

ANGELO STATE UNIVERSITY



**Respiratory Protection
Program**

October 2019

Table of Contents

INTRODUCTION	3
PURPOSE	4
SCOPE	4
RESPONSIBILITIES	4
a. EHSRM Office	4
b. Physician/Licensed Health Care Professional	4
c. Department/Supervisor	4
d. Employees	4
PROGRAM	5
a. Authority	5
b. Hazard Assessment	5
c. Medical Evaluation	5
d. Medical Clearance Procedures.....	5
e. Voluntary Use of Air Filtering Respirators (i.e., Dust Masks).....	6
f. Respirator Use under Special Conditions:.....	6
g. Program Administration.....	7
h. Respirator Selection	8
i. Training.....	9
j. Fit Testing.....	9
k. Maintenance and Storage.....	10
l. Record Keeping	11
m. Program Evaluation.....	11
DEFINITIONS.....	11
ATTACHMENT A - TYPES OF RESPIRATORS	15
ATTACHMENT B - ASSIGNED PROTECTION FACTORS FOR RESPIRATORS.....	22
ATTACHMENT C - TRAINING GUIDELINES FOR RESPIRATORY PROTECTION.....	23
ATTACHMENT D - QUALITATIVE FIT-TESTING PROTOCOL	27
ATTACHMENT E - PROCEDURES FOR CLEANING AND SANITIZING RESPIRATORS.....	30
ATTACHMENT F - RESPIRATOR INSPECTION CHECKLIST	32

INTRODUCTION

Potential exposure to respiratory hazards may occur while performing routine tasks and or during specialized work such as in confined spaces. To prevent potential occupational illnesses caused by exposure to airborne contaminants and to maintain compliance with the United States Department of Labor Occupational Health and Safety Administration (OSHA) Respiratory Protection Standard 29 CFR 1910.134, Angelo State University's Environmental Health, Safety and Risk Management (EHSRM) has developed a Respiratory Protection Program. However, the respiratory protection shall be used only after all other *engineering* and/or *administrative controls* have been exhausted. This guiding principle should be the focus of supervisors and EHSRM staff as they assess the need for respiratory protection.

Respiratory protection is available to personnel subject to exposure to concentrations of dusts, gases, fumes, mists, toxic materials above OSHA established permissible exposure limits (PEL), and/or working in atmospheres deficient in oxygen. If necessary, respiratory protection will be made available to personnel handling laboratory animals or other special tasks.

Avoiding or minimizing exposure to harmful substances can protect the respiratory system; however, in some cases this may not be possible and use of an appropriate respiratory protective device may be required. Use of respirator can reduce exposure to many contaminants present in that environment; therefore, proper selection of a respirator for the condition at hand is necessary.

The Code of Federal Regulations (CFR) 29 Part 1910 requires that a standard operating procedure be written to govern the selection and use of respirators based on the hazards to which the worker is exposed. The user must be physically able to wear the respirator and properly trained in its selection, use, and maintenance. The respirator should provide adequate protection against the particular hazards for which it is selected. The Angelo State University Respiratory Protection Program covers these elements:

- A written plan explaining how the respiratory protection program will be administered.
- A complete assessment of potential respiratory hazards that may be encountered in the workplace.
- Procedures and equipment to control respiratory hazards, including the use of engineering controls and work practices designed to limit or reduce employee exposure to such hazards.
- Guidelines for the proper selection of appropriate respiratory protective equipment.
- Employee training which will include: limitations of air purifying respirators, hazard recognition, dangers associated with respiratory hazards, proper use, care, and storage of respiratory protective equipment.
- Inspection, cleaning, and repair of respiratory equipment.
- Evaluation of respirator protection plan.
- Medical evaluation of employees.

PURPOSE

To establish acceptable practices for respirator use, delineate responsibilities, provide guidance on proper selection, individual fit testing, use and care of respirators in accordance with OSHA requirements and university policy.

SCOPE

This program applies university-wide for all personnel whose job responsibilities require the use of respiratory protection based on their exposure to a hazardous environment.

RESPONSIBILITIES

a. EHSRM Office

- (1) Establish a university-wide written respiratory protection program.
- (2) Recommend appropriate respiratory protective equipment.
- (3) Facilitate training on the proper use and care of respirators.
- (4) Facilitate fit-test and medical evaluations for all potential users.
- (5) Conduct periodic exposure surveillance of workplace hazards.
- (6) Maintain medical qualification statements, training, and fit-test records.
- (7) Issue guidelines for and updates to the program when necessary.

b. Physician/Licensed Health Care Professional

- (1) Review medical questionnaires completed by respirator users and provide medical clearance.
- (2) Determine if each user is capable of wearing respiratory protection equipment.
- (3) Approve employees for respirator use and specify any limitations.
- (4) Refer employees to a medical facility that needs further medical evaluation.
- (5) Answer employee questions regarding any health effects of respirator use.

c. Department/Supervisor

- (1) Coordinate risk assessment of work site and need determination for respiratory protection.
- (2) Arrange for the medical evaluation of potential respirator users.
- (3) Purchase only NIOSH approved respirators.
- (4) Coordinate training and fit testing with EHSRM.
- (5) Assume responsibility and/or appoint a respirator use coordinator within the department.
- (6) Ensure the availability of sufficient quantities of filters/chemical cartridges for specific contaminants, work activities, and cleaning agents.
- (7) Periodically evaluate effectiveness of the program to ensure that authorized personnel are fit tested, using proper respirators for the task, and properly cleaning and maintaining them.
- (8) Notify EHSRM if problems or deficiencies are observed.

d. Employees

- (1) Shall follow guidelines of this respiratory protection program.
- (2) Will clean, disinfect, and properly store their assigned respirator.

- (3) Will guard against damage to respirators during use, cleaning or storage.
- (4) Shall inspect the respirator for defects, missing parts, etc., and if found defective, return it to the supervisor.
- (5) Shall comply with fit test requirements.
- (6) Shall notify EHSRM and health provider of any change in his/her physical condition.

PROGRAM

a. Authority

The Office of EHSRM is responsible for administering the university's respiratory protection program and ensuring personnel use only authorized respiratory protection equipment and comply with all aspects of this program.

b. Hazard Assessment

A supervisor or an employee that feels that his/her work environment poses respiratory hazard shall contact EHSRM for a risk assessment to determine the need for respiratory protection in accordance with the OSHA Respiratory Protection Standard. After evaluating the hazards present in the workplace, EHSRM will determine the need for respiratory protection. It is the responsibility of the supervisor to ensure that employees who work in a hazardous environment wear proper respiratory protection before they are assigned the task.

