Types of Respirators

Texas Department of Insurance
Division of Workers' Compensation
Safety Education and Training Programs

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Goal

This program provides information on the different types of respirators and their approved use.

Objective

Workers will be able to identify the appropriate respirators required for the different atmospheric hazards.

Respirator Types

Two basic types of respirators are:

- air-purifying; and
- supplied-air respirators.

Air-purifying respirators remove airborne contaminants such as particles, toxic vapors, and/or gases. They are appropriate for use in environments of low-level contamination and in environments where there is sufficient oxygen.

Supplied-air respirators provide clean air from either a portable cylinder or from a remote source and are used in environments too hazardous for air-purifying respirators.

Air quality testing and the information from Material Safety Data Sheets (MSDS) are used to determine the appropriate type of respiratory protection.

Air Purifying

Air-Purifying Respirators (APR) are divided into two types: Particulate Filtering, which removes particulates such as dusts, mists, aerosols, and fumes; and Vapor and Gas Filtering, which removes vapors and gases from the air you inhale.

Air-purifying respirators (APR) are used under the following circumstances:

- the wearer is determined to be physically qualified by a doctor;
- contaminant identity and concentration are known;
- concentration of oxygen is at least 19.5%;
- work area is monitored;
- respirator is approved for protection against the specific contaminant and concentration level; and
- a successful fit-test is accomplished.

There are four common classes of APR facepieces:

- disposable;
- quarter mask;
- half-mask; and
- full-face.

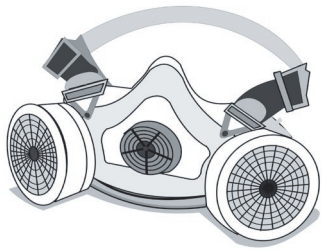
Disposable respirators (dust masks) provide protection against nuisance dusts and particulates.

Quarter mask respirators are used with cartridges or cloth filters. The quarter mask fits from the top of the nose to the top of the chin. The breathing resistance is high in comparison to larger masks.

Half-mask respirators fit from under the chin to above the nose. One or two cartridges are used to filter the air and are discarded once the use limits are reached. The half-mask has approved cartridges for pesticides, organic vapors, dusts, mists, fumes, acid gases, ammonia, and combinations of these.

Full-face respirators protect the entire face. Full-face masks use twin cartridges, chin-mounted canisters, or chest- or back-mounted canisters. All cartridges approved for the half-mask are available for the full-mask. Several other cartridges are also available for the full-mask.

Each cartridge is designed for use against specific contaminates. It is extremely important to know the contaminant present in the environment to make the appropriate cartridge selection.



Particle-Filtering

Particle-Filtering Respirators (PFR) provide a physical barrier to dusts, mists, fumes and fibers. The simplest PFRs are disposable and fit loosely over the nose and mouth. Filter pores become clogged easily and cause breathing difficulties. This makes frequent changing of the filter necessary. Disposable respirators protect against small amounts of nontoxic contaminants. More extreme hazards, like asbestos fibers, require a respirator with a replaceable filter that fits tightly over the face. A PFR does not protect against gases/vapors or oxygen deficiency.

Vapor and Gas Filters

Gases and vapors (from liquids such as solvents) are dissolved in the air and cannot be trapped with a particle filter. Gas and vapor respirators filter incoming air through one or more chemical containing cartridges or canisters. These chemicals absorb or chemically change the contaminant. They may also have a particle barrier. Some respirators contain more than one type of cartridge to filter several hazardous vapors at once. Cartridges are color-coded to identify which contaminants they filter. Refer to the National Institute of Occupational Safety and Health (NIOSH) for a list of color codes and the contaminants against which they protect.

Supplied-Air

Supplied-air respirators provide a clean source of Grade D breathable air. They are used when work environments contain contaminants that APRs cannot filter out or in oxygen deficient environments. Supplied-air respirators are also divided into two types: the Self-Contained Breathing Apparatus (SCBA) where the air tank is carried by the user, and the Air Line Respirator, where the air supply is some distance from the user and is supplied to the facepiece by an air-line hose.

Supplied-air respirators are used in the following situations:

- highly contaminated air often found in enclosed areas;
- toxic gases are present;
- oxygen deficient atmospheres where oxygen is deliberately replaced by another gas or chemically used up (by fire or the rusting process);
- air temperature is too hot or cold; and
- highly toxic environments like hazardous waste sites.

Supplied-air respirators' disadvantages include restricted mobility and the possibility of kinked or damaged air-line hoses.

The self-contained breathing apparatus (SCBA) is the respirator used for extremely hazardous environments. The SCBA consists of an air tank connected by a hose to a regulator that delivers 30 to 60 minutes of air to the mask. The tank is usually carried on the back.

A SCBA operates in one of two modes–demand or pressure-demand. In the demand mode when air is inhaled, negative pressure is created inside the facepiece and breathing tubes. The negative pressure depresses the regulator's diaphragm, opens the admission valve and allows air to be inhaled. Air flows to the facepiece as long as the negative pressure remains.

In 1987, the National Fire Protection Association (NFPA) prohibited the use of demand mode SCBAs by fire department and emergency response personnel. OSHA also does not permit demand mode SCBA equipment to be used in any area considered to be *Immediately Dangerous to Life and Health*, (IDLH), 29 CFR 1910.120 (HAZWOPER).

