



# Phenol

## Incident Management

### Key Points

#### General

- solid at room temperature
- distinctive sweet odour
- combustible when exposed to heat, flames or oxidising materials
- emits acrid smoke of irritating and flammable vapours when heated to decomposition

#### Health effects

- systemic effects and local irritation or burns may develop by any route of exposure
- contact can sometimes be painless due to local anaesthetic activity
- systemic effects include nausea, vomiting, hypotension, tachycardia, cardiac arrhythmias, metabolic acidosis, pallor, sweating and shock. Initial CNS such as agitation is followed by drowsiness and respiratory depression

#### Casualty decontamination at the scene

- phenol causes corrosive effects on contact with skin (that can sometimes be painless due to local anaesthetic effect of phenol); therefore, following disrobe, improvised wet decontamination should be considered


#### Environment

- hazardous to the environment; inform the Environment Agency where appropriate
- spillages and decontamination run-off should be prevented from entering watercourses


## Hazard Identification

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





#### *Solid phenol and phenol solution (see note)*

<b>UN</b>		<b>1671</b>	<b>Phenol, solid</b>	
		<b>2821</b>	<b>Phenol solution</b>	
<b>EAC</b>		2X	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body 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 slightly toxic substance	
<p><b>Note</b> Chemicals of different UN number are grouped in this table as they individually carry the same EACs  UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* 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 BS EN 137</p> <p><b>Reference</b>  Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2019.</p>				

**Phenol, molten**

<b>UN</b>		2312	Phenol, molten	
<b>EAC</b>		•3X	Use alcohol-resistant foam but, if not available, normal foam. Wear chemical protective clothing with liquid-tight connections for whole body 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 slightly toxic substance	
<p>UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number</p> <p>* 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 BS EN 137</p> <p><b>Reference</b>  Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2019.</p>				

**Classification, labelling and packaging (CLP)\***

<b>Hazard class and category</b>	Muta. 2	Germ cell mutagenicity, category 2	
	Acute Tox. 3	Acute toxicity (oral, dermal, inhalation), category 3	
	STOT RE 2	Specific target organ toxicity following repeated exposure, category 3	
	Skin Corr. 1B	Skin corrosion, category 1B	
<b>Hazard statement</b>	H341	Suspected of causing genetic defects	
	H331	Toxic if inhaled	
	H311	Toxic in contact with skin	
	H301	Toxic if swallowed	
	H373	May cause damage to organs through prolonged or repeated exposure	
	H314	Causes severe skin burns and eye damage	
<b>Signal words</b>	DANGER		
* Implemented in the EU on 20 January 2009			
<b>Reference</b>			
European Commission. Harmonised classification – Annex VI of 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 03/2019).			

**Specific concentration limits**


Concentration	Hazard class and category	Hazard statement	
$C \geq 3\%$	Skin Corr. 1B	H314	Causes severe skin burns and eye damage
$1\% \leq C < 3\%$	Skin Irrit. 2	H315	Causes skin irritation
$1\% \leq C < 3\%$	Eye Irrit. 2	H319	Causes serious eye irritation

\* Implemented in the EU on 20 January 2009

**Reference**

European Commission. Harmonised classification – Annex VI of 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 03/2019).

## Physicochemical Properties

<b>CAS number</b>	108-95-2
<b>Molecular weight</b>	94
<b>Formula</b>	C <sub>6</sub> H <sub>6</sub> O
<b>Common synonyms</b>	Carbolic acid, phenolic acid, hydroxybenzene
<b>State at room temperature</b>	Solid
<b>Volatility</b>	Vapour pressure = 0.35 mmHg at 25°C
<b>Specific gravity</b> <b>Vapour density</b>	1.1 (water = 1) 3.2 (air = 1)
<b>Flammability</b>	Combustible when exposed to heat, flames or oxidising materials
<b>Lower explosive limit</b>	1.3%
<b>Upper explosive limit</b>	9.5%
<b>Water solubility</b>	Moderately soluble in water
<b>Reactivity</b>	The solution in water is a weak acid. Reacts with oxidants generating fire and explosion hazard  Also incompatible with acids, aluminium chloride and calcium hypochlorite
<b>Reaction or degradation products</b>	Emits acrid smoke of irritating and flammable vapours when heated to decomposition
<b>Odour</b>	Distinctive sweet odour
<b>Structure</b>	
<b>References</b> International Programme on Chemical Safety. International Chemical Safety Card (ICSC) entry for phenol. ICSC 0070, 2017. World Health Organization: Geneva. Hazardous Substances Data Bank. Phenol. HSDB No. 113 (last revision date 15/10/2003). 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 03/2019).	