If it is determined that an employee needs a respirator, one will be procured by the university at no cost to the employee. All personnel required to wear respiratory protection shall be properly trained and fit tested. EHSRM will coordinate the training and fit testing with the medical provider.

c. Medical Evaluation

According to OSHA 29 CFR 1910.134 any individual assigned to a task that requires the use of respiratory protection should be physically able to wear a respirator. The standard also states that a physician or other licensed healthcare professional will make the determination of an employee's fitness. This medical evaluation should be conducted prior to any respirator fit testing or usage. Employees refusing to undergo a medical evaluation cannot be fit tested.

d. Medical Clearance Procedures

Once it has been determined that an individual needs respiratory protection, medical clearance is required. The purpose of clearance is to insure that the employee has adequate respiratory and cardiovascular fitness prior to wearing a respirator. EHSRM will coordinate a medical questionnaire for each employee that requires the use of a respirator. The form must be signed by a licensed healthcare professional and returned to EHSRM.

The EHSRM office will coordinate arrangements for employees to obtain their medical clearance during the individual fit testing. The examining physician or licensed health care professional will complete the "Medical Clearance Form" upon the completion of the review. Employees will not be responsible for any fees or charges associated with this medical exam.

e. **Voluntary Use of Air Filtering Respirators (i.e., Dust Masks)**

Under certain circumstances OSHA allows voluntary use of air filtering respirators, commonly referred to as dust masks. Only NIOSH approved filtering dust masks should be used. Users of filtering dust masks are not required to undergo fit testing. It will be the employee's supervisor's responsibility to inform the EHSRM of any voluntary dust mask usage prior to use. All other dust mask usage not condoned or approved by the EHSRM office is prohibited.

Users of Dust Masks must insure that they are donning a new, clean, and NIOSH approved dust mask prior to work being performed and once completed, properly dispose of used dust mask. Do not share or use a previously used dust mask. Consultation with EHSRM is recommended.

f. **Respirator Use under Special Conditions:**

The following are special situations, which may be encountered while wearing respiratory protective equipment:

(1) *Facial Hair*: Facial hair that lies along the sealing area of the respirator, such as beards, sideburns, mustaches, or even a few days growth of stubble, will not be permitted on employees who are required to wear respirators. Facial hair between the wearer's skin and the sealing surfaces of the respirator will prevent a good seal. A worker should not enter an area, in which it has been determined that respiratory protection is necessary, when conditions prevent a good seal of the respirator face piece to the face.

(2) *Eye Glasses*: Ordinary eyeglasses should not be used with full-face piece respirators. Eye glasses with temple bars or straps that pass between the sealing surface of a full - face piece and the worker's face will prevent a good seal. Special spectacle kits can be ordered and mounted inside a full-face piece respirator through the employee's supervisor.

Eyeglasses or goggles may interfere with the half face pieces. When interferences occur, a full-face piece with special corrective lenses may be necessary.

(3) *Contact Lenses*: Several factors may restrict or even prohibit the use of contact lenses while wearing any type of respiratory device. This is especially true of atmosphere-supplying respirators. With full-face pieces, incoming air directed toward the eye can cause discomfort from dirt, lint, or other debris lodging between the contact lens and the pupil.

Contact lenses should not be worn in hazardous environments without consultation with EHSRM. Instead the appropriate form of eye protection should be donned. This may come in the form of goggles or safety glasses.

(4) *Communication*: Verbal communication while wearing respiratory protection can be very difficult and may also contribute to a poor respirator seal. Therefore, hand signals may be an easier alternative. The hand signals should be worked out with the person you are working with prior to entry into a hazardous environment.

(5) *Temperature Extremes*: Low temperatures may cause respirator lenses to become fogged. Coating the inner surface of the lens with the anti-fogging compound should prevent this problem. Full-face pieces with nose cups that direct warm, exhaled air through the

exhalation valve without it's touching the lens are available. At very low temperatures, exhalation valves may freeze due to moisture.

- (6) *Physiological Response to Respirator Use:* Wearing any respirator, alone or in conjunction with other types of protective equipment, will impose some physiological stress on the wearer. Weight of the equipment, for example, increases the energy requirement for a given task. Selection of respiratory protective devices should be based on the breathing resistance, weight of the respirator, the type and amount of protection needed as well as the individual's tolerance of the given device.

Use of respirators in conjunction with personal protective equipment (PPE) can greatly affect the human response and endurance, especially in hot environments. Normally, in hot environments or during heavy work, the body relies a great deal on heat loss through the evaporation of sweat. With impermeable clothing, the heat loss due to water evaporation is not possible. Additionally, the weight of the respirator adds to the metabolic rate of workers, increasing the amount of heat the body produces. The net effect is one of heat stress.

When employees are wearing PPE the implementation of a work rest regimen should be implemented. This time spent working as opposed the time spent resting will be contingent upon the PPE being worn, temperature conditions, and physical demand of the work.

g. Program Administration

- (1) Respirators and accessories shall be available to all employees who require them for their assigned work exposed to a known contaminant above the Permissible Exposure Limit (PEL).
- (2) Respirators will be selected on the basis of hazards to which the person is exposed with consideration given to both safety and health factors, as well as to probable risks during routine operations and emergencies. Only NIOSH approved respirators shall be selected. Complete instruction on the use of respirators shall be given to those who use them. It is preferable that respirators are assigned to workers for their exclusive use.
- (3) Before initial use, each respirator must be properly fitted, leakage tests performed, and the face piece-to-face seal tested in a realistic test situation. Before each use, both positive and negative pressure tests shall also be conducted.
- (4) Respirators must be regularly cleaned and disinfected. Respirators should be stored in a convenient, clean, and sanitary location free of contaminants.
- (5) Respirators should be inspected during cleaning. Only trained personnel may replace worn or deteriorated parts with new parts. No attempt should be made to replace components or to make adjustments or repairs beyond the manufacturer's recommendations.
- (6) Workers shall be instructed and trained in the selection, use, care, and maintenance of respiratory protective devices. Training shall provide each user an opportunity to handle the

respirator, to have it fitted properly, to test its face piece-to-face seal, to wear it in normal air for a familiarization period, and to wear it in a realistic test atmosphere. Retraining shall be done as needed to maintain an effective program.

