



Chloroform

Incident Management

Key Points

Fire

- not combustible
- reacts violently with strong bases, strong oxidants and some metals
- emits toxic fumes of phosgene and hydrogen chloride on decomposition
- in the event of a fire involving chloroform, use fine water spray and normal fire kit with breathing apparatus

Health


- exposure may cause progressive CNS depression with initial excitement and nausea followed by ataxia, dysarthria, fatigue and dizziness
- delayed effects (up to 48 hours post exposure) may include liver and kidney damage
- inhalation causes nose and throat irritation, dry mouth and throat and shortness of breath
- ingestion causes a burning sensation of mouth and throat, nausea and vomiting
- dermal exposure causes irritation, defatting of skin and dermatitis
- ocular exposure to vapours may be irritating; direct contact with liquid causes immediate pain and conjunctivitis

Environment








- avoid release to the environment; inform the Environment Agency of substantial incidents where appropriate

Hazard Identification

Standard (UK) dangerous goods emergency action codes

UN		1888	Chloroform	
EAC		2Z	Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP		–	–	
Hazards	Class	6.1	Toxic substance	
	Sub-risks	–	–	
HIN		60	Toxic or slightly toxic substances	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Normal firefighting clothing is appropriate, ie breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, firefighters' gloves conforming to BS EN 659 and firefighters' boots conforming to home office specification A29 or A30</p> <p>Reference Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2017.</p>				

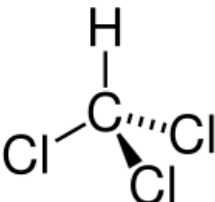
Classification, labelling and packaging (CLP)*

Hazard class and category	Acute Tox. 4	Acute toxicity (oral), Category 4	
	Skin Irrit. 2	Skin irritation, category 2	
	Eye Irrit. 2	Eye irritation, category 2	
	Acute Tox. 3	Acute toxicity (inhalation), Category 3	
	Carc. 2	Carcinogenicity, category 2	
	Repr. 2	Reproductive toxicity, category 2	
	STOT RE 1	Specific target organ toxicity – repeated exposure, category 2	
Hazard statement	H302	Harmful if swallowed	
	H315	Causes skin irritation	
	H319	Causes serious eye irritation	
	H331	Toxic if inhaled	
	H351	Suspected of causing cancer	

	H361d	Suspected of damaging the unborn child
	H372	Causes damage to organs through prolonged or repeated exposure
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 05/2017).		

Concentration	Hazard Class and Category	Hazard Statement	
C ≥ 5 %	STOT RE 2	H373	May cause damage to organs through prolonged or repeated exposure
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 05/2017).			

Physicochemical Properties

CAS number	67-66-3
Molecular weight	119
Formula	CHCl ₃
Common synonyms	Trichloromethane; Methyl trichloride.
State at room temperature	Liquid
Vapour pressure	160 mmHg
Specific gravity Vapour density	1.5 at 25°C 4.1 (air = 1)
Flammability	Not combustible
Lower explosive limit	Not applicable
Upper explosive limit	Not applicable
Water solubility	Low solubility 0.8g/100mL at 20°C
Reactivity	Reacts violently with strong bases, strong oxidants and some metals such as aluminium, magnesium and zinc – this generates and fire and explosion hazard. Attacks plastics, rubber and coatings.
Reaction or degradation products	Decomposes on contact with hot surfaces or flames producing fumes of hydrogen chloride and phosgene.
Odour	Sweet
Structure	
References	<p>Chloroform (HAZARDTEXT™ Hazard Management). In Klasco RK (Ed): TOMES® System, Truven Healthcare Analytics Inc, Greenwood Village CO, US. RightAnswer.com Inc, Midland MI, US. http://www.rightanswerknowledge.com (accessed 01/2017).</p> <p>Hazardous Substances Data Bank. Chloroform HSDB No. 56 (last revision date 05/05/2009). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 01/2017)</p> <p>International Programme on Chemical Safety. International Chemical Safety Card entry for Chloroform. ICSC 0027, 2000. World Health Organization: Geneva.</p>

