



UK Health
Security
Agency

Acrylonitrile

Incident management

Contents

Main points.....	3
General.....	3
Health.....	3
Casualty decontamination at the scene.....	3
Environment.....	3
Hazard identification.....	4
Physicochemical properties.....	7
Reported effect levels from authoritative sources.....	8
Published emergency response guidelines.....	9
Exposure standards, guidelines or regulations.....	10
Health effects.....	11
Decontamination at the scene.....	12
Disrobe.....	12
Improvised decontamination.....	13
Improvised dry decontamination.....	13
Improvised wet decontamination.....	13
Additional notes.....	14
Interim wet decontamination.....	14
Decontamination at the scene references.....	14
Clinical decontamination and first aid.....	15
Important notes.....	15
Clinical decontamination following surface contamination.....	15
Dermal exposure.....	16
Ocular exposure.....	16
Ingestion and inhalation.....	17
Clinical decontamination and first aid references.....	17
About the UK Health Security Agency.....	18

Main points

General

Acrylonitrile has a pungent, sweet odour and is a flammable liquid at room temperature. It reacts violently with strong acids and oxidants. When heated to decomposition, it will release toxic fumes of hydrogen cyanide and nitrogen oxide.

Health

Highly toxic by ingestion and toxic by inhalation and skin contact. Acrylonitrile is metabolised by the body to cyanide.

Presentation of symptoms following ingestion or skin contact may be delayed. Early features of exposure include non-specific symptoms such as headache, nausea, dizziness and anxiety followed by confusion, drowsiness, tachycardia and palpitations. Severe cases may result in deep coma, cardiovascular collapse and respiratory depression.

Eye exposure can cause pain, lacrimation, photophobia and corneal burns.

Casualty decontamination at the scene


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

Hazard identification

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

UN		1093	Acrylonitrile, stabilized	
EAC		3WE	Use normal foam, that is, 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]	
APP		A(fl)	Gas-tight chemical protective suit with breathing apparatus Fire kit intended to protect against flammable liquid	
Hazards	Class	3	Flammable liquids and desensitised liquid explosives	
	Sub-risks	6.1	Toxic substance	
HIN		336	Highly flammable liquid, toxic	

Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

Note 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.

Reference

'[Dangerous Goods Emergency Action Code List](#)' National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. The Stationery Office (2023)

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

Hazard class and category	Flam. Liq. 2	Flammable liquid, category 2	
	Acute Tox. 3	Acute toxicity (oral, dermal, inhalation), category 3	
	Skin Irrit. 2	Skin irritation, category 2	
	Skin Sens. 1	Skin sensitizer, category 1	
	Eye Dam. 1	Serious eye damage/eye irritation	
	STOT SE 3	Specific target organ toxicity following single exposure, category 3	
	Carc. 1B	Carcinogenicity, category 1B	

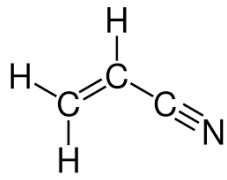
	Aquatic Chronic 2	Chronic hazard to the aquatic environment, category 2	
Hazard statement	H225	Highly flammable liquid and vapour	
	H301	Toxic if swallowed	
	H311	Toxic in contact with skin	
	H315	Causes skin irritation	
	H317	May cause an allergic skin reaction	
	H318	Causes serious eye damage	
	H331	Toxic if inhaled	
	H335	May cause respiratory irritation	
	H350	May cause cancer	
	H411	Toxic to aquatic life with long lasting effects	
Signal words	DANGER		

References

The Health and Safety Executive (HSE). '[GB CLP Regulation](#)' (viewed November 2023).

Physicochemical properties

Table 3. Physicochemical properties

CAS number	107-13-1
Molecular weight	53
Formula	C ₃ H ₃ N
Common synonyms	2-Propenenitrile; Cyanoethylene; Vinyl cyanide
State at room temperature	Liquid
Volatility	Vapour pressure = 109 mmHg at 25°C
Specific gravity	0.8 (water = 1) 1.8 (air = 1)
Flammability	Flammable
Lower explosive limit	3.1%
Upper explosive limit	17%
Water solubility	Soluble in water
Reactivity	<p>Polymerises when heated and under the influence of light and bases which generates a fire and explosion. Reacts violently with strong acids and strong oxidants. Attacks plastics and rubber.</p> <p>Releases toxic fumes including hydrogen cyanide and nitrogen oxides when heated to decomposition</p>
Odour	Pungent or sweet odour
Structure	 <p>The structure shows a central carbon atom double-bonded to a CH2 group and single-bonded to a CH group. The CH group is further single-bonded to a carbon atom that is triple-bonded to a nitrogen atom.</p>

References

International Programme on Chemical Safety. [International Chemical Safety Card entry for Acrylonitrile](#). ICSC 0092, 2001. World Health Organization (viewed November 2023).

