



AMMONIA

CHEMICAL PRODUCT

CHEMICAL NAME; CLASS: Ammonia - NH₃

PRODUCT USE: Refrigerant and for general analytical/ synthetic chemical uses.

INGREDIENT COMPOSITION INFORMATION

CHEMICAL NAME	Mole %	EXPOSURE LIMITS IN AIR					
		ACGIH		OSHA		IDLH	OTHER
		TLV L ppm	STE ppm	PEL ppm	STEL ppm		
Ammonia	99%	25	35	NE	35	300	NIOSH REL: 25 ppm, TWA; 35 ppm STEL DFG MAK: 20 ppm
Maximum Impurities	<1%						

NE=Not Established

C=Ceiling Limit

HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Ammonia is a pungent-smelling, toxic, corrosive, non-flammable gas having a suffocating odor. Ammonia is shipped both as a gas and a liquefied gas under its own vapor pressure. The gas can burn and damage eyes, skin, mucous membranes and any other exposed tissue. Inhalation can cause coughing and breathing difficulty. Overexposure to this gas may be fatal. Contact with rapidly expanding gases, or contact with the liquid, may cause frostbite. This gas is lighter than air. Although labeled as a non-flammable gas and not readily ignited, ammonia can burn. 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 ammonia must protect themselves from inhalation of the gas and ammonia mists, especially in areas which are downwind of the release. Extreme caution must be used when responding to releases.

SYMPTOMS OF OVER EXPOSURE: The most significant route of overexposure for this gas is by inhalation.

The following paragraphs describe symptoms of exposure.

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.

Exposure to high concentrations may cause unconsciousness, and under some circumstances, death. Exposure to the eyes may cause temporary blindness, leading to permanent vision impairment.

Repeated ammonia overexposures by inhalation can result in emphysema. The symptoms associated with specific ammonia concentrations are as follows:

CONCENTRATION	SYMPTOMS(s)
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.
>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.

CONTACT WITH SKIN OR EYES: Contact of the liquid or gaseous product (or the mist produced) with the skin can lead to severe burns or dermatitis (red, cracked, irritated skin), depending upon concentration and duration of exposure.

Contact of the liquid or gaseous product (or the mist produced by ammonia) with the eyes can cause pain and redness.

Prolonged exposure could cause blindness. Contact with the undiluted liquid will cause frostbite, ulceration of the skin (possibly delayed in appearance for several hours), blistering and pain. Contact with the liquid or rapidly expanding gas poses a severe frostbite hazard.

OTHER POTENTIAL HEALTH EFFECTS: While ingestion is highly unlikely, ingestion of ammonia can damage the tissues of the mouth, throat, esophagus and other tissues of the digestive system. Ingestion of ammonia containing substances can be fatal. Additionally, aspiration by inhalation is possible, causing chemical pneumonia or death.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: Overexposure to ammonia may cause the health effects listed below.

ACUTE: This gas is extremely corrosive and can burn and damage eyes, skin, mucous membranes and any other exposed tissue. If inhaled, irritation of the respiratory system may occur, with coughing and breathing difficulty. Overexposure to this gas may be fatal. Though unlikely to occur during occupational use, ingestion of large quantities may be fatal.

CHRONIC: Persistent irritation may result from repeated exposures to this gas mixture. Repeated ammonia overexposures by inhalation can result in emphysema and erosion of tooth enamel.

TARGET ORGANS: Respiratory system, skin and eyes.

FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO AMMONIA WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, self-contained breathing apparatus and personal protective equipment should be worn. If necessary, fire protection should be provided.

Remove victim(s) to fresh air, as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

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.

SKIN EXPOSURE: If ammonia contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

EYE EXPOSURE: If liquid is splashed into eyes, or if irritation of the eye develops after exposure to liquid or gas, 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.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of the label and MSDS to physician or other health professional with victim(s). Refer to "Recommendations to Physicians," Section (Toxicological Information) for additional information on first-aid measures.

FIRE FIGHTING MEASURES

FLASH POINT: Not applicable. Ammonia can be ignited.

AUTOIGNITION TEMPERATURE: 651 °C (1204°F)

FLAMMABLE LIMITS: (In air 15-28% (by volume)

LOWER (LEL): 15%

UPPER (UEL): 28%

FIRE EXTINGUISHING MATERIALS:

Water spray: YES

Carbon Dioxide: YES

Foam: YES

Halon: YES

Dry Chemical: YES

Other: Any "ABC" Class

UNUSUAL FIRE AND EXPLOSION HAZARDS: Ammonia is a toxic, corrosive gas and presents an extreme health hazard to firefighters. In the event of fire, cool containers of ammonia 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 near an active fire. Ammonia is lighter than air, but conditions associated with a release can cause it to accumulate in low-lying areas.

