Using Your SCBA

Respiratory protective equipment is designed to limit inhalation of toxic dusts, gases and vapors. Respiratory protection is required at many work sites where adequate protection cannot be provided through the use of engineering or administrative controls. OSHA Standard 29 CFR 1910.134 requires that a written respiratory protection program be developed by the employer where respirators are necessary to protect an employee's health or required by the employer. Using an SCBA (self-contained breathing apparatus) provides the highest level of protection, by supplying breathing air to the user.

Objectives

When you have completed this exercise, you will be better able to:

- Identify types of respiratory protection
- Identify components of your SCBA
- Identify fit testing requirements for SCBA use
- Identify practices you use for care of your SCBA
- Demonstrate checkout, donning and doffing of your SCBA

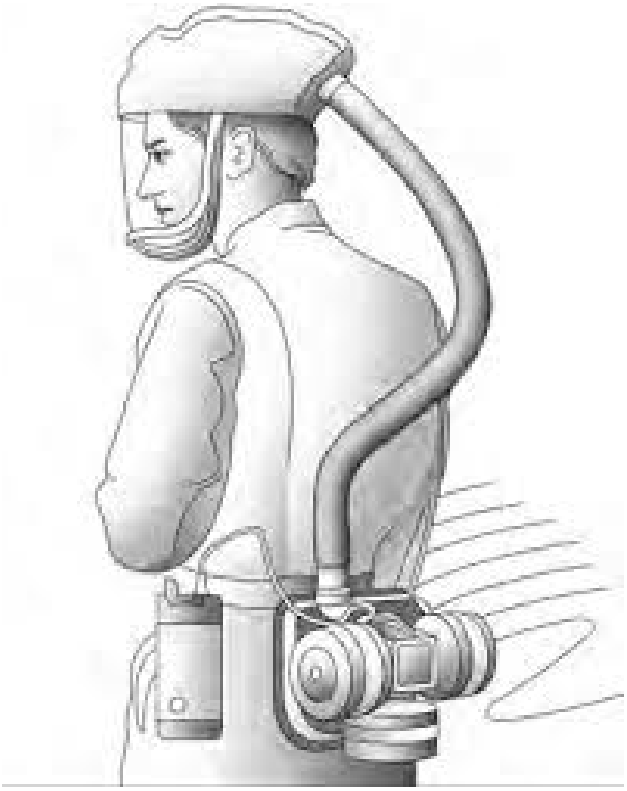
Respiratory Protection

Different types of hazards require different types of respirators. A number of factors should be considered when selecting a respirator. Respirator types and considerations in respirator selection are presented in the following sections. Selecting the appropriate respirator is the responsibility of designated personnel.

Types of Respirators

Two basic types of respiratory protection are:

- **Air-Purifying Respirator (APR)**, which protects against toxic dusts, gases, and vapors by removing the contaminant from the air before it enters the lungs. APRs include negative pressure and Powered Air Purifying Respirators (PAPR).



Powered Air-Purifying Respirator (PAPR)
(image from OSHA.gov)

- **Atmosphere-Supplying Respirator (ASR)**, which provides "breathing air from a source independent of the ambient atmosphere." ASRs include supplied-air respirators (SAR) and self-contained breathing apparatuses (SCBA). This exercise covers only ASR use.

Supplied-air respirator (SAR)

Self-contained breathing apparatus (SCBA) with escape bottle

(Images from OSHA.gov)

Each is detailed further below.

Exercise– Current Practices for Your SCBA

Complete the worksheet Current Practices for Using the SCBA assigned to you.

Atmosphere-Supplying Respirators (ASRs)

ASRs may have air supplied from a remote source (supplied air) or from a bottle or tank carried by the user (self-contained) as described below.

Supplied-Air Respirator (SAR)

A supplied-air respirator (SAR) provides a minimum Grade D breathing air to the worker from a stationary tank or other source through air lines. When using an SAR, the worker must wear (not carry) an escape bottle containing a minimum of 5 minutes of air. This

escape bottle, or egress unit, is required to allow the worker time to escape if air supply is interrupted. (See image of escape bottle on previous page.)