PubChem, Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. '[PubChem Compound Summary for CID 7855, Acrylonitrile](#)' (cited 1 December 2023).

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation of vapours

ppm	mg/m ³	Signs and symptoms	Reference
16 to 100	35 to 220	Headache, nausea, fullness in the chest and irritation of eyes, nose, throat and skin (20 to 45 minute exposure)	a

Table 5. Dermal exposure to vapours

ppm	mg/m ³	Signs and symptoms	Reference
16 to 100	35 to 220	Skin irritation	a

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. Agency for Toxic Substances and Disease Registry (ATSDR) (2023). '[Toxicological profile for Acrylonitrile \(draft for public comment\)](#)' 2023

Published emergency response guidelines

Table 6. Acute exposure guideline levels (AEGLs)

	Concentration (ppm)				
	10 minutes	30 minutes	60 minutes	4 hours	8 hours
AEGL-1 [note 1]	1.5	1.5	NR	NR	NR
AEGL-2 [note 2]	8.6	3.2	1.7	0.48	0.26
AEGL-3 [note 3]	130	50	28	9.7	5.2

Notes to Table 5

[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.

NR = Not reported due to insufficient data

Reference

US Environmental Protection Agency (EPA) '[Acute exposure guideline levels](#)' (viewed October 2023).

Exposure standards, guidelines or regulations

Table 7. Occupational standards

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m ³	ppm	mg/m ³
WEL	2	4.4	Not specified	

Abbreviations

WEL = workplace exposure limit.

LTEL = long-term exposure limit.

STEL = short-term exposure limit.

Reference

HSE. [‘EH40/2005 Workplace Exposure Limits, Fourth Edition’](#) (2020)

Table 8. Public health standards and guidelines

UK drinking water standard	No value specified
WHO guideline for drinking water quality	No guideline value specified
WHO air quality guideline	The estimated excess lifetime risk of lung cancer at an air concentration of 1µg/m ³ is 1.7 x 10 ⁻⁵

Reference

WHO Regional Office for Europe (2000). [‘Air quality guidelines for Europe, European Series, number 91, second edition’](#)

Health effects

Highly toxic by ingestion, inhalation, and skin contact. Acrylonitrile can be metabolised to cyanide.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation or Ingestion	<p>Initial features include headache, nausea, dizziness and anxiety followed by confusion, drowsiness, tachycardia, palpitations and tachypnoea.</p> <p>Cases of moderate toxicity may cause brief episodes of unconsciousness, convulsions, vomiting and hypotension.</p> <p>Cases of severe toxicity may cause deep coma, fixed unreactive pupils, cardiovascular collapse, respiratory depression, myocardial ischaemia, cardiac arrhythmias and pulmonary oedema.</p> <p>Sinus bradycardia or AV dissociation may occur in pre-terminal patients. Characteristic features include cherry red skin and bitter almond odour on the patient's breath, but this only occurs in 10 to 15% of cases.</p> <p>Profound lactic acidosis causing high anion gap metabolic acidosis is the most consistent feature of moderate and severe poisoning.</p>
Eyes	Pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia. Acidic and alkaline solutions may cause corneal burns.
Dermal	Systemic toxicity from dermal exposure requires a large surface area to be affected. Onset of toxicity may be delayed for several hours.

Reference

[TOXBASE](#) 'Acrylonitrile' February 2019 (viewed October 2023).

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 acrylonitrile 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 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

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

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 (July 2015)
- NHS England. '[Emergency preparedness, resilience and response \(EPRR\): guidance for the initial management of self-presenters from incidents involving hazardous materials](#)' (February 2019)
- JESIP. '[Initial operational response IOR to incidents suspected to involve hazardous substances or CBRN Materials](#)' (January 2023)

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

Acrylonitrile can be metabolised to cyanide. There are antidotes available for the treatment of cyanide poisoning. Further information is available on TOXBASE.

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

Carry out decontamination after resuscitation.

This should be performed in a well-ventilated area, preferably with its own ventilation system.

Avoid contaminating yourself with this product and wash any exposed area.

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 copious amounts of 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.

Maintain a clear airway and ensure adequate ventilation.

If appropriate, remove from exposure and give oxygen.

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

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 final conjunctival pH of 7.5 to 8.0. The conjunctivae may be tested with indicator paper. Retest 20 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

Maintain a clear airway and ensure adequate ventilation.

Administer oxygen to achieve adequate oxygenation.

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.

Clinical decontamination and first aid references

- TOXBASE (viewed October 2023).
- TOXBASE Acrylamide (2019)
- TOXBASE 'Chemicals splashed or sprayed into the eyes: features and clinical management' (2020)
- TOXBASE 'Skin decontamination: irritants' (2019)

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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