



Toluene

Incident Management

Key Points

Fire

- highly flammable
- toluene vapour is explosive when exposed to heat or flame
- emits acrid smoke and irritating fumes when heated to decomposition
- in the event of a fire involving toluene, use normal foam and normal fire kit with breathing apparatus

Health


- toxicity occurs typically following inhalation or ingestion
- inhalation causes irritation to the eyes, nose, throat and respiratory tract
- ingestion causes abdominal pain, and oropharyngeal and gastric irritation with vomiting
- systemic features include initial euphoria and hallucinations then drowsiness, confusion, ataxia, tremor, headache, slurred speech, coma, respiratory failure, convulsions and death
- dermal exposure causes irritation, dryness, erythema, defatting, blistering and necrotic skin burns if contact is extensive or prolonged
- ocular exposure causes burning, irritation, conjunctivitis and reversible corneal injury

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		1294	Toluene	
EAC		3YE	Use normal foam, ie protein based that is not alcohol resistant. Wear normal fire kit in combination with breathing apparatus*. There is a danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off should be prevented from entering drains and surface and groundwaters. There may be a public safety hazard outside the immediate area of the incident†	
APP		–	–	
Hazards	Class	3	Flammable liquids	
	Sub-risks	–	–	
HIN		33	Highly flammable liquid (flash-point below 23°C)	
<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 EN137 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>† 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>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)*

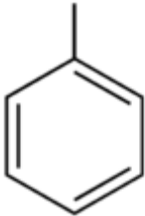
Hazard class and category	Flam. Liq. 2	Flammable liquid, category 2	
	Asp. Tox. 1	Aspiration toxicity, category 1	
	Skin Irrit. 2	Skin irritant, category 2	
	STOT SE 3	Specific organ toxicity, single exposure, category 3	
	Repr. 2	Reproductive toxicity, category 2	
	STOT RE 2	Specific organ toxicity, repeated exposure, category 2	
	Hazard statement	H225	Highly flammable liquid and vapour
H304		May be fatal if swallowed and entered airways	
H315		Causes skin irritation	
H336		May cause drowsiness or dizziness	
H361d		Suspected of damaging the unborn child	
H373		May cause 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).

Physicochemical Properties

CAS number	108-88-3
Molecular weight	92
Formula	C ₇ H ₈
Common synonyms	Methylbenzene; Phenylmethane
State at room temperature	Liquid
Volatility	Vapour pressure = 28.4 mm Hg at 25 °C
Specific gravity Vapour density	0.9 at 20 °C (water = 1) 3.1 (air = 1)
Flammability	Highly flammable
Lower explosive limit	1.1%
Upper explosive limit	7.1%
Water solubility	Very slightly soluble in water
Reactivity	Toluene can react vigorously with oxidizing materials; toluene vapour is explosive when exposed to heat or flame. It may form explosive mixtures with air. Toluene will attack some plastics, rubber and coatings.
Reaction or degradation products	Emits acrid smoke and irritating fumes when heated to decomposition.
Odour	Sweet pungent odour.
Structure	
<p>References</p> <p>Hazardous Substances Data Bank. Toluene HSDB No. 131 (last revision date 25/10/2016). 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 Toluene. ICSC 0078, 2002. World Health Organization: Geneva.</p> <p>Toluene (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>	

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
50-100	188-375	CNS effects - dizziness, headache, fatigue, respiratory tract irritation	a
200	750	Mild throat and eye irritation, prolonged eye-to-hand reaction time, some impaired cognitive function, mild headache, dizziness, sensation of intoxication, fatigue, general confusion and moderate insomnia	b
>200	750	Impaired performance	a
400	1500	Irritation of the eyes and throat, lacrimation, mental confusion and in-coordination (8 hours)	b
500-600	1,875-2,250	Anorexia, staggering gate, nausea, nervousness, momentary loss of memory, significant reduction in reaction time	b
1,500	5,625	Extreme weakness	b
4,000	15,000	Rapid impairment of reaction time and coordination. Exposures of 1 hour or longer may lead to narcosis and possibly death.	b
10,000-30,000	37,500-112,500	Onset of narcosis within minutes; longer exposures may be lethal	b
<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 TOXBASE. Toluene, 08/2016. http://www.toxbase.org (accessed 05/2017).</p> <p>b International Programme on Chemical Safety, Environmental Health Criteria 52: Toluene, 1986.</p>			

