



Hydrogen Peroxide

Incident Management

Key Points

Fire

- strongly oxidising substance, reacts violently with combustible and reducing materials, particularly in the presence of metal catalysis
- attacks organic substances
- decomposes under the influence of light and on warming to produce oxygen
- in the event of a fire involving hydrogen peroxide, use fine water spray and liquid-tight fire kit with breathing apparatus

Health

- hydrogen peroxide may cause irritation, coughing and dyspnoea, with greater exposures leading to more severe and persistent irritation and pulmonary oedema
- ingestion may cause nausea, vomiting and haematemesis
- impaired consciousness, apnoea, stridor, cyanosis, convulsions and cardiac arrest may occur rapidly when concentrated solutions have been ingested
- may cause a whitening of the skin, inflammation, blistering and burns
- weaker solutions may cause blurred vision, burning and redness while stronger solutions may cause corneal ulceration or perforation
- gas embolism may occur from ingestion, intravenous injection or wound irrigation



Environment

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



Hazard Identification

Standard (UK) dangerous goods emergency action codes


Hydrogen peroxide, aqueous solution

UN		2014	Hydrogen peroxide, aqueous solution (with not less than 20% but not more than 60% hydrogen peroxide (stabilised as necessary))	
EAC		2P	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must, however, still be exercised to avoid unnecessary pollution to watercourses	
APP		-	-	
Hazards	Class	5.1	Oxidising substances	
	Sub-risks	8	Corrosive substances	
HIN		58	Oxidising substance (fire-intensifying), corrosive	
<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>Reference Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC) Part of Ricardo-AEA. The Stationery Office, 2017.</p>				




Hydrogen peroxide, aqueous solution, stabilized

UN		2015	Hydrogen peroxide, aqueous solution, stabilized with more than 60% hydrogen peroxide	
EAC		2P	Use fine water spray. Wear chemical protective clothing with liquid-tight connections for whole body in combination with breathing apparatus*. Danger that the substance can be violently or explosively reactive. Spillages and decontamination run-off may be washed to drains with large quantities of water. Due care must, however, still be exercised to avoid unnecessary pollution to watercourses	
APP		-	-	
Hazards	Class	5.1	Oxidising substances	
	Sub-risks	8	Corrosive substances	
HIN		559	Strongly oxidising (fire-intensifying) substance, which can spontaneously lead to violent reaction	
<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>Reference Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC) Part of Ricardo-AEA. The Stationery Office, 2017.</p>				

Hydrogen peroxide, aqueous solution

UN		2984	Hydrogen peroxide, aqueous solution (with not less than 8% but less than 20% hydrogen peroxide (stabilised as necessary))	
EAC		2R	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 may be washed to drains with large quantities of water. Due care must, however, still be exercised to avoid unnecessary pollution to watercourses	
APP		-	-	
Hazards	Class	5.1	Oxidising substances	
	Sub-risks	-	-	
HIN		50	Oxidising (fire-intensifying) 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 relevant standards such as BS 8428 or EN 14605, in combination with breathing apparatus BS EN137</p> <p>Reference</p> <p>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)***Hydrogen peroxide solution ...%**

Hazard class and category	Ox. Liq. 1	Oxidising liquid, category 1	
	Acute Tox. 4	Acute toxicity (oral and inhalation), category 4	
	Skin. Corr. 1A	Skin corrosive, category 1A	
Hazard statement	H271	May cause fire or explosion; strong oxidiser	
	H332	Harmful if inhaled	
	H302	Harmful if swallowed	
	H314	Causes severe skin burns and eye damage	
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 08/2018).			

Specific concentration limits

Concentration	Hazard class and category	Hazard statement	
C ≥ 70 %	Ox. Liq. 1	H271	May cause fire or explosion; strong oxidiser
50 % ≤ C < 70 %	Ox. Liq. 2	H272	May intensify fire; oxidiser
C ≥ 70 %	Skin Corr. 1A	H314	Causes severe skin burns and eye damage
50 % ≤ C < 70 %	Skin Corr. 1B	H314	Causes severe skin burns and eye damage
35 % ≤ C < 50 %	Skin Irrit. 2	H315	Causes skin irritation
8 % ≤ C < 50 %	Eye Dam. 1	H318	Causes serious eye damage
5 % ≤ C < 8 %	Eye Irrit. 2	H319	Causes serious eye irritation
C ≥ 35 %	STOT SE 3	H335	May cause respiratory irritation
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 08/2018).			

