NIOSH

Respiratory Protection...

A Guide for the Employee

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

RESPIRATORY PROTECTION

A Guide for the Employee

U. S. Department of Health, Education, and Welfare
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
Division of Technical Services
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PREFACE

Respiratory protective equipment can be effective in protecting you from the inhalation of hazardous amounts of airborne contaminants. However, this effectiveness is dependent on the respirator being properly fitted, maintained in good condition, and most importantly, on your knowing its proper uses and limitations. If the contaminants in your work environment require you to wear a respirator, then wear it; the alternatives are not worth the risk. Exposure to high concentrations of a toxic substance, even for a short time, can cause serious injury or death; and even exposure to lower concentrations of certain toxic substances for long periods of time can cause permanent damage to critical body organs such as lungs, liver, and kidneys. Work environments where the oxygen content of the air you breathe is below acceptable levels can also be hazardous.

As a user of respiratory protective equipment, you have the right:

1. To know what hazards you are being exposed to and the reasons why a particular respirator was selected;
2. To be instructed in the use of equipment;
3. To be allowed to wear the equipment in a test atmosphere so as to check for leakage and proper fit;
4. To be advised of the capabilities and limitations of the equipment; and
5. To be instructed in the proper maintenance of the respiratory protective equipment.

This guide, prepared for you, discusses the above aspects in some detail to enable you to understand the do's and don'ts of respirator usage to safeguard your health from airborne hazards encountered in the work environment.

INTRODUCTION

The Occupational Safety and Health Administration (OSHA) has set maximum levels for many airborne toxic materials. If you are exposed to amounts of these materials in excess of the standard, the law requires that your employer install, implement, or institute feasible engineering or administrative controls so as to reduce your exposure to acceptable levels. If these controls do not prove feasible, or while they are being installed/instituted, your employer is required to furnish appropriate respiratory protection to each exposed employee. You may also have to wear respiratory protective equipment during cleaning and maintenance activities where you are briefly exposed to high concentrations of a hazardous substance. Further, your employer is required to establish a respiratory protection program with written standard operating procedures which detail, among other aspects, how the respirators were chosen and how they are to be used and maintained.

You should be familiar with the respirator selected and the proper maintenance procedures for the equipment.

I. RESPIRATORY PROTECTIVE EQUIPMENT SELECTION

The selection of the proper respiratory protective equipment involves, for the most part, three basic steps:

- Identification of the hazard;
- Evaluation of the hazard; and
- Selection of the proper respiratory protective equipment.

A. IDENTIFICATION OF THE HAZARD

Hazards may take many different forms. Since the selection of a respirator is based on the specific hazards to which you are exposed, JUST ANY RESPIRATOR WON'T DO. It is important to know something about the different kinds of hazardous materials which may exist within your facility requiring the use of respirators.

1. Gaseous Contaminants

Gaseous contaminants add another invisible material to the air we already breathe. There are two types of gaseous contaminants:

a. Gases include substances, e.g., carbon dioxide, which are solids or liquids only at very low temperatures and/or high pressures. Carbon dioxide is a gas at room temperature, but it also occurs as a solid, dry ice at low temperatures, and as a liquid in presurrized tanks.

b. Vapors are exactly like gases except that they are formed by evaporation of substances, such as acetone or trichloroethylene, which ordinarily exist as liquids.

2. *Particulate Contaminants*

Particulate contaminants are made of tiny particles or droplets of a material. There are three types of particulates:

a. Dusts are solid particles produced by such processes as grinding, crushing, and mixing of powder compounds. Examples are sand and plaster dust.

b. Mists are tiny liquid droplets given off whenever a liquid is sprayed, vigorously mixed, or otherwise agitated. Acid mists around diptanks used for metal cleaning and oil mists near newspaper printing presses are two examples.

c. Fumes are tiny metallic particles given off when metals are heated. Fumes are found in the air near soldering, welding, and brazing operations as well as near molten metal processes such as casting and galvanizing. The two basic forms — gaseous and particulates — frequently occur together. Paint spraying operations, for example, produce both paint mist (particulate) and solvent vapors (gaseous).

3. *Oxygen Deficient Atmosphere*

This condition is most commonly found in confined spaces with very poor ventilation. Examples are silos, petrochemical tanks, and the holds of ships. (In some situations an oxygen deficient atmosphere is purposely maintained. For instance, fruit is sometimes kept in warehouses with a lot of carbon dioxide and very little oxygen.) Oxygen deficient atmospheres occur in two different ways.

a. Oxygen is "used up" by a chemical reaction in which it is combined with other elements. This is what happens when fire burns or iron rusts.

b. Oxygen is "pushed out" by another gas. If a room with "normal" air (which contains about 21% oxygen) fills up with another gas, e.g., helium, there will be less oxygen in every breath you take because the oxygen is being steadily "displaced" by the helium.

