SECTION 1: Product and Company Identification

1.1 Product identifier

Product name	:	Ammonia
Trade name	:	Not applicable.

1.2 Other means of identification

Chemical Name	:	Ammonia
Chemical Formula	:	NH3

1.3 Recommended use and restrictions on use

Product use	:	Semiconductor Processes Industrial & Professional use Synthetic/Analytical chemistry Photovoltaic Processes

1.4 Details of supplier of the safety data sheet

Company identification	:	Iwatani Corporation (Singapore) Pte. Ltd.
Address	:	6 Shenton Way, OUE Downtown 2 #13-11, Singapore 068809
Phone	:	+65 6862 2111

1.5 Emergency contact

Emergency phone number	:	+65 6220 8347

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Physical hazards	:	Gases under pressure- liquefied gas.
Characteristic	:	Flammable, Category 2 (Warning)
Acute toxicity (inhalation)	:	Category 3
Skin corrosion/irritation	:	Sub-category 1B
Serious eye damage/eye irritation	:	Category 1
Acute aquatic toxicity	:	Category 1

2.2 GHS label elements, including precautionary statements

Pictogram(s) :

Signal word(s) : Danger

Hazard statement(s) :
H221 - Flammable gas
H280 – Contains gas under pressure; may explode if heated
H331 – Toxic if inhaled
H314 – Causes severe skin burns and eye damage

H400 – Very toxic to aquatic life

Precautionary statements

Prevention : P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P261- Avoid breathing dust/fume/gas/mist/vapours/spray.
P271 - Use only outdoors or with adequate area.
P260 - Do not breathe dust/fume/gas/mist/vapours/spray.
P264 - Wash skin thoroughly after handling.
P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection.
P273 - Avoid release to the environment.

Response : P337 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - In case of leakage, eliminate all ignition sources.
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P311 - Call a POISON CENTER or doctor/physician.
P321 - Specific treatment (see supplemental first aid instruction on this label).
P301+P330+P331 - IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P363 - Wash contaminated clothing before reuse.
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P310 -Immediately call a POISON CENTER or doctor.
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P391 - Collect spillage.

Storage : P403 - Store in a well-ventilated place.
P410+P403 - Protect from sunlight. Store in a well-ventilated place
P403+P233 - Store in a well-ventilated place. Keep container tightly closed.
P405 - Store locked up.

Disposal : P501 - Dispose of contents/ container to an approved waste disposal plant.

2.3 Other hazards which do not result in classification

Potential Health Effects :

Inhalation : Asphyxiant, effects are due to lack of oxygen. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, nausea, vomiting, and unconsciousness. The vapour from a liquid release may also cause incoordination, abdominal pain. Effects may be delayed. Lack of oxygen can kill.

SECTION 3. Composition/Information on ingredients

3.1 Substances / 3.2. Mixture

Substance name	Contents	CAS No.
Ammonia, anhydrous	100 %	7664-41-7

SECTION 4. First-aid measures

4.1 Description of first aid measures

Inhalation : Keep patient warm and at rest.
If unconscious place in a recovery position and seek medical advice.
Keep respiratory tract clear.
If symptoms persist, call a medical doctor.
Consult a medical doctor after significant exposure. Call a medical doctor immediately.

Skin contact : Immediate medical treatment is necessary as untreated wounds from corrosion of skin heal slowly and with difficulty.
If on skin, rinse well with water.
Take off and remove contaminated clothing and shoes.
If skin irritation persists, call a medical doctor.

Eye contact Small amounts splashed into eyes can cause irreversible tissue damage and blindness.
In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Continue rinsing eyes during transport to hospital.
Remove contact lenses. Protect unharmed eye. Keep eye wide open while rinsing.
If eye irritation persists, consult a specialist.

Ingestion : Keep respiratory tract clear.
Do NOT induce vomiting. Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.
Take victim immediately to hospital. If symptoms persist, call a medical doctor.

4.2 Most important symptoms/effect, acute and delayed

No information available.

4.3 Indication of immediate medical attention and special treatment needed, if necessary

Treat with corticosteroid spray as soon as possible after inhalation.
Obtain medical assistance.

4.4 Protection of first-aid providers

Wear self-contained breathing apparatus before approaching victim.

SECTION 5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media	:	Alcohol-resistant foam; carbon dioxide (CO_2) and dry chemical.
Unsuitable extinguishing media.	:	High volume water jet.

5.2 Special hazards arising from the substance or mixture

Specific hazards	:	Do not allow run-off from firefighting to enter drains or water courses. Exposure to fire may cause containers to rupture/explode.
Hazardous combustion products	:	If involved in a fire the following toxic and/or corrosive fumes may be produced by thermal decomposition. Nitric oxide/nitrogen dioxide.

5.3 Advice for fire-fighters

Specific methods	:	Collect contaminated fire extinguisher water separately. This must not be discharge into drains. Fire residues and contaminated fire extinguisher water must be disposed of in accordance with local regulations. For safety reasons in case of fire, containers should be stored separately in closed containments. Use a water spray to cool fully closed containers.
Special protective equipment for fire fighters	:	Wear self-contained breathing apparatus for firefighting if necessary.

