

## Material Safety Data Sheet

For Emergency Call: CHEMTREC -- (800) 424-9300

### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**Product Name:** Anhydrous Ammonia

**CAS Number:** 7664-41-7

**Product Uses:** Agricultural industry: Fertilizer  
Industrial applications: Manufacture of chemicals.  
Manufacture of synthetic fibers.  
Refrigerant.  
Cleaning solutions.

**Chemical Name:** Ammonia, anhydrous

**Chemical Family:** Inorganic Nitrogen Compounds

**Synonyms and Common Trade Names:** Liquid ammonia  
Ammonia

**Company Identification:**

Manufacturer's Name: CF Industries, Inc.  
Address: One Salem Lake Drive, Long Grove, Illinois, 60047-8402  
Telephone: (847) 438-9500

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	Weight Percentage	CAS Number
Ammonia	99.0-99.6	7664-41-7
Ammonium Hydroxide	0.4-1.0	1366-21-6

### 3. HAZARDS IDENTIFICATION

#### Emergency Overview

**Danger!** Corrosive. May be harmful or fatal if inhaled. Liquid anhydrous ammonia is extremely cold and can cause freezing or frostbite of tissues upon contact. Use ventilation adequate to keep exposures below recommended exposure limits (see Section 8). Do not breathe gas. Do not get in eyes, on skin or on clothing. Do not taste or swallow. Wash thoroughly after handling. Wear appropriate personal protective equipment.

Compressed gas or refrigerated liquid. Contents under pressure. Combustible when mixtures of ammonia and air are united under favorable conditions. Keep away from heat, sparks, flames, or other sources of ignition (e.g., static electricity, pilot lights, mechanical/electrical equipment).

Colorless liquid or gas with intense, pungent, suffocating odor.

#### Potential Health Effects:

**Eyes:** Corrosive. Contact with liquid or vapor may cause severe irritation, eye burns, and permanent eye damage.

**Skin:** Corrosive. Contact with liquid solutions and high concentrations of gaseous ammonia may cause severe irritation, skin burns, and permanent skin damage. No information regarding skin absorption, however, corrosivity of material suggests significant skin absorption will occur.

**Inhalation:** Corrosive and toxic. May be harmful if inhaled. May cause severe irritation and burns of the nose, throat, and respiratory tract. Effects of overexposure may include headaches, coughing, nausea, vomiting, breathing difficulties, pneumonitis (inflammation of the lungs) and pulmonary edema (accumulation of fluid in the lungs).

**Ingestion:** This material is a gas under normal atmospheric conditions and ingestion is unlikely. In the unlikely event of swallowing, may cause immediate burning in the mouth and throat. May cause severe pain in the mouth, chest, and abdomen; swallowing difficulty; drooling; and vomiting. Acute burns to the esophagus and perforation of the esophagus or stomach may occur.

**Pre-Existing Medical Conditions:** Conditions aggravated by exposure may include skin disorders and respiratory (asthma-like) disorders.

#### **Late Toxicities:**

**Cancer**—Inadequate data available to evaluate the cancer hazard of this material. This material is not listed as a carcinogen by NTP, IARC, or OSHA.

**Target Organs**—Late toxicities associated with the lungs and respiratory tract may occur following inhalation of high concentrations of ammonia.

**Developmental and Reproductive System Effects**—Inadequate data available for this material.

#### 4. FIRST AID

**Eyes:** Immediately move victim away from exposure and into fresh air. If irritation or redness develops, flush eyes with clean water. For direct contact, immediately hold eyelids apart and flush the affected eye(s) with clean water for at least 15 minutes. Seek medical attention immediately.

**Skin:** Immediately flush affected area(s) with large amounts of water while removing contaminated shoes, clothing, and constrictive jewelry. If skin surface is damaged, apply a clean dressing. If skin surface is not damaged, cleanse the affected area(s) thoroughly by washing with mild soap and water. Seek immediate medical attention.

