

Ammonia

Incident management

Key Points

Fire

- Anhydrous ammonia is non flammable. Ammonia vapour in air is flammable and may explode when ignited
- Chemically stable under normal conditions
- Emits toxic fumes of ammonia and oxides of nitrogen when heated to decomposition
- In the event of a fire involving ammonia, use fine water spray and liquid-tight protective clothing with breathing apparatus

Health



- Exposure by any route may be dangerous
- Secondary contamination may occur
- CHIP Classification: toxic and corrosive
- Inhalation causes irritation of the eyes and nose with sore throat, cough, chest tightness, headache, tachycardia and confusion. Pulmonary oedema may take up to 36 hours to develop
- Ingestion causes immediate burning of the mouth and throat, drooling, difficulty swallowing, abdominal pain, vomiting and haematemesis. Haemorrhagic or hypovolaemic shock and airway obstruction from laryngeal and/or epiglottic oedema are features of severe cases.
- Dermal exposure causes deep, full thickness burns
- Ocular exposure causes pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia. In severe cases corneal burns, glaucoma and cataracts may occur


Environment

- Dangerous for the environment
- Inform Environment Agency of substantial release incidents

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes^(a)


UN		1005	Ammonia, anhydrous	
EAC		2RE	Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus . Spillages and decontamination run-off may be washed to drains with large quantities of water. There may be a public safety hazard outside the immediate area of the incident**.	
APP		A(c)	Liquefied gas with boiling point below -20 °C. Gas-tight chemical protective suit with breathing apparatus*** .	
Hazards	Class	2.3	Toxic gases	
	Sub risks	8	Corrosive substance	
HIN		268	Toxic gas, corrosive	



UN		2073	Ammonia solution (35 – 50 %)	
EAC		2RE	Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus* . Spillages and decontamination run-off may be washed to drains with large quantities of water. There may be a public safety hazard outside the immediate area of the incident** .	
APP		-		
Hazards	Class	2.2	Non flammable, non toxic gases	
	Sub risks	-		
HIN		20	Asphyxiant gas or gas with no subsidiary risk	

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

^a Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2009.

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

UN		2672	Ammonia solution (10 – 35 %)	
EAC		2R	Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off may be washed to drains with large quantities of water.	
APP		-		
Hazards	Class	8	Corrosive substance	
	Sub risks	-		
HIN		80	Corrosive or slightly corrosive substance	

UN		3318	Ammonia solution (>50 %)	
EAC		2RE	Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off may be washed to drains with large quantities of water. There may be a public safety hazard outside the immediate area of the incident**.	
APP		B	Gas-tight chemical protective suit with breathing apparatus**.	
Hazards	Class	2.3	Toxic gases	
	Sub risks	8	Corrosive substance	
HIN		268	Toxic gas, corrosive	

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

* Liquid-tight chemical protective clothing (BS 8428) in combination with self-contained open circuit positive pressure compressed air 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.

*** Gas-tight chemical protective clothing (BS EN 943) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

^a Dangerous Goods Emergency Action Code List, The Stationery Office, 2009.

Chemical Hazard Information and Packaging for Supply Classification^(a)



Ammonia, anhydrous

Classification	F	Flammable	
	T	Toxic	
	C	Corrosive	
	N	Dangerous for the environment	
Risk phrases	R10	Flammable	
	R23	Toxic by inhalation	
	R34	Causes burns	
	R50	Very toxic to aquatic organisms	
Safety phrases	S(1/2)	Keep locked up out of the reach of children	
	S9	Keep container in a well ventilated place	
	S16	Keep away from sources of ignition- No smoking	
	S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice	
	S36/37/39	Wear suitable protective clothing, gloves and eye/face protection	
	S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)	
	S61	Avoid release to the environment. Refer to special instructions / safety data sheet	

^a Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.2.

<http://esis.jrc.ec.europa.eu/index.php?PGM=cla> (accessed 11/2011)

Ammonia... %





Classification	C	Corrosive	
	N	Dangerous for the environment	
Risk phrases	R34	Causes burns	
	R50	Very toxic to aquatic organisms	
Safety phrases	S(1/2)	Keep locked up out of the reach of children	
	S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice	
	S36/37/39	Wear suitable protective clothing, gloves and eye/face protection	
	S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)	
	S61	Avoid release to the environment. Refer to special instructions / safety data sheet	

Specific concentration limits

Concentration	Classification
C ≥ 10 %	C; R34
5 % ≤ C < 10 %	Xi; R36/37/38

Globally Harmonised System of Classification and Labelling of Chemicals (GHS)^(a)

Ammonia, anhydrous



Hazard Class and Category	Flam. Gas 2	Flammable gas, category 2	No symbol
	Press. Gas	Compressed gas	
	Acute Tox. 3	Acute toxicity (oral, dermal, inhalation), category 3	
	Skin Corr. 1B	Skin corrosion, categories 1B	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	
Hazard Statement	H221	Flammable gas	
	H331	Toxic if inhaled	
	H314	Causes severe skin burns and eye damage	
	H400	Very toxic to aquatic life	
Signal Words	DANGER		

Implemented in the EU on 20 January 2009.

