Personal Protective Equipment - Respiratory Protection

Background

In the control of occupational illness or diseases caused by breathing air contaminated with harmful dusts, fumes, mists, gases, smoke, vapors or oxygen deficient atmospheres, the primary objective shall be to prevent contamination of the workplace. The first line of defense is the use of engineering controls, such as ventilation and enclosed handling systems, and substitution with less toxic substances. When this cannot be feasibly accomplished, the last line of defense against inhalation of hazardous chemicals or oxygen deficient atmospheres is the use of respiratory protection. The selection of equipment depending upon the type of operation and the nature and concentration of contaminants is very important. The respiratory protective equipment should conform to approved standards.

This Guideline is issued as per Local Order No. 61 of 1991. All Employers or owners of industrial premises are required to provide protective devices free of cost for the use their employees.. It is the responsibility of the employer and supervisor to provide and ensure proper selection, maintenance, training and use of respiratory protective equipment by their employees. It is also the responsibility of each employee to properly use the respirator provided by the employer.

Guidelines:

1. Respiratory Protection Device Selection:

a) Respiratory protective devices shall be classified as:
   1. Air purifying devices
   2. Air supplied respirators
   3. Self contained breathing apparatus.

b) When selecting a respirator, a competent person shall evaluate the following: chemical and physical properties of the contaminant; the toxicity and exposure level; and oxygen level.

c) Table-1 gives suggested outline for selecting respiratory protection devices and Table-2 gives general guidelines for the selection of respiratory protection for certain operations. The manufacturer's recommendations complying with International Standards should be followed.

2. Requirements for a Minimum Acceptable Respiratory Protection Program:

a) Written standard operating procedures governing the selection and use of respirators shall be established in each factory.

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

c) The user shall be instructed and trained in the proper use of respirators and their limitations. Training shall include selection, donning & fit-testing of respirator; cleaning and disinfecting; and proper storage. Trainee must pass a *qualitative fit-test* before he is allowed to use a respirator. Also, respirator users must be trained on first aid conducted by a certified First-Aider.

d) Where practicable, respirators should be assigned to individual workers for their exclusive use. When a respirator will be used by more than one person, the respirator must be properly cleaned and disinfected before use by another person.

e) There shall be regular inspection and evaluation to determine the continued effectiveness of the Respiratory Protection Program.

f) Storage of respirator shall be in a clean dry place away from direct sunlight. Respirators and cartridges shall be placed in a plastic and a box or container exclusive for its use and labeled with the name of the authorized user.

g) Respirator users shall be subject to an annual medical surveillance that includes a *pulmonary function test.* No worker shall be allowed to use a respirator without an Occupational Health Card indicating his fitness to work.

3. Air Purifying Devices - Masks and Respirators

a) Dust and Fume Masks and Respirators:

1. A particulate - mechanical filter respirator should give satisfactory protection against respirable dust particles. Dust mask shall not be used for asbestos dust but other types of suitable respirator shall be selected.

2. Filters should be replaced whenever breathing becomes difficult due to plugging of filters by particulates.

3. The light fume cartridge respirator can be combined with a vapor absorption section and can be used for paint spraying

to protect against particulate and vapor hazards. Individual threshold limit values of vapor should be considered. The life of vapor absorption cartridges depends on atmosphere concentration and exposure.

b) Cartridge and Canister Respirators:

1. Contaminated air is purified by absorbents in the cartridge or canister, but no single absorbent will remove all. The type of absorbent must be carefully selected.

2. The life span of an air purifying canister or cartridge is limited by the concentration of the air contaminants, breathing demand of the wearer and the capacity of the air purifying absorbent.

3. Table-3 outlines the gas masks and their canisters (OSHA-NIOSH). Gases and vapors can be sub-divided into organic vapors, acid gases, and ammonia.

4. Canisters or cartridges should be used only for gases or vapors listed on the canister or cartridge label.

5. Cartridges should be replaced when another person used it or the user starts inhaling the toxic contaminant.

6. The efficient operation of the exhalation valve should be checked regularly. Defective valves (e.g. warping, cracks, etc.) shall be replaced before use.

7. The airtight fit should be checked each time that the respirator is worn.

4. Breathing Apparatus:

a) Fresh Air Breathing Apparatus:

1. The fresh air from uncontaminated atmosphere should be drawn by the wearer or blown by a hand or power operated blower.

2. The air intake may become contaminated due to wind change etc. Precautions should be taken against this possible hazard.

3. Negative pressure in the face piece may cause face piece leakage.

4. An "Air Tight" check should be carried out before entering the contaminated area.

5. Air tube should be attached to the waist belt to prevent accidental displacement of the mask.

b) Compressed Air Line Breathing Apparatus:

1. Face piece or hood should be connected to a combined filter and hand operated regulating valve.

2. Full-face piece type should provide combined respiratory, eye, and face protection to the wearer.

3. Air should be continuously supplied to the mask and the excess air and exhaled air escape via a non-return valve.

4. The compressed air should be of quality suitable for breathing purposes and may be supplied from compressed air cylinders or taken from a compressor direct or via a ring main system.

