UK Health Security Agency

Ethanol

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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Contents

Main points

General

Ethanol is highly flammable liquid. It reacts violently with strong oxidising agents including nitric acid, silver nitrate, mercuric nitrate and magnesium perchlorate, causing a fire and explosion hazard. Ethanol vapour mixes well with air and explosive mixtures are easily formed.

Health

The main route of exposure is ingestion.

Features are dependent on a person's tolerance to alcohol. Ingestion may cause disinhibition, excitation, emotional liability, euphoria, decreased reaction time, diminished judgement, fine motor incoordination, dysarthria and nausea. In severe cases respiratory depression, hypotension, loss of protective airway reflexes (risk of aspiration), hypothermia, incontinence, coma, hypoglycaemia (particularly in children), seizures and death may occur.

Inhalation may cause irritation of the nose and throat with choking and coughing.

Exposure to the eye can cause burning, stinging and lacrimation.

Exposure to the skin can cause burning and stinging in high concentrations. Prolonged or repeated contact can have a drying or irritant effect.

Casualty decontamination at the scene

Following disrobe, improvised dry decontamination should be considered for an incident involving ethanol, 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 1a. Standard (UK) dangerous goods emergency action codes for ethanol (ethyl alcohol) or ethanol solution (ethyl alcohol solution), packing group II

UN		1170	Ethanol (ethyl alcohol) or ethanol solution (ethyl alcohol solution), packing group II	
EAC		• 2YE	Use alcohol-resistant foam but, if not available, fine water spray can be used. Wear normal fire kit 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]	
Hazards	**Class**	3	Flammable liquids and desensitised liquid explosives	
HIN		33	Highly flammable liquid (flash-point below 23°C)	

Abbreviations

UN = United Nations Number.
EAC = Emergency Action Code.
HIN = Hazard Identification Number.

Notes to Table 1a

Note 1: Normal firefighting clothing is appropriate, that is self-contained open circuit positive pressure compressed air breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, fire fighters' gloves conforming to BS EN 659 and firefighters' footwear conforming to BS EN 15090 (Footwear for firefighters) type F3- Hazmat and structural firefighting [CH – marking for chemical resistance] or alternatively firefighters' boots conforming to Home Office Specification A29 (rubber boots) or A30 (leather boots). Leather footwear including those conforming to A30 may not provide adequate chemical resistance therefore caution should be exercised in the use of these boots.

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.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List' 2023 (viewed on 26 September 2024)

Table 1b. Standard (UK) dangerous goods emergency action codes for ethanol (ethyl alcohol) or ethanol solution (ethyl alcohol solution), packing group III

UN		1170	Ethanol (ethyl alcohol) or ethanol solution (ethyl alcohol solution), packing group III	
EAC		• 2Y	Use alcohol-resistant foam but, if not available, fine water spray can be used. Wear normal fire kit 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.	
Hazards	**Class**	3	Flammable liquids and desensitised liquid explosives	
HIN		30	Flammable liquid (flash-point below 23°C and 60°C inclusive) or flammable liquid or solid in the molten state with a flash point above 60°C, heated to a temperature equal to or above its flash point, or self-heating liquid.	

Abbreviations

UN = United Nations Number.
EAC = Emergency Action Code.
HIN = Hazard Identification Number.

Notes to Table 1b

Note 1: Normal firefighting clothing is appropriate, that is self-contained open circuit positive pressure compressed air breathing apparatus conforming to BS EN 137 worn in combination with fire kit conforming to BS EN 469, fire fighters' gloves conforming to BS EN 659 and firefighters' footwear conforming to BS EN 15090 (Footwear for firefighters) type F3- Hazmat and structural firefighting [CH – marking for chemical resistance] or alternatively firefighters' boots conforming to Home Office Specification A29 (rubber boots) or A30 (leather boots). Leather footwear including those conforming to A30 may not provide adequate chemical resistance therefore caution should be exercised in the use of these boots.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. 'Dangerous Goods Emergency Action Code List' 2023 (viewed on 26 September 2024)

Table 2. The GB classification, labelling and packaging (CLP) regulation for ethanol (ethyl alcohol)

