



Hydrazine

Incident Management

Key Points

Fire

- flammable
- reacts violently with many metals, metal oxides and porous materials, causing a fire and explosion hazard; very dangerous fire hazard when exposed to heat or flame
- emits toxic fumes of ammonia, hydrogen and nitrogen oxides when heated to decomposition
- in the event of a fire involving hydrazine use alcohol-resistant foam but, if not available, fine water spray can be used and chemical protective clothing with liquid-tight connections and breathing apparatus

Health

- highly toxic by any route of exposure
- inhalation causes irritation of the nose, sore throat, cough, chest tightness, shortness of breath and pulmonary oedema
- ingestion may cause a burning sensation in the mouth and throat with retrosternal and abdominal pain
- dermal exposure causes irritation after contact with liquid or vapour that may develop into severe burns, dermatitis and subsequent sensitisation
- ocular exposure causes eye itching, burning and swelling of the eyes, blurred vision and conjunctivitis




Environment

- hazardous to the environment; inform the Environment Agency of substantial incidents

Hazard Identification

Standard (UK) dangerous goods emergency action codes

Hydrazine, anhydrous

UN		2029	Hydrazine, anhydrous	
EAC		●2WE ⁽¹⁾	Use alcohol-resistant foam but, if not available, fine water spray can be used. 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(fl)	Gas-tight chemical protective suit with breathing apparatus [‡] Flammable liquid	
Hazards	Class	8	Corrosive substances	
	Sub-risks	3	Flammable liquids	
		6.1	Toxic substance	
HIN		–	–	

UN – United Nations number, EAC – emergency action code, APP – additional personal protection, HIN – hazard identification number

⁽¹⁾ Not applicable to the carriage of dangerous goods under RID or ADR

* 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



[†] 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

[‡] 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



Reference

Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2015.








Hydrazine aqueous solution with more than 37% hydrazine by mass, packing group I

UN		2030	Hydrazine aqueous solution with more than 37% hydrazine by mass, packing group I	
EAC		●2X	Use alcohol-resistant foam but, if not available, fine water spray can be used. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP		B	Gas-tight chemical protective suit with breathing apparatus [†]	
Hazards	Class	8	Corrosive substances	
	Sub-risks	6.1	Toxic substance	
HIN		886	Highly corrosive substance, toxic	
<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>† Chemical protective clothing should be gas tight conforming to BS EN 943 part 2 in combination with breathing apparatus conforming to BS EN 137</p> <p>Reference</p> <p>Dangerous Goods Emergency Action Code List, National Chemical Emergency Centre (NCEC), Part of Ricardo-AEA. The Stationery Office, 2015.</p>				

Hydrazine aqueous solution with more than 37% hydrazine by mass, packing group II & III

UN		2030	Hydrazine aqueous solution with more than 37% hydrazine by mass, packing group II & III	
EAC		●2X	Use alcohol-resistant foam but, if not available, fine water spray can be used. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses	
APP		–	–	
Hazards	Class	8	Corrosive substances	
	Sub-risks	6.1	Toxic substance	
HIN		86	Corrosive or slightly corrosive substance, toxic	
<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, 2015.</p>				

Classification, labelling and packaging (CLP)*

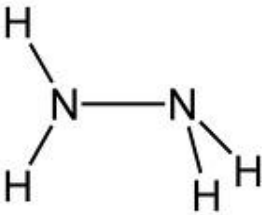
Hazard class and category	Flam. Liq. 3	Flammable liquid, category 3	
	Carc. 1B	Carcinogenicity, categories 1B	
	Acute Tox. 3	Acute toxicity (oral, dermal, inhalation), category 3	
	Skin Corr. 1B	Skin corrosion, category 1	
	Skin Sens. 1	Skin sensitiser, category 1	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	
	Aquatic Chronic 1	Chronic hazards to the aquatic environment, category 1	
	Hazard statement	H226	Flammable liquid and vapour
H350		May cause cancer	

	H331	Toxic if inhaled
	H311	Toxic in contact with skin
	H301	Toxic if swallowed
	H314	Causes severe skin burns and eye damage
	H317	May cause an allergic skin reaction
	H400	Very toxic to aquatic life
	H410	Very toxic to aquatic life with long lasting effects
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 07/2015).		

