

Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Compressed gases, toxic, flammable n.o.s. (arsine, hydrogen) (MSDS No. P-4871-D)	Trade Name: Ion Implantation Mixture (AsH ₃ -H ₂)
Chemical Name: Mixture of Arsine and Hydrogen	Synonyms: Not applicable
Formula: Mixture of AsH ₃ & H ₂	Chemical Family: Not applicable
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. Composition/Information on Ingredients

See section 16 for important information about mixtures.

INGREDIENT	CAS NUMBER	CONCENTRATION	OSHA PEL	ACGIH TLV-TWA (2002)
Arsine	7784-42-1	15%	0.05 ppm	0.05 ppm
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.

Causes severe red blood cell, lung, liver, kidney, nervous system, respiratory system, and heart damage.
Symptoms may be delayed.
May form explosive mixtures with air.
May ignite if valve is opened to air.
Suspect cancer hazard.

Self-contained breathing apparatus must be worn by rescue workers.
Odor: Garlic-like

THRESHOLD LIMIT VALUE: 0.05 ppm TLV-TWA (arsine) (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—Extremely toxic. May be fatal if inhaled. Arsine rapidly destroys red blood cells (intravascular hemolysis). It also produces hemoglobin in the urine (hemoglobinuria) with accompanying dark urine. The breath may smell of garlic. Weakness, shivering, decreased blood pressure, dizziness, headache, nausea, vomiting, and diarrhea may occur. The victim may complain of thirst, have pain in the abdomen and flanks, and may collapse. Acute exposure to high concentrations can make breathing difficult and cause pulmonary edema.

The interval between exposure and onset of symptoms depends on gas concentration and duration of exposure. Symptoms can be delayed up to 48 hours. Concentrations in excess of 50 ppm are rapidly fatal.

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: Repeated exposure can produce anemia, cardiovascular disease, and peripheral neuropathy (numbness, tingling, and weakness in the hands and feet). When inhaled, arsine produces inorganic arsenic; repeated exposure to which may darken and thicken the skin.

OTHER EFFECTS OF OVEREXPOSURE: Delayed effects include hemolytic anemia, jaundice and bronzing of the skin, pulmonary edema, and peripheral neuropathy. Severe overexposure can damage the kidneys, liver, and heart. Kidney failure with oliguria or anuria can lead to uremia and death.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Individuals with anemia or preexisting kidney, heart, liver, or nervous system disease may be at increased risk.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: The International Agency for Research on Cancer (IARC) has reported that there is sufficient evidence that inorganic arsenic compounds are human skin and lung carcinogens.

CARCINOGENICITY: Inorganic arsenic compounds are listed by NTP as *known to be human carcinogens*. Inorganic arsenic is an OSHA-regulated chemical—see OSHA Standard 1910.1018. Arsenic and arsenic compounds are listed by the IARC as *Group 1: Carcinogenic to Humans*.

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. Wash with soap and water. If discomfort persists, seek medical attention.

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

EYE CONTACT: Avoid breathing gas. 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: *Arsine is the most toxic form of arsenic, capable of producing rapid, massive intravascular hemolysis. Serious arsine poisoning produces symptoms within 30 to 60 minutes; however,*

symptoms can be delayed for up to 48 hours. Laboratory findings include severe hemolytic anemia, hemoglobinuria, and hemoglobinemia. Acute renal failure may be an early complication. Hypotension is occasionally seen; T-wave elevations are often observed.

BAL (Dimercaprol) treatment will not protect against hemolysis but may prevent long-term effects from arsine (arsenic) poisoning. If major hemolysis has occurred, exchange transfusions may be performed to remove plasma hemoglobin red blood cell debris and arsine-hemoglobin complexes, in conjunction with hemodialysis to preserve renal function. Hemodialysis may also assist in decreasing arsenic levels.

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:	Currently unknown	
FLAMMABLE LIMITS IN AIR , % by volume:	LOWER: 4% (Hydrogen). The lower flammable limit for arsine is 4.5%.	UPPER: 75% (Hydrogen). The upper flammable limit for arsine is 78%.

EXTINGUISHING MEDIA: Use media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES: DANGER! Toxic, flammable, high-pressure gas (see section 3). Evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Immediately cool cylinders with water spray from maximum distance, 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.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Forms explosive mixtures with air and oxidizing agents. 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 not equipped with a pressure relief device. If leaking or spilled arsine 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.

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 (see section 3). 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.

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 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 airflow to keep the arsine 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—Not applicable.

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: 0.463

SOLUBILITY IN WATER: Negligible

PERCENT VOLATILES BY VOLUME: 100

APPEARANCE, ODOR, AND STATE: Colorless, odorless gas at normal temperature and pressure; garlic-like odor.

10. Stability and Reactivity

STABILITY: Unstable Stable

INCOMPATIBILITY (materials to avoid): Nitric acid, oxidizing agents, aluminum, halogens, potassium, and ammonia.

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

HAZARDOUS POLYMERIZATION: May Occur Will Not Occur

CONDITIONS TO AVOID: Exposure to light or heat in the presence of moisture. Arsine component decomposes at temperatures in excess of 446-464°F (230-240°C).

11. Toxicological Information

LC₅₀ = 20 ppm, 1 hr, mouse, arsine. See section 3.

12. Ecological Information

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

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. (arsine, hydrogen)		
HAZARD CLASS: 2.3	IDENTIFICATION NUMBER: UN 1953	PRODUCT RQ: None
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): None

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): 100 lb (Arsine)

EHS RQ (40 CFR 355): 100 lb (Arsine)

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.

Arsine 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.

Arsine is listed as a regulated substance in quantities of 1000 lb (453.6 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.

Arsine 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: The arsine component (as inorganic arsenic) is listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

WARNING: Inorganic arsenic compounds are chemicals known to the State of California to cause cancer.

(California Health and Safety Code §25249.5 *et seq.*)

PENNSYLVANIA: This product 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, and 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 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 arsine

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.

HAZARD RATING SYSTEMS:

NFPA RATINGS:

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

HMIS RATINGS:

HEALTH = 4*
FLAMMABILITY = 4
PHYSICAL HAZARD = 2

**An asterisk used in conjunction with HMIS health hazard ratings designates a carcinogenic or reproductive hazard.*

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) 788-2700.7

- 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*

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