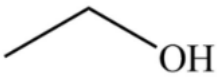
Hazard class and category	Flam. Liq. 2	Flammable liquid, category 2	
Hazard statement	H225	Highly flammable liquid and vapour	
Signal words	DANGER		

References

The Health and Safety Executive (HSE). 'GB CLP Regulation' (viewed on 26 September 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	64-17-5
Molecular weight	46.07
Formula	C_2H_6O
Common synonyms	Ethyl alcohol, grain alcohol
State at room temperature	Clear, colourless liquid
Volatility	Vapour pressure = 59.3 mmHg at 25°C, volatile
Specific gravity	0.8 (water = 1) 1.6 (air = 1)
Flammability	Highly flammable
Lower explosive limit	3.1%
Upper explosive limit	27.7%
Water solubility	Miscible in water
Reactivity	Reacts vigorously or explosively with strong oxidants such as nitric acid, silver nitrate, mercuric nitrate and magnesium perchlorate, causing fire and explosion hazard. Reacts slowly with calcium hypochlorite, silver oxide and ammonia, causing fire and explosion hazard. The vapour mixes well with air and explosive mixtures are easily formed.
Odour	Pleasant or vinous odour
Structure	

References

World Health Organization. International Programme on Chemical Safety International Chemical Safety Card entry for Ethanol (Anhydrous) ICSC 0044, 2018 (viewed on 3 October 2024)

PubChem Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. PubChem Compound Summary for CID 702, Ethanol (viewed on 3 October 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation of vapour

ppm	mg/L	Signs and symptoms	Reference
5000	9.6	Irritation and uncomfortable to breathe but tolerable	a
~5300-10000	10-20	Transient coughing and irritation to eyes and nose	a
~16000	30	Continuous lacrimation and marked coughing	a
>~20300	>40	Intolerable	a

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

Table 5. Exposure by ingestion

g/kg bw	mL/kg absolute ethanol	Signs and symptoms	Reference
3	4	Fatal dose in children	b
5-8	6-10	Fatal dose in adults	b

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. OECD Screening Information Data Set (SIDS). ‘Ethanol Initial Assessment Report for SIAM’ 2004 (viewed on 3 October 2024)

b. National Poisons Information Service (NPI). TOXBASE 'ethanol’ 2021 (viewed on 3 October 2024)

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs)

	Concentration				
	10 minutes	**30 minutes**	**60 minutes**	**4 hours**	**8 hours**
AEGL-1 [note 1]	No values specified				
AEGL-2 [note 2]					
AEGL-3 [note 3]					

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.

Exposure standards, guidelines or regulations

Table 7. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m³	ppm	mg/m³
WEL	1000	1920	No values specified	

Abbreviations

WEL = workplace exposure limit.

Reference

Health and Safety Executive (HSE). '[EH40/2005 Workplace Exposure Limits Fourth Edition]' 2020 (viewed on 3 October 2024)

Table 8. Public health standards and guidelines

Drinking water standard	No value specified
WHO guideline for drinking water quality	No value specified
UK indoor air quality guideline	No value specified
WHO indoor air quality guideline	No value specified
WHO air quality guideline	No value specified

Health effects

Ethanol toxicity increases risk of aspiration, coma and cardiorespiratory arrest. Features are dependent on a person's tolerance to alcohol.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms	
Inhalation	Irritation of the nose and throat with choking and coughing. CNS depression is possible at high doses.	
Contact with eyes	Stinging, burning, and lacrimation**.**	
Dermal	Burning and stinging in high concentrations. Prolonged or repeated contact can have a drying and irritant effect due to the defatting action of the skin. Contact urticaria and dermatitis have been reported.	
Ingestion	Mild	Disinhibition, excitation, emotional lability, sociable, talkative, euphoria, decreased reaction time, diminished judgement, fine motor incoordination, dysarthria, and nausea
	Moderate	Blurred vision, aggressive reaction, disorientation, confusion, ataxia, vasodilation, stupor, vomiting, and sweating
	Severe	Diplopia, marked incoordination, coma, hypothermia, hypoglycaemia, and convulsions may occur
	Potentially fatal	Respiratory depression, hypotension, loss of protective airway reflexes (leading to a risk of aspiration), incontinence, coma, hypoglycaemia (particularly in children) which can lead to convulsions. Cardiac arrhythmias (including atrial fibrillation and atrioventricular block) and myocardial infarction have been reported. Metabolic acidosis may be present and may be severe. Ketoacidosis may be present particularly following excessive ingestions in patients with a history of chronic ethanol abuse and malnutrition. Hypokalaemia, lactic acidosis, bradycardia, acute hepatitis, hypotonia. Rhabdomyolysis may occur especially following a period of unconsciousness.

