RESPIRATORY PROTECTION PROGRAM

CALIFORNIA STATE UNIVERSITY, FRESNO

OFFICE OF

ENVIRONMENTAL HEALTH AND SAFETY

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POLICY

It is the policy of California State University, Fresno insofar as is reasonable and practical, to ensure that employees are provided with and know how to properly use respiratory protection devices whenever they are or may be exposed to hazardous atmospheres or environments.

Employees who are or may be exposed to potentially hazardous atmospheres or environments shall be informed about the hazards of those environments and shall be provided with appropriate respiratory protection and trained in its proper use. No employee shall engage in, or be required to perform, any task that is determined to be unsafe or unreasonably hazardous.

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Joseph I Castro, President

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Deborah Adishian-Astone, Interim Vice President
for Administration

1.0 SCOPE

The purpose of this manual is to be a guideline to assist in protecting employees and complying with the Occupational Safety and Health Administrations (OSHA) Respirators Protection Standards in 8 CCR 5144 and 29 CFR 1910.134.

Jobs that may require the use of respirator protection include, but are not limited to, the following:

1. Open transferring of particulate or liquid materials.
2. Closed transferring of gaseous, liquid or solid materials where system leaks or spills are a potential problem.
3. Grinding, cutting or otherwise machining of solid materials that may liberate significant quantities of uncontrolled dust.
4. Chemical mixing, reacting or processing where the components, intermediates and/or final products may become airborne.
5. Use of materials with poor warning properties where overexposure may occur.
6. Manufacturing operations that require entry into oxygen deficient or potentially oxygen deficient atmosphere.
7. Maintenance requiring entry into confined work spaces or below-grade areas where oxygen deficiency may be a problem or where toxic materials may overcome employees.
8. Maintenance in areas processing, handing, storing or disposing of potentially toxic materials(s).
9. Maintenance that in and of itself liberates dusts, fumes, mists, vapors or gases.
10. Construction or dismantling operations where dusts, fumes, mists, vapors or gases are liberated.
11. Cleanup, turn around change-over operations that use organic solvents, acids or alkalis and/or that may liberate dusts, fumes, mists, vapors or gases.
12. Under emergency conditions (spills, vessel or pipe ruptures, unexpected chemical reactions, or other incidents) where potentially hazardous materials are released for escape, rescue, repairs or shutdowns.

Note: Respirators should not be used arbitrarily by any employee. Respirators should not be used to quiet employee complaints of exposure. A full investigation of the exposure complaint should be undertaken and appropriate corrective action taken, which may include the use of respiratory protection.

1.1 Administrative Responsibilities

The person selected to head the respiratory protection program should be adequately trained in all aspects of respiratory protection and have the ability to administer this often complex program.

Effective program administration will include the following:

1. Hazard assessment to determine the type and concentration of air contamination found in production areas and the conditions that may be found in maintenance or emergency situations.

2. Respirator selection using the guidelines set forth in this manual.

3. Worker training in the proper use of respirators.

4. Respirator fitting.

5. Maintenance and cleaning procedures.

6. Purchasing procedures and inventory control.

7. Guidelines for emergency respirator use.

8. Medical surveillance of employees using respiratory protection devices.

9. Program evaluation for effectiveness.

1.2 Requirements For The Respiratory Protection Program

1. Written standard operating procedures governing the selection and use of respirators shall be established.

2. Respirators shall be selected on the basis of the hazards to which the worker is exposed.

3. The user shall be instructed and trained in the proper use of respirators and their limitations.

4. The respirators will be assigned to individual workers for their exclusive use.

5. Respirators shall be regularly cleaned and disinfected. Those issued for the exclusive use of one worker should be cleaned after each day's use, or more often if necessary.

6. Respirators shall be stored in a convenient, clean and sanitary location.

7. Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency us such as self-contained devices, shall be thoroughly inspected at least once a month and after each use.

8. Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.

9. There shall be regular inspection and evaluation to determine the continued effectiveness of the program.

10. Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually).

11. Approved or accepted respirators shall be used when they are available. The respirator furnished shall provide adequate respirator protection against the particular hazard for which it was designed in accordance with standards established by competent authorities.

12. All forms will be filled out and filed with the EHS RMS Office prior to respirator use.

1.3 Classification of Respiratory Hazards

Respirators, particularly air-purifying ones, are designed and selected on the basis of the chemical and physical properties of air contaminants. Therefore, gas, vapor and particulate contaminants are listed according to their physical and chemical properties. Some principal respiratory hazards are defined as follows:

1. Dust: A solid, mechanically-produced particle with sizes varying from submicroscopic to visible or macroscopic. A pneumoconiosis-producing dust is one which, when inhaled, deposited and retained in the lungs, may produce symptoms of pulmonary disease.

2. Spray: A liquid, mechanically-produced particle with sizes generally in the visible or macroscopic range.

3. Fumes: A solid condensation particle of extremely small particle size, generally less than one micron in diameter.

4. Mist: A liquid condensation particle with a size ranging from submicroscopic to visible in diameter.

5. Fog: A mist of sufficient concentration to perceptibly obscure vision.

6. Smoke: A system which includes the products of combustion, pyrolysis or chemical reaction of substances in the form of visible and invisible solid and liquid particles and gaseous products in the air. Smoke is usually of sufficient concentration to perceptibly obscure vision.

7. Inert: Substances that do not react with other substances under most conditions, but create a respiratory hazard by displacing air and producing oxygen deficiency (for example: Helium, Neon, Argon).

8. Acidic: Substances that are acids or that react with water to produce an acid. In water, they produce positively charged hydrogen ions (H^+) and have a pH less than 7. They taste sour and many are corrosive to tissues (for example: hydrogen chloride, sulfur dioxide, fluorine, nitrogen dioxide, acetic acid, carbon dioxide, hydrogen sulfide and hydrogen cyanide).

9. Alkaline: Substances that are alkalines or that react with water to produce an alkali. In water, they produce negatively charged hydroxyl ions (OH^-) and have a pH greater than 7. They taste bitter and many are corrosive to tissues (for example: ammonia, amines, phosphine, arsine, and stibine).

10. Organic: The compound of carbon. Examples are saturated hydrocarbons (methane, ethane, butane), unsaturated hydrocarbons (ethylene, acetylene), alcohols (methyl ether, ethyl ether), aldehydes (formaldehyde, ketones (methyl ketone), organic acids (formic acid, acetic acid), halides (chloroform, carbon tetrachloride), amides (formanide, acetamide), nitriles (acetonitrile), isocyanates (toluene diisocyanate), amines (methylamine), epoxies (epoxyethane, propylene oxide) and aromatics (benzene, toluene, xylene).

11. Organometallic: Compounds in which metals are chemically bonded to organic groups (for example: ethyl silicate, tetraethyl lead and organic phosphate).

12. Hydrides: Compounds in which hydrogen is chemically bonded to metals and certain other elements (for example: diborane and tetraborane).

13. Oxygen Deficiency: The normal content of oxygen in the air is 20.9% by volume. Oxygen concentrations below 16% will not support combustion and are considered unsafe for human exposure because of harmful effects on body functions, mental processes and coordination. Current legislation requires that the oxygen percentage in the working place be not less than 19.5%.

1.4 Standard Operating Procedure For the Issue of Respiratory Protection Equipment

The following procedures will be used to ensure that respirators are issued to properly trained personnel and that the appropriate respirator for the hazard is selected:

1. All persons that have received respirator training and have passed a fit test of a respirator will be issued a course completion card.

2. Information on the face of the card will explain what respirator was selected for the operations the individual normally performs. The style and size of respirator fitted will also be listed on the back of the card. Any request for equipment other than that listed on the card will be approved by the Environmental Health and Hazardous Materials Manager.

3. A respirator issue log will be maintained for all transactions to aid in the control and inspection of respirators, with a copy sent to the Environmental Health and Hazardous Materials Manager.

4. All efforts will be made to ensure that where practicable, respirators will be issued and assigned to individual workers for their exclusive use.

5. Issue will not be performed until all initial hygiene testing and respirator selection processes have been completed.

1.5 Request For Medical Clearance For Respirator Use

This form is used to evaluate the present health condition of each employee who will be issued a respirator. It is important to know the health problems if any of each individual so that corrective measures can be followed in the issuance of respirators.

This form in its completion certified that the intended employee has been medically examined and classed for the use of a respirator.

1. No restrictions on respirator use.

2. Some specific use restrictions.

3. No respirator use permitted.

No employee shall be issued or use any respirator, gas mask, self-contained breathing apparatus (SCBA) etc., without having completed a medical clearance form.

1.6 Respirator Issuance and Fit Test

The Respirator Issuance and Fit Test Form, when completed allows the Safety Officer to locate and track required maintenance, fitting restrictions, limitations and type of respirator issued. When the individual signs this form he/she consents to have read the Respiratory Protection Program and understands its policies towards maintenance limitation and safe practices while working in a hazardous environment. If you have any questions at any time concerning the program, please contact your department manager or the Office of Environmental Health & Safety, Risk Management and Sustainability (EHS RMS) at (559) 278-7422.

1.7 Periodic Review of Medical Status

On an at least annual basis the employee's health status shall be reviewed to determine if any of the following have occurred:

1. the employee has reported medical signs or symptoms that are related to ability to use a respirator;
2. the supervisor or a health care professional recommends that an employee be reevaluated;
3. information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or
4. a change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

The review shall be conducted either through direct contact with the employee or the employee's supervisor. If it is determined that any of the above conditions have occurred then the employee shall complete the periodic review questionnaire and submit it to a physician for review. The physician will determine if further medical evaluation is indicated.

2.0 MEDICAL SURVEILLANCE

2.1 Introduction

OSHA 29 CFR 1910.134 (b) (10) and CAL-OSHA 8 CCR 5144 require that no employee be assigned to a task that requires the use of a respirator, unless it has been determined that the person is physically able to perform under such conditions. In addition, once a determination is made as to physical ability to wear a respirator and perform the work task, a review of the employee's health status must be made periodically -- for instance, "annually." A physician with knowledge of pulmonary disease and respiratory protection practices should determine what medical factors are pertinent, which tests will be performed and ultimately whether of not an employee may wear a respiratory protection device.

2.2 Physiological Factors

Wearing any type of respirator imposes some physiological stress on the wearer. With air-purifying devices, resistance to inhalation is always experienced because the filter or chemical cartridge restricts air flow; in addition, the wearer must work against the exhalation valve upon expiration. Similar breathing resistance will be encountered when using demand-type air-line respirators or self-contained breathing apparatus (SCBA). The exhalation valve used in pressure-demand SCBA or air-line devices is designed to always maintain positive pressure within the mask; therefore, significant exhalation breathing resistance is encountered when using this equipment.

The bulk and weight of SCBA (up to 34 lbs.) will be of some concern especially when the employee must perform strenuous work. Air-line respirator units require that the wearer drag around the air-line hose, which will also add to the stress of job performance.

2.3 Pulmonary Factors

Respirator wearers should be examined for any evidence of respiratory impairment such as emphysema, obstructive lung disease, bronchial asthma, etc. Historical and clinical evidence of impairment of pulmonary function, including x-ray findings, a reduction in vital capacity or forced expiratory volume, may justify forbidding a person to wear a respirator that restricts inhalation and exhalation (the individual may be able to perform adequately in a continuous-flow supplied air device). BREATHING DIFFICULTY MANY NOT, IN AND OF ITSELF, PROHIBIT THE WEARING OF A RESPIRATOR IF THE EMPLOYEE IS REASONABLY COMFORTABLE USING THE DEVICE, AND A PROPER MEDICAL CLEARANCE HAS BEEN OBTAINED, ESPECIALLY WHEN SUCH A PROHIBITION MIGHT DEPRIVE THE LIVELIHOOD OF THE INDIVIDUAL.

2.4 Cardiovascular Factors

The use of air-purifying, demand-type or pressure-demand supplied air devices may pose a serious problem for employees with cardiovascular disease. These people may be able to use continuous-flow devices. As always, the physician must make the final determination.

Serious consideration should be given to the assignment of employees with cardiovascular disease to a job where they need NOT respond to an emergency situation or escape from a contaminated area with respiratory protective devices.

2.5 Health Problems

Conditions that may prevent an employee from wearing a respirator, and thus from working in a contaminated area, include:

1. Diabetes, insipidous or mellitus;

2. Epilepsy, grand mal or petit mal;

3. Alcoholism;

4. Use of certain medication;

5. Punctured ear drum;

6. Skin sensitivities;

7. Impaired or non-existent sense of smell;

8. Emphysema;

9. Chronic pulmonary obstructive disease;

10. Bronchial asthma;

11. X-ray evidence of pneumoconiosis;

12. Evidence of reduced pulmonary function;

13. Coronary artery disease or cerebral blood vessel disease;

14. Severe or progressive hypertension;

15. Anemia, pernicious;

16. Pneumomediastinum gap;

17. Communication of sincus through upper jaw or oral cavity;

18. Experiences breathing difficulty when wearing a respirator;

19. Experiences claustrophobia when wearing a respirator;

20. Any other condition that the plant physician determines to place the employee at added physical risk.

2.6 Facial Limitation

Facial deformities or excessive facial hair, as determined by the examining physician, may prohibit wearing of certain types of respirator facepieces or mouthpieces, since the face-to-facepiece seal nay not be adequate or reliable.