A pressure-demand or positive-pressure mode SCBA maintains a positive pressure inside the facepiece at all times. The system is designed to keep the admission valve open until enough pressure is built up to close it. Pressure builds up because air does not leave the system until exhalation. Internal facepiece pressure is always greater than external air pressure. Any leakage from the facepiece outward increases the protection.

Circuits

Closed-circuit SCBAs (rebreathers) recycle the user's exhaled air instead of exhausting it to the atmosphere. The exhaled air passes through a canister containing soda lime, which filters out the CO_2. The filtered air then goes to a bag where it is mixed with bottled liquid or compressed oxygen. This restores the oxygen content to 21.5%. The air is then inhaled by the user and the cycle repeats.

Rebreathers operate in the demand mode and are not used for firefighting and hazardous materials work. They are used in mine rescue work because they extend the oxygen supply.

An open-circuit SCBA has a supply of compressed breathable air. The user breathes normally and the exhaled air is exhausted from the system. The air supply is limited to the amount the user can carry because the air is not recycled.

A SCBA has a low pressure warning alarm. This alarm sounds when 75-80% of the air supply has been consumed. This alerts the worker that 20-25% of his air is available for retreat. Only 20% of the air supply should be consumed to reach your destination in a hazardous environment. This allows enough air supply for exiting the area when the alarm sounds. When the low pressure alarm sounds, leave the area immediately.

Before entering an unsafe area, it is a good idea to map out a quick and safe escape route. OSHA also requires the buddy system be used in any condition requiring a SCBA.

Fit Testing

OSHA requires proper fit testing and training prior to workers using a respiratory device on the job. Training may include a familiarization period in normal air.

There are two basic facepiece fit tests–qualitative and quantitative. Qualitative testing exposes a person wearing a respirator to a test agent. The respirator is equipped with a purifying element to remove the test agent from the air. A satisfactory fit has been achieved if the wearer is unable to detect penetration of the test agent. Quantitative testing actually measures the amount of contaminant in the testing atmosphere and inside the respirator itself. A comparison of these two numbers determines the efficiency of the fit. OSHA mandates that fit testing must be performed prior to the initial respirator use, whenever a different respirator facepiece is used, and at least annually thereafter.

Maintenance

Respirators must be inspected before and after every use.

Consider the following:

- all parts should be clean and working properly;
- check the facepiece for dry rot, cracks, and holes;
- perform a leak check;
- replace valves and hoses if cracked, brittle or punctured;
- check head harness for damage or deterioration;
- tighten loose clamps or connectors;
- check for proper filter selection and placement; and
- replace damaged or clogged filters.

Following each use, respirators should be cleaned, disinfected and stored according to the manufacturer's instructions. If respirator use is mandatory due to hazardous levels of airborne contaminants in the workplace, a Full Respiratory Protection Program must be developed and implemented. If employees are allowed to use respirators for nuisance levels of airborne contaminants, a Voluntary Use Respiratory Protection Program must be developed and implemented. In either case, the respirator program must comply with OSHA's 29 CFR 1910.134.

Review

1. The three things you need to know about the contaminated atmosphere to determine the appropriate respirator are _____.
    a. temperature, humidity, and airflow patterns
    b. oxygen level, temperature, and contaminant identity
    c. contaminant identity, contaminant level, and oxygen level
    d. contaminant level, oxygen level, and foot-candle level
2. The difference between an air-purifying respirator and a supplied-air respirator is __.
    a. air-purifying respirators only use half-masks and supplied-air respirators only use full-face masks.
    b. air-purifying respirators filter contaminants from the air and supplied-air respirators provide breathing air from a remote source.
    c. air-purifying respirators do not need to be fit tested and supplied-air respirators require fit testing
    d. air-purifying respirators are disposable and supplied-air respirators are reusable.
3. Under what circumstances should air-purifying respirators be used?
    a. when the contaminant identity and concentration are known
    b. when the oxygen content is below 19.5%
    c. when the respirator is approved for that specific contaminant and contaminant level
    d. both a and c
4. Under what circumstances should air-purifying respirators be used?
    a. when the oxygen level is below 19.5%
    b. in IDLH conditions
    c. in highly contaminated air
    d. none of the above
5. When should a respirator be inspected?
    a. only after use in an IDLH environment
    b. annually
    c. before and after each use
    d. as determined by the user
6. When should a respirator be fit-tested?
    a. annually, prior to initial use, and whenever a new facepiece is issued.
    b. only when the respirator will be used in IDLH conditions
    c. once a month
    d. on a case by case basis
7. What should one look for when inspecting a respirator?
    a. broken head harness, expiration date, cracks, leaks, and damaged valves
    b. cracks, leaks, damaged valves, loose connections, and punctured hoses
    c. damaged filters, appropriate size, loose connections, and expiration date
    d. none of the above

8. What contaminants do air-purifying respirators protect against?

a. particles, ionizing radiation, gases, and vapors

b. gases, insufficient oxygen, particles, and radon daughters

c. all of the above

d. particles, gases, and vapors

Review Question Answers:

1. c
2. b
3. d
4. d
5. c
6. a
7. b
8. d

Resources

The Texas Department of Insurance, Division of Workers' Compensation (TDI/DWC) Resource Center offers a workers' health and safety video tape library. Call (512) 804-4620 for more information or visit our web site at www.tdi.state.tx.us.

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The Texas Department of Insurance,
Division of Workers' Compensation (TDI/DWC)
E-mail **resourcecenter@tdi.state.tx.us**
or call 1-800-687-7080 for more information.

Safety Violations Hotline
1-800-452-9595
safetyhotline@tdi.state.tx.us