



## 1. PURPOSE

The purpose of this plan is to identify, and mitigate potential risks of anhydrous ammonia exposure that Facilities Management staff may encounter while performing their duties at the Ian Stewart Complex ice rink. The majority of the 300 kg of ammonia is contained in the receiver and evaporator (brine chiller) of the ammonia plant room, located at the North end of the rink (Rm 150A). Ammonia vapour may also be found in the orange/red piping that extends through the Zamboni bay, whereby waste heat is captured by domestic hot water heat exchanger.

## 2. PHYSICAL PROPERTIES OF AMMONIA

Anhydrous ammonia is a colorless, highly irritating gas with a pungent suffocating odour. Ammonia gas is easily liquefied under pressure. Liquid ammonia is a clear fluid that evaporates quickly at room temperature. Although not classified as flammable under WHMIS, anhydrous ammonia gives off flammable vapours. Concentration in the range of 16 to 25% by volume of air can be ignited or caused to explode if heated to the auto-ignition temperature. The presence of oil or other combustible materials increase the fire hazard.

## 3. HEALTH HAZARD INFORMATION

- 3.1. The 8-hr Time Weighted Average (TWA) limit is the concentration of a substance in air which may not be exceeded over a normal 8 hour work period. OHS Regulation stipulates a TWA for ammonia of 25 ppm.
- 3.2. The Short-Term Exposure Limit (STEL) is the concentration of a substance in air which may not be exceeded over any 15 minutes period, limited to no more than 4 such periods in an 8 hour work shift, with at least one hour between any 2 successive 15 minute excursion periods. OHS Regulation stipulates a STEL of 35 ppm.
- 3.3. IDLH= Immediately Dangerous to Life and Health is an airborne exposure that is likely to cause death or permanent adverse health effects or prevent escape from the environment. WorkSafeBC references an IDLH of 300 ppm.

Ammonia can cause irritation to the eyes, nose and respiratory system. Because the gas is physically irritating, it is unlikely that any person will remain in an area contaminated with a detectable concentration of ammonia, unless addressing an issue or in trouble. Depending on the concentration, exposure to ammonia can cause coughing, chest pain, breathing difficulty, bronchopneumonia, pulmonary edema and death from bronchial spasm. *Long-term exposure to ammonia will not help you develop a tolerance to it; it will only weaken your ability to detect ammonia.*

It is a severe eye irritant and can penetrate this organ quickly, causing permanent blindness. Contact with the skin or eyes can cause severe or potentially fatal burns.

## 4. RESPONSIBILITIES

- 4.1. Facilities Senior Administration (Executive Director, Directors, Managers):
  - Establish specific responsibilities for the safe operation and maintenance of the refrigeration unit;
  - Ensure that all levels of supervision are held accountable for execution of this plan within the area of their responsibility.

#### 4.2. Mechanical Shop Supervisor:

- Ensure that all work that presents the possibility for ammonia exposure are pre-planned and that all necessary safe work procedures are available;
- Provide required personal protective equipment and equipment necessary to perform work;
- Ensure responsible staff are oriented and refreshed to operation, maintenance and emergency procedures relating to the ammonia refrigeration equipment;
- Ensure workers are current on training and fit-testing;
- Ensure that contracted parties performing work in this area are advised of the known hazards and have the appropriate trade qualifications.

#### 4.3. Mechanical Shop Workers:

- Attend and participate in training, instruction and respirator fit-testing sessions;
- Follow standard operating procedures, as required;
- Wear personal protective equipment, as required;
- Report any deficiencies, inconsistencies or note hazards to their supervisor immediately.

#### 4.4. EHS Coordinator:

- Initiate plan revisions as conditions and regulations change, and provide clarification and interpretation when required by Facilities staff;
- Arrange and coordinate training as requested/required
- Ensure records of training are maintained and kept;
- Conduct periodic audits to verify compliance with this plan;
- Coordinate an annual review of this plan.

## 5. RISK IDENTIFICATION, ASSESSMENT & CONTROL

Table 1, on the following page, outlines the locations for potential exposure risk to Facilities Management staff in the operation of the ammonia plant. The risk level was assessed on frequency of exposure, the work to be undertaken and the potential exposure levels. Associated controls in place or to be implemented are also outlined.

