



Terra Industries Inc.
Terra Centre – 600 Fourth Street
Sioux City, Iowa 51101

Anhydrous Ammonia

MSDS Number 2001 (Revised April 23, 2008)

10 Pages

1. CHEMICAL PRODUCT and EMERGENCY TELEPHONE CONTACT

Product Name:..... Anhydrous Ammonia
Chemical Family:..... Inorganic Nitrogen Compound
Synonyms:..... Ammonia, Liquid Ammonia, Nitro-Sil, Spirit of Hartshorn, NH₃
Formula:..... NH₃
Product Use:..... Fertilizers; Fibers and Plastics; Explosives; Animal Feed; SCR NO_x Control

EMERGENCY TELEPHONE NUMBER

CHEMTREC (U.S.):..... 800-424-9300
CANUTEC (Canada):..... 613-996-6666

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient Name/CAS Number	Concentration	Exposure Limits
Ammonia #7664-41-7	99-100%	25 ppm TWA 35 ppm STEL 50 ppm PEL 300 ppm IDLH

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Colorless gas and liquid (liquid under pressure). Vapor is toxic and irritating to eyes, nose, throat and skin. Liquid will burn skin and eyes and cause frostbite. Vapor is flammable under limited conditions. Use water to control fire and disperse vapors. Do not put water on liquid ammonia.

NFPA Hazard Classification	Health Hazard (Blue)	3
	Flammability (Red)	1
	Reactivity (Yellow)	0

POTENTIAL HEALTH EFFECTS

Primary Routes of Entry: Inhalation, skin contact/absorption and eye contact.

General Acute Exposure: Anhydrous ammonia reacts with moisture in mucosal surfaces (eyes, skin, and respiratory tract) to produce ammonium hydroxide, which may cause caustic injury. The severity of injury depends upon the concentration and duration of exposure. The extent of injury ranges from mild cough to laryngeal edema and life-threatening pulmonary edema.

Inhalation:

Acute Exposure: Ammonia is toxic and a severe irritant of the respiratory tract. It may cause a running nose, coughing, chest pain, cessation of respiration and death. It may cause severe breathing difficulties, which may be delayed in onset. **ADDITIONAL MEDICAL INFORMATION:** Bronchospasm, laryngitis, tracheitis, wheezing, dyspnea, and laryngeal stridor may be noted. Mucosal burns to the tracheobronchial tree, Pulmonary Edema, and associated hypoxemia frequently occur following exposure to concentrated ammonia.

Skin:

Acute Contact: Ammonia is a severe irritant of the skin. Skin exposure to high concentrations of the gas may cause burning and blistering. Contact with liquid may cause severe skin burns. **ADDITIONAL MEDICAL INFORMATION:** Concentrated ammonia may produce liquefaction necrosis and deep penetrating burns.

Eye:

Acute Contact: Exposure to the eyes (>700 ppm) may cause temporary or permanent blindness. **ADDITIONAL MEDICAL INFORMATION:** Eye exposure may result in conjunctivitis, lacrimation and/or corneal irritation. Total corneal epithelial loss may occur.

Neurologic:

Acute Exposure: An altered mental status (coma) may be seen, but is not characteristic unless hypoxemia occurs.

Gastrointestinal:

Acute Exposure: Nausea and vomiting occurs frequently following ingestion. Swelling of the lips, mouth, and larynx, and oral or esophageal burns may occur if concentrated ammonia solutions are ingested.

Genitourinary:

Acute Exposure: Urinary retention may occur.

Note to the Physician: Pneumonitis should be anticipated after inhalation or ingestion. If severe exposure is suspected, observe for 48-72 hours for delayed pulmonary edema.

Carcinogenicity:

NTP: Not Listed
IARC: Not Listed
OSHA: Not Regulated

Medical Conditions Aggravated by Exposure: Chronic respiratory or skin disease

4. FIRST AID MEASURES

First Aid for Eyes: Immediately flush eyes with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, excessive tearing, or light sensitivity persists, the patient should be seen in a health care facility and referral to an ophthalmologist considered.

