



Benzene

Incident management

Key Points

Fire

- Highly flammable
- Vapour/air mixtures may be explosive
- Low flash point
- In the event of a fire involving benzene, use normal foam and liquid tight fire kit with breathing apparatus

Health


- Toxic by inhalation, ingestion and skin contact
- Harmful and irritant
- Carcinogen and possible mutagen
- Exposure by any route may lead to CNS depression, convulsions and coma (consistent with solvent intoxication)
- Casualties may develop ventricular arrhythmias

Environment

- Avoid release into environment
- Inform Environment Agency of substantial release incidents

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

UN		1114	Benzene	
EAC		3WE	Use normal foam. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses. Substance can be violently or explosively reactive. There may be a public safety hazard outside the immediate area of the incident**.	
APP		-		
Hazards	Class	3	Flammable liquid	
	Sub risks	-		
HIN		33	Highly flammable liquid (flash-point below 23°C)	







UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

* Liquid-tight chemical protective clothing (BS 8428) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

** 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.

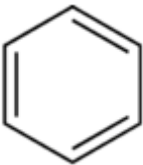
^a Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2004.

Chemical Hazard Information and Packaging for Supply Classification^(a)

Classification	F	Highly flammable	
	Carc. cat. 1	Category 1 carcinogen	
	Muta. Cat. 2	Category 2 mutagen	
	T	Toxic	
	Xn	Harmful	
	Xi	Irritant	
Risk phrases	R45	May cause cancer	
	R46	May cause heritable genetic damage	
	R11	Highly flammable	
	R36/38	Irritating to eyes and skin	
	R48/23/24/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed	
	R65	Harmful: may cause lung damage if swallowed	
Safety phrases	S53	Avoid exposure – obtain special instructions before use	
	S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)	

^a European Chemical Bureau, Classification and labelling, 2006 (<http://ecb.jrc.it/classification-labelling/>).

Physicochemical Properties

CAS number	71-43-2
Molecular weight	78
Empirical formula	C ₆ H ₆
Common synonyms	Benzol; Cyclohexatriene
State at room temperature	Liquid
Volatility	Highly volatile, vapour pressure: 102 mm Hg at 26°C
Specific gravity	0.9 at 15°C (water = 1)
Flammability	Flammable; flash point -11.1 °C
Lower explosive limit	1.3
Upper explosive limit	7.1
Water solubility	Low solubility in water; 0.2 % at 25 °C
Reactivity	May form explosive mixtures with air
Reaction or degradation products	-
Odour	Characteristic, sweet odour at lower concentrations with a disagreeable, irritating odour at higher concentrations.
Structure	

References^(a,b,c)

^a International Programme on Chemical Safety, Environmental Health Criteria 150: Benzene, 1993.

^b The Merck Index (14th Edition). Entry 1066: Benzene, 2006.

^c CIRUS Electronic Information System, London Fire Brigade, 2005 Edition.

Threshold Toxicity Values

EXPOSURE VIA INGESTION	
mg kg ⁻¹ bw	SIGNS AND SYMPTOMS
125	Lethal dose

EXPOSURE VIA INHALATION		
ppm	mg m ⁻³	SIGNS AND SYMPTOMS
25	80	No immediate clinical effects (8 hours)
50 – 150	160 – 480	Headache, lethargy, weakness (5 hours)
500	1,600	Symptoms of illness (60 minutes)
1,500	4,800	Serious symptoms (60 minutes)
7,500	24,000	Dangerous to life (30 minutes).
20,000	64,000	Central nervous system depression, cardiac arrhythmia, respiratory failure and death (5 – 10 minute exposure).

Reference^(a)

^a International Programme on Chemical Safety, Environmental Health Criteria 150: Benzene, 1993.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values^(a)

	Listed value (ppm)	Calculated value (mg m ⁻³)
ERPG-1*	50	160
ERPG-2**	150	480
ERPG-3***	1000	3200

[Calculations based on 1 ppm = 3.2 mg m⁻³ at 20C°]

* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr 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 hr 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 hr without experiencing or developing life-threatening health effects.

Acute Exposure Guideline Levels (AEGs)^(b)

	ppm				
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1[†]	130	73	52	18	9
AEGL-2^{††}	2,000*	1,100	800	400	200
AEGL-3^{†††}	**	5,600*	4,000*	2,000*	990

* ≥ 10 % LEL LEL = 14000 ppm

** 3-10 mins = 9700 ppm

For values denoted as * safety consideration against hazards of explosions must be taken into account.