2.7 Psychological Limitation

While somewhat less clearly defined than physical limitations in respirator usage, psychological factors may prevent an employee from wearing a respirator. A physician should be consulted for advice in these cases.

A somewhat more difficult problem to deal with is discomfort. A respirator that is improperly fitted or that causes continual discomfort will inevitably result in an industrial relations problem. These problems can generally be avoided by proper fitting, education and training.

3.0 INTRODUCTION TO SELECTION AND USE

The following sections provide information for selecting respirators for most manufacturing and maintenance operations.

Respirators must be selected on the basis of the hazards to which employees are exposed. The following decision considerations will help the plant respiratory protection program administrator select the correct equipment.

3.1 Decision Considerations

1. What is the estimated contaminant concentration where the respirator will be used, as determined by industrial hygiene monitoring information?

2. What is the permissible exposure limit (PEL) of the contaminant, threshold limit value (TLV) and short term exposure limit (STEL)?

   Health standards for many specific substances are available. The OSHA Standard 29 CFR 1910.1000, Tables Z1, Z2 and Z3, gives the required PEL's when no health standards supersede these tables. However, since these tables are established from the 1969 TLV list, good industrial hygiene practice would base respirator selection on current TLV's if lower, or other new toxicity data.

3. Is the contaminant a gas, vapor, mist, dust or fume?

   This information can be determined by studying the manufacturing or maintenance processes, raw materials, intermediate products, by-products and the wastes. See Safety Data Sheets when available.

4. Could the contaminant concentration be termed immediately dangerous to life or health?

   This knowledge is derived from the manufacturer of raw materials, the process engineer or chemist, the company or plant industrial hygienist, and Safety Data Sheets, when available. In addition, consideration should be given to the potential for contamination of atmospheres under abnormal or emergency considerations.

5. If the contaminant is flammable, does the estimated concentration approach the lower explosive limit (LEL) or do dust concentrations create a potential explosion problem?

   Besides creating a potential fire and explosion condition, in most situations flammable vapor or gas concentrations exceeding the LEL are immediately dangerous to life and health. Plant gas or vapor levels can be determined with an explosion meter. Here too, consideration should be given to emergency (such as spill) conditions.

6. Does the contaminant have adequate warning properties?

   Manufacturers can supply such information, directly through Safety Data Sheets. Warning properties such as odor, irritation or taste should ideally be present at concentrations at or below the PEL.

7. Will the contaminant irritate the eyes at the estimated concentration?

   Frequently this will be self-evident if the operation is in progress. This information too, is available from the Safety Data Sheets of the raw materials. For irritation materials, a full facepiece respirator should be employed.

8. If the contaminant is a gas or vapor, is there any available sorbent that traps it efficiently?

   Respirator manufacturers and company or plant industrial hygienists can provide this information.

9. Can the contaminant be absorbed through the skin as a vapor or a liquid? If so, will it significantly add to the employee's exposure and cause injury?

   Skin absorption is indicated in the OSHA Standard 29 CFR 1910.1000, Table Z1, by the notation "skin" after the material name. Material Safety Data Sheets will also indicate skin absorption potential.

10. What is the size of the employee's face?

    Some manufacturers offer the same model respirator in two or three sizes. This will help to fit most employees properly with one brand of respirators.

11. What types of respirators will give the required maximum use concentration (MUC)?

    The MUC is a measure of the degree of protection provided by a respirator to a wearer. It takes into account the respirator to wearer. It takes into account the respirator limitations and the ability of a user to get a satisfactory fit. Multiplying the PEL (or STEL) by the protection factor assigned to a respirator gives the maximum use concentration (MUC) of the hazardous material for which the respirator can be used. (MUC = PEL x Protection Factor).

3.2 <u>Respirator Assignment</u>

Where at all practicable, respirators should be assigned on an individual basis. Each employee should be responsible for assuring that their equipment is kept clean, sanitary and in good working order. These respirators should be durably marked with the employee's I.D.

3.3 Considerations For Routine Respirator Use

"Routine" use of a respirator connotes daily or frequent use on a regular basis. For such use, a respirator of low initial cost, simple maintenance (to keep operating costs down), minimal wearing discomfort, low resistance to breathing, light-weight and compact construction should be considered. Non-powered air-purifying respirators (disposable or reusable) and air-line respirators are suitable.

3.4 Selection

Once questions (1) through (11) have been answered and decisions have been made as to routine or emergency use of respirators, consult the individual respirator guide to selection and use, below, on this page and on page 28.

3.5 Approved Equipment

The OSHA Standards dealing with respiratory protection required that approved or accepted equipment be used when available. There are few, if any, work conditions in industry today for which an approved respirator does not exist. Therefore, companies should ensure that equipment is use is approved.

Approval is granted by NIOSH/MSHA. Plants should specify to vendors that only NIOSH/MSHA approved equipment will be accepted. Such equipment will have a special logo on the packaging material along with an approval number (TC-XXX-XXX).

All component and replacement parts must also have NIOSH/MSHA approval. In addition, respirators are approved as a system. Cartridges, canisters, filters, air-lines and regulators cannot be interchanged between equipment of different manufacturers or even between equipment of a given manufacturer unless specifically approved.

3.6 Assigned Protection Factor (APF)

This is the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program. See Table 1 to select an APF for specific types of respirators. For some types of regulated substances, you will need to consult with EH&S.

3.7 Maximum Use Concentration (MUC)

This 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 APF of the respirator or class of respirators and the PEL of the hazardous substance. The MUC can be determined by multiplying the APF of the respirator by the PEL of the substance.

3.8 General Considerations And Limitations

1. MECHANICAL FILTER RESPIRATORS MAY NOT BE USED IN ENVIRONMENTS IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH) OR IN ATMOSPHERES CONTAINING LESS THAN 19.5% OXYGEN.

2. Highly toxic materials – High-efficiency filter cartridges must be employed when the respirator wearer is exposed to highly toxic particulate matter or to radionuclides.

3. Particulate and gas/vapor exposures – When dusts, mists, fumes or radionuclides are present at the same time as vapor or gaseous contaminants, a combination gas/vapor-dust device must be employed. Consult Chemical Cartridge Respirators for further information.

4. Eye irritation – When working in contaminated environments where eye irritation is a consideration, a full facepiece unit must be used.

5. Nuisance dusts – Any filter respirator may be used for nuisance dusts.

3.9 Respirator Selection

Select the respirator system according to the Mechanical Filter Respirator Use Table. In addition, consideration must be given to the increased breathing resistance that develops as contaminants collect on the filter. DO NOT USE A MORE EFFICIENT RESPIRATOR FILTER OR CARTRIDGE THAN NECESSARY SINCE THE USE TIME OF THE UNIT WILL BE CONSIDERABLY REDUCED COMPARED WITH ONE OF THE CORRECT EFFICIENCY. For example, do not use a fume type cartridge for nuisance dust as it will clog up rapidly. For the same reason, do not use a dust/fume/mist unit for asbestos or silica. Refer to Mechanical Respiratory Filter Selection Table.

3.10 Respirator Use

1. After the correct filter, cartridge or disposal device has been chosen, place the cartridge or filter in the unit (not applicable for disposal units) and check for intactness. See section on Inspection, Cleaning, Maintenance and Storage for details.

2. Fit the respirator as outlined in section, “RESPIRATOR FIT TESTING.”

3. The filters, cartridges or disposable respirators may be used until breathing resistance increases to an “uncomfortable” level.

4. Filters and cartridges may be used on successive days until breathing resistance indicates replacement is necessary. The respirator should be stored as outlined in, "RESPIRATOR STORAGE."

5. Inspect, clean and maintain respirators as outlined in this program.

4.0 CHEMICAL CARTRIDGE RESPIRATORS

4.1 Introduction

Chemical cartridge respirators can protect against low concentrations of organic vapors and gases, alkaline gases, acid gases, mercury vapors, pesticides, paint vapors and mists, organic vapors or gases combined with acid or alkaline gases, and any of the above materials combined with dust, fumes or mists.

4.2 Maximum Use Concentrations (MUC)

In general, half mask style units can be used up to 10 times the substance PEL or 1000 ppm, whichever is lower*. Full facepiece units may be used up to 100 times the PEL or 1000 ppm, whichever is lower*. For certain gases and vapors with lower limits, the specified limit will govern the respirator usage. At no time should the respirator be used in environments that exceed the MUC.

4.3 General Considerations and Limitations

1. CHEMICAL CARTRIDGE RESPIRATORS MAY NOT BE USED IN ENVIRONMENTS IMMEDIATELY DANGEROUS TO LIFE OR HEALTH OR IN ATMOSPHERES CONTAINING LESS THAN 19.5% OXYGEN.

2. Warning properties of contaminant – Chemical cartridge respirators should not be used for exposure to air contaminants that cannot be easily detected by order or irritations. For example, chloride or hydrogen sulfide. The former is odorless; and the latter, while foul-smelling, paralyzes the olfactory nerve so quickly that odor detection is unreliable.

3. Eye irritation – When working in environments where concentrations are irritating to the eyes, full facepiece units must be used.

4. Chemical cartridge respirators cannot be used for protection against gases that are not effectively stopped be chemical fills utilized; for example, carbon monoxide.

DO NOT USE chemical cartridge respirators for the following materials:

1. Acrolein
2. Aniline

15. Methylene Biphenyl Isocyanate
16. Nickel Carbonyl

3. Arsine
4. Bromine
5. Carbon Monoxide
6. Dimethylaniline
7. Dimethyl Sulfate
8. Hydrogen Cyanide
9. Hydrogen Fluoride
10. Hydrogen Selenide
11. Hydrogen Sulfide
12. Methanol
13. Methyl Bromide
14. Methyl Chloride
17. Nitro Compounds:
    - Nitrobenzene
    - Nitrogen Oxides
    - Nitroglycerin
    - Nitromethane
18. Ozone
19. Phosgene
20. Phosphine
21. Phosphorus Trichloride
22. Stibine
23. Sulfur Chloride
24. Toluene Diisocyanate
25. Vinyl Chloride

NOTE: The above list is far from complete and is offered only as a guide to proper evaluation of the many contaminants found in industry.

4.4 Cartridge Selection

Select the cartridge or cartridge filter group that best fits the employee exposure. USING THE WRONG CARTRIDGE AND FILTER MAY BE LIKE USING NO RESPIRATORS AT ALL! For example, you cannot use an acid gas respirator for protection against organic vapors. You can however, use an organic vapor-acid gas respirator for one or both of the exposures. Check and recheck the label on the cartridges to make sure the correct ones are issued. See Cartridge Selection Table.

4.5 Respirator Use

1. After correct cartridges have been selected, screw the cartridges into the facepiece after checking it for intactness; see Inspection, Cleaning, Maintenance and Storage. Make sure cartridge seals (part of package) have been removed.

2. Fit the respirator as outlined in section titled Qualitative or Quantitative Fitting.

3. The cartridges may be used until the odor of the contaminant can be smelled, irritation occurs or the substance can be tasted by the wearer.

4. Do not use cartridges after expiration date printed on the label.

5. If the facepiece and cartridges are used by one employee and the cartridges are not used until exhaustion, they may be resealed after use, by the employee and reused at a future time. This may be done until cartridge exhaustion.

6. Inspect, clean and maintain respirators as outlined in the operating procedure for care, cleaning and maintenance of respirators.

7. Some manufacturers now supply a given model respirator in different sizes so that most employees can be fitted with a single brand of respirator.

5.0 GAS MASKS

5.1 Introduction

Gas masks protect against relatively high concentrations of organic vapors of gases, alkaline gases, acid gases, pesticides, paint vapors and mists, radioactive particulates, dust mists, fumes, and certain combinations of the above materials. Nearly all gas masks contain combinations of the above materials. Nearly all gas masks use full facepieces. Two basic styles of canisters are in use: a chin-type that screws directly into the facepiece, and a canister-type that connects to the facepiece with a hose and straps to the wearer's body with a harness. The configuration chosen will depend on concentrations encountered and the length of time required for task performance. GAS MASKS MAY BE USED FOR ESCAPE FROM IDLH ATMOSPHERES, BUT NEVER FOR RE-ENTRY INTO SUCH ENVIRONMENTS. Gas masks may also have routine precautionary applications in operations where IDLH atmospheres may develop rapidly in process excursions or upset conditions. Additionally, gas mask canisters provide a sorbent system for some air contaminants for which chemical cartridges are inadequate. Consult the manufacturer of such equipment to answer any question.

