



ARSINE

Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name	ARSINE
Product Code(s)	G-9
UN-No	UN2188
Recommended Use	Compressed gas.
Synonyms	Arsine Hydride; Arsenic Trihydride; Hydrogen Arsenide
Supplier Address*	Linde Gas North America LLC - Linde Merchant Production Inc. - Linde LLC 575 Mountain Ave. Murray Hill, NJ 07974 Phone: 908-464-8100 www.lindeus.com Linde Gas Puerto Rico, Inc. Las Palmas Village Road No. 869, Street No. 7 Catano, Puerto Rico 00962 Phone: 787-641-7445 www.pr.lindegas.com Linde Canada Limited 5860 Chedworth Way Mississauga, Ontario L5R 0A2 Phone: 905-501-1700 www.lindecanada.com * May include subsidiaries or affiliate companies/divisions. For additional product information contact your local customer service.
Chemical Emergency Phone Number	Chemtrec: 1-800-424-9300 for US/ 703-527-3887 outside US

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Flammable
Fatal if inhaled.

May cause adverse effects on the bone marrow and blood-forming system
This product contains one or more substances which are classified by IARC as carcinogenic to humans (Group I), probably carcinogenic to humans (Group 2A) or possibly carcinogenic to humans (Group 2B)
May adversely affect liver and kidney.

Contents under pressure
Keep at temperatures below 52°C / 125°F

Appearance Colorless**Physical State** Gas.**Odor** Garlic

Potential Health Effects

Principle Routes of Exposure Eye contact. Skin contact. Inhalation.

Acute Toxicity

Inhalation Fatal if inhaled. Early effects are commonly characterized by drowsiness, giddiness, headache, thirst and abdominal pain with vomiting. Arsine may discolor urine to red or a darkened color, and the skin to a bronze or jaundiced color.

Eyes High concentrations may cause eye damage, however, systemic poisoning will occur first. Contact with rapidly expanding gas near the point of release may cause frostbite.

Skin May cause irritation. Contact with rapidly expanding gas near the point of release may cause frostbite.

Skin Absorption Hazard No known hazard by skin absorption.

Ingestion Not an expected route of exposure.

Chronic Effects Prolonged or repeated exposure increases the risk. Possible risks of irreversible effects. Contains a known or suspected reproductive toxin. May cause adverse liver and kidney effects. May cause adverse effects on the bone marrow and blood-forming system.

Main Symptoms Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Aggravated Medical Conditions Blood disorders. Kidney disorders. Liver disorders. Respiratory disorders.

Environmental Hazard Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. See Section 12 for additional Ecological Information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Volume %	Chemical Formula
Arsine	7784-42-1	>99	AsH ₃

4. FIRST AID MEASURES

General Advice Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Eye Contact	In case of contact with substance, immediately flush eyes with running water for at least 30 minutes. Keep eye wide open while rinsing. Call a physician immediately.
Skin Contact	Immediate medical attention is required. Wash off immediately with soap and plenty of water for at least 30 minutes while removing all contaminated clothing and shoes.
Inhalation	PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF INHALATION OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious inhalation victims should be assisted to an uncontaminated area and inhale fresh air. If breathing is difficult, administer oxygen. Unconscious persons should be moved to an uncontaminated area and, as necessary, given artificial resuscitation and supplemental oxygen. Treatment should be symptomatic and supportive.
Ingestion	Not an expected route of exposure. Do NOT induce vomiting. Call a physician or Poison Control Center immediately. Never give anything by mouth to an unconscious person. Drink plenty of water.
Notes to Physician	Arsine is a powerful hemolytic agent. 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 showed evidence that arsine was the causal 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 arsenic neuropathy that appears to follow some cases of arsine poisoning. Severe hemolytic anemia may require transfusion of red cells. Alkalinization of the urine with small doses of oral sodium bicarbonate has been recommended by some clinicians in the management of hemoglobinuria. The advice of a nephrologist should be sought quickly.
Protection of First-aiders	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. FIRE-FIGHTING MEASURES

Flammable Properties	Extremely flammable. Containers may explode when heated.
Suitable Extinguishing Media	Water spray. DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.
Unsuitable Extinguishing Media	Do not use halogenated extinguishing agents or foam.
Hazardous Combustion Products	Arsenic compounds including arsenic trioxide.
<u>Explosion Data</u>	
Sensitivity to Mechanical Impact	None
Sensitivity to Static Discharge	Yes
Specific Hazards Arising from the Chemical	Low ignition energy. Continue to cool fire exposed cylinders until flames are extinguished. Cylinders may rupture under extreme heat. Damaged cylinders should be handled only by specialists.

Protective Equipment and Precautions for Firefighters

If possible, stop the flow of gas. Do not extinguish the fire until supply is shut off as otherwise an explosive-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Ventilation fans must be explosion proof. Use non-sparking tools to close container valves.