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
< 50	< 249	Discomfort	a
500	2,490	Symptoms of illness	a
2,000	9,960	Severe toxic effects (60 minutes exposure)	a
4,896 – 14,892	24,000 – 73,000	Induction of anaesthesia	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 163: Chloroform, 1994.</p>			

Exposure by ingestion

g	Signs and symptoms	Reference
7.5	Serious illness	a
45	Estimated mean lethal oral dose for an adult	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. Concise Chemical International Chemical Assessment Document 58. Chloroform, 2004.</p>		

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	NA	NA
ERPG-2 [†]	50	244
ERPG-3 [‡]	5,000	24,413

* 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

NA Not appropriate

Reference
American Industrial Hygiene Association (AIHA). 2016 Emergency Response Planning Guideline Values. <https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf> (accessed 05/2017).

Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	NR	NR	NR	NR	NR
AEGL-2 [†]	120	80	64	40	29
AEGL-3 [‡]	4,000	4,000	3,200	2,000	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

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 05/2017).

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	2	9.9	No guideline value specified	
<p>WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit</p> <p>Reference Health and Safety Executive (HSE). EH40/2005 Workplace Exposure Limits, 2nd Edition, 2011.</p>				

Public health guidelines

WHO guideline for drinking water quality value	0.3 mg/L
Air quality guideline	Guideline value not given
Soil guideline values and health criteria values	Guideline value not given
<p>Reference WHO Guidelines for Drinking-Water Quality, Fourth Edition. WHO, Geneva. 2011.</p>	

Health Effects

Major route of exposure

- toxic by inhalation and ingestion and to a lesser extent by eye and skin exposure

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation causes nose and throat irritation, dry mouth and throat. Shortness of breath may also occur
Ingestion	Ingestion causes a burning sensation of mouth and throat, nausea and vomiting. Systemic toxicity may follow
Dermal	Dermal exposure may cause irritation, defatting of skin and dermatitis. Prolonged skin contact may produce burns
Ocular	Ocular exposure with chloroform vapours may causes irritation. Direct contact with liquid causes immediate pain and conjunctivitis, loss of the corneal epithelium may occur, but with prompt regeneration
Systemic features	<p>Systemic toxicity: progressive CNS depression with initial excitement and nausea followed by ataxia, dysarthria, fatigue and dizziness. These effects will be markedly increased by co-ingestion of alcohol. In severe cases there is coma and respiratory depression. Cardiac arrhythmias and arrest are caused by sensitisation of the myocardium to circulating catecholamines</p> <p>After acute exposures, hepatotoxicity can occur up to 48 hours later. Effects can include enlarged liver, jaundice and elevated liver enzyme activities. Renal damage has also been reported</p>
Reference	
TOXBASE. Chloroform, 11/2015 http://www.toxbase.org (accessed 05/2017)	

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.

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

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.

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

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 note

- 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
- do **not** apply neutralising chemicals as heat produced during neutralisation reactions may cause thermal burns, and increase injury
- put soiled clothing in a sealed container to prevent escape of volatile substances
- 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, or until the pH of the skin is normal (pH of the skin is 4.5–6, although it may be closer to 7 in children, or after irrigation). **The earlier irrigation begins, the greater the benefit**
- 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
- if features of systemic toxicity are present manage as per ingestion
- 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 oxygen
- perform a 12-lead ECG in all patients who require assessment
- monitor vital signs, cardiac rhythm and measure blood sugar (BM)
- other measures as indicated by the patient's clinical condition

Ingestion

- maintain a clear airway and ensure adequate ventilation
- give oxygen
- activated charcoal is unlikely to be of benefit
- perform a 12-lead ECG in all patients who require assessment
- monitor vital signs, cardiac rhythm and measure blood sugar (BM)
- other measures as indicated by the patient's clinical condition

Health effects and decontamination references

TOXBASE	http://www.toxbase.org (accessed 05/2017)
TOXBASE	Chloroform, 11/2015
TOXBASE	Chemicals splashed or sprayed into the eyes – features and management, 02/2014
TOXBASE	Skin decontamination – solvents, 05/2012

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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