SECTION 6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment.
Ensure adequate ventilation.
Remove all sources of ignition.
Evacuate personnel to safe areas.
Beware of vapours accumulating to form explosive concentration. Vapours can accumulate in low areas.

6.2 Environmental precautions

Prevent product from entering drains.
Prevent further leakage or spillage if safe to do so.
If the product contaminates rivers and lakes or drains, inform respective authorities.

6.3 Methods and materials for containment and cleaning up

Neutralise with acid.

SECTION 7. Handling and storage

7.1 Precautions for safe handling

Do not breathe vapours /dust.
Avoid contact with skin and eyes.
For personal protection, see Section 8.
Smoking, eating and drinking should be prohibited in the application area.
Take precautionary measures against static discharges.
Provide sufficient air exchange and/or exhaust in work rooms.
Open cylinder/drum valve carefully as content may be under pressure.
Dispose of rinse water in accordance with local and national regulations.

7.2 Conditions for safe storage, including any incompatibilities

Prevent unauthorized access.
No smoking.
Keep container tightly closed in a dry and well-ventilated place.
Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Observe label precautions.
Electrical installations/working materials must comply with the technological safety standards.
Separate full containers from empty ones, make sure there are signs for the storage area.
Make sure the cylinders(60-68kg) are arranged in standing position on the lorry during loading/unloading. For drums(450-500kg), need to be arranged in lying position.
For customer using vapours in their system, make sure the cylinder is placed in standing position. While for those using liquid, make sure the cylinder is placed in a lying position with the bottom part of the cylinder not lifted more than 2 feet from the ground. Also make sure it is placed on a stable support and all safety precaution was taken.

SECTION 8. Exposure controls/personal protection

8.1 Control parameters/Occupational exposure limits

Components	CAS-No.	Value type (form of exposure)	Control parameters/permissible concentration	Basis
Ammonia	7664-41-7	PEL TWA	25 ppm 17 mg/m^3	MY
		TWA	25 ppm (Ammonia)	ACGIH
		STEL	35 ppm (Ammonia)	ACGIH

STEL = Short term exposure limit; TWA=Time weighted average; PEL= Permissible Exposure Limit

8.2 Appropriate engineering control measures

Provide adequate general and local exhaust ventilation.
Product to be handled in a closed system.
Preferably use permanent leak-tight installations (e.g., welded pipes).
System under pressure should be checked for leakages regularly.

Ensure exposure is below occupational exposure limits (where available).

8.3 Personal protection

Individual protection measures, such as personal protective equipment (PPE)		A risk assessment should be conducted and documented in each work area to assess the risks related to the use of the product and to select the PPE that matches the relevant risk. The following recommendations should be considered: Protect eyes, face and skin from liquid splashes. PPE compliant to the recommended EN/ISO standards should be selected.
Hand protection	:	Wear appropriate protective chemical-resistant gloves that protect chemicals directly. Standard EN 388 – Protective gloves against mechanical risk.
Eye/face protection	:	Wear facepiece with goggles to protect from scattering dust or toxic liquid. Further eye protection such as chemical goggles and/or protecting glasses must be worn when the possibility exists for eye contact due to splashing or spraying liquid or airborne particle. EN 166 - Personal Eye Protection.
Skin and Body protection	:	Wear work gloves when handling cylinders; welding gloves for welding and cutting. As needed, wear hand, and body protection, which help to prevent injury from radiation and sparks (see ANSI Z49.1. at a minimum), this includes welder's glove and may include arm protectors, aprons, hats, and shoulder protection, as well as substantial clothing. Wear safety shoes while handling containers. ISO 20345 - Personal protective equipment - Safety footwear.
Respiratory protection		Wear NIOSH/MESA approved full or half face piece (with goggles) respiratory protective equipment.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Ensure adequate ventilation.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state	:	Gas
Colour	:	Colourless
Odour	:	Pungent
Odour threshold	:	No data available.
pH	:	11.7
Melting point	:	-77.74 °C (-107.9 °F)
Boiling point	:	-33.4 °C (-28.1 °F)
Flash point	:	No data available.
Critical Temperature	:	-132 °C (-205.6 °F)
Flammability (solid, gas)	:	Flammable gas
Lower explosive limit	:	15.4 % (V) 108.000 mg/m^3

Upper explosive limit	:	33.6 % (V) 24.000 mg/m^3
Vapour pressure	:	8.5737 hPa @ 20°C
Relative vapour density	:	0.6
Density	:	0.6819 g/cm^3
Molecular mass	:	17.04 g/mol
Solubility	:	Water 541 g/l
Viscosity	:	No data available.
Partition coefficient: n-octanol/water	:	No data available.
Evaporation rate	:	Very fast.
Decomposition temperature	:	840 °C
Autoignition temperature	:	651 °C (1204 °F)

Section 10. Stability and reactivity

10.1 Reactivity
No decomposition if stored and applied as directed.

10.2 Chemical stability
No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions
No decomposition if stored and applied as directed.
Vapours may form explosive mixture with air.

