

Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Arsine (MSDS No. P-4565-G)	Trade Name: Arsine
Chemical Name: Arsine	Synonyms: Arsane, arsenic hydride, arsenic trihydride, arseniuretted hydrogen, arsenous hydride, hydrogen arsenide
Formula: AsH ₃	Chemical Family: Inorganic Hydride
Telephone:	Company Name: Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113
Emergencies: 1-800-645-4633* CHEMTREC: 1-800-424-9300* 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. 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	>99%*	0.05 ppm; 0.2 mg/m ³	0.05 ppm

* The symbol > means "greater than."

3. Hazards Identification

	EMERGENCY OVERVIEW DANGER! Toxic, flammable liquid and gas under pressure. Cancer suspect agent. May be fatal if inhaled. Causes severe red blood cell, lung, liver, kidney, nervous system, and heart damage. Liquid may cause frostbite. Symptoms may be delayed. May form explosive mixtures with air. Self-contained breathing apparatus must be worn by rescue workers. Odor: Garlic-like	
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THRESHOLD LIMIT VALUE: TLV-TWA, 0.05 ppm, 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 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.

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: 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 produce 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

FLASH POINT (test method):	Flammable gas	
AUTOIGNITION TEMPERATURE:	Currently unknown	
FLAMMABLE LIMITS IN AIR, % by volume:	LOWER: 4.5%	UPPER: 78%

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

SPECIAL FIRE FIGHTING PROCEDURES: DANGER! Toxic, flammable liquid and gas under pressure (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. 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.

HAZARDOUS COMBUSTION PRODUCTS: None known.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: DANGER! Toxic, flammable liquid and gas under pressure (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). 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.

EMERGENCY DISPOSAL: 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.

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 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.

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 arsine, see section 16. For further information on storage, handling, and use of this product, see *NFPA 55: Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*, published by the National Fire Protection Association.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST—Use explosion-proof local exhaust ventilation with sufficient air flow 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.

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

MOLECULAR WEIGHT:	77.95
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	2.69
GAS DENSITY at 68°F (20°C) and 1 atm:	0.2025 lb/ft ³ (3.24 kg/m ³)
VAPOR PRESSURE at 70°F (21.1°C):	219.7 psia (1514.7 kPa, abs)
SOLUBILITY IN WATER:	Slight
PERCENT VOLATILES BY VOLUME:	100
EVAPORATION RATE (Butyl Acetate = 1):	High
BOILING POINT at 1 atm:	-80.5°F (-62.5°C)
FREEZING POINT at 1 atm:	-178.4°F (-116.9°C)

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

10. Stability and Reactivity

STABILITY: Unstable Stable

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

HAZARDOUS DECOMPOSITION PRODUCTS: Arsenic, arsenic oxides, hydrogen.

HAZARDOUS POLYMERIZATION: May Occur Will Not Occur

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).

11. Toxicological Information

LC₅₀ = 20 ppm, 1 hr, mouse

12. Ecological Information

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

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier. For emergency disposal, see section 6.

14. Transport Information

DOT/IMO SHIPPING NAME: Arsine

HAZARD CLASS: 2.3	IDENTIFICATION NUMBER: UN 2188	PRODUCT RQ: None
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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: 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):

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 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: 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 liquid and gas under pressure.* May be fatal if inhaled. Do not breathe gas. Do not get vapors or liquid 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. Keep away from oxidizing agents and from other flammables. *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 plug tightly. *Never place a compressed gas cylinder where it may become part of an electrical circuit.*

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.

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.

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 connection is 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 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.

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.

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