First Aid for Skin: Immediately flush exposed area with copious amounts of tepid water for at least 15 minutes followed by washing area thoroughly with soap and water. The patient should be seen in a health care facility if irritation or pain persists.

First Aid for Inhalation: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If trained to do so administer supplemental oxygen with assisted ventilation as required. Administer artificial respiration if patient is not breathing.

First Aid for Ingestion: Call a physician. If conscious, give the patient 4 to 8 ounces of milk or water to drink immediately. Do not induce vomiting.

Caution: Clothing frozen to the skin should be thawed before being removed.

5. FIRE FIGHTING MEASURES

Flash Point:	Not Applicable
Lower Flammable Limit:	15.5 % Volume in Air
Upper Flammable Limit:.....	27.0 % Volume in Air
Autoignition Temperature.....	1204° F (651° C)

Extinguishing Media: Stopping the flow of gas rather than extinguishing the fire is usually the best procedure to follow when escaping gas is burning.

Small Fire:..... Dry chemical or CO₂

Large Fire:..... Water spray, fog or foam

Special Fire Fighting Procedures:

- a. Do not get water inside container.
- b. Move container from fire area if you can do it without risk.
- c. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks due to exploding potential when tanks are involved in a fire.
- d. Isolate area until gas has dispersed.
- e. Use water spray or foam to control vapors.
- f. Positive pressure self-contained breathing apparatus (SCBA) should be used when there is a potential for inhalation of vapors and/or fumes.
- g. Chemical protective clothing that is safe for use with ammonia involved in a fire should be worn.

CAUTION:

- a. With proper training, structural fire fighter's protective clothing and SCBA used in conjunction with water spray will provide limited protection for short-term exposure to ammonia vapors.
- b. Liquid ammonia may cause protective equipment to become brittle.
- c. Use of welding or flame cutting equipment on or in ammonia container is not recommended unless all ammonia has been purged, rinsed with water, and any oil residue removed.

Runoff from fire control or dilution water may cause pollution.

6. ACCIDENTAL RELEASE MEASURES

Spill or Leak Measures: Stop leak if you can do so without risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Evaluate the affected area to determine whether to evacuate or shelter-in-place by taping windows and doors, shutting off outside air intakes (attic fans, etc.), and placing a wet towel or cloth over the face (if needed). With proper training, self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing used in conjunction with water spray will provide limited protection in outdoor releases for short-term exposure. Fully encapsulating, vapor-protective clothing should be worn for spills and leaks with no fire. Use water spray or foam to control vapors. Mixing of water and liquid ammonia will increase vaporization rate. Do not put water on liquid ammonia unless more than 100 volumes of water are available for each volume of liquid ammonia.

CAUTION:

- a. Personal protective clothing may become brittle when exposed to liquid ammonia.
- b. Runoff from vapor control or dilution may cause pollution.

Determining Spill Size: Generally, a small spill is one that involves a single, small container (55-gallon capacity or less), or a small (non-continuing) leak from a larger tank or vessel.

Small Spill:

- a. Flush area with flooding amounts of water.
- b. First isolate 100 feet in all directions and then protect persons downwind 0.1 miles during daylight and 0.1 miles at night.

Large Spill:

- a. Dike far ahead of liquid spill for later disposal.
- b. Follow local emergency protocol for handling.
- c. First isolate 200 feet in all directions, than protect persons downwind 0.4 miles during daylight and 1.4 miles at night.

7. HANDLING AND STORAGE

Follow the current ANSI-K61.1 Standard, "Safety Requirements for the Storage and Handling of Anhydrous Ammonia", or applicable Ammonia Manufacturing Industry Standards. (See Section 15 for information on Equipment, Pressure Vessels and Testing).