5.2 Maximum Use Concentrations

Generally, chin-type canisters may be used in concentrations up to 0.5% (5000 ppm); industrial size canisters may be used in environments up to 2% (20,000 ppm), or, in ammonia environments, up to 3% (30,000 ppm). HOWEVER, THE MUC WILL PROBABLY BE GOVERNED BY THE FITTING METHOD USED. Thus, if qualitative fitting methods are used, a gas mask with a full-facepiece has an MUC of 100 or 1000 if quantitative fitting is performed. The service life of the canisters at the upper limit concentrations should not exceed 30 minutes. When heavy work is performed, the service time may be less. The super size canister (similar to the industrial gas mask, but somewhat larger), has approximately twice the useful time of the industrial unit. "N" type canisters, (a multi-contaminant unit) has approximately half the use time of the industrial canister, but are not used much anymore.

5.3 General Considerations And Limitations

1. GAS MASKS MAY NOT BE USED IN ENVIRONMENTS CONTAINING LESS THAN 19.5% OXYGEN.

2. Gas masks must never be used if the specific exposure concentration is suspected of exceeding the canister limitations. In such cases, only a self-contained breathing apparatus should be used.

3. Gas masks are not to be used in fire fighting or fire rescue.

4. The use of gas masks should be limited to emergency operations and in occasional situations where provisions have been made for a speedy rescue of the gas mask wearer. Where possible, the use of self-contained breathing apparatus should be substituted for gas mask equipment.

5. At very high concentrations of certain contaminants, notably carbon monoxide, high temperatures may develop inside the canister designed for that contaminant. When this occurs, the breathing air will become hot. The wearer should leave the area at once.

6. If gas masks must be used routinely against a substance that may be absorbed through the skin, then all exposed skin must be covered by protective clothing. In emergency situations where masks are used for escape, it would be difficult to meet this requirement and it should be ignored.

5.4 <u>Canister Selection</u>

Select the canister that best fits the employee exposure. A canister designed for a single contaminant provides longer protection than one designed for multiple gaseous or vapor contaminants. Where dust, mists and fumes are present, a canister incorporating the proper filter should be employed. Consult canister manufacturers as to proper canister selection for each given situation. OSHA 1910.1017, has special requirements for vinyl chloride respirator selection and use. This standard should be observed in making respirator selection.

5.5 <u>Gas Mask Use</u>

1. After the correct canister has been selected, place the canister in its harness and attach facepiece hose. For chin-type canisters, screw the canister into the facepiece. Check the equipment for intactness. Check hoses, valves, harness and facepieces for cracks and worn parts. See section on Inspection. Cleaning, Maintenance and Storage.

2. Fit and train all employees using gas masks as outlined in Section A, Issuance and Training.

3. Canisters may be used may be used until:

    a. Canister indicator (on canisters so equipped) changes color.
    b. Breakthrough is detected by smell, taste, or eye, nose, or throat irritation.
    c. Breathing resistance develops. Generally, it is a good practice to replace canisters periodically during use, such as every 20-30 minutes - a safety factor established by experience should be built into the periodic replacement period.

4. After a canister has been used it must be destroyed to prevent accidental reuse. NEVER USE A USED CANISTER OR ONE THAT HAS BEEN DAMAGED. When in doubt, use a new canister.

5. Never use an outdated canister. Discard all such units.

6. Inspect and maintain gas masks after each use as outlined in the Procedures for Care, Cleaning and Maintenance of Respirators.

5.6 Caution

Many injuries and fatalities have been reported over the years through improper use of gas mask equipment. Where possible, avoid the use of this type of equipment for routine operations. The concentration encountered where gas masks are in use shall not pose an immediate hazard to life or health unless the gas mask is to be used for escape only. It is absolutely necessary to train all gas mask users and their supervisors in all phases of equipment use.

6.0 SUPPLIED AIR RESPIRATORS

The respirable air supply is not limited to the quantity the individual can carry, and the devices are lightweight and simple.

Limitations: Limited to use in atmosphere from which the wearer can escape unharmed without the aid of the respirator.

The wearer is restricted in movement by the hose and must return to a respirable atmosphere by retracing his route of entry. The hose is subject to being severed or pinched off.

1. Hose Mask

   The hose inlet or blower must be located and secured in a respirable atmosphere.

   a. Hose mask with blower.
      If the blower fails, the unit still provides protection, although a negative pressure exists in the facepiece during inhalation.
   b. Hose mask without blower.
      Maximum hose length may restrict application of device.

2. Air-line Respirator (Continuous Flow, Demand and Pressure-Demand Types).

   The demand type produces a negative pressure in the facepiece on inhalation, whereas continuous flow and pressure-demand types maintain a positive pressure in the respiratory-inlet covering and are less apt to permit inward leakage of contaminants.

7.0 HOODED RESPIRATORS

These devices look somewhat like a space suit helmet, and cover the head and shoulders. Usually they are supplied with filtered air blown through the hood by motorized fan. The units may be powered by a portable battery or they may be powered from the electrical system of the spray vehicle. Some hooded respirators can be air-conditioned for use during hot weather.

Because of their superior protective capacity, supplied-air respirators are gas masks -- NOT cartridge-type respirators -- must be worn when pesticides are formulated or mixed in closed or inadequately ventilated spaces, or when operators are exposed directly to concentrated sprays or dusts, as in greenhouses or indoors. For special operations, such as dusting or spraying a lathhouse, greenhouses, etc., on hot calm days, full facepiece gas masks should be used.

8.0 AIR-LINE RESPIRATORS

8.1 Introduction

Air-line respirators protect against all airborne contaminants in concentrations that are not immediately hazardous to life or health. The air-line respirator consists of a half mask, full facepiece, hood or helmet to which respirable air is supplied through a small diameter hose. Three types of air supply may be used: (1) continuous flow to the mask which maintains the mask under positive pressure; (2) demand air flow, which supplies the mask with air only when the wearer inhales; (3) pressure demand, which keeps the mask under positive pressure, limits air requirements.

Air-line respirators, if equipped with an auxiliary tank of air carried by the wearer that can be activated by him/her for escape should the air-line supply fail, may be used in atmospheres immediately dangerous to life or health (IDLH).

8.2 Maximum Use Concentrations

As long as environments do not exceed concentrations immediately dangerous to life and health, air-line respirators may be used to the concentrations listed below:

	MUC FACTOR (1)	
	Continuous or Pressure-Demand Flow	Demand Flow (3) (4)
Half mask	IDLH (2)	10
Full facepiece	IDLH (2)	100
Hood, helmet or suit	IDLH (2)	

(1) Maximum use concentration factor - this is the factor by which the PEL is multiplied to determine maximum use concentration (MUC). Thus, MUC = Factor x PEL.

(2) When positive pressure air-line respirators are equipped with an auxiliary air tank, FOR ESCAPE, these units may be used in IDLH atmospheres.

(3) For those conditions where possible, inward leakage caused by negative pressure during inhalation (always present in demand systems) is unacceptable, and the high air consumption of continuous-flow units is not economical, the pressure-demand air-line respirator may be the best choice. It provides a positive pressure during both inhalation and exhalation. Consult respirator manufacturers for more specific information should such a system be required.

(4) The MUC as measured on each person is permitted if quantitative fitting methods are used, providing they do not exceed the IDLH.

Air-line suits may protect against atmospheres that irritate the skin or that may be absorbed through the unbroken skin.

Limitations: Air-line respirators provide no protection if the air supply fails. Some contaminants, such as tritium, may penetrate the material of an air-line suit and limit its effectiveness.

Other contaminants, such as fluorine, may react chemically with the material of an air-line suit and damage it.

8.3 Combination Air Line Respirators With Auxiliary SC Air Supply

The auxiliary self-contained air supply on this type of device allows the wearer to escape from a dangerous atmosphere. This device with auxiliary self-contained air supply is approved for escape and may be used for entry when it contains at least a 15 minute auxiliary self-contained air supply.

9.0 AIR PURIFYING RESPIRATORS

General Limitations: Air-purifying respirators do not protect against oxygen deficient atmospheres or against skin irritation by, or absorption through the skin of, airborne contaminants.

The maximum contaminant concentration against which an air purifying respirator will protect is determined by the design efficiency and capacity of the cartridge, canister, or filter, and the facepiece-to-face seal on the user. For gases and vapors, the maximum concentration for which the air-purifying element is designed is specified by the manufacturer or is listed on labels of cartridges and canisters.

Non-powered air purifying respirators will not provide the maximum design protection specified unless the facepiece or mouthpiece/nose clamp is carefully fitted to the wearer's face to prevent inward leakage. The time period over which protection is provided is dependent on canister, cartridge, or filter type; concentrations of contaminant; humidity levels in the ambient atmosphere; and the wearer's respiratory rate.

The proper type of canister, cartridge, or filter must be selected for the particular atmosphere and conditions. Non-powered air purifying respirators may cause discomfort due to a noticeable resistance to inhalation. This problem is minimized in powered respirators. Respirator facepieces present special problems to individuals required to wear prescription lenses. These devices do have the advantage of being small, light and simple in operation.

Use of air purifying respirators in atmospheres immediately dangerous to life and health is limited to specific devices under specified conditions.

10.0 VAPOR AND GAS-REMOVING RESPIRATORS

Limitations: No protection is provided against particulate contaminants. A rise in canister or cartridge temperature indicates that a gas or vapor is being removed from the inspired air.

An uncomfortably high temperature indicates a high concentration of gas or vapor and requires an immediate return to fresh air.

Use should be avoided in atmospheres where the contaminant(s) lack sufficient warning properties (that is: odor, taste, or irritation at a concentration in air at or above the permissible exposure limit.) (Vapor and gas-removing respirators are not approved for contaminants that lack adequate warning properties.)

Not for use in atmospheres immediately dangerous to life or health unless the device is a powered-type respirator with escape provisions.

1. Full Facepiece Respirator

   Provides protection against eye irritation in addition to respiratory protection.

2. Quarter-Mask and Half-Mask Facepiece Respirator

   A fabric covering (facelet) available from some manufacturers shall not be used unless approved for use with respirator.

3. Mouthpiece Respirator

   Shall be used only for escape applications. Mouth breathing prevents detection of contaminant odor. Nose clamp must be securely in place to prevent nasal breathing.

   A small lightweight device that can be donned quickly.

11.0 PARTICULATE-REMOVING RESPIRATORS

Limitations: Protection against non-volatile particles only. No protection against gases and vapors.

Not for use in atmospheres immediately dangerous to life or health unless the device is a powered-type respirator with escape provisions.

1. Full Facepiece Respirator

   Provides protection against eye irritation in addition to respiratory protection.

2. Quarter-Mask and Half-Mask Facepiece Respirator

   A fabric covering (facelet) available from some manufacturers shall not be used unless approved for use with respirator.

3. Mouthpiece Respirator

   Shall be used only for escape applications. Mouth breathing prevents detection of contaminant odor. Nose clamp must be securely in place to prevent nasal breathing.

   A small lightweight device that can be donned quickly.

12.0 POWERED AIR-PURIFYING RESPIRATORS

Powered air-purifying respirators protect particulates and/or gases and vapors. The great advantage of the powered air-purifying respirator is that it usually supplies air at a positive pressure so that any leakage is outward from the facepiece. It may be used with a helmet, hood or facepiece. Air can be supplied by a user mounted, battery-powered back pack purifier, or by a stationary pumper through up to 25 feet of low pressure hose. It has good applicability to abrasive blasting, grinding pesticide spraying and operations using asbestos.

12.1 Maximum Use Concentration (MUC)

Generally, powered air-purifying units can be used up to 100 times the PEL for dusts, mists, and fumes, when used with filters that are approved for materials with PELs NOT LESS than 0.05 mg/m^3 or 2 mppcf and nuisance dusts. Such respirators can be used up to 3000 times the PEL when used with high efficiency filters. For use in chemical vapor or gaseous atmospheres, the MUC depends on the chemical cartridge or canister used. In all cases check the manufacturer’s specifications and the NIOSH/MSHA approval for the particular configuration used. The units are expensive and complex to maintain. Consideration should be first given to standard air-purifying units, supplied air devices and SCBA.

13.0 SUPPLIED AIR SUITS

Where complete isolation from the work environment is required to protect employees, supplied air suits should be considered. Such conditions might include use of confirmed or suspected carcinogens, an extreme absorption hazard or an extremely hot environment where keeping the employee cool is required. The suits are bulky and limit movement. At the present time no NIOSH/MSHA schedule exists for supplied air suit approval.