## Reported Effect Levels from Authoritative Sources

### Exposure by skin

%	Signs and symptoms	Reference
1	Can cause irritation, dermatitis and burns to the skin following prolonged contact. Often results in painless white or brown necrotic lesions	a
>3	Corrosive to the skin	b
30	Death within 30 minutes	c
80–100	Contact with solutions, emulsions or preparations at this concentration for 5–30 minutes has been reported to result in death	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><b>References</b></p> <p>a TOXBASE. Phenol, 02/2019. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 03/2019).</p> <p>b EC. Risk Assessment Report. Phenol, 2006. European Commission.</p> <p>c Agency for Toxic Substances and Disease Registry. Toxicological Profile for Phenol. 2008.</p>		

## Published Emergency Response Guidelines

### Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m <sup>3</sup> )
<b>ERPG-1*</b>	10 <sup>(1)</sup>	39
<b>ERPG-2†</b>	50	193
<b>ERPG-3‡</b>	200	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-](https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf)

[involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf](https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2016%20ERPG%20Table.pdf)

(accessed 03/2019).

### Acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 min	30 min	60 min	4 hours	8 hours
<b>AEGL-1*</b>	19	19	15	9.5	6.3
<b>AEGL-2†</b>	29	29	23	15	12
<b>AEGL-3‡</b>	NR	NR	NR	NR	NR

\* 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

NR Not recommended due to insufficient data

Level of distinct odour awareness (LOA) = 0.25 ppm

#### Reference

US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm>

(accessed 03/2019).



## 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>	2	7.8	4	16
WEL – workplace exposure limit, LTEL – long-term exposure limit, STEL – short-term exposure limit <b>Reference</b> Health and Safety Executive (HSE). EH40/2005 Workplace Exposure Limits, 3 <sup>rd</sup> Edition, 2018.				

### Public health guidelines

<b>Drinking water standard</b>	Data not available
<b>Air quality guideline</b>	Data not available

## Health Effects

### Major route of exposure

- Highly toxic via ingestion, inhalation and dermal contact

### Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
<b>Inhalation</b>	Irritating or corrosive depending on the concentration
<b>Ingestion</b>	Irritating or corrosive depending on the concentration. Significant ingestion can cause white/brown skin and mucosal burns which may be painless as phenol destroys nerve endings. Laryngeal oedema can occur, and oesophageal stricture may be a late complication
<b>Dermal</b>	Even dilute solutions (1%) can cause irritation, dermatitis and burns to the skin following prolonged contact. Often presents as relatively painless white or brown necrotic lesions; the brown discolouration may remain after healing
<b>Ocular</b>	Causes irritation at low concentrations. Can cause corrosive damage manifesting as conjunctival and corneal oedema, and blindness in severe cases
<b>Systemic features</b>	<p>Nausea, vomiting, diarrhoea, hypotension, tachycardia, cardiac arrhythmias, elevated anion-gap, metabolic acidosis, pallor, sweating and shock. CNS stimulation is followed by drowsiness, respiratory depression, cyanosis, convulsions, coma, bronchospasm, acute lung injury, rapid onset pulmonary oedema and death</p> <p>Methaemoglobinaemia is recognised. Acute Heinz-body anaemia and intravascular haemolysis have been reported</p> <p>There have been reports of hepatic dysfunction with rises of aminotranferases and prothrombin time compatible with acute liver injury</p> <p>Renal dysfunction and acute tubular necrosis is possible, potentially requiring haemodialysis. Hyperkalaemia has been reported</p> <p>Urine tends to be a dark green/black colour and can contain protein and free haemoglobin</p>
<b>References</b>	
TOXBASE. Phenol, 02/2019. <a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 03/2019).	

