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espiratory Protection

to survive in unbreathable air

CONTAMINANTS, the unde- by-products of many indus- processes, provide some of the serious problems of occupa- and public health. These con- ants range from relatively "nuisance" substances to sts, vapors, mists, and gases. oval of contaminants at the and enclosure of processes ce concentrations in the ir should be the aim of and hygiene program but breakdowns of equipment ur. There are also opera- here exposure is brief or t. For such situations per- otection is needed.

worker's air intake may be ded by three principal

chanical filters to remove mists.

orption or chemical reaction ases and vapors.

ed air.

Five general types of equipment are:

er gas masks.

cal cartridge respirators.

respirators.

on the job keeps gas masks functioning efficiently. (Dia- Co.)

4. Supplied-air equipment (hose masks and air-line respirators).

5. Self-contained apparatus supplying oxygen or air.

Each type of equipment has a definite field of usefulness, as well as limitations. Manufacturers and dealers therefore want to know the type of exposure when equipment is ordered.

Approval. Equipment which meets accepted standards carries the label of the Bureau of Mines. Approval specifies type of exposure as well as design and construction.

Gas Masks

A gas mask consists of a face piece connected by a flexible tube to a canister. Inhaled air is drawn through the canister which cleans it chemically. No one chemical yet discovered will remove all contaminants, so the canister must be chosen for the exposure.

The greatest range of protection is provided by the universal mask for use against combinations of acid gases, organic vapors, ammonia, carbon monoxide, and smokes. However, as the number of gases increases, the service time of the canister decreases.

Canister gas masks with full facepiece are for emergency protection in atmospheres immediately dangerous to life. Their effectiveness is limited to concentrations of two per cent by volume, except for ammonia, for which the limit is three per cent.

Characteristics. Types of gas masks, their identifying colors and uses are:

White—Acid gases, such as hydrogen sulfide, sulfur dioxide, chlorine, hydrocyanic acid.

Black—Organic vapors, such as aniline, benzene, ether, gasoline, carbon tetrachloride, chloropicrin.

Green—Ammonia gas.

Blue—Carbon monoxide.

SANDBLASTER dons safety equipment before working in booth. Operator is supplied with air through dust-tight mask. (MSA.)

Yellow—Combination acid gas and organic vapor.

Brown—Combination acid gas, organic vapor and ammonia gas.

Red—Universal—all industrial gases, including carbon monoxide, smoke, and fumes.

White with green stripe—Hydrogen cyanide.

White with yellow stripe—Chlorine.

Cartridge Respirators

Chemical cartridge respirators usually have a half-mask face connected directly to a small container. Chemicals are similar to those used in gas masks.

Cartridge respirators are approved only for non-emergency situations —for atmospheres which are harmful only after prolonged or repeated exposures.

For hot jobs. A heat-exchanger cartridge permits work in excessively hot atmospheres. When the worker breathes in, heat is stored in the cartridge; when he exhales, heat is removed. Inhaled air is then reduced to a tolerable temperature. This respirator is worn with a specially designed hood.

Filter Respirators

Protection against any form of particulate matter can be provided by a mechanical filter respirator. Major items to be considered are resistance to breathing offered by the filter element, adaptation of

facepiece to faces of various shapes, and fineness of particles to be filtered out

ASA Code Z-2 requires that the complete respirator show a resistance not in excess of 50 mm of water at an inhalation rate of 85 liters of air per minute. Resistance to exhalation under the same conditions may not exceed 25 mm. Commercial respirators are usually held to considerably lower resistances.

Mechanical filter respirators are not effective against solvent vapors, injurious gases, or oxygen deficiency.