Vapors from liquefied gas are initially heavier than air and spread along ground. Vapors may accumulate in confined areas (basement, tanks, hopper/tank cars, etc.). Vapors may travel to source of ignition and flash back. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers.

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Additional chemical protective clothing may be required to protect from toxic decomposition products.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions

ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. All equipment used when handling the product must be grounded. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.

Environmental Precautions

Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas. Prevent spreading of vapors through sewers, ventilation systems and confined areas.

Methods for Containment

Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.

Methods for Cleaning Up

Return cylinder to Linde or an authorized distributor.

7. HANDLING AND STORAGE

Handling

Do not breathe gas. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Remove all sources of ignition. Use only in ventilated areas. Ground and bond all lines and equipment associated with product system. All equipment should be non-sparking and explosion proof. "NO SMOKING" signs should be posted in storage and use areas.

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.

Never attempt to lift a cylinder by its valve protection cap. Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Use equipment rated for cylinder pressure. Use backflow preventive device in piping.

Use an adjustable strap wrench to remove over-tight or rusted caps. Close valve after each use and when empty. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never attempt to refill a compressed gas cylinder without the owner's written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

Storage Protect from physical damage. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Keep at temperatures below 52°C / 125°F. 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. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Arsine 7784-42-1	TWA: 0.005 ppm	TWA: 0.2 mg/m ³	Ceiling: 0.002 mg/m ³ 15 min Ceiling: 0.002 mg/m ³ As 15 min

NIOSH IDLH: Immediately Dangerous to Life or Health.

Other Exposure Guidelines Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Engineering Measures Showers. Eyewash stations. Explosion proof ventilation systems. Exhaust gas should be vented to a gas treatment system.

Ventilation Use ventilation adequate to keep exposures below recommended exposure limits.

Personal Protective Equipment

Eye/Face Protection Tightly fitting safety goggles.

Skin and Body Protection Appropriate protective and chemical resistant gloves, clothing and splash protection, or fully encapsulating vapor protective clothing to prevent exposure. For materials of construction consult protective clothing manufacturer's specifications.

Respiratory Protection

General Use If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Emergency Use Use positive pressure air line respirator or self-contained breathing apparatus for exposure over exposure limits or emergency use. For exposures above IDLH, an additional escape bottle is required.

Hygiene Measures When using, do not eat, drink or smoke. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. Keep away from food, drink and animal feeding stuffs.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Colorless.	Odor	Garlic.
Odor Threshold	0.5* ppm	Physical State	Gas
Flash Point	No information available.	Autoignition Temperature	No information available.
Decomposition Temperature	No information available.	Boiling Point/Range	-62.48°C / -80.46°F
Freezing Point	-116.9°C / -178.4°F	Molecular Weight	77.94
Water Solubility	Slightly soluble	Evaporation Rate	No information available
Vapor Pressure	218 PSIA @ 70°F	Vapor Density	2.67 (air = 1)
VOC Content (%)	Not applicable.	Flammability Limits in Air	
		Upper	78%
		Lower	5.1%

Note: *The odor threshold of arsine is 10-fold greater than the OSHA permissible exposure limit. Odor is not an adequate indicator of arsine's presence and does not provide reliable warning of hazardous concentrations.

10. STABILITY AND REACTIVITY

Stability	Stable under recommended storage conditions.
Incompatible Products	Acids. Halogens. Oxidizing agents.
Conditions to Avoid	Ignitions sources - heat, sparks and open flames. Extremes of temperature and direct sunlight.
Hazardous Decomposition Products	Hydrogen gas. Arsenic and arsenic trioxide at above 450 F.
Hazardous Polymerization	Hazardous polymerization does not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

LD50 Oral:	No information available.
LD50 Dermal:	No information available.
LC50 Inhalation:	Per CGA P-20:LC50: 20 ppm/1 hr (Mouse) (time adjusted)
Inhalation	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 red blood cells causes the primary manifestation of hemolysis. Renal function impairment and possible complete shutdown is the most serious manifestation of arsine poisoning. Permanent injury, especially to the central nervous system or fatal consequences are also well recognized.
Repeated Dose Toxicity	No information available.

Chronic Toxicity

Chronic Toxicity	Prolonged or repeated exposure increases the risk. Possible risks of irreversible effects. Contains a known or suspected reproductive toxin. May cause adverse liver and kidney effects. May cause adverse effects on the bone marrow and blood-forming system.
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Arsine	A1	Group 1	Known	X

IARC: (International Agency for Research on Cancer)

Group 1 - Carcinogenic to Humans

NTP: (National Toxicity Program)

Known - Known Carcinogen

Irritation	No information available.
Sensitization	No information available.
Reproductive Toxicity	No information available.
Developmental Toxicity	No information available.
Synergistic Materials	None known.
Target Organ Effects	Blood. Kidney. Liver. Lungs. Lymphatic System.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Ozone depletion potential; ODP; (R-11 = 1): Does not contain ozone depleting chemical (40 CFR Part 82).