Oxygen deficient atmospheres have been classified as immediately dangerous to life. Typical early symptoms are dizziness and euphoria — like being slightly drunk. Lack of oxygen affects the brain very quickly, so you might not be aware of what is wrong until you are too confused to escape. Oxygen starvation can cause serious injury to the brain.

4. Atmospheres Immediately Dangerous to Life or Health

This is a term which is used to describe very hazardous atmospheres in which exposure will:

a. Cause serious injury or death within a matter of minutes. Examples are exposure to high concentrations of carbon monoxide or hydrogen sulfide.

b. Cause serious delayed effects. Exposure to critical levels of radioactive materials or cancer-causing agents are examples.

B. EVALUATION OF THE HAZARD

Once a potential hazard has been recognized and the hazardous substance or particulate identified, it is then necessary to determine the amount of contaminant (concentration) present. The measured concentration can be stated in various "units," depending on the form of the contaminant. The two most widely used units are (1) mg/M^3 — milligrams of contaminant in air per cubic meter of air and (2) ppm — parts of contaminant in air per million parts of air. The measured concentration (in appropriate units) is then compared with either the permissible exposure level (PEL), mandated in OSHA regulations, or the threshold limit value (TLV), recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). These values, as determined by these groups, are the maximum concentration to which a worker may be exposed day after day without adverse affects. It is your employer's responsibility to determine the concentration of the contaminant you are exposed to.

C. SELECTION OF THE RESPIRATORY PROTECTIVE EQUIPMENT

After the hazard(s) has been recognized and measured, the other factors still need to be considered.

- Is the contaminant recognized the *only* contaminant present?
- Does the contaminant have adequate warning properties? (Warning properties are especially important when *air-purifying* respirators are used against gases and vapors.)
- Will the contaminant irritate the eyes at the estimated concentration to which the user will be subjected?
- Can the contaminant be absorbed through the skin? If it can, will it result in a serious injury?

Now the proper respirator can be chosen.

What types are available?

1. Respirator types:

Respiratory protective devices can be divided into two general categories:

a. Air-purifying respirators
These devices remove the contaminant from the breathing air before it is inhaled. For each model of air-purifying respirator, there are usually many air-purifying filters available for protection against specific contaminants. These filters fall into two subgroups: particulate removing filters and vapor and gas removing filters called cartridges or canisters. These are discussed in Appendices I and II. Combination filters for protection against both particulates and organic vapors are also available.

b. Atmosphere Supplying Respirators
These devices supply uncontaminated breathing air to the user from a source other than the surrounding atmosphere. These types are usually complex and come in many configurations.

Atmosphere Supplying Respirators can be broken down into two subgroups.

Air Respirators, in which breathable air is conveyed to the user via a compressed air line or hose, and Self-contained Breathing Apparatus (SCBA), in which the user carries the breathing air sources which can be a compressed air tank or an oxygen generating device. See Appendices III and IV.

2. Selection Procedures

Selecting the proper respirator must be based on the hazard present, its concentration, and the form of the hazard (vapor, particulate, etc.).

3. Approved Respiratory Protective Equipment

OSHA requires that *approved* respirators be used if they are available. If only one brand of respirator on the market is approved for a particular hazard, then that brand is considered to be "available" and must be used.

An approved respirator is one that has been tested and found to meet minimum performance standards by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA). An approved respirator (by NIOSH) contains the following:

- An assigned identification number placed on each unit, e.g., TC-21C-101. The TC designation will always precede the identification number.

- A label identifying the type of hazard the respirator is approved to protect against.

- Additional information on the label which indicates limitations and identifies the component parts approved for use with the basic unit.

II. MEDICAL ASPECTS OF RESPIRATORY PROTECTIVE EQUIPMENT

The use of any type of respirator imposes some physiological stress on the user. *Air-purifying respirators,* for example, make breathing more difficult because the filter or cartridge can reduce the flow of air. The special exhalation valve on an *open circuit pressure demand* SCAB requires you to exhale against resistance. The bulk and weight of an SCBA can be a burden. If you are using an *airline respirator,* you might have to drag up to 300 feet of hose around. All of these factors can increase the "total" workload. If you have lung or heart problems, wearing a respirator could present an unacceptable risk. You should have some type of medical examination to determine if you are able to wear a respirator without it affecting your health.

A medical examination by a physician is the preferred screening mechanism. The following conditions may affect your ability to wear a respirator, and if they exist, you should get a medical opinion.

- Lung
  1. Do you have a history of asthma or emphysema?
  2. Do you have difficulty in breathing?
  3. Do you have any documented lung problems?

- Heart
  1. Do you have high blood pressure?
  2. Do you have artery diseases?
  3. Do you have documented heart problems?