**Inhalation:** Immediately move victim away from exposure and into fresh air. If victim is not breathing, immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.

**Ingestion:** This material is a gas under normal atmospheric conditions and ingestion is unlikely. In the unlikely case of ingestion, do not induce vomiting. If vomiting does occur, hold head down below hip level to prevent vomit from entering lungs. Do not administer activated charcoal. If person is unconscious, do not give anything by mouth. Victims who are conscious and able to swallow should be given 4 to 8 ounces of water. Seek immediate medical attention.

**Notes to Physician:** After inhalation, watch for delayed symptoms of ammonia exposure, e.g., pulmonary edema. Treat symptomatically, administering analgesics and corticosteroids as necessary. Surgical intervention (tracheostomy) may be needed to maintain an airway. Watch for chemical pneumonitis after ingestion or inhalation of fumes.

#### 5. FIRE FIGHTING MEASURES

**Flammability:** Slightly flammable in the presence of open flames and sparks. Narrow lower to upper flammability limits (16-25%) makes ignition difficult.

**Flash Point (test method):** Not applicable (gas)

**Flammable Limits:** 16% to 25% (by volume in air)

**Explosive Limits:** 16% to 25%

**Autoignition Temperature:** 651°C (1,204°F)

**Extinguishing Media:** Dry chemical, carbon dioxide, or water spray is recommended. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces.

**NFPA Fire Rating:**

Flammability	1
Health Hazard	3
Reactivity	0
Specific Hazard	Not applicable

**Key:** Least = 0, Slight = 1, Moderate = 2, High = 3, Extreme = 4

**Special Firefighting Procedures:** Wear full protective clothing and a self-contained breathing apparatus because toxic fumes are emitted. Note that many materials, particularly plastics, become brittle on contact with liquid ammonia. Stop flow of gas or liquid if possible. Use water to keep fire-exposed containers cool and to protect persons shutting off flow. For a serious leak, use fire hose with a fog nozzle and plenty of water to absorb the ammonia vapors. Do not direct water streams into pools of liquid ammonia because this will increase the formation of ammonia vapors.

**Unusual Fire and Explosive Hazards:** Compressed gas or refrigerated liquid. Gas may ignite at vapor concentrations between 16% and 25% in air. However, ammonia-air mixtures are difficult to ignite, and burn with little vigor. In the absence of oxygen enrichment, the risk of initiating an accidental fire or explosion is low. The presence of oil or other combustible materials increases the fire hazard. Do not allow ammonia vapors to accumulate in confined areas where ignition may occur. Intense heating particularly in contact with hot metallic surfaces may cause decomposition of ammonia generating hydrogen, a flammable gas.

**Hazardous Combustion Products:** Nitrogen oxides (NO, NO<sub>2</sub> ...)

## **6. ACCIDENTAL RELEASE MEASURES**

Clean-up workers should wear appropriate protective clothing (see Section 8). Persons not wearing protective equipment and clothing should be restricted from spill areas until clean up has been completed. Clean-up workers should stay upwind and keep out of low areas. Ventilate spill or leak area to disperse gas. Eliminate all sources of ignition. Stop flow of gas if possible. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air and allow the cylinder to empty. If small spill, either allow to vaporize or absorb the vapor in water. If large spill, spray the vapor cloud with water to reduce fire and fume hazard. Do not put water directly on leak or spill. Specific reporting requirements apply to accidental releases of ammonia. Refer to Section 15 (Regulatory Information) of this MSDS for details on these requirements.

**Neutralizing Chemicals:** Neutralization with acid is not recommended. Flush area with water.

If spill/release in excess of EPA Reportable Quantity is made into the environment, immediately notify the National Response Center at 1-800-424-8802. In case of a spill or release, contact local, state, and/or provincial regulatory agencies for information regarding additional or more stringent reporting requirements.