[†] The level of the chemical in air at or above which the general population could experience notable discomfort.

^{††} The 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.

^{†††} The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

^a American Industrial Hygiene Association (AIHA). Emergency Response Planning Guideline Values and Workplace Environmental Exposure Level Guides Handbook, Fairfax, VA, 2006.

^b U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 02/2007).

Exposure Standards, Guidelines or Regulations

Occupational standards

WEL^(a)	LTEL(8 hour reference period): 1 ppm (3 mg m ⁻³)
	STEL(15 min reference period): No guideline value specified

Public health guidelines

DRINKING WATER QUALITY GUIDELINE^(b)	1 µg L ⁻¹
AIR QUALITY GUIDELINE^(c)	5 ppb (future target of 1 ppb)
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES^(d)	Index Dose_{oral} 0.29 µg kg ⁻¹ bw day ⁻¹
	Index dose_{inhalation} 0.91 µg kg ⁻¹ bw day ⁻¹

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

^a Health & Safety Executive. EH40/2005 Workplace Exposure Limits 2005. The Stationery Office, London, 2005.

^b Interim Guidance on the Water Supply (Water Quality) Regulations 2000 (England) and the Water Supply (Water Quality) Regulations 2001 (Wales). Drinking Water Inspectorate, September 2003.

^c Expert Panel on Air Quality Standards: Benzene. Department of the Environment. 1994.

^d Department for Environment, Food and Rural Affairs (DEFRA). Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Benzene. 2003.

Health Effects

Major routes of exposure^(a)

- Toxic by ingestion, inhalation and skin contact.

Immediate signs or symptoms of acute exposure^(a)

- Ingestion may cause nausea, vomiting and abdominal pain.
- Inhalation may cause tracheitis, laryngitis, bronchial irritation, pulmonary haemorrhage, cough and pulmonary oedema. Systemic features may also occur.
- Dermal exposure may cause irritation with erythema, blistering and dermatitis due to the defatting effect of benzene. Second-degree burns have occurred. These effects may follow dermal exposure to benzene liquid or vapour. Systemic features may also occur.
- Ocular exposure may cause irritation and transient corneal damage.
- Systemic features of exposure are initial euphoria and excitation followed by dizziness, drowsiness, headache, incoordination, coma and convulsions. Cerebral oedema has been reported.
- Tachycardia and ventricular fibrillation may occur.
- There may be respiratory depression and respiratory arrest.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Benzene, 2006.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Flammability warning: prevent exposure to all sources of ignition such as naked flames, electrical equipment, oxidising chemicals and the smoking of tobacco products.

Dermal exposure^(a)

- Remove patient from exposure.
- The patient should remove all clothing and personal effects.
- Double-bag soiled clothing and place in a sealed container clearly labelled as a biohazard.
- Gently blot away any adherent liquid from the patient.
- Wash hair and all contaminated skin with copious amounts of water (preferably warm) and soap for at least 10-15 minutes. Decontaminate open wounds first and avoid contamination of unexposed skin.
- Pay special attention to skin folds, axillae, ears, fingernails, genital areas and feet.
- Observe for at least 4 hours after exposure.
- Monitor pulse, blood pressure, cardiac rhythm, GCS and respiratory rate. Perform 12 lead ECG.
- Apply other measures according to the patient's clinical condition.

Ocular exposure^(b)

- Remove patient from exposure.
- Remove contact lenses if necessary and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes.
- Patients with corneal damage or those whose symptoms do not resolve rapidly should seek urgent ophthalmological assessment.

Inhalation^(c)

- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give oxygen to symptomatic patients.
- Observe for at least 4 hours after exposure.
- Monitor pulse, blood pressure, cardiac rhythm, GCS and respiratory rate. Perform 12 lead ECG.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Benzene – skin exposure, 2006.

^b TOXBASE: Chemicals splashed or sprayed into the eyes, 2007.

^c TOXBASE: Benzene – inhalation, 2006.

- If the patient has clinical features of bronchospasm treat conventionally with nebulised bronchodilators.
- Apply other measures as indicated by the patient's clinical condition.

Ingestion^(a)

- Ensure a clear airway and adequate ventilation.
- Give oxygen to symptomatic patients.
- Gut decontamination is contraindicated because this may increase the risk of aspiration.
- Observe for at least 4 hours after exposure.
- Monitor pulse, blood pressure, cardiac rhythm, GCS and respiratory rate. Perform 12 lead ECG.
- Apply other measures as indicated by the patient's clinical condition.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Benzene – ingestion, 2006.