



RECOMMENDED SAFE PRACTICES BULLETIN

PHOSPHINE

Synonyms: Hydrogen phosphide,
phosphorus trihydride

CAS Number: 7803-51-2

Chemical Formula: PH₃

Date Completed: 10/88

HAZARD SUMMARY

- Phosphine causes adverse health effects when it is inhaled.
- Short-term exposure may cause nausea, vomiting, headache, fatigue, shortness of breath and cough.
- At higher levels, phosphine may cause seizures or coma, or even death.
- A dangerous accumulation of fluid in the lungs may occur 12 to 48 hours after high-dose exposure to phosphine.

GENERAL DESCRIPTION

Phosphine is a colorless gas with a disagreeable fishy or garlic-like odor. It is used primarily as a dopant in the manufacture of semiconductor devices and integrated circuit chips. It is also used as a grain fumigant and in the manufacture of organic compounds.

HEALTH HAZARD INFORMATION

ACUTE (short-term) HEALTH EFFECTS

Inhalation: Acute exposure to phosphine may cause mucous membrane irritation, nausea, vomiting, abdominal pain, headache, fatigue, dizziness, shortness of breath and cough. At higher levels, it can cause convulsions, irregular heart beat and coma; and can affect the kidneys and liver. A dangerous build-up of fluid in the lungs may occur 12 to 48 hours after high exposure. At very high levels phosphine can cause death.

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Department of Labor and Industries - Division of Occupational Hygiene
1001 Watertown Street, West Newton, MA 02165

Skin or eye exposure: Exposure to the liquified gas may cause frostbite, pain and redness.

CHRONIC (long-term) HEALTH EFFECTS

Information is not currently available on chronic effects of phosphine.

Cancer Hazard: Information is not available to determine a cancer hazard.

Reproductive Hazard: Information is not available to determine a reproductive hazard.

CONDITIONS THAT MAY BE AGGRAVATED BY EXPOSURE

Because of its irritant effects, phosphine may worsen symptoms of people who have impaired pulmonary function.

OCCUPATIONAL EXPOSURE LIMITS

Most OSHA exposure limits are based on recommendations made by the ACGIH. Other recommendations made by NIOSH, may be more protective of human health. Many chemicals have not been studied for long-term effects. Because of individual susceptibility, a small percentage of workers exposed to this substance at or below any of the recommended limits may experience some ill effects.

OSHA: The legal airborne exposure limit is 0.3 ppm, averaged over an 8-hour workshift.

ACGIH: The recommended airborne exposure limit is 0.3 ppm, averaged over an 8-hour workshift. The recommended short-term exposure limit, not to be exceeded during any 15-minute period, is 1 ppm.

MEDICAL MONITORING

Pre-employment and periodic medical histories and physical exams should be performed on workers who will be exposed to phosphine. Persons who have impaired pulmonary function may be at increased risk from exposure to phosphine.

EMERGENCY INFORMATION

FIRST AID

Inhalation: In case of inhalation, remove the person from the contaminated area to fresh air immediately. Give artificial respiration if the person is not breathing. Seek immediate medical attention. Delayed pulmonary edema is a possible outcome. A person should be observed for 48 hours after exposure if poisoning is suspected.

Skin: Remove contaminated clothing and shoes immediately. Wash affected area with soap and large amounts of water for 15 to 20 minutes. Get medical attention immediately.

Eyes: Wash eyes immediately with large amounts of water for 15 to 20 minutes. Get medical attention immediately.

FIRE AND EXPLOSION

NFPA Rating Flash Point: Flammable gas
Flammability: 4 Extinguishing Media: dry chemical, CO₂, water spray or foam
Reactivity: 1 Flammable Limits: lower = 1%; upper - NA
Health: 3

Respiratory Protection: Self-contained breathing apparatus with a full facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: No special precautions for exposure to the gas.

Special Precautions: Move container from fire area if possible. Cool containers from the side until fire is out. Stay away from tank ends. Use water as a fog, rather than a solid stream, from as far away as possible. Remain upwind.

SPILL, LEAK AND DISPOSAL PROCEDURES

Ignition sources should be shut off. The leak should be stopped if it can be done without risk. The area should be isolated until gas has dispersed. No smoking, flames, or flares are to be allowed. Closed spaces should be ventilated before entering.

Respiratory Protection: Self-contained breathing apparatus with a full-facepiece, operated in pressure-demand or other positive-pressure mode.

Protective Equipment: No special precautions for exposure to the gas.

Disposal: Once the leak has been stopped, the gas must be allowed to disperse into the atmosphere.