## **7. HANDLING AND STORAGE**

**Handling:** Contents under pressure. The use of explosion-proof equipment is recommended and may be required (see appropriate fire codes). Do not enter confined spaces such as tanks or pits without following proper entry procedures. The use of respiratory protection is advised when concentrations exceed any established exposure limits (see Section 8). Anhydrous ammonia is a product that must be handled only by trained personnel in approved equipment systems. Appropriate personal protective gear (e.g., protective clothing, gas masks, and self-contained breathing apparatus) should be available to personnel handling or transferring anhydrous ammonia. System designs and training programs must comply with all federal, state, and local regulations in addition to good engineering practices.

**Storage:** Keep container(s) tightly closed. Use and store this material in cool, dry, well-ventilated areas away from heat, direct sunlight, hot metal surfaces, and all sources of ignition. Store only in approved containers. Containers should have safety relief valves. Separate from other chemicals, particularly oxidizing gases, such as chlorine, bromine, iodine, acids, and metallic mercury. Post readily visible warning signs in the storage area listing emergency measures. Water supply should be readily available to knock down the vapor from spills. Protect container(s) against physical damage.

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

**Ventilation:** Use process enclosure, general dilution ventilation, or local exhaust systems, where necessary, to maintain airborne concentrations below the OSHA standard or in accordance with applicable regulations.

### Preventative Measures / Specific Personal Protective Equipment

**Eyes:** Wear chemical goggles and face shield unless protected by a respirator with a full-face piece. Do not wear contact lenses as they may trap vapors against the eyes and can make flushing ineffective.

**Skin:** The use of gloves, boots, and aprons impermeable to the specific material handled (for ammonia, includes Butyl, Teflon, Neoprene, and Viton) is advised to prevent skin contact, possible irritation, and skin damage. Note that many materials, particularly plastics, become brittle upon contact with liquid ammonia.

**Respiratory:** Protection is not normally required unless relevant exposure standards are exceeded. Use appropriate respirators when adequate engineering and work practice controls are not technically feasible or when performing certain maintenance, repair, or emergency operations where excessive exposure could occur. For ammonia vapor concentrations below 300 ppm and above standards, use a respirator with an ammonia cartridge. For higher or unknown concentrations, use a self-contained breathing apparatus with a full-face piece operating in a pressure-demand mode. A respiratory protection program that meets OSHA's 29 CFR 1910.134 requirements must be followed whenever workplace conditions warrant a respirator's use.

**Other:** Emergency showers and eyewash fountains should be readily available. In the field and during mobile operations, at least 5 gallons of fresh water should be available.

### Exposure Guidelines\*

ACGIH TLV: 25 ppm (17 mg/m<sup>3</sup>) TWA; 35 ppm (24 mg/m<sup>3</sup>) STEL

OSHA PEL: 50 ppm (35 mg/m<sup>3</sup>) TWA

NIOSH IDLH: 300 ppm

\* TLV = Threshold Limit Values; PEL = Permissible Exposure Limits;  
TWA = 8-hour Time-weighted Average; STEL = 15-minute Short Term Exposure Limit;  
IDLH = Immediately Dangerous to Life or Health

**9. PHYSICAL AND CHEMICAL PROPERTIES**

**Appearance:** Colorless liquid or gas

**Odor:** Pungent odor considered suffocating

**Odor threshold level:** Reported odor thresholds in humans range from 1-50 ppm.

**Physical state:** Liquid or gas

**pH:** 10.6-11.6 (0.02-1.7% aqueous solution)

**Vapor pressure:** 124.9 psi at 68°F (20°C) (liquid)

**Vapor density (Air = 1):** 0.597 (at 32°F and 760 mmHg); (lighter than air)

**Boiling point (760 mm Hg):** -28.1°F (-33.4°C)

**Melting point:** -108°F (-77.7°C)

**Solubility in water (per 100 g water):** 89.9 g at 32°F (0°C); 51 g at 68°F (20°C); 7.4 g at 212°F (100°C)

**Specific gravity (H<sub>2</sub>O = 1):** (liquid); 0.6818 at -28°F (-33.35°C), 1 atm; 0.6386 at 32°F (0°C), 4.238 atm; 0.5875 at 95°F (35°C), 13.321 atm; (lighter than water)