Physicochemical Properties

CAS number	7722-84-1
Molecular weight	34.0
Formula	H ₂ O ₂
Common synonyms	Dihydrogen dioxide, Hydrogen dioxide, Hydroperoxide
State at room temperature	Colourless liquid
Volatility	Vapour pressure = 1.97 mm Hg at 25°C
Specific gravity Vapour density	1.4 (90%) 1.3 (70%) (water=1) 1 (air=1)
Flammability	Not combustible. May ignite combustible materials
Lower explosive limit	-
Upper explosive limit	-
Water solubility	Miscible with water
Reactivity	Risk of fire and explosion on contact with heat or metal catalysts. Decomposes under the influence of light. Strong oxidant that reacts violently with combustible and reducing materials generating fire and explosion hazard particularly in the presence of metals. Attacks may organic substances e.g. textiles and paper
Reaction or degradation products	Decomposes on warming to produce oxygen
Odour	Slightly sharp odour
Structure	HO—OH
References	
Hazardous Substances Data Bank. Hydrogen peroxide HSDB No. 547 (last revision date 24/06/2005). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 08/2018)	
International Programme on Chemical Safety. International Chemical Safety Card entry for Hydrogen peroxide. ICSC 0164, 2000. World Health Organization, Geneva.	

Reported Effect Levels from Authoritative Sources

Exposure by ingestion

%	Signs and symptoms	Reference
≤ 5	Nausea, vomiting and flatulence (small quantities)	a
≤ 5	Severe toxicity following gas embolism (large quantities)	a
≥ 35	Severe toxicity and death	a
<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. Hydrogen Peroxide, 12/2015. http://www.toxbase.org (accessed 08/2018)</p>		

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	10	13.9
ERPG-2 [†]	50	69.5
ERPG-3 [‡]	100	139

* 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

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 08/2018).

Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	Not given				
AEGL-2 [†]					
AEGL-3 [‡]					

* 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

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	1	1.4	2	2.8
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 nd Edition, 2011.				

Public health guidelines

Guidelines not given

Health Effects

Major route of exposure

- inhalation, ingestion or skin contact

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	May cause respiratory tract irritation. Transient coughing and dyspnoea may follow inhalation of a dilute solution; however this may be more persistent where a concentrated solution is involved. Irritation may be severe, leading to pulmonary oedema 24 to 72 hours after exposure
Ingestion	May cause nausea, vomiting and haematemesis. Concentrated solutions may cause blistering of the mucosae and oropharyngeal burns. Foaming at the mouth may occur with a risk of obstruction to the respiratory tract and pulmonary aspiration. Impaired consciousness, apnoea, stridor, cyanosis, convulsions and cardiac arrest may occur rapidly when concentrated solutions have been ingested. Release of oxygen gas may cause belching and painful gastric distension
Dermal	May cause a whitening of the skin, inflammation, blistering and skin burns. Symptoms are expected to be mild when dilute solutions are involved
Ocular	Weak solutions may cause burning, redness and blurred vision. Stronger solutions (10% or more) may cause corneal ulceration or perforation
Other Information	Gas embolism may occur from ingestion, intravenous injection or wound irrigation
Reference	
TOXBASE. Hydrogen Peroxide, 12/2015. http://www.toxbase.org (accessed 08/2018)	

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.

Hydrogen peroxide is highly corrosive. Therefore, following disrobe, improvised wet decontamination should be considered (see below for details on wet decontamination).

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

- **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

- **safety first.** Avoid contaminating yourself. Wear protective clothing
- 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 neutralisation 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 special 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
- 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 or equivalent crystalloid (for example via an infusion bag with a giving set) for a minimum of 10 – 15 minutes irrespective of the initial conjunctival pH. 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 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
- perform a 12-lead ECG in all patients who require assessment
- other supportive measures as indicated by the patient's clinical condition

Ingestion

- maintain a clear airway and ensure adequate ventilation
- gut decontamination is contraindicated; hydrogen peroxide is rapidly decomposed, releasing oxygen gas
- monitor cardiac rhythm and respiration rate
- other supportive measures as indicated by the patient's clinical condition

Health effects and decontamination references

- TOXBASE <http://www.toxbase.org> (accessed 08/2018)
- TOXBASE Hydrogen peroxide – features and management, 01/2014
- TOXBASE Corrosives – inhalation, 09/2017
- TOXBASE Skin decontamination – corrosives, 01/2018
- TOXBASE Chemicals splashed or sprayed into the eyes, 06/2017
- TOXBASE Personal protective equipment and decontamination at the scene or in hospital

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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For queries relating to this document, please contact: chemcompendium@phe.gov.uk

For all other enquiries, please contact: phe.enquiries@phe.gov.uk

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