UK Health Security Agency

Methyl bromide

Incident management

This document provides information needed for response to a chemical incident, such as physicochemical properties, health effects and decontamination advice.

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Contents

Main points

General

Methyl bromide is a clear colourless gas. It is odourless but at high concentrations, emits a sweetish, chloroform-like odour. It is non-flammable in air except in presence of high heat source and strong oxidisers.

When heated to decomposition, methyl bromide emits toxic fumes of hydrogen bromide, bromine, carbon oxybromide, carbon dioxide and carbon monoxide.

Methyl bromide reacts with aluminium, magnesium and zinc to form pyrophoric compounds, causing a fire and explosion hazard.

Health

Methyl bromide is readily absorbed through the lungs and skin and is highly toxic via inhalation.

Inhalation causes irritation of eyes and mucous membranes, coughing, nausea, vomiting and abdominal pain. CNS features such as headache, confusion, hallucinations, drowsiness and altered vision may occur, and may be delayed in onset. In severe cases coma can occur.

Dermal exposure to high concentrations of vapour can cause redness and blistering. CNS effects have been reported following skin exposure. Splashes of liquid methyl bromide on the skin may cause pruritus, erythema and paraesthesia.

Ocular exposure causes severe irritation, conjunctivitis and corneal burns.

Casualty decontamination at the scene

Following disrobe, improvised wet decontamination should be considered for an incident involving methyl bromide, as it is a vesicant and may cause severe burns.

Environment

Inform the Environment Agency where appropriate and avoid release into the environment.

Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.

Hazard identification

Table 1. Standard (UK) dangerous goods emergency action codes for methyl bromide with not more than 2% chloropicrin

UN		1062	Methyl bromide, with not more than 2% chloropicrin	
EAC		2XE	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters. There may be a public safety hazard outside the immediate area of the incident [note 2].	
APP		B	Gas tight chemical protective clothing with breathing apparatus [note 3]	
Hazards	**Class**	2.3	Toxic gases	
	Sub-risks	–	–	
HIN		26	Toxic gas	

Abbreviations

UN = United Nations number.
EAC = emergency action code.
APP = additional personal protection.
HIN = hazard identification number.

Notes to Table 1

Note 1: 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 2: 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 250 m away from the incident.

Note 3: Chemical protective clothing should be gas-tight conforming to BS EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List'. 2023 (viewed on 28 November 2024)

Table 2. The GB classification, labelling and packaging (CLP) regulation for methyl bromide

Hazard class and category	Press. Gas	Pressurised gas	
	Muta. 2	Germ cell mutagenicity, category 2	
	Acute Tox. 3	Acute toxicity (oral/inhalation), category 3	
	STOT RE 2	Specific target organ toxicity following repeated exposure, category 2	
	Eye Irrit. 2	Eye irritation, category 2A	
	STOT SE 3	Specific target organ toxicity following single exposure, category 3	

	Skin Irrit. 2	Skin irritation, category 2	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	
	Ozone 1	Hazardous to the ozone layer, category 1	
Hazard statement	H341	Suspected of causing genetic defects	
	H331	Toxic if inhaled	
	H301	Toxic if swallowed	
	H373	May cause damage to organs through prolonged or repeated exposure	
	H319	Causes serious eye irritation	
	H335	May cause respiratory irritation	
	H315	Causes skin irritation	
	H400	Very toxic to aquatic life	
	H420	Harms public health and the environment by destroying ozone in the upper atmosphere	
Signal words	DANGER		

