



UK Health  
Security  
Agency

# Benzene

## Incident management

This document provides information needed for response to a chemical incident, such as physicochemical properties, health effects and decontamination advice.

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## Main points

### General

Benzene is a highly flammable, highly volatile liquid at room temperature. It has an aromatic petrol-like odour and low solubility in water. It is explosive, and reacts violently with oxidants, nitric acid, sulphuric acid and halogens.

### Health

Major routes of exposure are inhalation and ingestion.

Inhalation of benzene may result in mucous membrane irritation, sore throat, cough, hoarseness of voice and dyspnoea; pulmonary oedema and haemorrhage may follow severe exposure.

Ingestion causes burning sensation of the mouth, oesophagus and stomach; nausea, vomiting and abdominal pain may follow.

Dermal contact can cause irritation, erythema and dermatitis.

Benzene vapour may cause eye irritation at high concentrations.

### Casualty decontamination at the scene

Following disrobe, improvised dry decontamination should be considered for an incident involving benzene, 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.

Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.

## Hazard identification

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

<b>UN</b>	1114	Benzene		
<b>EAC</b>	3WE	Use normal foam, i.e., protein based foam that is not alcohol resistant. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus [note 1]. Substance can be violently or explosively reactive. Spillages, contaminated fire 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 [note 2]		
<b>APP</b>	A(fl)	Fire kit and gas-tight chemical protective suit with breathing apparatus [note 3]. Fire kit intended to protect against flammable liquid		
<b>Hazards</b>	<b>Class</b>	3	Flammable liquids and desensitised liquid explosives	
	<b>Sub-risks</b>	-	-	
<b>HIN</b>	33	Highly flammable liquid, (flashpoint below 23°C)		

### Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

### Notes to Table 1

Note 1: Chemical protective clothing with liquid tight connections for whole body (Type 3) conforming to the relevant standards such as BS 8428 or EN 14605 in combination with breathing apparatus conforming to BS EN 137.








Note 2: People should be warned to stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be eliminated and ventilation stopped. Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250 m away from the incident.

Note 3: Normal fire kit in combination with gas-tight chemical protective clothing conforming to BD EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137.

## Reference

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. '[Dangerous Goods Emergency Action Code List](#)'. 2023 (viewed on 02 October 2024)

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

<b>Hazard class and category</b>	Flam. Liq. 2	Flammable liquid, category 2	
	Asp. Tox. 1	Aspiration hazard, category 1	
	Skin Irrit. 2	Skin irritation, category 2	
	Eye Irrit. 2	Eye irritation, category 2	
	Muta. 1B	Germ cell mutagenicity, category 1B	
	Carc. 1A	Carcinogenicity, category 1A	
	STOT RE 1	Specific target organ toxicity following repeated exposure, category 1	
	<b>Hazard statement</b>	H225	Highly flammable liquid and vapour
H304		May be fatal if swallowed and enters airways	
H315		Causes skin irritation	


	H319	Causes serious eye irritation
	H340	May cause genetic defects
	H350	May cause cancer
	H372	Causes damage to organs through prolonged or repeated exposure
<b>Signal words</b>	DANGER	

### References

The Health and Safety Executive (HSE). '[GB CLP Regulation](#)' (viewed on 02 October 2024)

## Physicochemical properties

Table 3. Physicochemical properties

<b>CAS number</b>	71-43-2
<b>Molecular weight</b>	78
<b>Formula</b>	C <sub>6</sub> H <sub>6</sub>
<b>Common synonyms</b>	Benzol
<b>State at room temperature</b>	Liquid
<b>Volatility</b>	Highly volatile, vapour pressure: 94.8 mmHg at 25°C
<b>Specific gravity</b>	0.88 (water = 1) at 20°C 2.7 (air = 1)
<b>Flammability</b>	Highly Flammable
<b>Lower explosive limit</b>	1.2%
<b>Upper explosive limit</b>	8.0%
<b>Water solubility</b>	Low solubility in water
<b>Reactivity</b>	Will form explosive mixtures with air. Reacts violently with oxidants, nitric acid, sulphuric acid and halogens, generating a fire and explosion hazard. Attacks plastics and rubber.
<b>Odour</b>	Aromatic petrol-like odour
<b>Structure</b>	

### References

International Programme on Chemical Safety. '[International Chemical Safety Card entry for Benzene](#)' ICSC 0015, 2016. World Health Organization: Geneva. (viewed on 02 October 2024)

PubChem. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. '[PubChem Compound Summary for CID 241, Benzene](#)' (viewed on 02 October 2024).



