

RESPIRATORY PROTECTIVE EQUIPMENT

SAFETY ENGINEERING STANDARD

ISSUED	JAN 1964
THIS PAGE REVISED	SEPT 1978
STANDARD REAFFIRMED	SEPT 1978

S 2 H

Page 1 of 9

This standard includes requirements of the Occupational Safety and Health Act of 1970 (OSHA) as published in the Federal Register. OSHA information is printed in red.

This standard provides information for the selection, use, and care of respiratory protective equipment (respirators). The term "respirator" in this standard is used inclusively and applies to atmosphere-supplying and air-purifying devices that provide breathable air to the wearer within the limits of the equipment, whatever the source of air. This standard does not apply for exposure to airborne radioactive contamination for which special consideration may be necessary.

2.1 Respirators should not be used as a substitute for adequate exhaust ventilation or other engineering control methods.

2.2 Respirators shall be worn at all times where the atmosphere may be harmful to employees due to unusual conditions, and where work is necessary in contaminated or oxygen-deficient, confined areas.

2.2.1 When the air is deficient in oxygen, the symptoms range from increased volume of breathing and acceleration of pulse rate to unconsciousness and death, depending upon oxygen content and the degree of a person's activity. Unconsciousness is immediate when a man breathes pure nitrogen and death may follow in a few minutes.

2.2.2 An oxygen deficiency may indicate a hazard other than inert gas: e.g., flammability (see 4.4), skin toxicity, or absorption through the skin, particularly hydrogen cyanide. Threshold limit values (TLV's) of air contaminants are given in S2T. Portable oxygen and toxic-gas detectors are covered in S3T.

2.3 Pure oxygen shall not be used in atmosphere-supplying respirators.

3.1 Where schedules for a particular type of equipment have been established, only equipment listed and approved by the Bureau of Mines and the National Institute for Occupational Safety and Health shall be used.

Portions printed in red are from OSHA regulations, Section 1910.134

Vendors and merchandise designations are given to describe materials and may not include all acceptable products. Substitutions by suppliers are to be made only on approval of the legal authority initiating the use of this standard.

SULCOMMITTEE NO. 28

3.1.1 Respirators purchased on or before September 30, 1974 and meeting the following Bureau of Mines Schedules are approved for use until the following dates:

Type of Respirator	Bureau of Mines Approval Schedule	Terminal Use Date
Self contained	13 thru 13E	March 31, 1979
Gas masks	14F	" "
Supplied air	19B	March 31, 1980
Dust, fume, mist	21R	March 31, 1976
Chemical cartridge	23B	March 31, 1976

* Certain self-contained breathing apparatus may be operated to meet the requirements of 30 CFR, Part 11 and reinforced. Refer to manufacturer.

^{ee} Terminal use date has been withdrawn and is indefinite.

3.1.2 Respirators purchased after September 30, 1974 shall be manufactured per quality control plan approved under Title 30, Code of Federal Regulations, Part .11 and shall meet the requirements of the Bureau of Mines Schedules shown in 3.1.1. Such equipment will bear an approval label bearing the letters "TC" instead of "BM"

3.1.2.1 Exception. approved respirators purchased after September 30, 1974 and on or before June 30, 1975 may be marked "BM" if NIOSH has approved the vendor's quality control plan under which the respirator was manufactured.

3.1.3 Respirators purchased after June 30, 1975 shall meet the requirements of Chapter 1, Title 30, Code of Federal Regulations, Part 11 - Respiratory Protective Devices; Tests for Permissibility.

3.2 A list of the respirators and their manufacturers, certified by the National Institute for Occupational Safety and Health (NIOSH) per 3.1.3, may be obtained on request for HEW Publication No. (NIOSH) 75-119 plus cumulative supplements from:

NIOSH Testing and Certification Laboratory
944 Chestnut Ridge Rd
Morgantown, WV 26505

DUP 0960524

DU 040734

NIOSH Office of Technical Publications
Post Office Building
Cincinnati, OH 45202

U. S. Bureau of Mines
Health and Safety Research and Testing Center
3800 Forbes Ave
Pittsburgh, PA 15213

3.3 At the present time, there are no approval schedules for air-supplied suits.

3.4 A list of the several types of respiratory protective equipment, method of operation, use, limitations, and remarks is given in Table 1. For additional information in this regard, reference should be made to:

Practices for Respiratory Protection, ANSI Z88.2, American National Standards Institute, Inc. 1430 Broadway, New York, NY 10018

Respiratory Protective Equipment, Data Sheet D-444, National Safety Council, 425 North Michigan Avenue, Chicago, IL 60611

Respiratory Protective Devices Manual published by American Industrial Hygiene Association and American Conference of Governmental Industrial Hygienists (copies are available from Braun and Brumfield Inc, Box 1203, Ann Arbor, MI 48106)

4. USES AND LIMITATIONS

4.1 Users of respiratory protective equipment shall have medical approval.

4.2 The air-purifying respirators; i.e., canister gas masks, chemical cartridge respirators, and mechanical filter respirators (Table 1C) shall not be used for rescue work, or for emergency work of any nature. This is because these respirators do not supply oxygen and therefore do not protect against possible oxygen deficiencies. Other reasons for this requirement are that:

a. Gas masks are intended for use with no more than 2 percent, by volume, of most toxic gases.

b. Chemical cartridge respirators are intended for use in significantly lower toxic gas concentrations than canister gas masks. Limits vary from 0.05 percent maximum to 0.1 percent maximum.

