



AMMONIA ANHYDROUS LIQUEFIED

Chemwatch Material Safety Data Sheet
Issue Date: 12-Nov-2009
NC317TCP

Hazard Alert Code: HIGH

CHEMWATCH 1005
Version No:6
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Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

AMMONIA ANHYDROUS LIQUEFIED

SYNONYMS

NH₃, H₃-N, "ammonia gas", "liquefied ammonia liquid", "anhydrous gaseous ammonia", "spirit of hartshorn", Praxair

PROPER SHIPPING NAME

AMMONIA, ANHYDROUS

PRODUCT USE

■ The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation. Operators should be trained in procedures for safe use of this material.

Refrigerant gas; manufacture of fertilizers and nitric acid. Metal treatment and extraction of metals from ores. Processing crude oil, Manufacture of ammonium salts, dyes, pharmaceuticals, rayon and polymers.

SUPPLIER

Company: A- Gas (Australia) Pty Ltd

Address:

9- 11 Oxford Road

Laverton North

VIC 3026

Australia

Telephone: [+61] (0) 3 9368 9222

Emergency Tel: **ORICA: [+61] 1800 033 111**

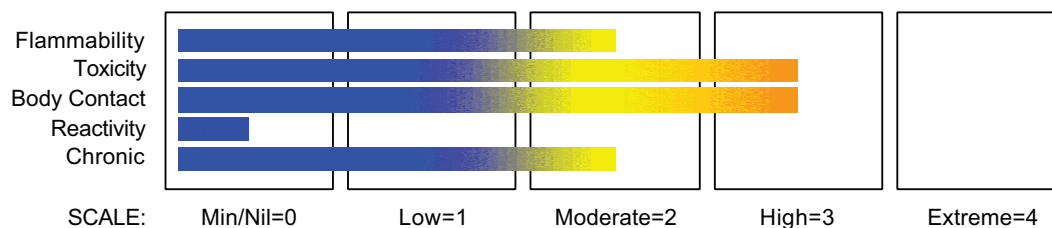
Fax: [+61] (0) 3 9368 9233

Section 2 - HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE

HAZARDOUS SUBSTANCE. DANGEROUS GOODS. According to NOHSC Criteria, and ADG Code.

CHEMWATCH HAZARD RATINGS



continued...

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Section 2 - HAZARDS IDENTIFICATION



RISK

- Flammable.
 - Toxic by inhalation.
 - Causes burns.
 - Risk of serious damage to eyes.
 - Risk of explosion if heated under confinement.
 - Very toxic to aquatic organisms.
 - Ingestion may produce health damage*.
 - Cumulative effects may result following exposure*.
- * (limited evidence).

SAFETY

- Keep locked up.
- Do not breathe gas/ fumes/ vapour/ spray.
- Avoid contact with eyes.
- Wear suitable protective clothing.
- In case of insufficient ventilation, wear suitable respiratory equipment.
- Use only in well ventilated areas.
- Keep container in a well ventilated place.
- Keep in a cool place.
- To clean the floor and all objects contaminated by this material, use water.
- Keep container tightly closed.
- This material and its container must be disposed of in a safe way.
- Keep away from food, drink and animal feeding stuffs.
- Take off immediately all contaminated clothing.
- In case of accident or if you feel unwell, IMMEDIATELY contact Doctor or Poisons Information Centre (show label if possible).
- Use appropriate container to avoid environment contamination.
- Avoid release to the environment. Refer to special instructions/ safety data sheets.
- This material and its container must be disposed of as hazardous waste.
- In case of accident by inhalation: remove casualty to fresh air and keep at rest.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
ammonia anhydrous liquefied	7664-41-7	>98
dissolves in water forming ammonia	1336-21-6	^

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Section 4 - FIRST AID MEASURES

SWALLOWED

- For advice, contact a Poisons Information Centre or a doctor.
- Not considered a normal route of entry.

EYE

- If product comes in contact with eyes remove the patient from gas source or contaminated area.
- Take the patient to the nearest eye wash, shower or other source of clean water.
- Open the eyelid(s) wide to allow the material to evaporate.
- Gently rinse the affected eye(s) with clean, cool water for at least 15 minutes. Have the patient lie or sit down and tilt the head back. Hold the eyelid(s) open and pour water slowly over the eyeball(s) at the inner corners, letting the water run out of the outer corners.
- The patient may be in great pain and wish to keep the eyes closed. It is important that the material is rinsed from the eyes to prevent further damage.
- Ensure that the patient looks up, and side to side as the eye is rinsed in order to better reach all parts of the eye(s)
- Transport to hospital or doctor.
- Even when no pain persists and vision is good, a doctor should examine the eye as delayed damage may occur.
- If the patient cannot tolerate light, protect the eyes with a clean, loosely tied bandage.
- Ensure verbal communication and physical contact with the patient.

DO NOT allow the patient to rub the eyes

DO NOT allow the patient to tightly shut the eyes

DO NOT introduce oil or ointment into the eye(s) without medical advice

DO NOT use hot or tepid water.

SKIN

■ If skin or hair contact occurs:

- Immediately flush body and clothes with large amounts of water, using safety shower if available.
- Quickly remove all contaminated clothing, including footwear.
- Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
- Transport to hospital, or doctor.