## Reported effect levels from authoritative sources

**Table 4. Exposure by inhalation**

ppm	mg/m <sup>3</sup>	Duration	Signs and symptoms	Reference
25	80	8 hours	No immediate clinical effects (8 hours)	a
300–3,000	957–9,570	–	CNS effects (drowsiness, dizziness, headache, vertigo, tremor, delirium and loss of consciousness)	b
7,500	24,000	30 minutes	Dangerous to life	a
10,000–20,000	-	5–10 minutes	Can be fatal	b
20,000	>64,000	5–10 minutes	CNS depression, cardiac arrhythmia, respiratory failure and death	a, b

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. Benzene. '[Environmental Health Criteria 150](#)' 1993 (viewed on 02 October 2024)

b. Agency for Toxic Substances and Disease Registry (ATSDR). '[Toxicological profile for Benzene](#)' 2007 (viewed on 02 October 2024)

**Table 5. Exposure by ingestion**

mg/kg bw	Signs and symptoms	Reference
125	Giddiness, vertigo muscular incoordination, unconsciousness and death.	a, b

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. United States Environmental Protection Agency. '[Toxicological Review of Benzene \(Noncancer Effects\)](#)' 2002 (viewed on 02 October 2024)

b. Agency for Toxic Substances and Disease Registry (ATSDR). '[Toxicological profile for Benzene](#)' 2007 (viewed on 02 October 2024)

## Published emergency response guidelines

**Table 6. Acute exposure guideline levels (AEGLs) for benzene**

	Concentration (ppm)				
	10 minutes	30 minutes	60 minutes	4 hours	8 hours
<b>AEGL-1</b> [note 1]	130	73	52	18	9
<b>AEGL-2</b> [note 2]	2,000 [note 4]	1,100	800	400	200
<b>AEGL-3</b> [note 3]	9,700 [note 5]	5,600 [note 4]	4,000 [note 4]	2,000 [note 4]	990

### Notes to Table 6

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.

Note 4: Value is greater than 10% of the lower explosive limit of 14,000 ppm. Safety considerations against the hazard(s) of explosion(s) must be taken into account.

Note 5: This value is greater than 50% of the lower explosive limit of 14,000 ppm. Extreme safety considerations against the hazard(s) of explosion(s) must be taken into account.

### Reference

US Environmental Protection Agency (EPA) '[Acute Exposure Guideline Levels](#)' 2024 (viewed on 02 October 2024)

## Exposure standards, guidelines or regulations

**Table 7. 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>	1	3.25	Not specified	

### Abbreviations

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 Fourth Edition](#)' 2020. (viewed on 02 October 2024)

**Table 8. Public health standards and guidelines**

<b>Drinking water standard</b>	1 µg/L
<b>WHO guideline for drinking water quality</b>	0.01 mg/L (10 µg/L)
<b>UK indoor air quality guideline</b>	No safe level of exposure can be recommended. The unit risk of leukaemia per 1µg/m <sup>3</sup> air concentration is $6 \times 10^{-6}$ . The concentrations of airborne benzene associated with an excess lifetime cancer risk of 1/10 000, 1/100 000 and 1/1 000 000 are 17, 1.7 and 0.17µg/m <sup>3</sup> .
<b>WHO indoor and outdoor air quality guidelines</b>	No safe level of exposure can be recommended. The unit risk of leukaemia per 1µg/m <sup>3</sup> air concentration is $6 \times 10^{-6}$ . The concentrations of airborne benzene associated with an excess lifetime cancer risk of 1/10 000, 1/100 000 and 1/1 000 000 are 17, 1.7 and 0.17µg/m <sup>3</sup> .