- Other
  1. Do you have missing or arthritic fingers?
  2. Do you have facial scars?
  3. Do you have claustrophobia?

III. PROPER FITTING OF RESPIRATORY PROTECTIVE EQUIPMENT

Once a respirator has been selected for the contaminant to which you are exposed, and is appropriate for the airborne concentration, you are fully protected, right? Wrong! A respirator won't protect you unless the air you breathe goes through the "business end" — the canister, filter, or air supply system. If the face seal isn't tight or the connections are lose you may think you're breathing through it, but you will actually be breathing *around* it.

You may have to try on several different respirators before you find the one that fits properly. Your employer should have several types of respirators to choose from. Your employer must show you how to put the respirator on and how to adjust the straps for the best fit. The respirator should fit snugly, but it should not leave red marks, deep indentations on your face, or make it difficult to turn your head.

Beards and bushy sideburns may have to go, since respirator facepieces won't seal over them. Similarly, gum and tobacco chewing cannot be allowed since excess facial movement can break the faceseal.

If you wear prescription glasses, you must wear a respirator facepiece which will accommodate the glasses (this is especially critical for full facepiece respirators). Contact lenses should not be worn while wearing a respirator. A properly fitted respirator — primarily a full facepiece respirator — will stretch the skin at the temples slightly so that the contact lens might pop out. Also, contaminants that do leak in around the sealing surface may get underneath the contact lens thus causing severe discomfort. Your first reaction would be to remove the facepiece to remedy the situation — which would be fatal in a lethal environment.

Two types of fitting tests are used to determine the proper fit of respiratory protective equipment: qualitative tests and quantitative tests. *Qualitative* tests are fast, usually simple, but not as accurate an indicator for improper fit as the quantitative test. The *quantitative* test, though more accurate, requires the purchase of expensive equipment, requires a specially trained operator, and is of limited use due to its complexity and bulk.

IV. MAINTENANCE OF RESPIRATORY PROTECTIVE EQUIPMENT

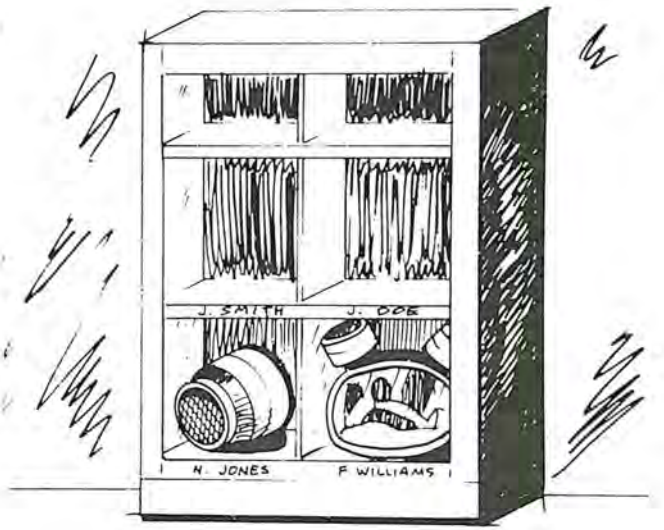
If you wear a respirator routinely it should be cleaned, inspected, and stored in a convenient location *after each use.*

A. CLEANING AND STORAGE

At the end of the workshift the respirator should be cleaned and stored in a convenient, clean location. If the respirator is shared, it should be cleaned *and* disinfected between users. In a large respirator program there may be a central facility for cleaning. In a small program, you may be expected to clean your own respirator. If so, the following method may be used.

- Wash with a detergent or a combination detergent and disinfectant, in warm water using a brush.
- Rinse in clean water, or rinse once with a disinfectant and once with clean water. (The clean water rinse is particularly important because traces of detergent or disinfectant left on the mask can cause skin irritation or dermatitis.)
- Dry on a rack or hang from a clothes line. In either case position the respirator so that the facepiece rubber won't "set" crooked as it dries.

Proper storage of a respirator is very important. The law requires that respirators be protected from dust, sunlight, heat, extreme cold, excessive moisture, and damaging or contaminating chemicals. A storage cabinet for air-purifying respiratory protective equipment is shown below.



B. INSPECTION

Inspection of the respirator is an important part of usage. You can further safeguard your health by performing (as appropriate) the below listed checks.

1. Disposable respirators, check for:

- Integrity of the filter (for holes);
- Straps for elasticity and deterioration;
- Metal nose clip for deterioration (if applicable).

