

Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Compressed gases, toxic, flammable, n.o.s. (phosphine, hydrogen) (MSDS No. P-4872-D)		Trade Name: Ion Implantation Mixture (PH ₃ -H ₂)	
Chemical Name: Mixture of phosphine and hydrogen		Synonyms: Not applicable.	
Formula: Mixture of PH ₃ & H ₂		Chemical Family: Not applicable	
Telephone:	Emergencies: 1-800-645-4633*	Company Name:	Praxair, Inc.
	CHEMTREC: 1-800-424-9300*		39 Old Ridgebury Road
	Routine: 1-800-PRAXAIR		Danbury, CT 06810-5113

* 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-PRAXAIR (1-800-772-9247).

2. Composition/Information on Ingredients

See section 16 for important information about mixtures.

INGREDIENT	CAS NUMBER	CONCENTRATION	OSHA PEL	ACGIH TLV-TWA (2002)
Phosphine	7803-51-2	15%	0.3 ppm	0.3 ppm; 1 ppm, 15-min STEL
Hydrogen	1333-74-0	85%	None currently established	Simple asphyxiant

3. Hazards Identification

EMERGENCY OVERVIEW



**DANGER! Toxic, flammable, high-pressure gas.
May be fatal if inhaled.**

**May cause liver, kidney, heart, nervous system, and respiratory system damage.
Symptoms may be delayed.**

May form explosive mixtures with air.

Can ignite on contact with air.

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

Odor: Decaying fish

THRESHOLD LIMIT VALUE: TLV-TWA 0.3 ppm, phosphine; 1 ppm, 15 min, STEL (ACGIH, 2002). TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION—Highly toxic. May be 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.

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

EYE CONTACT—No harm expected.

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 depression 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.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: None known.

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

4. First Aid Measures

INHALATION: Immediately remove to fresh air. If not breathing, give artificial respiration; avoid breathing air exhaled by victim. If breathing is difficult, qualified personnel may give oxygen. Get immediate medical attention, even if no symptoms are present.

SKIN CONTACT: Wash with soap and water; seek medical attention if discomfort persists.

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

EYE CONTACT: Flush eyes thoroughly with water. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Get medical attention if discomfort persists.

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

5. Fire Fighting Measures

FLASH POINT (test method):	Flammable gas	
AUTOIGNITION TEMPERATURE:	Approximately 212°F (100°C)	
FLAMMABLE LIMITS IN AIR , % by volume:	LOWER: Hydrogen: 4%; phosphine: approximately 1-2%	UPPER: 75% (Hydrogen). The upper flammable limit for phosphine is unknown.

EXTINGUISHING MEDIA: CO₂, dry chemicals, water spray, or fog.

SPECIAL FIRE FIGHTING PROCEDURES: DANGER! Toxic, flammable, high-pressure gas.

Do not approach area without self-contained breathing apparatus and protective clothing. Immediately spray cylinders 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. Stop flow of gas if without risk, while continuing cooling water spray. Remove all containers from area of fire if without risk. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Poisonous, flammable gas. May form explosive mixtures with air and oxidizing agents. Phosphine may ignite spontaneously on contact with air. Heat of fire can build pressure in cylinder and cause it to rupture. No part of a cylinder should be subjected to a temperature higher than 125°F (52°C). Cylinders containing this mixture are equipped with pressure relief devices. (Exceptions may exist where authorized by DOT.) If leaking or spilled phosphine catches fire, do not extinguish flames. Flammable and toxic vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check with an appropriate device. 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.

HAZARDOUS COMBUSTION PRODUCTS: None known.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: DANGER! Toxic, flammable, high-pressure gas. 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 well-ventilated area. Prevent runoff from contaminating surrounding environment. Poisonous, flammable vapors may spread from spill.

WASTE DISPOSAL METHOD: Prevent waste from contaminating the surrounding environment. Keep personnel away. 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 STORAGE: Store and use with adequate ventilation. Separate cylinders from oxygen, chlorine, and other oxidizers by at least 20 ft (6.1 m) or use a barricade of noncombustible material. This barricade should be at least 5 ft (1.53 m) high and have a fire resistance rating of at least ½ hour. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Store only where temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods. Post “No Smoking or Open Flames” signs in storage and use areas. There must be no sources of ignition. All electrical equipment in storage areas must be explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas.

PRECAUTIONS TO BE TAKEN IN HANDLING: 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. For other precautions in using this mixture, see section 16.

For additional information on storage and handling, refer to Compressed Gas Association (CGA) pamphlet P-1, *Safe Handling of Compressed Gases in Containers*, available from the CGA. Refer to section 16 for the address and phone number along with a list of other available publications.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST—Use explosion-proof local exhaust ventilation with sufficient air flow to keep the phosphine concentration below the TLV in the worker’s breathing zone.