- (7) Supervisor should conduct regular inspections to determine the continued effectiveness of the program. Similarly, EHSRM will periodically evaluate the effectiveness of the program.
- (8) Only clean-shaven skin may be in contact with any respirator sealing sources. Even a mild growth of whiskers will interfere with this seal. Small beards and moustaches that fit entirely within the respirator face piece may cause an exhalation valve to fail if a hair becomes lodged in it. Thick hair styles may also create problems in maintaining proper tension of respirator head straps. In addition, respirators should not be worn when conditions such as sideburns, a skull cap that projects under the face piece, temple pieces on corrective spectacles or goggles, or the absence of one or both dentures prevent a good face piece to face seal. Therefore, while on duty, all employees within the scope of this policy must be clean shaven in the areas of the respirator face piece to face seal. If hair growth, other than in the clean shaven area of face piece to face seal, interferes with a satisfactory fit, then it must be altered or removed to eliminate interference with the fit.
- (9) Contact lenses shall not be worn when half mask respirators are used without the approval of EHSRM. Corrective lenses, which interfere with the face piece to face sealing area, must not be used unless fitted with a bar.
- (10) Users shall be medically cleared by a licensed healthcare professional before using a respirator. The examining physician will be given information about the equipment to be used.
- (11) Employees must not be assigned tasks requiring the use of a respirator unless it has been determined by a physician or licensed healthcare professional that they are physically and physiologically able to perform their work while wearing the prescribed respiratory protection at no cost to employee. The examining physician will provide written opinion indicating the ability of the employee to wear the prescribed respirator and recommendations on limited respirator use, if any.

h. Respirator Selection

- (1) The guidelines outlined in this section provide assistance in the selection of appropriate respiratory protection. It is important that the supervisor assess the potential hazards and degree of control which can be exercised over each situation, and require employees to use respiratory protective devices to protect their health.
- (2) The degree of respiratory hazard, as it refers to the selection and classification of respirators, depends upon several things, such as the atmospheric oxygen concentration; a contaminant's physical state, toxicity, and concentration; the presence of other contaminants or stress factors in the working environment; and worker exposure time and susceptibility. Respiratory hazards may be classified as gas and vapor contaminants

(immediately or not immediately dangerous to life or health), and oxygen deficiencies. Each classification requires a different type of respiratory protection.

- (3) In the selection and use of respiratory protective devices, various health and safety factors must be considered. For example, the characteristics of hazardous operation or process, the intended use and limitations of respiratory protective devices, the activity of workers in the hazardous area, the movement and work rate limitations, the lower flammability limits, protection factor, etc., must be taken into consideration while selecting respirators.
- (4) Factors used to select the appropriate respirators cartridges are sorbet efficiencies, poor warning properties, skin absorption, eye irritation, and conditions immediately dangerous to life or health (IDLH). Reference materials are available to assist in determining the general conditions or situations indicating the most appropriate use of respiratory protective devices, e.g. NIOSH Respirator Decision Logic

i. Training

- (1) *Initial Training:* Selecting the appropriate respirator for a given hazard is very important, but equally important is using the selected device properly. Proper use can be ensured by carefully training users in selection, use, fitting, and maintenance of respirators. Unless the reasons for the use of respirators and the instructions on proper use and maintenance are thoroughly understood and an ongoing training provided, the devices might not be used because it may not work properly. Therefore, a well-established training program is an essential component of a respiratory protection program and all employees whose work requires the use of respirators must attend it. A detailed training outline is provided in Attachment D and includes:
 - (a) Instructions in the nature of hazards and possible results of not using a respirator.
 - (b) Discussion on engineering and administrative controls.
 - (c) Recognition of emergency situations and methods of dealing with them.
 - (d) Discussion of why a certain type of respirator is used in a particular environment; also, description of types of respirators, their capabilities, and limitations.
 - (e) Proper selection, use, cleaning, and maintenance of respirators.
- (2) *Annual Training:* All employees using respirators will be retrained and fit tested annually.

j. Fit Testing

- (1) All fit-testing will be coordinated by EHSRM.
- (2) Each user must be fit-tested before initial use and at least annually thereafter.
- (3) The test will be performed using the respirator determined to be the most effective during fit-test for a particular individual.

- (4) Prior to the selection process, the test subject will be shown how to put on a respirator, how to adjust strap tension, and how to assess a "comfortable" respirator
- (5) Assessment of comfort includes reviewing the following points with the test subject:
 - (a) Proper placement of chin
 - (b) Position of mask on nose
 - (c) Strap tension
 - (d) Fit across nose bridge
 - (e) Distance from nose to chin
 - (f) Room to talk
 - (g) Tendency to slip
 - (h) Self-observation in mirror
 - (i) Adequate time for assessment
- (6) EHSRM will use a qualitative fit-testing procedure to determine satisfactory facial seal with negative pressure respirators, as described in Attachment E.
- (7) After passing the fit-test, the test subject will again be questioned about the comfort of the respirator. If it is uncomfortable, another model will be tried.
- (8) A person may use only that make and model respirator for which a satisfactory fit was completed. Under no circumstances an employee shall use a respirator if the qualitative fit-testing indicates an unsatisfactory fit.
- (9) Facial hair, scars, hollow temples, protruding cheek bones, absence of teeth or dentures, etc. may result in unsatisfactory fit. Employee must inform their supervisor of any such change.

k. Maintenance and Storage

- (1) *Maintenance*
 - (a) The supervisor shall ensure that all respirators are properly maintained. If they are modified in any way, their protection factors may be reduced. The plan should include inspection, cleaning and sanitizing, repair and storage.
 - (b) Each respirator must be cleaned and sanitized after each use as prescribed in Attachment F. The respirator shall be inspected after cleaning to determine any defects or if it needs any replacement of parts or repair.
 - (c) Only a qualified person with proper tools and replacement parts should repair respirators. No one should ever attempt to replace components or to make adjustments or repairs beyond the manufacturer's recommendations.
 - (d) A record of inspection dates, findings, and repairs should be maintained.
- (2) *Storage*
 - (a) Manufacturer's storage instructions are usually furnished with new respirators, and they should be followed.
 - (b) After a respirator have been inspected and cleaned, it should be stored so as to protect against dust, light, damaging chemicals, and temperature extremes.

