



Methyl Bromide

Incident Management

Key Points

Fire

- non-flammable
- reacts with dimethyl sulphoxide, ethylene oxide and strong oxidisers
- reacts with aluminium, magnesium and zinc, causing a fire and explosion hazard
- emits toxic fumes of hydrogen bromide, bromine, carbon dioxide and carbon monoxide when heated to decomposition
- in the event of a fire involving methyl bromide, use fine water spray and liquid-tight chemical protective clothing with breathing apparatus

Health


- 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 on the skin may cause pruritus, erythema and paraesthesia
- ocular exposure causes severe irritation, conjunctivitis and corneal burns

Environment








- hazardous to the environment; inform the Environment Agency of substantial incidents



Hazard Identification

Standard (UK) dangerous goods emergency action codes

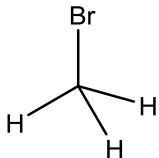
UN		1062	Methyl bromide, with not more than 2% chloropicrin	
EAC		2XE	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and surface and groundwaters. There may be a public safety hazard outside the immediate area of the incident [†]	
APP		B	Gas-tight chemical protective suit with breathing apparatus [‡]	
Hazards	Class	2.3	Toxic gases	
	Sub-risks	–	–	
HIN		26	Toxic gas	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* 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 BS EN 137</p> <p>[†] 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</p> <p>[‡] Chemical protective clothing should be gas tight conforming to BS EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137</p> <p>Reference Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA, The Stationery Office, 2015.</p>				

Classification, labelling and packaging (CLP)*

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	
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		
* Implemented in the EU on 20 January 2009			
Reference			
European Commission. Harmonised classification – Annexe VI to Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. http://echa.europa.eu/information-on-chemicals/cl-inventory-database (accessed 05/2015).			

Physicochemical Properties

CAS number	74-83-9
Molecular weight	94.95
Formula	CH ₃ Br
Common synonyms	Bromomethane, monobromomethane, embafume
State at room temperature	Clear colourless gas
Volatility	Vapour pressure = 1620 mmHg at 25°C
Specific gravity	3.355 at 25°C
Flammability	Non-flammable in air except in presence of high heat source and strong oxidisers
Lower explosive limit	10%
Upper explosive limit	15%
Water solubility	Insoluble
Reactivity	Reacts with dimethyl sulphoxide, ethylene oxide, and strong oxidisers. Attacks various metals in the presence of water
Reaction or degradation products	When heated to decomposition forms 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	<p>Hazardous Substances Data Bank [Internet]. Bethesda (MD): National Library of Medicine (US); [Last Revision Date 08/03/2013]. Methyl bromide; Hazardous Substances Databank Number: 779. Available from: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (as accessed 05/2015).</p> <p>International Programme on Chemical Safety (IPCS). International Chemical Safety Card entry for methyl bromide, ISCS 0109, 2009. World Health Organization: Geneva.</p> <p>Methyl bromide (HAZARDTEXT™ Hazard Management). In: Klasco RK (Ed): TOMES® System, Truven Healthcare Analytics Inc., Greenwood Village, Colorado, USA. (electronic version).RightAnswer.com,Inc.,Midland,MI, USA, Available at: http://www.rightanswerknowledge.com (assessed 05/2015).</p>

Reported Effect Levels from Authoritative Sources

Exposure by skin

g/m ³	duration	Signs and symptoms	Reference
~40	40 minutes	Vapour can cause redness and blistering despite wearing PPE	a
<p>These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values</p> <p>Reference</p> <p>a TOXBASE. Methyl bromine, 2012. http://www.toxbase.org (accessed 05/2015).</p>			

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
100–500	390–1,950	Non-fatal poisoning	a
>500	>1,950	Eye and throat irritation	b
>8,600	>33,000	Potentially fatal	a
<p>These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values</p> <p>References</p> <p>a International Programme on Chemical Safety. Environmental Health Criteria 166, Methyl Bromide, 1995. World Health Organization: Geneva.</p> <p>b Agency for Toxic Substances Disease Registry (ATSDR). Medical Management Guidelines for Methyl Bromide, 2014 http://www.atsdr.cdc.gov/MMG/MMG.asp?id=818&tid=160 (accessed 05/2015).</p>			

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	N/A	N/A
ERPG-2 [†]	50	194
ERPG-3 [‡]	200	776

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

N/A Not appropriate

Reference
American Industrial Hygiene Association (AIHA). 2015 Emergency Response Planning Guideline Values. <https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2014%20ERPG%20Values.pdf> (accessed 06/2015).

Acute exposure guideline levels (AEGs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	NR	NR	NR	NR	NR
AEGL-2 [†]	940	380	210	67	67
AEGL-3 [‡]	3,300	1,300	740	230	130

* Level of the chemical in air at or above which the general population could experience notable discomfort

[†] 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

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

NR Not recommended due to insufficient data

Reference
US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 05/2015).

Exposure Standards, Guidelines or Regulations

Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m ³	ppm	mg/m ³
WEL	5	20	15	59

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 (second edition, published 2011).