14.0 SELF-CONTAINED BREATHING APPARATUS

14.1 Introduction

Self-contained breathing apparatus (SCBA) can provide respiratory protection in oxygen deficient environments and in situations where high or unknown concentrations of toxic gases, vapor or particulates are present. The SCBA can protect in emergency situations. When using the SCBA, the wearer is independent of the surrounding atmosphere because he/she is breathing within a system admitting no outside air. All SCBA use a full facepiece connected to a wearer-carried source of air or oxygen. Closed circuit (re-breathing) devices also contain a carbon dioxide absorbing material.

SCBA are divided into three basic types:

1. Demand or pressure demand, open circuit systems supplied by cylinder-stored compressed air or oxygen.

2. Self-generating closed circuit devices.

3. Liquid or compressed oxygen, closed (re-breathing) devices.

14.2 Maximum Use Concentrations

While all SCBA may be used in oxygen deficient environments, only units operating with positive pressure always maintained inside of mask provide complete protection in atmospheres immediately dangerous to life or health (IDLH). Demand mode units provide no more protection against toxic substances than most air-purifying devices. Factors for determining maximum use concentrations are listed below:

Maximum use concentration (MUC) equals the PEL multiplied by the factor given in the table. MUC = PEL x MUC Factor.

SCBA TYPE	MUC* FACTOR	USE IN IDLH ENVIRONMENTS	USE IN OXYGEN DEFICIENT ENVIRONMENTS
Any positive pressure type open or closed.	10,000+	Yes	Yes
Demand, open or closed circuit, supplied with quarter or half-mask facepiece.	10	No	Yes
Demand, open or closed circuit, supplied with full facepiece or mouthpiece/nose clamp.	100	No (1)	Yes (1)

(1) May be used in IDLH atmospheres for mine rescue and mine recovery operations only.

*Higher MUC's permitted if quantitatively fit.

14.3 Training

Self-contained breathing apparatus, while providing the greatest protection to the wearer, are by far the most complex respirators in use today. Training in respirator use is essential.

14.4 General Considerations And Limitations

1. All SCBA may be used in oxygen deficient environments. It is generally required that only positive pressure units be used in IDLH environments. Demand devices have protective factors no greater than air purifying devices with the same facepiece.

   Where long term (greater than 30 minutes) operations must be undertaken, closed circuit breathing units must be used; here great care should be taken to fit the facepiece properly. POSITIVE PRESSURE SCBA PROVIDE A HIGHER DEGREE OF PROTECTION THAN DEMAND OR CLOSED CIRCUIT EQUIPMENT AND ARE GENERALLY PREFERABLE.

2. Under emergency conditions, a SCBA may be used for escape and rescue.

3. Open circuit demand or pressure-demand units, designed for routine operations, fire fighting and industrial emergencies, can provide up to 30 minutes of breathing time, less under extreme exertion. Closed circuit devices can provide up to 4 hours of breathing time.

4. SCBA with less than a 15 minute air supply may be used for emergency escape only.

5. All SCBA equipment must have a functioning “remaining service indicator” or warning device that shows or alarms when only 20-25% of service time remains.

6. A facepiece whose exhalation valve is designed for demand operation cannot be used with a pressure-demand regulator, since air flow will continuously and quickly exhaust the air supply.

7. SCBA are approved as systems. The interchange of parts from one manufacturer’s unit to another’s will void the approval except that the interchanging of different manufacturer’s cylinders with the same pressure rating is acceptable for fire-fighting operations. RESPIRATOR APPROVALS WILL HOWEVER BE VOIDED WHEN CYLINDERS ARE EXCHANGED.

8. Oxygen must not be used to fill SCBA tanks unless the entire respirator is specifically designed for oxygen use. Violent explosions can occur if pure oxygen comes in contact with dirt and grease. For nearly all open circuit applications, air will be an adequate source for respiration. OXYGEN SHALL NEVER BE PUT INTO A CYLINDER WHICH PREVIOUSLY CONTAINED AIR. If oxygen is used in respiratory protection devices specifically designed for its use, the oxygen must meet the requirements of the United States Pharmacopoeia for medical or breathing oxygen.

9. When using SCBA equipment, the use of a buddy system is required when working in IDLH environments.

10. Where contaminants pose a hazard through skin absorption, precautions must be taken to cover all exposed skin surfaces with impermeable clothing.

11. Always follow manufacturer’s instructions for SCBA use and cylinder charging.

14.5 SCBA Selection

Equipment selection will be based on the conditions of use. The following are considerations:

1. Does the atmosphere have the potential for being IDLH?

2. Is the atmosphere oxygen deficient?

3. What type of emergency conditions can be expected?

4. What are the economics?

14.6 Cylinder Charging

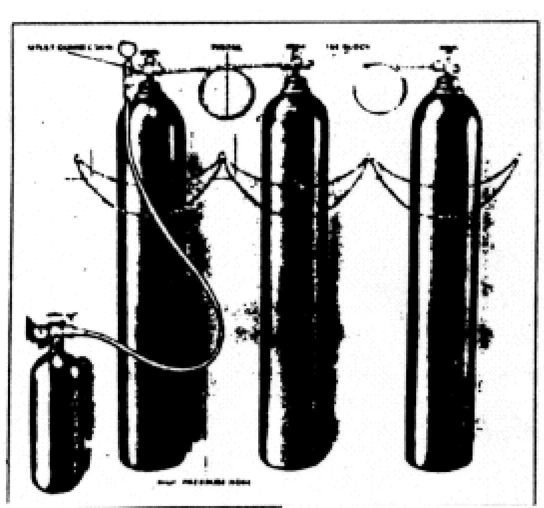
Plants using SCBA equipment on a regular basis should set up a charging station. Where units are used for emergency situations, local distributors can arrange for charging. WHEN A PLANT DOES NOT HAVE A METHOD FOR CYLINDER CHARGING, ENOUGH SPARE CYLINDERS SHOULD BE AVAILABLE TO DEAL WITH EMERGENCY SITUATIONS.

Manufacturers' procedures must be carefully followed. CYLINDERS MUST NOT BE REFILLED.

14.7 Cascade Refilling System

A cascading system for cylinder refilling as pictured, is the easiest method for plant use. It is based on the equalization of pressure between large cylinder supply tanks and the SCBA tank.

Generally, two or more supply tanks of respirable quality are connected in series (cascaded) through tee block fittings and pigtails. A manifold outlet is connected to the last cylinder complete with high pressure gauge. A five foot high pressure hose with an air (or oxygen) fitting is used to connect the SCBA tank to the manifold.



14.8 Instructions For Use Of Cascade Refilling System

1. Check the pressure in the apparatus cylinder by observing the pressure gauge on the cylinder valve. If the valve has no gauge, the pressure may be determined by opening the valve slowly and observing the pressure on the outlet connection gauge. Close the cylinder valve.

2. Open and close each valve in the supply cylinder bank to find the cylinder with the lowest pressure. If the pressure in this cylinder is not greater than that in the cylinder to be recharged, locate the supply cylinder with a pressure higher than that of the apparatus cylinder but lower than those of the other supply cylinders.

3. Slowly open the valve on the apparatus cylinder. Then, slowly open the valve on the supply cylinder with the lowest pressure as determined in Step 2. Observe the outlet connection gauge. When the pressure of that gauge stops dropping, the pressure in the two cylinders have equalized. Close the supply cylinder valve. If the desired pressure in the apparatus cylinder has not been reached, repeat the procedure using the cylinder with the next highest pressure.

4. If the last supply cylinder does not fully recharge the apparatus cylinder, replace the supply cylinder having the lowest pressure with a full cylinder and repeat Steps 2 and 3. Once the apparatus cylinder is full, close all valves in the system and disconnect the apparatus cylinder.

14.9 Compressor Charging (In Plant)

Breathing air used to fill SCBA cylinders must meet the requirements of ANSI Z86.1989. Any compressor designed to meet these requirements may be used. The SCBA manufacturer can assist you in setting up a charging system.

14.10 Charging By Manufacturer

Empty cylinders can be recharged at the nearest distributor of the SCBA in use at your location. It is recommended that an adequate number of spare cylinders be kept on hand.

14.11 Purchasing

Contact the local distributors of the manufacturers. Buy NIOSH/MSHA approved equipment only.

14.12 Air Quality Requirements

The compressed air supplied to the facepiece, hood or helmet must meet the requirements of the Compressed Gas Association Specification G7.1 (ANSI Z86.1989) for Type 1, Class D Gaseous Air. This requires that carbon monoxide levels not exceed 5 mg/m^3. OXYGEN SHALL NEVER BE USED IN AIR-LINE SYSTEMS.

With internally lubricated piston-type compressors, overheating may produce carbon monoxide. Periodic testing for carbon monoxide is needed, continuous monitoring is more desirable.

When plant compressed air is used for breathing air, a trap and carbon filter must be installed to remove oil, water, scale odor and taste; a pressure reducing valve must be installed to reduce air pressure to respirator requirements; and an automatic control must be provided to either sound an alarm or shutdown the compressor in case of overheating.

14.13 Compressed Gas Cylinders

Compressed gas cylinders may be used in the absence of a compressor or where it is not feasible to use a plant compressor. The quality of this air must meet the requirements discussed above. A suitable regulator must be used to reduce air pressure to the respiratory specifications. Generally, when a tank of compressed air is employed, constant slow type respirators should not be used due to the limited quantity of air available. Cylinders will be marked “Breathing Air.”

14.14 Air Flow Requirements

The air supply must meet the following requirements:

TYPE OF RESPIRATOR	AIR FLOW (CFM)	
	MIN	MAX
Continuous flow - full or half facepiece	4	15
Continuous flow - hood or helmet	6	15
Demand flow - full or half facepiece	4	15
Pressure demand - full or half facepiece	4	15

15.0 MECHANICAL RESPIRATORY FILTER SELECTION TABLE

FOR PROTECTION AGAINST	UNIT TYPE	MUC FACTOR* (1)	PROTECTS EYES (2)
Silica, coal dust, textile fibers, cotton dust and nuisance dusts.	Disposable dust respirator.	10	No
Dusts and mists with PEL's NOT less than 0.05 mg/m^3 or 2 mppcf (3) and nuisance dusts.	Quarter mask w/single; Special disposable units.	10	No
Dusts and mists with PEL's NOT less than 0.05 mg/m^3 or 2 mppcf, asbestos-containing dusts and mists and nuisance dusts.	Half mask with twin filters plus a high efficiency filter cartridge.	10	No
Dusts, fumes and mists with PEL's less than 0.05 mg/m^3 and radionuclides.	Half mask with twin high efficiency filter cartridge.	10	No
Dusts, fumes and mists with PEL's less than 0.05 mg/m^3 and radionuclides.	Full facepiece with twin high efficiency filter cartridge.	100	Yes
Dusts and mists with PEL's NOT less than 0.05 mg/m^3 or 2 mppcf, asbestos-containing dusts and mists and nuisance dusts.	Full facepiece with twin filters.	100	Yes
Dusts, fumes and mists with PEL's NOT less than 0.05 mg/m^3 OR 2 mppcf and nuisance dusts.	Full facepiece with twin cartridges.	100	Yes
Dusts, fumes and mists with PEL's less than 0.05 mg/m^3 and radionuclides.	Full facepiece with single high efficiency filter cartridge.	100	Yes
Dusts, fumes and mists with PEL's NOT less than 0.05 mg/m^3 OR 2 mppcf and nuisance dusts.	Powered air-purifying unit.	3000	Yes (full facepiece) No (half mask)
Dusts, fumes and mists with PEL's less than 0.05 mg/m^3 and radionuclides.	Powered air-purifying unit with high efficiency filter.	3000	Yes (full facepiece) No (half mask)

(1) Factor by which the PEL is multiplied to determine maximum use concentration (MUC).
Thus: MUC = Factor x PEL. If a standard or manufacturer specified a lower concentration, that number overrides the MUC.
(2) Eye protection against irritant dusts.
(3) Milligrams per cubic meter or million particles per cubic foot.

*MUC Factors given are for qualitative respirator fitting. Higher MUC's may be used if respirators are fitted quantitatively.

IF ANY DOUBT EXISTS IN RESPIRATOR SELECTION OR USE, CONTACT THE SAFETY OFFICER BEFORE USE OF RESPIRATORS IS INITIATED.