Types of mechanical filters approved by the Bureau of Mines are:

1. **Pneumoconiosis-producing and nuisance dust respirators,** for such dusts as aluminum, cellulose, cement, coal, charcoal, coke, flour, gypsum, iron ore, limestone, and wood.
2. **Toxic dust respirators,** for protection against toxic dusts that are not significantly more toxic than lead, such as arsenic, cadmium, chromium, lead, manganese, selenium, vanadium, and their compounds.
3. **Mist respirators,** for protection against pneumoconiosis-producing, chromic acid, and nuisance mists.
4. **Fume respirators,** for protection against fumes (solid dispersion or particulate matter) formed by condensation of vapors, as from heated metals or other substances.

POTENTIAL ASPHYXIA HAZARDS

(Globe Industries, Inc.)

Class	Type	Preventive Measures
1. Diseases	a. Cardiac conditions b. Asthmatic, circulatory cases c. Hypertension sufferers	Regular physical checkups Constant surveillance and encouragement to observe doctor's advice Employee instruction and job selection
2. Equipment	a. Chemical, oil tanks b. Vats and containers c. Poorly ventilated rooms	Hoods over tanks, etc. Exhaust systems Make-up air systems Oxygen masks (self-contained breathing apparatus) for special areas and jobs Employee training
3. Electricity	a. Power and transmission lines b. Powered equipment c. Transformers d. Portable power tools e. Lightning	Signs, identifying color, guard rails and fences Maintenance and inspection of tools Proper grounding of tools Isolation of areas Employee training
4. Asphyxiating gases	a. Carbon monoxide b. Exothermic and endothermic atmospheres c. Carbon dioxide d. Volatile hydrocarbons	Signs, identifying color, guard rails and fences Hoods and exhaust equipment Continuous atmosphere sampling and checking Regular maintenance of all equipment, pipes, fittings and tanks Oxygen masks (self-contained breathing apparatus) for special jobs and areas not rendered safe by other methods Employee training
5. Chemical irritants	a. Chlorine b. Ammonia c. Hydrochloric acid d. Hydrogen sulphide e. Lime f. Sulphur g. Hydrofluoric acid gas h. Nitrous fumes i. Chloride of lime j. Bromine k. Beryllium l. Nitric acid m. Phenols n. Phosgene o. Benzol p. Anticholinesterase agents q. Naphthol r. Sulphuric acid s. Hydrocyanic acid	

Supplied Air

Hose masks. Atmospheres immediately hazardous to life require air supply from a point beyond the contaminated area. With a hose mask, air is normally supplied by a blower. The wearer can inhale through the hose when the blower is not operating.

Hose lines (with at least a 5 connection) are recommended rather than *air lines* connected to a compressed air system for most operations. In a case of failure of air supply, it is possible to breathe through a considerable length of hose.

Hose masks are not approved with more than 150 ft. of hose or where inhalation resistance exceeds 2.5 in. of water, or the exhalation resistance exceeds 1 in. of water.

Attachments of additional hose should not exceed the total prescribed length. It should be approved for use with that type of mask and should have approved couplings. The blower should be located so that only fresh, clean air is supplied to face masks.

The hose mask should always be used for work which involves entering tanks or pits where there is dangerous or unknown concentration of dust, mist, vapor, or gas, or oxygen deficiency.

Harness to pull the hose in should be inspected before use. Component parts of harness must be able to withstand a pull of at least 250 lbs.

Air-line respirators, connected to compressed air lines, provide essentially the same protection as hose masks. They are not intended for atmospheres immediately hazardous to life where the wearer could not escape if failure of the air supply required him to remove the respirator.

This respirator differs from the hose mask mainly in two features

it has a hand-operated, quickly detachable coupling connected to the belt or body harness so that the operator can connect to a compressed air hose, also a flow-limiting device to permit air flows only between 2 and 20 cfm.

A trap and filter installed in the compressed air line ahead of the masks to separate oil, water, scale, or other extraneous matter from the air stream is desirable.

An air-pressure regulator in the line is required if air is supplied at a pressure in excess of 25 psi., also a pressure release valve which will operate if the regulator fails.