**Evaporation rate (Butyl acetate = 1):** Not applicable

**Viscosity:** 0.475 cP at -92°F (-69°C); 0.317 cP at -58°F (-50°C); 0.276 cP at -40°F (-40°C); 0.255 cP at -28°F (-33.5°C)

**Percentage volatile by volume (%):** 100%

**Molecular weight:** 17.03

**Molecular formula:** NH<sub>3</sub>

**Water/Oil Distribution Coefficient:** -1.14 at 25°C

**10. STABILITY AND REACTIVITY**

**Stability (thermal, light, etc.):** Stable under normal conditions of storage and handling.

**Incompatibility (Materials to avoid):** Corrosive to copper, brass, silver, zinc, and galvanized steel. Contact with strong oxidizers can result in fires and explosions. Forms explosive products when in contact with calcium hypochlorite bleaches, halogens, gold, mercury, and silver. Heat is generated when ammonia dissolves in water, and a harmful visible vapor cloud is produced from contact with water.

**Hazardous Decomposition Products:** Combustion may yield nitrogen oxides. Intense heating of the gas, particularly in contact with hot metallic surfaces, may cause decomposition of ammonia to hydrogen and nitrogen.

**Hazardous Polymerization:** Will not occur

**Conditions to Avoid:** Avoid contact with acids, bromine, chlorine, iodine, and oxidizing agents.

## 11. TOXICOLOGICAL INFORMATION

**Irritancy:** In rabbits, subacute and chronic exposure to 100 to 200 ppm produced moderate to severe eye irritation; 200 to 1,000 ppm produced eye damage. Ammonia was corrosive to rabbit skin.

**Acute Oral Effects:** The oral LD50 for rats is 350 mg/kg (anhydrous ammonia). The oral LD50 for rats is 350 mg/kg (ammonium hydroxide).

**Acute Inhalation Effects:** Rat inhalation LC50 for the rat and mouse ranges from 4,230 to 19,960 total NH<sub>3</sub>/m<sup>3</sup>. No LC50 data for ammonium hydroxide.

**Sensitization Capability:** No data found

**Synergistic Chemicals:** No data found

**Genetic Toxicity:** Anhydrous ammonia tested negative for mutagenicity using standard in-vitro bacterial studies (Ames Test) at concentrations up to 25,000 ppm. No evidence of mutagenicity was observed in an *in vivo* Drosophila test. There is no data showing that ammonia is mutagenic in mammals nor is it carcinogenic.

**Human Experience:** Occupational exposure of soda ash plant workers to anhydrous ammonia in the air indicated no significant effects at an average concentration of 9.2 ppm. Inhalation exposure of ammonia by human volunteers was tolerated easily up to 100 ppm, although some eye, nose and throat irritation was observed.

### **Subchronic Toxicity:**

#### **Anhydrous Ammonia**

Rats, guinea pigs, rabbits, dogs, and monkeys were exposed via inhalation to 1,100 ppm, 8 hr/day, 5 days/week, for 6 weeks. This produced transitory mild to moderate eye and nasal irritation and no systemic effects. There was no significant irritation after 5 days of exposure. An exposure to 680 ppm continuously for 90 days was lethal to 13/15 rats, 4/15 guinea pigs, 0/3 rabbits, 0/2 dogs, and 0/3 monkeys. Marked eye irritation was noted in rabbits and dogs.

An exposure to 650 ppm continuously for 90 days resulted in death by day 65 for 32/51 rats.

An exposure to 380 ppm continuously for 24 hours for 90 days produced mild nasal irritation in 25% (12 out of 49) of the rats; a slightly elevated leukocyte count was reported in 4 rats.