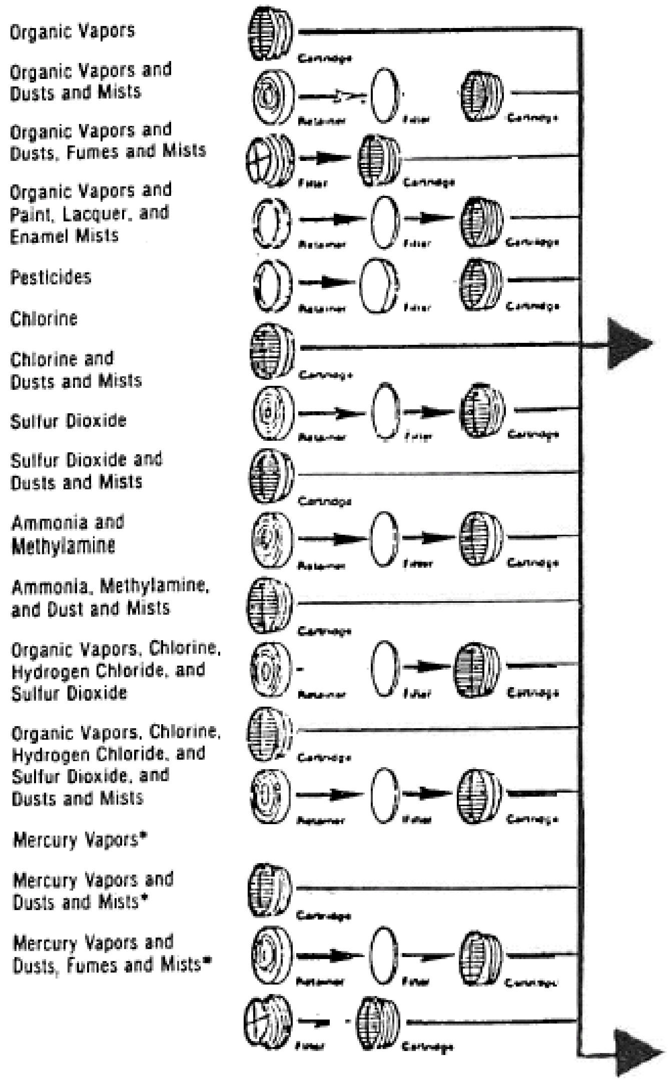
16.0 COLOR CODE FOR CARTRIDGES AND GAS MASK CANISTERS (ANSI K13.1-1973)

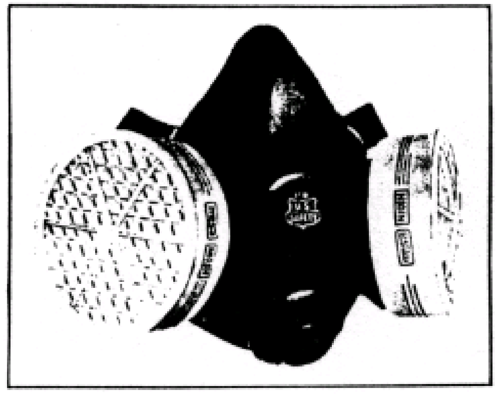
ATMOSPHERIC CONTAMINANTS TO BE PROTECTED AGAINST	COLOR ASSIGNED
Acid gases	White
Organic vapor	Black
Ammonia gas	Green
Carbon monoxide gas	Blue
Acid gases and organic vapors	Yellow
Acid gases, ammonia and organic vapors	Brown
Acid gases, ammonia, carbon monoxide and organic vapors	Red
Other vapors and gases not listed above	Olive
Radioactive materials (except tritium and noble gases)	Purple
Dusts, fumes and mists (other than radioactive materials)	Orange

NOTES:

1. A purple stripe shall be used to identify radioactive material in combination with any vapor or gas.
2. An orange stripe shall be used to identify dusts, fumes and mists in combination with any vapor or gas.
3. Where labels only are colored to conform with this table, the canister or cartridge body shall be gray or a metal canister or cartridge body may be left in its natural color.
4. The user shall refer to the wording of the label to determine the type and degree of protection the canister or cartridge will afford.

17.0 CARTRIDGE SELECTION GUIDE





a

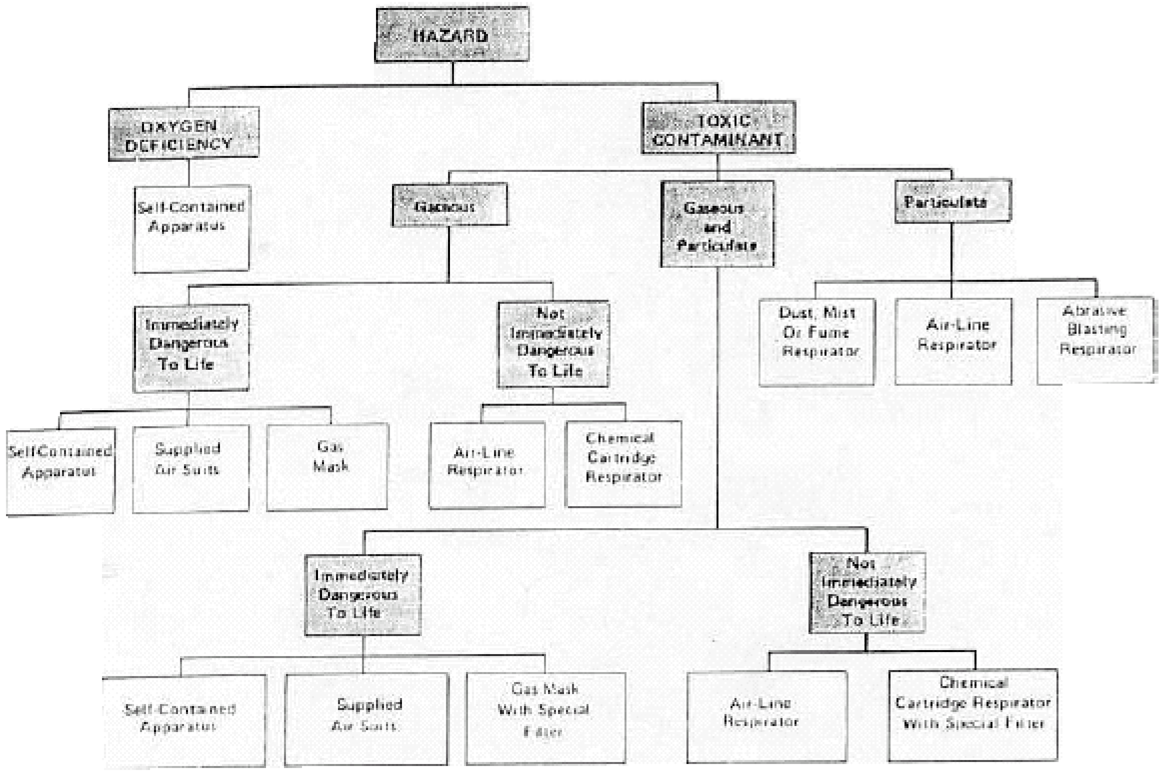
Figure 6 — (a) Half-mask facepieces may be used to protect against substances that do not irritate the eyes and that are not absorbed through the skin. (b) Full-facepiece masks should be used to protect employees against eye irritations and excessive exposure to a material through skin absorption.

b

*At the time of this manual's printing, mercury respirators have not been approved by NIOSH but they may be considered "accepted" equipment by "OSHA".

17.1 Guide To Selection And Use

GUIDE TO SELECTION AND USE



The numbers in parentheses refer to the section of this guideline where detailed information on each respirator system can be found.

18.0 RESPIRATOR TYPES

1. Disposable dust respirator
2. Quarter mask dust respirator
3. Half-mask with twin cartridges
4. Full facepiece with twin cartridges
5. Full facepiece with high-efficiency canister
6. Industrial gas mask
7. Supersize gas mask
8. Chin-type gas mask
9. Multi-contaminant gas mask with canister exhaustion indicator
10. Half-mask airline respirator
11. Pressure demand full facepiece airline respirator
12. Powered air-purifying respirator with half-mask
13. Powered air-purifying respirator with welder’s mask
14. Simple flexible plastic fall suit
15. Complex full suit for protection in demanding conditions

19.0 RESPIRATOR FIT TESTING

19.1 Fit Testing

Respirator users, both supervisors and workers, must be properly instructed by a competent person in selection, use and maintenance. Training must give persons a chance to handle the respirator, have it fitted properly, test its facepiece-to-face seal, wear it in normal air for a long familiarity period and finally wear it in a test atmosphere. Every employee required to wear a respirator must be fit tested and trained.

1. Each wearer must be shown and have practice in how to wear the respirator, how to adjust it and how to determine if it fits properly. Respirators must not be worn if there is not a good face seal because of a growth of beard, side burns, skull cap projections, temple pieces on glasses, etc. Also, denture wearers may not be able to achieve a good facepiece seal. The periodic checks evaluate the worker's diligence in following these instructions. The wearer must check the facepiece fit in accordance with the manufacturers' fitting instructions each time he puts it on.

2. Respirators are difficult to fit for persons wearing corrective glasses, since the temple bars extending through the sealing edge of a full facepiece prevent a proper seal. Do not permit the wearing of contact lenses with the respirator in contaminated atmospheres. As a temporary measure, glasses with short or no temple bars may be taped to the head. Special types of full facepieces have mountings for corrective lenses within the facepiece, but the facepiece and lenses must be fitted by qualified individuals to assure good vision, comfort and a gas-tight seal.

3. If corrective spectacles or goggles are required, they must not affect the fit of the facepiece. Proper selection of equipment will minimize or avoid the problem.

19.2 Test 1 – Negative Pressure Test

The wearer can perform this test alone in the field. It consists of merely closing off the inlets of the canister, cartridge(s) or filter(s) by covering with the palm(s) or replacing the seals over the canister or cartridge inlets or by squeezing breathing tubes so that air cannot pass; inhaling gently so the facepiece collapses slightly; and holding the breath for ten seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator is probably tight enough. This test, of course, can only be used on respirators with tightly fitting facepieces.

Although this test is simple, it has several major drawbacks, primarily that the wearer must handle the respirator after it has supposedly been positioned on the face. Handling can modify the facepiece-to-face seal. When the respirator is to be used in a relatively toxic atmosphere, this test should only be used as a very gross determination of fit. The wearer should use this test just before entering any toxic atmosphere.

19.3 Test 2 – Positive Pressure Test

This test is very much like the negative pressure test; it has the same advantages and limitations. It is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can be built up inside the facepiece without any evidence of outward leakage. For some respirators, this method requires the wearer to remove the exhalation valve cover and then carefully replace it after the test, often a more difficult task which can disturb the respirator fit even more than does the negative pressure test. If removing and replacing the valve cover is required, this test should be used sparingly. For respirators whose valve covers have a single small port that can be covered by the palm or finger, this test is easy. It should be performed just before entering any hazardous atmosphere.

19.4 Test 3 – Isoamyl Acetate Vapor (Banana Oil) Test

The chemical isoamyl acetate has a pleasant, easily detectable odor, so it is used widely in checking respirator fit.

This test gives the user the required opportunity to wear the respirator in a test atmosphere. Generally, it consists of creating an atmosphere containing banana oil around the wearer of an atmosphere-supplying or air-purifying respirator with an organic vapor removing cartridge(s) or canister. IF THE HAZARD IS PARTICULATE MATTER OR A NON-ORGANIC VAPOR OR GAS, THE ORGANIC VAPOR CARTRIDGE(S) OR CANISTER MUST BE REPLACED WITH A PARTICULATE FILTER(S) OR PROPER CARTRIDGE(S) OR CANISTER AFTER THIS TEST. Thus, this test can be used for any facepiece that has the capability of accepting chemical cartridges and particulate filters. It must be emphasized however, that the correct cartridge, canister or filter be placed on the facepiece before the wearer enters the specific area.

The simplest use of the isoamyl acetate test is to saturate a piece of cotton or cloth with the liquid and pass it close to the respirator near the sealing surface, taking care to avoid skin contact. The second method is to use a stencil brush filled with isoamyl acetate in the same manner as the cotton or cloth.

In general, the isoamyl acetate fitting test should be performed as follows:

1. The wearer puts on the respirator in a normal manner in an area where he/she cannot smell banana oil and thus not be influence by the odor while performing the fitting test. If it is an air-purifying device, it must be equipped with a cartridge(s) or canister specifically designed for protection against organic vapors.

2. The saturated cloth or stencil brush is passed close to the respirator sealing surfaces.

3. If the wearer smells banana oil, he readjusts the facepiece and/or adjusts the head straps without unduly tightening them.

4. The wearer repeats step 2. If banana oil is not smelled, there is assumed to be a satisfactory seal. If the wearer smells the vapor, an attempt should be made to find the leakage point. If the leak cannot be located, another respirator of the same type and brand should be tried. If this leaks, another brand of respirator with a face piece of the same type but slightly different shape or size should be tried.

5. After a fit is obtained, if the respirator is an air-purifying device, it must be equipped with the correct filter(s), cartridge(s) or canister for the anticipated hazard.