Table 1: Risk Identification for Ammonia Plant Operation

<i>Potential Exposures</i>	<i>Ammonia Exposure Risk Level, Frequency of Task</i>	<i>Persons at Risk</i>	<i>Controls**</i>
<i>Leak</i>	<i>Moderate/ High, Infrequent</i>	<i>Shift Engineer, Mechanical Tradesworkers, Public</i>	<i>Follow Ammonia Release Emergency Procedures.</i>
<i>Minor leak detection and control</i>	<i>Moderate, Infrequent</i>	<i>Shift Engineer, Refrigeration Technician</i>	<i>Follow Ammonia Release Emergency Procedures. Leak detection should always include a full-face respirator.</i>
<i>Testing/calibrating ammonia alarm</i>	<i>Low, Biannual</i>	<i>External contractor</i>	<i>Contractor to determine their controls. Mechanic Shop to be advised when any work is scheduled to occur in space. Follow Safe Work Procedure #25 (BPV Manual)</i>
<i>Draining of oil from the chiller</i>	<i>Moderate, Biweekly to Quarterly (depending on oil usage)</i>	<i>Shift Engineer</i>	<i>Primary control is draining line into bucket of water. Ensure full-face respiratory protection. Follow Safe Work Procedure #24 (BPV Manual)</i>
<i>Adding oil to the compressor</i>	<i>Low, Weekly</i>	<i>Shift Engineer</i>	<i>Follow Safe Work Procedure #24 (BPV Manual)</i>
<i>Start-up of ammonia ice plant</i>	<i>Moderate, Annual</i>	<i>Shift Engineer, Refrigeration Contractor</i>	<i>Follow Safe Work Procedure #27 (BPV Manual). Contractor Procedures.</i>
<i>System shut-down</i>	<i>Moderate, Every 5 years</i>	<i>Shift Engineer</i>	<i>Follow Safe Work Procedure #26 (BPV Manual)</i>
<i>High pressure shut-down</i>	<i>Low, Annual</i>	<i>Shift Engineer, Refrigeration Contractor</i>	<i>Follow Safe Work Procedure #22 (BPV Manual). Contractor Procedures.</i>
<i>Low pressure shut-down</i>	<i>Low, Annual</i>	<i>Shift Engineer, Refrigeration Contractor</i>	<i>Follow Safe Work Procedure #23 (BPV Manual). Contractor Procedures.</i>
<i>Routine maintenance on pumps</i>	<i>Low, Annual</i>	<i>Shift Engineer, Mechanical Tradesworker, Refrigeration Contractor</i>	<i>Isolation of system to work on. Working alone procedures. If impact to ammonia/ brine system will escalate risk rating and need ticketed trade. Contractor Procedures.</i>
<i>Routine maintenance on compressors</i>	<i>Moderate, Annual</i>	<i>Refrigeration Contractor, Shift Engineer assist</i>	<i>Isolation of system to work on. Working alone procedures. Ticketed trade. Contractor procedures.</i>
<i>Emergency Lighting Testing</i>	<i>Low, Annual</i>	<i>Electrician</i>	<i>General controls outlined.</i>
<i>Lighting Repair/ Troubleshooting</i>	<i>Low, Annual</i>	<i>Electrician</i>	<i>General controls outlined.</i>
<i>Routine maintenance on motors</i>	<i>Low, Annual</i>	<i>Electrician, Shift Engineer</i>	<i>Inform Mechanic Shop. Isolation of system to work on. Working alone procedures. If impact to ammonia/ brine system will escalate risk rating and need ticketed trade.</i>
<i>Minor leak on cooling water lines</i>	<i>Low, Infrequent</i>	<i>Plumber</i>	<i>General controls outlined.</i>

**\*\* Controls required/present under all conditions include: continuous ventilation from machine room, localized sensor with associated alarms, restricted access to authorized individuals (locked), escape respirator on person. Any work on ammonia/brine system to be undertaken by ticketed trade (Power Engineer or Refrigeration).**

## 6. WRITTEN WORK PROCEDURES

Written work procedures are available in the Mechanical Shop's "Boiler & Pressure Vessels: Safety Procedures Manual." These work procedures, specific to the ammonia unit, are also available on-site in the electrical ante room. Work procedures currently include:

- Charging system with ammonia
- Minor leak detection and control
- Testing ammonia alarm
- Draining of oil from the chiller
- Adding oil to the compressor
- Checking on a worker working alone
- Start-up of ammonia ice plant
- System shut-down procedures
- High pressure shut down
- Low pressure shut down
- Routine maintenance of equipment (such as pumps and piping)

Considerations for inclusion when drafting or revising procedures relating to ammonia operations include:

- Contact lenses shall not be worn when exposure to ammonia is possible
- Do not stand in line with the opening from valves or fittings—particularly pressure relief valves
- As ammonia mixes with oils, the lower explosive limit (LEL) can be lowered, caution should be exercised and an LEL meter acquired.

The current master standing agreement refrigeration contractor is **Rocky Mountain Refrigeration Ltd** - 250-686-2600 (24-hr emergency hotline/switchboard).

## 7. PERSONAL PROTECTIVE EQUIPMENT

### 7.1. Skin Protection:

- Gloves should be worn for all tasks where the potential exists for contact with liquid ammonia. The skin protection should be insulated against cold temperatures and be made from butyl, Teflon or Viton. For larger liquid ammonia leaks, full-body protective suits are necessary (and are outside the capacity of FMGT).

### 7.2. Eyewear:

- Eye irritation from exposure to ammonia gas normally does not occur until concentration reach about 70 ppm. Therefore, eye protection is not mandatory under normal working conditions (i.e. < 25 ppm). All respirators, except the escape respirator, must provide full face protection, as a minimum.

### 7.3. Respirators:

- At all times upon entry into the ammonia mechanical room, workers are required to have the escape respirator on their person.
- Any time workers are performing leak detection tests or standard maintenance that has the potential to generate ammonia gas, a full-face respirator must be worn. Full-face piece respirators with green-labelled ammonia gas cartridge filters are appropriate for work in environments with ammonia concentrations less than 300 ppm. Nonetheless, as per emergency protocols, any condition that generates ammonia levels above 200 ppm will cease and workers will leave the vicinity. For unexpected circumstances, the escape respirator is readily available.
- For further information, a copy of the controlled product Safety Data Sheet (SDS) can be found in the Appendix of this document.

The following sign has been posted at the entrance to the ammonia machine room to re-enforce respiratory requirements:



Personal protective equipment such as gloves, respirators and eyewear are readily available.

## 8. HYGIENE FACILITIES & DECONTAMINATION

8.1. OHS Regulations require:

- A tempered, continuous flow eyewash facility with a minimum duration of 15 minutes or more, within 5 seconds walking distance of the hazard area, but no further than 6 m (20 feet). For high risk corrosive gases such as ammonia, the facilities must not be located in the gas storage or use area, but rather, adjacent to it.
- A tempered, continuous flow emergency shower facility with a minimum duration of 15 minutes or more, within 5 seconds walking distance of the hazard area, except that the shower may be located further than 6 m if (a) a supplementary emergency washing facility such as a non-tempered drench hose is located within 5 seconds walking distance of the hazard area but no further than 6 m, and (b) a tempered shower facility is available within the building to start emergency washing within 5 minutes of the contact.

