



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards and EC Standards

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME: AMMONIA, ANHYDROUS
CHEMICAL FAMILY: Inorganic Nitrogen Compound / Inorganic Base
FORMULA: NH₃
SYNONYMS: Ammonia

MANUFACTURER: SPECTRA GASES, INC.
ADDRESS: 3434 Route 22 West
 Branchburg, NJ 08876, U.S.A.
PHONE: 908/252-9300
FAX: 908/252-0811

SPECTRA GASES EMERGENCY CONTACT: 800/932-0624 8:30 am - 7:00 pm (EST)
24 HOUR EMERGENCY CONTACT, CHEMTREC: 800/424-9300, 202/484-7616
DATE OF PREPARATION: October 12, 2006
MSDS NUMBER: 1040
PRODUCT USE: Various

SECTION 2. COMPOSITION and INFORMATION ON INGREDIENTS

COMPOSITION: Ammonia, Anhydrous 100%
CAS NUMBER: 7664-41-7
EINECS NUMBER: 231-635-3
EXPOSURE LIMITS: (10,000 ppm = 1%)

OSHA PELs:	ACGIH TLVs:	NIOSH RELs:
TWA = 50	TWA = 25 ppm	TWA = 25 ppm
STEL = 35	STEL = 35 ppm	STEL = 25
(1989 Vacated PEL)		IDLH = 300 ppm

SECTION 3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Ammonia is a suffocating, pungent-smelling, toxic, liquefied, corrosive gas, which is shipped under pressure. This gas is lighter than air. Ammonia is not readily ignited, but explosions of ammonia in confined spaces have been reported. Vapor clouds of the gas may be controlled using a water fog. Persons who respond to releases of this product must protect themselves from inhalation of the ammonia gases and mists, especially in areas which are downwind of the release. The odor of Ammonia cannot be used as a reliable indication of a release as olfactory fatigue can occur. Extreme caution must be used when responding to releases.

ROUTES OF ENTRY, SYMPTOMS OF ACUTE EXPOSURE: WARNING - If rescue personnel need to enter an area suspected of having a toxic level of Ammonia, they should be equipped with Self-Contained Breathing Apparatus (SCBA), and, if available, a full-body, chemically resistant suit. Acute overexposure to this gas may cause the following health effects:

EYE CONTACT: Contact of the gas or the mist produced by this product with the eyes can cause pain, redness, tearing, and burns. Severe exposure to the eyes may cause corneal ulceration, and symptoms resembling acute-angle closure glaucoma, and temporary blindness, leading to permanent vision impairment. Release of a high-pressure gas may result in airborne objects.

INHALATION: Inhalation of Ammonia vapors or gases may lead to irritation of the nose and throat. Exposures to high concentrations of Ammonia gas can lead to symptoms such as coughing, labored breathing, sore throat, and in some instances, chemical pneumonitis and pulmonary edema. High concentrations of Ammonia gas may cause an oxygen deficient atmosphere. Additional symptoms can include, loss of smell, runny nose, vomiting, drooling, nausea, high blood pressure, headache, weakness, anxiety, restlessness, respiratory spasm, suffocation and lung damage. Exposure to high concentrations may cause unconsciousness, and under some circumstances, death.

SECTION 3. HAZARD IDENTIFICATION (Continued)

INHALATION (continued): The symptoms associated with specific Ammonia concentrations are as follows:

<u>CONCENTRATION</u>	<u>SYMPTOM(s)</u>
0.6 - 53 ppm	Odor Threshold
25 - 50 ppm	Irritation of the eyes and mucous membranes, which can be tolerated for several hours.
100 - 150 ppm	Immediate irritation of the throat, which may be tolerated for an hour.
400 - 700 ppm	Immediate, severe irritation of the respiratory system and eyes occurs.
> 5000 ppm	This level of exposure may result in rapid death due to suffocation or fluid in the lungs. Exposure to concentrations in excess of 5000 ppm may cause laryngeal spasms, resulting in death.