During the test, the subject should make movements that approximate a normal working situation. These may include, but not necessarily be limited to, the following:

1. Normal breathing.

2. Deep breathing like during a heavy exertion period. This should not be done long enough to cause hyperventilation.

3. Slowly performing side-to-side and up-and-down head movements. These movements should be exaggerated, but should approximate those that take place on the job.

4. Talking. This is most easily accomplished by reading prepared text loudly enough to be understood by someone standing nearby.

5. Other exercises may be added depending upon the situation. For example, if wearers are going to spend a significant part of their time bent over at some task, it may be desirable to include an exercise approximating this bending.

If the test is used in training workers and selecting the respirators that fit best, they should perform the complete set of exercises. However, the number exercises may be reduced when the test is used as a quick field check before routine entry into a contaminated atmosphere.

The major drawback of the isoamyl acetate test is that the odor threshold varies widely among individuals (most people can smell between one and ten ppm of this chemical). Furthermore, the sense of smell will fatigue at one to ten ppm during the test so that the wearer can detect only high vapor concentrations.

Another disadvantage is that isoamyl acetate smells pleasant, even in high concentrations. Therefore, a wearer may say that the respirator fits although it has a large leak. This is usually because he/she likes the comfort of the particular respirator or is following the lead of someone else in selecting the same respirator. Conversely, a wearer may claim that a particular respirator leaks if it is uncomfortable, etc. Therefore, unless the worker is highly motivated toward wearing respirators, the results of this test must sometimes be suspect.

19.5 Test 4 – Irritant Smoke Test

This test is similar to the isoamyl acetate test in concept. It usually involves exposing the respirator wearer to an irritating aerosol produced by commercially available stannic chloride titanium tetrachloride smoke tubes normally used to check the quality of ventilation systems. (Note: Other types of smoke tubes such as acetic acid are available, but should not be used for respirator fitting. Check with the manufacturer that stannic chloride or titanium tetrachloride tubes are being supplied.) When the tube ends are broken and air is passed through it, the material inside reacts with the moisture in the air to produce a dense, highly irritating smoke, consisting of hydrochloric acid absorbed in small solid particles. As a qualitative means of determining respirator fit, this test has a distinct advantage in that the wearer usually reacts involuntarily to leakage by coughing or sneezing. The likelihood of this giving a false indication of proper fit is reduced. On the other hand, the aerosol is very irritating and must be used carefully to avoid injury. Also it is advisable to have exhaust ventilation behind the subject to protect the person doing the testing.

This test can be used for both air-purifying and atmosphere-supplying respirators, but air-purifying respirators must have a high-efficiency filter(s). After the test, it may be necessary to replace the high-efficiency filter(s) on the air-purifying respirator with another type of air-purifying elements(s) depending upon the hazard to which the respirator wearer is to be exposed. This test can be used for worker training or respirator selection.

The irritant smoke test must be performed with proper safeguards because the aerosol is highly irritating. The suggested procedure is as follows:

1. The wearer puts on the respirator normally, taking care not to tighten the headstrap uncomfortably, and stands with his/her back to a source of exhaust ventilation.

2. The tester tells the wearer to close his/her eyes, even if wearing a full facepiece respirator, and to keep them closed until told to open them.

3. The tester lightly puffs smoke over the respirator, holding the smoke tube at least two feet from it. At this time, the tester should keep the amount of smoke minimal and pause between puffs.

4. If the wearer detects no leakage, the tester may increase the smoke density and move the smoke tube progressively closer to the subject, still remaining alert to any reactions.

5. When the smoke tube has been brought to within about six inches of the respirator with no leakage detected, the tester may start to direct smoke specifically at potential sources of leakage, around the sealing surfaces and exhalation valve, while the subject's head is still.

6. At this point, if no leakage has been detected, the wearer may cautiously begin the head movements mentioned in the isoamyl acetate test. The tester should remain especially alert and be prepared to stop producing smoke immediately.

7. If leakage is detected at any time, the tester should stop the smoke and let the wearer readjust the facepiece or headstrap tension. The tester should then start the test at step 2.

This test is not as time consuming as it sounds. Also, because of its greater sensitivity and lesser reliance on subjective response, it is considered more reliable than the isoamyl acetate test. If the wearer's eyes are closed and the smoke is increased gradually, there is little danger of discomfort.

19.6 Test 5 – Bitrex™ Vapor Test

This test is also similar to the isoamyl acetate and irritant smoke tests. It usually involves exposing the respirator wearer to an aerosol containing denatonium benzoate, which when inhaled leaves a very bitter taste in the mouth. This chemical is often used to prevent children from ingesting commercial products. An areosolizer is used to vaporize the liquid solution inside a hood worn by the wearer. If there is any leakage of the respirator the wearer will immediately detect the bitter taste. However since some individuals are not sensitive to the Bitrex™ solution, a sensitivity check must be done first without the respirator being worn

This test can be used for any facepiece that has the capability of accepting chemical cartridges and particulate filters. It must be emphasized however, that the correct cartridge, canister or filter be placed on the facepiece before the wearer enters the specific area.

In general, the Bitrex™ vapor fit test should be performed as follows:

1. The wearer puts on the respirator normally, taking care not to tighten the headstrap uncomfortably, and stands or sits as desired.

2. The tester then places the hood and collar assembly over the wearer's head.

3. The tester lightly sprays the vapor inside the hood, up to five sprays per exercise or until the wearer detects the vapor.

During the test, the subject should make movements that approximate a normal working situation. These may include, but not necessarily be limited to, the following:

1. Normal breathing.

2. Deep breathing like during a heavy exertion period. This should not be done long enough to cause hyperventilation.

3. Slowly performing side-to-side and up-and-down head movements. These movements should be exaggerated, but should approximate those that take place on the job.

4. Talking. This is most easily accomplished by reading prepared text loudly enough to be understood by someone standing nearby.

5. Other exercises may be added depending upon the situation. For example, if wearers are going to spend a significant part of their time bent over at some task, it may be desirable to include an exercise approximating this bending.

If the test is used in training workers and selecting the respirators that fit best, they should perform the complete set of exercises. However, the number exercises may be reduced when the test is used as a quick field check before routine entry into a contaminated atmosphere.

20.0 INSPECTION

20.1 Introduction

Respirator maintenance must be an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all. Workers wearing defective devices think they are protected when, in reality, they are not. Emergency escape and rescue devices are particularly vulnerable to poor maintenance as they generally are used infrequently, and then in the most hazardous and demanding conditions during emergency escape or rescue.

The OSHA standard strongly emphasizes the importance of an adequate maintenance program. All programs are required to include at least:

1. Inspection for defects (including a leak check).

2. Cleaning and disinfecting.

3. Repair as required.

4. Proper and sanitary storage of equipment.

A proper maintenance program will ensure that the worker's respirator remains as effective as when it was new.

20.2 Inspection For Defects

The most important part of a respirator maintenance program is continual inspection of the devices. If properly performed, inspections will identify damaged or malfunctioning respirators before they can be used. The OSHA standard outlines two types of inspections.

1. While the respirator is in use.

2. While it is being cleaned.

In plants where the workers maintain their own respirators, the two types of inspections become essentially one.

20.3 Frequency of Inspection

The OSHA requires that "all respirators be inspected before and after each use," and that those not used routinely, i.e., emergency escape and rescue devices, "shall be inspected after each use and at least monthly..." Obviously, emergency escape and rescue devices do not require inspection before use. Records of inspection should be kept.

20.4 Inspection Procedures

The OSHA standard states that the respirator inspection shall include checking of:

1. Tightness of the connections.

2. Facepiece.

3. Valves.

4. Connecting tubes.

5. Canisters, filters or cartridges.

In addition, the standard also states that the regulator and warning devices on SCBA shall be checked for proper function.

20.5 <u>Field Inspection of Air-Purifying Respirators</u>

Routinely used air-purifying respirators should be checked as follows before and after each use:

1. Examine the facepiece for:

   a. Excessive dirt;
   b. Cracks, tears, holes or physical distortion of shape from improper storage;
   c. Inflexibility of rubber facepiece (stretch and kneed to restore flexibility;
   d. Cracked or badly scratched lenses in full facepieces;
   e. Incorrectly mounted full facepiece lenses, or broken or missing mounting clips;
   f. Cracked or broken air-purifying element holder(s), badly worn threads or missing gaskets(s) if required.

2. Examine the head straps or head harness for:

   a. Breaks;
   b. Loss of elasticity;
   c. Broken or malfunctioning buckles and attachments;
   d. Excessively worn serrations on head harness, which might permit slippage (full facepiece only).

3. Examine the exhalation valve for the following after removing its cover:

   a. Foreign material, such as detergent residue, dust particles or human hair under the valve seat;
   b. Cracks, tears or distortion in the valve material;
   c. Improper insertion of the valve body in the facepiece;
   d. Cracks, breaks or chips in the valve body, particularly in the sealing surface;
   e. Missing or defective valve cover;
   f. Improper installation of the valve in the valve body.

4. Examine the air-purifying element for:

   a. Incorrect cartridge, canister or filter for the hazard;
   b. Incorrect installation, loose connections, missing or worn gasket or cross threading in the holder;
   c. Expired shelf-life date on the cartridge or canister;
   d. Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet.

5. If the device has a corrugated breathing tube, examine it for:

   a. Broken or missing connectors;

b. Missing or loose hose clamps;
c. Deterioration, determined by stretching the tube and looking for cracks.

6. Examine the harness of a front- or back-mounted gas mask for:

   a. Damage or wear to the canister holder, which may prevent its being held in place;
   b. Broken harness straps for fastening.

20.6 Atmosphere-Supplying Respirators

For a routinely used atmosphere-supplying device, use the following procedures:

1. If the device is a tight-fitting facepiece, use the procedures outlined under air-purifying respirators, except those pertaining to the air-purifying elements.

2. If the device is a hood, helmet, blouse or full suit, use the following procedures:

   a. Examine the hood, blouse or full suit for rips and tears, seam integrity, etc.;
   b. Examine the protective headgear, if required, for general condition with emphasis on the suspension inside the headgear;
   c. Examine the protective face shield, it any, for cracks or breaks or impaired vision;
   d. Make sure the protective screen is intact and secured correctly over the face shield of abrasive blasting hoods and blouses.

3. Examine the air supply system for:

   a. Integrity and good condition of air supply lines and hoses, including attachment and end fittings;
   b. Correct operation and condition of all regulators, or other air flow regulators.

20.7 Self-Contained Breathing Apparatus (SCBA)

In addition to the above, for SCBA units also determine that:

1. The high pressure cylinder of compressed air or oxygen is sufficiently charged for the intended use, preferably fully charged.

2. On closed circuit SCBA, a fresh canister of CO_2 (carbon dioxide) sorbent is installed.

3. On open circuit SCBA, the cylinder has been recharged if less than 25% of the useful service time remains.

All SCBAs are required to have a warning device that indicates when the 25% level is reached. However, it is recommended that an open-circuit SCBA be fully charged before use.

20.8 Non-Routine Use of Air-Purifying or Atmosphere Supplying Devices

When air-purifying or atmosphere supplying devices are used non-routinely, all the above procedures should be followed after each use. The OSHA requires that devices for emergency use be inspected once a month and that “a record shall be kept of inspection dates and findings for respirators maintained for emergency use.”

20.9 Defects Found in Field Inspection

If defects are found during any field inspection, two remedies are possible. If the defect is minor, repair and/or adjustment may be made on the spot. If it major, the device should be removed from service until it can be repaired. (A spare unit should replace the unit removed from service.) Under no circumstances should a device that is known to be defective remain in the field.

20.10 Inspection During Cleaning

Because respirator cleaning usually involves some disassembly, it presents a good opportunity to examine each respirator thoroughly. The procedures outlined above for a field inspection should be used. Respirators should be inspected after cleaning operations and reassembly have been accomplished.

The OSHA requires, as part of an inspection program, that all respirators be leak checked, a determination that the complete assembly is gas tight. Follow field inspection procedures to examine the freshly cleaned, reassembled respirator.

21.0 CLEANING AND DISINFECTING

The OSHA 1910.134 states “routinely used respirators shall be collected, cleaned and disinfected as frequently as necessary to ensure that proper protection is provided...” and that emergency use respirators “shall be cleaned and disinfected after each use.”

When used routinely, respirators should be exchanged daily for cleaning and inspection. Where respirators are used only occasionally, the exchange period could be weekly or monthly. Workers maintaining their own respirators should be thoroughly briefed on cleaning and disinfecting them. Although workers may not be required to maintain their own respirators, briefing on the cleaning procedure will encourage their acceptance of a respirator by providing knowledge of what is a clean, disinfected, properly maintained device. This is particularly important where respirators are not individually assigned.

Where respirators are individually assigned (a practice to be encouraged), they should be durably identified to ensure that the worker always receives the same device. Identification markers must not penetrate the facepiece, block the filter, cartridge parts or exhaust valves.