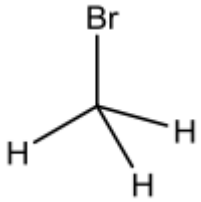
References

The Health and Safety Executive (HSE). ‘GB CLP Regulation’ (viewed on 28 November 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	74-83-9
Molecular weight	94.94
Formula	CH_3Br
Common synonyms	Bromomethane, monobromomethane, embafume, terabol
State at room temperature	Clear colourless gas
Volatility	Vapour pressure = 1620 mmHg at 25°C
Specific gravity	1.7 (water = 1, liquid 0°C) 3.3 (air = 1)
Flammability	Non-flammable in air except in presence of high heat source and strong oxidisers
Lower explosive limit	10%
Upper explosive limit	16%
Water solubility	Slightly soluble in water
Reactivity	Attacks various metals in the presence of water. Reacts with dimethyl sulphoxide, ethylene oxide, and strong oxidisers. Can give flammable products if mixed with potassium hydroxide, sodium hydroxide and other strong bases.
Reaction or degradation products	Reacts slowly with water to give methyl alcohol and hydrobromic acid. When heated to decomposition emits toxic fumes of hydrogen bromide, bromine, carbon oxybromide, carbon dioxide and carbon monoxide. Reacts with aluminium, magnesium and zinc to form pyrophoric compounds, causing a fire and explosion hazard.
Odour	Odourless, but at high concentrations sweetish, chloroform-like odour

Structure	

References

World Health Organization. International Programme on Chemical Safety ‘International Chemical Safety Card entry for Methyl Bromide’ ICSC 0109, 2009 (viewed on 4 December 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. ‘PubChem Compound Summary for CID 6323, Bromomethane’ (viewed on 4 December 2024)

Reported effect levels from authoritative sources

Table 4. Dermal exposure to vapours

g/m^3	Duration (minutes)	Signs and symptoms	Reference
~40	40	Vapour can cause redness and blistering of the skin despite wearing PPE	a

Table 5. Exposure by inhalation

ppm	mg/m^3	Signs and symptoms	Reference
10-500	390-1,950	Non-fatal poisoning	b
>500	>1,950	Eye and throat irritation	c
≥8,600	≥33,000	Potentially fatal	b

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

References

a. National Poisons Information Service (NPIS). TOXBASE 'methyl bromide' 2020 (viewed on 4 December 2024)

b. World Health Organisation. International Programme on Chemical Safety. 'Environmental Health Criteria methyl bromide' EHC 166, 1995. (viewed on 4 December 2024)

c. Agency for Toxic Substances and Disease Registry (ATSDR). 'Medical Management Guidelines for methyl bromide (bromomethane)' 2020 (viewed on 4 December 2024)

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	NR	NR	NR	NR	NR
AEGL-2 [note 2]	940	380	210	67	67
AEGL-3 [note 3]	3300	1300	740	230	130

Notes to Table 6

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 reported due to insufficient data

Reference

US Environmental Protection Agency (EPA). ‘Acute Exposure Guideline Levels’ (viewed on 4 December 2024)

Exposure standards, guidelines or regulations

Table 7. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	**mg/m³**	**ppm**	**mg/m³**
WEL	5	20	15	59

Abbreviations

WEL = workplace exposure limit.
LTEL = long-term exposure limit.
STEL = short-term exposure limit.

Reference

Health and Safety Executive (HSE). 'EH40/2005 Workplace Exposure Limits Fourth Edition' 2020 (viewed on 4 December 2024)

Table 8. Public health standards and guidelines

Drinking water standard	No value specified
WHO guideline for drinking water quality	No value specified
UK indoor air quality guideline	No value specified
WHO indoor air quality guideline	No value specified
WHO air quality guideline	No value specified