In case of cold burns (frost-bite):

- Move casualty into warmth before thawing the affected part; if feet are affected carry if possible
- Bathe the affected area immediately in luke-warm water (not more than 35 deg C) for 10 to 15 minutes, immersing if possible and without rubbing
- DO NOT apply hot water or radiant heat.
- Apply a clean, dry, light dressing of "fluffed-up" dry gauze bandage
- If a limb is involved, raise and support this to reduce swelling
- If an adult is involved and where intense pain occurs provide pain killers such as paracetamol
- Transport to hospital, or doctor
- Subsequent blackening of the exposed tissue indicates potential of necrosis, which may require amputation.

INHALED

- Following exposure to gas, remove the patient from the gas source or contaminated area.
- NOTE: Personal Protective Equipment (PPE), including positive pressure self-contained breathing apparatus may be required to assure the safety of the rescuer.
- Prostheses such as false teeth, which may block the airway, should be removed, where possible, prior to initiating first aid procedures.
- If the patient is not breathing spontaneously, administer rescue breathing.
- If the patient does not have a pulse, administer CPR.

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- If medical oxygen and appropriately trained personnel are available, administer 100% oxygen.
- Summon an emergency ambulance. If an ambulance is not available, contact a physician, hospital, or Poison Control Centre for further instruction.
- Keep the patient warm, comfortable and at rest while awaiting medical care.
- MONITOR THE BREATHING AND PULSE, CONTINUOUSLY.
- Administer rescue breathing (preferably with a demand-valve resuscitator, bag-valve mask-device, or pocket mask as trained) or CPR if necessary.
- Inhalation of vapours or aerosols (mists, fumes) may cause lung oedema.
- Corrosive substances may cause lung damage (e.g. lung oedema, fluid in the lungs).
- As this reaction may be delayed up to 24 hours after exposure, affected individuals need complete rest (preferably in semi-recumbent posture) and must be kept under medical observation even if no symptoms are (yet) manifested.
- Before any such manifestation, the administration of a spray containing a dexamethasone derivative or beclomethasone derivative may be considered.

This must definitely be left to a doctor or person authorised by him/her.
(ICSC13719).

NOTES TO PHYSICIAN

■ Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation is therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorised by him/her should be considered.
(ICSC24419/24421).

for irritant gas exposures:

- the presence of the agent when it is inhaled is evanescent (of short duration) and therefore, cannot be washed away or otherwise removed
 - arterial blood gases are of primary importance to aid in determination of the extent of damage. Never discharge a patient significantly exposed to an irritant gas without obtaining an arterial blood sample.
 - supportive measures include suctioning (intubation may be required), volume cycle ventilator support (positive and expiratory pressure (PEEP), steroids and antibiotics, after a culture is taken
 - If the eyes are involved, an ophthalmologic consultation is recommended
- Occupational Medicine: Third Edition; Zenz, Dickerson, Horvath 1994 Pub: Mosby.

For acute or short term repeated exposures to ammonia and its solutions:

- Mild to moderate inhalation exposures produce headache, cough, bronchospasm, nausea, vomiting, pharyngeal and retrosternal pain and conjunctivitis. Severe inhalation produces laryngospasm, signs of upper airway obstruction (stridor, hoarseness, difficulty in speaking) and, in excessively, high doses, pulmonary oedema.
- Warm humidified air may soothe bronchial irritation.
- Test all patients with conjunctival irritation for corneal abrasion (fluorescein stain, slit lamp exam)
- Dyspneic patients should receive a chest X-ray and arterial blood gases to detect pulmonary oedema.

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

- Water spray or fog.
- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.

FIRE FIGHTING

■ -----
GENERAL

continued...

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Section 5 - FIRE FIGHTING MEASURES

-
- Alert Fire Brigade and tell them location and nature of hazard.
 - May be violently or explosively reactive.
 - Wear full body protective clothing with breathing apparatus.
 - Fight fire from a safe distance, with adequate cover.
 - If safe, switch off electrical equipment until vapour fire hazard removed.
 - Use water delivered as a fine spray to control fire and cool adjacent area.
 - DO NOT approach cylinders suspected to be hot.
 - Cool fire exposed cylinders with water spray from a protected location.
 - If safe to do so, remove cylinders from path of fire.
 - Equipment should be thoroughly decontaminated after use.

FIRE FIGHTING PROCEDURES:

-
- Excessive pressures may develop in a gas cylinder exposed in a fire; this may result in explosion.
 - Cylinders with pressure relief devices may release their contents as a result of fire and the released gas may constitute a further source of hazard for the fire-fighter.

Cylinders without pressure-relief valves have no provision for controlled release and are therefore more likely to explode if exposed to fire.

FIRE FIGHTING REQUIREMENTS:

-
- Positive pressure, self-contained breathing apparatus is required for fire-fighting of hazardous materials.
 - Full structural fire-fighting (bunker) gear is the minimum acceptable attire.
 - The need for proximity, entry and special protective clothing should be determined for each incident, by a competent fire-fighting safety professional.