In plants where a relatively small number of respirators are used, or where workers clean their own respirators, the generally accepted procedure is washing with detergent and warm water using a brush, thoroughly rinsing in clean water and drying in a clean place. Precautions should be taken to prevent damage from rough handling during this procedure.

In plants where large numbers of respirators are used, it is recommended that a centralized cleaning and maintenance facility with specialized equipment and personnel trained in respirator maintenance be established.

21.1 Respirator Disassembly

The used respirators are collected and deposited in a central location. They are taken to an area where the filters, cartridges or canisters are removed and discarded. Canisters should be damaged to prevent accidental reuse. If facepieces are equipped with reusable dust filters, they may be cleaned with compressed air in a hood. This prevents dust from getting into the room and affecting the respirator personnel. If SCBA are used, tanks are removed and connected to a charging station; the rest of the unit is sent to an area where the SCBA regulator and low-air warning devices are tested. SCBA facepieces are cleaned like air-purifying respirator facepieces.

21.2 Caution – Chemox Canisters

If oxygen-generating canisters are used in closed circuit SCBA devices, they must be disposed of properly. Mine Safety Appliances Co. suggests the following procedure for disposing of its “Chemox” oxygen-generating canister:

Punch holes in the front, back and bottom of the canister. Gently place it in a bucket of clean water deep enough to cover it by at least three inches. When bubbling stops, any residual oxygen will have been dissipated and the canister is expended. Pour the water, which is now caustic, down a drain or dispose of it by other suitable manner.

Not following this procedure, particularly neglecting to punch holes in the canister, can cause a violent explosion.

21.3 Cleaning and Sanitizing

The actual cleaning may be done in a variety of ways. It is recommended that a commercial dishwasher be used. A standard domestic clothes washer may also be used if a rack is installed around the agitator to hold the facepieces in fixed positions. If the facepieces are placed loose in the washer, the agitator may damage them. A standard domestic dishwasher may be used, but it is not preferred because it does not immerse the facepieces. Any good detergent may be used, followed by a disinfecting rinse or a combination disinfectant-detergent may be used for a one step operation. Disinfection is not absolutely necessary if the respirator is reused by the same person. However, where individual issue is not practical, disinfection is strongly recommended. Reliable, effective disinfectants may be made from readily available household solutions, including:

1. Hypochlorite solution (50 ppm of chlorine) made be adding approximately two milliliters of bleach (such as Clorox) to one liter of water, or two tablespoons of bleach per gallon of water. A two-minute immersion disinfects the respirators.

2. Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or one teaspoon of tincture of iodine per gallon of water. Again, a two-minute immersion is sufficient.

If the respirators are washed by hand, a separate disinfecting rinse may be provided. If a washing machine or dishwasher is used, the disinfectant must be added to the rinse cycle; the amount of water in the machine at that time will have to be measured to determine the correct amount of disinfectant.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140°F, but it should not be less than 120°F, to ensure adequate cleaning. In addition, if commercial or domestic dishwashers are used, the drying cycle should be eliminated, since the temperature reached in these cycles may damage the respirators.

21.4 Rinsing

When cleaning and disinfecting respirators, they should be rinsed thoroughly in water (140°F maximum) to remove all traces of detergent and disinfectant. This is very important for preventing dermatitis.

21.5 Drying

The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes, but care must be taken not to damage or distort the facepieces. Another method is to equip a standard steel storage cabinet with an electric heater that has a built-in circulating fan, and to replace the solid steel shelves with steel mesh.

21.6 Reassembly and Inspection

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed and the completely reassembled respirator should be tested for leaks.

For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

22.0 MAINTENANCE AND REPAIR

The OSHA standard states that "replacement or repair shall be done by experienced persons with parts designed for the respirator." Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval of the device.

Maintenance personnel must be thoroughly trained. They must be aware of the limitations and never try to replace components or make repairs and adjustments beyond the manufacturer's recommendations, unless they have been specially trained by the manufacturer.

These restrictions apply primarily to maintenance of the more complicated devices, especially closed- and open-circuit SCBA, and more specifically, regulator valves and low pressure warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair.

There should be no problems in repairing and maintaining most respirators, particularly the commonly used air-purifying type.

An important aspect of any maintenance program is having enough spare parts on hand. Only continual surveillance of replacement rates will determine what parts and quantities must be kept in stock. It is desirable to have a recording system to indicate spare parts usage and the inventory on hand.

23.0 RESPIRATOR STORAGE

The OSHA requires that respirators be stored to protect against:

1. Dust
2. Sunlight
3. Heat
4. Extreme Cold
5. Excessive Moisture

6. Damaging Chemicals

7. Mechanical Damage

Damage and contamination of respirators may take place if they are stored on a workbench, or in a tool cabinet or toolbox, among heavy tools, grease and dirt.

Freshly cleaned respirators should be placed in heat sealed or reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set."

Air-purifying respirators kept ready for non-routine or emergency use should be stored in a cabinet with individual compartments. The storage cabinet should be readily accessible, and all workers should be made aware of its location, as is done for fire extinguishers. Preventing serious injury from the inhalation of a toxic substance depends entirely on how quickly workers can get to the emergency respirators.

A chest or wall-mounted case may be purchased from the respirator manufacturer for storing SCBA for use in emergencies. Again, the location of SCBA should be well-known and clearly marked. Unlike fire extinguishers however, they should be located in an area that will predictably remain uncontaminated. Putting on a SCBA in a highly contaminated atmosphere such as might be created by massive release of a toxic material may take too long a time to perform safely in that area. Therefore, the first reaction should be to escape to an uncontaminated area, then put on the SCBA, which should be located there, and re-enter the hazardous area for whatever task must be done. Exceptions to this rule may be encountered, and only a through evaluation of the process and escape routes will permit a final decision about the correct storage location for the SCBA.

Respirators thus should be stored in a plastic bag inside a rigid container. The OSHA standard suggests that respirators be in their original cartons, but this would provide only minimal protection from mechanical damage.

If the worker is trained adequately, he/she should develop a respect for respirators which will be an automatic incentive to protect them from damage. Besides providing better assurance of adequate protection this training will lower maintenance costs by decreasing damage.

24.0 STANDARD OPERATING PROCEDURE FOR DISASSEMBLY, CARE, CLEANING AND MAINTENANCE OF RESPIRATORS

1. The following procedures will be followed to ensure the proper maintenance of all respirators. Respirators that are issued on an as needed or intermittent basis will be disassembled, cleaned and inspected after each use. Respirators permanently assigned are required to be monthly disassembled, cleaned and inspected.

a. The departments are responsible to ensure the following monthly tasks are performed.

1. Remove cartridges, canisters or filters and all gaskets that are not affixed to seats and discard.

2. Visually inspect facepieces and part; discard faulty items.

3. Remove all elastic headbands.

4. Remove exhalation valve cover and valve.

5. Remove inhalation valves.

6. Wash, sanitize and rinse facepiece (maximum water temperature 140°F, optimum range 120°F – 140°F).

   (a) Wash first in mild detergent solution.
   (b) Rinse in a disinfectant hypochlorite solution. (Note: Use two tablespoons Clorox per gallon of water to mix solution.)
   (c) Rinse in clean water to remove all traces of detergent and disinfectant.

7. Dry mask in drying cabinet.

8. Hand wipe facepieces, valves, valve seats with damp, lint-free cloth to remove any soap or water residue or foreign materials.

9. Visually inspect all respirator parts for deterioration, distortion, or other faults. Replace any questionable or obviously faulty parts. Replace only with parts specifically designed for that particular respirator.

   (a) Examine the facepiece for:
       1. Excessive dirt;
       2. Cracks, tears, holes, or distortion from improper storage;
       3. Inflexibility (stretch and massage to restore flexibility.);
       4. Cracked or badly scratched lenses in full facepieces;
       5. Incorrectly mounted full facepiece lens or broken or missing mounting clips;
       6. Cracked or broken air-purifying elements holder(s), badly worn threads, or missing gasket(s) if required.
   (b) Examine:
       1. Breaks;
       2. Loss of elasticity;
       3. Broken, malfunctioning buckles and attachments;

4. Excessively worn separations on the head harness which might permit slippage. (Full facepieces only.)

(c) Examine the exhalation valve for the following, removing the cover:

1. Foreign materials, such as detergent reside, dust particles, or human hair under the valve seat;
2. Cracks, tears, or distortion in the valve material;
3. Improper insertion of the valve body in the facepiece;
4. Cracks, breaks, or chips in the valve body, particularly in the sealing surface;
5. Missing or defective valve cover;
6. Improper installation of the valve in the valve body.

(d) If the device has corrugated breathing tube, examine it for:

1. Broken or missing connectors;
2. Missing or loose hose clamps;
3. Deterioration, determined by stretching the tube and looking for cracks.

(e) Examine the harness of a front- or back-mounted gas mask for:

1. Damage or wear to the canister holder which may prevent its being held securely in place;
2. Broken harness strap or fastening.

10. Reassemble respirator and inspect assembly.

11. Install, as necessary, new filters, cartridges or canisters.

12. Clean and apply fogproof to lens. (Full facepiece only.)

13. Individually seal each respirator in a plastic bag.

14. Store in a clean, dry, convenient location.

b. Operators are responsible for the care, cleaning, disassembly, reassembly and storage of their respirator. The monthly respirator inspection record will be kept on file with the unit supervisor or safety officer. If the inspection form is not received, the respirator will be recalled.

25.0 <u>STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS DURING ASBESTOS OPERATIONS</u>

1. Respirator Selection

a. Three respirators have been selected for use in asbestos operators. The type used will be determined after several considerations have been examined.

Exposure levels, work to be done, work conditions and user comfort are all factors determining final selection.

b. The half face or full face powered respirator fitted with a high efficiency filter, a half face respirator fitted with a high efficiency cartridge, or an air-line type, have all been selected for use during asbestos operations.

2. Respirator Surveillance

It is the unit supervisor's responsibility to see that protective equipment provided, is properly used and maintained.

26.0 <u>STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS IN CONFINED SPACES</u>

1. Respirator Selection

a. The atmosphere in a confined space may be immediately dangerous to life or health because of toxic air contaminants or lack of oxygen. Tests shall be made prior to entry to determine the hazards.

b. Air-purifying or air-line respirators may be worn if the test shows adequate oxygen and that air contaminants are below the level immediately dangerous to life and health. While wearing these types of respirators in a confined space, the atmosphere must be monitored continuously.

c. If the level of contaminant is above the IDLH level, or the oxygen content is low, those who must enter the space shall wear a SCBA or a combination air-line and self-contained breathing respirator that always maintains positive pressure. Entry into an area of unknown concentration will be considered to be above IDLH and the unit supervisor or safety officer will be notified if an emergency entry is necessary.

2. Respirator Surveillance

It is the unit supervisor's responsibility to see that protective equipment provided, is properly used and maintained.

3. Work Surveillance

Constant surveillance by two safety men is required. Frequent or constant monitoring by the gas free engineer or the unit supervisor or safety officer may also be required. One safety man is to have a SCBA, life line, and other outfitting as determined by the unit supervisor.

27.0 STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS DURING PAINTING OPERATIONS

1. Respirator Selection

    a. On the basis of the worker’s exposure to toxic materials during painting operations an air-purifying cartridge half-face respirator fitted with an organic vapor cartridge and paint spray/mist prefilter, has been selected In the case of a paint booth an air-line respirator will be used.
    b. This selection provides protection against:
        1. Mists of paint, lacquers and enamels.
        2. 1,000 ppm organic vapors.
        3. Any combination of the two.
    c. During painting operations involving polyurethane paints, containing isocyanates, supplied air respirators will be used instead of a cartridge respirator.

2. Respirator Surveillance

    It is the supervisor’s responsibility to see that protective equipment provided, is properly used and maintained.

28.0 STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS DURING WELDING OPERATIONS

1. Respirator Selection

    a. On the basis of the worker’s exposure to a variety of toxic materials during welding operations an air-purifying cartridge respirator with a half-face has been selected.
    b. This selection enables the user to fit the respirator with the proper cartridge for the work performed and will provide for a protection factor of 10 times the TLV for the given hazard. This selection protects the user during routine operations. Whenever exotic materials, beryllium, cadmium, stainless steel, etc., are involved additional measures are required.

2. Respirator Surveillance

    It is the unit supervisor’s responsibility to see that protective equipment provided, is properly used and maintained.

29.0 STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS IN IDLH ATMOSPHERES

1. Respirator Selection

a. For an atmosphere that through analytical testing has been determined to be immediately dangerous to life and health (IDLH), a combination air-line and self-contained breathing respirator that always maintains positive pressure has been selected.
b. If the atmosphere is a confined space or if the work involves emergency operations, the appropriate SOP shall be referred to.