4.3 The following warning signs require immediate return to fresh air:

a. Uncomfortable heat in the inhaled air. (A properly operating canister will become warm on exposure to certain gases or vapors, but a canister which

becomes extremely hot indicates that concentrations above the canister limit have been encountered.)

b. If nausea, dizziness or signs of distress develop.

c. If the canister has a window indicator which shows the specified color change.

d. If any leakage is detected by smell, taste, eyes, nose or throat irritation.

e. If high breathing resistance develops.

4.4 Air purifying respirators should not be used in atmospheres immediately dangerous to life and health or when the contaminant has poor warning properties, except for escape.

4.5 Users should select canisters and cartridges specifically approved for the toxic gas and concentration to be encountered. Canister masks that bear the label "All-Service," "All-Purpose," or "Universal" should not be used for a specific gas or vapor if a canister is available for that specific gas or vapor.

4.6 Although self-contained breathing apparatus or combination air-line and self-contained breathing apparatus have no concentration limit in regard to toxicity, many toxic gases and vapors are flammable and the user could be exposed to a potential fire or explosion. The 2-percent concentration limits approved for toxic gas removal with canister-type masks is within the flammable range for some gases. Work in atmospheres in or near the flammable range is prohibited. When the possibility of flammable atmospheres exists, a check should be made with an explosimeter and permissible concentrations confirmed prior to entry. Standard F6J provides information and instructions for use of portable flammable vapor and gas detectors.

4.7 Respiratory protection is required for cancer suspect agents. Refer to OSHA regulations for specific requirements, Section 1910.1000 series and to S2T.

4.8 An uncontaminated supply of air must be assured when using a hose mask with blower.

5. SELECTION

5.1 In selecting a respirator, the following factors (5.1 - 5.1.6.1) and Tables 1 and 2 should be considered. Engineering Dept Report, Accession No. 15167 "Respirator Selection," also will provide guidance.

a. Nature of the hazard

b. Severity of the hazard

c. Type of contaminant

Portions printed in red are from OSHA regulations, Section 1910.1000 series



CONFIDENTIAL 0960525

DU 040735

REV DEC 1979

- d. Concentration of the contaminant
- e. Period protection is required
- f. Location of the contaminated area with respect to a source of respirable air
- g. Expected activity of the wearer
- h. Operating characteristics and limitations of the available respirators
- i. Safety regulations of state or local governments

5.1.1 Self-contained breathing apparatus rated for at least 30-minute service time should be used for entry into an irreparable atmosphere.

5.1.2 Self-contained breathing apparatus with less than a 30-minute air supply shall be used only for emergency egress and not for rescue work or reentry.

5.1.3 Operating time for self-contained apparatus is based on moderate work rates. Operating time is reduced by increased respiration required by heavy exertion.

5.1.4 Only self-contained breathing apparatus, or combination air-line respirator and self-contained breathing apparatus, shall be used in oxygen-deficient atmospheres or where the contaminant is, or might be, immediately dangerous to life. The air in the self-contained unit of the combination air-line respirator and self-contained breathing apparatus shall be used only for egress in event the line supply of air is interrupted. The volume of this air supply may vary for different applications, but shall be ample to allow the worker sufficient air to escape from the contaminated area. In any case, this supply shall not be less than 3 minutes. Consideration should be given to using only positive pressure units.

5.1.5 Escape masks are used only while the wearer leaves a contaminated area. They are approved under Subpart I, 30 CFR Part 11 and have a half mask facepiece, or a mouthpiece. Where eye irritation is a consideration, a full facepiece should be used. For escape or emergency purposes from unknown concentrations of extremely hazardous atmospheres (any gas or vapor having a rated lethal concentration LC 50 of less than 10 ppm), a pressure demand self-contained breathing apparatus or combination pressure demand supplied air respirator with pressure demand self-contained breathing apparatus shall be used.

5.1.6 Entry Masks. Use self-contained breathing apparatus with at least a 30-minute air supply or a combination supplied air respirator with self-contained breathing air apparatus. Unit shall be of the pressure demand type. The entry masks should be located outside of the potentially affected area in a noncontaminated area and properly identified and protected.

Portions printed in red are from OSHA regulations, Section 1910.134.