FIRE/EXPLOSION HAZARD

- Containers may explode when heated - Ruptured cylinders may rocket
 - May burn but does not ignite easily.
 - Fire exposed cylinders may vent contents through pressure relief devices thereby increasing vapour concentration.
 - Fire may produce irritating, poisonous or corrosive gases.
 - Runoff may create fire or explosion hazard.
 - May decompose explosively when heated or involved in fire.
 - Contact with gas may cause burns, severe injury and/ or frostbite.
 - POISONOUS: MAY BE FATAL IF INHALED, SWALLOWED OR ABSORBED THROUGH SKIN.
- Decomposition may produce toxic fumes of: nitrogen oxides (NO_x).
- Contains low boiling substance: Closed containers may rupture due to pressure buildup under fire conditions.

FIRE INCOMPATIBILITY

- None known.

HAZCHEM

2RE

Personal Protective Equipment

Breathing apparatus.
Gas tight chemical resistant suit.
Limit exposure duration to 1 BA set 30 mins.

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Section 6 - ACCIDENTAL RELEASE MEASURES

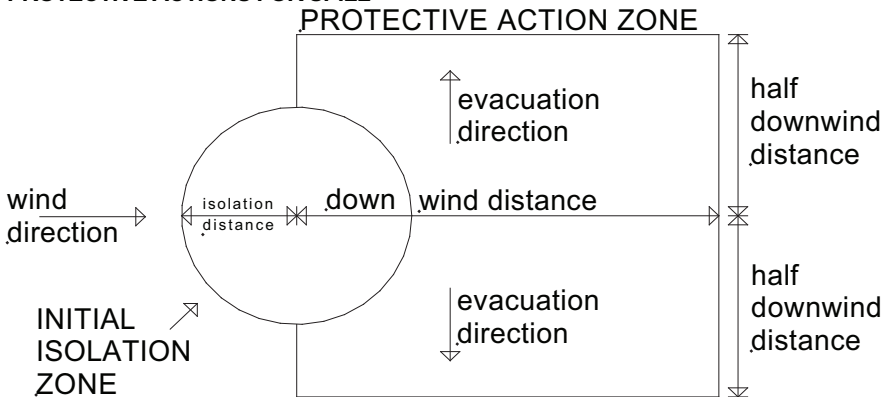
MINOR SPILLS

- Avoid breathing vapour and any contact with liquid or gas. Protective equipment including respirator should be used.
- DO NOT enter confined spaces where gas may have accumulated.
- Increase ventilation.
- Clear area of personnel.
- Stop leak only if safe to do.
- Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve.
- Do not exert excessive pressure on the valve; do not attempt to operate a damaged valve
- Orientate cylinder so that the leak is gas, not liquid, to minimise rate of leakage
- Keep area clear of personnel until gas has dispersed.

MAJOR SPILLS

- Clear area of all unprotected personnel and move upwind.
- Alert Emergency Authority and advise them of the location and nature of hazard.
- Wear full body clothing with breathing apparatus.
- Prevent by any means available, spillage from entering drains and water-courses.
- Consider evacuation.
- Increase ventilation.
- No smoking or naked lights within area.
- Stop leak only if safe to do.
- Water spray or fog may be used to disperse vapour.
- DO NOT enter confined space where gas may have collected.
- Keep area clear until gas has dispersed.
- Remove leaking cylinders to a safe place.
- Fit vent pipes. Release pressure under safe, controlled conditions
- Burn issuing gas at vent pipes.
- DO NOT exert excessive pressure on valve; DO NOT attempt to operate damaged valve.

PROTECTIVE ACTIONS FOR SPILL



From US Emergency Response Guide 2000
Guide 125

SMALL SPILLS

Name	Isolation Distance	Downwind Day	Protection Night
Ammonia, anhydrous	100 ft (30 m)	0.1 mile (0.2 km)	0.1 mile (0.2 km)

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LARGE SPILLS

Name	Isolation Distance	Downwind Day	Protection Night
Ammonia, anhydrous	200 ft (60 m)	0.3 mile (0.5 km)	0.7 mile (1.1 km)
From IERG (Canada/Australia)			
Isolation Distance	100 metres		
Downwind Protection Distance	800 metres		
IERG Number	7		

FOOTNOTES

- 1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
- 2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
- 3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
- 4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills".
LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
- 5 Guide 125 is taken from the US DOT emergency response guide book.
- 6 IERG information is derived from CANUTEC - Transport Canada.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG)

The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour WITHOUT experiencing or developing

life-threatening health effects is:
ammonia anhydrous liquefied 750ppm

irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:
ammonia anhydrous liquefied 150ppm

other than mild, transient adverse effects without perceiving a clearly defined odour is:
ammonia anhydrous liquefied 25ppm

American Industrial Hygiene Association (AIHA)

Ingredients considered according to the following cutoffs

Very Toxic (T+)	>= 0.1%	Toxic (T)	>= 3.0%
R50	>= 0.25%	Corrosive (C)	>= 5.0%
R51	>= 2.5%		
else	>= 10%		

where percentage is percentage of ingredient found in the mixture

Personal Protective Equipment advice is contained in Section 8 of the MSDS.