Supplied-air respirators are the best type for continuous use at one location. Other types may give adequate protection, but offer breathing resistance and are consequently more fatiguing.

To obtain clean air, the compressor intake must be kept away from sources of contamination. The compressor should be well maintained. It must not run too hot, as dangerous amounts of carbon monoxide can be produced by decomposition of lubricating oil.

Air-supplied suits. Sometimes rescue or emergency repair work must be done in atmospheres extremely corrosive to the skin and mucous membranes, in addition to being acutely poisonous. For these conditions, complete suits of impervious material with breathing equipment are available.

If a hose line is used, it should be connected to the suit itself as well as to the helmet. Unless well ventilated, such a suit is fatiguing and dangerous to wear for long periods.

Abrasive blasting requires an adequate supply of filtered air, also mechanical protection for the head and neck—either an impregnated cloth hood or a helmet of some rigid material. It should be covered both inside and outside with a plastic material, such as soft rubber, to increase both comfort of wearer and resistance to abrasive.

A window of transparent material, suitable for optical use, protected from the abrasive by a 30- to 40-mesh fine wire screen should be provided. Both window and protective screen should be readily replaceable.

Self-Contained Apparatus

For work in atmospheres immediately hazardous to life at distances more than 150 ft. from the source of fresh air, self-contained oxygen-breathing apparatus should be used.

Two principal types of self-contained apparatus are: (1) Compressed air or compressed oxygen type; (2) Internal generation type which produces oxygen by reaction of chemicals in the canister with the moisture in exhaled breath.

Care of Equipment

A central station for care and maintenance of respiratory equipment is desirable where many respirators are in use. Such a unit should also handle distribution and maintenance of other personal protective equipment.

Each employee should be provided with two respirators in either a locker or a hook at a central station. Each respirator should be branded or tagged with the employee's number.

Cleaning and disinfecting. All parts, except canisters and cartridges, should be cleaned after use. Facepieces, air lines and hoses should be washed with soap and water, rinsed, and dried.

All respiratory devices should be disinfected before being passed from employee to employee. Methods of sterilizing include:

1. Immersion in solution of quaternary ammonium salt detergent. This material is not injurious to skin or to rubber.
2. Subjection to a moist atmosphere of antiseptic gas, such as formaldehyde, for 10 minutes.
3. Immersion for 10 minutes in a solution of formalin made by diluting 1 part of 40 per cent formaldehyde in 9 parts of water.

Parts should be rinsed thoroughly after sterilizing to remove traces of disinfectant, then dried.

Elastic head bands may be disinfected by sterilizing but they should be washed with soap and water.

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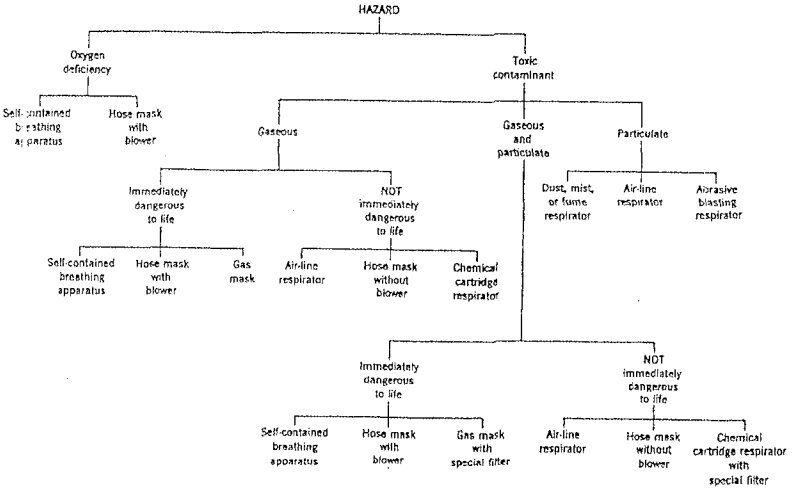

RESPIRATORY protective devices for various types of exposure. (Reprinted from Information Circular 7792, U. S. Bureau of Mines.)