2. Air-purifying respirators (quarter-mask, half-mask, full-facepiece, and gas mask):

a. Rubber Facepiece, check for:

- excessive dirt;
- cracks, tears, or holes;
- distortion from improper storage;
- cracked, scratched or loose fitting lens (full-facepiece);
- broken or missing mounting clips.

b. Headstraps, check for:
- breaks;
- loss of elasticity;
- broken or malfunctioning buckles or attachments;
- excessively worn serrations of the head harness which might allow the facepiece to slip (full-facepiece only).

c. Inhalation Valve, Exhalation Valve, check for:
- Detergent residue, dust particles, or dirt on valve or valve seat;
- Cracks, tears, or distortion in the valve material, or valve seat;
- Missing or defective valve cover.

d. Filter Element(s), check for:
- Proper filter for the hazard;
- Approval designation;
- Missing or worn gaskets;
- Worn threads — both filter threads and facepiece threads;
- Cracks or dents in filter housing;
- Deterioration of harness (gas mask canister);
- Service life indicator, or end of service date — for expiration (gas mask).

e. Corrugated Breathing Tube (gas masks), check for:
- Cracks;
- Missing or loose hose clamps;
- Broken or missing connectors.

3. Atmosphere-Supplying Respirators

a. Check facepiece, headstraps, valves, and breathing tube as discussed previously.

b. Hood, Helmet, Blouse, or Full Suit (if applicable), check for:
- Rips and torn seams;
- Headgear suspension;
- Cracks or breaks in faceshield;
- Protective screen to see that it is intact and fits correctly over the faceshield (abrasive blasting hoods and blouses).

c. Air Supply System, check for:

- Breaks or kinks in air supply hoses and end fitting attachments;
- Tightness of connections;
- Proper setting of regulators and valves (consult manufacturer recommendations);
- Correct operation of air purifying elements and carbon monoxide or high-temperature alarms.

d. Self-contained Breathing Apparatus (SCBA):

- Consult manufacturer's literature.

If defects are observed in a respirator, it must be removed from use until adequately repaired, or it must be replaced.

C. REPAIR

Sooner or later your respirator will need a new part or some other repair. The law requires that the people who repair respirators be well trained. And it is important for everyone to realize that respirator parts from different manufacturers are not interchangeable. The NIOSH approval will not hold if an air hose or a gasket or any other part has been replaced by one from a different brand of respirator. This is true even if the respirator seems to work just as well with the substitute part.

V. EMPLOYEE RESPONSIBILITIES

As a user of respiratory protective equipment, you also have responsibilities.

- Use respiratory protective equipment as instructed.
- Guard against damaging the respirator.
- Go immediately to an area of "clean" air if your respirator malfunctions.
- Report any malfunctioning of respiratory protective equipment to your supervisor. This would include but not be limited to:

— Discomfort;
— Resistance to breathing;
— Fatigue due to respirator usage;
— Interference with vision or communication;
— Restriction of movement.

It is impossible to cover briefly all the considerations that you should be familiar with because of the many types of respirators available. The manufacturer can supply much of the needed information. However, to be of value, it must be fully read and applied.

The appendices in this guide provide specific information on the general types of respirators most commonly in use. They are not all-inclusive, but do provide the basic information an employee should know about his particular respirator.

APPENDIX I

AIR-PURIFYING, PARTICULATE-REMOVING FILTER RESPIRATORS

A. DESCRIPTION

These are generally called "dust," "mist," or "fume" respirators, and by a "filtering" action remove particulates before they can be inhaled.

1. Single-use, dust

Side view showing
proper position of straps

The single-use respirator is a respirator which is completely disposed of after use. They are for individual use and should be discarded when resistance becomes excessive or the respirator is damaged. Generally, these respirators are approved only for pneumoconiosis- or fibrosis-producing dust such as coal dust, silica dust, and asbestos.

2. Quarter-mask, dust and mist, and half-mask, dust and mist

The quarter-mask covers the mouth and nose; the half-mask fits over the nose and *under the chin.* The half-mask usually produces a better facepiece-to-face seal than does the quarter-mask and is therefore preferred for use against more toxic dusts and mists.

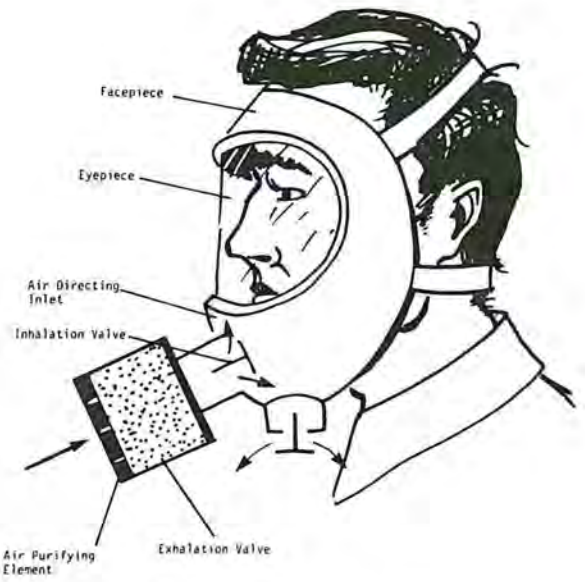
These dust and mist respirators are designed for protection against dusts and mists whose TLV is greater than .05 mg/M^3 or 2 mppcf.