### Reference

[The Private Water Supplies \(England\) Regulations \(2016\)](#) and [The Private Water Supplies \(Wales\) Regulations \(2017\)](#). (viewed on 02 October 2024)

[The Water Supply \(Water Quality\) Regulations \(2018\)](#) (Water, England and Wales) (viewed on 02 October 2024)

World Health Organization. '[Guidelines for Drinking-water Quality, 4th Edition Incorporating First and Second Addendum](#)' 2022 (viewed on 02 October 2024)

World Health Organization Regional Office for Europe, Copenhagen World Health Organization Regional Publications. '[Guidelines for indoor air quality: selected pollutants](#)' 2010 (viewed on 02 October 2024)

Public Health England. '[Indoor Air Quality Guidelines for selected Volatile Organic Compounds \(VOCs\) in the UK](#)' 2019 (viewed on 02 October 2024)

World Health Organization Regional Office for Europe. '[Air Quality Guidelines for Europe, European Series, No. 91, 2nd Edition](#)' 2000 (viewed on 02 October 2024)

## Health effects

Toxic by ingestion, inhalation and less commonly by skin contact. Vapours and droplets may burn eyes at high concentration.

**Table 9. Signs or symptoms of acute exposure**

Route	Signs and symptoms
<b>Inhalation</b>	<p>Mucous membrane irritation, sore throat, cough, hoarseness of voice and dyspnoea. Severe exposure to benzene vapours causes inflammation of the airways with pulmonary oedema and haemorrhage.</p> <p>Benzene is well absorbed by inhalation and patients might develop systemic features.</p>
<b>Ingestion</b>	<p>Burning sensation of the mouth, oesophagus and stomach, with nausea, vomiting and abdominal pain.</p> <p>Gastrointestinal ulceration, severe gastric inflammation and later pyloric stenosis have also been reported</p> <p>Aspiration of benzene causes inflammation (pneumonitis), pulmonary oedema and haemorrhage</p>
<b>Eyes</b>	<p>Benzene vapour may cause eye irritation at high concentrations and droplets may cause a burning sensation</p>
<b>Dermal</b>	<p>Benzene is a skin irritant and prolonged or excessive contact may cause erythema and dermatitis.</p> <p>Chemical burns are possible. Sub-acute low dose exposures to vapours has caused membrane irritation and skin irritation</p>
<b>Systemic</b>	<p>Initial euphoria and excitation followed by CNS depression, dizziness, drowsiness, headache, ataxia (incoordination, staggering gait), cardiac arrhythmia, respiratory failure, delirium, coma and convulsions. Cerebral oedema has been reported</p>

### Reference

National Poisons Information Service (NPIS). TOXBASE. '[Benzene](#)' 2022 (viewed on 02 October 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 benzene unless casualties are demonstrating obvious signs 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

Improvised dry decontamination should be considered for an incident involving benzene unless casualties are demonstrating obvious signs of chemical burns or skin irritation.

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

Wet decontamination should be used if contamination with a caustic chemical substance is suspected.

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 (viewed on 02 October 2024)

National Health Service England. '[Emergency Preparedness, Resilience and Response \(EPRR\): Guidance for the initial management of self-presenters from incidents involving hazardous materials.](#)' February 2019 (viewed on 02 October 2024)

Joint Emergency Service Interoperability Programme. '[Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials](#)' June 2024 (viewed on 02 October 2024)

## 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.

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 to 15 minutes.

Pay particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears.

The earlier irrigation begins, the greater the benefit.

## Dermal exposure

Decontaminate (as above) the patient following surface contamination.

If symptomatic manage as per ingestion/inhalation.

For management of chemical burns seek advice from your regional burns unit.

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 crystalloid (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 neutral conjunctival pH of 7 to 7.2. The conjunctivae may be tested with indicator paper. Retest at 15 to 30 minutes after irrigation and use further irrigation if necessary.

Any particles lodged 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 and Inhalation

Remove the patient from exposure and decontaminate.

Maintain a clear airway and ensure adequate ventilation.

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.

## Clinical decontamination and first aid references

National Poisons Information Service. [TOXBASE](#). (viewed on 02 October 2024).

National Poisons Information Service. TOXBASE. '[Benzene](#)' 2022 (viewed on 02 October 2024)

National Poisons Information Service. TOXBASE. '[Chemicals Splashed or Sprayed into the Eyes – features and management](#)' 2020 (viewed on 02 October 2024)

National Poisons Information Service. TOXBASE. '[Skin decontamination – irritants](#)' 2019 (viewed on 02 October 2024)

## 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.

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