



UK Health  
Security  
Agency

# Arsine and stibine

## Incident management

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## Main points

### General

Arsine and stibine are both colourless gases at room temperature. Arsine has a garlic-like or fishy odour, whereas stibine has an unpleasant odour similar to that of rotten eggs (hydrogen sulphide).

Both of these compounds are extremely flammable.

They both react with strong oxidants; stibine reacts with chlorine, nitric acid and ozone.

Arsine decomposes on heating, in light, and with moisture producing toxic 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

The health effects of arsine and stibine are similar and both are toxic by inhalation.

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 fever, anaemia, jaundice, enlargement of the liver, hyperkalaemia, prolongation of the prothrombin time and pulmonary oedema may develop.

### Casualty decontamination at the scene

Decontamination should not be necessary following exposure to arsine and stibine as they exist as relatively unreactive gases at room temperature. These gases may be stored as liquid under pressure in cylinders for industrial use; this liquid will rapidly volatilise on release, though it may cause thermal burns on contact with skin.

## Environment

Hazardous to the aquatic environment.

Inform the [Environment Agency](#) where appropriate and avoid release into the environment.

## Hazard identification

**Table 1a. Standard (UK) dangerous goods emergency action codes for arsine**

<b>UN</b>		2188	Arsine	
<b>EAC</b>		2PE [note 1]	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 2]. Substance can be violently or explosively reactive. Where there is an immediate threat to people, spillages and decontamination run-off may be washed to drains with large quantities of water [note 3]. There may be a public safety hazard outside the immediate area of the incident [note 4]	
<b>APP</b>		A(cf)	Fire kit with gas-tight chemical protective clothing with breathing apparatus [note 5]. Fire kit intended to protect against liquid flammable gas with a boiling point below -20°C	
<b>Hazards</b>	<b>Class</b>	2.3	Toxic gas	
	<b>Sub-risks</b>	2.1	Flammable gases	
<b>HIN</b>		-	-	

### Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

### Note to Table 1a

[note 1] Not applicable to the carriage of dangerous goods under the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) or the Agreement Concerning the International Carriage Dangerous Goods by Road (ADR).

[note 2] Chemical protective clothing with liquid tight connections for whole body (Type 3) conforming to the relevant standards such as BS 8428 or EN 14605 in combination with breathing apparatus conforming to BS EN 137.

[note 3] In such cases due care must be exercised to avoid unnecessary pollution of surface and groundwaters and wherever possible control measures such as the sealing of drains should be employed.

[note 4] People should be warned to stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be eliminated and ventilation stopped. Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250m away from the incident.

[note 5] Normal fire kit in combination with gas-tight chemical protective clothing conforming to BS EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137. Suitable thermal resistant gloves should be worn, such as those conforming to BS EN511 or BS EN407.

### Reference

[The Dangerous Goods Emergency Action Code List 2023](#). National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. The Stationery Office (2023)

**Table 1b. Standard (UK) dangerous goods emergency action codes for stibine**

<b>UN</b>		2676	Stibine	
<b>EAC</b>		2PE [note 1]	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 2]. Substance can be violently or explosively reactive. Where there is an immediate threat to people, spillages and decontamination run-off may be washed to drains with large quantities of water [note 3]. There may be a public safety hazard outside the immediate area of the incident [note 4]	
<b>APP</b>		A(fg)	Fire kit with gas-tight chemical protective suit with breathing apparatus [note 5]. Fire kit intended to protect against flammable gas	
<b>Hazards</b>	<b>Class</b>	2.3	Toxic Gas	
	<b>Sub-risks</b>	2.1	Flammable gases	
<b>HIN</b>		-	-	

### Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

### Note to Table 1b

[note 1] Not applicable to the carriage of dangerous goods under the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) or the Agreement Concerning the International Carriage Dangerous Goods by Road (ADR).

[note 2] Chemical protective clothing with liquid tight connections for whole body (Type 3) conforming to the relevant standards such as BS 8428 or EN 14605 in combination with breathing apparatus conforming to BS EN 137.