Health effects

Highly toxic by inhalation. Extremely irritating to the skin, eyes, mucous membranes and respiratory tract. Absorption occurs readily through the lungs and also through the skin. At low concentrations, methyl bromide may not be detectable by odour but may still be present in sufficient concentrations to cause toxic effects.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation/ Systemic	May cause irritation of the eyes and mucous membranes, coughing, nausea, vomiting and abdominal pain. Onset of local effects is rapid after exposure to high concentrations. Death usually occurs from respiratory or cardiovascular collapse. Exposure to low concentrations may cause only CNS features, which may be delayed in onset, occurring up to 48 hours after exposure. GI upset may progress to gastric haemorrhage. **Cardiovascular** features include hypotension, tachypnoea, metabolic acidosis and cyanosis. Cardiovascular shock and ventricular fibrillation have occurred in severe cases. **Respiratory** features include respiratory tract irritation, cough, chest tightness and burning sensation of the nose and oropharynx. Tachypnoea and cyanosis may develop. Features may progress to respiratory depression and pulmonary oedema, which may be delayed up to 4 to 5 days post-exposure. **Neurological** features include headache, fatigue, delirium, agitation, hallucinations, memory loss, confusion, tremor, hyperreflexia, hyperthermia, ataxia, nystagmus, paraesthesia, dizziness, slurred/incoherent speech, lethargy, drowsiness, convulsions, intracranial haemorrhage and coma. Convulsions and myoclonus may cause rhabdomyolysis. Extrapyramidal symptoms and organic brain syndrome have been reported as sequelae. Hepatic and renal injury may occur, with hepatomegaly, jaundice and hepatic necrosis in severe toxicity.

Route	Signs and symptoms
Eyes	May cause severe irritation, conjunctivitis and corneal burns. Vapour exposure may result in altered vision (painful eyes, blurred or double vision and difficulty focussing) and temporary blindness.
Dermal	Severe burns may occur. Exposure to high concentrations of the vapour can lead to redness and blistering of the skin. Skin lesions may be delayed and show a preference for relatively moist areas. Peripheral neuropathy and CNS toxicity have been reported after skin exposure. Methyl bromide is a vesicant. Splashes of liquid methyl bromide may cause pruritus, erythema and paraesthesia. Repeated exposure to small amounts causes dermatitis. Tight-fitting clothing may trap gas close to the skin.

Reference

National Poisons Information Service (NPIS). TOXBASE ‘methyl bromide’ 2020 (viewed on 4 December 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.

Methyl bromide (liquid or gas) is a vesicant and may cause severe burns. Therefore, following disrobe, improvised wet decontamination should be considered (see below for details).

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

Disrobe

The disrobe process is highly effective at reducing exposure to HAZMAT/CBRN material when performed within 15 minutes of exposure.

Therefore, disrobe must be considered the primary action following evacuation from a contaminated area.

Where possible, disrobing should be conducted at the scene and by the casualty themselves. Disrobing should be systematic to prevent transfer of contaminant from clothing to skin. Clothing should not be pulled over the head if possible.

Clothing stuck to the casualty by the contaminant should not be forcefully removed, as this risks causing further harm.

Consideration should be given to ensuring the welfare and dignity of casualties as far as possible. Immediately after decontamination the opportunity should be provided to dry and dress in clean robes or clothes.

Improvised decontamination

Improvised decontamination is an immediate method of decontamination prior to the use of specialised resources. This should be performed on all contaminated casualties unless medical advice is received to the contrary. Improvised dry decontamination should be considered for an incident involving chemicals unless the agent appears to be corrosive or caustic.

Unprotected first responders and members of the public should not approach casualties incapacitated by exposure to administer improvised decontamination, as they may be exposed to contaminants and become a casualty themselves.

Important note: Improvised decontamination should continue until more structured intervention, such as an Interim Operational Response is conducted, or Specialist Operational Response are present.

Improvised dry decontamination

Any available dry absorbent material can be used such as kitchen towel, paper tissues (for example blue roll) and clean cloth.

Exposed skin surfaces should be blotted first and then rubbed, starting with the face, head, and neck, and moving down and away from the body.

Blotting and rubbing should not be too aggressive, as it could drive contamination further into the skin.

Casualties should also blow their nose to remove contaminants from the nasal cavities.

All waste material arising from decontamination should be left in situ, and ideally bagged, for disposal at a later stage.

Improvised wet decontamination

Water decontamination should be used if contamination with a caustic chemical substance is suspected.

Wet decontamination may be performed using copious amounts of water from any available source such as taps, showers, water bottles, fixed installation hose-reels and sprinklers to gently rinse the affected skin. Other natural sources of water may be considered unless this creates greater risks to the individuals affected. Wet wipes or baby wipes may be used as an effective alternative.

Improvised decontamination should not involve overly aggressive methods to remove contamination as this could further damage affected tissues and drive the contamination further into the skin.