5.1.7 Fire Fighting. Use self-contained breathing apparatus with at least a 30-minute air supply. Unit shall be the pressure demand type.

5.1.8 Schedule 13E of the U. S. Bureau of Mines on self-contained breathing apparatus requires a remaining service-life indicator or warning for compressed breathing air (except for self-rescue). Some equipment now on plants may not have these alarms. These can and should be obtained from equipment suppliers for apparatus not so equipped.

5.1.8.1 When the device is a combination self-contained breathing apparatus and air-line respirator (supplied-air respirator), either a manual or automatic valve(s) shall be provided to change to the self-contained air supply if the air-line supply fails, and to prevent the wearer breathing contaminated air from the outside atmosphere. If a manual valve is provided, it shall be easily operable and located in a position which is convenient to the wearer. If an automatic valve is provided, a warning also shall be provided to alert the wearer that he is breathing from the self-contained air supply. (1) when his normal air-line supply fails, or (2) when the self-contained air supply falls below 95 percent of its full container pressure. A quick disconnect and check valve shall be provided between the apparatus and the air-line supply hose to permit ready escape from the area, and to prevent loss of breathing air from the device or inhaling the surrounding atmosphere, respectively.

6. BREATHING AIR

6.1 Both purchased and manufactured breathing air shall meet or exceed the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Commodity Specification G-7.1-1966. See table below for gas analysis summary:

Gas	Content Analysis†
O ₂	19 percent min to 23 percent max
CO	20 ppm max
CO ₂	1,000 ppm max
Hydrocarbons	0.020 mg/liter max (as condensables)
H ₂ O	Dew point less than the lowest probable temperature to be encountered ‡
N ₂	Balance
Odor	Free of all objectionable odors

† See 6AT for data on direct reading portable detectors for oxygen and other gases and vapors.

‡ This is necessary to prevent freeze-up and stoppage of air flow to the mask. For tables refer to "Handbook of Compressed Gases."

6.2 A reliable supplier should be chosen. Visit his facilities to determine his degree of control over the



CONFIDENTIAL

DUP 0960526

DU 040736

operation. If an air compressor is used, it should be nonlubricated. If a lubricated compressor is used, it must have a carbon monoxide or high temperature (or both) alarm. Annual contacts should be made to assure equipment and procedures have not changed.

6.3 Preferably, certified breathing air should be purchased from a reliable supplier. If a choice has to be made between certified air from a questionable supplier and uncertified air from a reliable supply, the latter would be the recommended choice.

6.4 Determine if the air is provided by compression or reconstitution (mixing nitrogen and oxygen) and analyze as follows:

Method of Preparation	Analysis Recommendation
Compression - supplier does not fill cylinders with any gases other than air.	Check 10 percent of cylinders from each lot for percent CO and odor.
Compression - supplier fills cylinders with gases other than air	Analyze all cylinders for percent O_2 . Check 10 percent of cylinders from each lot for percent CO and odor.
Reconstitution	Analyze all cylinders for percent O_2 . Check 10 percent of cylinders from each lot for percent CO and odor.

6.5 In addition a complete analysis should be conducted periodically to assure compliance with Table 3 specifications.

7. PRECAUTIONS

7.1 An extensive list of instructions in use and precautions for each type of respirator is given in ANSI Z88.2. Some precautions are given in Table 1 under headings of Limitations and Remarks.

7.2 The manufacturer's instructions or precautions of the ANSI standard should be posted with the respiratory device.

7.3 All persons who may have occasion to use respiratory devices, or cause them to be used, should be properly trained in their use. Also, in execution of plant disaster plans, proper training in use of respiratory protective equipment will aid in the performance of smooth and safe rescue or repair operations.

7.4 A slight negative pressure occurs inside the facepiece of face-fitting air-purifying respirators (Table 1C). Care must be taken to obtain an effective seal between the facepiece and face to prevent inward contaminant leakage.

Portions printed in red are from OSHA regulations, Section 1910.134

Also, demand-type air-supplied respirators and demand-type self-contained respirators operate under negative pressure when the wearer inhales. Since some inward leakage of contaminant may be possible, these types provide much less protection. When purchasing new air-supplied, self-contained or combination type, pressure-demand should be specified.

7.4.1 A pressure-demand type self-contained respirator or air-supplied combination self-contained should be used in atmospheres containing contaminants which cannot be detected by smell or where special precautions must be taken to prevent the wearer from inhaling any trace of contaminant. In this type equipment a small positive pressure is maintained inside the facepiece at all times, such that if a leak should develop, there would be no leakage of contaminant into the facepiece.

7.5 A proper seal cannot be established if the temple bars of eye glasses extend through the sealing edge of full-face masks.