MECHANICAL (general)—Not recommended as a primary ventilation system to control worker’s exposure.

SPECIAL—A canopy type of forced-air fume hood equipped with an explosion-proof device may be more desirable for certain applications.

OTHER—None

RESPIRATORY PROTECTION: Use air-supplied respirators for concentrations up to 10 times the applicable permissible exposure limit. For higher concentrations, a full-face, self-contained breathing apparatus is required. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134.

SKIN PROTECTION: Neoprene gloves.

EYE PROTECTION: Wear safety glasses when handling cylinders. Select per OSHA 29 CFR 1910.133.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for cylinder handling and protective clothing where needed. Select per OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

9. Physical and Chemical Properties

SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	0.237
SOLUBILITY IN WATER:	Negligible
PERCENT VOLATILES BY VOLUME:	100
APPEARANCE, ODOR, AND STATE: Colorless gas at normal temperature and pressure; odor of decaying fish.	

10. Stability and Reactivity

STABILITY:	<input type="checkbox"/> Unstable	<input checked="" type="checkbox"/> Stable
INCOMPATIBILITY (materials to avoid): Oxidizing agents, especially oxygen and halogens, acids, and copper.		
HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition or burning may produce phosphorous, phosphorous oxides, and additional hydrogen.		
HAZARDOUS POLYMERIZATION:	<input type="checkbox"/> May Occur	<input checked="" type="checkbox"/> Will Not Occur
CONDITIONS TO AVOID: High temperatures: phosphine decomposes at temperatures in excess of 689°F (365°C).		

11. Toxicological Information

LC₅₀ = 20 ppm, 1 hr, rat, phosphine. See section 3.

12. Ecological Information

No information available on ecological effects. Phosphine and hydrogen do not contain any Class I or Class II ozone-depleting chemicals. Phosphine and hydrogen are not listed as marine pollutants by DOT.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Keep waste from contaminating surrounding environment. Keep personnel away. Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Compressed gases, toxic, flammable, n.o.s. (phosphine, hydrogen)		
HAZARD CLASS: 2.3	IDENTIFICATION NUMBER: UN 1953	PRODUCT RQ: 100 lb (45.4 kg), phosphine
SHIPPING LABEL(s):	POISON GAS, FLAMMABLE GAS*	
PLACARD (when required):	POISON GAS, FLAMMABLE GAS*	

*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(b)].

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), phosphine

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):

Threshold Planning Quantity (TPQ): 500 lb (226.8 kg), phosphine

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

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: No

FIRE: Yes

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

Phosphine and mixtures containing it are 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.

Hydrogen is listed as a regulated substance in quantities of 10,000 lb (4536 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: The mixture components are 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.

Hydrogen is not listed in Appendix A as a highly hazardous chemical. However, any process that involves a flammable gas on site in one location in quantities of 10,000 lb (4536 kg) or greater is covered under this regulation unless the gas is used as a fuel.

STATE REGULATIONS:

CALIFORNIA: None of the components of this mixture is listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: This mixture 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: *Toxic, flammable, high-pressure gas.* May be fatal if inhaled. Do not breathe gas. Do not get vapors in eyes, on skin, or on clothing. (See section 3.) Have safety showers and eyewash fountains immediately available. Use piping and equipment adequately designed to withstand pressures to be encountered. *May form explosive mixtures with air.* Keep away from heat, sparks, or open flame. Ground all equipment. Use only spark-proof tools and explosion-proof equipment. Store and use with adequate ventilation at all times. Use only in a closed system. Close valve after each use; keep closed even when empty. *Follow safe practices when returning cylinder to supplier.* Be sure valve is closed; then tightly install valve outlet plug or cap. *Never work on a pressurized system.* If there is a leak, close the cylinder valve. Blow down the system in an environmentally safe manner in compliance with all federal, state, and local laws; then repair the leak. *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.*

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.

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.

Product: 15% Phosphine – 85%
Hydrogen Mixture

P-4872-D

Date: January 2003

HAZARD RATING SYSTEMS:

NFPA RATINGS:

HEALTH = 4
FLAMMABILITY = 4
INSTABILITY = 2
SPECIAL = None

HMIS RATINGS:

HEALTH = 4
FLAMMABILITY = 4
PHYSICAL HAZARD = 2

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: 0-3000 psig CGA-350
PIN-INDEXED YOKE: 0-3000 psig 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 pamphlets V-1 and V-7 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 about this product can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700.

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*
V-7 *Standard Method of Determining Cylinder Valve Outlet Connections for Industrial Gas Mixtures*
— *Handbook of Compressed Gases, Fourth Edition*

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Hydrogen Mixture

P-4872-D

Date: January 2003

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.

Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current Praxair MSDSs for these products, contact your Praxair sales representative or local distributor or supplier. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR;
Address: Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14151-0044).

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