Handling Precautions: Use proper personal protective equipment when working with or around ammonia. See Section 8.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Respiratory Protection Requirements:

- <25 ppm: No protection required.
- 25 to 35 ppm: Protection required if the daily TWA is exceeded.
- 35 to 50 ppm: Protection required if exposed for more than 15 minutes.
- 50 to 250 ppm: Minimum of an air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
- 250 to 300 ppm: Minimum of a full-face air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
- >300 ppm: A fresh air supply system must be used (i.e. positive pressure self contained breathing apparatus).

Skin Protection Requirements: Skin protection is required for exposure to liquid, mist, and > 1000 ppm of ammonia gas or vapors. Neoprene or rubber gauntlet-type gloves, ammonia resistant clothing (overalls, jacket, and boots) or vapor suit, as required.

Eye Protection Requirements: Use chemical (indirectly vented) goggles when there is a potential for contact with liquid or mist. A full-face shield is recommended in addition to goggles for added protection.

Other Protective Equipment: Safety shower and eyewash fountain should be provided in the ammonia handling area. In agricultural distribution, provide easily accessible shower and/or at least 100 gallons of clean water in open top container (check regulations). When transporting, provide at least 5 gallons of readily accessible, clean water and personal protective equipment.

Engineering Controls: Maintain adequate ventilation to keep ammonia concentrations below applicable standards when possible.

NOTE: See Section 2 for regulatory exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Gas (liquid under pressure)
Color:	Colorless gas and liquid, forms white vapor in contact with moisture
Odor:	Strong pungent penetrating odor, ammonia.
Boiling Point:	-28.1° F (-33° C) at 1 atm
Melting point:	-107.9° F (-78° C)
Ph:	Approximately 12.0 (neat)
Solubility:	510 - 530 g/L @ 20° C
Specific Gravity:	0.6818 @ -33.35° C and 1 atm
Vapor Density:	0.597 @ 0° C (0.60 @ 60° F)
Vapor Pressure:	7,600 mm Hg @ 25° C (93 psig @ 60° F)
% Volatile by Volume:	100
Molecular Weight:	17.03
Density:	0.696 g/L @ 20° C (5.14 lb./gal. @ 60° F)
Critical Temperature:	271° F (133° C)
Critical Pressure:	1636 psia

10. REACTIVITY

Stability: This is a stable material.
Hazardous Polymerization: Will not occur.

Decomposition: Hydrogen is released on heating above 850° F (454° C). The decomposition temperature may be lowered to 575° F (300° C) by contact with certain metals such as nickel. At 1290° F (690° C) or in the presence of an electric spark, ammonia decomposes into nitrogen and hydrogen gases, which may form a flammable mixture in the air.

Incompatibilities:

- Ammonia has potentially explosive or violent reactions with interhalogens, strong oxidizers, Nitric Acid, Fluorine, and Nitrogen Oxide.
- Ammonia forms sensitive explosive mixtures with air and hydrocarbons, Ethanol and Silver Nitrate, and Chlorine; and explosive products are formed by the reaction of ammonia with Silver Chloride, Silver Oxide, Bromine, Iodine, Gold, Mercury, and Tellurium Halides.
- Ammonia is incompatible or has potentially hazardous reactions with Silver, Acetaldehyde, Acrolein, Boron, Halogens, Perchlorate, Chloric Acid, Chlorine Monoxide, Chlorites, Nitrogen Tetroxide, Tin, and Sulfur.

NOTE: The incompatibilities above are a partial list taken from two books by Sax & Lewis: "Dangerous Properties of Industrial Materials", 7th. ed., 1989 and "Hawley's Condensed Chemical Dictionary", 11th. ed. 1987, both published by Van Nostrand Reinhold Company, New York. It is recommended that if additional information is required, the reader refer to these and other published information.