2. Respirator Surveillance

It is the unit supervisor's responsibility to see that protective equipment provided, is properly used and maintained.

3. Work Surveillance

Constant surveillance by two safety men is required. Frequent or constant monitoring by the gas free engineer or the unit supervisor or safety officer may also be required.

30.0 STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS DURING OPERATIONS INVOLVING ORGANIC SOLVENTS

1. Respirator Selection

a. For respiratory protection against selected organic vapors an air-purifying cartridge respirator with either a half or full facepiece will be worn.
b. Fitted to the respirator will be an organic vapor cartridge and a dust/mist prefilter when necessitated by operations.
c. This selection will provide protection in atmospheres of 1,000 ppm organic vapors and dust/mist having a time-weighted average not less than 0.05 milligram per cubic meter or two million particles per cubic foot.

2. Respirator Surveillance

It is the supervisor's responsibility to see that protective equipment provided, is properly used and maintained.

31.0 STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS DURING OPERATIONS INVOLVING NUISANCE DUST

1. Respirator Selection

a. For respiratory protection against nuisance dust an air-purifying disposable respirator or a cartridge respirator will be worn.
b. This selection will provide protection against dust having a time-weighted average not less than 0.05 milligram per cubic meter.

2. Respirator Surveillance

It is the supervisor's responsibility to see that protective equipment provided, is properly used and maintained.

32.0 <u>STANDARD OPERATING PROCEDURE FOR USE OF RESPIRATORS DURING OPERATIONS INVOLVING CHLORINE GAS</u>

1. Respirator Selection

   a. Exposure to chlorine gas is on an intermittent basis for repair and emergency operations. Concentrations will vary with each situation, therefore SCBA respirators have been selected.
   b. Entry into an area of unknown concentration will be considered to be above IDLH, and the unit supervisor or safety officer will be notified if an emergency entry is necessary.

2. Respirator Surveillance

   It is the unit supervisor's responsibility to see that protective equipment provided, is properly used and maintained.

33.0 <u>PROCEDURES IN EMERGENCY SITUATIONS</u>

33.1 <u>Performance</u>

Now that we have knowledge of why we must use the breathing apparatus, how it operates, its' care, maintenance some of it's' limitations and capabilities, we must have some idea of what to do in emergency situations where the breathing apparatus is worn or when an unusual circumstance takes place. It may be too late to try to find a solution to a problem when life is at stake, especially when it could have been worked out prior to the emergency situation. We must have some idea of what to do when it happens.

33.2 <u>Entry</u>

Entry is very important because you are leaving a safe, clean atmosphere, and entering a hazardous atmosphere. You, your breathing apparatus, and facepiece seal must be ready.

1. Remain calm and do not panic as this puts you into a state of incapability, both mentally and physically. An emotional state will increase your breathing rate.

2. Work with a partner, check each other out, stay together and communicate.

3. Stay low upon entry, especially where heat is involved as it is cooler close to ground level. Also this aids in visibility when smoke is present. If you cannot see where you are going, feel ahead of you for obstructions or holes.

4. Use radio sets in large buildings, basements, cellars or wherever else the situation warrants their use.

5. Use lights to penetrate smoke and darkness.

33.3 Life Line

The life line is very seldom used, but we still should know the proper procedures and usage.

The line must be used in any area that is or appears to be highly hazardous from the standpoint of a worker becoming lost or separated. Some of these areas include basements, cellars and large enclosed areas.

The life line should be tied around the waist with a bowline or snapped around the waist. For confined space entry through a small top opening, a parachute harness is required.

The signals for the life line are easy and simple to remember. The word "OATH" is the key:

0-K	=	one pull
A-dvance	=	two pulls
T-ake up slack	=	three pulls
H-elp	=	four pulls

The signals should be transmitted with full arm swings and acknowledged by the person receiving the signal.

While traveling up or down stairs, inclines or ladders, while wearing a life line, have a sufficient amount of the life line in your hand to release in case you are signaled at that moment. This way, you can release the slack, and not be pulled down or off the ladder, stairs, or incline when signaled.

The line tender must pay attention to the line at all times and keep track of the time the wearer has been in the area or building. The line tender must not tend more than two lines.

33.4 Conservation of Air

When using the breathing apparatus, the conservation air is very important. The air that you learn how to conserve may be the air that is needed to rescue one or more victims, or get you out of the hazardous area. To conserve the air, the wearer must develop proper breathing control. This means slowing your free breathing rhythm, (no skip breathing or extra shallow breaths). To acquire this breathing control takes experience, not only during emergencies, but in actual organized training programs.

Excitement, emotions, and fears will consume air. The wearer must try to stay calm and relaxed in any situation to conserve air, and to think logically. Work should be accomplished at a good steady pace, so as not to over exert and expend all your energy and waste air. The wearer’s physical condition also has a bearing on air consumption. Develop your physical stamina through regular exercise.

When the breathing apparatus is not needed, remove the facepiece if you are in a safe atmosphere and if your clothing is safe. Before you re-enter the hazardous atmosphere, put the facepiece back on.

33.5 Air Supply Exhaust

Respirator users have died from running out of air while in a smoke charged building. You must Know what to do in this situation before it actually happens. As in All cases, you must remain calm and relaxed in order to think logically. Follow these steps:

1. Get closer to the floor, below the smoke level, and either remove the facepiece or disconnect the breathing tube and hand hold, then move to safety.

2. Disconnect the breathing tube and place it under your clothing. Crawl to safety on hands and knees, or while lying on the floor, making sure your body does not crimp the hose.

3. Disconnect the breathing tube and either cup container in palm of hand or place wet rag over the opening. Stay low and move to safety.

4. If you have a hose line, set nozzle between a 30-40 degree stream, disconnect breathing tube and regulator and place connector into center of stream, pointing away from the nozzle.

5. Move to a window, open or break it to climb out. In case of windows above the ground floor, open or break, then place tube out and down to reach the smoke free air.

Training in the above methods is very important if you are to survive in emergency situations where you can run out of air. It is your life that is at stake.

33.6 Lost in a Building

Remain calm, think and:

1. Follow the hose line out.

2. Follow the life line out.

3. Move to a wall and follow to a window or a door. Remember, not all doors lead to outside. Be careful.

4. Look for light entering through windows or around doors.

5. Listen for noise from men working outside, from inside, or from equipment and men on the outside.

6. If you come across a fire hose line and want to know which way to go, move to a coupling and feel for the male side.

7. Use radio set to contact someone outside and give your approximate location, such as, basement, ground floor or second floor, and any other valuable information. Someone from the outside will be sent approximately to your nearest exit location to either shout, pound on a metal object, or shine lights into the area to aid you in getting to safety.

33.7 If You Need Assistance (Trapped Or Pinned)

Attract someone's attention by:

1. Signaling with life line.

2. Shouting – you can open bypass and lift facepiece.

3. Wetting anyone you see with a fire hose.

4. Projecting a constant-flow water stream out a window.

5. Rapping on air cylinder with metal object four times, pausing, and then repeating until acknowledged and you are found.

6. Closing cylinder valve slowly until audible alarm begins to ring while you are breathing.

33.8 Regulator Malfunction

Since the regulator is a mechanical device, it may malfunction at any time, and you must react quickly. The steps are few and easy to follow:

1. Advise your partner.

2. Open bypass and regulate flow.

3. Close main line valve.

4. Move out of the area to safety.

Note: A full cylinder will last approximately ten minutes when only the bypass is in use. Once you are outside, the breathing apparatus must be put out of service or the situation corrected.

To put the breathing apparatus out of service, remove the waist buckle, put it in your pocket and then tie a knot in the waist strap so that the shoulder straps are enclosed in the knot center. This indicates that the breathing apparatus has malfunctioned in some way and should not be used.

33.9 Special Atmospheres

The breathing apparatus is designed to give full respiratory protection, but it cannot protect you from gases or toxic substances that attack the body through the skin. Other protection is needed along with the breathing apparatus.

Examples:

1. Ammonia – Extremely irritating, attacking the skin, especially the moist areas.

2. Hydrocyanic Acid – Absorbed through the skin. Hydrocyanic Acid gas is water soluble.

3. Pesticides and Poisons – These can enter the body by:

    a. Absorption through the skin;
    b. Ingestion;
    c. Inhalation;
    d. Through a puncture or wound.

Protect yourself by wearing full protective clothing.

33.10 Coming Out Of Toxic Areas

When leaving a toxic or radioactive area, do not remove the facepiece as soon as you are in a clean atmosphere. Your clothing may be contaminated to the point where the removal of the facepiece could produce serious injury or death. Wait to be checked. If your air supply is expended, disconnect the breathing tube from the regulator, hold the end of the tube away from your clothing, and continue to breathe while wearing the facepiece until you have been monitored.

33.11 Facepiece is Leaking or Does Not Provide Good Seal

Protect yourself by opening bypass to create a higher positive pressure in the facepiece, to expel smoke, and to prevent smoke or toxic gases from entering on your inhalation. Leave the area immediately.

34.0 TRAINING

Constant and in-depth training with the breathing apparatus will build your knowledge of its operation, limitations and capabilities. Most important, you gain confidence in its use because you are familiar with the apparatus. Training sessions should be very practical and as realistic as possible.

At least once a year, it is recommended that you wear the breathing apparatus during a training session that includes strenuous work, working on and climbing ladders, and working or moving in close or narrow passageways. This type of session will build your confidence in the use of the breathing apparatus, develop breathing control and closely simulate emergency usage.

It is also recommended that you put on the apparatus at least once a month. This will enable you to quickly and efficiently put on the apparatus upon any emergency, in a series of natural moves without thinking of the steps.

Preparing the apparatus for storage is very important, since the unit must be ready for the next use. When it is not stored ready for use, the efficient put on of the apparatus in a quick manner has been nullified. When putting apparatus back in a compartment or case, your must:

1. Have waist straps in proper position.

2. Have shoulder straps in proper position.

3. Have waist buckle in proper position.

4. Bleed off pressure in the system.

5. Open all strap buckles to the extreme loose position.

6. Recharge the air cylinder if necessary.

34.1 Emergency Selection and Use

There are three conditions for which respirators are used in emergency situations:

1. For an employee's self-rescue when process excursions, spills, etc., create a suddenly occurring hazardous environment.

2. For the rescue of personnel trapped or overcome in a hazardous environment.

3. To shut down or repair an operation that is creating a hazardous environment.

34.2 Rescue, Repair and Shutdown

Since the concentrations encountered in emergency situations cannot be quickly and easily determined, the only type of respirator acceptable for performing work in such an area is a pressure demand SCBA (Self-Contained Breathing Apparatus) or a positive pressure air line respirator with an auxiliary air tank for escape. Only pressure SCBA should be used for rescue.

34.3 Protection of Escape Respirator

Respirator cartridges are received from the manufacturer with a protective sea in place. They should be installed in the respirator with the seal intact. Each employee should be instructed in how to remove the seal when use of the respirator is necessary and how to properly put on the respirator.

In order to keep the respirator clean, once a practice session is completed and straps are set properly for future use, it should be placed in a polyethylene bag. It is then placed in a canvas bag attached to the employee's belt. Belts and canvas bags are available from respirator suppliers.

34.4 Escape Conditions

In an area having the potential for unexpected and paid release of dangerous concentrations of gases or vapors, each employee and/or visitor in the area, and in adjacent areas, should carry an escape respirator. Also, in all areas where the rapid release of toxic gases is possible, one should carry an escape respirator.

34.5 Acceptable Escape Respirators

1. Mouth piece respirators.

2. Standard chemical cartridge respirators.

3. Gas Masks.

4. Self-contained breathing apparatus, 5-15 minute supply.

See the Emergency Selection Table, next page.

34.6 Storage and Inspection

Store respirators for emergency use in conspicuous and accessible places. Inspect these units monthly, record these inspections on the correct inspection form. If these forms are not available, contact Environmental Health & Safety, Risk Management and Sustainability at 8-7422.

34.7 Training

Employee working in areas where the release of toxic gases or vapors is possible, must be thoroughly trained in:

1. Escape respirator usage.

2. Escape routes.

3. Shut down procedures.

4. Rescue (designated personnel).

34.8 Emergency Selection Table

Conditions	Type of Respirator (2)
Escape - short and direct route to exit (no oxygen deficiency).	Mouthpiece Respirator (1) Chemical Cartridge Respirator (2) 5 Minute SCBA
*Escape - long and/or indirect to exit (no oxygen deficiency).	Gas Mask (2) 15 Minute SCBA
Rescue, repair and/or shutdown, and/or entry into unknown environments or oxygen deficiency.	Pressure-Demand SCBA (3)

*Where eye irritation may hinder escape, a full face mask should be used.