



Methanol

Incident Management

Key Points

General

- liquid at room temperature, miscible in water
- alcoholic odour
- flammable, methanol forms an explosive mixture with air
- reacts violently with strong oxidants, acids and reducing agents
- emits acrid smoke and irritating fumes when heated to decomposition

Health effects

- toxic by ingestion, inhalation and following skin absorption, and systemic effects may occur
- absorption of methanol is rapid, but the onset of metabolic toxic features may be delayed for several hours
- ataxia, drowsiness, dysarthria and nystagmus may occur within 30 minutes of ingestion
- headache, confusion and vertigo occur with mild to moderate toxicity; convulsions and coma are seen in severe toxicity
- blurred vision, "snow field" effect and photophobia are common visual features
- may be directly irritating to the eyes, causing an immediate stinging and burning sensation with lacrimation

Casualty decontamination at the scene



- following disrobe, improvised dry decontamination should be considered for an incident involving methanol, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances

Environment




- hazardous to the environment; inform the Environment Agency where appropriate
- spillages and decontamination run-off should be prevented from entering watercourses

Hazard Identification

Standard (UK) dangerous goods emergency action codes

UN		1230	Methanol	
EAC		2WE	Use alcohol-resistant foam but, if not available, 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 watercourses. Substance can be violently or explosively reactive. There may be a public safety hazard outside the immediate area of the incident†	
APP		A(fl)	Gas-tight chemical protective suit with breathing apparatus‡ Flammable liquid	
Hazards	Class	3	Flammable liquid	
	Sub-risks	6.1	Toxic substance	
HIN		336	Highly flammable liquid, toxic	
<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>‡ Normal fire kit in combination with gas-tight chemical protective clothing conforming to BS EN 943 part 2</p> <p>Reference Dangerous Goods Emergency Action Code List. National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2019.</p>				

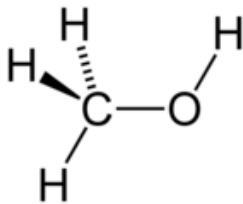
Classification, labelling and packaging (CLP)*

Hazard class and category	Flam. Liq. 2	Flammable liquid, category 2	
	Acute Tox. 3	Acute toxicity (oral, dermal, inhalation), category 3	
	STOT SE 1	Specific target organ toxicity following single exposure, category 1	
Hazard statement	H225	Highly flammable liquid and vapour	
	H301	Toxic if swallowed	
	H311	Toxic in contact with skin	
	H331	Toxic if inhaled	
	H370	Causes damage to organs	
Signal words	DANGER		
* Implemented in the EU on 20 January 2009			
Reference			
European Commission. Harmonised classification – Annex VI of 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 03/2019).			

Specific concentration limits

Concentration	Hazard class and category	Hazard statement	
$C \geq 10\%$	STOT SE 1	H370	Causes damage to organs
$3\% \leq C < 10\%$	STOT SE 2	H371	May cause damage to organs
* Implemented in the EU on 20 January 2009			
Reference			
European Commission. Harmonised classification – Annex VI of 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 03/2019).			

Physicochemical Properties

CAS number	67-56-1
Molecular weight	32
Formula	CH ₃ OH
Common synonyms	Methyl alcohol, wood alcohol, carbinol
State at room temperature	Liquid
Volatility	Vapour pressure = 127 mmHg at 25°C
Relative density Relative vapour density	0.79 at 20°C (water = 1) 1.1 (air = 1)
Flammability	Flammable
Lower explosive limit	6%
Upper explosive limit	50%
Water solubility	Miscible
Reactivity	The vapour mixes well with air, explosive mixtures are easily formed. Reacts violently with strong oxidants, acids and reducing agents generating fire and explosion hazard
Reaction or degradation products	When heated to decomposition, it emits acrid smoke and irritating fumes, including formaldehyde
Odour	Alcoholic odour
Structure	
References	<p>Hazardous Substances Data Bank. Methanol. HSDB No. 93 (last revision date 26/07/2018). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 03/2019).</p> <p>International Programme on Chemical Safety. International chemical safety card entry for methanol. ICSC 0057, 2018. World Health Organization: Geneva.</p>

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
> 300	> 400	Toxicity has been associated with inhalation of methanol vapours at this level	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 a International Programme on Chemical Safety. Methanol. Environmental Health Criteria 196, 1997. World Health Organization: Geneva.</p>			

Exposure by ingestion

mL (pure methanol)	Signs and symptoms	Reference
10	Has resulted in blindness	a
30	Has resulted in death	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 a TOXBASE. Methanol, 12/2016. http://www.toxbase.org (accessed 03/2019).</p>		

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	200	262
ERPG-2†	1,000	1,310
ERPG-3‡	5,000	6,552

* 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

Reference

American Industrial Hygiene Association (AIHA). 2016 Emergency Response Planning Guideline Values.

[https://www.aiha.org/get-](https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf)

[involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf](https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf) (accessed 03/2019).

