



Tetrachloroethylene

Incident Management

Key Points

Fire

- reacts violently with finely divided metals generating a fire and explosion hazard
- decomposes on contact with hot surfaces or flames, producing fumes of hydrogen chloride, phosgene and chlorine
- decomposes slowly on contact with moisture to produce trichloroacetic acid and hydrochloric acid
- in the event of a fire involving tetrachloroethylene, use fine water spray and normal fire kit with breathing apparatus

Health


- systemic features may occur by inhalation and ingestion
- systemic features include excitement, headache and dizziness leading to drowsiness, ataxia and dysarthria; coma and respiratory depression may occur in severe cases
- inhalation can cause irritation of the respiratory tract; sudden death has been associated with abuse of hydrocarbons
- Ingestion may cause burning in mouth and throat, epigastric pain, nausea and vomiting
- may cause skin irritation, and may cause dermatitis due to its defatting action on the skin
- may be irritating to the eyes; eye contact has caused injury to the corneal epithelium

Environment



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

Hazard Identification

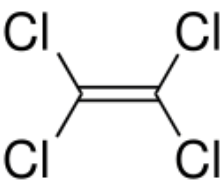
Standard (UK) dangerous goods emergency action codes

UN		1897	Tetrachloroethylene	
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 substances	
	Sub-risks	–	–	
HIN		60	Toxic and slightly toxic substance	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* Normal firefighting clothing is appropriate, i.e. 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	Carc. 2	Carcinogenicity, category 2	
	Aquatic Chronic 2	Chronic aquatic hazard, category 2	
Hazard statement	H351	Suspected of causing cancer	
	H411	Toxic to aquatic life with long lasting effects	
Signal words	Warning		
<p>* Implemented in the EU on 20 January 2009</p> <p>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).</p>			

Physicochemical Properties

CAS number	127-18-4
Molecular weight	166
Formula	C ₂ Cl ₄
Common synonyms	Tetrachloroethene; perchloroethylene; ethylene tetrachloride; PCE
State at room temperature	Liquid
Volatility	Vapour pressure 19.0 mmHg at 25°C
Specific gravity Vapour density	1.6 at 20°C (water = 1) 5.7 (air = 1)
Flammability	Not combustible
Lower explosive limit	Not applicable
Upper explosive limit	Not applicable
Water solubility	Low solubility in water, 150 mg/L at 25°C
Reactivity	Reacts violently with finely divided metals generating a fire and explosion hazard.
Reaction or degradation products	Decomposes on contact with hot surfaces or flames, this produces fumes of hydrogen chloride, phosgene and chlorine. Decomposes slowly on contact with moisture to produce trichloroacetic acid and hydrochloric acid. Reacts violently with concentrated nitric acid producing carbon dioxide.
Odour	Sweet
Structure	
References	
International Programme on Chemical Safety. International Chemical Safety Card entry for Tetrachloroethylene. ICSC 0076, 2013. World Health Organization: Geneva.	
Tetrachloroethylene (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).	

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
74	500	Eye irritation	a
103	700	Central nervous system depression and nose and throat irritation (such effects are reversible on cessation of exposure, but increase in severity with both increasing concentration and duration of exposure)	a

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 International Programme on Chemical Safety. 1,2-dichloroethane. Environmental Health Criteria 31, 1984. World Health Organization: Geneva.

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	100 ⁽¹⁾	678
ERPG-2 [†]	200	1,356
ERPG-3 [‡]	1,000	6,780

* 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

(1) Odour should be detectable near ERPG-1

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) (Interim)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	35	35	35	35	35
AEGL-2 [†]	230	230	230	120	81
AEGL-3 [‡]	1,600	1,600	1,200	580	410

* 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

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	50	345	100	689

WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit

Reference
Health Safety Executive (HSE). EH40/2005 Workplace Exposure Limits, 2nd Edition, 2011.

Public health guidelines

UK drinking water standard	10 µg/L (the sum of the concentrations of trichloroethene and tetrachloroethene)
WHO drinking water quality guideline value	40 µg/L
Air quality guideline	0.25 mg/m ³ (annual average)

Reference
The Water Supply (Water Quality) Regulations 2016
The Private Water Supplies (England) Regulations 2016 and The Private Water Supplies (Wales) Regulations 2010
WHO. Guidelines for Drinking-Water Quality, 4th Edition, 2011. World Health Organization: Geneva.
WHO guidelines for indoor air quality: selected pollutants. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications. 2010.
Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.

Health Effects

Major route of exposure

- toxic by inhalation and ingestion

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation can cause irritation of the respiratory tract. Sudden death (due to cardiac arrhythmias) has been associated with abuse of hydrocarbons. Systemic features are common following inhalation and CNS depression is usually the first presenting feature
Ingestion	Ingestion may cause 'burning' in the mouth and throat, epigastric pain, nausea and vomiting. There is a risk of aspiration leading to chemical pneumonitis, particularly if vomiting occurs. Systemic features are possible
Dermal	May cause skin irritation, and may cause dermatitis due to its defatting action on the skin. Significant dermal exposure with certain chlorinated hydrocarbons may lead to systemic toxicity
Ocular	May be irritating to the eyes; eye contact has caused injury to the corneal epithelium
Systemic features	Chlorinated hydrocarbons predominantly cause CNS depression. Symptoms include excitement, headache and dizziness leading to drowsiness, ataxia and dysarthria. Coma and respiratory depression may occur in severe cases. Cardiac arrhythmias may occur as a result of sensitisation of the heart to endogenous catecholamines. Hypoxia increases the risk of developing cardiac dysrhythmias Chlorinated hydrocarbons can be nephrotoxic and hepatotoxic in large exposures
Reference	
TOXBASE. Tetrachloroethylene, 09/2016. http://www.toxbase.org (accessed 05/2017).	
TOXBASE. Chlorinated hydrocarbons – features and management 09/2016. 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 tetrachloroethylene, **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

- secondary care staff should not need to wear secondary protection other than routine precautions against secondary contamination with vomit and body fluids

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 soap and water under low pressure for at least 10-15 minutes
- 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) following surface contamination
- if symptoms of systemic toxicity are present, manage as per inhalation/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/Ingestion

- maintain a clear airway and ensure adequate ventilation
- gastric decontamination after ingestion is contraindicated due to the increased risk of aspiration
- monitor vital signs, cardiac rhythm and measure blood sugar (BM)
- perform a 12-lead ECG in all patients who require assessment
- other measures as indicated by the patient's clinical condition

Health effects and decontamination references

TOXBASE <http://www.toxbase.org> (accessed 05/2017)

TOXBASE Chlorinated hydrocarbons – features and management 09/2016

TOXBASE Chemical splashed or sprayed into the eyes – features and management 02/2014

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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