An exposure to 180 ppm continuously for 24 hours for 90 days produced no observable effects on the organs of 48 rats.

No definitive information available on carcinogenicity, mutagenicity, target organs, or developmental toxicity. In a one generation reproduction study in pigs, ammonia at 35 mg/kg temporarily depressed mean daily weight gain in young female pigs.

#### **Ammonium Hydroxide**

No data regarding subchronic toxicity.

No definitive information available on carcinogenicity, mutagenicity, target organs or developmental toxicity.

#### **Chronic Toxicity:**

Ammonia and ammonium hydroxide are not recognized as carcinogens by IARC, NTP, or the Occupational Safety and Health Administration (OSHA).

## **12. ECOLOGICAL INFORMATION**

If spilled into water, ammonia is harmful to aquatic life at very low concentrations. Notify local health and wildlife officials and operators of any nearby water intakes upon contamination of surface water.

#### **Ecotoxicity Information:**

**Acute Toxicity to Fish:** The LC<sub>50</sub> for fish ranges from 0.09 to 3.51 mg of un-ionized NH<sub>3</sub>/L (21.4-279 mg total NH<sub>3</sub>/L). Variability is due to test species, test type (static or flow-through), temperature, and most notably, pH.

**Acute Toxicity to Invertebrates:** The 48-hour LC<sub>50</sub> for *Daphnia magna* is 0.66 mg/L, and the 96-hour LC<sub>50</sub> for snails is 90 mg/L. The most sensitive marine invertebrate species is the fingernail clam with a 96-hour LC<sub>50</sub> of 1.10 mg/L.

**Toxicity to Aquatic Plants (Algae):** LOEC ranges from 0.5 to 500 mg NH<sub>3</sub>-N/L.

**Chronic Toxicity to Fish:** NOEC ranges from 0.025 to 1.2 mg un-ionized NH<sub>3</sub>/L.

**Chronic Toxicity to Invertebrates:** NOEC ranges from 0.163 to 0.42 mg un-ionized NH<sub>3</sub>/L.

**Toxicity to Terrestrial Plants:** LOEC ranges from 3 to 250 ppm NH<sub>3</sub>.

**Environmental Fate Information:** Ammonia dissipates relatively quickly in ambient air and rapidly returns to the soil via combination with sulfate ions or washout by rainfall. Ammonia strongly adsorbs to soil, sediment particles, and colloids in water under aerobic conditions. Biodegradation of ammonia to nitrate occurs in water under aerobic conditions resulting in a biological oxygen demand (BOD).

## **13. DISPOSAL CONSIDERATIONS**

Anhydrous ammonia is not considered a hazardous waste under Federal Hazardous Waste Regulations 40 CFR 261. Consult local, state and/or provincial environmental regulatory authorities for acceptable disposal procedures and locations. Follow standard disposal procedures.

**14. TRANSPORT INFORMATION**

The following U.S. Department of Transportation (DOT), Transport Canada (TC), and International Maritime Organization (IMO) requirements and United Nations (UN) recommendations pertain to anhydrous ammonia.

	<b>U.S. DOT / IMO</b>	<b>TDG - Canada</b>
Proper Shipping Name	Ammonia, Anhydrous	Ammonia, Anhydrous
Hazard Class	2.2 Non-Flammable Compressed Gas	2.2 (8) Non-Toxic / Non Flammable Compressed Gas, Sub Class Corrosive
Identification Number	UN 1005	UN 1005
DOT Placard	Non-Flammable Gas 2.2, color: green	Class 2.2, Non-Flammable and Non-Toxic Gases; Black or White: Symbol, number and line 5 mm inside the edge for a label and 1.2 mm inside the edge for a placard. Green: Background The symbol is a gas cylinder.
Special Provisions	Inhalation Hazard - See below "Other DOT Requirements"	Inhalation Hazard – See below "Other TDG Requirements"
OSHA Label Required	Yes	N/A
Reportable Quantity (RQ)	100 pounds	N/A

**Other DOT Requirements:** Anhydrous ammonia is shipped in pressurized containers with pressure-relief safety devices. The maximum quantity that may be transported in one package on cargo planes is 25 kg. Transport is prohibited on passenger planes and passenger railcars.