There are three classifications of supplied air respirators:

- Hose mask with blower (Type A)
- Hose mask without blower (Type B)
- Air-line respirators (Type C)

Air-Line Respirator (Type C)
(image from DOT.gov)

Air-line respirators must operate in either **continuous-flow** or **pressure-demand** mode. In continuous –flow mode, air is always flowing, even when the wearer is not inhaling. In pressure-demand mode, a constant positive pressure is maintained inside the facepiece. Air flows when the positive pressure in the facepiece is reduced as the wearer inhales. A third mode of operation is **demand mode**, in which air only flows when the pressure inside the facepiece becomes negative due to the wearer inhaling. Demand mode provides the least protection, because contaminants can leak into a poorly sealed facepiece when the pressure becomes negative.
NOTE: Not allowed in unknown or **Immediately Dangerous to Life or Health** (IDLH) concentrations.

Compressors used to supply air must meet special requirements. Compressor exhaust and lubricants must not contaminate the air they supply. Compressor air intakes must be located in a contaminant-free area. (29CFR1910.134(i)).

Self-Contained Breathing Apparatus (SCBA)

A self-contained breathing apparatus is an atmosphere-supplying respirator where the breathing air is designed to be carried by the user. A self-contained breathing

apparatus is used when extremely toxic chemicals are present, in an oxygen-deficient atmosphere, or when the contaminant or concentration is not known. SCBAs are also typically used in emergency situations.

SCBAs consist of:

- **bottle (tank or cylinder)** contains compressed breathing air (2216 psi-5500 psi)
- **harness** secures cylinder and connects user to apparatus
- **gauge** displays current cylinder pressure
- **safety/by-pass valve** by-passes the regulator in case of malfunction of the regulator. The by-pass valve should be open only when needed.
- **pressure regulator(s)** provide reduced pressure air during inhalation.
- **full facepiece** isolates user's face from exterior environment

The SCBA is equipped with an alarm to warn the wearer when air in the tank falls below a specified capacity (the 2013 edition of NFPA 1981 specifies a 33% capacity alarm). Most SCBAs operate in an open-circuit mode; that is, the exhaled air is vented to the atmosphere and not re-breathed.

SCBAs and cylinders differ by manufacturer and type. You must be trained in the manufacturer's instructions and checkout procedures before using any SCBA. These should be NIOSH certified for IDLH, full facepiece and with a minimum duration of 30 minutes or combined with SAR with auxiliary SCBA escape bottle. SCBA can operate in either demand mode (less protective) or pressure-demand mode. SCBA cylinders may be constructed of steel, aluminum, or composite materials. These have varying service lives and hydrostatic testing requirements. Users should familiarize themselves with their specific cylinders. A positive-pressure SCBA or positive-pressure air-line respirator equipped with an escape air supply must be used when exposure levels are likely to present an Immediately Dangerous to Life or Health (IDLH) situation or impair the ability to escape.

The equipment should be donned according to the manufacturer's recommended procedures. Periodic training and practice are especially important for workers who may use this equipment infrequently.

- When the contaminant is unknown, wear a pressure-demand SCBA with a full facepiece, or a pressure-demand SAR with a full facepiece in combination with an auxiliary pressure-demand SCBA.
- Auxiliary SCBA must be of sufficient duration to permit escape to safety if the air supply is interrupted.