The electrical ante room for the Ian Stewart Complex ammonia room is equipped with a plumbed shower immediately outside the compressor room, and an eyewash located next to the exterior door.

8.2. Decontamination:

Clothing or skin that is soaked with ammonia solutions may be caustic and expose rescuers, as well as victims, to vapours.

To decontaminate:

- Remove soaked clothing from the person and double-bag it immediately.
- Flush exposed skin and hair with soap and water for 15 minutes. If frostbite has occurred, do not wash or rub skin.

## 9. FIRST AID MEASURES

Immediate first aid treatment can help reduce the impact of injuries and prevent further injuries from occurring. Below outlines some basic first aid measures for inhalation, skin contact and eye contact. In all circumstances, send for medical help, as soon as possible.

### 9.1 Inhalation

- a) Assess the victim's breathing.
- b) If breathing has stopped, begin artificial respiration and continue until the victim resumes breathing. If the victim is having difficulty breathing (gasping, coughing), place the victim in the most comfortable position, usually semi-sitting.
- c) If an oxygen therapy unit and trained personnel are available, administer oxygen.
- d) Ensure that the victim is transported to hospital in case of a delayed reaction in the form of pulmonary edema. Any physical exertion, excitement or apprehension increases the chances and severity of a delayed reaction. Keep the victim warm and completely at rest. Reassure the victim while waiting for assistance.

### 9.2 Skin Contact

- a) Assess the victim's breathing. See above if affected.
- b) As soon as the victim resumes breathing, flush the victim's contaminated skin and clothing with large amounts of water for 30 minutes.
- c) Remove all contaminated clothing while flushing.
- d) Continue flushing until all traces of ammonia have been removed.
- e) Dress obvious burns with sterile gauze and bandage them loosely. Apply insulated cold packs to help reduce pain.
- f) Call for an ambulance to take the victim to a hospital.

### 9.3 Eye Contact

- a) Flush the eyes immediately with large amounts of running water (preferably lukewarm) if any amount of liquefied ammonia has entered the eyes or exposure to gaseous ammonia causes persistent eye irritation.
- b) Hold the eyelids apart forcibly to ensure full flushing of the eyes and eyelids.
- c) After flushing has removed all traces of ammonia, cover both eyes with moistened sterile gauze pads and bandage enough to keep light out.
- d) Apply insulated cold packs to help reduce pain.
- e) Call for an ambulance to take the victim to a hospital.

Do not attempt to neutralize the ammonia with other chemicals or apply oils, ointments or medication to the eyes.

## 10. TRAINING & EDUCATION

10.1. Exposure Control Plan + Emergency Plan: All new affected employees will be thoroughly instructed in this plan before they begin their initial work assignments and informed where the plan will be kept. An up-to-date copy of the plan is kept in the Facilities Management OHS Program Binders and Emergency Operations Binders located in every shop.

10.2. Emergency Drills: Drills will be conducted annually. Drills may include table top exercises or site practice drills.

10.3. Workplace Hazardous Materials Information System: FMGT staff are required to complete WHMIS training, provided by the UVic Occupational Health Safety & Environment office. Internally, a three year requirement for refresher training has been established.

10.4. Safe Work Procedures: The supervisor for the Mechanical Shop is responsible for reviewing safe work procedures with staff assigned to work with this equipment/machinery before their initial work assignments. These procedures should be located in the Boiler & Pressure Vessel Manual.

Associated programs include Working Alone and Respirator Protection Program.

## 11. ACCIDENT INVESTIGATION

WorkSafeBC must be immediately notified of any major release of ammonia, whether or not any injury occurred. In the case of ammonia, a major release is:

- Any leak or spill producing an airborne concentration of ammonia in excess of 300 ppm in the work area or outside the building; or
- Any leak or spill lasting longer than 24 hours and producing an airborne ammonia concentration in excess of 35 ppm in the work area; or
- Any leak or spill resulting in a person requiring medical attention.

A formal investigation of any accident involving a release of ammonia gas shall be undertaken to determine the root causes of the accident and to detail measures to ensure no recurrence of the problem.

Any releases of ammonia (>5 kg) to the outside air or any sewer, waterway or groundwater must be reported to the BC Ministry of Environment promptly. Responsibility for reporting a release will be reviewed by parties (i.e. OHSE, UVic Site Response Team) involved in the incident. Front line staff is not expected to undertake this responsibility.

## 12. PLAN MAINTENANCE & REVIEW

This Plan will be reviewed annually by:

- The Manager Energy Systems and Supervisor Mechanical Shop;
- EHS Coordinator for FMGT; and
- Facilities Management Joint Health & Safety Committee.

The EHS Coordinator, in conjunction with those responsible for the operation of the ammonia refrigeration equipment at the Stewart Complex, will review the plan forthwith in situations where the plan, as implemented, may not protect workers or be in non-compliance with legislative requirements.

## 13. DOCUMENTATION

The documentation that will be maintained as part of the Anhydrous Ammonia Exposure Control Plan includes:

- Written exposure control plan
- Training & fit-test records for respiratory protection
- Emergency response procedures
- Related safe work procedures
- Shift log book
- Preventative maintenance records
- Engineering design and process diagrams
- Incident investigation reports

## 14. REFERENCES & RESOURCES

- WorkSafeBC OHS Regulation, Section [5.54](#), [6.116-6.132](#)
- WorkSafeBC Publication, [Ammonia in Refrigeration Systems](#)
- Canadian Standards Association B52-05: Mechanical Refrigeration Code and B339-02: Cylinders, Spheres, and Tubes for the Transportation of Dangerous Goods.”
- Safety Standards Act
- Electrical Safety Regulation
- Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation
- Ammonia Release Emergency Procedures, University of Victoria 2018.