3. Half-mask, high efficiency

This mask uses a high efficiency filter. Because of this high efficiency filter, this respirator can be used in atmospheres containing dusts, mists, fumes, or combinations of these forms where the TLV is *less* than .05 mg/M^3 or 2 mppcf.

4. Full facepiece

Full facepiece respirators cover the face from the hairline to below the chin. In addition to providing more protection to the face, the full facepiece gives a better seal than do the half- or quarter-masks. These respirators provide protection against dusts, mists, fumes, or any combination of these contaminants depending upon the type of filter used.



Typical full facepiece respirator.

B. LIMITATIONS

- Air-purifying respirators do *not* provide oxygen, so they must *never be worn in oxygen-deficient atmospheres.*
- Particulate-removing air-purifying respirators offer *no* protection against atmospheres containing contaminant gases or vapors.
- These respirator types should not be used for abrasive blasting operations.

C. PROBLEMS

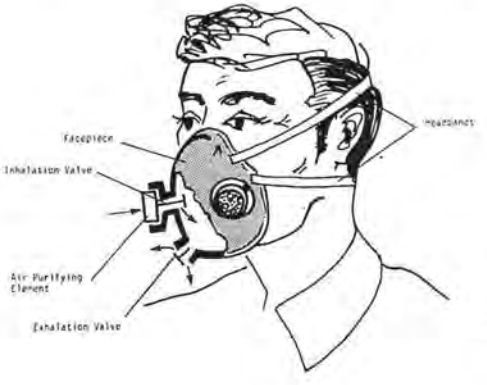
- The air flow resistance of a particulate-removing respirator filter element increases as the quantity of particles it retains increases, thus increasing the breathing resistance. *As a rule of thumb,* when comfortable breathing is impaired because of dust build-up, the filter should be replaced.
- Performance of some filter materials is affected by open storage in very humid atmospheres. Care should be taken in storing filter elements.

APPENDIX II

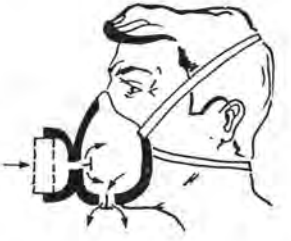
AIR-PURIFYING, CHEMICAL CARTRIDGE AND CANISTER RESPIRATORS FOR GASES AND VAPORS

A. DESCRIPTION

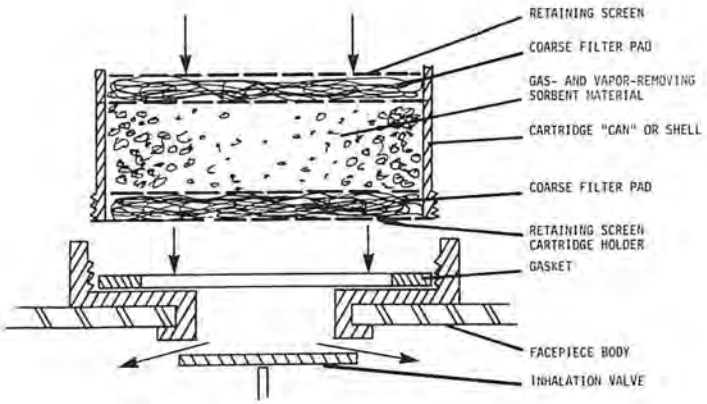
Vapor and gas-removing respirators use cartridges or canisters containing chemicals to trap or react with specific vapors and gases and remove them from the air breathed. The basic difference between a cartridge and a canister is the volume of the sorbent. Generally, a "cartridge" refers to a chemical filtering element which attaches directly to the facepiece, whereas a "canister" refers to the chemical filter element held in a harness and which is connected to the facepiece via a corrugated breathing tube. Some typical cartridge and canister respirators are shown below.



Typical half-mask respirator.



Typical quarter-mask respirator.



Typical chemical cartridge.

1. Half-mask and Quarter-mask Chemical Cartridge or Canister Respirators

These are available for protection against single chemicals such as ammonia or against entire classes such as organic vapors. Be sure to read the label on the cartridge or canister since it tells what the cartridge or canister protects against, the maximum concentration in which the element can be used, and in some instances, the service life or expiration date of the element.

2. Full facepiece

The full facepiece respirator may use a canister or cartridge(s) as the protective element. The front, back, and chin-mounted full-facepiece canister respirators are also referred to as "gas masks."