INGESTION: Ingestion of Ammonia in gaseous form is not a likely route of industrial exposure. If liquefied Ammonia is ingested, damage the tissues of the mouth, throat, esophagus, and other tissues of the digestive system may occur. Symptoms of ingestion can include burns, drooling, difficulty breathing, irregular heartbeat, low blood pressure, suffocation, kidney damage and shock. Ingestion of Ammonia can be fatal. Additionally, aspiration by inhalation is possible, causing severe damage to the lungs, chemical pneumonia or death.

SKIN CONTACT: Contact of the gas or the mist produced by this product with the skin can lead to severe burns or dermatitis (red, cracked, irritated skin), depending upon concentration and duration of exposure.

OTHER HEALTH EFFECTS: Contact with rapidly expanding gases (which are released from under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain caused by frostbite can quickly subside, masking the injury. In addition, the sudden release of a pressurized gas (such as may occur in the event of a valve failure), presents a severe hazard of mechanical injury.

HMIS RATINGS: HEALTH: = 3; FLAMMABILITY: = 1; REACTIVITY: = 0;

PPE: Level H (see Section 8, Exposure Controls/Personal protective Equipment)

ROUTES OF ENTRY, SYMPTOMS OF CHRONIC EXPOSURE:

ROUTE OF ENTRY: Inhalation, skin and eye contact.

TARGET ORGANS: Respiratory System, Eyes, Skin

SYMPTOMS: Persistent irritation may result from repeated exposure to this gas. Repeated over-exposure to Ammonia may result in emphysema. Prolonged exposure to the eyes could cause blindness. Repeated exposure of Ammonia can result in dermatitis.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Pre-existing dermatitis, other skin conditions, and respiratory disorders may be aggravated by over-exposure to this gas.

CARCINOGENICITY: Ammonia, Anhydrous is not found on the FEDERAL OSHA Z LIST, NTP, CAL/OSHA, or IARC Carcinogenicity lists and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies.

SECTION 4. FIRST AID MEASURES

EYE CONTACT: If this gas contaminates the eyes, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Administer anesthetic eye drops after one minute of flushing if victim suffers from spasms to the eyes, in order to facilitate irrigation. In the event of a severe overexposure, victim should consult with an ophthalmologist.

INGESTION: Ingestion is an unlikely route of exposure for the gaseous form of Ammonia. **DO NOT INDUCE VOMITING. CALL PHYSICIAN OR LOCAL POISON CONTROL CENTER FOR MOST CURRENT INFORMATION.** If the victim vomits naturally, position victim to ensure that aspiration into the lungs does not occur.

INHALATION: Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. In the event of severe, immediate effects or delayed symptoms which develops after exposure, victim must seek appropriate medical attention.

SKIN CONTACT: If this gas contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Victim should seek appropriate medical attention if symptoms persist. In case of frostbite, place the frostbitten part in warm water. **DO NOT USE HOT WATER.** If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT: Not determined. Ammonia can be ignited; see information below, on autoignition temperature.

AUTOIGNITION: 651°C (1204°F)

FLAMMABLE RANGE: Lower (LEL): 15.0% Upper (UEL): 28.0%

NFPA RATINGS:

HEALTH: = 3

FLAMMABILITY: = 1

REACTIVITY: = 0

SPECIAL: None

EXTINGUISHING MEDIA:

Water Spray: YES

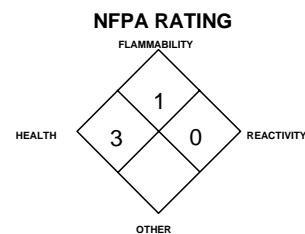
Carbon Dioxide: YES

Foam: YES

Dry Chemical: YES

Halon: YES

Other: Any "ABC" Class.



**See Section 16 for
Definition of Ratings**

SPECIAL FIRE-FIGHTING PROCEDURES: In the event of fire, cool containers of this product with water to prevent failure. Use a water spray or fog to reduce or direct vapors. Do not direct a water spray at the source of a release.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas may ignite explosively, if released near an active fire. Ammonia is lighter than air, but conditions associated with a release can cause it to accumulate in low-lying areas. Exposure to high heat, as in a fire situation, can cause the cylinder to rupture.

EXPLOSION SENSITIVITY TO MECHANICAL IMPACT: Not sensitive.

EXPLOSION SENSITIVITY TO STATIC DISCHARGE: There is insufficient information to classify Ammonia as to its sensitivity to static discharge.

