

PRODUCT NAME: ARSINE ($\geq 0.4\%$) IN HYDROGEN**1. Chemical Product and Company Identification**

**BOC Gases,
Division of
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974**

**TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE
NUMBER: CHEMTREC (800) 424-9300**

**BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3V8**

**TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE
NUMBER: (905) 501-0802
EMERGENCY RESPONSE PLAN NO: 20101**

PRODUCT NAME: ARSINE ($\geq 0.4\%$) IN HYDROGEN

CHEMICAL NAME: Arsine in Hydrogen

**COMMON NAMES/SYNONYMS: Arsine Hydride in Hydrogen, Arsenic Trihydride in Hydrogen,
Hydrogen Arsenide in Hydrogen**

TDG (Canada) CLASSIFICATION: 2.3 (2.1)

WHMIS CLASSIFICATION: A, B1, D1A, D2A

PREPARED BY: Loss Control (908)464-8100/(905)273-7700

PREPARATION DATE: 2/3/97

REVIEW DATES: Not Applicable

2. Composition, Information on Ingredients

INGREDIENT	% VOLUME	PEL-OSHA ¹	TLV-ACGIH ²	LD ₅₀ or LC ₅₀ Route/Species
Arsine FORMULA: AsH ₃ CAS: 7784-42-1 RTECS #: CG6475000	≥ 0.4	0.05 ppm TWA	0.05 ppm TWA	LC ₅₀ : 20 ppm/1 H inhalation/rat
Hydrogen FORMULA: H ₂ CAS: 1333-74-0 RTECS #: MW8900000	< 99.6	Simple Asphyxiant	Simple Asphyxiant	Not Available

¹ As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

² As stated in the ACGIH 1996-97 Threshold Limit Values for Chemical Substances and Physical Agents

3. Hazards Identification**EMERGENCY OVERVIEW**

Highly poisonous and flammable gas with "garlic-like" odor. Arsine inhalation may cause headache, delirium, nausea, vomiting, general malaise, tightness in the chest, and pain in the abdomen and loins. Exposure may destroy red blood cells and can cause widespread organ injury. Fire and explosion hazard. Avoid heat, sparks, and flames. Contents under pressure. Use and store below 120 °F.

PRODUCT NAME: ARSINE ($\geq 0.4\%$) IN HYDROGEN

ROUTE OF ENTRY:

Skin Contact Yes	Skin Absorption No	Eye Contact Yes	Inhalation Yes	Ingestion No
---------------------	-----------------------	--------------------	-------------------	-----------------

HEALTH EFFECTS:

Exposure Limits Yes	Irritant Yes	Sensitization No
Teratogen No	Reproductive Hazard No	Mutagen No
Synergistic Effects None Reported		

Carcinogenicity: -- NTP: No IARC: Yes OSHA: No

EYE EFFECTS:

Eye contact with product may cause irritation.

SKIN EFFECTS:

Skin contact with product may cause irritation.

Dermatitis is associated with exposure to other arsenic compounds but not necessarily arsine.

INGESTION EFFECTS:

Ingestion is unlikely.

INHALATION EFFECTS:

The symptoms of inhalation of this mixture are not well known. However, ARSINE IS AN EXTREMELY TOXIC GAS that destroys red blood cells and can cause widespread organ injury. Early symptoms of arsine exposure include weakness, headache, shivering, thirst and abdominal pain. The weakness proceeds to muscle cramps and occasionally hypotension. Delirium, nausea, vomiting, general malaise, tightness in the chest, and pain in the loins may also occur. Severe hemolysis can cause red or darkened urine and bronze or jaundiced colored skin. Symptoms may not occur until several hours after exposure.

The sense of smell detects arsenic at about 0.5 ppm. If a "garlic-like" odor is detected, exposure has already occurred.

Arsine is listed by the International Agency for Research On Cancer as a Group 1 Carcinogen and by the National Toxicology Program as a confirmed carcinogen (see Arsenic and Certain Arsenic Compounds).

CHRONIC:

Long-term exposure to arsine can increase the risks of developing respiratory and lymphatic cancer and low-grade hemolytic anemia.

