

Product: Phosphine	SDS No. P-4643-H March 2012
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1. Chemical Product and Company Identification

Product Name: Phosphine (MSDS No. P-4643-H)		Trade Names: Phosphine
Chemical Name: Phosphine		Synonyms: Hydrogen phosphide, phosphorous hydride, phosphorus trihydride, phosphorated hydrogen
Chemical Family: Inorganic hydride		Product Grades: 5.7, 6.0 semiconductor process gas
Emergency Telephone Numbers: *		Company Name: Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113
Onsite emergencies:	1-800-645-4633	
CHEMTREC:	1-800-424-9300	

* Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-772-9247.

2. Hazard Identification

EMERGENCY OVERVIEW



DANGER! Toxic, flammable high-pressure liquid and gas.



Fatal if inhaled.

Can cause severe respiratory tract irritation.

May cause lung, liver, kidney, heart, and central nervous system damage.

Symptoms may be delayed.

Can ignite on contact with air.

May form explosive mixtures with air.

Liquid may cause frostbite.

Self-contained breathing apparatus and protective clothing must be worn by rescue workers.

At normal temperature and pressure, this material is a colorless gas with an odor of decaying fish.

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OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

Effects of a Single (Acute) Overexposure

Inhalation. Highly toxic. Fatal if inhaled. Effects include irritation of the respiratory tract and lungs, chest pain, difficulty in breathing, fatigue, headache, abdominal pain, nausea, vomiting, diarrhea, drowsiness, dizziness, staggering, convulsions, and collapse. The interval between onset of exposure and symptoms is dependent on the concentration of gas and duration of exposure. Symptoms can be delayed up to 48 hours.

Skin Contact. No harm expected from vapor. Liquid may cause frostbite.

Swallowing. An unlikely route of exposure. This product is a gas at normal temperature and pressure, but frostbite of the lips and mouth may result from contact with the liquid.

Eye Contact. No harm expected to eye tissue from vapor. Liquid may cause frostbite.

Effects of Repeated (Chronic) Overexposure. When inhaled, phosphine releases inorganic phosphorus. Repeated overexposure to phosphorus can result in anemia, bronchitis, and gastrointestinal disturbances.

Other Effects of Overexposure. May cause kidney, liver, and heart damage. Central nervous system and cardiac arrhythmia may also occur.

Medical Conditions Aggravated by Overexposure. Breathing of vapor or mist may aggravate asthma and inflammatory or fibrotic pulmonary disease. Individuals with pre-existing kidney, heart, liver, or nervous system disease may be at increased risk.

CARCINOGENICITY: Phosphine is not listed by NTP, OSHA, or IARC.

POTENTIAL ENVIRONMENTAL EFFECTS: None known. For further information, see section 12, Ecological Information.

3. Composition/Information on Ingredients

See section 16 for important information about mixtures.

COMPONENT	CAS NUMBER	CONCENTRATION
Phosphine	7803-51-2	>99%*

*The symbol > means "greater than."

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4. First Aid Measures

INHALATION: IF INHALED, OR SUSPICION OF ANY EXPOSURE, remove to fresh air. If not breathing, give artificial respiration. If breathing, qualified personnel should give oxygen. Call a physician even if no symptoms are present. Keep under medical observation. Symptoms may be delayed. Consider any exposure as a potentially toxic dose.

SKIN CONTACT: If exposed to liquid, avoid breathing vapor. Flush with water and immediately warm frostbite area with warm water not to exceed 105°F (41°C). In case of massive exposure, remove contaminated clothing while showering with warm water. Get immediate medical attention.

SWALLOWING: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

EYE CONTACT: In case of splash contamination, immediately flush eyes thoroughly with warm water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN: *Phosphine is a severe pulmonary irritant; delayed onset of pulmonary edema can occur. Serious phosphine poisoning produces symptoms within several hours; however, symptoms can be delayed for up to 48 hours. Organs with the greatest oxygen requirements appear to be especially sensitive to damage. There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions of the patient.*

Contact the Poison Control Center in your area for additional information on patient management and follow-up.

5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Flammable gas. May form explosive mixtures with air and oxidizing agents. May ignite spontaneously on contact with air.

SUITABLE EXTINGUISHING MEDIA: CO₂, dry chemical foam, water spray, or fog.

PRODUCTS OF COMBUSTION: Thermal decomposition or burning may produce hydrogen, phosphorus, phosphorus oxides.

PROTECTION OF FIREFIGHTERS: DANGER! Toxic, flammable high-pressure liquid and gas. Evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Immediately spray containers with water from maximum distance until cool, taking care not to extinguish flames. Solid streams of water may be ineffective. Remove sources of ignition if without risk. If flames are accidentally extinguished, explosive reignition may occur. Reduce toxic vapors with water spray or fog.

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Remove all containers from fire area if without risk; continue cooling water spray while moving containers. Do not extinguish any flames emitted from containers; stop flow if without risk, or allow flames to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

If leaking or spilled phosphine catches fire, do not extinguish flames. Flammable and toxic vapors may spread from leak, creating an explosive reignition hazard. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an approved explosion meter.