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### Reference

[‘Dangerous Goods Emergency Action Code List’](#). National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. The Stationery Office (2023)

**Table 2a. The GB classification, labelling and packaging (CLP) regulation for arsine**

<b>Hazard class and category</b>	Flam. Gas 1	Flammable gas, category 1	
	Press. Gas 1	Gases under pressure	
	Acute Tox. 2	Acute toxicity (inhalation), category 2	
	STOT RE 2	Specific Target Organ Toxicity (repeated exposure), category 2	
	Aquatic Acute 1	Hazardous to the aquatic environment – acute hazard, category 1	
	Aquatic Chronic 1	Hazardous to the aquatic environment – chronic hazard category 1	
<b>Hazard statement</b>	H220	Extremely flammable gas	
	H330	Fatal if inhaled	
	H373	May cause damage to organs through prolonged or repeated exposure	
	H400	Very toxic to aquatic life	
	H410	Very toxic to aquatic life with long lasting effects	
<b>Signal words</b>	DANGER		

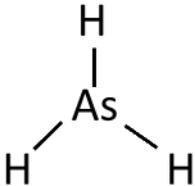
**There is no harmonised classification for stibine**

**Reference**

The Health and Safety Executive (HSE). '[GB CLP Regulation](#)' (viewed January 2024)

## Physicochemical properties

Table 3a. Physicochemical properties Arsine

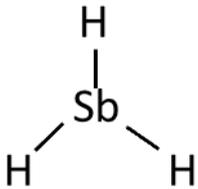
<b>CAS number</b>	7784-42-1
<b>Molecular weight</b>	77.946
<b>Formula</b>	AsH <sub>3</sub>
<b>Common synonyms</b>	Arsenic hydride, Arsenic trihydride, Hydrogen arsenide
<b>State at room temperature</b>	Gas
<b>Volatility</b>	Vapour pressure = 11,000mmHg at 20°C
<b>Specific gravity</b>	2.66 (air = 1)
<b>Flammability</b>	Extremely flammable
<b>Lower explosive limit</b>	4.5%
<b>Upper explosive limit</b>	78.0%
<b>Water solubility</b>	Low solubility in water, 280mg/L at 20°C
<b>Reactivity</b>	<p>Arsine reacts with strong oxidants, causing risk of explosion. May explosively decompose upon shock, friction or concussion.</p> <p>Decomposes on heating and in the presence of light and moisture, producing toxic fumes of arsenic.</p>
<b>Odour</b>	Garlic
<b>Structure</b>	

### References

International Programme on Chemical Safety. '[International chemical safety card entry for a arsine](#)' ICSC 0222, 2018. World Health Organization (WHO) Geneva (Viewed January 2024)

PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. '[PubChem Compound Summary for CID 23969, Arsine](#)' (Viewed January 2024)

**Table 3b. Physiochemical properties stibine**

<b>CAS number</b>	7803-52-3
<b>Molecular weight</b>	125
<b>Formula</b>	SbH <sub>3</sub>
<b>Common synonyms</b>	Antimony hydride, Antimony trihydride, Hydrogen antimonide
<b>State at room temperature</b>	Gas
<b>Volatility</b>	Vapour pressure > 760mm Hg at 20°C
<b>Specific gravity</b>	4.4 (air = 1)
<b>Flammability</b>	Extremely flammable
<b>Lower explosive limit</b>	Limits not known
<b>Upper explosive limit</b>	Limits not known
<b>Water solubility</b>	Poor
<b>Reactivity</b>	<p>Stibine reacts violently with chlorine, concentrated nitric acid and ozone causing risk of fire and explosion.</p> <p>Decomposes slowly at room temperature but quickly when heated to 200°C, to form metallic antimony and hydrogen gas.</p>
<b>Odour</b>	Resembles rotten eggs (hydrogen sulphide)
<b>Structure</b>	

### References

PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. [PubChem Compound Summary for CID 9359, Stibine](#) (Viewed January 2024)

International Programme on Chemical Safety. [‘International chemical safety card entry for stibine’ ICSC 0776.](#) World Health Organization (WHO) Geneva (Viewed January 2024)

## Reported effect levels from authoritative sources

**Table 4a. Exposure by inhalation of arsine**

ppm	mg/m <sup>3</sup>	Signs and symptoms	Reference
25-50	81-162	Lethal (~30 minute exposure)	a
250	810	Instantly lethal	a

These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values.