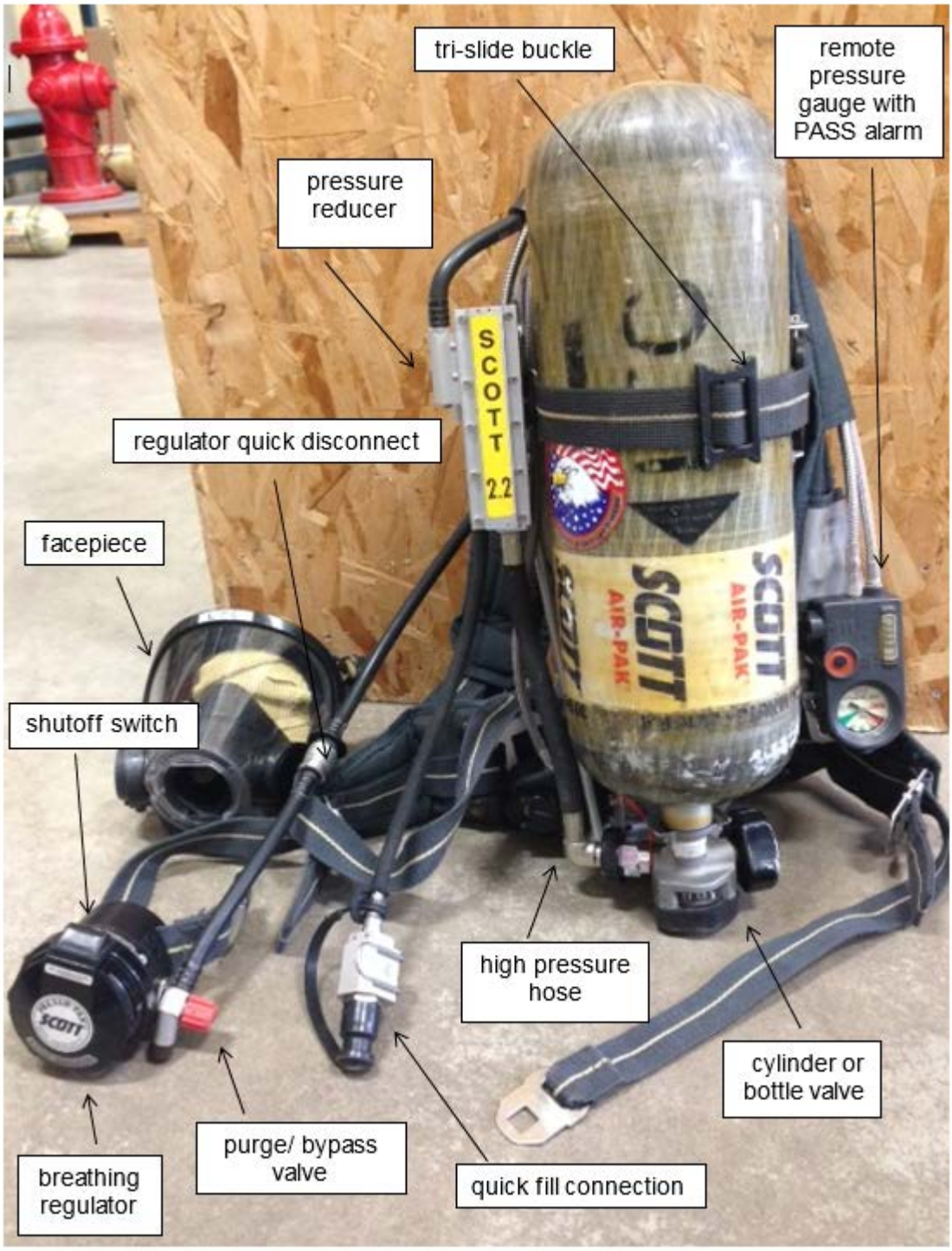
Certain contaminants are covered by individual standards that specify respirator selection and use. A list of these contaminants may be found by searching the OSHA

website for “advisor genius substances” or using this link: https://www.osha.gov/SLTC/etools/respiratory/advisor_genius_nrdl/substances.html.

For any questions on PPE use, the NIOSH Personal Protective Technology Laboratory (NPPTL) may be contacted at 888-654-2294, or emailed at PPEConcerns@cdc.gov.