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	50 ¹	189
ERPG-2 [†]	300	1,131
ERPG-3 [‡]	1,000	3,770

* 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 (AEGs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	67	67	67	67	67
AEGL-2 [†]	1,400 ⁽¹⁾	760	560	310	250
AEGL-3 [‡]	10,000 ⁽²⁾	5,200 ⁽¹⁾	3,700 ⁽¹⁾	1,800 ⁽¹⁾	1,400 ⁽¹⁾

* 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

Notes (1) and (2): lower explosive limit (LEL) = 14,000 ppm
(1) = >10% LEL; (2) = >50% LEL

(1) safety considerations against the hazard(s) of explosion(s) must be taken into account
(2) extreme safety considerations against the hazard(s) of explosion(s) must be taken into account

Reference
US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemist.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	191	100	384
<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 drinking water guideline value	0.7 mg/L
WHO Air quality guideline	0.26 mg/m ³ (weekly average)
<p>Reference Guidelines for Drinking-Water Quality, Fourth Edition. WHO, Geneva. 2011. Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.</p>	

Health Effects

Major route of exposure

- toxicity occurs following inhalation or ingestion
- toluene is only slowly absorbed through intact skin, although patients with significant dermal exposure are also likely to have inhalation exposure

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	May cause irritation to the eyes, nose, throat and respiratory tract. Respiratory complications include acute bronchitis, bronchospasm, pneumonitis, asphyxia and pulmonary oedema. Systemic features may occur
Ingestion	May result in abdominal pain, oropharyngeal and gastric irritation with vomiting. There is one report of corrosive oesophageal injury. Systemic features may occur
Dermal	Skin may cause irritation, dryness, transient erythema, defatting, blistering and necrotic skin burns if contact is extensive or prolonged
Ocular	Eye exposure can cause burning, irritation, conjunctivitis and reversible corneal injury
Systemic features	<p>Systemic toxicity includes initial euphoria and hallucinations then drowsiness, confusion, ataxia, tremor, headache, slurred speech, coma, respiratory failure, convulsions and death</p> <p>Cardiovascular features include hypertension or hypotension, tachycardia or bradycardia. Ventricular fibrillation, cardiac arrest and myocardial infarction may also occur, although are more common after chronic exposure</p> <p>Rhabdomyolysis, hepatic and renal damage can occur. The latter is characterised by distal renal tubular injury causing hyperchloraemic metabolic acidosis with associated hypokalaemia and hypophosphataemia. These features are more common after chronic exposure</p> <p>Other features of exposure include nausea, vomiting, paraesthesiae and peripheral neuropathy</p>
Reference	
TOXBASE. Toluene, 08/ 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 toluene, **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

Clinical decontamination following surface contamination

- avoid contaminating yourself
- do not allow smoking nearby, there may be a risk of fire
- carry out decontamination in a well-ventilated area, preferably with its own ventilation system
- the patient should remove soiled clothing and wash him/herself if possible
- put soiled clothing in a sealed container to prevent escape of volatile substances
- 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) 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

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

Ingestion

- gut decontamination is contraindicated
- maintain a clear airway and ensure adequate ventilation
- give oxygen if required
- monitor vital signs, cardiac rhythm and measure blood sugar (BM)
- 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 05/2017)
TOXBASE	Toluene – features and management, 08/2016
TOXBASE	Chemicals splashed or sprayed into the eyes, 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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