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Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- Consider use in closed pressurised systems, fitted with temperature, pressure and safety relief valves which are vented for safe dispersal.
- Consider the use of doubly-contained piping; diaphragm or bellows sealed, soft seat valves; backflow prevention devices; flash arrestors; and flow monitoring or limiting devices. Gas cabinets, with appropriate exhaust treatment, are recommended, as is automatic monitoring of the secondary enclosures and work areas for release.
- Use a pressure reducing regulator when connecting cylinder to lower pressure (<100 psig) piping or systems
- Use a check valve or trap in the discharge line to prevent hazardous back-flow into the cylinder
- Check regularly for spills or leaks. Keep valves tightly closed but do not apply extra leverage to hand wheels or cylinder keys.
- Valve protection caps must remain in place unless container is secured with valve outlet piped to use point.
- Do NOT drag, slide or roll cylinders - use a suitable hand truck for cylinder movement
- Test for leakage with brush and detergent - NEVER use a naked flame.
- Do NOT heat cylinder by any means to increase the discharge rate of product from cylinder.
- Leaking gland nuts may be tightened if necessary.
- If a cylinder valve will not close completely, remove the cylinder to a well ventilated location (e.g. outside) and, when empty, tag as FAULTY and return to supplier.
- Obtain a work permit before attempting any repairs.
- DO NOT attempt repair work on lines, vessels under pressure.
- Atmospheres must be tested and O.K. before work resumes after leakage.
- When connecting or replacing cylinders take care to avoid airborne particulates violently ejected when system pressurises.
- DO NOT transfer gas from one cylinder to another.

SUITABLE CONTAINER

- Cylinder:
- Ensure the use of equipment rated for cylinder pressure.
- Ensure the use of compatible materials of construction.
- Valve protection cap to be in place until cylinder is secured, connected.
- Cylinder must be properly secured either in use or in storage.
- Cylinder valve must be closed when not in use or when empty.
- Segregate full from empty cylinders.

WARNING: Suckback into cylinder may result in rupture. Use back-flow preventive device in piping.

STORAGE INCOMPATIBILITY

- For ammonia:
- Ammonia forms explosive mixtures with oxygen, chlorine, bromine, fluorine, iodine, mercury, platinum and silver.
- Fire and/or explosion may follow contact with acetaldehyde, acrolein, aldehydes, alkylene oxides, amides, antimony, boron, boron halides, bromine chloride, chloric acid, chlorine monoxide, o-chloronitrobenzene, 1-chloro-2,4-nitrobenzene, chlorosilane, chloromelamine, chromium trioxide, chromyl chloride, epichlorohydrin, hexachloromelamine, hypochlorites (do NOT mix ammonia with liquid household bleach), isocyanates, nitrogen tetraoxide, nitrogen trichloride, nitril chloride, organic anhydrides, phosphorous trioxide, potassium ferricyanide, potassium mercuric cyanide, silver chloride, stibine, tellurium halides, tellurium hypopentachloride, tetramethylammonium amide, trimethylammonium amide, trioxygen difluoride, vinyl acetate.
- Shock-, temperature-, and pressure sensitive compounds are formed with antimony, chlorine, germanium compounds, halogens, heavy metals, hydrocarbons, mercury oxide, silver compounds (azides, chlorides,

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nitrates, oxides).

- Vapours or solutions of ammonia are corrosive to copper, copper alloys, galvanised metal and aluminium. Mixtures of ammonia and air lying within the explosive limits can occur above aqueous solutions of varying strengths.
- Avoid contact with sodium hydroxide, iron and cadmium.
- Several incidents involving sudden "boiling" (occasionally violent) of a concentrated solution (d, 0.880, 35 wt %.) have occurred when screw-capped winchesters are opened. These are attributable to supersaturation of the solution with gas caused by increases in temperature subsequent to preparation and bottling. The effect is particularly marked with winchesters filled in winter and opened in summer.
- Ammonia polymerises violently with ethylene oxide.
- Ammonia attacks some coatings, plastics and rubber.
- Attacks copper, bronze, brass, aluminium, steel and their alloys.
- Avoid contact with copper, aluminium and their alloys.
- Compressed gases may contain a large amount of kinetic energy over and above that potentially available from the energy of reaction produced by the gas in chemical reaction with other substances.

PACKAGING MATERIAL INCOMPATIBILITIES

Chemical Name	Container Type
Ammonia, anhydrous	" ABS plastic" , " Acetal (Delrin)" , Brass, Bronze, Copper, " Fluorocarbon (FKM)" , Hypalon, Hytrel, " Natural rubber" , Polycarbonate, Polyurethane, Viton

STORAGE REQUIREMENTS

- Cylinders should be stored in a purpose-built compound with good ventilation, preferably in the open.
- Such compounds should be sited and built in accordance with statutory requirements.
- The storage compound should be kept clear and access restricted to authorised personnel only.
- Cylinders stored in the open should be protected against rust and extremes of weather.
- Cylinders in storage should be properly secured to prevent toppling or rolling.
- Cylinder valves should be closed when not in use.
- Where cylinders are fitted with valve protection this should be in place and properly secured.
- Gas cylinders should be segregated according to the requirements of the Dangerous Goods Act.
- Preferably store full and empty cylinders separately.
- Check storage areas for hazardous concentrations of gases prior to entry.
- Full cylinders should be arranged so that the oldest stock is used first.
- Cylinders in storage should be checked periodically for general condition and leakage.
- Protect cylinders against physical damage. Move and store cylinders correctly as instructed for their manual handling.

