larger cartridges
    d. Reclassify the employee to restricted duty status

3. **What is the primary purpose of respirator fit testing?**

    a. Determine if the employee can use a class of respirators
    b. Identify which canisters are best suited for the user
    c. Analyze the back pressure created by negative-pressure respirators
    d. Identify the specific make, model, style and size of a suitable respirator

4. **Which of the following conditions could prevent a good respirator face seal?**

    a. foggy glasspiece
    b. beard or sideburns
    c. use of contacts
    d. skull cap above the facepiece

5. What should you do if a cartridge on your respirator is missing the NIOSH label?

a. Get another NIOSH label and attach it to the cartridge.
b. Smell the inside of the facepiece to make sure the cartridge is good.
c. Use the cartridge if it is color-coded correctly.
d. Replace the cartridge with a new suitable NIOSH-approval cartridge.

Module 5: Inspection and Training

Inspection Requirements

Respiratory protection is no better than the respirator in use, even though it is worn correctly. Frequent random inspections must be conducted by a qualified individual to make sure respirators are properly selected, used, cleaned, and maintained.

All respirators: For all respirators, inspections must include 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.

The elastomeric parts must be evaluated for pliability and signs of deterioration. Remember these important points about inspecting respirators:

- inspect SCBAs monthly;
- inspect respirators that are used routinely before each use and during cleaning;
- replace any worn or deteriorated parts;
- be sure to thoroughly inspect SCBAs for emergency use at least once a month and after each use;
- the program administrator should keep a record of emergency respirator inspections. Records should include dates, serial numbers, findings, any remedial action;
- make sure air and oxygen cylinders are fully charged according to the manufacturer's instructions. They should be recharged if pressure falls to 90% of the manufacturer’s recommended pressure;
- make sure the regulator and warning devices function properly;
- check the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters;

- inspect rubber or elastomer (elastic rubber) parts for pliability and signs of deterioration;
- stretch and manipulate rubber or elastomer parts with a massaging action to keep them pliable and flexible and prevent them from taking a set during storage; and
- a record must be kept of inspection dates and findings for respirators maintained for emergency use.

Repair: Respirators that fail to pass inspection or are otherwise found to be defective must be removed from service, and discarded, repaired, or adjusted by properly trained personnel, using only the respirator manufacturer's NIOSH-approved parts designed for that respirator.

The repairs also must be made in accordance with the manufacturer's recommendations and specifications regarding the type and extent of repairs to be performed. Because components such as reducing and admission valves, regulators, and alarms are complex and essential to the safe functioning of the respirator, they are required to be adjusted and repaired only by the manufacturer or a technician trained by the manufacturer.

When a respirator is taken out of service, the respirator must be tagged "out of service," and the employee should be given a replacement of the same make, model, and size.

Inspecting the work area: Make sure appropriate surveillance of work area conditions and degree of employee exposure or stress is conducted.

Audit the program: Regularly audit and evaluate the program to determine its continued effectiveness.

The program administrator should conduct evaluations of the respiratory protection program as necessary to make sure each component has been properly implemented. Evaluations of the program should determine whether the correct respirators are being used and worn properly and whether the training program is effective.

The program administrator should regularly consult with employees wearing respirators to get their views on program effectiveness and to identify any problems. This assessment must determine if the respirators are properly fitted. It must also evaluate:

- whether employees are able to wear the respirators without interfering with effective workplace performance;
- respirators are correctly selected for the hazards encountered;
- respirators are being worn when necessary; and

- whether respirators are being maintained properly.

The program administrator identifies and corrects any problems associated with wearing a respirator that are identified by employees or that are revealed during any other part of the program evaluation.

OSHA's CPL 02-02-054 - Respiratory Protection Program Guidelines provides insight into the OSHA inspection protocol for respiratory protection. Design your own audits with these strategies in mind.

Training

Training is an important part of the respiratory protection program and is essential for correct respirator use. In your initial and annual respirator training, be sure to include both an educational component and a training component. The educational component increases the learner's understanding of the importance of using respirators. The training component establishes or improves the skills needed to use the respirator.

Employees must receive training prior to using a respirator. For the training to be effective, the training must be comprehensive and presented in an understandable way.

Initial training: Initial training should be conducted prior to the employee's first exposure to respiratory hazards and must cover, at a minimum, the following topics:

- the general requirements of the OSHA respiratory protection standard;
- a discussion of why the use of the respirator is necessary. Such training should address the identification of the hazards involved during inspections, the extent of employee exposures to those hazards, and the potential health effects of such exposures;
- proper selection of respirators;
- the procedures for inspecting the respirator, donning and removing it, checking the fit and seal, and actually wearing it;
- information regarding the consequences of improper fit, usage, or maintenance;
- limitations and capabilities of the respirator selected, including ESLI and change schedules;
- how to use the respirator effectively in emergency situations, including situations when malfunctions occur;
- proper procedures for maintenance and storage; and

- how to recognize medical signs and symptoms that may limit or prevent the effective use of respirators (e.g., shortness of breath, dizziness).

Annual Retraining and Refresher Training: Retraining must be done annually and under some conditions, additional retraining might be required. Circumstances which would require retraining include situations where:

- changes in the type of respirator assigned to the employee render previous training obsolete;
- when the employee has not retained the requisite understanding or skill to use the respirator properly; or
- any other situation in which retraining appears necessary to ensure safe respirator use.

For example, training in the operation and use of SCBAs must be ongoing and continuous. Individuals who are designated to use SCBA must follow the manufacturer's instructions and be trained annually. Training must include the wearing and using SCBAs during exercise situations (e.g., walking).

All respirator training should be documented by the program administrator, and the documentation should include the type, model, and size of the respirator assigned to each employee.

Make sure students wear the respirator in normal air for a long familiarity period and then in a test atmosphere.

Module 5 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **When should respirator oxygen cylinders be recharged?**

    a. When the employee believes it needs to be recharged
    b. Monthly, unless the cylinder has not been used
    c. When pressure is below 75% of the OSHA PEL
    d. If pressure falls to 90% of the recommended pressure

2. **Who may repair the components of respirator?**

    a. The manufacturer or technician trained the manufacturer
    b. The user or user's representative
    c. A trained maintenance worker
    d. Anyone familiar with the make or model of respirator

3. **The _____ increases the learner's understanding of the importance of using respirators.**

    a. enforcement component
    b. compliance component
    c. training component
    d. educational component

4. **The _____ establishes or improves the skills needed to use the respirator.**

    a. enforcement component
    b. compliance component
    c. training component
    d. educational component

5. When is respirator training required?

a. Quarterly or more often
b. Whenever changes make previous training obsolete
c. Monthly and upon notification by safety staff
d. If OSHA is due to inspect within the next month

Endnotes

1. DHHS (NIOSH) Publication No. 2005-100, NIOSH, Retrieved from http://www.cdc.gov/niosh/docs/2005-100/default.html

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