

Product: Compressed gases, toxic,
flammable n.o.s. (phosphine,
hydrogen)

P-4872-E

Date: December 2007

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-E)	Trade Names: Ion Implantation Mixture (PH ₃ -H ₂)
Chemical Name: Mixture of phosphine and hydrogen	Synonyms: Not applicable.
Chemical Family: Not applicable.	Product Grades: None assigned.
Telephone:	Emergencies: 1-800-645-4633*
	CHEMTREC: 1-800-424-9300*
	Routine: 1-800-PRAXAIR
	Company Name: Praxair, Inc. 39 Old Ridgebury Road 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. Hazards Identification

EMERGENCY OVERVIEW



**DANGER! Poisonous, 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 and protective clothing must be worn by
rescue workers.**

**Under ambient conditions, this is a colorless gas mixture with an odor of
decaying fish.**



OSHA REGULATORY STATUS: The components of this mixture are considered hazardous by the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

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.

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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.

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	15%
Hydrogen	1333-74-0	85%

4. First Aid Measures

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

SKIN CONTACT: Avoid breathing gas. See "Inhalation" if any gas is inhaled. No harm expected from skin contact.

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

EYE CONTACT: Avoid breathing gas. See "Inhalation" if any gas is inhaled. No harm expected from eye contact.

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.

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5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Flammable gas. Forms explosive mixtures with air and oxidizing agents.

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

PRODUCTS OF COMBUSTION: Water, phosphorous, phosphorous oxides, additional hydrogen

PROTECTION OF FIREFIGHTERS: DANGER! Poisonous, flammable, high-pressure gas. (See section 2.) Evacuate all personnel from danger area. 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 ignition sources 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.

Specific Physical and Chemical Hazards. 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 cylinder should be subjected to a temperature higher than 125°F (52°C). Cylinders containing this mixture are equipped with a pressure relief device. (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 the 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.

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! Poisonous, flammable, high-pressure 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 flow if without risk. Ventilate area or move cylinder to a well-ventilated area. Prevent runoff from contaminating surrounding environment. Poisonous, flammable vapors may spread from spill.

Environmental Precautions. 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.

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7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: *Poisonous, 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 2.) Have safety showers and eyewash fountains immediately available. ***May form explosive mixtures with air.*** Keep away from heat, sparks, and open flame. Ground all equipment. Use only spark-proof tools and non-sparking or explosion-proof equipment. ***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. ***Protect cylinders from damage.*** Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. ***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.

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. For other precautions in using this mixture, see section 16.

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. For further information specific to hydrogen, see NFPA 50A, *Standard for Gaseous Hydrogen Systems at Consumer Sites*, published by the National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101; 1-800-344-3555; www.nfpa.org.

8. Exposure Controls/Personal Protection

COMPONENT	OSHA PEL	ACGIH TLV-TWA (2007)
Phosphine	0.3 ppm	0.3 ppm; 1 ppm, 15 min STEL
Hydrogen	None currently established	Simple asphyxiant

TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

IDLH = 50 ppm, phosphine

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ENGINEERING CONTROLS:

Local Exhaust. Inadequate to control worker's exposure. See Special.

Mechanical (General). Inadequate. Not recommended as a primary ventilation system to control worker's exposure.

Special. Use only in a closed system.

Other. See Special.

PERSONAL PROTECTIVE EQUIPMENT:

Skin Protection. Neoprene gloves. 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.

Eye/Face Protection. Wear safety glasses when handling cylinders. 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 rules as specified in 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:	Not available.
BOILING POINT at 1 atm:	Not available.
FLASH POINT (test method):	Flammable gas
EVAPORATION RATE (Butyl Acetate = 1):	Not applicable.
FLAMMABILITY:	Flammable
FLAMMABLE LIMITS IN AIR , % by volume (based on the phosphine component):	LOWER: 1.6% UPPER: 98% (estimated)
VAPOR PRESSURE at 68°F (20°C):	Not applicable.
VAPOR DENSITY at 70°F (21.1°C) and 1 atm:	Not applicable.
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	0.237
SOLUBILITY IN WATER 68°F (20°C):	Negligible
PARTITION COEFFICIENT: n-octanol/water:	Not available.
AUTOIGNITION TEMPERATURE:	Approximately 212°F (100°C)
DECOMPOSITION TEMPERATURE:	Not available.
PERCENT VOLATILES BY VOLUME:	100
MOLECULAR WEIGHT:	Not applicable.
MOLECULAR FORMULA:	Mixture of PH ₃ & H ₂

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10. Stability and Reactivity

CHEMICAL STABILITY: Unstable Stable

CONDITIONS TO AVOID: High temperatures: phosphine decomposes at temperatures in excess of 689°F (365°C).

INCOMPATIBLE MATERIALS: Oxidizing agents, especially oxygen and halogens, acids, and copper.

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition or burning may produce phosphorous, phosphorous oxides, and additional hydrogen.

POSSIBILITY OF HAZARDOUS REACTIONS: May Occur Will Not Occur

May ignite spontaneously in air. Thermal decomposition or burning releases poisonous substances.

11. Toxicological Information

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

STUDY RESULTS: None known.

12. Ecological Information

ECOTOXICITY: No known effects.

OTHER ADVERSE EFFECTS: Neither component of this mixture is a Class I or Class II ozone-depleting chemical.

13. Disposal Considerations

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

14. Transport Information

DOT/IMO SHIPPING NAME: Compressed gases, toxic, flammable n.o.s. (phosphine, hydrogen)

HAZARD CLASS:	PACKING GROUP/Zone:	IDENTIFICATION NUMBER:	PRODUCT RQ:
2.3	NA*/A	UN1953	100 lb (45.4 kg), phosphine

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

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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)].

MARINE POLLUTANTS: Neither component of this mixture is 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), 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):

TPQ: 500 lb (226.8 kg), phosphine

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

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 components of this mixture are listed on the TSCA inventory.

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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 (45.3 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: Neither component of this mixture is listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: The components of this mixture are 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: *Poisonous, flammable, high-pressure gas.* Use piping and equipment adequately designed to withstand pressures to be encountered. Use a backflow prevention device in any piping. ***May form explosive mixtures with air.*** Use only in a closed system. ***Follow safe practices when returning cylinder to supplier.*** Be sure valve is closed; then install valve outlet plug or cap, leak-tight. ***Never work on a pressurized system.*** If there is a leak, close the cylinder valve. Blow the system down in a safe and environmentally sound 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.*

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.

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HAZARD RATING SYSTEMS:

NFPA RATINGS:

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

HMIS RATINGS:

HEALTH = 4
FLAMMABILITY = 4
PHYSICAL HAZARD = 3

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED: CGA-350
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), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, <http://www.cganet.com/Publication.asp>.

- 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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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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