

Arsine and Stibine

Incident management

Key Points

Fire

- Extremely flammable
- Arsine and stibine react with strong oxidants. Stibine reacts with chlorine and concentrated nitric acid
- Arsine decomposes on heating, in light and with moisture producing arsenic fumes. Stibine decomposes to produce metallic antimony and hydrogen gas
- In the event of a fire involving arsine or stibine, use fine water spray and liquid and gas tight chemical protective clothing with breathing apparatus

Health



- Toxic by inhalation
- The health effects of arsine and stibine are similar
- Arsine is very toxic, stibine is harmful
- The onset of symptoms is often delayed for several hours
- Inhalation of arsine or stibine may cause headache, malaise, thirst, dizziness and breathlessness followed by abdominal pain, nausea, vomiting and diarrhoea leading to hypovolaemic shock
- Myocardial depression and cardiovascular collapse may also occur
- 24-48 hours after inhalation, fever, tachycardia, severe haemolytic anaemia, jaundice, pulmonary oedema, acute hepatic and renal failure may occur.

Environment

- Dangerous for the environment
- Inform Environment Agency of substantial releases

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes^(a)



UN		2188	Arsine	
EAC		2PE^b	Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus *. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must however still be exercised to avoid unnecessary pollution to watercourses. There may be a public safety hazard outside the immediate area of the incident**.	
APP		A(cf)	Gas-tight chemical protective suit with breathing apparatus *. Fire kit intended to protect against liquefied flammable gas with a boiling point below -20 °C.	
Hazards	Class	2.3	Toxic gases	
	Sub risks	2.1	Flammable gases	
HIN		-		

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

^a Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2004.

^b Not applicable to the carriage of dangerous goods under the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) or the European Agreement Concerning the International carriage Dangerous Goods by Road (ADR)

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

UN		2676	Stibine	
EAC		2PE^b	Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus *. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must however still be exercised to avoid unnecessary pollution to watercourses. There may be a public safety hazard outside the immediate area of the incident**.	
APP		A(f)	Gas-tight chemical protective suit with breathing apparatus *. Fire kit intended to protect against flammable gas.	
Hazards	Class	2.3	Toxic gases	
	Sub risks	2.1	Flammable gases	
HIN		-		

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*Liquid-tight chemical protective clothing (BS 8428) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).





** People should stay indoors with windows and doors closed, ignition sources should be eliminated and ventilation stopped. Non-essential personnel should move at least 250 m away from the incident.

^a Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2004.

^b Not applicable to the carriage of dangerous goods under the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) or the European Agreement Concerning the International carriage Dangerous Goods by Road (ADR)



Chemical Hazard Information and Packaging for Supply Classification

Arsine^(a)

Classification	F+	Extremely flammable	
	T+	Very toxic	
	Xn	Harmful	
	N	Dangerous for the environment	
Risk phrases	R12	Extremely flammable	
	R26	Very toxic by inhalation	
	R48/20	Harmful: danger of serious damage to health by prolonged exposure through inhalation	
	R50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment	
Safety phrases	S1/2	Keep locked up and out of the reach of children	
	S9	Keep container in a well-ventilated place	
	S16	Keep away from sources of ignition - No smoking	
	S28	After contact with skin, wash immediately with plenty of ... (to be specified by the manufacturer)	
	S33	Take precautionary measures against static discharges	
	S36/37	Wear suitable protective clothing and gloves	
	S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)	
	S60	This material and its container must be disposed of as hazardous waste	
S61	Avoid release to the environment. Refer to special instructions/safety data sheet		

^a European Chemicals Bureau, Classification and Labelling, Annex I of Directive 67/548/EEC; <http://ecb.jrc.it/classification-labelling/> (accessed 02/2007).

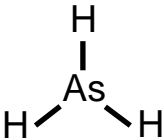
Stibine^(a)

Classification	Xn	Harmful	
	N	Dangerous for the environment	
Risk phrases	R20/22	Harmful by inhalation and if swallowed	
	R50/53	Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment	
Safety phrases	S2	Keep out of the reach of children	
	S61	Avoid release to the environment. Refer to special instructions/safety data sheet	

^a European Chemicals Bureau, Classification and Labelling, Annex I of Directive 67/548/EEC; <http://ecb.jrc.it/classification-labelling/> (accessed 02./2007).

Physicochemical Properties

Arsine

CAS number	7784-42-1
Molecular weight	78
Empirical formula	AsH ₃
Common synonyms	Arsenic hydride; Arsenic trihydride; Hydrogen arsenide
State at room temperature	Gas
Volatility	Vapour pressure 11,000 mm Hg at 25°C
Specific gravity	2.7 at 20°C (air = 1)
Flammability	Extremely flammable
Lower explosive limit	4.5%
Upper explosive limit	78.0%
Water solubility	Low solubility in water, 280 mg L ⁻¹ at 20°C. Soluble in chloroform, benzene. Slightly soluble in ethanol
Reactivity	Reactive. Arsine reacts with strong oxidants, causing risk of explosion. May explosively decompose upon shock or friction
Reaction or degradation products	Decomposes on heating and in the presence of light and moisture, producing toxic fumes of arsenic
Odour	Garlic
Structure	

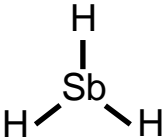
References^(a,b,c)

^a Arsine (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System. Thomson Micromedex, Greenwood Village, Colorado (accessed 02/2007).