Specific Physical and Chemical Hazards. Heat of fire can build pressure in container and cause it to rupture. To provide maximum containment up to cylinder burst pressure, phosphine cylinders are not equipped with a pressure relief device. No part of a container should be subjected to a temperature higher than 125°F (52°C). To protect persons from cylinder fragments and toxic fumes should a rupture occur, evacuate the area if the fire cannot be brought under immediate control.

Protective Equipment and Precautions for Firefighters. Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! Toxic, flammable high-pressure liquid and gas.

Personal Precautions. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Gas forms explosive mixtures with air (see section 5). Before entering area, especially a confined area, check atmosphere with an appropriate device. Remove all sources of ignition if without risk. Reduce vapors with fog or fine water spray. Shut off leak if without risk. Ventilate area of leak or move leaking cylinder to a well-ventilated area. Flammable vapors may spread from spill. Cover spill with an absorbent or flush with water, taking care to prevent runoff.

Environmental Precautions. Prevent waste from contaminating the surrounding environment. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: Do not breathe gas. Do not get liquid or vapor in eyes, on skin, or on clothing. Have safety showers and eyewash fountains immediately available. **May form explosive mixtures with air.** Keep away from heat, sparks, and open flame. Use only spark-proof tools and explosion-proof equipment. Ground all equipment. Keep

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away from oxidizing agents and other flammables. **Protect cylinders from damage.** Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. Electrical equipment must be non-sparking or explosion-proof. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. **Open valve slowly.** If valve is hard to open, discontinue use and contact your supplier. Close valve after each use; keep closed even when empty. For other precautions in using phosphine, see section 16.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Store only where temperature will not exceed 125°F (52°C). Post “No Smoking or Open Flames” signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g., NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure cylinders upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the cylinder is not in use. Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

RECOMMENDED PUBLICATIONS: For further information on storage, handling, and use, see Praxair publication P-14-153, *Guidelines for Handling Gas Cylinders and Containers*. Obtain from your local supplier.

8. Exposure Controls/Personal Protection

COMPONENT	OSHA PEL	ACGIH TLV (2012)
Phosphine	0.3 ppm	0.3 ppm TWA (8-hour time-weighted average); 1 ppm STEL (15-minute short term exposure limit)

IDLH = 50 ppm

ENGINEERING CONTROLS:

Local Exhaust. Inadequate to control worker’s exposure.

Mechanical (General). Inadequate to control worker’s exposure.

Special. Use only in a closed system.

Other. None

PERSONAL PROTECTIVE EQUIPMENT:

Skin Protection. Wear work gloves and metatarsal shoes for cylinder handling and protective clothing where needed. (Neoprene provides skin protection from contact with product.) Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.

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Eye/Face Protection. Wear safety glasses when handling cylinders; wear vapor-proof goggles and a face shield during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.133.

Respiratory Protection. Use an air-supplied respirator or a full-face, positive-pressure, self-contained breathing apparatus. Respiratory protection must conform to OSHA 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

9. Physical and Chemical Properties

APPEARANCE:	Colorless gas		
ODOR:	Decaying fish		
ODOR THRESHOLD:	Not available.		
PHYSICAL STATE:	Gas at normal temperature and pressure		
pH:	Not applicable.		
MELTING POINT at 1 atm:	-208.8°F (-133.78°C)		
BOILING POINT at 1 atm:	-125.93°F (-87.74°C)		
FLASH POINT (test method):	Not applicable.		
EVAPORATION RATE (Butyl Acetate = 1):	High		
FLAMMABILITY:	Flammable		
FLAMMABLE LIMITS IN AIR , % by volume:	LOWER:	Approximately 1-2%*	UPPER: Unknown
	* Studies indicate that the lower flammable limit may range from 1.2 to 1.8 %.		
VAPOR PRESSURE: at 68°F (20°C)	607.4 psia (4188 kPa abs)		
VAPOR DENSITY at 70°F (21.1°C) and 1 atm:	0.0879 lb/ft ³ (1.408 kg/m ³)		
SPECIFIC GRAVITY (H ₂ O = 1) at 68°F (20°C):	0.57		
SPECIFIC GRAVITY (Air = 1) 77°F (25°C) and 1 atm:	1.18		
SOLUBILITY IN WATER vol/vol at 62.6°F (17°C):	0.26%		
PARTITION COEFFICIENT: n-octanol/water:	Not available.		
AUTOIGNITION TEMPERATURE:	100°F (37.8°C)*		
	*Pure phosphine has an autoignition temperature of approximately 38°C, but because of the presence of other phosphorus hydrides, particularly diphosphine (P ₂ H ₄), as impurities, phosphine often ignites spontaneously at room temperature (IPCS INCHEM online, 26 Mar 2012).		
DECOMPOSITION TEMPERATURE:	>689°F (365°C)		
PERCENT VOLATILES BY VOLUME:	100		
MOLECULAR WEIGHT:	33.998		
MOLECULAR FORMULA:	PH ₃		

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10. Stability and Reactivity

CHEMICAL STABILITY: Unstable Stable

This material is stable as shipped and stored under normal conditions, i.e., 70°F (21.1°C), so long as exposure to incompatible materials is avoided.

