



Hydrogen Sulphide

Incident Management

Key Points

Fire

- extremely flammable
- reacts with strong oxidants generating fire and explosion hazard; attacks many metals and some plastics
- decomposes on burning, producing sulphur oxides
- in the event of a fire involving hydrogen sulphide, use fine water spray and chemical protective clothing with liquid-tight connections in combination with breathing apparatus

Health

- prolonged inhalation causes irritation, vomiting, diarrhoea, headaches, dizziness, drowsiness, tachycardia and convulsions
- inhalation of high concentrations leads rapidly to collapse, respiratory paralysis, coma, cardiac arrhythmias and death
- eye exposure causes pain, blepharospasm, lacrimation, conjunctivitis and photophobia
- dermal contact can result in itching, pain, redness and skin discolouration



Environment

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





Hazard Identification

Standard (UK) dangerous goods emergency action codes

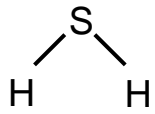
Hydrogen sulphide

UN		1053	Hydrogen sulphide	
EAC		2WE	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 should be prevented from entering drains and watercourses. There may be a public safety hazard outside the immediate area of the incident [†]	
APP		A(cf)	Gas-tight chemical protective suit with breathing apparatus [‡] Fire kit intended to protect against liquid flammable gas with a boiling point below -20°C	
Hazards	Class	2.3	Toxic gases	
	Sub-risks	2.1	Flammable gases	
HIN		263	Toxic gas, flammable	
<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>[†] 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>[‡] Normal fire kit in combination with gas-tight chemical protective clothing conforming to BS EN 943 part 2, thermal-resistant gloves should be worn such as those conforming to BS EN 511:2006 or BS EN 407:2004</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)***Hydrogen sulphide**

Hazard class and category	Press. Gas	Pressurised gas	
	Flam. Gas 1	Flammable gas, category 1	
	Acute Tox. 2	Acute toxicity (inhalation), category 2	
	Aquatic Acute 1	Acute hazard to the aquatic environment	
Hazard statement	H220	Extremely flammable gas	
	H330	Fatal if inhaled	
	H400	Very toxic to aquatic life	
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).			

Physicochemical Properties

CAS number	7783-06-4
Molecular weight	34.0
Formula	H ₂ S
Common synonyms	Dihydrogen sulphide
State at room temperature	Gas
Volatility	Vapour pressure = 1880 kPa at 20°C
Vapour density	1.19 (air = 1)
Flammability	Extremely flammable
Lower explosive limit	3.9 %
Upper explosive limit	45.5 %
Water solubility	Soluble in water: 0.5 g/100 mL water at 20°C
Reactivity	Heating may cause violent combustion or explosion. Reacts with strong oxidants generating fire and explosion hazard
Reaction or degradation products	Decomposes on burning – this produces sulphur oxides. Attacks many metals and some plastics
Odour	Strong rotten egg odour
Structure	
References	<p>Hazardous Substances Data Bank. Hydrogen sulphide HSDB No. 576 (last revision date 09/04/2013). US National Library of Medicine: Bethesda MD. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB (accessed 08/2018)</p> <p>International Programme on Chemical Safety. International Chemical Safety Card entry for Hydrogen sulphide. ICSC 0165, 2017. World Health Organization, Geneva.</p>

Reported Effect Levels from Authoritative Sources

Exposure by inhalation

ppm	mg/m ³	Signs and symptoms	Reference
2	2.8	Bronchial constriction in asthmatic individuals	a
3.6	5	Increased eye complaints	a
20	28	Fatigue, loss of appetite, headache, irritability, poor memory, dizziness	a
> 50	> 70	Severe damage to eye tissue (exposure of an hour or more)	b
> 100	> 140	Olfactory paralysis	b
320-530	450-750	Pulmonary oedema	c
≥ 500	≥ 700	Potentially fatal (rapid respiratory failure)	d, a
530-1,000	750-1,400	Strong CNS stimulation, hyperpnoea followed by respiratory arrest	c
800	1,112	Lethal concentration for 50% of an exposed human population for 5 minutes exposure (LC ₅₀)	d
1,000-2,000	1,400-2,800	Immediate collapse with respiratory paralysis	c

These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values

References

- a Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.
- b International Programme on Chemical Safety (IPCS), Hydrogen sulfide. Concise International Chemical Assessment Document 53, 2003, WHO: Geneva.
- c Scientific Committee on Occupational Exposure Limits (SCOEL), Hydrogen Sulphide - Occupational Exposure Limits and Biological Limit Values, 2007, European Union.
- d Health and Safety Executive (HSE). Managing hydrogen sulphide detection offshore. 2009 (As accessed 03/16).

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	0.1 ¹	0.14
ERPG-2 [†]	30	41.7
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

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 08/2018).

Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	0.75	0.60	0.51	0.36	0.33
AEGL-2 [†]	41	32	27	20	17
AEGL-3 [‡]	76	59	50	37	31

* 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

Level of distinct odour awareness = 0.01 ppm

Reference
US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 08/2018).

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	5	7	10	14

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, 2nd Edition, 2011.

Public health guidelines

WHO guideline value	<p>Not given</p> <p>It is unlikely that a person could consume a harmful dose of hydrogen sulphide from drinking-water; hence, a health-based guideline value has not been derived for this compound</p> <p>Taste and odour threshold estimated to be between: 0.05 and 0.1 mg/L</p>
Air quality guideline	0.15 mg/m ³ with an averaging time of 24 hours. Concentrations should not be allowed to exceed 7 µg/m ³ with a 30-minute averaging period

Reference
Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.
Guidelines for drinking-water quality: fourth edition incorporating the first addendum. Geneva: World Health Organization; 2017

Health Effects

Major route of exposure

- inhalation is the most likely route of exposure

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	<p>Prolonged exposure causes respiratory tract irritation, with rhinitis, pharyngitis, bronchitis, dyspnoea and pulmonary oedema</p> <p>Systemic effects include vomiting, diarrhoea, headache, nystagmus, dizziness, agitation, drowsiness, tremor, muscular weakness, convulsions, tachycardia and hypotension</p> <p>Inhalation of high concentrations leads rapidly to collapse, respiratory paralysis, cyanosis, convulsions, coma, cardiac arrhythmias and death within minutes</p>
Dermal	Pain, itching, redness and skin discolouration may occur. Exposure to the compressed liquid may cause frostbite injury
Ocular	Pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia. May cause corneal burns
<p>Reference</p> <p>TOXBASE. Hydrogen sulphide, 09/2013. http://www.toxbase.org (accessed 08/2018)</p>	

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.

Decontamination should not be necessary following exposure to hydrogen sulphide as it exists as a gas at room temperature. Hydrogen sulphide is stored as a liquid under pressure in cylinders; this liquid will rapidly volatilise if released, though it may cause thermal burns on contact with skin.

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.

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.

Clinical decontamination following surface contamination

- skin decontamination is unlikely to be necessary as hydrogen sulphide is a gas

Dermal exposure

- removing patient's clothing and washing the skin with water and a mild detergent may reduce the risk of odour related complaints in healthcare personnel, but this is not a priority if dealing with a critically ill patient
- if the skin has been exposed to compressed liquid treat frostbite injury conventionally
- 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
- remove from exposure and give oxygen in as high a concentration as possible

- monitor pulse, blood pressure, oxygen saturation and cardiac rhythm
- perform a 12-lead ECG in patients who require assessment

Health effects and decontamination references

TOXBASE <http://www.toxbase.org> (accessed 08/2018)

TOXBASE Hydrogen sulphide – features and management, 09/2013

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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