



# Trichloroethylene

## 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 phosgene and hydrogen chloride
- slowly decomposed by light in the presence of moisture producing hydrochloric acid
- in the event of a fire involving trichloroethylene, use fine water spray and normal fire kit with breathing apparatus

#### Health


- systemic toxicity may occur by all routes of exposure
- inhalation can cause irritation of the respiratory tract, and sudden death
- ingestion may cause burning sensation and pain throughout GI tract, nausea and vomiting; there is a risk of aspiration leading to chemical pneumonitis
- dermal exposure can cause skin irritation and dermatitis
- features of systemic toxicity include CNS depression with coma and respiratory depression in severe cases
- eye exposure may cause irritation

#### Environment






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

## Hazard Identification

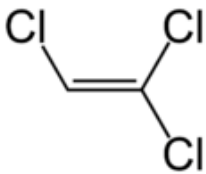
### Standard (UK) dangerous goods emergency action codes

<b>UN</b>		1710	Trichloroethylene	
<b>EAC</b>		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	
<b>APP</b>		–	–	
<b>Hazards</b>	<b>Class</b>	6.1	Toxic substance	
	<b>Sub-risks</b>	–	–	
<b>HIN</b>		60	Toxic or highly 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, 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><b>Reference</b>            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)\***

<b>Hazard class and category</b>	Skin Irrit. 2	Skin irritation, category 2	
	Eye Irrit. 2	Eye irritation, category 2	
	STOT SE 3	Specific target organ toxicity – single exposure, category 3	
	Muta. 2	Germ cell mutagen, category 2	
	Carc. 1B	Carcinogenicity, category 1B	
	Aquatic Chronic 3	Chronic hazard to the aquatic environment, category 3	
	<b>Hazard statement</b>	H315	Causes skin irritation
	H319	Causes serious eye irritation	
	H336	May cause drowsiness or dizziness	
	H341	Suspected of causing genetic defects	
	H350	May cause cancer	
	H412	Harmful to aquatic life with long lasting effects	
<b>Signal words</b>	Danger		
* Implemented in the EU on 20 January 2009			
<b>Reference</b>			
European Commission. Harmonised classification – Annexe VI to Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures. <a href="http://echa.europa.eu/information-on-chemicals/cl-inventory-database">http://echa.europa.eu/information-on-chemicals/cl-inventory-database</a> (accessed 05/2017).			

## Physicochemical Properties

<b>CAS number</b>	79-01-6
<b>Molecular weight</b>	131
<b>Formula</b>	C <sub>2</sub> HCl <sub>3</sub>
<b>Common synonyms</b>	Trichloroethene; ethylene trichloride; TCE
<b>State at room temperature</b>	Liquid
<b>Volatility</b>	Vapour pressure 69 mmHg at 25°C
<b>Specific gravity</b> <b>Vapour density</b>	1.5 at 20°C (water = 1) 4.5 (air = 1)
<b>Flammability</b>	Combustible under specific conditions
<b>Lower explosive limit</b>	8.0%
<b>Upper explosive limit</b>	10.5%
<b>Water solubility</b>	Low solubility in water, 1.3 g/L at 25°C.
<b>Reactivity</b>	Reacts violently with finely divided metals generating a fire and explosion hazard.
<b>Reaction or degradation products</b>	Decomposes on contact with hot surfaces or flames, this produces fumes of phosgene and hydrogen chloride. Will also decompose on contact with strong alkalis to produce dichloroacetylene. Slowly decomposed by light in the presence of moisture producing hydrochloric acid.
<b>Odour</b>	Sweet
<b>Structure</b>	
<b>References</b>	
<p>Hazardous Substances Data Bank. Trichloroethylene HSDB No. 133 (last revision date 03/05/2012). US National Library of Medicine: Bethesda MD. <a href="http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB">http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB</a> (accessed 02/2017).</p> <p>International Programme on Chemical Safety. International Chemical Safety Card entry for Trichloroethylene. ICSC 0081, 2013. World Health Organization: Geneva.</p> <p>Trichloroethylene (HAZARDTEXT™ Hazard Management). In Klasco RK (Ed): TOMES® System, Truven Healthcare Analytics Inc, Greenwood Village CO, US. RightAnswer.com Inc, Midland MI, US. <a href="http://www.rightanswerknowledge.com">http://www.rightanswerknowledge.com</a> (accessed 02/2017).</p>	