NOTE: A 'G' size cylinder is usually too heavy for an inexperienced operator to raise or lower.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



+: *May be stored together*

O: *May be stored together with specific preventions*

X: *Must not be stored together*

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m ³	STEL ppm	STEL mg/m ³
Australia Exposure Standards	ammonia anhydrous liquefied (Ammonia)	25	17	35	24
Australia Exposure Standards	ammonia (Ammonia)	25	17	35	24

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m ³)	Revised IDLH Value (ppm)
ammonia anhydrous liquefied		300

MATERIAL DATA

AMMONIA ANHYDROUS LIQUEFIED:

■ for exposure to ammonia gas/ vapours:

Odour Threshold Value: Variously reported as 0.019 ppm and 55 ppm; AIHA Value 16.7 ppm (detection)

NOTE: Detector tubes for ammonia, measuring in excess of 1 ppm, are commercially available.

The TLV-TWA is thought to be protective against irritation of the eyes and respiratory tract and minimise discomfort among workers that are not inured to its effects and systemic damage. Acclimatised persons are able to tolerate prolonged exposures of up to 100 ppm without symptoms. Marked irritation has been seen in persons exposed to ammonia concentrations between 50 and 100 ppm only when the exposures involved sudden concentration peaks which do not permit short-term acclimatisation. The detoxification capacity of the liver is significant since the amount of ammonia formed endogenously in the intestines markedly exceeds that from external sources.

Human exposure effects, at vapour concentrations of about:

Concentration (ppm)	Possible Effects
5	minimal irritation
9- 50	nasal dryness, olfactory fatigue and moderate irritation
125- 137	definite nose, throat and chest irritation
140	slight eye irritation
150	laryngeal spasm
500	30 minute exposures may produce cyclic hypernea, increased blood pressure and pulse rate, and upper respiratory tract irritation which may persist for 24 hours
700	immediate eye irritation
1, 500- 10, 000	dyspnea, convulsive coughing, chest pain, respiratory spasm, pink frothy sputum, rapid asphyxia and delayed pulmonary oedema which may be fatal. Other effects include runny nose, swelling of the lips, restlessness, headache, salivation, nausea, vomiting, glottal oedema, pharyngitis, tracheitis, and speech difficulties. Bronchopneumonia, asphyxiation due to spasms, inflammation, and oedema of the larynx, may be fatal. Residual effects include hoarseness, productive cough, and decreased respiratory function

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

>2, 500 severe eye irritation, with swelling of the eyelids, lachrymation, blepharospasm, palpebral oedema, increased intraocular pressure, oval semi- dilated, fixed pupils, corneal ulceration (often severe) and temporary blindness. Depending on duration of exposure, there may be destruction of the epithelium, corneal and lenticular opacification, and iritis accompanied by hypopyon or haemorrhage and possible loss of pigment from the posterior layer of the iris. Less severe damage is often resolved. In the case of severe damage, symptoms may be delayed; late complications including persistent oedema, vascularisation and corneal scarring, permanent opacity, acute angle glaucoma, staphyloma, cataract, and atrophy of the retina, iris, and symblepharon. Long- term exposure to sub- acute concentrations or single exposures to high concentrations may produce chronic airway dysfunction, alveolar disease, bronchiolitis, bronchiectasis, emphysema and anxiety neuroses

Odour Safety Factor(OSF)
OSF=3.8 (AMMONIA).

PERSONAL PROTECTION



EYE

- Chemical goggles.
- Full face shield may be required for supplementary but never for primary protection of eyes
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59].

HANDS/FEET

- When handling sealed and suitably insulated cylinders wear cloth or leather gloves.
- Insulated gloves:

NOTE: Insulated gloves should be loose fitting so that may be removed quickly if liquid is spilled upon them. Insulated gloves are not made to permit hands to be placed in the liquid; they provide only short-term protection from accidental contact with the liquid.

OTHER

- Overalls.
- PVC Apron.
- PVC protective suit may be required if exposure severe.
- Eyewash unit.
- Ensure there is ready access to a safety shower.

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

RESPIRATOR

- Positive pressure, full face, air-supplied breathing apparatus should be used for work in enclosed spaces if a leak is suspected or the primary containment is to be opened (e.g. for a cylinder change)
- Air-supplied breathing apparatus is required where release of gas from primary containment is either suspected or demonstrated.

GLOVE SELECTION INDEX

■ Glove selection is based on a modified presentation of the: "Forsberg Clothing Performance Index".
The effect(s) of the following substance(s) are taken into account in the computer-generated selection: ammonia anhydrous liquefied

■ Protective Material CPI *

BUTYL/NEOPRENE	A
VITON/NEOPRENE	A
CPE	A
SARANEX- 23	B

■ * CPI - Chemwatch Performance Index

A: Best Selection

B: Satisfactory; may degrade after 4 hours continuous immersion

C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

RESPIRATOR

■ Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half- face Respirator	Full- Face Respirator
1000	10	K- AUS	-
1000	50	-	K- AUS
5000	50	Airline *	-
5000	100	-	K- 2
10000	100	-	K- 3
	100+		Airline**

* - Continuous Flow

** - Continuous-flow or positive pressure demand.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required. For further information consult site specific CHEMWATCH data (if available), or your Occupational Health and Safety Advisor.