HAZARDOUS COMBUSTION PRODUCTS: Toxic combustion products Ammonia include oxides of nitrogen.

SECTION 6. ACCIDENTAL RELEASE MEASURES

FIRST RESPONSE: In the event of a leak of this product, operator should close the gas source, if possible to do so safely. Evacuate immediate area. In the event of a significant release from a single cylinder, the North American Response Guidebook (Guidebook #115) recommends 100 feet initial isolation from release.

Large releases of Ammonia will be evident by the cloud of ammonia hydroxide mist formed. If a small leak is suspected, detected by smell or monitoring, the system should be purged and an inert gas should be used to determine location of the leak.

TRAINED RESPONSE TEAM: Personal Protective Equipment should include chemically resistant suit, gloves, and Self-Contained Breathing Apparatus (SCBA). Fire-retardant clothing may be considered in event of large release. Eliminate sources of ignition. A water fog or mist can be used to control the vapor cloud resulting from the release. Do not direct a water spray directly at the source of release. Allow the gas, which is lighter than air, to dissipate. Any supplemental ventilation should be explosion-proof equipment.

ENTRY TO AREA: Monitor the surrounding area for toxic gas level. (Note that ammonia gas is lighter than air). Ammonia levels should be below the limits shown in Section 2 (Composition and Information on Ingredients), before personnel are allowed in the area without Self-Contained Breathing Apparatus.

REPAIR/FOLLOW-UP: If leak was in user's gas handling equipment or system, ensure cylinder is closed, system is purged and all high pressure is vented before attempting repairs. If leak was from the cylinder, cylinder valve or the valve pressure relief device (PRD), contact your supplier.

THIS IS A TOXIC, CORROSIVE GAS. Protection of all personnel and the area must be maintained. All responders must be adequately protected from exposure.

SECTION 7. HANDLING AND STORAGE

STORAGE: Cylinders should be stored upright (with valve protection caps or plugs in place) and firmly secured to prevent falling or being knocked over. Cylinders should be stored in dry, well-ventilated areas. Protect from salt or other corrosive materials. Storage should be away from heavily traveled areas, walkways, elevators, platform edges or other objects or situations that could damage the cylinder wall. Do not store in a manner that will block emergency exits, fire extinguishers or other safety equipment. Do not allow storage temperature to exceed 125°F (52°C). Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Store empty cylinders away from full cylinders. Consideration should be taken to install leak detection and alarm equipment for storage areas. **NOTE:** Use only DOT or ASME code cylinders designed for compressed gas storage. Cylinders must not be recharged except by or with the consent of owner.

SECTION 7. HANDLING AND STORAGE (Continued)

HANDLING: This gas can be dangerous and should only be handled by trained personnel. Wearing contact lenses is not recommended when handling this gas. Spectra Gases, Inc., strongly recommends that this gas only be handled in areas with extensive venting capabilities, preferably a gas handling cabinet. Monitoring may be considered for areas in which this gas is used. Detection of Ammonia should trigger immediate response and corrective action. Contaminated clothing should be removed and laundered separately before reuse.

MATERIALS OF CONSTRUCTION: Most common metals are not effected by dry ammonia. However, when combined with water vapor, ammonia will attack copper, zinc or alloys containing copper as a major alloying element, and therefore, these materials should not be used in construction of Ammonia handling equipment. DOT regulations prohibit the use of copper, zinc, silver or alloys of these materials in the construction of containers for ammonia that are used in its shipment. Use non-sparking ventilation systems, approved explosion-proof equipment, and appropriate electrical systems. Electrical equipment used in gas-handling operations, or located in storage areas, should be non-sparking or explosion-proof. If leaks develop in Ammonia lines, they must be given prompt attention because they will become progressively worse.

Before using this gas, meticulous leak checking using inert gas is strongly recommended, particularly after new connections are made. Cylinder valves should be inspected regularly for physical damage or corrosion (apparent by discoloration or rust). Care should be taken to inspect the following valve locations for corrosion: neck (where valve inserts into cylinder); bonnet nut (where handle attaches to valve body). Close valve after each use and when empty. The failure of a valve can result in violent release of the pressurized gas, creating a severe mechanical injury hazard.