- (c) Each unit shall be sealed in a plastic bag and placed in a separate box. It should not be hung or pressed against walls.
- (d) Cartridges must be stored, with their original seals intact, in their sealed plastic bag until ready for use.

l. Record Keeping

- (1) EHSRM shall maintain all medical clearance statements and necessary training and fit testing records as required by the applicable regulations. These records should include:
 - (a) Name of test subject
 - (b) Date of fit test
 - (c) Name and type of face piece satisfactory to test subject
 - (d) Challenge agent used
 - (e) Certificate from the licensed health care professional stating that the subject is physically able to use respirator
- (2) Supervisor shall maintain the records of inspection and maintenance of respirator.
- (3) Records shall be made available to the employees upon a written request

m. Program Evaluation

Wearing PPE of any type can cause undue stress on the individual wearing it. Therefore, engineering controls must be explored along with any other means to reduce employee exposure before utilizing PPE. If respirators must be used, supervisors through regular inspections and evaluations should determine the effectiveness of the respiratory protection program. EHSRM will assess the need for respiratory protection along with any changes (upgrade or downgrade) to the program.

DEFINITIONS

Aerosol is solid or liquid particles suspended in air.

Air-purifying respirator is a respirator in which ambient air is passed through an air purifying element, removing contaminants. Air is passed through the air purifying element by means of the breathing action or by a blower.

ANSI American National Standard Institute

Assigned protection factor (APF) is the minimum expected workplace level of respiratory protection that would be provided by a properly functioning respirator.

Atmosphere-supplying respirator is a class of respirators that supply a respirable atmosphere independent of the workplace atmosphere.

Canister/cartridge is a container with a filter, sorbent, or catalyst or combination which removes specific contaminants from the air as it passes through it.

Ceiling concentration is the concentration of an airborne substance that shall not be exceeded during any part of the working exposure.

Certified items are evaluated and listed as permissible by the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA).

Confined space is an enclosed space which has limited openings for entry and exit, unfavorable natural ventilation that could contain or produce dangerous air contaminants, could contain a hazardous atmosphere, and which is not intended for continuous occupancy.

Contaminant is a harmful, irritating, or nuisance airborne material.

Continuous flow respirator is an atmosphere supplying respirator which provides a continuous flow of respirable gas to the respiratory inlet covering.

Demand respirator is an atmosphere supplying respirator, which admits respirable gas to the face piece only when a negative pressure is created by inhalation.

Dust is an aerosol consisting of mechanically produced solid particles derived from the breaking up of larger particles.

End-of-service-life indicator (ESLI) is a system that warns the respirator user of the approach of the end of adequate respiratory protection. For example, that the sorbent is approaching saturation.

Escape-only respirator is a respirator intended only for use during emergency egress from a hazardous atmosphere.

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

Fit or seal check is a test conducted by the user to determine if the respirator is properly seated to the face.

Fit test is the use of a challenge agent to evaluate the fit of a respirator to a particular individual.

Fume is solid aerosols formed by condensation of a gas or a vapor. Fumes generally have a smaller particle size when compared to dusts.

Hazardous atmosphere is an atmosphere that contains contaminants in excess of the exposure limits or is oxygen deficient.

Helmet is a hood that offers head protection against impact or penetration.

High efficiency particulate air (HEPA) filter is a filter, which removes from air 99.97% or more of aerosols having a diameter of 0.3 micrometer.

Hood is a respiratory inlet covering which completely covers the head, neck, and may cover portions of the shoulder.

Immediately dangerous to life or health (IDLH) is any atmosphere that poses an immediate hazard to life or poses immediate irreversible debilitating effects on health.

Loose fitting face piece is a respiratory inlet covering that is designed to form a partial seal with the face, and may or may not protect the head against impact or penetration.

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

Mist An aerosol composed of liquid particles.

Negative pressure respirator is a respirator in which the air pressure inside the respiratory inlet covering is negative during inhalation with respect to the ambient air pressure.

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

Permissible Exposure Limit (PEL) is the maximum allowable concentration of a contaminant in the air to which an individual may be exposed. It may be expressed in short term or ceiling limits.

Poor warning properties are found in substances that its odor, taste or irritation effects are not detectable and not persistent at concentrations at or below the exposure limit.

Positive pressure respirator is a respirator in which the pressure inside the respiratory inlet covering is normally positive with respect to ambient air pressure.

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

Pressure demand respirator is a positive pressure atmosphere supplying respirator, which admits respirable, gas when the positive pressure is reduced inside the face piece by inhalation.

Qualitative fit test is a pass/fail fit test that relies on the individual's sensory response to detect the challenge agent.

Quantitative fit test is a fit test that uses an instrument to measure the challenge agent inside and outside the respirator.

Respirator is a personal device designed to protect the wearer from the inhalation of hazardous atmosphere.

Respiratory inlet covering is the portion of a respirator, which connects the wearer's respiratory tract to an air purifying device or respirable gas source, or both. It may be a face piece, helmet, hood, suit or mouth piece/nose clamp.

Self-contained breathing apparatus (SCBA) is an atmosphere supplying respirator in which the respirable gas source is designed to be carried by the wearer.

Service life is the period of time that a respirator provides adequate protection to the wearer.

Sorbent is a material which is contained in a cartridge or canister and removes specific gases and vapors from the inhaled air.

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

Tight fitting face piece is a respiratory inlet covering that is designed to form a complete seal with the face.

Time-weighted average (TWA) is the average concentration of a contaminant in air during a specific time period.

Vapor is the gaseous phase of matter which normally exists in a liquid or solid state at room temperature.