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U. S. Bureau of Mines

List of Respiratory Protective De...

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Bands should be replaced when the respirator is transferred to another employee.

The respirator should be turned in to the central station at the end of each shift to be cleaned and sterilized and repaired if necessary.

Where the maintenance crew works several shifts, one respirator per employee may be sufficient. Usually, however, it is necessary to have one complete unit in the process of cleaning while the other is being worn.

Filters should be replaced when clogged, and used ones discarded. Canisters should be replaced at regular intervals. Even when not in use they lose their effectiveness with time. * * *

Training in Use of Respiratory Equipment

Respirators are often used as emergency equipment under conditions of strain and excitement. Those who will have to use them should therefore be trained thoroughly

Regular inspection is also necessary to avoid deterioration of equipment which is not used regularly.

Training

1. Train each person in putting mask on and adjusting it rapidly to his face.
2. Have each person wear it long enough to become accustomed to the breathing resistance and to putting it on and taking it off.
3. Repeat training at regular intervals.

Maintenance

1. Set up a card for each mask to indicate date of latest inspection and replacement of canister and amount of use, if any, which canister has had.
2. Replace canister at least annually, even if not used.
3. When a canister is replaced, examine facepiece, harness, hose, and headbands for leaks or deterioration. Replace defective parts.
4. Canisters are ordinarily supplied with seals to keep out air while in storage. Remove seals when canister is placed in service.
5. Store mask in a place as cool and dry as possible and accessible to hazardous area.
6. If mask is for emergency use only, canister should be replaced after use. * * *

HOSE MASKS and life lines safeguard crews checking new gas service connection in manhole. Crank supplies air to men underground.

Safety Gear Saves Boilermaker 5 Times

JOE KASPER, 40 years a boiler maker at the Standard Oil Company's (Indiana) Casper, Wyo., refinery, is a walking testimonial for safety equipment. His unusual record is described in Standard Oil's employee magazine, *The Torch,* for January 1959.

If Joe hadn't used his hard hat, safety shoes, and goggles on and off the job, today he'd probably be totally blind and unable to walk properly.

Back in the days before hard hats, Joe was clipped twice by falling rivets. Medical treatment involved seven stitches, plus. When hard hats were issued, he was just about first in line . . . and glad to be there.

One day he climbed a 120-ft. tower and began to install a steel sheet. He had on his hard hat. A sudden blast of wind lifted the metal and swung it with crushing force against his hat. He didn't suffer a scratch.

Another time, he was walking by a still that was being repaired. A falling chunk of steel knocked off his hard hat. Unharmed, he picked up his dented headgear and went on his way.

And he's had similar luck with safety-toe shoes. He was wearing this type of footwear one day, while he and two helpers put a 1000-lb. sheet of boiler steel in place. The sheet dropped, pinning one of Joe's feet.

His assistants rushed in with a jack and raised the plate. The shoe was ruined. And all that troubled Joe was a slight bruise over the arch of his foot. (The two helpers scrambled to order safety shoes.)

Joe is also indebted to safety goggles. Once, he and a fellow worker were shaping a power box for a still. Just as the helper was about to hit the chisel, Joe remembered about wearing safety goggles. He halted work and put them on. Then at his signal the other man swung. A piece of metal smashed the goggles' right lens. But the eye was unhurt.

Even off the job Joe's safety gear has earned him continued eyesight. On a building project he grabbed a heavy hammer and attacked a concrete partition. A piece of rock shattered the left lens of his safety goggles.

At times Joe has had a dented hard hat, crushed shoes, and smashed goggles—but he's satisfied.

CLEAN, sterilized respirators should be available where there is a possibility of a contaminated atmosphere. (Mine Safety Appliances Co.)