**Appendix A- Anhydrous Ammonia Safety Data Sheet (inserted)**

# Safety Data Sheet

Material Name: AMMONIA, ANHYDROUS

SDS ID: 00232586

## Section 1 - PRODUCT AND COMPANY IDENTIFICATION

### Material Name

AMMONIA, ANHYDROUS

### Synonyms

ANHYDROUS AMMONIA; AMMONIA GAS; AMMONIA; SPIRIT OF HARTSHORN; AMMONIA, ANHYDROUS, LIQUIFIED; UN 1005; H3N;

### Chemical Family

inorganic, Gas

### Product Use

Industrial and Specialty Gas Applications.

### Restrictions on Use

None known.

### Details of the supplier of the safety data sheet

POLAR CRYOGENICS

2734 SE Raymond

Portland , OR 97202

Phone: (800) 426-0689

Emergency Phone #: Outside the US: 703-527-3887 (Call collect)

Fax: 1-800-424-9300 (CHEMTREC)

## Section 2 - HAZARDS IDENTIFICATION

### Classification in accordance with paragraph (d) of 29 CFR 1910.1200.

Flammable Gases - Category 1

Gases Under Pressure - Liquefied gas

Acute Toxicity - Oral - Category 3

Acute Toxicity - Inhalation - Gas - Category 3

Skin Corrosion/Irritation - Category 1

Serious Eye Damage/Eye Irritation - Category 1

Respiratory Sensitization - Category 1

Germ Cell Mutagenicity - Category 2

Specific Target Organ Toxicity - Single Exposure - Category 1 ( Respiratory system. )

Specific Target Organ Toxicity - Repeated Exposure - Category 2 ( Respiratory system. )

Hazardous to the Aquatic Environment - Acute - Category 1

Hazardous to the Aquatic Environment - Chronic - Category 1

### GHS Label Elements

#### Symbol(s)



### Signal Word

Danger

### Hazard Statement(s)

Extremely flammable gas.

Contains gas under pressure; may explode if heated.

# Safety Data Sheet

**Material Name: AMMONIA, ANHYDROUS**

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Toxic if swallowed.  
Toxic if inhaled.  
Causes severe skin burns and eye damage.  
May cause allergy or asthma symptoms or breathing difficulties if inhaled.  
Suspected of causing genetic defects.  
Causes damage to organs.  
May cause damage to organs through prolonged or repeated exposure.  
Very toxic to aquatic life with long lasting effects.

## **Precautionary Statement(s)**

### **Prevention**

Obtain special instructions before use.  
Do not handle until all safety precautions have been read and understood.  
Keep away from heat/sparks/open flame/hot surfaces - No smoking.  
Use only outdoors or in a well-ventilated area.  
Wear protective gloves/protective clothing/eye protection/face protection.  
Do not breathe dust/fume/gas/mist/vapors/spray.  
Wear respiratory protection.  
Wash thoroughly after handling.  
Do not eat, drink or smoke when using this product.  
Avoid release to the environment.

### **Response**

Leaking gas fire: Do not extinguish, unless leak can be stopped safely.  
Eliminate all ignition sources if safe to do so.  
Collect spillage.  
If exposed: Call a POISON CENTER or doctor/physician.  
IF INHALED: Remove person to fresh air and keep comfortable for breathing.  
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  
IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse.  
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.  
Immediately call a POISON CENTER or doctor.  
Specific treatment (see label).

### **Storage**

Store in a well-ventilated place. Keep container tightly closed.  
Store locked up.  
Protect from sunlight.

### **Disposal**

Dispose of contents/container in accordance with local/regional/national/international regulations.

### **Statement(s) of Unknown Acute Toxicity**

Oral 0% of the mixture consists of ingredient(s) of unknown acute toxicity.  
Inhalation 0% of the mixture consists of ingredient(s) of unknown acute toxicity.

### **Statement(s) of Unknown Aquatic Toxicity**

0% of the mixture consists of ingredient(s) of unknown acute aquatic toxicity.  
0% of the mixture consists of ingredient(s) of unknown chronic aquatic toxicity.

### **Other Hazards**

Frostbite may occur from rapid evaporation of the liquified gas.

## **Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS**

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Material Name: AMMONIA, ANHYDROUS

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CAS	Component Name	Percent
7664-41-7	AMMONIA, ANHYDROUS	100.0

## Section 4 - FIRST AID MEASURES

### Inhalation

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

### Skin

Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing before reuse. Destroy contaminated shoes.

### Eyes

Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

### Ingestion

If swallowed, get medical attention.

### Most Important Symptoms/Effects

#### Acute

skin burns, eye burns, allergic reactions, lung damage

#### Delayed

skin burns, eye burns, lung damage, respiratory system effects Causes genetic defects.

### Note to Physicians

For inhalation, consider oxygen. For ingestion, consider esophagoscopy. Avoid gastric lavage.

## Section 5 - FIRE FIGHTING MEASURES

### Extinguishing Media

#### Suitable Extinguishing Media

carbon dioxide, regular dry chemical, Large fires: Use regular foam or flood with fine water spray.

#### Unsuitable Extinguishing Media

None known.

### Special Hazards Arising from the Chemical

Negligible fire hazard. Moderate explosion hazard. Containers may rupture or explode if exposed to heat.

### Hazardous Combustion Products

ammonia, oxides of nitrogen

### Fire Fighting Measures

Do not get water inside container. Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Keep unnecessary people away, isolate hazard area and deny entry. Stop flow of gas.