Reference

National Poisons Information Service (NPIS). TOXBASE ‘Ethanol’ 2019 (viewed on 3 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 ethanol unless casualties are demonstrating signs or symptoms 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, Climate, and Environmental Hazards 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 a more structured intervention, such as an Interim Operational Response is carried out, or Specialist Operational Response are present.

Improvised dry decontamination

Improvised dry decontamination should be considered for an incident involving ethanol 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 2015 (viewed on 3 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' 2019 (viewed on 3 October 2024)

Joint Emergency Service Interoperability Programme. 'Initial Operational Response (IOR) to Incidents Suspected to Involve Hazardous Substances or CBRN Materials' 2024 (viewed 3 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 in a well-ventilated area, preferably with its own ventilation system.

The patient should remove soiled clothing and wash him or herself if possible.

Contaminated clothing should be removed, double-bagged, sealed and stored safely to prevent escape of volatile substances.

Decontaminate open wounds first and avoid contamination of unexposed skin. Wash hair and all contaminated skin with liberal amounts of water (preferably warm) and soap.

Pay special attention to skin folds, fingernails and ears.

Dermal exposure

Decontaminate (as above) the patient following surface contamination.

If features of systemic toxicity are present manage as per ingestion.

Chemical burns totalling more than 15% of body surface area in adults (> 10% in children) will require standard fluid resuscitation as for thermal burns.

Cover affected area with a clean non-adherent dressing.

Chemical burns should be reviewed by a burns specialist. Excision or skin grafting may be required.

Other measures as indicated by the patient's clinical condition.

Ocular exposure

If symptomatic immediately irrigate the affected eye thoroughly.

At home, use lukewarm tap water, trickled into the eye or in a small cup held over the eye socket. An eye dropper is an alternative.

In hospital, immediately irrigate the affected eye thoroughly with 1000 mL 0.9% saline or equivalent crystalloid (for example via an infusion bag with a giving set) for a minimum of 10 to 15 minutes. A Morgan Lens may be used if anaesthetic has been given.

If symptoms persist seek medical assistance.

Other supportive measures as indicated by the patient’s clinical condition.

Inhalation

Symptomatic and supportive management only.

Ingestion

Maintain a clear airway and adequate ventilation.

In the event of cardiac arrest in hospital or witnessed out of hospital cardiac arrest with bystander CPR, resuscitation should be continued for at least one hour and only stopped after discussion with a senior clinician.

Prolonged resuscitation for cardiac arrest may be appropriate following poisoning as recovery with good neurological outcome may occur.

Gut decontamination (including activated charcoal) is unlikely to be of benefit

Monitor vital signs and check capillary glucose.

Check and record pupil size.

Monitor capillary blood glucose using reagent strips in all patients.

If hypothermic, rewarm slowly using conventional means.

Other supportive measures as indicated by the patient's clinical condition.

Clinical decontamination and first aid references

National Poisons Information Service (NPIS). TOXBASE 'Ethanol' 2021 (viewed on 3 October 2024)

National Poisons Information Services (NPIS). TOXBASE 'Eye irritants – features and management' 2022 (viewed on 3 October 2024)

National Poisons Information Services (NPIS). TOXBASE 'Skin decontamination – solvents' 2019 (viewed on 3 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.

This document from the UKHSA Radiation, Chemicals, Climate, and Environmental Hazards Directorate 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@ukhsa.gov.uk or enquiries@ukhsa.gov.uk

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