EMERGENCY INFORMATION SERVICES

CHEMTREC: (800) 424-9300

Poison Information Center: (800) 682-9211; 232-2120 (Boston area only)

PROTECTIVE MEASURES

ENGINEERING CONTROLS

Engineering controls are better than personal protective equipment. Engineering controls may include local exhaust ventilation, enclosure of the process, general dilution ventilation, and others. However, for some jobs (such as outside work, confined-space entry, non-routine maintenance, emergencies, and jobs done while workplace controls are being installed), personal protective equipment may be appropriate.

RESPIRATORY PROTECTION

Improper use of respirators can be dangerous. Only respirators that have been approved by NIOSH or MSHA for exposure to phosphine should be used. Such equipment should only be used if the employer has a written program that takes into account air concentrations of the contaminant, and includes respirator fit testing, regular training, maintenance, inspection, cleaning, and evaluation.

The recommended types of respirators are shown in the following table:

<u>Gas Concentration</u>	<u>Minimum Respiratory Protection</u>
3 ppm or less	Any chemical cartridge respirator providing protection against phosphine.
15 ppm or less	A chemical cartridge respirator with full facepiece and a cartridge providing protection against phosphine.
200 ppm or less	Type-C supplied-air respirator operated in pressure-demand or other positive-pressure mode.
Greater than 200 ppm or unknown	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.
Escape	Any gas mask providing protection against phosphine.

PROTECTIVE EQUIPMENT

Eve Protection: Not applicable

Clothing: No special precautions for exposure to the gas. If contact with the liquid is possible, wear appropriate clothing to prevent skin from freezing.

STORAGE AND REACTIVITY INFORMATION

REACTIVITY

Phosphine is subject to spontaneous combustion above room temperature. The liquified gas may be detonated by a powerful impact. It may spontaneously react violently in air or with moisture.

INCOMPATIBILITIES

Phosphine reacts spontaneously, and often explosively, with acids, halogens, halogenated hydrocarbons, and oxidants.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may release toxic oxides of phosphorus.

STORAGE

Phosphine storage tanks should be kept in a cool, dry, well-ventilated area.

PHYSICAL AND CHEMICAL DATA

Boiling Point: -125°F (-88°C)	Molecular Weight: 34.04
Melting Point: -209°F (-134°C)	Solubility in Water: 26% at 17°C
Vapor Pressure: gas at room temperature	Evaporation Rate: NA
Specific Gravity (water = 1): 0.75 at -126°F	Vapor Density: 1.17

DEFINITIONS

ACGIH is the American Conference of Governmental Industrial Hygienists. It recommends upper limits for exposure to workplace chemicals.

Action level is the amount of a chemical in the air above which OSHA-specified medical and air monitoring must be done.

A carcinogen is a substance that causes cancer.

The C.A.S. number is assigned by the Chemical Abstracts Service to identify a specific chemical.

The flash point is the temperature at which a liquid or solid gives off enough vapor to form a flammable mixture with air.

mg/m³ means milligrams of a chemical in a cubic meter of air. It is a measure of how much of a chemical is in the air.

MSHA is the Mine Safety and Health Administration, the federal agency that regulates mining. It also evaluates and approves respirators.

A mutagen is a substance that causes a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

OSHA is the Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

ppm means parts of a substance per million parts of air. It is a measure of how much gas or vapor is in the air.

A teratogen is a substance that causes birth defects by damaging the fetus.

The vapor pressure is a measure of how easily a liquid or a solid gives off vapors. A higher vapor pressure indicates a higher concentration of the substance in the air, and therefore increases the amount of it breathed in.

WHERE TO GO FOR ADDITIONAL INFORMATION

The following information is available from the Massachusetts Department of Labor and Industries.

RIGHT TO KNOW INFORMATION

The Right to Know Program can answer questions about particular chemicals, training, labeling, and other Right to Know matters. Violations of the Right to Know Law should be reported to the nearest office of the Department of Labor and Industries.

PUBLIC PRESENTATIONS

Presentations and educational programs on occupational health or the Right to Know Law can be given for labor unions, trade associations and other groups.

OCCUPATIONAL HEALTH AND SAFETY SERVICES

Upon receipt of a complaint, an inspection may be conducted at your workplace. An inspection may include a walk-through, air monitoring, and evaluation of existing conditions and controls. Complaints about workplace health and safety conditions may be reported to any office of the Department of Labor and Industries. Such complaints are maintained strictly confidential. In addition, employers may obtain free technical assistance in complying with OSHA standards and the Massachusetts Right to Know Law.

MEDICAL EVALUATION

The Division of Occupational Hygiene has the names of various occupational health services and occupational physicians who are board-certified. This information is available upon request.

MASSACHUSETTS DEPARTMENT OF LABOR AND INDUSTRIES

Division of Occupational Hygiene

West Newton (617) 969-7177

Division of Industrial Safety

Boston (617) 727-3460
Lawrence (617) 681-7798

New Bedford (617) 997-8263
Springfield (413) 734-1421

Worcester (617) 752-6504
Pittsfield (413) 445-4214