Do not drag, roll, slide or drop cylinder. Use a suitable hand truck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure regulator to safely discharge product from cylinder. Use a check valve to prevent reverse flow into cylinder. Once cylinder has been connected to properly purged process, open cylinder valve slowly and carefully. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, etc.) into valve cap openings; doing so may damage valve, causing a leak to occur. Use an adjustable strap-wrench to remove over-tight or rusted caps.

Do not heat cylinders by any means to increase the discharge rate of product from the cylinder. Never apply flame or localized heat directly to any part of the cylinder. Cylinders should not be artificially cooled as certain types of steel undergo property changes when cryogenically cooled, thus making the cylinder unstable.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Purge gas handling equipment with inert gas and relieve pressure before attempting repairs.

SPECIAL PRECAUTIONS: Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, Inc. (telephone 703-412-0900) pamphlet CGA P-1, *Safe Handling of Compressed Gases in Containers*. Local regulations may require specific equipment for storage and use.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Forced ventilation systems for the general work area should be provided. Spectra Gases, Inc. recommends that cylinders in use be secured within a ventilated enclosure such as a gas cabinet. Systems should be corrosion-proof and explosion-proof. Employee exposure should be monitored and reduced to the lowest practical levels using ventilation or other appropriate engineering controls.

RESPIRATORY PROTECTION: Maintain exposure levels of Ammonia below the levels listed in Section 2 (Composition / Information on Ingredients). Use supplied air respiratory protection if Ammonia levels exceed exposure limits, or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent U.S. State standards, standards of Canada, the European Standard EN149, and EC member states.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued): The following guidelines, based on NIOSH respiratory protection recommendations, are for Ammonia, Anhydrous.

CONCENTRATION RESPIRATORY EQUIPMENT of AMMONIA

Up to 250 ppm	Supplied Air Respirator (SAR)
Up to 500 ppm	Supplied Air Respirator operated in continuous-flow mode, or a Powered Air Purifying Respirator (PAPR) with Ammonia cartridges, or a gas mask with a Ammonia canister, or a SCBA.
Emergency or Planned	Entry into Unknown Concentration or IDLH Conditions: Positive-pressure, full facepiece SCBA or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
Escape	Gas mask or mouth-piece respirator with Ammonia cartridges or SCBA should be used.

EYE PROTECTION: Use approved safety goggles or safety glasses, with a face-shield, as described in OSHA 29 CFR 1910.133 or by the European Standard EN166. Eye wash stations/safety showers should be available.

SKIN PROTECTION: Work (such as leather) gloves are recommended when handling cylinders of this gas. Use appropriate gloves for spill response.

OTHER PROTECTIVE EQUIPMENT: Use body protection appropriate for task. An apron, or other impermeable body protection is suggested. Safety shoes are recommended when handling cylinders. Full-body chemical protective clothing is recommended for emergency response procedures.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

MOLECULAR WEIGHT: 17.031

GAS DENSITY @ 21.1°C (70°F): 0.0481 lb/ft³ (0.77 kg/m³)

BOILING POINT @ 1 atm: -33.3°C (-28.°F)

FREEZING/MELTING POINT @ 1 atm: -77.7°C (-107.9°F)

SPECIFIC GRAVITY (air = 1) @ 21.1°C (70°F): 0.5970

SOLUBILITY IN WATER vol/liq @ 15.5°C (68°F): 0.8480.0105

SPECIFIC VOLUME @ 0°C (32°F): 20.78 lb/ft³ (1.297 m³/kg)

CRITICAL PRESSURE: 1657 psia (11.425 kPa abs)

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

ODOR THRESHOLD: 0.6 - 53 ppm (detection)

GAS DENSITY @ 21.1°C (70°F): 0.0481 lb/ft³ (0.77 kg/m³)

VAPOR PRESSURE @ 21.1°C (70°F): 114.1 psig (786.7 kPa)

APPEARANCE, ODOR AND STATE: Ammonia is a suffocating, pungent-smelling, toxic, corrosive liquefied gas. This gas is lighter than air and fumes strongly in moist air, producing a cloud of ammonium hydroxide mist.

WARNING PROPERTIES FOR THIS GAS: The odor of Ammonia cannot be relied upon for detection of this gas, as olfactory fatigue can occur. The dense appearance of this gas may act as a warning property when released.