### Special Protective Equipment and Precautions for Firefighters

Wear personal protective clothing and equipment such as self-contained breathing apparatus (SCBA) for protection against possible exposure.

## Section 6 - ACCIDENTAL RELEASE MEASURES

### Personal Precautions, Protective Equipment and Emergency Procedures

Wear personal protective clothing and equipment, see Section 8.

### Methods and Materials for Containment and Cleaning Up

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so. Stop leak if safe to do so - Prevent entry into waterways, drains, or confined areas. Keep unnecessary people away,

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isolate hazard area and deny entry. Ventilate closed spaces before entering. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304).

## Environmental Precautions

Avoid release to the environment.

## Section 7 - HANDLING AND STORAGE

### Precautions for Safe Handling

Subject to handling regulations: U.S. OSHA 29 CFR 1910.119.

### Conditions for Safe Storage, Including any Incompatibilities

Store in a well-ventilated place. Keep container tightly closed.

Store locked up.

Protect from sunlight.

Subject to storage regulations: U.S. OSHA 29 CFR 1910.101.

### Incompatible Materials

Acids, combustible materials, metals, oxidizing materials, metal salts, halo carbons, halogens, amines, reducing agents, Cyanides, bases

## Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

### Component Exposure Limits

AMMONIA, ANHYDROUS	7664-41-7
ACGIH:	25 ppm TWA
	35 ppm STEL
NIOSH:	25 ppm TWA ; 18 mg/m <sup>3</sup> TWA
	35 ppm STEL ; 27 mg/m <sup>3</sup> STEL
	300 ppm IDLH
Europe:	20 ppm TWA ; 14 mg/m <sup>3</sup> TWA
	50 ppm STEL ; 36 mg/m <sup>3</sup> STEL
OSHA (US):	50 ppm TWA ; 35 mg/m <sup>3</sup> TWA
Mexico:	25 ppm TWA VLE-PPT ; 18 mg/m <sup>3</sup> TWA VLE-PPT
	35 ppm STEL [PPT-CT] ; 27 mg/m <sup>3</sup> STEL [PPT-CT]

### ACGIH - Threshold Limit Values - Biological Exposure Indices (BEI)

There are no biological limit values for any of this product's components.

### Engineering Controls

Provide local exhaust ventilation system. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

### Individual Protection Measures, such as Personal Protective Equipment

#### Eye/face protection

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Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

## Skin Protection

Wear appropriate chemical resistant clothing.

## Respiratory Protection

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

## Glove Recommendations

For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.

## Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

<b>Appearance</b>	Not available	<b>Physical State</b>	gas
<b>Odor</b>	pungent odor	<b>Color</b>	colorless
<b>Odor Threshold</b>	1 - 5 ppm	<b>pH</b>	11.6
<b>pH Solution</b>	1 N	<b>Melting Point</b>	-78 °C (-108 °F)
<b>Boiling Point</b>	-33 °C (-27 °F)	<b>Boiling Point Range</b>	Not available
<b>Freezing point</b>	Not available	<b>Evaporation Rate</b>	Not available
<b>Flammability (solid, gas)</b>	Not available	<b>Autoignition Temperature</b>	651 °C (1204 °F)
<b>Flash Point</b>	Not available	<b>Lower Explosive Limit</b>	15 %
<b>Decomposition temperature</b>	Not available	<b>Upper Explosive Limit</b>	28 %
<b>Vapor Pressure</b>	6658 mmHg @ 21 °C	<b>Vapor Density (air=1)</b>	0.5967
<b>Specific Gravity (water=1)</b>	Not available	<b>Water Solubility</b>	38 % (@ 20 °C)
<b>Partition coefficient: n-octanol/water</b>	Not available	<b>Viscosity</b>	Not available
<b>Kinematic viscosity</b>	Not available	<b>Solubility (Other)</b>	Not available
<b>Density</b>	0.7067 g/L at 25 °C	<b>Physical Form</b>	gas , liquid
<b>Molecular Formula</b>	N-H3	<b>Molecular Weight</b>	17.03

## Solvent Solubility

### Soluble

methanol, ethanol, chloroform, ether, organic solvents

## Section 10 - STABILITY AND REACTIVITY

### Reactivity

No reactivity hazard is expected.

### Chemical Stability

Stable at normal temperatures and pressure.

### Possibility of Hazardous Reactions

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Will not polymerize.

## Conditions to Avoid

Minimize contact with material. Avoid inhalation of material or combustion by-products. Containers may rupture or explode if exposed to heat.

## Incompatible Materials

Acids, combustible materials, metals, oxidizing materials, metal salts, halo carbons, halogens, amines, reducing agents, Cyanides, bases

## Hazardous decomposition products

ammonia, oxides of nitrogen

## Section 11 - TOXICOLOGICAL INFORMATION

### Information on Likely Routes of Exposure

#### Inhalation

Toxic if inhaled. burns May cause allergic or asthmatic symptoms or breathing difficulties if inhaled.

#### Skin Contact

burns

#### Eye Contact

burns

#### Ingestion

burns

#### Acute and Chronic Toxicity

Suspected of causing genetic defects. May cause damage to organs through prolonged or repeated exposure.

#### Component Analysis - LD50/LC50

The components of this material have been reviewed in various sources and the following selected endpoints are published:

#### AMMONIA, ANHYDROUS (7664-41-7)

Oral LD50 Rat 350 mg/kg (aqueous solution )

Inhalation LC50 Rat 2000 ppm 4 h

#### Product Toxicity Data

#### Acute Toxicity Estimate

No data available.

#### Immediate Effects

Toxic if inhaled. skin burns. eye burns.