^a Annex VI to Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging of Substances and Mixtures- Table 3.1.

<http://esis.jrc.ec.europa.eu/index.php?PGM=cla> (accessed 11/2011)

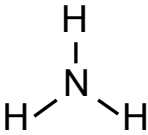
Ammonia... %

Hazard Class and Category	Skin Corr. 1B	Skin corrosion, categories 1B	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	
Hazard Statement	H314	Causes severe skin burns and eye damage	
	H400	Very toxic to aquatic life	
Signal Words	DANGER		

Specific concentration limits

Concentration	Hazard Class and Category	Hazard Statement	
C ≥ 5 %	STOT SE 3; H335	H335	May cause respiratory irritation

Physicochemical Properties

CAS number	7664-41-7
Molecular weight	17
Empirical Formula	NH ₃
Common synonyms	Hydrogen nitride
State at room temperature	Gas
Volatility	Vapour pressure = 7600 mm Hg at 25.7 °C
Specific gravity	0.8 at 21 °C (air = 1)
Flammability	Anhydrous ammonia is non flammable. Ammonia vapour in air is flammable and may explode when ignited
Lower explosive limit	15 %
Upper explosive limit	28 %
Water solubility	Highly soluble, forming solutions of ammonium hydroxide and evolving heat
Reactivity	Stable. Incompatible with strong oxidising substances, acids, calcium hypochlorite bleaches and halogens. Liquid ammonia attacks some plastics, rubbers and coatings. Corrosive to copper and galvanised surfaces.
Reaction or degradation products	Emits toxic fumes of ammonia and oxides of nitrogen when heated to decomposition
Odour	Characteristic, pungent odour of drying urine
Structure	

References^(a,b,c)

^a Ammonia (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System. Thomson Micromedex, Greenwood Village, Colorado (accessed 08/2010).

^b The Merck Index (14th Edition). Entry 492: ammonia, 2006.

^c The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 1, 1999.

Threshold Toxicity Values

EXPOSURE VIA INHALATION		
ppm	mg m⁻³	SIGNS AND SYMPTOMS
50	35	Slight irritation to eyes, nose and throat
100	70	Rapid irritation to eye and respiratory tract
700	488	Immediately irritating to eyes and throat
1500	1045	Pulmonary oedema and coughing
2500	1742	Life threatening

Reference^(a)

^a International Programme on Chemical Safety, Environmental Health Criteria 54: Ammonia, 1986.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values^(a)

	Listed value (ppm)	Calculated value (mg m ⁻³)
ERPG-1*	25 [^]	18
ERPG-2**	150	105
ERPG-3***	750	525

* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr 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 hr 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 hr without experiencing or developing life-threatening health effects.

[^] Odour should be detectable near ERPG-1.

Acute Exposure Guideline Levels (AEGLs)^(b)

	ppm				
	10 min	30 min	60 min	4 hr	8 hr
AEGL-1[†]	30	30	30	30	30
AEGL-2^{††}	220	220	160	110	110
AEGL-3^{†††}	2700	1600	1100	550	390

[†] The level of the chemical in air at or above which the general population could experience notable discomfort.

^{††} The 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.

^{†††} The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

^a American Industrial Hygiene Association (AIHA). Emergency Response Planning Guideline Values and Workplace Environmental Exposure Level Guides Handbook, Fairfax, VA, 2010.

^b U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 01/2011).

Exposure Standards, Guidelines or Regulations

Occupational standards

WEL^(a)	LTEL(8 hour reference period): 25 ppm (18 mg m ⁻³)
	STEL(15 min reference period): 35 ppm (25 mg m ⁻³)

Public health guidelines

DRINKING WATER QUALITY GUIDELINE^(b)	0.5 mg L ⁻¹ as NH ₄
AIR QUALITY GUIDELINE	No guideline value specified
SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES	No guideline values specified

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

^a List of approved workplace exposure limits (as consolidated with amendments October 2007). <http://www.hse.gov.uk/coshh/table1.pdf> (An update to EH40/2005: Workplace Exposure Limits 2005. The Stationery Office, London) (accessed 01/2011).

^b The Water Supply (Water Quality) Regulations 2000 (England) and the Water Supply (Water Quality) Regulations 2001 (Wales) (accessed 01/2011).