CONDITIONS TO AVOID: Decomposition occurs at temperatures in excess of 689°F (365°C). Thermal decomposition or burning may produce hydrogen, phosphorus, phosphorus oxides.

INCOMPATIBLE MATERIALS: Halogenated hydrocarbons, oxidizing agents, especially oxygen and halogens, acids, as well as aluminum alloys and copper.

HAZARDOUS DECOMPOSITION PRODUCTS: Per input or existing MSDS.

POSSIBILITY OF HAZARDOUS REACTIONS: May Occur Will Not Occur

Flammable gas. Thermal decomposition or burning may produce hydrogen, phosphorus, phosphorus oxides.

11. Toxicological Information

ACUTE DOSE EFFECTS: LC₅₀, 1 hr, rat = 20 ppm

STUDY RESULTS: None known.

12. Ecological Information

ECOTOXICITY: No information available on ecological effects.

OTHER ADVERSE EFFECTS: Phosphine does not contain any Class I or Class II ozone-depleting chemicals.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

CAUTION: Any disposal must be conducted in accordance with federal, state, and local regulations.

Emergency Disposal: Phosphine can be slowly introduced into a gas disposal system containing adequate quantities of sodium hypochlorite, calcium hypochlorite, potassium permanganate, bromine water, or sodium hypobromite solution.

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14. Transport Information

DOT/IMO SHIPPING NAME: Phosphine			
HAZARD CLASS: 2.3	PACKING GROUP/Zone: NA*/A	IDENTIFICATION NUMBER: UN2199	PRODUCT RQ: 100 lb (45.4 kg)
SHIPPING LABEL(s): POISON GAS, FLAMMABLE GAS **			
PLACARD (when required): POISON GAS, FLAMMABLE GAS **			

*NA = Not Applicable.

**The words in the POISON GAS diamond are INHALATION HAZARD.

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Additional Marking Requirement: INHALATION HAZARD

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(e)].

MARINE POLLUTANTS: Phosphine is not listed as a marine pollutant by DOT.

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): 100 lb (45.4 kg)

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of Extremely Hazardous Substances (EHS) (40 CFR Part 355):

TPQ: 500 lb (226.8 kg)

EHS RQ (40 CFR 355): 100 lb (45.4 kg)

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SECTIONS 311/312: Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: Yes

PRESSURE: Yes

DELAYED: Yes

REACTIVITY: Yes

FIRE: Yes

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

Phosphine is subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) and 40CFR Part 372.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Phosphine is listed as a regulated substance in quantities of 5000 lb (2268 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: Phosphine is listed on the TSCA inventory.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Phosphine is listed in Appendix A as a highly hazardous chemical in quantities of 100 lb (45.4 kg) or greater.

STATE REGULATIONS:

CALIFORNIA: Phosphine is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: Phosphine is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: *DANGER!*
Toxic, flammable high-pressure liquid and gas. Use piping and equipment adequately designed to withstand pressures to be encountered. Use only in a closed system. ***Prevent reverse flow.*** Use a backflow prevention device in any piping. ***Never work on a pressurized***

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system. If there is a leak, close the cylinder valve. Blow the system down in an environmentally safe manner in compliance with all federal, state, and local laws; then repair the leak. **Follow safe practices when returning cylinder to supplier.** Be sure valve is closed; then install valve outlet plug, leak-tight. **Never place a compressed gas cylinder where it may become part of an electrical circuit.**

NOTE: Prior to using any plastics, confirm their compatibility with phosphine.

Mixtures. When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

RECOMMENDED EQUIPMENT: In semiconductor process gas and other suitable applications, Praxair recommends the use of engineering controls such as gas cabinet enclosures, automatic gas panels (used to purge systems on cylinder changeout), excess-flow valves throughout the gas distribution system, double containment for the distribution system, and continuous gas monitors.

HAZARD RATING SYSTEMS:

NFPA RATINGS:

HEALTH = 4
FLAMMABILITY = 4
INSTABILITY = 1
SPECIAL = None

HMIS RATINGS:

HEALTH = 4
FLAMMABILITY = 4
PHYSICAL HAZARD = 3

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: CGA-350, CGA-660 (limited standard)
PIN-INDEXED YOKE: Not applicable.
ULTRA-HIGH-INTEGRITY CONNECTION: CGA-632

Use the proper CGA connections. **DO NOT USE ADAPTERS.** Additional limited-standard connections may apply. See CGA pamphlet V-1 listed below.

Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for this product. Further information can be found in the following materials published by the Compressed Gas Association, Inc. (CGA), www.cganet.com.

AV-1 *Safe Handling and Storage of Compressed Gases*
P-1 *Safe Handling of Compressed Gases in Containers*
V-1 *Compressed Gas Cylinder Valve Inlet and Outlet Connections*
— *Handbook of Compressed Gases*

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Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

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Praxair, Inc.
39 Old Ridgebury Road
Danbury, CT 06810-5113