ATTACHMENT A - TYPES OF RESPIRATORS

1. INTRODUCTION

Respirators are divided into classes or types; air purifying and air supplying. In addition, these devices may be either tight-fitting, usually in the form of a face piece which covers at least the nose and mouth, or loose-fitting, which covers the head and, in some cases, the body. An important aspect of respirator operation and classification is the pressure within the face piece. The face piece pressure may be above or below the outside air pressure. If face piece pressure is lower than the outside air pressure, it is classified as negative; if above, it is positive. The concept of negative and positive pressure operation is extremely important when considering potential contaminant leakage into the respirator.

a. Tight-Fitting Respirators

A tight-fitting respirator usually has a face piece of molded rubber or plastic which adheres to the skin of the wearer. These units are usually available in three categories; quarter mask, half mask, and full face mask.

b. Loose-Fitting Respirators

In this case, breathing air is supplied by a hose which is attached to a helmet or suit. The air could be supplied from an external source or from a tank worn by the individual. For this type of unit, it is important that a sufficient quantity of air be provided to the wearer to ensure that there is an outward flow of air so that contaminants do not enter the breathing zone.

c. Negative-Pressure Respirators

This type of respirator must have a tight-fitting face piece. Air-purifying respirators are the most common negative pressure devices, although some air-supplied respirators also operate in the negative pressure mode. These air-purifying devices may be further divided into two major classes; aerosol removing and vapor and gas removing. In the former case, the removal process depends primarily on the size of the aerosol, regardless of the aerosol composition. In the latter case, the vapor or gas is absorbed onto an activated charcoal media or chemical, which may be selective in the material absorbed.

(1) Aerosols are removed from the breathing air by a variety of filters. All filtration mechanisms depend on passing the air through a fibrous media of some type. The mechanisms of impaction, interception, and diffusion are directly related to the size of the aerosol and the filter medium being used. Along with mechanical entrapment methods such as air impaction, various additives can be applied to the filter medium to increase efficiency. The most common additive is a resin with a high dielectric constant. As particles lodge on the filter, breathing resistance increases. This factor creates an excellent end of service life indicator.

(2) Dust and mist filters. Almost all approved dust filters also have an approval for mist. While some disposable respirators are made of fiberglass, most other dust/mist filters are made either of synthetic fibers, resin-impregnated wool, or synthetic fiber felt materials. The fiber media for disposables are usually thinner than the dust/mist filters.

- (3) Fume filters are used for protection against metal fumes such as those generated by welding. They are being replaced by high efficiency filters; thin sheets of filter material with small fiber diameter and high resistance to flow per unit area. The high efficiency filter must be 99.97 percent efficient against 0.3 um dioctyl phthalate aerosol. The high efficiency filter was originally designed for use in atmospheres containing radioactive particulates. However, its efficiency has made it popular for use with all highly toxic particulates.
- (4) Gas and vapor sorption respirators use a chemical bed either to adsorb or absorb the contaminant in question. The danger with this method is that of possible breakthrough of the chemical in question before the work period is completed. The most effective technique to counter this hazard is to calculate a conservative breakthrough time and change cartridges or connectors at that time. Ideally, cartridges should be disposed of after each day's activity.
- (5) Universal canisters do not offer the same duration of protection from a specific contaminant as does a canister which is designed for the contaminant in question. Universal canisters should be replaced after each use and they should never be used if only one specific contaminant is expected.
- (6) Pesticide cartridges and canisters were at one time tested against various pesticides. This program is no longer in existence. Now they are tested to prove whether they furnish protection against aerosols as well as organic vapors.
- (7) Combination. Cartridges and canisters are also designed to be combined to protect against aerosols and organic vapors. However, the size and weight of these cartridges may cause breakage of the face seal on most half-face respirators. A full-face respirator should be used when these types of cartridges are required. The issue of combination cartridge leakage will be determined by ANFT.

d. Air Supplied Respirators

This type of unit depends on air or oxygen supplied from an external source. The air or oxygen can be supplied in a demand, pressure demand, or continuous mode. When wearers of this type of respirator carry their own air or oxygen source, the unit is classified as either a closed circuit or open circuit breathing apparatus.

- (1) In the demand mode, a negative pressure is required inside the face piece to open a valve and permit air to enter the respirator. The negative pressure may draw contaminated air through any gaps in the face piece-to-face seal.
- (2) The pressure-demand mode allows a positive pressure to build up inside the face piece. Thus, any leaks in the face piece-to-face seal will result in air flowing out of the face mask. This feature will prevent any contaminated air from entering the face mask as long as the maximum flow rate of the regulator is not exceeded as a result of rigorous activity by the wearer.

- (3) In the continuous mode, air is constantly flowing to the respirator user, usually from an air compressor or compressed air tank. The flow must be regulated so that the user gets as much air as he needs, as well as additional air flow sufficient to maintain the pressure inside the mask.
 - (4) An open circuit SCBA consists of a compressed air tank, an airline and regulator, and a face piece from which the expired air is exhausted to the outside environment.
 - (5) A closed circuit SCBA does not exhaust the expired air to the outside. After the carbon dioxide has been removed from the exhaled air, it is placed in a breathing bag internal to the unit. At that point, oxygen is injected into the breathing bag and mixed with the expended air. This atmosphere is then supplied to the user.
- e. Powered Air-Purifying Respirators (PAPR)
- Essentially, the powered devices are air-purifying respirators with an electrically operated blower inserted between the face piece and the air-purifying element to provide the energy necessary to force air through the air-purifying unit and into the face piece. These respirators, however, are for air-purifying only and must never be used in an oxygen-deficient atmosphere.

2. TYPES OF RESPIRATORS

a. Air-Purifying Respirators

(1) Description

Half-mask, full face piece, or mouthpiece respirators equipped with air purifying units (filter, cartridge, or canister) to remove gases, vapors, and particulate matter from the ambient air prior to its inhalation. Some air-purifying respirators are blower-operated and provide respirable air to the face piece, helmet, or hood.

(2) Limitations

- (a) Air-purifying respirators do not protect against oxygen-deficient atmospheres or against skin irritation by, or absorption through the skin, of airborne contaminants.
- (b) The maximum contaminant concentration against which an air-purifying respirator will protect is determined by the designed efficiency and maximum concentration for which the unit is effective. The protection provided by these respirators is dependent on canister, cartridge, filter-type, concentration of contaminant, and the wearer's respiratory rate. As a limit, all chemical cartridges, as well as any universal chemical canisters, should preferably be discarded after each day's use. The proper type of cartridge, canister, or filter must be selected for the particular atmosphere and conditions.