#### Delayed Effects

Causes genetic defects. May cause allergic or asthmatic symptoms or breathing difficulties if inhaled. skin burns. eye burns. Causes damage to organs. May cause damage to organs through prolonged or repeated exposure.

#### Irritation/Corrosivity Data

No data available.

#### Respiratory Sensitization

No data available.

#### Dermal Sensitization

No data available.

#### Component Carcinogenicity

None of this product's components are listed by ACGIH, IARC, NTP, DFG or OSHA

#### Germ Cell Mutagenicity

May cause genetic defects.

#### Tumorigenic Data

No data available

#### Reproductive Toxicity

No data available.

#### Specific Target Organ Toxicity - Single Exposure

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No data available.

### Specific Target Organ Toxicity - Repeated Exposure

No data available.

### Aspiration hazard

No data available.

### Medical Conditions Aggravated by Exposure

eye disorders, respiratory disorders, skin disorders and allergies

## Section 12 - ECOLOGICAL INFORMATION

### Component Analysis - Aquatic Toxicity

AMMONIA, ANHYDROUS	7664-41-7
Fish:	LC50 96 h Cyprinus carpio 0.44 mg/L; LC50 96 h Lepomis macrochirus 0.26 - 4.6 mg/L; LC50 96 h Lepomis macrochirus 1.17 mg/L [flow-through ]; LC50 96 h Pimephales promelas 0.73 - 2.35 mg/L; LC50 96 h Pimephales promelas 5.9 mg/L [static ]; LC50 96 h Poecilia reticulata >1.5 mg/L; LC50 96 h Poecilia reticulata 1.19 mg/L [static ]
Invertebrate:	LC50 48 h Daphnia magna 25.4 mg/L IUCLID

### Persistence and Degradability

No information available for the product.

### Bioaccumulative Potential

No information available for the product.

### Mobility

No information available for the product.

## Section 13 - DISPOSAL CONSIDERATIONS

### Disposal Methods

Dispose in accordance with all applicable regulations.

### Component Waste Numbers

The U.S. EPA has not published waste numbers for this product's components.

## Section 14 - TRANSPORT INFORMATION

### US DOT Information:

Shipping Name: AMMONIA, ANHYDROUS

Hazard Class: 2.2

UN/NA #: UN1005

Required Label(s): 2.2

Marine pollutant

### TDG Information:

Shipping Name: AMMONIA, ANHYDROUS

Hazard Class: 2.2

UN#: UN1005

Required Label(s): 2.2

Marine pollutant

International Bulk Chemical Code



# Safety Data Sheet

**Material Name: AMMONIA, ANHYDROUS**

**SDS ID: 00232586**

This material does not contain any chemicals required by the IBC Code to be identified as dangerous chemicals in bulk.

## Section 15 - REGULATORY INFORMATION

### U.S. Federal Regulations

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), and/or require an OSHA process safety plan.

<b>AMMONIA, ANHYDROUS</b>	<b>7664-41-7</b>
SARA 302:	500 lb TPQ
SARA 313:	1 % de minimis concentration (includes anhydrous Ammonia and aqueous Ammonia from water dissociable Ammonium salts and other sources, 10% of total aqueous Ammonia is reportable under this listing )
CERCLA:	100 lb final RQ ; 45.4 kg final RQ
OSHA (safety):	10000 lb TQ (anhydrous ); 15000 lb TQ (solution ,>44% Ammonia by weight )
SARA 304:	100 lb EPCRA RQ

### SARA Section 311/312 (40 CFR 370 Subparts B and C) reporting categories

Flammable; Gas Under Pressure; Acute toxicity; Skin Corrosion/Irritation; Respiratory/Skin Sensitization; Serious Eye Damage/Eye Irritation; Specific Target Organ Toxicity; Germ Cell Mutagenicity

### U.S. State Regulations

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA
<b>AMMONIA, ANHYDROUS</b>	<b>7664-41-7</b>	Yes	Yes	Yes	Yes	Yes

### Not listed under California Proposition 65

### Canada Regulations

#### Canadian WHMIS Ingredient Disclosure List (IDL)

Components of this material have been checked against the Canadian WHMIS Ingredients Disclosure List. The List is composed of chemicals which must be identified on MSDSs if they are included in products which meet WHMIS criteria specified in the Controlled Products Regulations and are present above the threshold limits listed on the IDL

<b>AMMONIA, ANHYDROUS</b>	<b>7664-41-7</b>
	1 %

### WHMIS Classification

A , E

### Component Analysis - Inventory

#### AMMONIA, ANHYDROUS (7664-41-7)

US	CA	EU	AU	PH	JP - ENCS	JP - ISHL	KR KECI - Annex	KR KECI - Annex	KR - REACH CCA	CN	NZ	MX	TW	VN - NCI (Draft)
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# Safety Data Sheet

**Material Name: AMMONIA, ANHYDROUS**

**SDS ID: 00232586**

							1	2						
Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

**Section 16 - OTHER INFORMATION**

**NFPA Ratings**

Health: 3 Fire: 1 Reactivity: 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