## 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.

Phenol causes corrosive effects on contact with skin (that can sometimes be painless due to local anaesthetic effect of phenol). Therefore, following disrobe, improvised wet decontamination should be considered (see below for details on wet 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.

## General advice on disrobe and decontamination

### Important notes

- primary responders should wear appropriate personal protective equipment (PPE)
- if the patient has not been decontaminated following surface contamination, secondary carers must wear appropriate NHS PPE for chemical exposure to avoid contaminating themselves

### 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 (e.g. 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

- 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

### 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

Home Office. Initial operational response to a CBRN incident. Version 2.0, July 2015. NHS England.

NHS England. Emergency Preparedness, Resilience and Response (EPRR). Guidance for the initial management of self presenters from incidents involving hazardous materials. February 2019.

## 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 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

### 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
- do **not** apply neutralising chemicals as heat produced during neutralization reactions may cause thermal burns, and increase injury
- 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 copious amounts of water under low pressure for at least 10–15 minutes, or until the pH of the skin is normal (pH of the skin is 4.5–6, although it may be closer to 7 in children, or after irrigation). **The earlier irrigation begins, the greater the benefit**
- pay particular attention to skin folds, fingernails and ears

### Dermal exposure

- decontaminate (as above) the patient following surface contamination
- following decontamination, recheck the pH of affected areas after a period of 15–20 minutes and repeat irrigation if abnormal. Burns with strong solutions may require irrigation for several hours or more
- once the pH is normal and stabilised, treat as for a thermal injury
- burns totalling more than 15% of body surface area in adults (more than 10% in children) will require standard fluid resuscitation as for thermal burns

- moderate/severe chemical burns should be reviewed by a burns specialist; excision or skin grafting may be required
- see below for management of systemic toxicity
- other supportive measures as indicated by the patients clinical condition

## Ocular exposure

- remove contact lenses if present
- anaesthetise the eye with a topical local anaesthetic (e.g. 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 (e.g. by an infusion bag with a giving set) for a minimum of 10-15 minutes irrespective of initial conjunctival pH. Amphoteric solutions are available and may be used. A Morgan Lens may be used if anaesthetic has been given. 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 discussed urgently with an ophthalmologist**
- other supportive measures as indicated by the patient's clinical condition

## Inhalation

- maintain a clear airway and adequate ventilation
- give oxygen if required
- monitor respiratory rate and oxygen saturation
- perform a 12 lead ECG in all patient who require assessment
- see below for management of systemic toxicity
- other supportive measures as indicated by the patient's clinical condition

## Ingestion and systemic toxicity (all routes of exposure)

- maintain a clear airway and ensure adequate ventilation
- **in severely affected patients critical care input is essential. Urgent assessment of the airway is required. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction**
- children are at increased risk of airway obstruction

- do **not** attempt gastric lavage
- do **not** give neutralising chemicals as heat produced during neutralisation reactions may increase injury
- monitor vital signs, cardiac rhythm and check capillary blood sugar
- perform a 12 lead ECG in all patients that require assessment
- other supportive measures as indicated by the patient's clinical condition

## Clinical decontamination and first aid references

TOXBASE	<a href="http://www.toxbase.org">http://www.toxbase.org</a> (accessed 03/2019)
TOXBASE	Phenol, 02/2019
TOXBASE	Phenols and cresols – features and management, 02/2019
TOXBASE	Chemicals splashed or sprayed into the eyes, 06/2017
TOXBASE	Skin decontamination – corrosives, 01/2018
TOXBASE	Corrosives – inhalation, 11/2018

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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