Note: For U.S. domestic transport, the words **Inhalation Hazard** (1) must be entered on each shipping paper in association with the shipping description, (2) shall be marked on each non-bulk package in association with the proper shipping name and identification number, and (3) shall be marked on two opposing sides of each bulk package. RQ must be on the label for Ammonia in packages greater than 100 pounds.

**Other TDG Requirements:** Dangerous goods must not be transported in any quantity on board a passenger carrying ship or on a passenger carrying road vehicle or a passenger carrying railway vehicle.

**15. REGULATORY INFORMATION**

**OSHA (Occupational Safety and Health Administration):** This material is considered to be hazardous as defined by the OSHA Hazard Communication Standard.

**CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act):** Designated as a hazardous substance. Reportable Quantity (RQ) is 100 lb (45.4 kg). Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately when there is a release in an amount equal to or greater than the RQ. Toll free (800) 424-8802 or Washington D.C. metropolitan area (202) 426-2675.

**SARA TITLE III (Superfund Amendment and Reauthorization Act of 1986):** This product contains the following toxic chemicals subject to the reporting requirements of Section 302 and/or Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40 CFR 372:

CAS No.	Chemical Name	Amount of Chemical in CFI Product (% by weight)	302 Threshold Planning Quantity for Chemical (lbs.)	313 De Minimis Concentration (% by weight)
7664-41-7	Ammonia	99.0-99.6	500	1.0

User should contact local, state and/or provincial regulatory agencies for information on additional or more stringent reporting requirements.

**Sections 311/312:** This product has been reviewed according to the U.S. EPA "Hazard Categories" promulgated under Sections 311 and 312 of SARA Title III and is considered, under applicable definitions, to meet the following categories:

Acute: yes      Chronic: yes      Fire: yes      Reactivity: no

**CAA (Clean Air Act):** Ammonia is listed as a regulated toxic substance under 112© for purposes of accidental release planning under the Risk Management Program. Threshold quantity is 10,000 lbs. for anhydrous ammonia and 20,000 lbs. for ammonia in solution (or aqua ammonia) at concentrations of 20% or greater.

**FWPCA/CWA (Federal Water Pollution Control Act / Clean Water Act):** Designated as a hazardous substance. Reportable quantity is 100 lbs. (45.4 kg).

**U.S. Coast Guard:** Listed as a Liquefied Hazardous Gas (LHG) subject to U.S. Coast Guard regulations at 33 CFR 127 for LHG facilities and 46 CFR 154 for vessels carrying bulk liquefied gases.

**DOT (Department of Transportation):** Please refer to Section 14 (Transport Information) for guidance concerning transportation.

This material is also regulated by the following states: California, Illinois, Louisiana, New Jersey, New York, Massachusetts, Pennsylvania, and Wisconsin.

**Proposition 65 (CA Health & Safety Code Section 25249.5):** NOT LISTED

This material has not been identified as a carcinogen by NTP, IARC, or OSHA.

**16. PREPARATION INFORMATION AND DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES**

MSDS Prepared By: Environmental Health Decisions (949-481-8600)

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The information in this MSDS is based on data available to us as of the revision date given herein, and believed to be correct. Judgments as to the suitability of information herein for the individual user's own use or purposes are the responsibility of the individual user. Although reasonable care has been taken in the preparation of such information, CF Industries extends no warranties, makes no representations (other than those warranties and representations required by law), and assumes no responsibility as to the accuracy or suitability of such information for application to the individual user's purpose or the consequences of its use for such purpose.