10.4 Conditions to avoid
Heat, flames and sparks.

10.5 Incompatible materials
No data available.

10.6 Hazardous decomposition products
No data available.

SECTION 11. Toxicology information

11.1 Information on toxicological effects

Acute toxicity (Oral)	:	LD_{50} (Rat): 350 mg/kg
Acute toxicity (Inhalation)	:	LC_{50} (Rat, male): 14166 ppm. 1hr Remarks: Fatality occurred in human from 2500ppm
Skin corrosion or irritation	:	Species: Rabbit Corrosive

		12% aqueous ammonia was corrosive to the rabbit skin following a 4-hour occlusive exposure.
Serious eye damage or irritation	:	Serious eye damage/eye irritation.
Respiratory or skin sensitization	:	Exposure route: Inhalation In person who are hyper reactive to other respiratory irritants, or who are asthmatic, would be expected to be more susceptible to ammonia inhalation effects. Exposure route: Skin contact Not classified.
Germ cell mutagenicity	:	Not classified.
Carcinogenicity	:	Not classified.
Reproductive toxicity	:	Classification not possible.
Specific Target Organ Toxicity (STOT)-single exposure	:	Respiratory system / Asphyxiant. Respiratory system. Immediate irritation to eye, nose and throat starting at 50 ppm. Lung oedema, coughing and airway obstruction may occur at elevated levels of gas. Immediate oral/pharyngeal pain which can progress to difficulty in swallowing. After 24-36hr, lung edema may ensue.
STOT-repeated exposure	:	Target organs: Respiratory system. May cause damage to organs through prolonged or repeated exposure.
Aspiration hazard	:	Not classified.

SECTION 12. Ecological information

12.1 Ecotoxicity

Toxicity to fish	:	LC_{50} (Salmo salar (Atlantic salmon)): 27.1 mg/l. 96hrs
Toxicity to daphnia and other aquatic invertebrates		LC_{50} (Daphnia magna (Water flea)): 101 mg/l. 48hrs
Toxicity to algae	:	Classification not possible.
Toxicity to bacteria	:	Classification not possible.
Toxicity to fish (Chronic toxicity)	:	NOEC: 0.37 mg/l
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	NOEC: 0.75 mg/l

12.2 Persistence and degradability

When ammonia appears in water under the normal conditions (aerobic), it is rapidly converted to nitrate by nitrification; the principal water contaminant normally being nitrate.

12.3 Bioaccumulative potential

Bioaccumulation	:	Remarks: Plants have a high affinity for gaseous ammonia when leaf stomata are open in daylight.
Partition coefficient; n-octanol /water	:	No data available.

12.4 Mobility in soil

Mobility	:	Medium: Soil. Remarks: Strongly adsorbed to soil.

SECTION 13. Disposal information

13.1 Disposal methods

Waste from residues	:	Waste must be disposed of in accordance with federal, state and local environmental control regulations. Refer to the EIGA code of practice (Doc.30 "Disposal of Gases", downloadable at http://www.eiga.org) for more guidance on suitable disposal methods
Contaminated packaging	:	Container may remain hazardous when empty. Continue to observe all precaution. Handle empty container with care because residual vapours are flammable. Do not puncture or incinerate container. Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Iwatani for proper disposal.

SECTION 14. Transport information

14.1 UN number

: UN1005

14.2 UN proper shipping name

: AMMONIA, ANHYDROUS

14.3 Transport Hazard Class(es)

UNRTDG (United Nations Recommendations Transport Dangerous Goods)

Class	:	2.3
Subsidiary risk	:	8

IATA-DGR (International Air Transport Association – Dangerous Goods)

Not permitted for transport

IMDG (International Maritime Dangerous Goods) – Code

Class	:	2.3
Subsidiary risk	:	8

14.4 Packing group

Not assigned by regulation

14.5 Environmental hazards

Transport by road/rail (ADR/RID)	:	Environmentally hazardous substance / mixture.
Transport by air (ICAO-TI / IATA-DGR)	:	Not permitted for transport
Transport by sea (IMDG)	:	Marine pollutant

14.6 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

Hazchem Code : 2RE

14.6 Special precaution for user

Avoid transport on vehicles where the load space is not separated from the driver's compartment.

Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.

Before transporting product containers:

- Ensure there is adequate ventilation.
- Ensure that containers are firmly secured.
- Ensure valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.

SECTION 15. Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Restrictions on use	:	None.
Other information, restriction and prohibition regulations	:	Ensure all national/local regulations are observed.
Applicable national regulations	:	Safety, health and environmental regulations/legislation specific for the substance or mixture are observed.

SECTION 16. Other information

16.1 Other information

Indication of changes	:	Ensure all national/local regulations are observed.
Disclaimer of liability	:	Before using this product in any new process or experiment, a thorough material combability and safety study should be carried out. Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use ca be accepted.

End of Safety Data Sheet