ENGINEERING CONTROLS

- CARE: Explosive vapour air mixtures may be present on opening vessels which have contained liquid ammonia. Fatalities have occurred.
- Areas where cylinders are stored require good ventilation and, if enclosed, need discrete/controlled

continued...

AMMONIA ANHYDROUS LIQUEFIED

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Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

exhaust ventilation.

- Secondary containment and exhaust gas treatment may be required by certain jurisdictions
 - Local exhaust ventilation is required in work areas.
 - Consideration should be given to the use of doubly-contained piping; diaphragm or bellows-sealed, soft-seat valves; backflow prevention devices; and flow- monitoring or limiting devices.
 - Gas cabinets, with appropriate exhaust treatment, are recommended, as is automatic monitoring of the secondary enclosures and workplaces, for potential release.
 - Automated alerting systems with automatic shutdown of gas-flow may be appropriate and may in fact be mandatory in certain jurisdictions.
 - Respiratory protection in the form of air-supplied or self-contained breathing equipment must be worn if the oxygen concentration in the workplace air is less than 19%.
 - Cartridge respirators do NOT give protection and may result in rapid suffocation.
- Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:
gas discharge (active generation into zone of rapid air motion)

Air Speed:
1- 2.5 m/s (200- 500 f/min.)

Within each range the appropriate value depends on:

Lower end of the range

- 1: Room air currents minimal or favourable to capture
- 2: Contaminants of low toxicity or of nuisance value only.
- 3: Intermittent, low production.
- 4: Large hood or large air mass in motion

Upper end of the range

- 1: Disturbing room air currents
- 2: Contaminants of high toxicity
- 3: High production, heavy use
- 4: Small hood- local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2.5 m/s (200-500 f/min.) for extraction of gases discharged 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE

■ Packed as liquid under pressure and remains liquid only under pressure. Sudden release of pressure or leakage may result in rapid vapourisation with generation of large volumes of gas.

Colourless, corrosive alkaline gas (or liquid) with a penetrating, intensely irritating, pungent, suffocating odour; very soluble in water forming alkaline solution. Moderately soluble in alcohol and ether. Critical Temperature 133 deg.C: Critical Pressure 11.4 mPa Packed in pressure cylinders. Gas will ignite with difficulty.

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Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Gas.
Mixes with water.
Corrosive.
Toxic or noxious vapours/gas.

State	Liquefied gas	Molecular Weight	17.04
Melting Range (°C)	- 77.7	Viscosity	Not Applicable
Boiling Range (°C)	- 33.4	Solubility in water (g/L)	Miscible
Flash Point (°C)	Not available.	pH (1% solution)	11.7
Decomposition Temp (°C)	Not Applicable	pH (as supplied)	Not applicable
Autoignition Temp (°C)	669	Vapour Pressure (kPa)	882 @ 20 C
Upper Explosive Limit (%)	25	Specific Gravity (water=1)	0.7067 @ 25 C.
Lower Explosive Limit (%)	16	Relative Vapour Density (air=1)	0.6 less dense
Volatile Component (%vol)	100	Evaporation Rate	Very Fast
Gas group	IIA		

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

- The material can produce chemical burns within the oral cavity and gastrointestinal tract following ingestion.

Accidental ingestion of the material may be damaging to the health of the individual.

Not normally a hazard due to physical form of product.

Considered an unlikely route of entry in commercial/industrial environments.

Large doses of ammonia or injected ammonium salts may produce diarrhoea and may be sufficiently absorbed to produce increased production of urine and systemic poisoning. Symptoms include weakening of facial muscle, tremor, anxiety, reduced muscle and limb control.

Ingestion of alkaline corrosives may produce burns around the mouth, ulcerations and swellings of the mucous membranes, profuse saliva production, with an inability to speak or swallow. Both the oesophagus and stomach may experience burning pain; vomiting and diarrhoea may follow. Epiglottal swelling may result in respiratory distress and asphyxia; shock can occur. Narrowing of the oesophagus, stomach or stomach valve may occur immediately or after a long delay (weeks to years). Severe exposure can perforate the oesophagus or stomach leading to infections of the chest or abdominal cavity, with low chest pain, abdominal stiffness and fever.

All of the above can cause death.

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Section 11 - TOXICOLOGICAL INFORMATION

EYE

■ The material can produce chemical burns to the eye following direct contact. Vapours or mists may be extremely irritating.

If applied to the eyes, this material causes severe eye damage.

Irritation of the eyes may produce a heavy secretion of tears (lachrymation).

Direct eye contact with corrosive bases can cause pain and burns. There may be swelling, epithelium destruction, clouding of the cornea and inflammation of the iris. Mild cases often resolve; severe cases can be prolonged with complications such as persistent swelling, scarring, permanent cloudiness, bulging of the eye, cataracts, eyelids glued to the eyeball and blindness.

SKIN

■ The material can produce chemical burns following direct contact with the skin.

Skin contact is not thought to produce harmful health effects (as classified under EC Directives using animal models). Systemic harm, however, has been identified following exposure of animals by at least one other route and the material may still produce health damage following entry through wounds, lesions or abrasions. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.

Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.

Solution of vapour in moisture on the skin, or perspiration, may cause serious skin irritation and even cause burns.