Health Effects

Major routes of exposure^(a)

- Toxic by any route of exposure (ingestion, inhalation, dermal or ocular exposure)

Immediate Signs or Symptoms of Acute Exposure^(b-e)

- Inhalation causes irritation of eyes and nose with sore throat, cough, chest tightness, headache, fever, wheeze, tachycardia and confusion. Chemical pneumonitis, tachypnoea, dyspnoea and stridor due to laryngeal oedema may follow. Pulmonary oedema with increasing breathlessness, wheeze, hypoxia and cyanosis may take up to 36h to develop. Optic neuropathy has been reported following both acute and chronic inhalation.
- Ingestion can cause immediate pain with burning in the mouth, throat and stomach. This may be followed by abdominal pain, vomiting, haematemesis and dyspnoea. Pain and oedema may make swallowing difficult, causing drooling. Haemorrhagic or hypovolaemic shock and airway obstruction from laryngeal and/or epiglottic oedema are features of severe cases. Stridor and respiratory complications (including pneumonitis, pulmonary oedema, ARDS and pulmonary necrosis) can develop following aspiration of corrosive materials. Alkalis often damage the oesophagus. However, ingestion of large volumes can also involve the stomach and small intestines. Ulceration may be sufficiently severe to cause perforation with complications including mediastinitis, pneumonitis and cardiac injury. The depths of the burns are usually much greater with alkalis, and may continue to develop some time after exposure.
- Systemic features may include circulatory collapse, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, haemolysis and disseminated intravascular coagulation (DIC).
- Dermal exposure causes direct damage to tissues by the saponification of fats. This causes liquefaction burns and necrosis with a softening of the tissues which can further lead to deep tissue penetration and full thickness burns.
- Ocular exposure causes pain, blepharospasm, lacrimation, conjunctivitis, palpebral oedema and photophobia. Alkaline solutions may cause corneal burns and may penetrate all layers of the eye and find their way into the chambers causing iritis, anterior and posterior synechia, corneal opacification, cataracts, glaucoma and retinal atrophy.

TOXBASE - <http://www.toxbase.org> (accessed 01/2011)

^a TOXBASE: Ammonia, 07/2001.

^b TOXBASE: Corrosives – inhalation, 06/2010

^c TOXBASE: Corrosives – ingestion, 07/2010.

^d TOXBASE: Skin decontamination – corrosives, 06/2010.

^e TOXBASE: Chemicals splashed or sprayed into the eyes, 07/2007.

Decontamination and First Aid

Important Notes

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Secondary contamination may occur.

Dermal Exposure^(a,b)

- Remove patient from exposure.
- The patient should remove all clothing and personal effects.
- Double-bag soiled clothing and place in a sealed container clearly labelled as a chemical hazard.
- Brush away any adherent solid particles and gently blot away any adherent liquid from the patient.
- Wash hair and all contaminated skin with copious amounts of water (preferably warm) and soap for at least 10-15 minutes. Decontaminate open wounds first and avoid contamination of unexposed skin. The earlier the irrigation begins, the greater the benefit.
- Pay special attention to skin folds, axillae, ears, fingernails, genital areas and feet.
- Cover affected area with a clean non-adherent dressing.
- Burns totalling more than 15% of body surface area in adults (> 10% in children) will require standard fluid resuscitation as for thermal burns.
- Chemical burns should be reviewed by a burns specialist.
- Apply other supportive measures as indicated by the patient's clinical condition.

Ocular Exposure^(c)

- Remove patient from exposure.
- Remove contact lenses if necessary and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes.
- Patients with corneal damage or those whose symptoms do not resolve rapidly should be referred for urgent ophthalmological assessment.

Inhalation^(d)

- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give oxygen to symptomatic patients.
- All patients with abnormal vital signs, chest pain, respiratory symptoms or hypoxia should have a 12 lead ECG performed.

TOXBASE - <http://www.toxbase.org> (accessed 01/2011)

^a TOXBASE: Ammonia, 07/2001.

^b TOXBASE: Skin decontamination - corrosives, 06/2010.

^c TOXBASE: Chemicals splashed or sprayed into the eyes, 07/2007.

^d TOXBASE: Corrosives – inhalation, 06/2010

- If the patient has clinical features of bronchospasm treat conventionally with nebulised bronchodilators and steroids.
- Endotracheal intubation, or rarely, tracheostomy may be required for life threatening laryngeal oedema.
- Apply other supportive measures as indicated by the patient's clinical condition.

Ingestion^(a)

- MAINTAIN AIRWAY AND ESTABLISH HAEMODYNAMIC STABILITY
- In severely affected patients critical care input is essential. Urgent assessment of the airway is required. A supraglottic-epiglottic burn with erythema and oedema is usually a sign that further oedema will occur that may lead to airway obstruction. It is an indication for consideration of early intubation or tracheotomy.
- Do **NOT** attempt gastric lavage.
- Do **NOT** give neutralising chemicals as heat produced during neutralization reactions may increase injury.
- The use of water or milk (maximum initial volume = 100 - 200 mL in an adult; 2 mL/kg in a child) as diluents in the management of corrosive ingestion may be of some symptomatic benefit (*but caution is necessary following large ingestions where 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.
- Monitor BP, pulse and oxygen saturation.
- Treat haemorrhagic or hypovolaemic shock by replacing lost fluids and blood intravenously.
- Apply other supportive measures as indicated by the patient's condition.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.

^a TOXBASE: Corrosives – ingestion, 07/2010.