## Reported Effect Levels from Authoritative Sources

### Exposure by inhalation

ppm	mg/m <sup>3</sup>	Signs and symptoms	Reference
<300	1,611	No or marginal CNS effects	a
1,000	5,370	Impaired visual-motor coordination, light-headedness, dizziness and lethargy (exposure over 2 hours)	b, c
5,000-20,000	27,000-107,400	Anaesthesia	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 SCOEL/SUM/142 April 2009 Recommendation from the Scientific Committee on Occupational Exposure Limits for Trichloroethylene.

b Agency for Toxic Substances and Disease Registry (ATSDR). Draft Toxicological Profile for Trichloroethylene, 2014. US Department of Health and Human Services: Atlanta, US .

c European Union Risk Assessment Report Trichloroethylene. 2004.

### Exposure by eyes

ppm	mg/m <sup>3</sup>	Signs and symptoms	Reference
5,133-20,157	27,500-108,000	Eye irritation and reversible, superficial damage to the cornea	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, Environmental Health Criteria 50: Trichloroethylene, 1985.

### Exposure by ingestion

mL/kg	Signs and symptoms	Reference
3-5	Estimated fatal dose	a
<b>mL</b>		
20	CNS effects (varying from headache and slight confusion to coma)	b, c
>50	May be fatal	c

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 TOXBASE. Trichloroethylene, 02/2012. <http://www.toxbase.org> (accessed 05/2017)

b SCOEL 2009 Recommendation from the Scientific Committee on Occupational Exposure Limits for Trichloroethylene

c European Union Risk Assessment Report TRICHLOROETHYLENE 2004

## Published Emergency Response Guidelines

### Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m <sup>3</sup> )
ERPG-1*	100	550
ERPG-2 <sup>†</sup>	500	2,750
ERPG-3 <sup>‡</sup>	5,000	27,500

\* 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

<sup>†</sup> 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

<sup>‡</sup> 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-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf> (accessed 05/2017).

### Acute exposure guideline levels (AEGs) (Interim)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEG-1*	260	180	130	84	77
AEG-2 <sup>†</sup>	960	620	450	270	240
AEG-3 <sup>‡</sup>	6,100	6,100	3,800	1,500	970

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

<sup>†</sup> 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

<sup>‡</sup> 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 <sup>3</sup>	ppm	mg/m <sup>3</sup>
<b>WEL</b>	100	550	150	820

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, 2<sup>nd</sup> Edition, 2011.

### Public health guidelines

<b>UK drinking water standard</b>	10 µg/L (the sum of the concentrations of trichloroethene and tetrachloroethene)
<b>WHO provisional drinking water quality guideline value</b>	20 µg/L
<b>Air quality guideline</b>	Unit risk estimate of $4.3 \times 10^{-7}$ per µg/m <sup>3</sup>  The concentrations of airborne tetrachloroethylene associated with an excess lifetime cancer risk of 1:10 000, 1:100,000 and 1:1,000,000 are respectively 230, 23 and 2.3 µg/m <sup>3</sup>
<p><b>Reference</b></p> <p>The Water Supply (Water Quality) Regulations 2016</p> <p>The Private Water Supplies (England) Regulations 2016 and The Private Water Supplies (Wales) Regulations 2010</p> <p>WHO guidelines for indoor air quality: selected pollutants. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications. 2010.</p> <p>Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.</p> <p>WHO. Guidelines for Drinking-Water Quality, 4th Edition, 2011. World Health Organization: Geneva.</p>	

## Health Effects

### Major route of exposure

- inhalation, ingestion and dermal absorption

### Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
<b>Inhalation</b>	Inhalation can cause irritation of the respiratory tract, and sudden death (due to cardiac arrhythmias) has been associated with abuse of hydrocarbons such as trichloroethylene. Systemic features are common following inhalation and CNS depression is usually the first presenting feature
<b>Ingestion</b>	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
<b>Dermal</b>	May cause skin irritation, and may cause dermatitis due to its defatting action on the skin. Skin absorption from vapour is negligible although prolonged dermal contact with the liquid may result in absorption and systemic effects
<b>Ocular</b>	May be irritating to the eyes; eye contact has caused injury to the corneal epithelium
<b>Systemic features</b>	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
<b>Reference</b>	
TOXBASE. Trichloroethylene, 02/2012. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 05/2017).	
TOXBASE. Chlorinated hydrocarbons – features and management 09/2016. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (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 trichloroethylene, **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](http://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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