(c) Air-purifying respirators may cause discomfort and objectionable resistance to breathing, and are of limited value in an atmosphere immediately dangerous to life and health (IDLH).

b. Gas and Vapor Removing Respirators

(1) Description

Packed sorbent beds (cartridge or canister) remove single gases or vapors (e.g., chlorine gas), a single class of gases or vapors (e.g. organic vapors), or a combination of two or more classes of gases and vapors (e.g. acid gases, organic vapors, ammonia, and carbon monoxide) by absorption, chemical reaction or a combination of these methods.

(2) Limitations

No protection is provided against particulate contaminants, unless specified on canister or cartridge label. Their use should be avoided in atmospheres where the contaminants lack sufficient warning properties (e.g. odor, taste, or irritation).

c. Particulate-Removing Respirators

(1) Description

These include all completely assembled respirators designed for use as respiratory protection during entry into a hazardous particulate atmosphere which contains adequate oxygen to support life. They are equipped with filters to remove a single type of particulate matter (e.g. dust) or a combination of particulate matter (e.g. dust and fumes) from air.

(2) Limitations

Protect against non-volatile particles only. No protection against gases and vapors.

(a) Half-mask face pieces

Fabric covering is permissible only in atmosphere of coarse dusts and mists of low toxicity. No protection is provided for the eyes.

(b) Mouthpiece Respirator

Nose clip must be firmly in place to prevent nasal breathing. Mouth breathing prevents the detection of any incidental vapor contaminants by odor. No protection is provided for the eyes.

d. Combination Gas, Vapor, and Particulate Removing Respirators

(1) Description

Includes all the devices discussed having either canisters or cartridges with filters for protection against dusts, mists, fumes, gases, and vapors. These include respirators which have been tested against lacquer and enamel mists (paint spray respirators).

(2) Limitations

The same limitations, as discussed for the other devices, also apply to the combination device, with the exception that it protects against gases, vapors and particulates.

e. Powered Air-Purifying Respirators (PAPR)

(1) Description

Air is drawn through a filter by a pump before it is delivered to the wearer. This airstream has the advantage of providing a cooling effect in warm temperatures. These respirators do not restrict mobility.

(2) Limitations

They are bulky, complex in design, and need continual maintenance, i.e., replacement of air-purifying elements. The battery has a limited life and the blower will have to be replaced periodically. Out-of-doors use presents special problems if hot or very cold air is supplied to the respiratory inlet covering.

f. Atmosphere Supplying Respirators

(1) Description

A respirable atmosphere is supplied independent of the ambient air surrounding the wearer. These devices provide protection against oxygen deficiency and most toxic atmospheres.

(2) Limitations

Except for the supplied-air suit, no protection is provided against skin irritation by materials such as ammonia and hydrochloric acid (HCl), or against absorption through the skin of such materials as hydrocyanic acid (HCN), tritium, or organophosphate pesticides. Face pieces present special problems for individuals required to wear prescription lenses.

g. Self-Contained Breathing Apparatus (SCBA)

(1) Description

Includes all completely assembled, portable, self-contained devices designed for use as respiratory protection during entry into and/or escape from hazardous atmospheres. A supply of air, oxygen, or oxygen-generating material is carried by the wearer. Its use is permissible in atmospheres immediately dangerous to life or health (IDLH).

(a) Closed-circuit apparatus

An apparatus of the type in which the exhalation is rebreathed by the wearer after the carbon dioxide has been effectively removed and a suitable oxygen concentration restored by a compressed or liquid oxygen source or an oxygen-generating solid.

(b) Open-circuit apparatus

Are apparatus of the following types from which exhalation is vented to the atmosphere and not re-breathed.

- Demand type apparatus
Is an apparatus in which the pressure inside the face piece in relation to the immediate environment is positive during exhalation and negative during inhalation? The demand valve permits oxygen or air-flow only during inhalation.
- Pressure-demand type apparatus
Is an apparatus in which the pressure inside the face piece in relation to the immediate environment is positive during both exhalation and inhalation? A warning device is provided to inform the wearer when the service life is at a low level.

(2) Limitations

The period of protection is limited by the amount of air or oxygen, the ambient atmospheric pressure, and the workload. Those SCBAs designed only for escape (self-rescue) from an IDLH atmosphere provide only a few minutes of service. The chief limitations of SCBAs are their weight and bulk, their limited service life, and the training required for their maintenance and safe use.

(a) Closed-circuit apparatus

The closed-circuit operation conserves oxygen and permits longer service life.

(b) Open-circuit demand and pressure demand

The demand type features a negative pressure in the face piece on inhalation whereas the pressure-demand type maintains a positive pressure in the face piece and is less likely to permit inward leakage of contaminants.

h. Supplied-Air Respirators

(1) Description

The air is supplied from an uncontaminated source through a hose. The source could be either a hand or motor-operated air blower or compressed air.

(2) Limitations

The wearer's movements are restricted by the hose and he must return to a respirable atmosphere by retracing his route of entry. The hose may be severed or pinched off or the source may fail.

(a) Hose Mask

There are two types of hose mask with blower; hand-operated or a motor driven blower; and there is a hose mask without blower, where the wearer provides the motivating force to pull air through the hose. The hose inlet must be located in a respirable atmosphere. Blower could fail, or hose pinched off. The length of hose may restrict application of the device.

(b) Air-line Respirators

These are of either the continuous flow type, the demand type, or the pressure demand type. The respirable air is supplied through a hose from a compressor or compressed air cylinder. The hose is attached to the wearer by belt and a flow control valve is provided to govern the rate of air-flow. These respirators provide no protection if air supply fails. Some contaminants, such as tritium, may penetrate the material of an air-line suite. Other contaminants, such as fluorine, may react chemically with the material of an air-line suite and damage it.

i. Emergency Egress Respirators

(1) Description

These may be either air-purifying or air-supplying. The air-purifying variety usually consists of a mouthpiece device with nose clamp and small canister, or a tight-fitting gas mask with full face piece, air hose, and large canister. Air-supplying devices are usually continuous flow devices with a universal hood over the user's head, or light weight short service-time demand SCBA type units which utilize a full, tight-fitting face piece. Continuous-flow devices may use compressed air or generate oxygen.