**Summary of Changes**

Updated: 05/01/2015

**Key / Legend**

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CA/MA/MN/NJ/PA - California/Massachusetts/Minnesota/New Jersey/Pennsylvania\*; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CFR - Code of Federal Regulations (US); CLP - Classification, Labelling, and Packaging; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSD - Dangerous Substance Directive; DSL - Domestic Substances List; EC - European Commission; EEC - European Economic Community; EIN - European Inventory of (Existing Commercial Chemical Substances); EINECS - European Inventory of Existing Commercial Chemical Substances; ENCS - Japan Existing and New Chemical Substance Inventory; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime Dangerous Goods; ISHL - Japan Industrial Safety and Health Law; IUCLID - International Uniform Chemical Information Database; JP - Japan; Kow - Octanol/water partition coefficient; KR KECI Annex 1 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL); KR KECI Annex 2 - Korea Existing Chemicals Inventory (KECI) / Korea Existing Chemicals List (KECL) , KR - Korea; LD50/LC50 - Lethal Dose/ Lethal Concentration; LEL - Lower Explosive Limit; LLV - Level Limit Value; LOLI - List Of Lists™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; MX - Mexico; NDSL - Non-Domestic Substance List (Canada); NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PEL - Permissible Exposure Limit; PH - Philippines; RCRA - Resource Conservation and Recovery Act; REACH - Registration, Evaluation, Authorisation, and restriction of Chemicals; RID - European Rail Transport; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TCCA - Korea Toxic Chemicals Control Act; TDG - Transportation of Dangerous Goods; TLV - Threshold Limit Value; TSCA - Toxic Substances Control Act; TW - Taiwan; TWA - Time Weighted Average; UEL - Upper Explosive Limit; UN/NA - United Nations /North American; US - United States; VLE - Exposure Limit Value (Mexico); VN NCI (Draft) - Vietnam National Chemicals Inventory (NCI) (Draft); WHMIS - Workplace Hazardous Materials Information System (Canada) .

**Other Information**

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# Safety Data Sheet

**Material Name: AMMONIA, ANHYDROUS**

**SDS ID: 00232586**

## Appendix B- Audit of Compliance with Toxic Process Gas (Ammonia) Requirements

No.	Requirement	Actions/Processes
1	Written exposure control plan? (6.119)	December 2018.
2	Reviewed annually?	Yes
3	SOPs for safe handling of ammonia? [6.120(1)]	Limited, in BPV manual. Mechanical drawings verified for accuracy and matching identity tags applied to system components.
4	Are the SOPs current?	Last date of revisions in BPV manual was March 2018.
5	Are the SOPs readily available [6.120(3)]	Copies of the BPV manuals are held by each shift engineer, as well as in Mechanic Shop.
6	Emergency procedures for evacuation and rescue? [6.120(2)]	Latest version July 2018. Currently under revision.
7	Emergency procedures tested on a regular basis? [6.120(2)]	Sessions undertaken in May and October 2014.
8	Emergency procedures are readily available? [6.120(3)]	In EOP binder, ammonia emergency response available (in all shops). Also available in electrical ante room at ISC (Room 150AA).
9	Do workers have training and effective education for operating equipment/machinery? [6.121(a)]	Workers authorized to work on the system are qualified refrigeration mechanics or 3 <sup>rd</sup> Class Power Engineers. A non-documented orientation is provided to operating staff upon hire.
10	Are records of the education and training maintained? [6.121(b)]	In-house training documented in database maintained by EHS Coordinator. Copies of credentials held in HR personnel files.
11	Is Room 150A designed, constructed and maintained to prevent fugitive emissions from entering occupied work areas? [6.122(a)]	Ammonia room is in proximity to Zamboni storage and ice rink. It is designed as a stand-alone room. At low alarm, auto-switch will initiate fan for negative pressure of space. At high alarm, building general intake exhaust is automatically shut down.
12	Is Room 150A provided with exhaust ventilation to ensure effective inward air flow into the enclosure at all times? [6.122(b)]	Room is designed to cross ventilate passively. Manual or auto-switch at low alarm level or higher will initiate fan for negative pressure.
13	Is Room 150A provided with a safe means of entry and exit? [6.122(c)]	There is clear access to doorway for entering and exiting room. Display panel outside ammonia room with concentration display and alarm; remotely tied in to University alarms and monitoring system. Lights on-site also connected to alarms for safe entry assessment.
14	Is Room 150A designated as a restricted work area limited to entry by authorized personnel? [6.122(d)]	Yes, signage affixed on ammonia room door; mechanical key access required.
15	Is Room 150A posted with signs which clearly identify the hazards and the precautions required for safe entry? [6.122(e)]	Signage on ante room to ammonia indicates ammonia and plant capacity.
16	Does the posted sign indicate the total weight of ammonia stored in the system? (WSBC Resource p.17)	Yes—300 kg.

No.	Requirement	Actions/Processes
17	Is there a safe means to check and test conditions inside Room 150A before entry? [6.123]	Yes, display panel outside ammonia room with concentration display, lights and alarm.
18	Are exhaust systems designed to exhaust ammonia directly to the outdoors in a safe manner? [6.124(a)]	Exhaust stack was added to direct room exhaust to the height to 3 meters above the adjacent roof line (May.2018)
19	Are there grilles providing makeup air from adjacent occupied area? Are they equipped with gas-rated, back-draft dampers? [6.124(b)]	The intake grille is directly from outside (roof height). No gas-rated, back-draft dampers but built in accordance with CSA B51-97.
20	Are critical parts of the ventilation system, such as fans, motors, air flow, monitored to ensure that workers are alerted to malfunctions of the system? [6.124(c)]	DDC system monitors the amperage of fans (on/off) and will signal to operator associated malfunction.
21	Is the ventilation ducting vapour proof, dedicated and resistant to corrosion? [6.124(d)]	Built to CSA B51-97.
22	Are the fans located on the outside of the building, so as to maintain the duct work within the occupied area under a negative pressure differential? [6.124(e)]	Fans exhaust to roof of "standalone" ventilated mechanical room. Ducting does not pass through any other spaces of the building.
23	Can the gas supply be shut down manually from a remote location or by the alarm system so as to isolate the reserve? [6.126(1)(a)]	Not applicable to the operation of this system. It is a recirculating system.
24	When the remote shut-down device is activated, are the operators alerted? [6.126(2)]	Operators can remotely shutdown compressors and receive feedback re: operation. Mechanical alarms are associated with the operation of the compressors.
25	What personal protective equipment is provided? [6.127(1)]	Full-face respirators, escape respirator, cryogenic gloves, safety goggles/glasses, coveralls, steel-toe foot wear.
26	Have workers been fit-tested on the full-face respirator within the last year?	Yes (November 2018)
27	Is the full-face respirator in the shift engineer's vehicle?	One in vehicle, two at the ice plant in the ante room.
28	Do all staff understand which cartridge is to be used and how to maintain equipment?	Training provided on specific cartridge use during annual emergency exercise and during fit-testing.
29	Is the escape respirator available and in good condition? When was the last time the cartridges were changed?—recommended 6 months or after use.	Escape respirators are stored in the adjacent electrical ante room, one adjacent to the log book and a second in the first aid cabinet.
30	Are workers entering the restricted access enclosure carrying the escape respirator? [6.127]	Workers have been informed to always carry the escape respirator when entering the ammonia mechanical room. See signage in Section 7.3, posted on machine room entry door.
31	Is there a continuous monitoring system to detect fugitive emissions and accidental releases? [6.128(1)]	Yes, ammonia alarm is in continuous operation and monitored.

