

Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Arsine (MSDS No. P-4565-I)	Trade Names: Arsine
Chemical Name: Arsine	Synonyms: Arsane, arsenic hydride, arsenic trihydride, arseniuretted hydrogen, arsenous hydride, hydrogen arsenide
Chemical Family: Inorganic Hydride	Product Grades: 5.7-, 6.0-Semiconductor Process Gas
Telephone:	Company Name: Praxair, Inc.
Emergencies: 1-800-645-4633*	39 Old Ridgebury Road
CHEMTREC: 1-800-424-9300*	Danbury, CT 06810-5113
Routine: 1-800-PRAXAIR	

*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



Cancer suspect agent.

DANGER! Poisonous, flammable liquid and gas under pressure.
May be fatal if inhaled.

Causes severe red blood cell, lung, liver, kidney, and other organ damage.

Symptoms may be delayed.

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, arsine is a colorless gas with a garlic-like odor.

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. 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 expected damage to skin from vapor. Liquid may cause frostbite.

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

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

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 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.

CARCINOGENICITY: Inorganic arsenic compounds are listed by NTP as *known to be human carcinogens*. Inorganic arsenic is an OSHA-regulated chemical that per OSHA Standard 1910.1018 “may cause lung cancer.” Arsine, however, is excluded from the OSHA definition of *inorganic arsenic*. Arsenic and arsenic compounds are listed by the IARC as *Group 1: Carcinogenic to Humans*. NIOSH lists arsine as a *potential occupational carcinogen*.

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
Arsine	7784-42-1	>99%*

*The symbol > means “greater than.”

4. First Aid Measures

INHALATION: If inhaled or on suspicion of any exposure, immediately remove victim to fresh air. Symptoms may be delayed. If not breathing, give artificial respiration with supplemental oxygen given by qualified personnel. If breathing, qualified personnel should give oxygen. Keep under medical observation. Call a physician even if no symptoms are present. Consider any exposure as a potentially toxic dose.

SKIN CONTACT: If exposed to liquid, avoid breathing vapor. Flush with water, and warm frostbite area with warm water not to exceed 105°F (41°C). In case of massive exposure, remove 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. Seek the advice of a physician, preferably an ophthalmologist, immediately.

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 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

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

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

PRODUCTS OF COMBUSTION: Oxides of arsenic—carcinogenic.

PROTECTION OF FIREFIGHTERS: DANGER! Poisonous, flammable liquid and gas under pressure. 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.

Specific Physical and Chemical Hazards. Heat of fire can build pressure in cylinder and cause it to rupture. To provide maximum containment up to cylinder burst pressure, arsine cylinders are not equipped with a pressure relief device. No part of cylinder should be subjected to a temperature higher than 125°F (52°C). If leaking or spilled arsine 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.

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 liquid and gas under pressure.

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). Toxic, flammable vapors may spread from spill. 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 of leak or move cylinder to well-ventilated area. Prevent runoff from contaminating surrounding environment.

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.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: *May be fatal if inhaled.* Do not breathe gas. Do not get vapors or liquid 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, or open flame. Use only spark-proof tools and explosion-proof equipment. Keep away from oxidizing agents and from other flammables. **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. **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 arsine, see section 16.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Separate arsine 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.

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-TWA (2007)
Arsine	0.05 ppm; 0.2 mg/m ³	0.005 ppm

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 = 3 ppm

ENGINEERING CONTROLS:

Local Exhaust. Use explosion-proof local exhaust ventilation. See Special.

Mechanical (General). 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:	Garlic-like
ODOR THRESHOLD:	Not available.
PHYSICAL STATE:	Gas at normal temperature and pressure
pH:	Not applicable.
MELTING POINT at 1 atm:	-178.37°F (-116.87°C)
BOILING POINT at 1 atm:	-80.46°F (-62.48°C)
FLASH POINT (test method):	Flammable gas
EVAPORATION RATE (Butyl Acetate = 1):	High
FLAMMABILITY:	Flammable
FLAMMABLE LIMITS IN AIR , % by volume:	LOWER: 4.5% UPPER: 78.0%
VAPOR PRESSURE at 68°F (20°C):	219.7 psia (1514.7 kPa, abs)
LIQUID DENSITY at 77°F (25°C) and 1 atm:	82.47 lb/ft ³ (1321 kg/m ³)
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	2.691
VAPOR DENSITY at 70°F (21.1°C) and 1 atm	0.2025 lb/ft ³ (3.228 kg/m ³)
SOLUBILITY IN WATER 68°F (20°C):	Slight
PARTITION COEFFICIENT: n-octanol/water:	Not available.

AUTOIGNITION TEMPERATURE:	Not available.
DECOMPOSITION TEMPERATURE:	446-464°F (230-240°C)
PERCENT VOLATILES BY VOLUME:	100
MOLECULAR WEIGHT:	77.945
MOLECULAR FORMULA:	AsH ₃

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 container remains sealed and exposure to incompatible materials is avoided.

CONDITIONS TO AVOID: Exposure to light or heat in the presence of moisture. Decomposition occurs at temperatures on the order of 446-464°F (230-240°C).

INCOMPATIBLE MATERIALS: Nitric acid, oxidizing agents, halogens, potassium, and ammonia.

HAZARDOUS DECOMPOSITION PRODUCTS: Arsenic, arsenic oxides, hydrogen

POSSIBILITY OF HAZARDOUS REACTIONS: May Occur Will Not Occur

Exposure to high temperatures may generate toxic, flammable by-products.

11. Toxicological Information

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

EFFECTS IN HUMANS: One study showed a fatality rate of 20% among approximately 470 cases of occupational exposure to arsine. Deaths resulted from renal damage following extensive hemolysis. Information on concentrations was not available for this study, but other researchers have reported that a ½-hour concentration of arsine at 250 ppm is lethal in humans. In this study, symptoms of poisoning occurred after a few hours of exposure at 1 to 3.3 ppm. Another study has reported nonfatal arsenic poisoning at an estimated arsine concentration of 0.4 ppm for 4 hours.

12. Ecological Information

ECOTOXICITY: No information available on ecological effects.

OTHER ADVERSE EFFECTS: Arsine 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.

Emergency Disposal.

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

Arsine 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.

14. Transport Information

DOT/IMO SHIPPING NAME: Arsine

HAZARD CLASS:	2.3	PACKING GROUP/Zone:	NA*	IDENTIFICATION NUMBER:	UN2188	PRODUCT RQ:	None
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(b)].

MARINE POLLUTANTS: Arsine 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): 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):

TPQ: 100 lb (45.4 kg)

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

DELAYED: Yes

PRESSURE: Yes

REACTIVITY: Yes

FIRE: Yes

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

Arsine, as an *arsenic compound*, 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.

Arsine is listed as a regulated substance in quantities of 1,000 lb (454 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: Arsine 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.

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

STATE REGULATIONS:

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

WARNING: Arsine is a chemical known to the State of California to cause cancer. (California Health and Safety Code §25249.5 et seq.)

PENNSYLVANIA: Arsine 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: *Poisonous, flammable liquid and gas under pressure.* Use piping and equipment adequately designed to withstand pressures to be encountered. Use a backflow prevention device in any piping. **Ground all equipment.** Electrical equipment must be non-sparking or explosion-proof. Use only in a closed system. **Never work on a pressurized 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 cap or 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 arsine.

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 = 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: 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*
— *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 MSDSs for these products, contact your Praxair sales representative or local distributor or supplier, or download from www.praxair.com. 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).

Praxair and the *Flowing Airstream* design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.



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