7.6 Contact lenses shall not be worn with full-face masks. See S4H.

7.7 All eyepieces in full-face masks approved by the Bureau of Mines will pass the ball drop test, but some plastic eyepieces may not pass the needle drop test (S4H). Current schedules of the Bureau of Mines, however, require that eyepieces shall meet the pertinent requirements for impact and penetration specified in the most recent ANSI Z87.1 Safety Code for Eye Protection.

7.7.1 Full-face masks have been developed with systems for mounting corrective lenses inside the facepieces. Contact the manufacturers for assistance.

7.8 Major problems in the use of full-face masks at low temperatures are poor visibility and freezing of exhalation valves. Antifog compounds can be used to coat the inside and outside of the eyepiece to prevent its fogging down to about 32°F. Below 0°F, however, antifog compound will not prevent severe fogging. Antifog compounds break down and require reapplication periodically.

7.9 A half-mask facepiece should not interfere with the wearer's use of spectacles or goggles. Proper selection of equipment normally will eliminate any problem of proper fit when using a combination of half-mask facepiece and spectacles or goggles.

7.10 Persons required to wear respirators must be clean shaven in the area of the respirator seal.

7.11 Conventional respirators do not constitute an absolute barrier to transmission of speech. The respirator exhalation valve usually provides a satisfactory pathway for speech transmission over short distances in relatively



CONFIDENTIAL

DUP 0960527

REV. DEC 1978

DU 040737

quiet areas. Speech transmission devices are available. **Caution:** check for acceptability of electrical classification for use in hazardous areas, and NIOSH approval when mounted on respirator).

2.12 Hoses for air supply should be selected to resist chemicals to which they may be exposed.

8. CARE

8.1 **General.** A centralized maintenance, cleaning, and storage station should be used to care for respiratory protective equipment.

8.2 Procedures Applicable to All Respirators

8.2.1 **Inspection.** All respirators shall be inspected routinely before and after each use. Those held ready for emergency use shall be inspected at least monthly and after each use.

8.2.1.1 Self-contained breathing apparatus shall be inspected monthly.

8.2.2 **Maintenance.** When it is necessary to replace worn or deteriorated parts, only those made specifically for the device shall be used; and the repair work shall be accomplished by trained personnel. For most plants, it is preferable that parts of this type (subassemblies) be replaced as a unit or returned to the manufacturer or factory trained personnel for repair.

8.2.3 **Cleaning and Disinfecting.** Respiratory protective equipment, except canisters and cartridges, should be cleaned and disinfected after each use, unless assigned to individuals, when they shall be cleaned as necessary to assure a sanitary and properly functioning mask.

8.2.4 **Storage.** All respiratory protective equipment shall be stored in a clean, cool, dry place, out of direct sunlight, under conditions of moderate temperature. They should be located for easy accessibility and the location adequately labeled if necessary. Respirators should not be stored in such places as lockers or tool boxes unless they are in carrying cases or boxes.

8.3 Special Procedures for Maintaining, Cleaning, Disinfecting, and Storing Respirators

8.3.1 **Self-Contained Breathing Apparatus.** In demand-type (Table 1B), the cylinder pressure should be checked periodically and recharged if below rated pressure (corrected to 70°F). Recharge after each use, following manufacturer's instructions. Follow manufacturer's instructions on tightness tests for self-contained respirators and hydrostatic testing of compressed-air cylinders. Assure that regulator and low-pressure alarms are functioning.

Portions printed in red are from OSHA regulations, Section 1910.134

8.3.2 Cylinders shall be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR, Part 173).

8.3.3 **Hose Masks.** Check the blower periodically for proper operation. Check hose for wear and tear after each use and clean when necessary. Keep hose capped when not in use to prevent entrance of dust or other contaminants.

8.3.4 **Air-Line Respirators.** The facepiece should be serviced after each use, as for all other respirators. The flow control valves should be inspected after each use and cleaned and repaired, if necessary. Air-line hose should be checked for wear and tear after each use and be cleaned when necessary. See SIH on air-supply system.

8.3.5 **Self-Rescuers.** Monthly inspection is the most important phase of the maintenance program with this type of equipment because the equipment is seldom used but must always be ready.

8.3.6 Chemical Cartridge Respirators

8.3.6.1 In plants with centralized maintenance stations, cartridges sometimes are discarded after a predetermined period of use. Masekoff Laboratory will establish chemical cartridge breakthrough times for specific toxic atmospheres on request to assist plants in establishing use period criteria.

8.3.6.2 Replacement should be incorporated into the maintenance and cleaning program. In most cases, the wearer should not be responsible for scheduling replacement cartridges in his respirator. However, chemical cartridges should be changed when the wearer detects the odor or irritating effect of the contaminant.

8.3.6.3 Where the expected contaminant has no odor or irritating effect, chemical cartridge respirators shall not be used.

8.3.6.4 Mouthpiece respirators shall not be used for routine protection, because breathing through the mouth may bypass the odor or irritation warning of an expended cartridge. Those do not have NIOSH approval.