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.

CONDITIONS TO AVOID: Cylinders should not be exposed to temperatures in excess of 125°F (52°C).

MATERIALS WITH WHICH GAS IS INCOMPATIBLE: Ammonia is not compatible with most metals, acids, oxidizers. Ammonia can form explosive compounds with mercury, gold or silver compounds or the elements. Ammonia reacts violently with telluriumtetra bromide and tetrachloride, chlorine, bromine, fluorine, or the interhalogen compounds, and with acid halides, ethylene oxide, and hypochlorites (including household bleach). Poisoning or death can occur if ammonia (or ammonia-containing products) are mixed with household bleach.

REACTIVITY:

A) HAZARDOUS DECOMPOSITION PRODUCTS: Ammonia does not decompose, but reacts with water to form ammonium hydroxide.

B) HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicological data are available for Ammonia, Anhydrous.

D.O.T. LC ₅₀ = 4000 ppm	Eye effects-Rat 140 ppm/30 minutes	Inhalation-Rabbit, adult LC ₅₀ : 270 ppm/30 minutes
D.O.T. LC ₅₀ = 7338 ppm	Eye effects-Mouse 467 ppm/5 minutes	Inhalation-Guinea Pig, adult LC ₅₀ : 170 ppm/1 hour
Mutation in Microorganisms-Salmonella typhimurium 1 mg/plate	Eye effects-Dog, adult 68 ppm/1 hour	Inhalation-dog LC: >93 ppm/1 hour: Lungs, Thorax, or Respiration - cough: Lungs, Thorax, or Respiration: dyspnea: Gastrointestinal: nausea or vomiting
Eye effects-Human 25 ppm/5 minutes: Mild irritation effects	Inhalation-Rat LC ₅₀ : 185 ppm/1 hour	
	Inhalation-Mouse LC ₅₀ : 150 ppm/1 hour	

CARCINOGENICITY: Ammonia has not been found to be carcinogenic.

IRRITANCY OF PRODUCT: Ammonia is severely irritating to contaminated tissue.

SENSITIZATION OF PRODUCT: Ammonia is not known to be a sensitizer upon prolonged or repeated contact.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas on the human reproductive system.

Mutagenicity: This gas is not expected to cause mutagenic effects in humans. Ammonia, has been reported to cause mutagenic effects in microorganisms during experimental studies with exposures at relatively high doses.

Embryotoxicity: This gas is not expected to cause embryotoxic effects in humans.

Teratogenicity: This gas is not expected to cause teratogenic effects in humans.

Reproductive Toxicity: This gas is not expected to cause adverse reproductive effects in humans.

A *mutagen* is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An *embryotoxin* is a chemical that causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A *teratogen* is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines. A *reproductive toxin* is any substance that interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Ammonia.

SECTION 12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Ammonia is stable in the environment. All work practices should be aimed at eliminating environmental contamination.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Due to the corrosive and toxic nature of this gas, animals exposed to this product will experience tissue damage, burns, and may be killed. Plants contaminated with this product may be adversely affected or destroyed.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Release of Ammonia to an aquatic environment can be detrimental to aquatic life. If a large release this product occurs near a river or other body of water, there is a potential for fish and other aquatic life to be harmed or killed. The following aquatic toxicity data are currently available for this gas:

LC (goldfish, yellow perch) = 2.0-2.5 ppm/1-4 days	LC ₅₀ (<i>Salmo trutta</i>) = >0.15 mg/L, 0.6-0.9 mg/L / 18 hours, 96 hours	LC ₅₀ (<i>Micropterus salmoides</i>) = >0.21-1.7 mg/L, 96 hours
LC ₁₀₀ (crayfish) = 60-80 ppm/3 days	LC ₅₀ (<i>Salvelinus fontinalis</i>) = 0.96-1.05 mg/L, 96 hours	LC ₅₀ (<i>Notropis lutrensis</i>) = 0.9-1.1 mg/L, 96 hours
TL _m (fathead minnow) = 8.2 ppm/96 hours	LC ₅₀ (<i>Catostomus platyrhynchus</i>) = 0.67-0.82 mg/L, 96 hours	LC ₅₀ (<i>Mugil cephalus</i>) = 1.2-2.4 mg/L, 96 hours
LC ₅₀ (coho salmon) = 0.45 mg/L/96 hours	LC ₅₀ (<i>Oimephales promelas</i>) = 0.73-3.4 mg/L, 96 hours	LC ₅₀ (<i>Morone americana</i>) = 0.52-2.13 mg/L, 96 hours
LC ₅₀ (guppy fry) = 1.2-74 mg/L/72 hours	LC ₅₀ (<i>Catostomus commersoni</i>) = 0.79-1.4 mg/L, 96 hours	LC ₅₀ (<i>Notropis spilopterus</i>) = 1.2-1.35 mg/L, 96 hours
LC ₅₀ (cutthroat trout fry, <i>Salmo clarki</i>) = 0.5-0.8 mg/L/96 hours	LC ₅₀ (<i>Lepomis macrochirus</i>) = 0.26-4.6 mg/L, 96 hours	LC ₅₀ (<i>Lepomis cyanellus</i>) = 0.6-2.1 mg/L, 96 hours
LC ₅₀ (rainbow trout: fertilized egg, alevins (0-50 days old), fry (85 days old), adults) = >3.58, >3.58, 0.068, 0.097 mg/L/24 hours	LC ₅₀ (<i>Lepomis macrochirus</i>) = 0.024-2.3 mg/L, 48 hours	LC ₅₀ (<i>Lepomis gibbosus</i>) = 0.14-0.86 mg/L, 96 hours
LC ₅₀ (walking catfish) = 0.28 mg/L/48 hours		

MOBILITY: Ammonia is strongly absorbed on soil, on sediment particles and colloids in water. This absorption results in high concentrations of sorbed ammonia in oxidized sediments. Under anoxic conditions, the absorptive capacity of sediments is less, resulting in the release of Ammonia to either the water column or to an oxidized sediment layer above.

PERSISTENCE AND BIODEGRADABILITY: Persistence: In the atmosphere, it is theorized that Ammonia combines with sulfate ion in the atmosphere or in washout by rainfall, resulting in a rapid return of Ammonia to the soil. In the soil and water, Ammonia will biodegrade and not persist. Biodegradation: Ammonia rapidly converts to nitrate by nitrification, in an aquatic environment. Bacteria convert the ammonia to nitrate, creating an oxygen demand (BOD) several days after introduction of Ammonia to the environment. Temperature, oxygen supply and pH of the water are factors in determining the rate of biodegradation.

SECTION 12. ECOLOGICAL INFORMATION (Continued)

POTENTIAL TO BIOACCUMULATE: Plants have a high affinity for gaseous Ammonia when leaf stomata are open in daylight. No data are currently available on this gas related to bioaccumulation in animals.

OZONE-DEPLETION POTENTIAL: Ammonia, Anhydrous is not a Class I or Class II ozone depleting chemical (40 CFR Part 82).

SECTION 13. DISPOSAL CONSIDERATIONS

UNUSED PRODUCT / EMPTY CONTAINER: Do not dispose of residual product. Return residual product in cylinders to: Spectra Gases, Inc., 80 Industrial Drive, Alpha, NJ 08865 or Spectra Gases, Inc., 1261 Activity Drive, Vista, CA 92083.

DISPOSAL INFORMATION: Residual product in system can be neutralized using various caustic systems (e.g., activated alumina or soda lime). Neutralization should only be done by appropriately trained and experienced personnel. Disposal shall be done in accordance with U.S. Federal, State and local regulations, regulations of the provinces of Canada or EC member states.

SECTION 14. TRANSPORT INFORMATION

U.S. SHIPPING INFORMATION: The following information is for U.S. domestic shipments only.

PROPER SHIPPING NAME: Ammonia, anhydrous, liquefied

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

UN IDENTIFICATION NUMBER: UN 1005

PACKING GROUP: Not applicable.

DOT LABEL(S) REQUIRED: Non-Flammable Gas

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position in a well-ventilated truck (never transport in passenger compartment of a vehicle). Ensure cylinder valve is properly closed, valve outlet cap has been reinstalled, and valve protection cap is secured before shipping cylinder.

CAUTION: Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of Federal law (49 CFR 173.301).