### Reference

a. International Programme on Chemical Safety. [Poisons Information Monograph 044, Arsine](#) (Viewed January 2024)

**Table 4b. Exposure by inhalation of stibine**

ppm	mg/m <sup>3</sup>	Signs and symptoms	Reference
No human exposure data was found for the exposure to stibine			

## Published emergency response guidelines

**Table 5a. Acute exposure guideline levels (AEGLs) for arsine**

	Concentration (ppm)				
	10 minutes	30 minutes	60 minutes	4 hours	8 hours
<b>AEGL-1</b> [note 1]	NR	NR	NR	NR	NR
<b>AEGL-2</b> [note 2]	0.30	0.21	0.17	0.04	0.02
<b>AEGL-3</b> [note 3]	0.91	0.63	0.50	0.13	0.06

**Table 5b. Acute exposure guideline levels (AEGLs) for stibine**

	Concentration (ppm)				
	10 minutes	30 minutes	60 minutes	4 hours	8 hours
<b>AEGL-1</b> [note 1]	NR	NR	NR	NR	NR
<b>AEGL-2</b> [note 2]	4.2	2.9	1.5	0.36	0.18
<b>AEGL-3</b> [note 3]	28	19	9.6	2.4	1.2

### Notes to Tables 5a & 5b

[note 1] Level of the chemical in air at or above which the general population could experience notable discomfort.

[note 2] 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.

[note 3] Level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

NR = Not recommended

### References

US Environmental Protection Agency. '[Acute Exposure Guideline Levels](#)' (viewed January 2024)

## Exposure standards, guidelines or regulations

**Table 6. Occupational standards**

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
<b>Arsine</b>	0.05	0.16	No guideline specified	
<b>Stibine</b>	No guideline specified		No guideline specified	

### Abbreviations

WEL = workplace exposure limit.

LTEL = long-term exposure limit.

STEL = short-term exposure limit.

### Reference

HSE. '[EH40/2005 Workplace Exposure Limits](#). Fourth Edition' (2020)

**Table 7a. Public health standards and guidelines for arsine**

<b>UK drinking water standard</b>	No guideline value specified
<b>WHO guideline for drinking water quality</b>	No guideline value specified
<b>WHO air quality guideline</b>	No guideline value specified

**Table 7b. Public health standards and guidelines for stibine**

<b>UK drinking water standard</b>	No guideline value specified
<b>WHO guideline for drinking water quality</b>	No guideline value specified
<b>WHO air quality guideline</b>	No guideline value specified

## Health effects

Arsine is extremely toxic via inhalation, even at concentrations below the odour threshold. The toxic effects of stibine are expected to be similar to arsine.

**Table 8. Signs or symptoms of acute exposure**

Route	Signs and symptoms
<b>Inhalation</b>	<p>The onset of features is often delayed for several hours. Features include headache, malaise, thirst, dizziness, shivering and breathlessness followed by nausea and vomiting, abdominal pain, paraesthesiae/dysaesthesiae and severe haemolysis. Weakness with muscle cramps and occasionally hypotension may occur.</p> <p>Painless dark red urine (due to the presence of haemoglobin) generally develops within 4 to 6 hours of exposure. Bronze/orange discolouration of the skin and orange-red staining of the conjunctiva and sclera may occur as a result of haemolysis and is probably due to the presence of circulating degradation products of haemoglobin in plasma.</p> <p>After 24 to 48 hours, fever, anaemia, jaundice, enlargement of the liver, hyperkalaemia, prolongation of the prothrombin time (INR) and pulmonary oedema may ensue.</p> <p>Investigations may show peaked T-wave on ECG most probably secondary to hyperkalaemia, leucocytosis and reticulocytosis.</p> <p>Hyperbilirubinaemia, an increase in serum LDH concentration and a reduced haptoglobin concentration are present in patients with significant haemolysis.</p> <p>Acute hepatic and renal failure may occur.</p> <p>Mild methaemoglobinaemia is recognised but is unlikely to be clinically significant.</p> <p>Urine and blood arsenic concentrations will be elevated.</p> <p>Peripheral neuropathy with weakness, myalgia and paraesthesiae may be delayed and persistent. Horizontal white lines on the nails (Mees' lines) may appear.</p>
<b>Dermal</b>	Superficial cutaneous desquamation of exposed skin has occurred.