11. TOXICOLOGICAL INFORMATION

Toxicity

Acute Inhalation Toxicity

LC₅₀ Rat, mouse:..... 4,200 - 19,060 mg NH₃/m³ (1 hr)

Acute Toxicity, Other Routes

LC₅₀ Rat, mouse:..... 45.5 - 195.1 mg NH₃/kg bw (1 hr intravenous)

Corrosiveness / Irritation

Skin Irritation / Corrosion:..... Corrosive to skin

Eye Irritation / Corrosion:..... Subacute and chronic exposure to 200 – 1,000 ppm produced eye damage. 100 – 200 ppm produced moderate to severe irritation.

Repeated Dose Toxicity

Rats, guinea pigs, rabbits, etc:.....No mortality (Inhalation up to 770 mg/m³)

Genetic Toxicity *in vitro*

Salmonella typhimurium, etc:.....Negative (Bacterial gene mutation assay)

Chick fibroblasts:.....Induced chromosomal clumping, polyploidy, and arrested spindle formation. No data showing that ammonia is mutagenic in mammals. (Cytogenetic assay)

Genetic Toxicity *in vivo*

Drosophila melanogaster:.....No evidence for mutagenicity

Carcinogenicity

All:.....No carcinogenic effects

Toxicity to Reproduction

Pig:.....Temporarily depressed mean daily gain (MDG) at 35 mg/kg in gilts (One generation study)

Human Experience

Inhalation, human volunteers:.....Nasal and pulmonary irritation at concentrations of about 100 ppm and higher.

Ecotoxicity

Acute Toxicity to Fish

LC₅₀ Many species:..... 0.09 – 3.51 mg un-ionized NH₃/L (96 hr)

Acute Toxicity to Aquatic Invertebrates

LC₅₀ *Daphnia magna*:..... 2.94 mg un-ionized NH₃-N/L (48 hr)

Toxicity to Aquatic Plants

LOEC Benthic diatoms:..... 0.5 – 1.0 mg N/L (Up to 25 days)

LOEC *Chlorella vulgaris*:..... 500 mg N/L (21 days)

Toxicity to Bacteria

EC₅₀ *Photobacterium phosphoreum*:..... 1.49 mg un-ionized NH₃/L (5 min)

Chronic Toxicity to Fish

NOEC Many species:0.025 – 1.2 mg un-ionized NH₃/L (Varied 12 days – 5 years)

Chronic Toxicity to Aquatic Invertebrates

NOEC *Daphnia magna* and others:.....0.163 – 0.42 mg un-ionized NH₃/L (Varied 21 days – 76 weeks)

Toxicity to Terrestrial Plants

LOEC Many species3 – 250 ppm (Varied 4 min – 16 hrs)

Toxicity to Other Non-Mammalian Terrestrial Species

LD₅₀ *G. Domesticus*:.....2.72 mM (1 hr injections)

Source: TFI Product Testing Program April 2003

12. ECOLOGICAL INFORMATION

- a. Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes.
- b. Local health and wildlife authorities, as well as operators of water intakes in the vicinity, should be notified of water releases.
- c. Waterfowl toxicity may occur at elevated concentrations.
- d. Ammonia does not concentrate in the food chain.
- e. The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of dissolved oxygen (referred to as nitrogenous oxygen demand).

Effect on water treatment process: Chlorination will produce chloramines, which are more readily detected by taste and odor.

Note: See Ecotoxicity information in section 11.

13. DISPOSAL CONSIDERATIONS

Reclaim as fertilizer if possible. Waste must be disposed of in accordance with federal, state, and local environmental control regulations.

14. TRANSPORTATION INFORMATION

U.S. DOT and Canadian TGD Act

Shipping Name:..... Ammonia, anhydrous

Shipping Class/Division:..... 2.2 (8) U.S.; 2.3 (8) Canada

Hazard Class: Non-Flammable Gas (Corrosive) U.S.; Toxic Gas (Canada)

Product Identification Number (PIN): UN1005

DOT Placard: Non-Flammable Gas 2.2, color: green (U.S.); Class 2.3 or UN1005, color: white (Canada)

DOT Special Provision: 13, "Inhalation Hazard"

OSHA Label Required: Yes

RQ (Reportable Quantity):..... 100 pounds

STCC Number: 4904210

15. **REGULATORY INFORMATION**

Controlled Products Regulations Classification: A: Compressed Gas; E: Corrosive

OSHA: This product is considered a hazardous material under criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200 (Toxic; Corrosive), and is listed as a Highly Hazardous Chemical subject to the requirements of the Process Safety Management Standard 29 CFR 1910.119.