NFPA HAZARD CODES

Health: 4 (as arsine)
Flammability: 4 (as hydrogen)
Reactivity: 0

HMIS HAZARD CODES

Health: 4 (as arsine)
Flammability: 4 (as hydrogen)
Reactivity: 0

RATINGS SYSTEM

0 = No Hazard
1 = Slight Hazard
2 = Moderate Hazard
3 = Serious Hazard
4 = Severe Hazard

4. First Aid Measures

EYES:

Flush contaminated eye(s) with copious quantities of water for 15 minutes. Part eyelids to assure complete flushing. Seek immediate medical attention for possible inhalation exposure.

SKIN:

Remove affected clothing as rapidly as possible and wash exposed area thoroughly with soap and water. Seek immediate medical attention if inhalation exposure is suspected.

INGESTION:

Give water by mouth to dilute. Never give anything by mouth to an unconscious person. Call your local poison control center for advice, giving identity of chemical.

INHALATION:

PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF EXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH FULL-FACEPIECE SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE PRESSURE MODE. BE AWARE OF EXTREME FIRE AND EXPLOSION HAZARD. REGARD ANYONE EXPOSED AS HAVING A POTENTIALLY TOXIC DOSE. Quick removal from the contaminated area is most important. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Unconscious persons should be moved to an uncontaminated area, and given artificial resuscitation and supplemental oxygen if they are not breathing. Further treatment should be symptomatic and supportive. Advise physician of the toxic properties of arsine as a powerful hemolytic agent.

See Note To Physician below.

NOTE TO PHYSICIAN: The principle clinical manifestation of arsine toxicity is acute intravascular hemolysis and consequent renal failure. Bronze skin pigmentation may be confused with jaundice. In all cases of exposure, T-wave elevation of serial EKGs has been found. Survivors followed for as long as 18 months gave evidence that arsine was the casual agent of myocardial degeneration and cardiac failure. Management of intoxication is dependent on treatment of the hemolytic episode and its consequences. Dimercaptol does not appear to alter the course of hemolysis; however, it may be useful in the treatment of the arsenic neuropathy that appears to have followed some cases of arsine poisoning. Severe hemolytic anemia may require transfusion of red cells. Alkalization of the urine with small doses of oral sodium bicarbonate has been recommended by some clinicians in the management of hemoglobinurea. The advice of a nephrologist should be sought quickly.

5. Fire Fighting Measures

Conditions of Flammability: Highly Flammable		
Flash point: Not Available	Method: Not Applicable	Autoignition Temperature: 1085 °F (585 °C) (as Hydrogen)
LEL(%): 4 (Hydrogen)		UEL(%): 78 (Arsine)
Hazardous combustion products: Arsenic compounds including arsenic trioxide		
Sensitivity to mechanical shock: Not Available		
Sensitivity to static discharge: Yes		

FIRE AND EXPLOSION HAZARDS:

Extremely flammable mixture with low ignition energy. Arsine is flammable in air at a concentration of 5.8%. Extremely flammable gas mixture. Easily ignited over a wide range of vapor/air concentrations. Hydrogen is very light and may collect in the upper portions of storage areas. Arsenic is heavier than air and may travel to a source of ignition and flash back. Hydrogen burns with an almost invisible flame. Rapid flame propagation or flashback possible. High pressure hydrogen releases often ignite with no apparent source of ignition, possibly via static electricity. Arsine decomposes at 572 °F with deposition of arsenic which vaporizes at 852°F.

EXTINGUISHING MEDIA:

Use water spray to cool surrounding containers. Inerting the atmosphere to reduce oxygen levels may extinguish the flame, allowing capping of the leaking containers. **DO NOT ATTEMPT REPAIR UNLESS YOU ARE SPECIALLY TRAINED.**

FIRE FIGHTING INSTRUCTIONS:

Stop the flow of gas and allow the fire to burn itself out. Fire fighters should use NIOSH/MSHA approved full-facepiece self-contained breathing apparatus and full turnout gear. Approach fire from upwind to avoid hazardous vapors and toxic decomposition products. Fight fire from protected location or maximum possible distance. Use fine spray or fog to control fire by preventing its spread and absorbing some of its heat, disperse vapors, and protect personnel.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. Direct 500 GPM water stream onto containers above liquid level with remote monitors. Limit the number of personnel in proximity to the fire. Evacuate surrounding areas to at least 3000 feet in all directions.

Be alert of water runoff for environmental contamination.