Exercise – Identify All the Parts of Your SCBA

Find and identify all the parts of your SCBA and complete the worksheet distributed by the facilitator. This may be done in groups or individually.


tri-slide buckle
remote pressure gauge with PASS alarm
pressure reducer
regulator quick disconnect
facepiece
shutoff switch
high pressure hose
cylinder or bottle valve
breathing regulator
purge/ bypass valve
quick fill connection
SCOTT
2.2
SCOTT
AIR-PAK

Respirator Fit

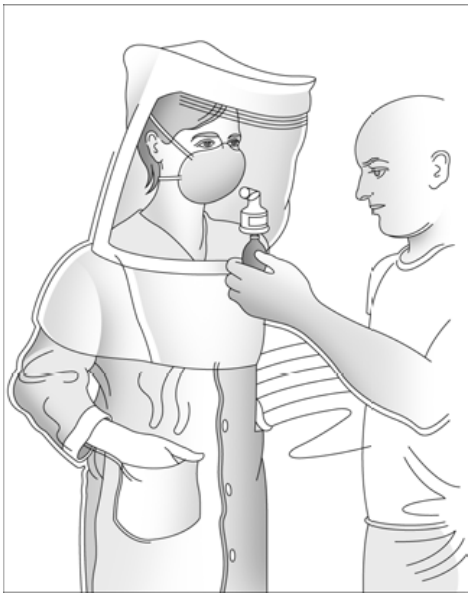
A respirator is effective only if there is a good seal between the facepiece and the wearer's face. Therefore, all persons wearing respirators must first be fit-tested. Fit-testing includes qualitative or quantitative testing, as well as routine positive-and negative-pressure fit checks. See 29CFR1910.134(m)(2).

Because human faces come in many different shapes and sizes, manufacturers have a number of facepieces to best match an individual. The purpose of fit-testing is to find the manufacturer/size combination which offers the best protection. Factors such as weight loss or gain, dentures, dental work, or facial injury can change the shape of the face, thus potentially changing the fit and efficiency of the respirator. If any of these factors exist, retesting is required. There shall be no facial hair in the area of the respirator seal.

A protection factor has been determined in the laboratory for each type of respirator (APR, PAPR, SCBA, etc.) and mask (half or full-face). Never assume you will get this much protection. That is why fit-testing is required.

Annual Fit-Tests

Two types of fit-testing, **qualitative** and **quantitative,** may be used to determine the size and model of respirator that an individual should wear, as well as how good the face-to-facepiece seal is. These tests should be repeated annually to document the respirator's effectiveness. Fit-tests **shall not** be performed if facial hair is present in the seal area of the respirator.



Qualitative Testing

Purpose: Checks effectiveness of preventing substances from entering the facepiece.

Method: While the individual is wearing a respirator, a test substance is released, as shown on the right. The test substance could be smelly (banana oil), sweet (saccharin), bitter (Bitrex) or an irritant (special smoke tube). The wearer should not be able to detect the substance while performing a series of prescribed tasks.

Requirements: This test or its equivalent is required by OSHA at least once a year.

There are several important cautions to qualitative fit-testing:

- Some of the test substances may irritate the eyes or cause coughing.
- A sensitivity test is first performed to determine the individual is capable of sensing the test solution.
- Fit-testing is often done in "ideal" environments. The fit may change after wearing the respirator several hours or during strenuous activity.
- Must be used only for Fit Factor (described later) ≤ 100.

NOTE: This method is not appropriate for SCBA facepieces. A quantitative method must be used.

Quantitative (Numerical) Testing

This test provides an objective assessment of the effectiveness of the respirator for the person who will wear it. This test measures the fit factor (FF), which is a comparison of the concentration of the substance outside of the mask to the concentration of the substance inside of the mask. This FF is useful in determining whether the respirator will effectively protect the wearer from specific chemicals. A disadvantage to this test is that special equipment and trained personnel are needed to administer it, although a computer and software can perform the calculations required.

Purpose: Measures effectiveness of the respirator in preventing a substance from entering the facepiece.

Methods: There are two methods for quantitative fit testing based on the fit testing device.