B. LIMITATIONS, CHEMICAL CARTRIDGE OR CANISTER

• These respirators do not supply oxygen, so they must *never be worn in oxygen deficient atmospheres.*

• They must not be used if the chemical to be protected against lacks adequate warning properties — odor, taste, or irritation, unless their use is permitted by applicable OSHA or MHSA standards. Warnings such as these are necessary to alert you that the sorbent is saturated, and the contaminant is passing through the cartridge or canister, and you are breathing contaminated air.

- They must not be used in atmospheres immediately dangerous to life or health, except for escape.

- They provide protection only from the specific gases or vapors they were designed to protect against (they may be worthless for other gases or vapors).

APPENDIX III

ATMOSPHERE SUPPLYING RESPIRATORS — SUPPLIED-AIR

Atmosphere-supplying respirators, rather than removing the hazardous material from the air, exclude the workplace air altogether and provide clean air from an independent source. There are two kinds of atmosphere supplying respirators: a *supplied-air respirator* in which the user is supplied with respirable air through a hose, and a *self-contained respirator* in which the user carries a supply of respirable air.

A. DESCRIPTION — SUPPLIED-AIR RESPIRATOR

Supplied-air respirators use a central source of breathing air that is delivered to the wearer through an air supply line or hose. There are essentially two major groups of supplied-air respirators — the airline device and the hose mask with or without a blower.

1. Airline Devices

The distinction of airline devices is that they use a stationary source of compressed air delivered through a high-pressure hose. Airline devices can be equipped with half or full-face masks, helmets, or hoods, or the device can come as a complete suit. Airline respirators can be used for protection against either particulates, gases, or vapors. They provide a high degree of protection against these contaminants but they *cannot be used in at-*

mospheres immediately dangerous to life or health because the user is completely dependent on the integrity of the air supply hose and the air source. If something happens to either the hose or air supply, he may not be able to escape from the contaminated area fast enough without endangering his life.

A great advantage of the airline respirator is that it can be used for long continuous periods. There are three types of airline respirators.

a. Demand Airline Device

In a demand device, the air enters the facepiece only on "demand" of the wearer, i.e., when the person inhales. This is due to the nature of the valve and pressure regulator. An example of a demand, half-mask airline device is shown below.

During inhalation there is a negative pressure in the mask, so if there is leakage, contaminated air may enter the mask and be breathed by the user. The leakage problem is a major drawback of the demand device. Demand devices are also available with a full-face mask, which provides a better seal than does the half-mask.

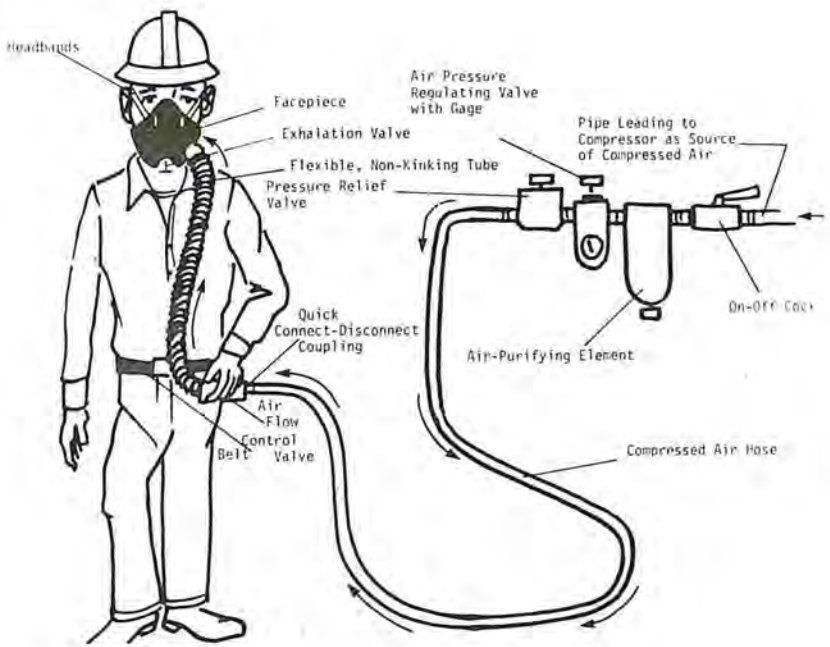
b. Pressure Demand Airline Devices

The pressure demand device has a regulator and valve design

such that there is a continuous flow (until a fixed static pressure is attained) of air into the facepiece at all times, regardless of the "demand" of the user. The airflow into the mask creates a positive pressure outward. As such, there is no problem of contaminant leakage into the facepiece. This is a significant advantage of this type of device.

c. Continuous-flow Airline Device

The continuous-flow airline respirator maintains a constant airflow at all times and doesn't use a regulator, but uses an airflow control valve or orifice which regulates the flow of air. A continuous flow-full facepiece device is shown below.