5. The compressor should be provided with a system to remove water, oil mist and carbon monoxide. High temperature and carbon monoxide alarms shall be fitted to compressors.

6. The compressor should be sited in an uncontaminated area and away from the exhaust of any gasoline or diesel engine.

7. Breathing air quality:

Specifications for breathing air quality	**Limits**
Oxygen content, *% volume*	20-22
Condensed hydrocarbon (oil mist), *mg/m3 max.*	0.5
Carbon dioxide, *ppm max*	500 (900 mg/m3)
Inert nuisance particulates, *mg/m3 max*	0.5
Water (Present as liquid)	***Nil***

c) Self Contained Breathing Apparatus:

1. Regenerative Oxygen type:

   i. Chemical absorbent removes the carbon dioxide from the air.

   ii. The air after removal of carbon dioxide returns to the reservoir and the oxygen make up system is supplied from a high-pressure system via reduction valve.

   iii. This is not recommended for regular work. This is only for longer rescue work of 2 hours.

2. Open Circuit Compressed Air Type:

   i. Self contained breathing apparatus is supplied with compressed air from a cylinder carried on the back of the wearer or in trolley. The air should be supplied via reduction and demand valves to the face piece.

   ii. Positive pressure should be maintained in the face piece.

   iii. The valve must be fitted with an audible low volume warning alarm. In confined spaces, alarm must activate by at least 5-15 minutes before full consumption of air. Consideration shall be given to the estimated time of escape especially when more than one person is inside the confined space.

   iv. Pressure gauge should be fitted to the Unit.

   v. Adequate air should be available for the work planned.

   vi. The wearer of breathing apparatus should be properly trained on an annual basis.

   vii. A “Escape Set” with less capacity air cylinder is preferred to the canister gas mask for escape purposes.

   viii. Cylinders must be hydraulically pressure-tested once in every 4 years.

   ix. Respirators, hose, fittings and accessories should be checked before and after each use.

x. Specifications of air quality should be complied with and there must be periodical monitoring of air quality.

5. Further References:

ANSI Z88.2 Standard Practice for Respiratory Protection.
ANSI K 13.1 Identification of air purifying respirator canisters and cartridges.
ANSI Z 86.1 Respirable Air.
US 29 Code of Federal Regulations 1910.94 & 1910.134
US 41 Code of Federal Regulations 50-204.7
Compressed Gas Association, Inc., USA
BS - 2091 Respirators for protection against harmful dust, gases
BS - 4275 Recommendations for the selection, use and maintenance of respiratory protective equipment
BS - 4555 Dust respirators
BS - 4558 Positive pressure powered respirator
BS - 4667 Part 1 and 2 Closed and open circuit breathing apparatus
BS - 4667 Part 4 Escape Breathing Apparatus
BS - 4771 Positive Pressure Powered dust Hoods
BS - 6016 Specification for filtering face piece dust respirators.

FOR FURTHER INFORMATION CONTACT
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TABLE - 1