(2) Limitations

- (a) The mouthpiece-nose clamp device affords no protection for the wearer's eyes. In addition, this device must be used with extreme care-if the nose-clamp is not properly positioned, the protection received by the wearer may be reduced.
- (b) A gas mask should be used for escape from and not for entry into an IDLH atmosphere. The gas mask has the same limitations as any air-purifying respirator; if the full face piece does not fit properly due to improper size, facial hair, or eyeglasses, the protection factor of this device will be reduced. These devices may not be used in an oxygen deficient atmosphere.
- (c) The continuous-flow self-contained breathing apparatus with a universal hood will eliminate problems with improper fitting. However, many individuals experience difficulty slipping the plastic bag neck seal over their heads. This device is subject to over-breathing effects since it is a continuous-flow device. Because the air flow is insufficient to supply the needs of a wearer who becomes extremely excited and attempts a rapid egress from a dangerous situation, most manufacturers of these devices recommend that an individual stay calm and walk away from a serious situation. Since the hood is not tight-fitting, contaminants migrate up through the neck seal if the wearer over breathes the unit. If this type of unit is over-stressed in an oxygen deficient atmosphere, oxygen levels within the hood are further reduced.
- (d) Short service time-demand and pressure-demand SCBA escape units are bulky and some individuals may find them uncomfortable. Proper face fit is important, especially with the demand units.

ATTACHMENT B - ASSIGNED PROTECTION FACTORS FOR RESPIRATORS

Employers must use the assigned protection factors (APFs) listed in Table 1 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

Table 1 Assigned Protection Factors⁶

Type of respirator ^{1, 2}	Quarter Mask	Half Mask	Full Facepiece ³	Helmet/Hood	Loose-Fitting Face piece
1. Air-Purifying Respirator	5	⁴ 10	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	⁵ 25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	⁵ 25/1,000	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	.....

Notes:

¹Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

²The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

³Only full face piece respirators are to be used in contaminant concentrations.

⁴This APF category includes filtering face pieces, and half masks with elastomeric face pieces.

⁵The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting face piece respirators, and receive an APF of 25.

⁶These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d) (2) (ii).

ATTACHMENT C - TRAINING GUIDELINES FOR RESPIRATORY PROTECTION

1. RESPIRATORY HAZARDS

- a. Hazards
 - (1) O₂ deficiency
 - (2) Air contaminants gas, vapor, and particulate, eye irritants
 - (3) Toxicology of air contaminant
- b. Routes of Entry
 - (1) Oral
 - (2) Dermal
 - (3) Inhalation
- c. Comparison and Importance

2. CONTROL OF HAZARDS

- a. Engineering Control
 - (1) Substitution
 - (2) Containment
 - (3) Proper ventilation
 - (a) Local exhaust
 - (b) General exhaust
- b. Administrative Control
 - (1) Rotation
 - (2) Limiting access
- c. Use of Personal Protection Equipment
- d. Use of respirators

3. REGULATORY REQUIREMENTS

- a. OSHA requirements
- b. University Policy

4. TYPES OF RESPIRATORS

a. Air Purifying Respirators

- (1) advantages and disadvantages
- (2) particulate removal type
- (3) vapor and gas type
- (4) powered and non-powered

b. Atmosphere Supplying Respirators

- (1) Advantages and disadvantages
- (2) Airline respirator
- (3) Self-contained breathing apparatus (SCBA)
- (4) Combination

5. SELECTION OF A RESPIRATOR

a. Criteria for selection

- (1) Nature of hazard
- (2) Concentration and toxicity
- (3) Duration of exposure
- (4) Characteristics of toxic processes
- (5) O₂ deficiency

b. Respirator Protection Factors

c. Emergency

- (1) Recognition
- (2) Procedures

d. IDLH

6. MEDICAL EVALUATION

a. Importance

b. Frequency

7. FIT-TESTING

a. Reason for Fit-Testing

- b. Type of Fit-Testing
 - (1) Quantitative
 - (2) Qualitative
- c. Frequency of Fit-Testing
- d. Factors Affecting Fit-Testing

8. MAINTENANCE AND STORAGE

- a. Inspection
 - (1) Inspection for defects
 - (2) Inspection of air-purifying respirators
 - (3) Inspection of atmosphere-supplying respirators
 - (4) Inspection during cleaning
- b. Cleaning and Disinfecting
 - (1) Cleaning
 - (2) Rinsing
 - (3) Drying
 - (4) Disinfecting
 - (5) Reassembly
- c. Storage
 - (1) Avoid exposure to dust, sunlight, temperature extremes, moisture, chemicals, etc.
 - (2) Use a heavy duty re-sealable plastic bag for storage
 - (3) Do not hang respirator from straps
 - (4) Do not store in contaminated area

9. RESPONSIBILITIES

- a. Supervisor
- b. Employees
- c. EHSRM
- d. Physician/Licensed Health Care Professional
- e. Employees

10. ACTUAL FIT-TESTING

- a. Proper selection of respirators by employees
- b. Demonstration of donning and doffing
- c. Discomfort Check
- d. Difficulty in Breathing
- e. Proper Placement
- f. Demonstration of Negative and Positive Fit Check
- g. Noting Any Unusual Signs and Symptoms
- h. Performing Qualitative Fit-Testing as Described in Appendix E

ATTACHMENT D - QUALITATIVE FIT-TESTING PROTOCOL

1. REQUIREMENTS

Before any kind of fit-testing is done, each test subject must have written approval from the University Occupational Health Physician attesting that the individual is physically able to wear a respirator.

2. PROCEDURE

Irritant smoke can be used for both types of respirators. Air-purifying respirators should be tested with a commercially available smoke tube normally used to check the performance of a ventilation system.

Adequate ventilation should be provided when carrying out tests to prevent contamination of the room; or they should be conducted in a room that is not used for selection and fitting. The test subject must keep his/her eyes closed during the test.