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.

SPECIAL FIRE-FIGHTING PROCEDURES: Initial fire responders should wear eye protection. Structural fire-fighters must wear self-contained breathing apparatus and full protective equipment. Move fire-exposed cylinders if it can be done without risk to fire-fighters. Otherwise, cool containers with a hose stream and protect personnel. Withdraw immediately in case of rising sounds from venting safety devices, or any discoloration of tanks due to the fire. If ammonia is involved in a fire, fire run-off water should be contained to prevent possible environmental damage.

ACCIDENTAL RELEASE MEASURES

SPELL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. proper protective equipment should be used. In case of a large release, clear the affected area, protect people, and respond with trained personnel. Eliminate sources of ignition. Supply maximum possible ventilation with explosion-proof equipment.

Minimum personal protective equipment should be Level A: triple-gloves (neoprene rubber gloves and nitrile gloves, over latex or N-DeXTM gloves), fully-encapsulating chemical resistant suit and boots, hard-hat, and self-contained breathing apparatus. Large releases of ammonia will be evident by the cloud of ammonia hydroxide mist which is formed. Small releases of ammonia can be detected by means of an atomizer or squeeze bottle filled with concentrated hydrochloric acid, where a white cloud will show the location of the leak, or with wet pH paper which will turn blue. Attempt to close the main source valve prior to entering the area. If this does not stop the release, or it is not possible to reach the valve, allow the gas to release in place or remove it to safe area and allow the gas to be released there. Monitor the surrounding area for ammonia gas and oxygen levels. The ammonia level must be below 25 ppm AND the atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without self-contained breathing apparatus.

If possible, stop the gas flow at the source. A water fog or mist can be used to control the vapor cloud resulting from the release.

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

HANDLING AND STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting ammonia ON YOU or IN YOU. Wash hands after handling chemicals. Do not eat or drink while handling chemicals. All work practices should minimize the release of ammonia. Be aware of any signs of effects of exposure indicated in the Hazard Identification section; exposures to fatal concentrations of ammonia could occur rapidly.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Avoid breathing the gas or sprays or mists generated by ammonia. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Use only compatible materials for cylinders, process lines, and other ammonia handling equipment. Lines should be purged with dry nitrogen both before and after maintenance activity. Copper, tin, zinc and their alloys are not suitable materials for use with ammonia. Keep container tightly closed when not in use. Keep cylinders away from incompatible material. Wash thoroughly after using this material. Workers must be thoroughly trained to handle ammonia without causing overexposure. Periodic inspections of process equipment by knowledgeable persons should be made to ensure that the equipment is used appropriately and the system is kept in suitable operating condition. Ammonia emergency equipment should be available near the point of use. Workers who handle ammonia should wear protective clothing, as listed in the Exposure Controls - Personal Protection section. Instant-acting showers should be available in the event of an emergency.

Special eye wash fountains or similar equipment should be available for eye irrigation.

Proper respiratory protection equipment must be provided and workers using such equipment must be carefully trained in its operation and limitations.

Precautions must always be taken to prevent suck-back of foreign materials into the cylinder by using a check-valve, vacuum break, or trap, since suck-back may cause dangerous pressure changes within the cylinder. The cylinder valve should be closed after each use.

Determine cylinder contents by weight. The tare weight of the cylinder is stamped on the cylinder.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow the area where cylinders are stored to exceed 52°C (125°F). Isolate from incompatible materials (see Section, Stability and Reactivity for more information). Use a check valve in the discharge line to prevent hazardous backflow. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to work situations in which cylinders are being used:

Before Use: Move cylinders with suitable hand-truck. Secure cylinders firmly. Leave the valve protection cap in place until cylinder is ready for use.

During Use: Use designated regulators, CGA fittings, and other support equipment. Do not use adapters. Do not use oil or grease on gas handling fittings or equipment. All equipment must be properly grounded and bonded. Ammonia cylinders should never be directly connected to a vessel containing a liquid since suck-back may occur causing a violent reaction within the cylinder. To prevent suck-back, a trap, check valve or vacuum break should be inserted into the line. The trap should be adequate size to take the total liquid volume sucked-back.

The rate of gas flow can be increased by improving air circulation about the container or by increasing the temperature of the room if it is below normal. Never apply heat directly to the cylinder for any reason. Do not manifold cylinders to increase output unless check valves have been inserted at the cylinder outputs to prevent exchange of material from one cylinder to another, causing a cylinder to become over-full.