1. While an individual wears a respirator modified with a probe, the concentrations of particulates in the air inside and outside of the respirator are measured, as shown in the accompanying photo. The test is repeated while the person performs specific tasks (speaking, running in place, etc.) that may affect fit (see photo).

Photo courtesy of TSI Inc. to MWC.

2. While an individual wears a respirator connected to a fit testing device, a vacuum is drawn in the mask to assess seal for leaks. Then the user removes and re-dons the mask and the test is repeated twice.

Requirements: This test is mandated when a minimum fit factor of 50 for a full face mask is required.

Routine User Checks: Two types of user seal checks, **positive**- and **negative-pressure** checks, should be done each time a respirator is donned and before each use in the field to check the seal of the respirator. They do not replace yearly fitting but provide a routine assessment as to whether the fit is still adequate.

Positive-Pressure Check

Purpose: Checks the facepiece components for leaks at valves or other points. NOTE: Not all positive-pressure respirators allow easy access to the exhalation valve for this test.

Method: Close off the exhalation valve (if possible) 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. This is only performed if the cover can be manually removed.

Requirements: Shall be done before each use.

Negative-Pressure Check

Purpose: Checks the facepiece-to-face seal.

Method: SCBA wearer disconnects the regulator and places hands over the hole for the regulator connection and inhales. No outside air should be felt leaking into the facepiece.

User Seal Check: worker covering inlets and inhaling
(negative pressure check)
(image from OSHA.gov)

Requirements: Shall be done each time the respirator is donned (first use, break, lunch).

Positive- and negative-pressure checks can be done quickly and easily in the field. If the wearer is unable block the holes or cartridges with their hands, additional measures may need to be performed to accomplish the blocking requirement to detect the leaks.

Assigned Protection Factors: Protection factors also exist for combinations of the above respirators. For example, an SAR with a full-face mask and an auxiliary SCBA equals 10,000. This value assumes that the facepiece has been properly selected to provide the best possible fit and cannot be achieved for persons with facial hair as it interferes with the seal of the facepiece.

Cleaning, Storage, Inspection and Maintenance of Respirators

Proper inspection, maintenance, and storage are essential to assure that the respirator is always ready for use. The OSHA respirator standard requires employers to provide for the cleaning and disinfection, storage, inspection and repair of respirators used by employees. Always consult manufacturers' recommendations for use, care and maintenance also.

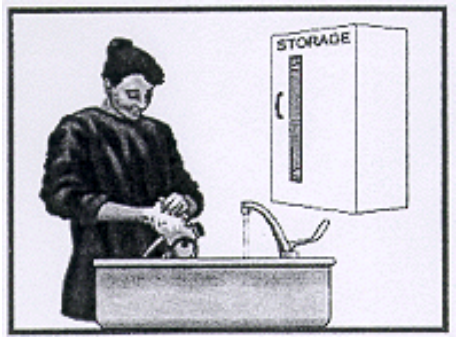
Cleaning Respirators

Appendix B-2 to 29 CFR 1910.134 requires the following respirator cleaning procedures. Manufacturers' recommendations may be used as an alternative, provided that they are at least as effective as those specified here:

A. 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.



Rinsing respirator
(image from OSHA.gov)

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 (approximately 20 drops) of laundry bleach to one liter of water (about a 1000:1 dilution) at 43 deg. C (110 deg. F); or,
   2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters (about 16 drops) of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water (about a 1250:1 dilution) 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 face pieces 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.

H. Test the respirator to ensure that all components work properly.

I. Respirators must be cleaned and disinfected after each use, unless they are being used routinely exclusively by the same employee. In that case, they must be cleaned and disinfected as often as needed to be sanitary.

Respirator Storage

OSHA requires that all respirators be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and that they must be packed or stored to prevent deformation of the facepiece and exhalation valve.