NAERG (NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK) #: 125

CANADIAN SHIPPING INFORMATION:

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as dangerous goods. Use the following for the preparation of Canadian Shipments.

PROPER SHIPPING NAME: Ammonia, anhydrous, liquefied

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

8 (Corrosive)

UN IDENTIFICATION NUMBER: UN 1005

PACKING GROUP: Not applicable.

HAZARD LABEL(S) REQUIRED: Class 2.2 (Compressed Gas)

Class 8 (Corrosive)

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): 125

SPECIAL PROVISION: 102 (Poison-Inhalation Hazard) 109 Emergency Response Assistance Planning requirements must be met for shipments in excess of 5 kg or liters. Placards on trucks must be changed at the border.

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA):

Note: US Hazardous Material Transportation regulations prohibit shipment of ammonia in or from the US by air (49 CFR 171.11(c))

IATA DESIGNATION: This gas is considered as dangerous goods, per the International Air Transport Association.

PROPER SHIPPING NAME: Ammonia, anhydrous

HAZARD CLASS NUMBER and DESCRIPTION: 2.3 (Toxic Gas)

UN IDENTIFICATION NUMBER: UN 1005

HAZARD LABEL(S) REQUIRED: Primary Hazard: Toxic Gas

Subsidiary Hazard: Corrosive

The following Packaging Information is applicable to this product:

PASSENGER AND CARGO AIRCRAFT		CARGO AIRCRAFT ONLY			
Limited Quantity		Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg
Packing Instruction	Max. Qty per Pkg				
////	////				

SECTION 14. TRANSPORT INFORMATION (Continued)
--

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO):

IMO DESIGNATION: This gas is considered as dangerous goods, per the International Maritime Organization.

PROPER SHIPPING NAME:	Ammonia, anhydrous
HAZARD CLASS NUMBER and DESCRIPTION:	2.3 (Toxic Gas)
UN IDENTIFICATION NUMBER:	UN 1005
HAZARD LABEL(S) REQUIRED:	Primary Hazard: Toxic Gas Subsidiary Hazard: Corrosive
IMDG CODE:	Page 2104
STOWAGE CATEGORY:	Category D - Clear of Living Quarters "Separated from" Chlorine.

MARINE POLLUTANT: Ammonia, Anhydrous is not designated by the IMO to be Marine Pollutants.

EUROPEAN SHIPPING INFORMATION:**EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS**

BY ROAD (ADR): This gas is considered by the Economic Commission for Europe to be dangerous goods. Additional information is as follows:

SUBSTANCE IDENTIFICATION NO.:	1005
NAME OF SUBSTANCE:	Ammonia, anhydrous
HAZARD IDENTIFICATION NO.:	268
LABEL:	6.1 + 8
CLASS AND ITEM NUMBER:	2, 1 ^o TC

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:**EPA - ENVIRONMENTAL PROTECTION AGENCY:**

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (40 CFR Parts 117 and 302)

Reportable Quantity (RQ): Ammonia, Anhydrous = 100 lb. (45.4 kg)

SARA TITLE III: Superfund Amendment and Reauthorization Act**SECTIONS 302/304:** Emergency Planning and Notification (40 CFR Part 355)

Ammonia, Anhydrous is listed.

Threshold Planning Quantity (TPQ): Ammonia, Anhydrous = 500 lb. (227.5 kg)

Reportable Quantity (RQ): Ammonia, Anhydrous = 100 lb. (45.4 kg)

SECTIONS 311/312: Hazardous Chemical Reporting (40 CFR Part 370)

IMMEDIATE HEALTH: Yes

PRESSURE: Yes

DELAYED HEALTH: Yes

REACTIVITY: Yes

FIRE: No

SECTION 313: Toxic Chemical Release Reporting (40 CFR 372)

Releases of Ammonia, Anhydrous require reporting under Section 313.

CLEAN AIR ACT:**SECTION 112 (r):** Risk Management Programs for Chemical Accidental Release

(40 CFR Part 68)

Threshold Planning Quantity (TPQ): Ammonia, Anhydrous = 10,000 lb. (4544 kg);

However, Ammonia when used as an agricultural nutrient, and when held by farmers, is exempt from all provisions of this regulation.