Public health guidelines

Drinking water standard	No guideline value specified
Air quality guideline	No guideline value specified
Soil guideline values and health criteria values	No guideline value specified

Health Effects

Major route of exposure

- absorption readily occurs through the lungs and skin

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation/ Systemic	<p>May cause irritation of the eyes and mucous membranes, coughing, nausea, vomiting and abdominal pain. Exposure to low concentrations may cause only CNS features, which may be delayed in onset, occurring up to 48 hours after exposure</p> <p>Gastrointestinal features include anorexia, nausea, vomiting, abdominal pain, diarrhoea and gastric haemorrhage</p> <p>Cardiovascular features include hypotension, tachypnoea, metabolic acidosis and cyanosis. Cardiovascular shock and ventricular fibrillation have occurred in severe cases</p> <p>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 4-5 days post-exposure</p> <p>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</p> <p>Extrapyramidal symptoms and organic brain syndrome have been reported as sequelae</p> <p>Hepatic and renal injury may occur, with hepatomegaly, jaundice and hepatic necrosis in severe toxicity</p>
Dermal	<p>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</p> <p>Peripheral neuropathy and CNS toxicity have been reported after skin exposure</p> <p>Methyl bromide is a vesicant. Splashes of liquid methyl bromide may cause pruritis, erythema and paraesthesia. Repeated exposure to small amounts causes dermatitis. Tight-fitting clothing may trap gas close to the skin.</p>
Ocular	<p>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</p>
References	
TOXBASE. Methyl bromide, 12/2015. http://www.toxbase.org (accessed 11/2016).	

Decontamination at the Scene

Summary

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 Public Health England (Centre for Radiation, Chemical and Environmental Hazards) 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, disrobe at the scene should be conducted by the casualty themselves and should be systematic to avoid transferring any contamination from clothing to the skin. Consideration should be given to ensuring the welfare and dignity of casualties as far as possible.

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**.

Improvised dry decontamination

- any available dry absorbent material can be used such as kitchen towel, paper tissues (eg blue roll) and clean cloth
- exposed skin surfaces should be blotted and rubbed, starting with the face, head and neck and moving down and away from the body
- rubbing and blotting should not be too aggressive, or it could drive contamination further into the skin

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

Improvised wet decontamination

- water should only be used for decontamination where casualty signs and symptoms are consistent with exposure to caustic or corrosive substances such as acids or alkalis
- wet decontamination may be performed using any available source of water such as taps, showers, fixed installation hose-reels and sprinklers
- when using water, it is important to try and limit the duration of decontamination to between 45 and 90 seconds and, ideally, to use a washing aid such as cloth or sponge
- improvised decontamination should not involve overly aggressive methods to remove contamination as this could 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 etc) 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
- 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/clothes
- people who are processed through improvised decontamination should subsequently be moved to a safe location, triaged and subject to health and scientific advice. Based on the outcome of the assessment, they may require further decontamination

Interim wet decontamination

Interim decontamination is the use of standard fire and rescue service (FRS) equipment to provide a planned and structured decontamination process prior to the availability of purpose-designed decontamination equipment.

Decontamination at the scene references

National Ambulance Resilience Unit. Joint Emergency Services Interoperability Programme (JESIP). Initial operational response to a CBRN incident. Version 1.0, September 2013.

NHS England. Emergency Preparedness, Resilience and Response (EPRR). Chemical incidents: planning for the management of self-presenting patients in healthcare settings. April 2015.

Clinical Decontamination and First Aid

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

Detailed information on clinical management can be found on TOXBASE – www.toxbase.org.

Important notes

- tight-fitting clothing may trap gas close to the skin
- methyl bromide penetrates all types of material, including rubber and leather
- 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

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
- 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 copious amounts of water under low pressure for at least 10–15 minutes. **The earlier irrigation begins, the greater the benefit**
- pay special attention to mucous membranes, moist areas such as skin folds, fingernails and ears

Dermal exposure

- 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
- burns totalling more than 15% of body surface area in adults (more than 10% in children) will require standard fluid resuscitation as for thermal burns
- moderate/severe chemical burns should be reviewed by a burns specialist
- if features of systemic toxicity are present, manage as per inhalation
- other supportive measures as indicated by the patient's clinical condition

Ocular exposure

- remove contact lenses if present
- anaesthetise the eye with a topical local anaesthetic (eg oxybuprocaine, amethocaine or similar); **however, do not delay irrigation if local anaesthetic is not immediately available**
- immediately irrigate the affected eye thoroughly with 1,000 mL 0.9% saline (eg by an infusion bag with a giving set). A Morgan Lens may be used if anaesthetic has been given. Irrigate for 10–15 minutes irrespective of initial conjunctival pH. Aim for a final conjunctival pH of 7.5–8.0. The conjunctivae may be tested with indicator paper. Retest 20 minutes after irrigation and use further irrigation if necessary
- 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 referred urgently to an ophthalmologist**
- other supportive measures as indicated by the patient's clinical condition

Inhalation

- maintain a clear airway and ensure adequate ventilation
- give high flow oxygen to symptomatic patients
- monitor vital signs, cardiac rhythm and measure blood sugar (BM)
- perform 12 lead ECG
- other supportive measures as indicated by the patient's clinical condition

Ingestion

- not applicable

Clinical decontamination and first aid references

TOXBASE. <http://www.toxbase.org> (accessed 11/2016)

TOXBASE. Methyl bromide, 12/ 2015

TOXBASE. Chemicals splashed or sprayed into the eyes, 02/2014

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