Inspection

Respirators must be inspected before and after each use and checked at least monthly, even if the respirator has not been in use. A company policy may include more frequent inspections. OSHA requires that inspections include:

- A check of respirator function
- Tightness of connections
- The condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, and canisters or filters
- A check of elastomeric parts for pliability and signs of deterioration.
- SCBAs must be inspected monthly regardless of use.
- Air and oxygen cylinders must be maintained in a fully charged state and be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer must determine that the regulator and warning devices function properly.

Maintenance

OSHA requires that defective respirators be removed from service and discarded, or repaired/adjusted as follows:

- Repairs or adjustments must be made only by trained persons, using the manufacturer’s NIOSH-approved parts.
- Repairs must be made according to the manufacturer’s recommendations and specifications.
- Critical parts including reducing and admission valves, regulators and alarms may only be adjusted or repaired by the manufacturer or a technician trained by the manufacturer.

Consult the company respiratory protection program for detailed requirements.

Exercise – Monthly Checks (optional)

Complete the checklist on the required monthly checklist for your SCBA distributed by the facilitator. This may be done in groups or individually.

Minimum Requirements for a Respiratory Protection Program

OSHA requires that employers who make respirators available to their employees have a written respiratory protection program with work-specific procedures (29CFR1910.134(c)). The program must be evaluated and updated as necessary. Programs shall be updated as requirements change and/or modifications occur that reflect changes in the workplace. OSHA requires the use of NIOSH-approved respirators. Approval numbers will be clearly written on all approved equipment or on written materials shipped with the respirator. Respirators manufactured after 2008 are marked with an approval designation known as a "TC" number. [Example: TC #XXX-XXXX].

A respiratory protection program must include the following points:

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

The employer must designate a program administrator who is qualified to oversee the respiratory protection program and conduct the required evaluations of its effectiveness. Respirator training and the required medical evaluations are provided to the employee at no cost. The respiratory protection program also may include:

- Provision for corrective lenses in full-facepiece respirators. (Using a spectacle kit that clips into the facepiece or is permanently mounted in the facepiece)

- Restriction of use of contact lenses.(See ANSI Z87.1)
- Communication needs.
- Guidelines for use in dangerous atmospheres, including confined spaces.
- Guidelines for use in extreme temperatures.

The respiratory protection program will include a description of who is responsible for the various aspects of the program including selection, periodic and routine fit-testing, inspection, cleaning, repair, and maintenance. Persons using respirators under unusual conditions (e.g., a high concentration of acid vapor) should review special requirements with supervisors or the employee safety and health representatives. For a sample respiratory protection program, see: http://www.osha.gov/dcsp/compliance_assistance/sampleprograms.html#Respiratory Protection.

Medical Fitness to Wear a Respirator

Before an employee receives clearance to wear a respirator, a medical evaluation must be performed by a physician or other licensed health care professional (PLHCP), as described in 29CFR1910.134(e). The evaluation helps assure that the employee is physically capable of working with the added physical stress of a respirator. Any follow-up evaluations and testing will be determined by the PLHCP.

Some medical conditions which may prevent an individual from wearing a respirator include: lung disease, claustrophobia, severe high blood pressure, heart disease.

Other conditions that should be considered when wearing a specific type of respirator include:

- Contact lenses.
- Eyeglasses.
- Moustache.
- Perforated tympanic membrane (ruptured eardrum).

Special eyeglass kits are available for full-facepiece respirators.

Exercise – Donning and Doffing your SCBA

Using your SCBA, complete the worksheet provided by the facilitator.

Exercise – Current Practices for Your SCBA Revisited

Review the completed worksheet on Current Practices and identify any area where your SCBA work practices will change, based on this exercise.

Report back any work practices that could be improved. How can this be accomplished within the organization?

Closing

Did you:

- Identify types of respiratory protection?
- Identify components of your SCBA?
- Identify fit testing requirements for SCBA use?
- Identify practices you use for care of your SCBA?
- Demonstrate checkout, donning and doffing of your SCBA?

Based on this exercise, what takeaways do you have as you go back to work?

Please ask any remaining questions.