TSCA: Toxic Substances Control Act

Ammonia, Anhydrous is listed on the TSCA Inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR Part 1910.119: Process Safety Management of Highly Hazardous Chemicals.

Threshold Planning Quantity (TPQ): Ammonia, Anhydrous = 10,000 lb. (4544 kg)

U.S. STATE REGULATORY INFORMATION:

CALIFORNIA PROPOSITION 65: Ammonia, Anhydrous is not a listed substance which the State of California requires warning under this statute.

SECTION 15. REGULATORY INFORMATION (Continued)

Ammonia, Anhydrous is listed by the following State regulations (more specific regulations exist in some States):

Alaska - Designated Toxic and Hazardous Substances: Ammonia, Anhydrous.

California - Permissible Exposure Limits for Chemical Contaminants: Ammonia, Anhydrous.

Florida - Substance List: Ammonia, Anhydrous.

Illinois - Toxic Substance List: Ammonia, Anhydrous.

Kansas - Section 302/313 List: Ammonia, Anhydrous.

Massachusetts - Substance List: Ammonia, Anhydrous.

Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: Ammonia, Anhydrous.

Missouri - Employer Information/Toxic Substance List: Ammonia, Anhydrous.

New Jersey - Right to Know Hazardous Substance List: Ammonia, Anhydrous.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: Ammonia, Anhydrous.

Pennsylvania - Hazardous Substance List: Ammonia, Anhydrous.

Rhode Island - Hazardous Substance List: Ammonia, Anhydrous.

Texas - Hazardous Substance List: Ammonia, Anhydrous.

West Virginia - Hazardous Substance List: Ammonia, Anhydrous.

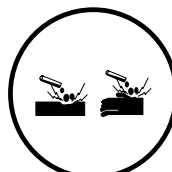
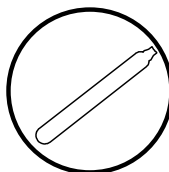
Wisconsin - Toxic and Hazardous Substances: Ammonia, Anhydrous.

CANADIAN FEDERAL REGULATIONS:

CANADIAN DSL INVENTORY STATUS: Ammonia, Anhydrous is listed on the Canadian DSL Inventory.

OTHER CANADIAN REGULATIONS: Ammonia, Anhydrous would be categorized as a Controlled Product, Hazard Classes A, and E, as per the Controlled Product Regulations. This gas is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS: **Class A:** Compressed Gas
Class E: Corrosive Material

**EUROPEAN ECONOMIC COMMUNITY REGULATIONS:**

EC LABELING AND CLASSIFICATION: Ammonia, Anhydrous is classified, per the European Community Council Directive 67/548/EEC.

EC CLASSIFICATION: F (Flammable); T (Toxic by Inhalation); C (Causes Burns); N (Very Toxic to Aquatic Organisms)

EC RISK PHRASES: Flammable. Toxic by inhalation. Toxic in contact with skin.. Very toxic to Aquatic Organisms [R: 10, 23, 24, 50]

EC SAFETY PHRASES: Keep locked up and out of the reach of children.* **This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only.* Keep container in a well ventilated place. Keep away from sources of ignition - No smoking. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing, gloves and eye/face protection. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). Avoid release to the environment. Refer to special instructions/Safety data sheets. [S:(1/2)*, 9, 16, 26, 36/37/39, 45, 61]

EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOLS:

EC COMMENTS: In terms of Ammonia, Anhydrous toxicity, use the following concentration limits:

C > 5%: Toxic by inhalation and in skin. [R: 23/34]

0.5% ≤ C < 5%: Toxic by inhalation. [R: 26-34]

1% ≤ C < 5%: Harmful. Irritating to eyes, respiratory system and skin [R: 20, 36/37/38]

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits.

TLV - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit (**STEL**), and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register; 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

The DFG - MAK is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL.

NIOSH is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program; **RTECS** - the Registry of Toxic Effects of Chemical Substances; **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

REGULATORY INFORMATION:

U.S. and CANADA: This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label.

EUROPEAN: **EC** is the European Community (formerly known as the **EEC**, European Economic Community). **EINECS**: This the European Inventory of Now-Existing Chemical Substances. The **ARD** is the European Agreement Concerning the International Carriage of Dangerous Goods by Road and the **RID** are the International Regulations Concerning