UK Health Security Agency

Chloroform

Incident management

Contents

Main points

General

Chloroform is a non-combustable liquid with a sweet pleasant odour.

It reacts violently with strong bases, strong oxidants and some metals.

Emits toxic fumes of phosgene and hydrogen chloride on decomposition.

Health

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.

Inhalation and ingestion exposure can lead to systemic toxicity including progressive central nervous system (CNS) depression, delayed effects (up to 48 hours post exposure) may include liver and kidney damage.

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

Casualty decontamination at the scene

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.

Environment

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

Hazard identification

Table 1. Standard (UK) dangerous goods emergency action codes for Chloroform

UN		1888	Chloroform	
EAC		2Z	Use fine water spray. Wear normal fire kit in combination with breathing apparatus [note 1]. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.	
APP		–	–	
Hazards	**Class**	6.1	Toxic substance	
	Sub-risks	–	–	
HIN		60	Toxic or slightly toxic substance	

Abbreviations

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

Note to Table 1a

[note 1] Normal firefighting clothing is appropriate, such as self-contained open circuit positive pressure compressed air breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, fire fighters' gloves conforming to BS EN 659 and firefighters' footwear conforming to BS EN 15090 (Footwear for firefighters) type F3- Hazmat and structural firefighting (CH – marking for chemical resistance) or alternatively firefighters' boots conforming to Home Office Specification A29 (rubber boots) or A30 (leather boots). Leather footwear including those conforming to A30 may not provide adequate chemical resistance therefore caution should be exercised in the use of these boots.

Reference

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

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

Hazard class and category	Carc. 2	Carcinogenicity, category 2	
	Repr. 2	Reproductive toxicity, category 2	
	Acute Tox 3.	Acute toxicity, category 3 (inhalation)	
	Acute Tox 4.	Acute toxicity, category 4 (oral)	
	STOT RE 1	Specific target organ toxicity, repeated exposure, category 1	
	Eye Irrit. 2	Serious eye damage or eye irritation	
	Skin Irrit. 2	Skin corrosion or irritation	
Hazard statement	H351	Suspected of causing cancer	
	H361d	Suspected of damaging the unborn child	

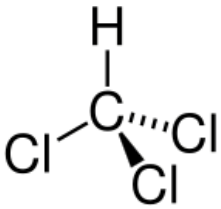
	H331	Toxic if inhaled
	H302	Harmful if swallowed
	H372	Causes damage to organs through prolonged or repeated exposure
	H319	Causes serious eye irritation
	H315	Causes skin irritation
Signal words	DANGER	

Reference

The Health and Safety Executive (HSE) 'GB CLP Regulation' (viewed January 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	67-66-3
Molecular weight	119
Formula	$CHCl_3$
Common synonyms	Trichloromethane, Trichlormethan, Formyl trichloride
State at room temperature	Liquid
Volatility	Vapour pressure = 197 mmHg at 25°C
Specific gravity	1.5 at 25°C
Flammability	Not combustible
Lower explosive limit	Not applicable
Upper explosive limit	Not applicable
Water solubility	Low, 0.8g/100 mL 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. Decomposes on contact with hot surfaces or flames producing fumes of hydrogen chloride, chlorine and phosgene.
Odour	Pleasant, sweet
Structure	

References

- International Programme on Chemical Safety ‘International Chemical Safety Card for chloroform’ ICSC 0027, 2000 (viewed January 2024)
- PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information 2004 ‘PubChem Compound Summary for CID 6212, Chloroform’ (viewed January 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation

ppm	mg/m^3	Signs and symptoms	Ref
<50	<249	Discomfort	a
500	2,490	Acute symptoms of illness	a
920	4,581.6	Dizziness and vertigo	b
20,000-30,000	-	Anasthesia	b
~40,000	192,000	Death (several minutes of exposure)	b

Table 5. Exposure by ingestion

g	Signs and symptoms	Reference
7.5	Serious illness	c
14.8	Death	b
45	Estimated mean lethal oral dose for an adult	c

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 (IPCS) 'Chloroform (EHC 163, 1994)' (viewed October 2023)

b. Agency for Toxic Substances and Disease Registry (ATSDR) 2024 'Toxicological Profile for Chloroform (Draft for Public Comment)' (viewed January 2024)

c. International Programme on Chemical Safety (IPCS) 'Concise International Chemical Assessment Document 58' 2004 (viewed October 2023)

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]	120	80	64	40	29
AEGL-3 [note 3]	4,000	4,000	3,200	2,000	1,600

Notes to Table 5

[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.

Reference

US Environmental Protection Agency (EPA) 'Acute Exposure Guideline Levels' (viewed January 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	2	9.9	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 8. Public health standards and guidelines

UK drinking water standard	0.1 mg/L [note1]
WHO guideline for drinking water quality	0.3 mg/L
WHO air quality guideline	No guideline value specified

[note 1] Value for total trihalomethanes including chloroform, bromoform, dibromochloromethane and bromodichloromethane.

References

The Private Water Supplies (England) Regulations (2016) and The Private Water Supplies (Wales) Regulations (2017)

The Water Supply (Water Quality) Regulations (2018) (Water, England and Wales)

World Health Organisaton (WHO) 'Guidelines for Drinking-water Quality, fourth edition incorporating first and second addendum' 2022

Health effects

Inhalation or ingestion are the main routes of exposure.

Table 9. Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation may cause nose and throat irritation, dry mouth and throat. Shortness of breath may occur.
Ingestion	Ingestion may cause a burning sensation of mouth and throat, nausea and vomiting.
Dermal	Skin contact is likely to cause irritation, defatting of skin and dermatitis. Prolonged skin contact may produce burns and systemic toxicity.
Ocular	Eye exposure to vapours can be irritating. Direct contact with liquid is likely to cause immediate pain and conjunctivitis; loss of the corneal epithelium may occur.
Systemic features	Progressive CNS depression is the hallmark of toxicity. In severe cases there is coma and respiratory depression. Cardiac arrhythmias and arrest are caused by sensitisation of the myocardium to circulating catecholamines. After acute toxic 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. Enterocolitis, erosive oesophagitis, erosive gastritis and ulceration have been reported.

Reference

TOXBASE ‘Chloroform’ December 2019 (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.

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 the UK Health Security Agency (UKHSA) Radiation, Chemicals and Environment 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 interventions such as Interim 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 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 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 (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)

JESIP ‘Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’ (January 2023)

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

Avoid contaminating yourself.

Carry out decontamination after resuscitation.

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

The patient should remove soiled clothing and wash themself if possible.

Contaminated clothing should be removed, double-bagged, sealed and stored safely to prevent escape of volatile substances.

Decontaminate open wounds first and avoid contamination of unexposed skin. Wash hair and all contaminated skin with liberal amounts of water (preferably warm) and soap.

Pay special attention to 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.

Chemical 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.

Cover affected area with a clean non-adherent dressing.

Chemical burns should be reviewed by a burns specialist.

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 (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 crytalloid (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 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.

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.

Ingestion

Maintain a clear airway and ensure adequate ventilation.

Where the practical expertise exists, consider gastric aspiration in adults within 1 hour of a large amount, providing the airway can be protected.

Activated charcoal is contraindicated.

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.

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

Clinical decontamination and first aid references

- TOXBASE (viewed October 2023).
- TOXBASE ‘Chloroform – features and management’ (2019)
- TOXBASE ‘Skin decontamination – solvents’ (2019)
- TOXBASE ‘Chemicals splashed or sprayed into eyes – features and management’ (2020)

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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