Vapourising liquid causes rapid cooling and contact may cause cold burns, frostbite, even through normal gloves. Frozen skin tissues are painless and appear waxy and yellow. Signs and symptoms of frost-bite may include "pins and needles", paleness followed by numbness, a hardening and stiffening of the skin, a progression of colour changes in the affected area, (first white, then mottled and blue and eventually black; on recovery, red, hot, painful and blistered).

Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

Mild irritation is produced on moist skin when vapour concentrations of ammonia exceed 10000 ppm. High vapour concentrations (>30000 ppm) or direct contact with solutions produces severe pain, a stinging sensation, burns and vesiculation and possible brown stains. Extensive burning may be fatal. Vapour exposure may, rarely, produce urticaria.

Skin contact with alkaline corrosives may produce severe pain and burns; brownish stains may develop. The corroded area may be soft, gelatinous and necrotic; tissue destruction may be deep.

INHALED

■ Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce toxic effects.

Inhalation of the vapour is hazardous and may even be fatal.

The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Inhalation of toxic gases may cause:

- Central Nervous System effects including depression, headache, confusion, dizziness, stupor, coma and seizures;
- respiratory: acute lung swellings, shortness of breath, wheezing, rapid breathing, other symptoms and respiratory arrest;
- heart: collapse, irregular heartbeats and cardiac arrest;
- gastrointestinal: irritation, ulcers, nausea and vomiting (may be bloody), and abdominal pain.

The highly irritant properties of ammonia vapour result as the gas dissolves in mucous fluids and forms irritant, even corrosive solutions.

Inhalation of the ammonia fumes causes coughing, vomiting, reddening of lips, mouth, nose, throat and conjunctiva while higher concentrations can cause temporary blindness, restlessness, tightness in the chest, pulmonary oedema (lung damage), weak pulse and cyanosis.

Inhalation of high concentrations of vapour may cause breathing difficulty, tightness in chest, pulmonary

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oedema and lung damage. Brief exposure to high concentrations > 5000 ppm may cause death due to asphyxiation (suffocation) or fluid in the lungs.

Prolonged or regular minor exposure to the vapour may cause persistent irritation of the eyes, nose and upper respiratory tract. Massive ammonia exposures may produce chronic airway hyperactivity and asthma with associated pulmonary function changes. The average nasal retention of ammonia by human subjects was found to be 83%.

Material is highly volatile and may quickly form a concentrated atmosphere in confined or unventilated areas.

Vapour is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant.

This may happen with little warning of overexposure.

CHRONIC HEALTH EFFECTS

■ Repeated or prolonged exposure to corrosives may result in the erosion of teeth, inflammatory and ulcerative changes in the mouth and necrosis (rarely) of the jaw. Bronchial irritation, with cough, and frequent attacks of bronchial pneumonia may ensue. Gastrointestinal disturbances may also occur. Chronic exposures may result in dermatitis and/or conjunctivitis.

Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.

Principal route of occupational exposure to the gas is by inhalation.

Prolonged or repeated minor exposure to ammonia gas/vapour may cause long-term irritation to the eyes, nose and upper respiratory tract. Repeated exposure or prolonged contact may produce dermatitis, and conjunctivitis.

Other effects may include ulcerative changes to the mouth and bronchial and gastrointestinal disturbances. Adaptation to usually irritating concentrations may result in tolerance. In animals, repeated exposures to sub-lethal levels produces adverse effects on the respiratory tract, liver, kidneys and spleen. Exposure at 675 ppm for several weeks produced eye irritation in dogs and rabbits; corneal opacity, covering between a quarter to one half of the total surface area, was evident in rabbits.

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY

Oral (human) TDLo: 0.15 ml/kg

Inhalation (human) LCLo: 5, 000 ppm/5m

Unreport (human) LDLo: 132 mg/kg

Inhalation (rat) LDLo: 2000 ppm/4h

IRRITATION

Nil Reported

■ Asthma-like symptoms may continue for months or even years after exposure to the material ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.

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Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:

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Marine Pollutant: Yes

- Very toxic to aquatic organisms.
- Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters. Wastes resulting from use of the product must be disposed of on site or at approved waste sites.
- In air ammonia is persistent whilst, in water, it biodegrades rapidly to nitrate, producing a high oxygen demand. Ammonia is strongly adsorbed to soil. Ammonia is non-persistent in water (half-life 2 days) and is moderately toxic to fish under normal temperature and pH conditions. Ammonia is harmful to aquatic life at low concentrations but does not concentrate in the food chain.

Drinking Water Standards:

0.5 mg/l (UK max.)

1.5 mg/l (WHO Levels)

Soil Guidelines: none available.

Air Quality Standards: none available.

- DO NOT discharge into sewer or waterways.

Very toxic to aquatic organisms.

Fish toxicity: LC50: > 3.58 mg/l/24hr (Rainbow trout, fertilized egg)

>3.58 mg/l/24hr (" " , alevins)

0.068 mg/l/24hr (" " , 85 day old fry)

0.097 mg/l/24hr (" " , adults)

Daphnia magna: LC50: 24gm/L 48 hr.