Specific concentration limits

Concentration	Hazard class and category	Hazard statement	
$C \geq 10\%$	Skin Corr. 1B	H314	Causes severe skin burns and eye damage
$3\% \leq C < 10\%$	Skin Irrit. 2	H315	Causes skin irritation
$3\% \leq C < 10\%$	Eye Irrit. 2	H319	Causes serious eye 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 07/2015).			

Physicochemical Properties

CAS number	302-01-2
Molecular weight	32.1
Formula	N_2H_4 / H_2N-NH_2
Common synonyms	Diamide, diamine, nitrogen hydride
State at room temperature	Colourless liquid
Volatility	Vapour pressure: 14.4 mmHg at 25°C
Specific gravity Vapour density	1.01 (water = 1) 1.1 (air = 1)
Flammability	Flammable
Lower explosive limit	4.7%
Upper explosive limit	100%
Water solubility	Miscible in water
Reactivity	Hydrazine is a very dangerous fire hazard when exposed to heat or flame. It reacts violently with many metals, metal oxides and porous materials, causing a fire and explosion hazard. It is a strong reducing agent and reacts violently with oxidants. The substance is a medium strong base
Reaction or degradation products	Decomposes to produce ammonia fumes, hydrogen and nitrogen oxides
Odour	Ammonia odour
Structure	
References	<p>Hydrazine (HAZARDTEXT™ Hazard Management). In Klasco RK (Ed): TOMES® System, Truven Healthcare Analytics Inc, Greenwood Village CO, US. RightAnswer.com Inc, Midland MI, US. http://www.rightanswerknowledge.com (accessed 07/2015).</p> <p>International Programme on Chemical Safety. International Chemical Safety Card entry for hydrazine. ICSC 0281, 2009. World Health Organization: Geneva.</p>

Reported Effect Levels from Authoritative Sources

Exposure by ingestion

mL	Signs and symptoms	Reference
20–50	Severe intoxication, may be lethal	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>Reference</p> <p>a International Programme on Chemical Safety. Hydrazine. Environmental Health Criteria No. 68, 1991. World Health Organization: Geneva.</p>		

Published Emergency Response Guidelines

Emergency response planning guideline (ERPG) values

	Listed value (ppm)	Calculated value (mg/m ³)
ERPG-1*	0.5	0.6
ERPG-2 [†]	5	6.5
ERPG-3 [‡]	30	39

* 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). 2015 Emergency Response Planning Guideline Values. <https://www.aiha.org/get-involved/AIHAGuidelineFoundation/EmergencyResponsePlanningGuidelines/Documents/2015%20ERPG%20Levels.pdf> (accessed 09/2015).

Acute exposure guideline levels (AEGLs)

	ppm				
	10 min	30 min	60 min	4 hours	8 hours
AEGL-1*	0.1	0.1	0.1	0.1	0.1
AEGL-2 [†]	23	16	13	3.1	1.6
AEGL-3 [‡]	64	45	35	8.9	4.4

* 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

Reference
US Environmental Protection Agency. Acute Exposure Guideline Levels. <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 05/2015).