Route	Signs and symptoms
Ocular	Potential irritant which can cause lacrimation. Orange-red staining of the sclerae occurs when haemolysis is present.

#### Reference

[TOXBASE](#). Arsine. February 2022 (viewed January 2024)

## Decontamination at the scene

### Chemical specific advice

The approach used for decontamination at the scene will depend upon the incident, location of the casualties and the chemicals involved. Therefore, a risk assessment should be conducted to decide on the most appropriate method of decontamination.

Decontamination should not be necessary following exposure to arsine and stibine as they exist as relatively unreactive gases at room temperature. These gases may be stored as liquid under pressure in cylinders for industrial use; this liquid will rapidly volatilise on release, though it may cause thermal burns on contact with skin.

Emergency services and public health professionals can obtain further advice from the UK Health Security Agency (UKHSA) Radiation, Chemicals and Environment Directorate using the 24-hour chemical hotline number: 0344 892 0555.

## Clinical decontamination and first aid

Clinical decontamination is the process where trained healthcare professionals, using purpose-designed decontamination equipment, treat contaminated persons individually.

[Detailed information on clinical management](#) can be found on TOXBASE.

### Important notes

Once body surface contaminants have been removed or if your patient was exposed by ingestion or inhalation, the risk that secondary care givers may become contaminated is very low. Secondary carers should wear standard hospital PPE as a precaution against secondary contamination from vomit and body fluids.

If the patient has not been decontaminated following surface contamination, secondary carers must wear appropriate NHS PPE for chemical exposure to avoid contaminating themselves.

The area should be well ventilated.

For comprehensive clinical advice consult [TOXBASE](#) directly.

### Clinical decontamination following surface contamination

Carry out decontamination after resuscitation.

This should be performed in a well-ventilated area, preferably with its own ventilation system.

Avoid contaminating yourself with this product and wash any exposed area.

Contaminated clothing should be removed, double-bagged, sealed and stored safely.

Decontaminate open wounds first and avoid contamination of unexposed skin.

Any particulate matter adherent to skin should be removed and the patient washed with soap and copious amounts of water under low pressure for at least 10 to 15 minutes.

Pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears.

The earlier irrigation begins, the greater the benefit.

## Dermal exposure

If required decontaminate the patient (as above) following surface contamination.

Other measures as indicated by the patient's clinical condition.

Patients should be advised on discharge to seek medical attention if symptoms subsequently develop.

## Ocular exposure

Remove contact lenses if present.

Anaesthetise the eye with a topical local anaesthetic (for example, oxybuprocaine, amethocaine or similar). However, do not delay irrigation if local anaesthetic is not immediately available.

Immediately irrigate the affected eye thoroughly with 1,000mL 0.9% saline or equivalent crystalloid (for example, by an infusion bag with a giving set) for a minimum of 10 to 15 minutes irrespective of initial conjunctival pH. A Morgan Lens may be used if anaesthetic has been given.

Aim for a final conjunctival pH of 7.5 to 8.0. The conjunctivae may be tested with indicator paper. Retest 20 minutes after irrigation and use further irrigation if necessary.

Any particles lodged in the conjunctival recesses should be removed.

Repeated instillation of local anaesthetics may reduce discomfort and help more thorough decontamination. However, prolonged use of concentrated local anaesthetics is damaging to the cornea.

Patients with corneal damage, those who have been exposed to strong acids or alkalis and those whose symptoms do not resolve rapidly should be discussed urgently with an ophthalmologist.

Other supportive measures as indicated by the patient's clinical condition.

## Inhalation

Maintain a clear airway and ensure adequate ventilation.

If appropriate, remove from exposure and give oxygen.

Monitor vital signs and cardiac rhythm; check the capillary blood glucose.

Check and record pupil size.

Perform a 12-lead ECG in all patients who require assessment.

Other supportive measures as indicated by the patient's clinical condition.

## Clinical decontamination and first aid references

- [TOXBASE](#) (viewed January 2024)
- TOXBASE: Arsine - features and management (2022)
- TOXBASE: Chemicals splashed or sprayed into eyes – features and management (2020)
- TOXBASE: Skin decontamination – irritants (2019)

## About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation health secure.

[UKHSA](#) is an executive agency, sponsored by the [Department of Health and Social Care](#).

This document from the UKHSA Radiation, Chemicals and Environment Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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