^b The Merck Index (14th Edition). Entry 809: Arsine, 2006.

^c The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 2, 1999.

Stibine

CAS number	7803-52-3
Molecular weight	125
Empirical formula	SbH ₃
Common synonyms	Antimony hydride
State at room temperature	Gas
Volatility	Vapour pressure >760mm Hg at 20°C
Specific gravity	4.4 at 15°C (air = 1)
Flammability	Extremely flammable
Lower explosive limit	Limits not known
Upper explosive limit	Limits not known
Water solubility	Solubility in water, 4.1g L ⁻¹ at 0°C. Soluble in ethanol, carbon disulphide and other organic solvents
Reactivity	Reactive. Stibine reacts violently with chlorine, concentrated nitric acid and ozone causing risk of fire and explosion. Reacts with oxidisers and acids
Reaction or degradation products	Decomposes slowly at room temperature but quickly when heated to 200°C, to form metallic antimony and hydrogen gas
Odour	Resembles rotten eggs (hydrogen sulphide)
Structure	

References^(a,b)

^a Stibine (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System. Thomson Micromedex, Greenwood Village, Colorado (accessed 02/2007).

^b The Merck Index (14th Edition). Entry 8811: Stibine, 2006.

Threshold Toxicity Values

Arsine

EXPOSURE VIA INHALATION		
ppm	mg m⁻³	SIGNS AND SYMPTOMS
3 – 10	10 – 32	Exposure may result in symptoms within a few hours
25 – 50	81 – 162	Lethal (30 minute exposure)
250	810	Instantly lethal

Reference^(a)

Note: The effects of stibine are likely to be similar to those of arsine but not necessarily at the same concentrations

^a International Programme on Chemical Safety, Poisons Information Monographs 044: Arsine.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values^(a)

<i>Arsine</i>	Listed value (ppm)	Calculated value (mg m ⁻³)
ERPG-1*	-	-
ERPG-2**	0.5	1.6
ERPG-3***	1.5	4.8

<i>Stibine</i>	Listed value (ppm)	Calculated value (mg m ⁻³)
ERPG-1*	-	-
ERPG-2**	0.5	2.6
ERPG-3***	1.5	7.7

* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.

** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

*** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

Acute Exposure Guideline Levels (AEGs)^(b)

<i>Arsine</i>	ppm				
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1[†]	-	-	-	-	-
AEGL-2^{††}	0.30	0.21	0.17	0.04	0.02
AEGL-3^{†††}	0.91	0.63	0.50	0.13	0.06

<i>Stibine</i>	ppm				
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1[†]	Data not available				
AEGL-2^{††}					
AEGL-3^{†††}					

[†] The level of the chemical in air at or above which the general population could experience notable discomfort.

^{††} The level of the chemical in air at or above which there may be irreversible or other serious long-lasting effects or impaired ability to escape.

^{†††} The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

^a American Industrial Hygiene Association (AIHA). Emergency Response Planning Guideline Values and Workplace Environmental Exposure Level Guides Handbook, Fairfax, VA, 2005.

^b U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 02/2007).

Exposure Standards, Guidelines or Regulations

Occupational standards

Arsine

WEL^(a)	LTEL(8 hour reference period): 0.5 ppm (0.2 mg m ⁻³)
	STEL(15 min reference period): No guideline value specified

Public health guidelines

DRINKING WATER QUALITY GUIDELINE	No guideline value specified
AIR QUALITY GUIDELINE	No guideline value specified
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	No guideline value specified

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

^a Health & Safety Executive. EH40/2005 Workplace Exposure Limits 2005. The Stationery Office, London, 2005.

Health Effects

Major route of exposure^(a)

- Toxic via inhalation

Immediate signs or symptoms of acute exposure^(b)

- Early features of arsine or stibine exposure: the onset is often delayed for several hours. Initial features include headache, malaise, thirst, dizziness and breathlessness followed by abdominal pain, nausea, vomiting and diarrhoea leading to hypovolaemic shock.
- Weakness with muscle cramps may occur as well as myocardial depression and cardiovascular collapse.
- Painless, dark red urine develops 4-6 hours post exposure. Red staining of the conjunctiva and sclera may occur.
- After 24-48 hours: fever, tachycardia, severe haemolytic anaemia, jaundice, hyperkalaemia, pulmonary oedema, T wave changes on ECG, leucocytosis and reticulocytosis. Acute hepatic and renal failure may occur.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Arsine, 2003.

^b TOXBASE: Arsine – features and management, 2003.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Flammability warning: prevent exposure to all sources of ignition such as naked flames, electrical equipment, oxidising chemicals and the smoking of tobacco products.

Dermal exposure

- Not applicable

Ocular exposure^(a)

- Remove patient from exposure.
- Remove contact lenses if present and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes.
- Patients with corneal damage or those whose symptoms do not resolve rapidly should be referred for urgent ophthalmological assessment.

Inhalation^(a)

- Remove patient from exposure.
- Ensure a clear airway and ensure adequate ventilation.
- Give humidified oxygen.
- Monitor pulse, blood pressure, oxygen saturation, respiratory rate and cardiac rhythm.
- Apply other supportive measures as indicated by the patient's clinical condition.

Ingestion

- Not applicable

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Arsine – features and management, 2003.