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	0.02	0.03	0.1	0.13
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

Drinking water standard	No guideline specified
Air quality guideline	No guideline specified
Soil guideline values and health criteria values	No guideline specified

Health Effects

Major route of exposure

- highly toxic by any route of exposure and corrosive
- absorbed through the skin and by inhalation

Immediate signs or symptoms of acute exposure

Route	Signs and symptoms
Inhalation	Inhalation of vapours can cause irritation of the nose, sore throat, cough, chest tightness, shortness of breath and pulmonary oedema. Acute inhalation causes nausea, vomiting and dizziness. Systemic toxicity is possible
Ingestion	Ingestion may cause a burning sensation in the mouth and throat with retrosternal and abdominal pain. There is a risk of oedema, airway compromise and burns to the oesophagus and gastrointestinal tract with more concentrated solutions. Systemic toxicity may occur
Dermal	Caustic effects are likely with significant exposure. Lesser exposure may cause skin irritation, dermatitis and subsequent sensitisation. Systemic toxicity is possible
Ocular	Exposure to hydrazine vapour causes itching, burning and swelling of the eyes, blurred vision and conjunctivitis. Features may develop over several hours after exposure to the vapour. Exposure to high concentrations of vapour may cause temporary blindness lasting for approximately 24 hours. Liquid hydrazine is likely to cause corrosive injury to the eye
Systemic	Headache, dizziness, nausea and vomiting are common. Hypotension may occur. Agitation, lethargy, confusion, tremor and convulsions or coma may occur after a delay and/or be prolonged for several days. Methaemoglobinaemia has been reported. Hepatic toxicity is common. Hypoglycaemia, or hyperglycaemia followed by hypoglycaemia, may develop, depending upon liver glycogen stores Haematuria and oliguria may occur Paraesthesia and peripheral neuropathy of the limbs may persist for several weeks after exposure
References	
TOXBASE. Hydrazine, 05/2016. http://www.toxbase.org (accessed 11/2016).	

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.

Hydrazine liquid and vapour are 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 persons individually.

Detailed information on clinical management can be found on TOXBASE – www.toxbase.org.

Important notes

- if the patient has not been decontaminated following surface contamination, secondary carers must wear appropriate NHS PPE for chemical exposure to avoid contaminating themselves
- **hydrazine can self-ignite in contact with cloth; remove soiled clothes rapidly but carefully**
- carry out decontamination after resuscitation; resuscitate the patient according to standard guidelines

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 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 particular attention to mucous membranes, moist areas such as skin folds, fingernails and ears

Dermal exposure

- decontaminate (as above) the patient following surface contamination
- for systemic toxicity see 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 (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 (eg by an infusion bag with a giving set). A Morgan Lens may be used if anaesthetic has been given. Irrigate for 10–15 minutes irrespective of initial conjunctival pH. 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 ensure adequate ventilation
- give oxygen if required
- **in severely affected patients, especially those with tachypnoea, stridor or upper airway damage, critical care input is essential with urgent assessment of the airway. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction**
- perform 12 lead ECG
- other supportive measures as indicated by the patient's clinical condition

Ingestion

- maintain a clear airway and ensure adequate ventilation
- give oxygen if required
- **in severely affected patients, especially those with tachypnoea, stridor or upper airway damage, critical care input is essential with urgent assessment of the airway. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction**
- the use of water (maximum initial volume = 100 - 200 mL in an adult; 2 mL/kg in a child) as diluent in the management of corrosive ingestion may be of some symptomatic benefit (but caution is necessary as mucosal damage / perforation may have already developed).
- there is experimental evidence to suggest that early dilution therapy with water or milk reduces acute alkali injury of the oesophagus but administration of large volumes of fluid should be avoided as they may induce vomiting and increase the risk of oedema

- perform 12 lead ECG
- other supportive measures as indicated by the patient's clinical condition

Clinical decontamination and first aid references

TOXBASE <http://www.toxbase.org> (accessed 06/2016)
TOXBASE Hydrazine, 05/2016
TOXBASE Chemical splashed or sprayed into the eyes, 02/2014

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.

© Crown copyright 2016, www.gov.uk/phe

Re-use of Crown copyright material (excluding logos) is allowed under the terms of the Open Government Licence, visit www.nationalarchives.gov.uk/doc/open-government-licence/version/3/ for terms and conditions.

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

First published: January 2016

Update: November 2016 Health Effects, Decontamination at the Scene & Clinical Decontamination and First Aid