8.3.6.5 Particular care should be exercised in the storage of chemical cartridges because they deteriorate if exposed to excess moisture and to gaseous air contaminants. Cartridges should not be stored in the area where the workmen use them.

8.3.7 **Mechanical Filter Respirators.** Mechanical filters of the "throw-away" type should be discarded when the breathing resistance becomes bothersome to the wearer. Some mechanical filter respirators use replaceable filters, in which case the filters are cleaned when the respirator is being serviced.

CONFIDENTIAL

DDP 0960528



TABLE 1 - TYPES OF RESPIRATORY PROTECTIVE EQUIPMENT (CONTD ON PAGE 7)

Table 1A - Air-Supplied Suit

Method of Operation	Air supply from supplied-air breathing apparatus. See S1H on air-distribution system.
Use	Operating or repair work where there is exposure to substances that are irritating or corrosive to the skin and mucous membranes, but where the atmosphere is not immediately dangerous to life. If immediately dangerous to life, the respiratory equipment should be provided as in S.1.4 and the air-supplied suit should be kept with a slight positive pressure. In any case the air supply should not be less than 18 minutes to allow the worker sufficient air to escape from the contaminated area. A body harness is required to handle the hose line and the life line, which always should be worn as a rescue device. Helper (wearing similar air-supplied suit, body harness, and life line) should be assigned with no other duties than to observe the man in the hazardous area, attend the life line and in emergency, ask for help and be ready to rescue the worker. (See S18G).
Limitations	The wearing of an impervious suit for any extended period is extremely fatiguing and dangerous unless it is well ventilated. The suit must be impervious to the substance encountered. With the longest hose length for which use is intended assembled to the respirator, and the lowest inlet pressure intended for operation introduced to the air-supply hose, constant flow units must deliver at least 4 cfm measured at the facepiece. The exhalation resistance at 85 liters per minute shall not exceed 1 inch of water. When helmets or hoods are used, the same requirements must be met except that the flow rate must be at least 6 cfm. For both types of assemblies with the highest inlet pressure and shortest hose length, the maximum flow shall not exceed 15 cfm.
Remarks	No NIOSH* approval. For additional information, see Fleming, A. J., D'Alonzo, C. A., and Zapp, J. A., "Modern Occupational Medicine," Chapter 7, "Protective Clothing for the Chemical Industry," Lea and Febiger, Philadelphia (1980). A Ranque-Hilch vortex tube** worn as a portable refrigerator can satisfactorily cool compressed air for personnel wearing industrial protective clothing. The vortex tube is light and small, and can be strapped to the belt where it does not interfere with physical movement. The tube operates on 20 to 25 cfm of compressed air at 60 to 100 ps and delivers 15 to 18 cfm of air cooled 50 to 60°F below the inlet air temperature. The tube can be reversed and used as a heater.

* National Institute for Occupational Safety and Health, U. S. Dept of Health, Education and Welfare

** Available from
Eneon Manufacturing Company
P O Box 9825-TR
Houston, TX 77001

CONFIDENTIAL

DUP 0960529

DU 040739

CONFIDENTIAL

JANUARY 1984

This Page Rev Sept 1978

RESPIRATORY PROTECTIVE EQUIPMENT

B 2 H

Page 7

TABLE 1 - TYPES OF RESPIRATORY PROTECTIVE EQUIPMENT (CONTD ON PAGE 8)
Table 1B - Atmosphere Supplying Respirators