Interim acute exposure guideline levels (AEGs)

	Concentration (ppm)				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	670	670	530	340	270
AEGL-2†	11,000 ⁽¹⁾	4,000	2,100	730	520
AEGL-3‡	— ⁽²⁾	14,000 ⁽¹⁾	7,200 ⁽¹⁾	2,400	1,600

* 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

Lower explosive limit (LEL) = 55,000 ppm

⁽¹⁾ = >10% LEL, ⁽²⁾ = >50% LEL

AEGL-3: 10 min = ⁽²⁾ 40,000 ppm

For values denoted as ⁽¹⁾ safety considerations against the hazard(s) of explosion(s) must be taken into account

For values denoted as ⁽²⁾ extreme safety considerations against the hazard(s) of explosion(s) must be taken into account

Level of distinct odour awareness (LOA) = 8.9 ppm

Reference

US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm>

(accessed 03/2019).

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	200	266	250	333
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, 3 rd Edition, 2018.				

Public health guidelines

Drinking water standard	No guideline value specified
Air quality guideline	No guideline value specified

Health Effects

Major route of exposure

- toxic by ingestion, inhalation and skin absorption

Important note

- absorption of methanol is rapid, but the onset of metabolic toxic features may be delayed for several hours, particularly if co-ingested with ethanol which delays methanol metabolism due to competitive inhibition

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Ingestion/ inhalation/ dermal	<p>Ataxia, drowsiness, dysarthria and nystagmus may occur within 30 minutes of ingestion, followed by a latent period of 12–24 hours before metabolic toxicity becomes apparent</p> <p>Poor prognostic features include convulsions, coma, shock, persistent acidosis, bradycardia and renal failure</p> <p>Severe, but reversible cardiac failure and ECG abnormalities have been described</p> <p>Central nervous system: headache, confusion and vertigo occur with mild to moderate toxicity. Convulsions and coma are seen in severe toxicity. Extraparamidal features may develop in patients who survive severe toxicity. This is due to necrosis in the putamen and subcortical white matter, which can often be shown by MRI scan</p> <p>Visual: common features include blurred vision, with the appearance of a "snow field", and photophobia. Optic disc and retinal oedema occur with diminished pupillary light response. The extent of these features appears to correlate with the severity of toxicity. Patients may be left with persistent visual impairment including optic atrophy, diminished visual acuity, loss of colour vision, central scotoma or blindness. Blindness is usually permanent, but in some cases a degree of recovery may occur over a period of months</p> <p>Gastrointestinal: common features include nausea, vomiting and abdominal pain. Acute pancreatitis can occur and a small, transient rise in liver transaminases may be seen</p> <p>Metabolic: a severe metabolic acidosis with an increased anion and osmolar gap is usually seen. Tachypnoea is common. Hyperglycaemia may occur. Renal failure may develop in severe cases</p>
Ocular	May be irritating to the eyes, causing an immediate stinging and burning sensation with lacrimation

Reference

TOXBASE. Methanol, 12/2016. <http://www.toxbase.org> (accessed 03/2019).

TOXBASE. Eye irritants, 01/2016. <http://www.toxbase.org> (accessed 03/2019).

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.

Following disrobe, improvised dry decontamination should be considered for an incident involving methanol, unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

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.

General advice on disrobe and decontamination

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 (e.g. 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

Home Office. Initial operational response to a CBRN incident. Version 2.0, July 2015.

NHS England. Emergency Preparedness, Resilience and Response (EPRR). Guidance for the initial management of self presenters from incidents involving hazardous materials. February 2019.

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

- there are antidotes available for the treatment of methanol poisoning. Further information is available on TOXBASE. **Early treatment with an antidote will prevent the production of toxic metabolites, severe acidosis and renal failure. Delay in commencing treatment with an antidote will result in a more severely poisoned patient**
- **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

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

Dermal exposure

- decontaminate (as above) the patient following surface contamination
- other supportive measures as indicated by the patient's clinical condition

Ocular exposure

- if symptomatic, immediately irrigate the affected eye thoroughly

- for patients at home, use lukewarm tap water, trickled into the eye or in a small cup held over the eye socket; an eye dropper is an alternative
- in hospital, 1,000 mL 0.9% saline at room temperature by an infusion bag with a giving set is appropriate, irrigate for 10–15 minutes
- refer for ophthalmological assessment if there is doubt regarding the management of corneal damage
- other supportive measures as indicated by the patient's clinical condition

Inhalation

- maintain a clear airway and ensure adequate ventilation
- if features of systemic toxicity manage as for ingestion
- other supportive measures as indicated by the patient's clinical condition

Ingestion

- maintain a clear airway and ensure adequate ventilation
- monitor vital signs and check capillary blood sugar
- ensure adequate hydration to maintain an adequate urine output
- perform a 12 lead ECG in all patients who require assessment
- other supportive measures as indicated by the patient's clinical condition

Health effects and decontamination references

TOXBASE	http://www.toxbase.org (accessed 03/2019)
TOXBASE	Methanol, 12/2016
TOXBASE	Eye irritants, 01/2016
TOXBASE	Methanol – features and management, 12/2016
TOXBASE	Skin decontamination – irritants, 01/2018

This document from the PHE Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced here.

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