CAA Chemical Accident Prevention: Ammonia is considered a regulated substance subject to the Chemical Accident Prevention provisions of 40 CFR Part 68. The threshold quantity for this substance is 10,000 lbs.

SARA TITLE III:

- a. EHS (Extremely Hazardous Substances) List: Listed (EPA, 1992a)
- b. SARA RQ (Reportable Quantity): 100 pounds
- c. TPQ (Threshold Planning Quantity): 500 pounds
- d. Regulation: "Emergency Planning and Notification" - 40 CFR Part 355 (Appendices A and B).
- e. Section 313: "Specific Toxic Chemical Listings" - 40 CFR Part 372
Ammonia is subject to the reporting requirements of Section 313 "Specific Toxic Chemical Listings" 40 CFR Part 372. Terra is required by 40 CFR 372.45 to notify certain customers as to which of its mixture or trade name products contain those chemicals. The purpose of that notification is to ensure that facilities that may be subject to the reporting requirements of Section 313 and that use products of unknown formulation will have knowledge that they are receiving products that contain chemicals subject to those reporting requirements.

CERCLA Hazardous Substances List:

- a. CERCLA RQ (Reportable Quantity): 100 pounds
- b. Regulation: "Designation, Reportable Quantities, Notification" - 40 CFR 302

TSCA Inventory: Listed (RTECS)

Chemical Facility Anti-Terrorism Standard (CFATS) / 6 CFR Part 27:

Ammonia (anhydrous) is listed in Appendix A as a Chemical of Interest (COI) due to threat of "Release"

Screening Threshold Quantity (STQ): 10,000 pounds

Equipment, Pressure Vessels, Testing, Etc.: All equipment used to handle, store, transfer or apply anhydrous ammonia must be properly engineered, constructed and maintained in compliance with all applicable regulations and standards. Pressure vessels, piping and appurtenances should be regularly inspected and tested using methods designed to reveal external and internal deterioration or defects that may impair the integrity of the equipment such that an unintended release of anhydrous ammonia may result. Consult with your State Department of Agriculture and other experts, as applicable, concerning the methods that would be most appropriate given the particular circumstances. Refer to 29 CFR 1910.111, *Storage and Handling of Anhydrous Ammonia*; 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Materials*; and the current ANSI standard K61.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*, for additional information.

16. OTHER INFORMATION

Dec. 18, 1995: The MSDS was rewritten to comply with ANSI Standard Z400.1-1993.
July 1, 2003: Added toxicity information from the TFI Product Testing Program April 2003.
October 4, 2006: Added NFPA hazard classification information and updated isolation / protective action distances per ERG 2004.
Dec. 19, 2006: Added Equipment, Pressure Vessel and Testing Information.
August 24, 2007: Reviewed and revised.
January 2, 2008: Revised 15. Regulatory Information to add CFATS requirements
April 23, 2008: Revised 14. Transportation Information to change Canadian TDG requirements

The information and recommendations herein are taken from data contained in independent, industry-recognized references including but not limited to NIOSH, OSHA, ANSI, NFPA, DOT ERG, the TFI Product Testing Program, Global Engineering Documents, MEDITEXT, HAZARDTEXT, SARATEXT, CHRIS, OHM/TADS, and IRIS. Terra Industries Inc. makes no guarantee, warranty or other representation concerning this substance, since conditions of its use are beyond the control of the company. Terra Industries Inc. disclaims any liability for loss or damage incurred in connection with the use of this substance.