Note: Ammonia is readily oxidised to nitrite which is also toxic to fish.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
ammonia anhydrous liquefied	LOW		LOW	HIGH

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / Cas No / RTECS No	EHS	TRN	A1a	A1b	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3
--------------------------------	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----	----

Ammonia (anhydrous and aqueous, 28% or less) / CAS:7664- 41-7 / BO0875000	91	114	0	0	0	R	3	2	1	(2)	3	3	3			DE	3
--	----	-----	---	---	---	---	---	---	---	-----	---	---	---	--	--	----	---

Legend:

EHS=EHS Number (EHS=GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships) NRT=Net Register Tonnage, A1a=Bioaccumulation log Pow, A1b=Bioaccumulation BCF, A1=Bioaccumulation,

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A2=Biodegradation, B1=Acuteaquatic toxicity LC/ECIC50 (mg/l), B2=Chronic aquatic toxicity NOEC (mg/l), C1=Acute mammalian oral toxicity LD50 (mg/kg), C2=Acutemammalian dermal toxicity LD50 (mg/kg), C3=Acute mammalian inhalation toxicity LC50 (mg/kg), D1=Skin irritation & corrosion, D2=Eye irritation& corrosion, D3=Long-term health effects, E1=Tainting, E2=Physical effects on wildlife & benthic habitats, E3=Interference with coastal amenities,

For column A2: R=Readily biodegradable, NR=Not readily biodegradable.

For column D3: C=Carcinogen, M=Mutagenic, R=Reprotoxic, S=Sensitising, A=Aspiration hazard, T=Target organ systemic toxicity, L=Lunginjury, N=Neurotoxic, I=Immunotoxic.

For column E1: NT=Not tainting (tested), T=Tainting test positive.

For column E2: Fp=Persistent floater, F=Floater, S=Sinking substances.

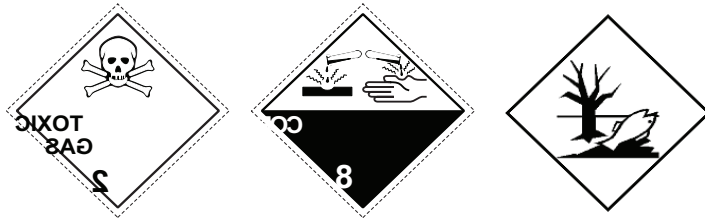
The numerical scales start from 0 (no hazard), while higher numbers reflect increasing hazard.

(GESAMP/EHS Composite List of Hazard Profiles - Hazard evaluation of substances transported by ships)

Section 13 - DISPOSAL CONSIDERATIONS

- Evaporate residue at an approved site.
- Return empty containers to supplier. If containers are marked non-returnable establish means of disposal with manufacturer prior to purchase.
- Ensure damaged or non-returnable cylinders are gas-free before disposal.

Section 14 - TRANSPORTATION INFORMATION



Labels Required: TOXIC GAS,CORROSIVE

HAZCHEM:

2RE (ADG7)

Land Transport UNDG:

Class or division:	2.3	Subsidiary risk:	8
UN No.:	1005	UN packing group:	None
Shipping Name:AMMONIA, ANHYDROUS			

Air Transport IATA:

ICAO/IATA Class:	2.3	ICAO/IATA Subrisk:	8
UN/ID Number:	1005	Packing Group:	-
Special provisions:	A2		
Cargo Only			
Packing Instructions:	Forbidden	Maximum Qty/Pack:	Forbidden
Passenger and Cargo			
Packing Instructions:	Forbidden	Maximum Qty/Pack:	Forbidden
Passenger and Cargo Limited Quantity			
Packing Instructions:	-	Maximum Qty/Pack:	-

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Shipping Name: AMMONIA, ANHYDROUS

Maritime Transport IMDG:

IMDG Class:	2.3	IMDG Subrisk:	8
UN Number:	1005	Packing Group:	None
EMS Number:	F-C, S-U	Special provisions:	23
Limited Quantities:	0	Marine Pollutant:	Yes

Shipping Name: AMMONIA, ANHYDROUS

GESAMP hazard profiles for this material can be found in section 12 of the MSDS.

Section 15 - REGULATORY INFORMATION

POISONS SCHEDULE S6 S3NZ

REGULATIONS

ammonia anhydrous liquefied (CAS: 7664-41-7) is found on the following regulatory lists;

"Australia - Australian Capital Territory - Environment Protection Regulation: Pollutants entering waterways taken to cause environmental harm (Aquatic habitat)", "Australia - Australian Capital Territory Environment Protection Regulation Pollutants entering waterways - Domestic water quality", "Australia - Queensland Hazardous Materials and Prescribed Quantities for Major Hazard Facilities", "Australia Exposure Standards", "Australia Hazardous Substances", "Australia High Volume Industrial Chemical List (HVICL)", "Australia Inventory of Chemical Substances (AICS)", "Australia National Pollutant Inventory", "Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Appendix E (Part 2)", "Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Appendix F (Part 3)", "Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Schedule 5", "Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Schedule 6", "GESAMP/EHS Composite List - GESAMP Hazard Profiles", "IMO IBC Code Chapter 17: Summary of minimum requirements", "International Council of Chemical Associations (ICCA) - High Production Volume List", "OECD Representative List of High Production Volume (HPV) Chemicals", "WHO Guidelines for Drinking-water Quality - Chemicals for which guideline values have not been established"

Section 16 - OTHER INFORMATION

■ Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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Section 16 - OTHER INFORMATION

This is the end of the MSDS.