NOTE: Arsenic Trioxide, which may be generated from an ARSINE fire is identified as a carcinogen by NTP and IARC. Arsenic trioxide from an arsine fire exists as aerosol particles which are toxic and can be carried great distances by the wind. A water spray aimed at the "smoke" from an arsine fire may be used to "wash" the aerosol particles from the air and prevent them from being distributed or scattered.

6. Accidental Release Measures

Eliminate all ignition sources. Evacuate all personnel from affected area. Approach release from upwind. Stop or control the leak if it can be done without risk. Use water spray to cool and disperse vapors and protect personnel. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

7. Handling and Storage

Electrical Classification:

Class 1, Group B (for Hydrogen)

Earth-ground and bond all lines and equipment associated with the system. All electrical equipment should be non-sparking or explosion proof.

PRODUCT NAME: ARSINE ($\geq 0.4\%$) IN HYDROGEN

Aluminum, Carbon steel, stainless steel, Monel® and Hastelloy C® are preferred materials for handling arsine. Brass should be avoided. Kel-f® and Teflon® are preferred gasket materials; Viton® and Nylon® are acceptable. Some steels are susceptible to hydrogen attack or embrittlement at high temperature and pressure.

Use only in well ventilated areas.

Stationary customer site vessels should be operated in accordance with the manufacturer's and BOC's instructions. Do not attempt to repair, adjust or in any other way modify the operation of these vessels. If there is a malfunction or other type of operations problem with the vessel, contact the closest BOC location immediately for assistance.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Outside or detached storage is preferred. Isolate from oxidizing materials, acids, and halogens. Post "NO SMOKING OR OPEN FLAMES" signs in storage and use areas. DO NOT allow the temperature where cylinders are stored to exceed 120 °F (49 °C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time.

Valve protection caps must remain in place unless container is secured with valve outlet piping to use point. Close valve after each use and when the container is empty. Do not drag, slide or roll cylinders on their sides. Use a suitable hand truck for container movement. Use a pressure reducing regulator when connecting container to piping or systems. Do not use gas directly from container. Do not heat container by any means to increase the discharge rate of product from the container.

For additional information, consult the Compressed Gas Association (CGA) pamphlets P-1, P-14, G5, G5.3, P6 and Safety Bulletin SB-2.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

8. Exposure Controls, Personal Protection

EXPOSURE LIMITS¹:

INGREDIENT	% VOLUME	PEL-OSHA ²	TLV-ACGIH ³	LD ₅₀ or LC ₅₀ Route/Species
Arsine FORMULA: AsH ₃ CAS: 7784-42-1 RTECS #: CG6475000	≥ 0.4	0.05 ppm TWA	0.05 ppm TWA	LC ₅₀ : 20 ppm inhalation/rat
Hydrogen FORMULA: H ₂ CAS: 1333-74-0 RTECS #: MW8900000	< 99.6	Simple Asphyxiant	Simple Asphyxiant	Not Available

¹ Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.

² As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)

³ As stated in the ACGIH 1996-1997 Threshold Limit Values for Chemical Substances and Physical Agents.

IDLH: 3 ppm (arsine)

ENGINEERING CONTROLS:

Use local exhaust ventilation to reduce concentrations to below acceptable exposure guidelines. A laboratory type hood is suitable for handling small or limited quantities.

MSDS: G-288

Revised: 2/3/96

PRODUCT NAME: ARSINE ($\geq 0.4\%$) IN HYDROGEN

EYE/FACE PROTECTION:

Gas-tight safety goggles or full-face piece respirator.

SKIN PROTECTION:

Protective gloves: neoprene, butyl rubber, PVC, polyethylene or Teflon (R).

RESPIRATORY PROTECTION:

Use full-facepiece SCBA operated in positive pressure mode for emergency use and exposures above the IDLH. Air purifying respirators may not afford an adequate level of protection.

OTHER/GENERAL PROTECTION:

Safety shoes, safety shower, eyewash "fountain", face shield.

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure at 70°F (Arsine)	: No Data	psia
Vapor density (Arsine) (Air = 1)	: No Data	
Evaporation point	: Not Available	
Boiling point	: No Data	°F
	: No Data	°C
Freezing point	: No Data	°F
	: No Data	°C
pH	: Not Available	
Specific gravity	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H ₂ O)	: Not Soluble	
Odor threshold	: 0.5 ppm	(as arsine)
Odor and appearance	: A colorless gas with a repulsive, slight garlic odor	

10. Stability and Reactivity

STABILITY:

Stable

INCOMPATIBLE MATERIALS:

Arsine reacts with potassium permanganate, bromine and sodium hypochlorite to form arsenic compounds. Oxidants and Oxidizing agents. Hydrogen is incompatible with oxidizers, chlorine, fluorine, lithium metal, and titanium.