Method of operation	Self-Contained Type		Supplied-Air Respirator			
	Approved	Demand Type	With Breater (Type A Supplied-Air Respirator)	Without Breater (Type B Supplied-Air Respirator)	Continuous Flow Air-Line Respirator	Demanded Close Air-Line Respirator (Type C Supplied-Air Respirator)
In chlorine, carbon monoxide, or other gases with a gravimetric density greater than 1.25 (air = 1.0) in a container. CO ₂ also is included. Purified breath is inhaled through breathing bag.		Air from high pressure cylinders normally 2000 psi and at distance over 300 ft from a source of respirable air-protection for limited periods.	Respirable air is forced through a large diameter breather hose by a hand blower to a full facepiece. (U.S. Bureau of Mines has conducted with electric motor on blower.)	Respirable air is drawn through a large flexible hose by wearer's breathing effort.	Pressurized air supplied through a small-diameter hose to full-face hood, full facepiece, or a loose fitting hood at head.	Source of air at demand valve is: sealed by small hose to demand valve; or: sealed by slight negative pressure when respirator is inhaled.
Not approved		Required under conditions immediately dangerous to life and health (IDLH) and at distances over 300 ft from a source of respirable air-protection for limited periods.	Up to 300 ft of hose from source of respirable air. Protection provided for an unlimited period.	Nonemergency work, up to 75 ft of hose from source of respirable air. Protection provided for an unlimited period.	Limitations by manufacturer for air supply hose length and range of air pressure. Protection for unlimited periods.	Disinfectant to protect head and face from flying particles (abrasive blowing, spraying of material, etc. or paint).
Limitations		No environmental limitation in regard to toxicity or an oxygen content. Absorption through the skin or skin irritations are possible limitations. Even-also training in use and care is required. Respirator due to weight.	Limitations in regard to toxicity or an oxygen content. Absorption through the skin or skin irritations are possible limitations. Even-also training in use and care is required. Respirator due to weight.	See limitations for Type A at left. Not for emergency use. Not approved in any situation where inhalation resistance exceeds 2.5 in. H ₂ O or where exhalation resistance exceeds 1 in. H ₂ O. Hose inlet shall be fitted with a fine (200 mesh) SST screen, and shall be furnished in a zone of clean air.	When used alone, this device is limited to concentrations of gases or vapors that are not immediately dangerous to life or health (IDLH) and the air of the respirator must be worn in oxygen-deficient atmospheres. Trend is limited by the length of the air-supply hose. Resists must be released. Absorption through the skin or skin irritations are possible limitations. Combination air-line respirator and self-contained breathing apparatus may be used in an inbreathable atmosphere (See 5.1.1).	When used alone, this device is limited to concentrations of gases or vapors that are not immediately dangerous to life or health (IDLH) and the air of the respirator must be worn in oxygen-deficient atmospheres. Trend is limited by the length of the air-supply hose. Resists must be released. Absorption through the skin or skin irritations are possible limitations. Combination air-line respirator and self-contained breathing apparatus may be used in an inbreathable atmosphere (See 5.1.1).
Remarks	Not approved	Approved for 30 min only. Scott Air Pak is an example. * Pressure demand respirators maintain the facepiece under a slight positive pressure during the entire breathing cycle to further protect against leakage of toxic atmospheres.	Breater must permit two entrances of air when it is not operating. Helper should be assigned with no other duties than to observe the man in the hazardous atmosphere, stand by the line and, in emergency, operate the blower. A helper operator also should be provided. A body harness is required to handle the hose line and the lifeline, which straps should be worn as a rescue device (see 7.3.2).	See remarks for Type A at left regarding helper and harness.	Nonbreathable hose should be used if operating pressure is greater than 5 psi (see 6.3.4).	Remarks or heads are not used with this respirator. See 5.1.1 on air-line distribution system.

† Not approved for use at Company sites



DUP 0960530

DU 040740

TABLE 1 - TYPES OF RESPIRATORY PROTECTIVE EQUIPMENT (CONT'D FROM PAGE 7)

Table 1G - Air Purifying Respirators

(Not for use in oxygen-deficient atmospheres or where the contaminant is, or might be, immediately dangerous to life)

Method of operation	Chemical-Filtration Type			Mechanical-Filtration Type Respirators	Combination Chemical and Mechanical Filtration Respirators
	Canister Gas Mask (Full Facepiece Respirator)	Chemical Cartridge Respirator (Half Mask Respirator)	Self-Contained Breathing Apparatus		
Tragic gases or vapors removed from inspired air by absorption, adsorption, chemical reaction, or catalysis, or a combination of these in a packed solvent bed of the canister or cartridge. Exhausted breath goes to atmosphere.				Respirators remove particulate matter such as dust, fumes, or mist, from inspired air by capture on the filter, which is usually a fibrous pad.	Some gas mask canisters contain special filters which provide respiratory protection against particulate matter, as well as against gases and vapors. Some chemical cartridge respirators contain filters for the same purpose.
Provides respiratory protection against single or combination of 2 or more gases and vapors. For escape only. Provides greatest protection consistent with size of device.				Designed to provide respiratory protection against a single specific dust, fume, or mist, a single class such as toxic dusts or a combination of several classes of particulate matter such as dusts, fumes, and mists. It offers no protection against gases or vapors.	For particulate matter, gases and vapors in concentration within capacity of the device.
See Section 4. Cannot be used in atmospheres lacking in the air.	See Section 4. Cannot be used in atmospheres lacking in the air.	See Section 4. Cannot be used in atmospheres lacking in the air.	See Section 4. Cannot be used in atmospheres lacking in the air.	Practical limit of concentration is determined by time required to plug filter, but these respirators should not be used in high concentrations of particulate matter. Not to be used when flying particles may cause injury, for which conditions the alternative breathing respirator should be used, see Table 1B. Does not protect against oxygen deficiency and toxic vapors or gases.	The limitations of the combination are generally the same as for each type of respirator given on the list. The limitations of dust filters in regard to protection against gases and vapors in combination with the type is indicated by the protection afforded by the chemical filter respirator against gases and vapors. See Section 4.
Canisters are color coded for identification, per ANSI Z39.1.	See 8.3.6.	See 8.3.6.	See 8.3.6.	See 8.3.7. Presence of the particles to be filtered out of the air controls the fineness of the filtering element, and range of the toxicity hazard to a governing factor in selection of equipment. (NIOSH approved mechanical filter respirators according to the following classification: (1) "Preventative" - Protecting and Isolating - Dust Respirators (2) "Trails" - Dust Respirators (not significantly more toxic than lead) (3) "Dust" Respirators (not significantly more toxic than lead) (4) "Toxic" Respirators (not significantly more toxic than lead)	

* Dust - Dispersoids or particulate matter, smaller than 100 microns, formed when solid materials are disintegrated by such processes as crushing, grinding, and abrading.