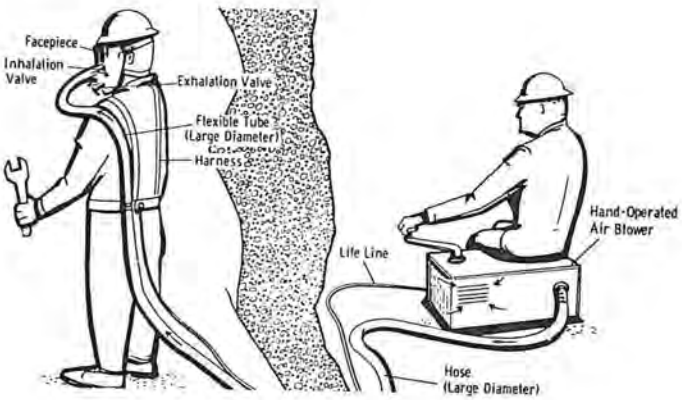
The continuous-flow device creates a "positive" pressure in the facepiece, and as a result, does not have the problem of inward leakage of contaminant.

A special type of continuous-flow device that provides protection against flying particles of abrasive materials is also available. The abrasive blasting airline respirator, shown below, incorporates a loose fitting facepiece.

2. Hose Masks

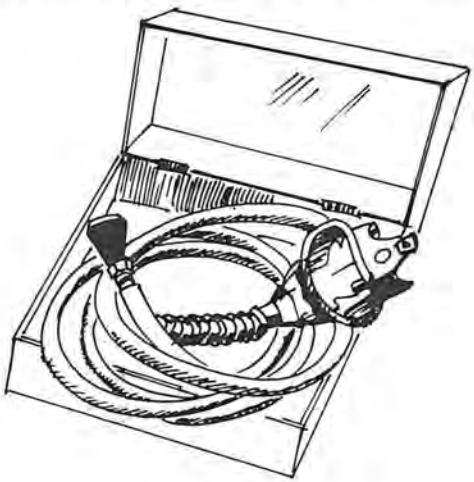
Hose masks supply air from an uncontaminated source through a strong, large diameter hose to the facepiece, and do *not* use compressed air or have any pressure regulating devices. (An advantage of the hose mask *with* a blower is its minimal resistance to breathing). Advantages of the hose mask *without* a blower are its theoretically long use periods and its simple construction, low bulk, easy maintenance, low initial cost, and minimal operating cost. Two types are available:

a. Those masks with hand or motor operated air blowers have a full facepiece mask. The hose length can be up to 300 feet. It must not be used in atmospheres immediately dangerous to life or health.



Hose mask respirator with hand operated blower.

b. Hose masks without blowers must have a tight fitting full facepiece. Helmets and hoods cannot be used. The hose mask without a blower can have up to 75 feet of hose.



Hose mask without Blower.

B. LIMITATIONS

1. Airline Devices

a. These devices must not be used in atmospheres immediately dangerous to life or health since the user is dependent upon an air hose which, if cut, crushed, or damaged, leaves him with little or no protection.

b. The trailing air supply hose of the airline respirator severely restricts the wearer's mobility. This may make the airline respirator unsuitable for those who must move frequently between widely separated work stations.

2. Hose Mask

a. The hose mask with a blower cannot be used in atmospheres immediately dangerous to life or health because the low air volume flow may result in a negative pressure being produced in the mask during inhalation allowing contaminated air to leak into the mask. Also, if the air hose is cut or obstructed, the user will be unprotected.

b. The trailing air supply hose of the hose mask severely limits mobility, so it may be unsuitable if frequent movement among separated work stations is required.

c. A severe restriction of the hose mask without a blower is that it is limited to a maximum hose length of 75 feet. Also, it requires the wearer to inhale against the resistance to air flow offered by the air hose which may become significant during heavy work. Inhaling against this resistance may cause fatigue.

APPENDIX IV

ATMOSPHERE SUPPLYING RESPIRATORS — SELF-CONTAINED BREATHING APPARATUS (SCBA)

The self-contained breathing apparatus (SCBA) allows the user to carry a respirable breathing supply with him/her, and does not need a stationary air source such as a compressor to provide breathable air. The air supply may last from 3 minutes to 4 hours depending on the nature of the device.