Suggested outline for selecting Respiratory Protection devices

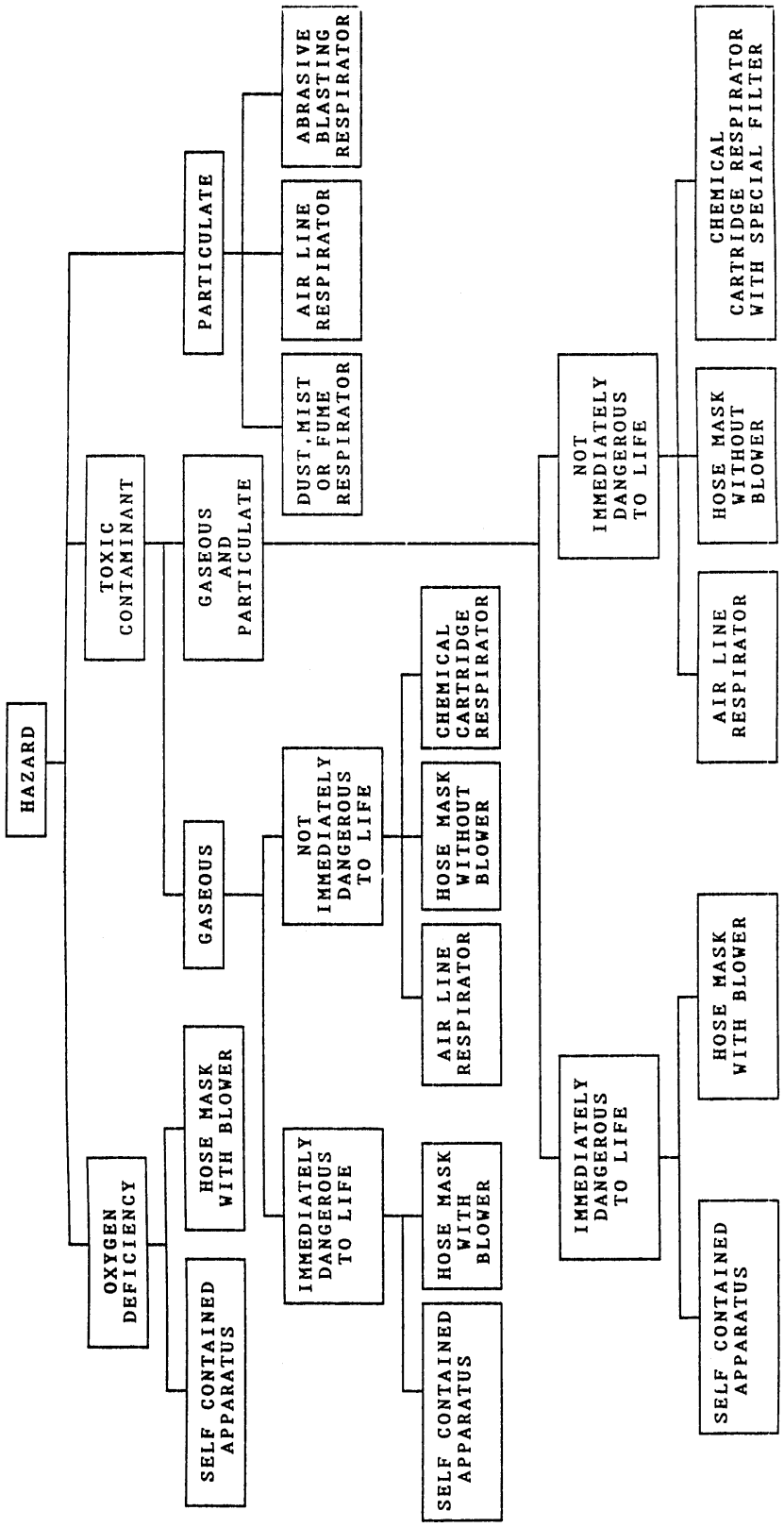

TABLE 2

Suitable Respiratory Protection

Activity	Type of Respiratory Device (● = *suitable)*														
	a	***b***	***c***	***d***	***e***	***f***	***g***	***h***	***j***	***k***	***l***	***m***	***n***	***o***	***p***
Boiler/furnace operations				●	●					●					
Blast cleaning (grit)	●													●	
Dust laden atmospheres -toxic				●	●										
Dust laden atmospheres Non- Toxic									●	●	●	●			●
Electric welding (unventilated)								●							
Fire fighting					●										
Gaseous atmosphere -open air				●	●										
Gaseous atmosphere -confined spaces		●	●		●	●									
Handling asbestos (Note 1)		●		●	●	●				●	●				
Handling chemicals		●	●		●	●	●			●	●				
Laboratories - General		●			●		●			●	●				
Metal spraying				●		●	●	●							
Paint spraying										●	●		●		
Spillage, chemical - cleanup		●	●		●	●	●			●	●				
Spillage, oil clean up		●	●	●	●	●									
Tank/vessel cleaning															
- Chemical		●	●		●	●	●			●	●				
- Leaded gasoline				●	●										
- Crude/Other products				●	●										

Legend:

a	Hoods *(heavy duty , abrasion resistant)*	***j***	Respirator, single filter
b	Hoods *(Poisonous vapour)*	***k***	Respirator, twin filter
c	Airline mask with blower	***l***	Mask, lightweight disposable
d	Mask, compressed air demand flow	***m***	Respirator, lightweight disposable
e	Compressed air breathing apparatus	***n***	Respirator, lightweight disposable
f	Gas/dust mask with filter	***o***	Hoods-airline-with window *(toxic)*
g	Ori-nasal air line mask	***p***	Hoods-natural draught-with window *(non-toxic)*
h	Respirator, lightweight		

Note 1 = Suitable where work area is ventilated

TABLE 3
Characteristics of Gas Masks and Canisters

Mask	Max. Concentration of gas % by volume	
Acid Gas (for protection against gases such as hydrogen sulfide, sulfur dioxide, chlorine, hydro cyanic acid)	2%	The time of protection decreases rapidly as the concentration of gas increases
Organic Vapor (for protection against vapors such as aniline benzene, ether, gasoline, carbon tetrachloride, chloropicrin)	2%	
Ammonia gas	3%	
Carbon Monoxide	2%	The air becomes noticeably warmer as the percentage of carbon monoxide increases.
Dust, fumes, mists, fogs and smokes in combination with any of the above gases or vapors	2%	
Combination acid gas and organic vapor	2% Acid gas 2% Organic vapor	
Combination acid gas, Organic vapor and Ammonia	2% Acid gas 2% Organic Vapor 2% Ammonia	As the number of gases increases, the service time of the canister decreases.
Combination acid gas Ammonia	2% Acid gas 3% Ammonia	
Universal for protection against combination of acid gases, organic vapors, ammonia, Carbon monoxide and smoke	Not exceeding 2% Gases 3% Ammonia 2% Carbon monoxide 2% Organic vapors Not more than 2% poisonous gases	

Note: 1. No gas mask will provide protection where the atmosphere is deficient in oxygen.

2. ANSI K13.1 Identification of air purifying respirator canisters and cartridges and British Standard Specification specifies the color coding for each type.

3. Only clearly indicated gas masks must be used.