Fume - Solid dispersoids formed when vapors are condensed from heated solids and other substances.

Mist - Liquid dispersoids formed when liquid is disintegrated as in spraying, washing, and atomizing.

** All approved under (1) and (2). Some approved under (3) are approved for protection of dusts that are not significantly more toxic than lead.

CONFIDENTIAL



DUP 0960531

DU 040741

CONFIDENTIAL

JANUARY 1984

This Page Rev Sept 1978

RESPIRATORY PROTECTIVE EQUIPMENT

S 2 H

Page 7

TABLE 1 - TYPES OF RESPIRATORY PROTECTIVE EQUIPMENT (CONT'D ON PAGE 8)

Table 1B - Atmosphere Supplying Respirators

Method of operation	Self-Contained Type		Supplied-Air Respirator			
	Not approved	Demand Type	With Breuer (Type A Supplied-Air Respirator)	Without Breuer (Type B Supplied-Air Respirator)	Air-Line Respirator (Type C Supplied-Air Respirator)	
	In Chemical shield under vapor reacts with a granular chemical to liberate O ₂ in a container. CO ₂ also is removed. Purified breath is inhaled through breathing bag.	Air from high pressure cylinders normally 2000 psi (2200 psi) supplied in a container. Breath is inhaled through breathing bag. Both demand and pressure demand modes.	Respirable air is forced through a large flexible hose by a hand pump or a battery powered electric motor (see Note 1).	Respirable air is drawn through a large flexible hose by wearer's breathing effort.	Continuous Flow Air-Line Respirator	Demand Class Air-Line Respirator
Use	Not approved	Required under conditions immediately dangerous to life and limb at distances over 300 ft from a source of respirable air-protection for limited periods.	Up to 300 ft of travel from source of respirable air-protection provided for an unlimited period.	Nonemergency work, up to 75 ft of travel from source of respirable air-protection provided for an unlimited period.	Protective Flow Air-Line Respirator	Demand Class Air-Line Respirator
Limitations		No environmental limitation in regard to toxicity or an O ₂ content. Absorption through the skin or skin irritation are possible limitations. Extensive training in use and care is required. Fatiguing due to weight.	Limitation in regard to toxicity or an oxygen content. Absorption through the skin or skin irritation are possible limitations. Wearer must return to fresh air by retaining entry mask. An unconscious ability of fresh air must be secured.	See limitations for Type A at left. Not for emergency use. Not approved in any situation where inhalation resistance exceeds 2.5 in H ₂ O or where exhalation resistance exceeds 1 in H ₂ O. Wearer must shut the mask with a line (200) much 80/10 screen, and shut the fastener in a cone of clean air.	When used alone, this device is limited to concentrations of gases or vapors that are not immediately dangerous to life or limb. Not for use in situations where the wearer can escape unaided without the aid of the respirator. Not to be worn in oxygen-deficient atmospheres. Travel is limited by the length of the air supply hose. Hose must be retracted. Absorption through the skin or skin irritation are possible limitations. Combination of air-line respirator and self-contained breathing apparatus may be used in an irrespirable atmosphere (See 3.1.4).	When used alone, this device is limited to concentrations of gases or vapors that are not immediately dangerous to life or limb. Not for use in situations where the wearer can escape unaided without the aid of the respirator. Not to be worn in oxygen-deficient atmospheres. Travel is limited by the length of the air supply hose. Hose must be retracted. Absorption through the skin or skin irritation are possible limitations. Combination of air-line respirator and self-contained breathing apparatus may be used in an irrespirable atmosphere (See 3.1.4).
Remarks	Not approved	Approved for 30 min only. Scott Air Pk is an example.	Breuer must permit two or three of air when it is not operating. Wearer should be equipped with no other duties than to observe the man in the hazardous atmosphere, stand by the line and, in emergency, operate the Breuer A. Breuer operator also should be provided a handkerchief to wipe his face and the line, which always should be worn as a rescue device (see 7.3).	See remarks for Type A at left regarding respirator and harness.	Noninhalable hose should be used if operating pressure is greater than 5 psi (see 3.1.4).	Noninhalable hose should be used if operating pressure is greater than 5 psi (see 3.1.4).