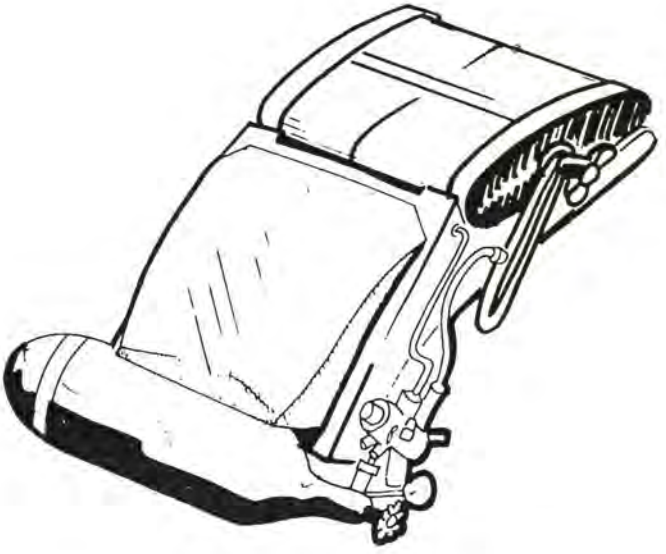
A. DESCRIPTION — SCBA

1. Closed Circuit SCBA

Another name for closed circuit SCBA is "rebreathing" device. The air is rebreathed after the exhaled carbon dioxide has been removed and the oxygen content restored by a compressed oxygen source or an oxygen-generating solid. These devices are designed primarily for 1-4 hour use in toxic atmospheres. Because negative pressure is created in the facepiece during inhalation, there is increased leakage potential. Therefore, the devices should be used in atmospheres immediately hazardous to life and health only when their long-term use is necessary, as in mine rescue. Two types of closed circuit SCBA are available.

a. Compressed Oxygen Cylinder Type

In this device, breathable air is supplied from an inflatable bag. Exhaled air from the wearer is filtered to remove carbon dioxide and the oxygen consumed is replenished from an oxygen cylinder.



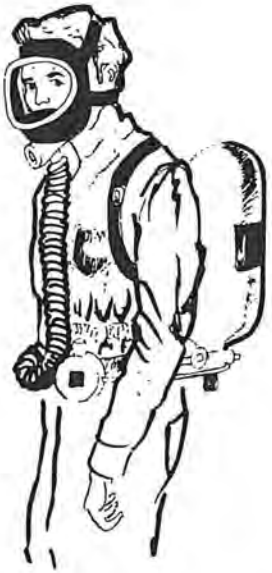
Typical oxygen-supplying closed circuit SCBA.

2. Open Circuit SCBA

An open circuit SCBA exhausts the exhaled air to the atmosphere instead of recirculating it. A tank of compressed air carried on the back, supplies air via a regulator to the facepiece. Because there is no recirculation of air, the service life of the open circuit SCBA is shorter than a closed circuit system. Two types of open circuit SCBA are available, "demand" or "pressure demand."

a. Demand SCBA

In a demand SCBA, air flows into the facepiece only on "demand of the wearer," i.e., when the person inhales. This is due to the nature of the valves and pressure regulator. An example of a demand open circuit is shown below. During inhalation there is a negative pressure in the mask, so if there is leakage, contaminated air can enter the mask and be breathed by the user. The leakage problem is a major drawback of the demand device. Because of this problem, a demand type open circuit SCBA should not be used in atmospheres immediately dangerous to life or health.



Typical open circuit SCBA.

b. Pressure Demand SCBA

The pressure demand open circuit SCBA has a regulator and valve design which maintains a positive pressure in the facepiece at all times regardless of the "demand" of the user. As such, there is no problem of contaminant leakage into the facepiece. This is a significant advantage of the pressure demand device. A pressure demand SCBA is identical in appearance to a demand SCBA, but has a different regulator assembly and facepiece exhalation valve design.

3. Combination Atmosphere Supplying Respirator: Supplied Air and SCBA

Designed primarily as a long duration device, this respirator combines an airline respirator with an auxiliary air supply (usually compressed air) to protect against the possible failure of the primary air supply (the airline). The additional supply can be approved for 15 minutes or even longer. The choice depends upon how long it would take to escape from the toxic atmosphere if the primary air supply failed.

Typical combination air line and SCBA respirator.

B. LIMITATIONS

- The air supply is limited to the amount in the cylinder (SCBA's using a compressed air tank) and therefore the respirator cannot be used for extended periods without recharging or replacing the cylinders.
- Because these respirators are bulky and heavy, they are often unsuitable for strenuous work or use in confined spaces.
- Because of the *short* service time of the auxiliary air supply, the escape portion of the combination unit can be used only for escape from atmospheres Immediately Hazardous to Life or Health (IDLH) unless the escape portion has a minimum of 15 minutes service life. Such devices can then be used for entry into immediately dangerous to life or health atmospheres, provided not more than 20% of the available breathing supply is used. These devices may always be used for entry into IDLH atmosphere when utilized with the external air supply.

NIOSH AND OSHA REGIONAL OFFICES

The following pages list NIOSH and OSHA regional offices. Either of these facilities serving the state can provide information on the Occupational Safety and Health Act including questions on standards interpretations, voluntary compliance information, copies of the OSHA Standards, OSH Act, Employee Rights Posting Notice, and other OSHA publications.

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Room 1401
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617/223-6668

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Occupational Safety and Health Administration
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