



Phosphine



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Recognizing Phosphine

Appearance: Phosphine is a colorless gas at room temperature.

Odor: Disagreeable, garlic-like, or decaying fish odor when found in commercial products. Pure phosphine gas is odorless.

Odor Threshold: Minimum: 0.03 ppm Average: 0.5 ppm.

Odor Safety Class: D (only 10-50% of distracted individuals perceive warning of the permissible exposure level). **Note:** *Odor is not a good indicator of the presence of phosphine vapors and does not provide reliable warning of hazardous concentrations which occur at levels below odor detection.*

Vapor Density: 1.2 (air = 1.0). Phosphine is slightly heavier than air.

Containers & Packaging

Commercial: Aluminum and zinc phosphide release phosphine gas when exposed to moisture. Both products are used as rodenticides. Aluminum phosphide is also used as a grain fumigant. Commercial pesticides containing aluminum phosphide are Celphos, Phostoxin, and Quick Phos. Phosphine gas for air monitoring instrument calibration is available from chemical supply companies in pressurized containers.

Pharmaceutical: There are no pharmaceutical uses of phosphine gas.

Role in Drug Synthesis

Phosphine gas is an unintended, undesirable, and potentially lethal by-product produced during the manufacture of methamphetamine using the Hydriodic Acid/Red-Phosphorus method (Figure 1).

Health Hazards

Inhalation Exposure: Inhalation is the primary route of exposure for phosphine gas. Effects from short-term exposure to high concentrations (greater than 2 ppm) may result in severe lung irritation, cough, and chest tightness. Neurological effects include dizziness, lethargy, convulsions, and coma; agitation and psychotic behavior are often present as well. Signs of phosphine toxicity include rapid and/or irregular heart rate, low blood pressure, shock, nausea, abdominal pain, vomiting, diarrhea, and cardiac arrest. Most acute symptoms occur within the first few hours after exposure; however, the onset of liver and kidney toxicity and severe fluid accumulation in the lungs (pulmonary edema) may be delayed for up to 72 hours. For this reason, persons with known exposure to phosphine gas should be hospitalized and observed for several days.

Skin (Dermal) Exposure: Direct skin contact is not likely to be a significant route of exposure for phosphine gas.

Eye Contact: Direct eye contact may cause irritation, tearing, pain, swelling, and sensitivity to light.

Ingestion: If ingested, certain types of waste generated by clandestine methamphetamine labs may result in the release of phosphine gas in the stomach. Symptoms of chemicals that produce phosphine internally when ingested are similar to those that occur following acute inhalation of phosphine gas.

Chronic Effects: Long-term exposure to low concentrations (0.5 to 2 ppm) include anemia, bronchitis, nausea, vomiting, abdominal pain, diarrhea, tremors, double vision, impaired gait, and difficulty speaking. Liver and kidney damage, structural changes in chromosomes of peripheral blood cells, and chemical-induced asthma may also occur.



Figure 1: Photo of a heat-resistant vessel containing a hydriodic acid / red phosphorus methamphetamine synthesis reaction mixture. Phosphine gas is an unwanted potentially lethal by-product generated during the synthesis. Phosphine may be present in the air space above the liquid reaction mixture. *Photo Courtesy of CA Department of Justice.*

Clandestine Labs/ "Meth":

Phosphine

Environmental Concerns

Air: Phosphine is extremely volatile. It is found as a gas at room temperature and will readily disperse in the atmosphere. Any residue of phosphine present in or generated by solid or liquid waste should quickly disperse in the air.

Soil and Water: Large amounts of buried phosphorus-containing waste may generate phosphine gas in large enough quantities to present a significant source of soil and ground water contamination. However, the amount of phosphine gas produced by a typical clandestine laboratory does not represent a significant threat to soil or ground water. Due to its extreme volatility, any release of phosphine to surface water would quickly evaporate to the surrounding air.

Indoors: Phosphine will not likely accumulate on indoor surfaces but may be present as a gas in indoor environments.

Natural Occurrence: Phosphine is formed in small amounts from the putrefaction of organic matter. Detection of low concentrations of phosphine in drains, sewers, or septic systems would not be unexpected and should be noted if found.

First Aid

General: People have died from exposure to phosphine gas at methamphetamine labs. There is no specific antidote for this chemical. Medical treatment is generally supportive.

Inhalation Exposure: Move to fresh air. If victim has difficulty breathing, give oxygen. If victim is not breathing, give artificial respiration. Get medical attention immediately.

Contact with Clothing or Skin (Dermal Exposure): Remove contaminated clothing. Flush exposed skin and hair with water for at least 15 minutes. Thoroughly wash with soap and water when possible. Get medical attention immediately.

Contact with Eyes: Flush eyes with water for at least 30 minutes. Get medical attention immediately.

Ingestion (Oral) Exposure: Do not induce vomiting. Seek immediate medical attention.

Special Concerns for Children: Children may inhale relatively larger amounts of phosphine gas due to their faster

respiratory rates and greater lung size to body weight ratio. Children may also receive higher doses due to their short stature. Phosphine is slightly heavier than air and may settle close to the ground in the breathing zone typical for children.

Handling & Safety



Exposure Limits

Occupational Exposure Limits (NIOSH, OSHA, & ACGIH)

Short-Term Exposure Limit (STEL): 1 ppm (1.4 mg/m³)
8-Hr Time Weighted Average (TWA): 0.3 ppm (0.4 mg/m³)
10-Hr Time Weighted Average (TWA): 0.3 ppm (0.4 mg/m³)
Immediately Dangerous (IDLH): 50 ppm

Preliminary Remediation Goals (PRGs)

(U.S. EPA, Reg. 9):

Air: 0.31 µg/m³
Soil, residential: 18 mg/kg
Soil, industrial: 180 mg/kg
Tap Water: 11 µg/m³

Chemical Hazards

Reactivity: Phosphine combines violently with oxygen and halogenated compounds. Phosphine also reacts with copper, silver, gold, and salts of these metals as well as with air, oxidizers, chlorine, acids, and moisture.

Flammability: NFPA flammability rating = 4 (very flammable). The lower explosive limit in air = 1.8 % (26 g/m³). Phosphine is very flammable and potentially explosive. It may ignite spontaneously on contact with air.

Chemical Incompatibilities: Phosphine reacts with air and moisture along with copper, halogenated hydrocarbons, chlorine, oxidizers, and acids.

More Information

Office of Environmental Health
Hazard Assessment (OEHHA)
www.OEHHA.CA.Gov

Department of Toxic
Substances Control (DTSC)
www.DTSC.CA.Gov