[Not approved for use as Company shoe

DUP 0960532

DU 040742

TABLE 1 - TYPES OF RESPIRATORY PROTECTIVE EQUIPMENT (CONTS FROM PAGE 7)

Table 1C - Air Purifying Respirators

(List for use in oxygen-deficient atmospheres or where the concentration of oxygen is less than 19.5% by volume)

Method of operation	Chemical Filter Type			Mechanical Filter Type Respirators	Combination Chemical and Mechanical Filter Respirators
	Canister Gas Mask (Full Facepiece Respirator)	Chemical Cartridge Respirator (Full Face Respirator)	Self-Contained Breathing Apparatus		
Method of operation	Fills gases or vapors removed from inspired air by absorption, adsorption, chemical reaction, or catalysis, or a combination of these in a packed column bed of the canister or cartridge. Exhaled breath goes to atmosphere.			Respirators remove particulate matter such as dust, fumes, or mist, from inspired air by capture on the filter, which is usually a fibrous pad.	Some gas mask canisters contain special filters which provide respiratory protection against particulate matter, as well as against gases and vapors. Some chemical cartridge respirators contain filters for the same purpose.
Use	Provides respiratory protection against single or combination of 2 or more gases and vapors. For escape only. Provides greatest protection available with size of device.			Designed to provide respiratory protection against a single specific dust, fume, or mist, a single class such as toxic dusts or a combination of several classes of particulate matter such as dusts, fumes, and mists. It offers no protection against gases or vapors.	For particulate matter, gases and vapors in concentration within capacity of the device.
Limitations	See Section 4. Cannot be used in atmospheres irritating to the skin. Limited to use in atmospheres consisting of at least 19.5% oxygen and to the minimum gas concentration for which the specific canister is recommended (generally 0.1% minimum or less; only 2% minimum or less).			Prohibited limit of concentration is determined by time required to plug filter, but these respirators should not be used in high concentrations of particulate matter. Not to be used when flying particles may cause injury, for which condition the protective blading respirator should be used, see Table 1B. Does not protect against oxygen deficiency and toxic vapors or gases.	The limitations of the combination are generally the same as for each type of respirator given on the list. The limitation of dust filters in regard to protection against gases and vapors in mechanical filter type is modified by the protection afforded by the chemical filter respirator against gases and vapors. See Section 4.
Remarks	Canisters are color coded for identification, per ANSI Z35.1.	See 6.3.8.		See 6.3.7. Flammability of the particles to be filtered out of the air controls the success of the filtering element, and nature of the safety hazard is a governing factor in selection of equipment. NIOSH approves mechanical filter respirators according to the following classification: (1) "Toxicants" - Poisoning and Irritation - Dust Respirators (2) "Toxicants" - Dust Respirators (not significantly more toxic than toxic) (3) "Toxicants" (not significantly more toxic than toxic) (4) "Toxicants" (not significantly more toxic than toxic)	

* Dust - Dispersible or particulate matter, smaller than 100 microns, formed when solid materials are disintegrated by such processes as

cracking, grinding, and abraded.

Fume - Solid dispersible formed when vapors are condensed from heated metals and other substances.

Mist - Liquid dispersible formed when liquid is disintegrated or is spraying, coating, and atomizing.

** All approved under (1) and (2) Same approved under (4) are approved for protection of dusts that are

not significantly more toxic than toxic.

DUP 0960533

DU 040743

JANUARY 1984

RESPIRATORY PROTECTIVE EQUIPMENT

8 2 H

This Page Rev Sept 1978

Page 8

TABLE 2 - SELECTION OF RESPIRATORY PROTECTIVE DEVICE

Hazard	Respirator
Oxygen deficiency	Self-contained breathing apparatus Combination air-line respirator and self-contained breathing apparatus
Gaseous contaminant Immediately dangerous to life (see 5.1.4)	Self-contained breathing apparatus Combination air-line respirator and self-contained breathing apparatus
Not immediately dangerous to life	Air-line respirator Hose mask without blower Chemical-cartridge respirator
Particulate contaminant Immediately dangerous to life (see 5.1.4)	Self-contained breathing apparatus Combination air-line respirator and self-contained breathing apparatus
Not immediately dangerous to life	Mechanical filter respirator Air-line respirator Abrasive-cleaning respirator Hose mask without blower
Combination gaseous and particulate contaminant Immediately dangerous to life (see 5.1.4)	Self-contained breathing apparatus Combination air-line respirator and self-contained breathing apparatus
Not immediately dangerous to life	Air-line respirator Hose mask without blower Combination chemical and mechanical filter respirators

Notes: The self-contained breathing apparatus, combination air-line respirator and self-contained breathing apparatus, would give respiratory protection against any of the hazards listed, but these devices are not included in the list of respirators that could be used in the less hazardous situations.

CONFIDENTIAL

DUP 096053