The following procedure for fit-testing should be followed:

a. Respirator Selection

- (1) Only NIOSH approved respirators should be recommended for use.
- (2) Test subject should be allowed to select the respirator that is most comfortable.
- (3) Preferably, the fitting process should be conducted in a room separate from the fit test room to prevent contamination of the room. Prior to the selection, the test subject should be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension, and how to assess "comfort".
- (4) Assessment of comfort will include reviewing the following points with the test subject:
 - (a) Proper chin placement
 - (b) Positioning of mask on nose
 - (c) Strap tension
 - (d) Fitting across nose bridge
 - (e) Room for safety glasses
 - (f) Distance from nose to chin
 - (g) Room to talk
 - (h) Tendency to slip
 - (i) Cheeks filled out
 - (j) Self-observation in mirror
 - (k) Adequate time for assessment

- (5) The test subject will conduct the conventional positive-and negative-pressure fit cheeks (e.g. see ANSI Z88.2-1992), as described below. Before conducting these cheeks, the subject will be told to seat the mask by rapidly moving the head side-to-side and up and down, taking a few deep breaths.
 - (6) At this time, the test subject is ready for fit-testing.
 - (7) After passing the fit-test, the test subject will be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model should be tried.
- b. Negative Pressure Test
- The test subject should conduct this test after the selection of a comfortable respirator. It consists of closing off the inlet of the canister, cartridge, or filter (by covering with the palms or replacing the seals, or by squeezing the breathing tube so that air does not go through), then inhaling gently so that the face piece collages slightly, and holding the breath for ten seconds. If the face piece remains slightly collapsed and no leakage is detected, the respirator is considered tight enough. This test can be used only on respirators with tight-fitting face pieces.
- c. Positive Pressure Test
- Very much like the negative pressure test, this test is conducted by closing off the exhalation valve and exhaling gently into the face piece. The fit is considered satisfactory if slight positive pressure can be build up inside the face piece without any evidence of outward leakage. The test has some limitations depending on the type of respirator selected, which should be considered before making the test.
- d. Fit-Testing
- (1) Each respirator used for fitting and fit-testing will be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges will be changed at least weekly.
 - (2) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit-testing room.
 - (3) Each test subject will wear the respirator for at least ten minutes before starting the fit-test.
 - (4) The test subject should perform the following exercises for about one minute:
 - (a) Normal breathing
 - (b) Deep breathing
 - (c) Turning head from side-to-side, taking care that the movement is complete, the respirator is not bumped on the shoulders, and inhalation is done at either side.
 - (d) Nodding head up a down, with complete motions at a frequency of one per second and making sure that the respirator remains tight.
 - (e) Talking. Talk aloud and slowly for several minutes.

- (f) Normal breathing.
- (5) If the irritant smoke causes the test subject to cough, the test should be stopped, the respirator rejected, and another one selected.
- (6) Each test subject who passes the smoke test without evidence of a response is given a sensitivity check of the smoke from the same tube to determine whether the subject reacts to the smoke. Failure to evoke a response voids the fit-test.

ATTACHMENT E - PROCEDURES FOR CLEANING AND SANITIZING RESPIRATORS

The following procedures are recommended for cleaning and sanitizing respirators unless specified differently by the manufacturer.

1. When necessary, remove the following components of respirators-inlet covering assemblies before cleaning and sanitizing.
 - a. Filter, cartridge, canisters;
 - b. Speaking diaphragms;
 - c. Demand and pressure demand valves assemblies; and
 - d. Any components recommended by the respirator manufacturer.
2. Wash respirator in warm water with a mild soap solution using a sponge or cloth. A soft bristle brush may be used to facilitate removal of dirt or other foreign material.
3. Rinse respiratory inlet covering assemblies in clean, warm water.
4. Drain all water and air-dry the respiratory-inlet covering assemblies.
5. Clean and sanitize all parts removed from respiratory-inlet covering as recommended by the manufacturer.
6. Hand-wipe respiratory-inlet covering assemblies, all parts, and all gaskets and surfaces with damp lint-free clothe as needed to remove water residue and all foreign materials and let air dry.
7. Inspect parts and replace any, which are defective.
8. Reassemble parts on respiratory-inlet covering assemblies.
9. Attach new filters, cartridges, and canisters to respiratory-inlet covering.
10. Visually inspect and, where possible, test parts and respirator assemblies for proper function
11. Place assembled respirators in appropriate containers for storage.

Ultrasonic cleaners and dishwashers have been successfully used for cleaning and drying respirators. Exposure to temperatures above those recommended by the manufacturer (normally 49°C or 120°F maximum) is likely to damage the respirator. Cleaner sanitizers that effectively clean the respirator and contain a bactericidal agent are commercially available. The bactericidal agent frequently used is a quaternary ammonium compound.

Strong cleaning and sanitizing agents and many solvents can damage rubber or elastomeric respirator parts. These materials must be used with caution. Alternatively, respirators may be washed in a detergent solution and then sanitized by immersion in sanitizing solution. Some solutions, which have proven effective, are:

1. Hypochlorite solution (50ppm chlorine), two minute immersion
2. Aqueous iodine solution (50ppm iodine), two minute immersion
3. Quaternary ammonium solution (200ppm of quaternary ammonium compounds in water with less than 500ppm total hardness), two minute immersion

Different concentrations of quaternary ammonium salts may be required based on water hardness to develop a proper sanitizing solution. Inflammation of the user's skin may occur if the quaternary ammonium compounds are not completely rinsed from the respirator. The hypochlorite and iodine solutions are unstable and break down as time progresses; they may cause deterioration of rubber or elastic and may be corrosive to metallic parts. Immersion times should not be extended beyond the recommended time periods, and the sanitizers must be thoroughly rinsed from the respirator parts.

Respirators may become contaminated with toxic materials. If the contamination is light, normal cleaning procedures should provide satisfactory decontamination; otherwise separate decontamination steps may be required before cleaning. Follow manufacturer's recommendations.

ATTACHMENT F - RESPIRATOR INSPECTION CHECKLIST

Type of Respirator:	Location:
Respirator Issued to:	Type of Hazard:
Face piece	<input type="checkbox"/> Cracks, tears, or holes <input type="checkbox"/> Face mask distortion <input type="checkbox"/> Cracked or loose lenses/face shield
Head straps	<input type="checkbox"/> Breaks or tears <input type="checkbox"/> Broken buckles
Valves	<input type="checkbox"/> Residue or dirt <input type="checkbox"/> Cracks or tears in valve material
Filters/Cartridges	<input type="checkbox"/> Approval designation <input type="checkbox"/> Gaskets <input type="checkbox"/> Cracks or dents in housing <input type="checkbox"/> Proper cartridge for hazard
Air Supply Systems	<input type="checkbox"/> Breathing air quality/grade <input type="checkbox"/> Condition of supply hoses <input type="checkbox"/> Hose connections <input type="checkbox"/> Settings on regulators and valves
Rubber/Elastomer Parts	<input type="checkbox"/> Pliability <input type="checkbox"/> Deterioration