HAZARDOUS DECOMPOSITION PRODUCTS:

Hydrogen, arsenic and arsenic trioxide at about 450°F (232°C).

HAZARDOUS POLYMERIZATION:

Will not occur.

11. Toxicological Information

CARCINOGENICITY:

Arsine is listed by the International Agency for Research On Cancer as a Group 1 Carcinogen and by the National Toxicology Program as a known carcinogen (see Arsenic and Certain Arsenic Compounds).

MSDS: G-288

Revised: 2/3/96

PRODUCT NAME: ARSINE ($\geq 0.4\%$) IN HYDROGEN

INHALATION:

Serious arsine exposure may produce symptoms in 30 to 60 minutes but may be delayed for several hours. In the first minutes after severe exposures, the patient may look and feel relatively well. A garlicky breath odor may be noted. The rapid and severe Coombs-negative hemolytic anemia is characteristic of arsine and does not occur with arsenic.

Clinical polyneuropathy produced by arsine was similar to that produced by arsenic poisoning. This suggests that arsine polyneuropathy is due to action of arsenic.

OTHER:

Arsine is a powerful reducing agent and has a strong affinity for the hemoglobin in the blood. The hemolysis of the red blood cells causes renal failure. The destruction of the red blood cells causes the appearance of hemoglobin and its degradation products in the blood plasma and the urine. Jaundice is also a primary manifestation of hemolysis. Renal function impairment and possible complete shutdown is the most serious secondary manifestation of arsine poisoning. Permanent injury, especially to the central nervous system, or fatal consequences are also well recognized.

12. Ecological Information

OTHER ENVIRONMENTAL INFORMATION:

Arsine is an EPA Extremely Hazardous Substance.

Threshold Planning Quantity: 100 lbs.

Reportable Quantity (RQ): Arsine is included in the broad class of arsenic and compounds. No RQ has been assigned to this broad class of compounds.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Compressed gases, flammable, toxic n.o.s. (Arsine in Hydrogen)	Compressed gases, flammable, toxic n.o.s. (Arsine in Hydrogen)
HAZARD CLASS:	2.3	2.3 (2.1)
IDENTIFICATION NUMBER:	UN 1953	UN 1953
SHIPPING LABEL:	POISON GAS, FLAMMABLE GAS	POISON GAS, FLAMMABLE GAS

Additional Marking Requirement (For Arsine ≥ 4000 ppm): "Inhalation Hazard"

Additional Shipping Paper Description Requirement: "Poison Inhalation Hazard, Zone A, B, C, or D"

depending on Arsine concentration as follows:

Zone A (Arsine $\geq 10\%$),

Zone B ($10\% > \text{Arsine} \geq 2\%$),

Zone C ($2\% > \text{Arsine} \geq 6700$ ppm),

Zone D ($6700 \text{ ppm} > \text{Arsine} \geq 4000$ ppm)

Note: For Arsine < 4000 ppm, ship as Compressed gases, flammable, n.o.s.

(Arsine in Hydrogen), 2.1, UN 1954, FLAMMABLE GAS.

15. Regulatory Information

SARA TITLE III NOTIFICATIONS AND INFORMATION

Hydrogen and arsine are listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with threshold quantities (TQ) of 10,000 and 1,000 pounds, respectively.

Arsine is listed as an extremely hazardous substance (EHS) subject to state and local reporting under Section 304 of SARA Title III (EPCRA) with a reportable quantity (RQ) of 100 pounds.

The presence of arsine in quantities in excess of the threshold planning quantity (TPQ) of 100 pounds requires certain emergency planning activities to be conducted.

SARA TITLE III - HAZARD CLASSES:

Acute Health Hazard
Chronic Health Hazard
Fire Hazard
Sudden Release of Pressure Hazard

SARA TITLE III - SECTION 313 SUPPLIER NOTIFICATION:

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

CAS NUMBER	INGREDIENT NAME	PERCENT BY VOLUME
7784-42-1	Arsine	$\geq 0.4\%$

This information must be included on all MSDSs that are copied and distributed for this material. Arsine is included under the broad category of arsenic compounds.

16. Other Information

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:

Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).