Where appropriate, seek professional advice on how to dispose of contaminated water and prevent run-off going into the water system.

Additional notes

Following improvised decontamination, remain cautious and observe for signs and symptoms in the decontaminated person and in unprotected staff.

If water is used to decontaminate casualties this may be contaminated, and therefore hazardous, and a potential source of further contamination spread.

All materials (paper tissues and so on) used in this process may also be contaminated and, where possible, should not be used on new casualties.

The risk from hypothermia should be considered when disrobe and any form of wet decontamination is carried out.

People who are contaminated should not eat, drink or smoke before or during the decontamination process and should avoid touching their face.

When vulnerable people are affected by a hazardous substance, they may need additional support to remove themselves, their clothing or the substance.

Casualties should remain in the area and should not leave to seek care at a hospital, as this presents a contamination risk. Further care will be administered on site by the appropriate emergency services.

Interim wet decontamination

Interim decontamination is the use of standard Fire and Rescue Service equipment to provide a planned and structured decontamination process prior to the availability of purpose-designed decontamination equipment.

Decontamination at the scene references

Home Office. ‘Initial operational response to a CBRN incident’ Version 2.0 2015 (viewed on 4 December 2024)

National Health Service England. ‘Emergency Preparedness, Resilience and Response (EPRR): Guidance for the initial management of self-presenters from incidents involving hazardous materials’ 2019 (viewed on 4 December 2024)

Joint Emergency Service Interoperablility Programme. ‘Initial Operational Response (IOR) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’ 2024 (viewed on 4 December 2024)

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

Methyl bromide penetrates all types of material, including rubber and leather.

Tight-fitting clothing may trap gas close to the skin.

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.

Carry out decontamination after resuscitation; resuscitate the patient according to standard guidelines.

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.

For comprehensive clinical advice consult TOXBASE directly.

Clinical decontamination following surface contamination

Avoid contaminating yourself.

Carry out decontamination after resuscitation. This should be performed in a well-ventilated area preferably with its own ventilation system.

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 copious amounts of water under low pressure for at least 10 to 15 minutes, or until pH of skin is normal (pH of the skin is 4.5 to 6 although it may be closer to 7 in children, or after irrigation).

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

Decontaminate (as above) the patient following surface contamination.

Methyl bromide penetrates all types of material, including rubber and leather. Remove patient from exposure and carry out decontamination.

Treat as per a thermal burn.

Chemical burns totalling more than 15% of body surface area in adults (> 10% in children) will require standard fluid resuscitation as for thermal burns.

Moderate/severe chemical burns should be reviewed by a burns specialist. Excision or skin grafting may be required.

If features of systemic toxicity are present, manage as per inhalation.

Other supportive 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 neutral conjunctival pH of 7 to 7.2. The conjunctivae may be tested with indicator paper. Retest at 15 to 30 minutes after irrigation and use further irrigation if necessary.

Any particles lodges 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 so should not be prescribed for home use. Topical anaesthesia in the eye may last for up to one hour. The patient should be discouraged from rubbing the eye during this time. A temporary patch may be used to cover the eye until sensation returns.

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.

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

Inhalation and systemic toxicity

Maintain a clear airway and ensure adequate ventilation.

Administer oxygen to achieve adequate oxygenation.

In severely affected patients, especially those with tachypnoea, stridor or upper airway damage, critical care input is essential with urgent assessment of the airway. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction.

Children are at increased risk of airway obstruction and treating clinicians should have a low threshold for establishing a protected airway.

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.

Carry out other supportive measures as indicated by the patient's clinical condition.

Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE ‘methyl bromide’ 2020 (viewed on 4 December 2024)

National Poisons Information Service (NPIS). TOXBASE ‘chemicals splashed or sprayed into the eyes - features and clinical management’ 2020 (viewed on 4 December 2024)

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, Climate and Environmental Hazards Directorate reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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For queries relating to this document, please contact chemcompendium@ukhsa.gov.uk or enquiries@ukhsa.gov.uk

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