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods	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 Linde for proper disposal.
Contaminated Packaging	Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT

Proper Shipping Name	Arsine
Hazard Class	2.3
Subsidiary Class	2.1
UN-No	UN2188
Special Provisions	This material is toxic by inhalation in Hazard Zone A.
Description	UN2188,Arsine,2.3,(2.1),Marine Pollutant
Additional Description:	"Toxic-Inhalation Hazard Zone A". If net weight of product is greater than or equal to 100 lbs., the shipping description must also contain the letters "RQ".
Additional Marking Requirements:	"Inhalation Hazard". If net weight of product is greater than or equal to 100 lbs., the container must also be marked with the letters "RQ".
Emergency Response Guide Number	119

TDG

Proper Shipping Name	Arsine
Hazard Class	2.3
Subsidiary Class	(2.1)
UN-No	UN2188
Description	UN2188,ARSINE,2.3(2.1),Marine Pollutant

MEX

Proper Shipping Name	Arsine
Hazard Class	2.3
Subsidiary Class	2.1
UN-No	UN2188
Description	UN2188 Arsine,2.3

IATA

UN-No	UN2188
Proper Shipping Name	Arsine
Hazard Class	2.3
Subsidiary Class	2.1
ERG Code	10P
Description	UN2188,Arsine,2.3(2.1)
Maximum Quantity for Passenger	Forbidden
Maximum Quantity for Cargo Only	Forbidden
Limited Quantity	No information available.

IMDG/IMO

Proper Shipping Name	Arsine
Hazard Class	2.3
Subsidiary Class	2.1
UN-No	UN2188
EmS No.	F-D, S-U
Description	UN2188, Arsine,2.3(2.1),Marine Pollutant

ADR

Proper Shipping Name	Arsine
Hazard Class	2.3
UN-No	UN2188
Classification Code	2TF
Description	UN2188 Arsine,2.3,
ADR/RID-Labels	.1

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL	Complies
EINECS/ELINCS	Complies

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

U.S. Federal RegulationsSARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372:

Chemical Name	CAS-No	SARA 313 - Threshold Values %
Arsine	7784-42-1	0.1

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	Yes
Reactive Hazard	No

Clean Water Act

This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42):

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Arsine		X		

Risk and Process Safety Management Programs

This material, as supplied, contains one or more regulated substances with specified thresholds under 40 CFR Part 68 or regulated as a highly hazardous chemical pursuant to the 29 CFR Part 1910.110 with specified thresholds:

Chemical Name	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances	U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
Arsine	1000 lbs		100 lb

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)

This product contains the following substances which are listed hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act:

Chemical Name	CAS-No	HAPS data	VOC Chemicals	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Arsine	7784-42-1	Present (including Arsine and any unique chemical substance that contains Arsenic as part of its infrastructure)			

CERCLA/SARA

This material, as supplied, contains one or more substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355):

Chemical Name	Hazardous Substances RQs	Extremely Hazardous Substances RQs	TPQ
Arsine		100 lb	100 lb TPQ

U.S. State RegulationsCalifornia Proposition 65

This product contains the following Proposition 65 chemicals:

Chemical Name	CAS-No	California Prop. 65
Arsine	7784-42-1	Carcinogen

U.S. State Right-to-Know Regulations

Chemical Name	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Arsine	X	X	X	X	X

International Regulations

Chemical Name	Carcinogen Status	Exposure Limits
Arsine	A1	Mexico: TWA= 0.05 ppm Mexico: TWA= 0.2 mg/m ³

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class

A Compressed gases

B1 Flammable gas

D1A Very toxic materials

D2A Very toxic materials



Chemical Name	NPRI
Arsine	X

Legend

NPRI - National Pollutant Release Inventory

16. OTHER INFORMATION

Prepared By	Product Stewardship 23 British American Blvd. Latham, NY 12110 1-800-572-6501
Issuing Date	17-Mar-2010
Revision Date	10-Sep-2010
Revision Number	1
Revision Note	(M)SDS sections updated. 1.

<u>NFPA</u>	Health Hazard 4	Flammability 4	Stability 1	Physical and Chemical Hazards -
<u>HMIS</u>	Health Hazard 4*	Flammability 4	Physical Hazard 2	Personal Protection -

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

General Disclaimer

For terms and conditions, including limitation of liability, please refer to the purchase agreement in effect between Linde LLC, Linde Merchant Production, Inc. or Linde Gas North America LLC (or any of their affiliates and subsidiaries) and the purchaser.

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End of Safety Data Sheet