No.	Requirement	Actions/Processes
32	Can the monitoring systems effectively determine work conditions within the restricted access area? [6.128(2)]	Yes, unless sensor fails—then we have Dräger and PID backup.
33	Do workers know what the set alarm levels are? Is this posted anywhere for reference?	Posted on alarm panel and outlined in the emergency response plan.
34	Are the continuous monitors connected to alarm systems to adequately warn workers of conditions and activate appropriate control measures? [6.128(2)]	The monitors are connected to flashing lights. Low alarms are orange and high alarm light is red. Low and high alarms automatically activate the exhaust fan.
35	Is the monitoring and alarm systems tested at least monthly for proper operation? [6.128(3)(a)]	Implemented in January 2014 rounds and conducted henceforth.
36	Is the monitoring and alarm system calibrated at least annually? [6.128(3)(b)]	Yes, PM in FMIS has CMJ Equipment providing semi-annual calibration of the unit.
37	Do all pressure relief valves or similar safety-release devices direct relief gas to the outdoors in a safe manner? [6.129(1)]	Yes, pressure relief valves (2) are visible red piping extending to 3 meters above highest adjacent roof level.
38	Does the reporting system inform the operators if a pressure relief safety device is engaged? [6.129(2)]	Yes. Sensors have been installed at pressure relief valves to notify shift engineer and Campus Security of activation.
39	Are all critical components of the equipment clearly identified? [6.130(a)]	Yes. Signage is in place throughout on vessels and piping.
40	Can the function of every control device be readily determined? [6.130(b)]	Yes.
41	Is the piping system constructed of compatible materials resistant to corrosion by the gas? [6.131(1)(a)]	Plant was constructed in accordance with CSA B51-97.
42	Is the piping constructed to withstand the system pressures to which is will be subjected? [6.131(1)(b)]	Plant was constructed in accordance with CSA B51-97.
43	Is the piping safely routed, supported and protected from impact, damage, shock and vibration? [6.131(1)(c)]	Yes.
44	Are the piping and valves leak and pressure tested before the system is put into operation? [6.131(2)]	Yes, as tested by the external contractor.
45	Is the piping system equipment with isolation, pressure venting or bleed valves designed to purge the lines safety before maintenance/servicing? [6.131(3)]	Yes.
46	Does the servicing and maintenance of the equipment address all critical components? [6.132]	Maintenance and servicing details maintained in FMIS. Semi-annual inspection on auxiliary equipment (ventilation system and circ. pumps brine side); annual major inspection and corrective work to main plant components (i.e. refrigeration compressors).

No.	Requirement	Actions/Processes
47	Is there a tempered eyewash available within 6 m?	Yes, plumbed eyewash fountain located in electrical ante room.
48	Is there a tempered shower (or drench hose) available within 6 m?	Yes, shower installed immediately outside compressor room door in electrical ante room
49	Is an SDS for anhydrous ammonia readily available and current (<3 years of age)?	Added to MSDSonline and current (2017).
50	Workers authorized to work in this area are current in their WHMIS training (<3 years)?	Yes
51	Do operators know how to use Drager tube? Understand limitations?	Operations of Drager tubes/pump reviewed during emergency exercise in May/October 2014.
52	Are the Drager tubes current or expired?	Current (purchased in 2018).
53	Do staff work alone at this location? Have working alone procedure be written? And are followed?	Yes, shift engineer is equipped with cell phone and radio patched in to Security continuously. Back-up always required for emergency situations-camera monitoring on-site.
54	Wind socks remain in good condition? One on approach to complex and one on rear of building?	Windsocks installed on approach to building and over former weight room. Saanich Fire Hall 3 informed.
55	First aid training for shift engineers? Back-ups?	Primary first aid for campus is CSEC, available 24 hours (in direct contact via radios).
56	Is current ventilation maintaining 15 air changes/hour in the machine room? (WSBC Resource p. 27)	Designed in compliance with CSA B51-97 for ACH.
57	Does this room meet the definition of a Class "T" room under the Safety Standards Act and PEBPV and RSR? (WSBC Resource p.26)	Based on review of B52 (1995), current configuration does not have exit leading directly outside from machine room.
58	Litmus paper for leak detection stored outside of machine room?	Located in the electrical ante room, along with sulphur sticks for leak locating.
59	Do we store more than 300 lbs of ammonia or 20% of the normal ammonia charge (whichever is less) in the machine room? (WSBC Resource)	No "storage" of ammonia. The system is recirculating, with little to no recharging required.