Hoisting of cylinders is not recommended. If hoisting cannot be avoided, always use a lifting clamp, cradle or carrier. Never use a lifting magnet, rope or chain spring. Do not store ammonia cylinders near cylinders of hydrogen, acetylene, fuel gases, ether, turpentine, hydrocarbons, organic matter, or finely-divided metals. Never mix ammonia with other gases in the cylinder. Do not store ammonia cylinders near elevators or gangways or in location where heavy objects may fall and strike them.

Open cylinder valves slowly. The use of large wrenches or pipe wrenches will damage the valve. One complete turn of the valve stem in a counter-clockwise direction opens the valve sufficiently to permit maximum discharge. "Empty" containers still contain ammonia gas and should be handled with all precautions described in this MSDS. If leaks develop in ammonia lines, they must be given prompt attention because they will become progressively worse. Refer to Section (Accidental Release Measures) for release response protocol.

After Use: Close main cylinder valve. Replace valve protection cap (where provided). Mark empty cylinders "EMPTY".

NOTE: Use only NDOT or ASME code containers designed for storage. Earth-ground and bond all lines and equipment associated with ammonia. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner.

TANK CAR SHIPMENTS: Tank cars carrying ammonia should be loaded and unloaded in strict accordance with tank car manufacturer's recommendations and all established on-site safety procedures. Appropriate personal protective equipment must be used during tank car operations. All loading and unloading equipment must be inspected, prior to each use. Loading and unloading operations must be attended at all times. Tank cars must be level and wheels must be locked or blocked prior to loading or unloading. Tank cars (for loading) or storage tanks (for unloading) must be verified to be correct for receiving ammonia and be properly prepared, prior to starting the transfer operations. Hoses must be verified to be clean and free of incompatible chemicals, prior to connection to the tank car or vessel. Valves and hoses must be verified to be in the correct positions, before starting transfer operations. A sample (if required) must be taken and verified (if required) prior to starting transfer operations. All lines must be blown-down and purged before disconnecting them from the tank car or vessel.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow the practices indicated in the Accidental Release Measures section. Make certain application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen before attempting repairs.

EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. A hood with forced ventilation is preferable. Because of high hazard associated with ammonia, stringent control measures such as a gas cabinet enclosure or isolation may be necessary. Duct work should be constructed of non-metallic material, or should be lined to resist corrosion. If necessary, install automatic monitoring devices for ammonia and oxygen.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below exposure limits listed in the Composition and Information on Ingredients section.

Use supplied-air respirations protection during emergency response procedures to releases. The following respiratory protection recommendations for ammonia are provided for additional information.

CONCENTRATION	CONCENTRATION EQUIPMENT
Up to 250 ppm:	Chemical cartridge respirator or Supplied Air Respirator (SAR).
Up to 300 ppm:	SAR in the continuous flow mode, or a Powered Air Purifying Respirator (PARPR) with ammonia cartridges, or full-face chemical cartridge respirator with ammonia cartridge, or a gas mask with an ammonia canister, or full-face self-contained breathing apparatus (SCBA), or full-face SAR.

Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-face SCBA or positive pressure, full-face SAR with an auxiliary positive pressure SCBA.

Escape: Gas mask with canister to protect against ammonia, or escape-type SCBA

EYE PROTECTION: Splash goggles or safety glasses and face shield.

HAND PROTECTION: Wear neoprene rubber gloves for industrial use. Use triple gloves for spill response.

BODY PROTECTION: Use body protection appropriate for task. An apron, or other impermeable body protection is suggested. Full-body chemical protective clothing is recommended for emergency response procedures.

PROTECTION FOR TANK CAR OPERATIONS: Splash-suit, gloves, goggles, face-shield, boots and hard-hat should be worn during operations involving tank cars or trucks containing ammonia.

HAND PROTECTION: Wear mechanical resistant gloves when handling cylinders of ammonia.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied product, as well provide sufficient insulation from extreme cold.

PHYSICAL and CHEMICAL PROPERTIES

ABSOLUTE DENSITY, gas @ 101.325 kpa @ 25°C = 0.7067 kg/m³

RELATIVE DENSITY gas @ 101.325 kpa @ 25°C (Air=1) = 0.597

SOLUBILITY IN WATER: @ 101.325 kpa (total pressure @ 20° C = 34.6 kg NH₃/ 100 kg of Solution cube

ODOR THRESHOLD: 0.6 - 53 ppm (detection)

SPECIFIC VOLUME: @ 21.1°C, 101.325 kpa - 22.6 ft. ³/lb

COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

pH: Not applicable. (A 1% solution in water will have a pH > 13)

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

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor and dense appearance of this gas are distinctive warning properties associated with ammonia.

EVAPORATION RATE (nBuAc=1): Not applicable

TRIPLE POINT TEMPERATURE -77.7°C

BOILING POINT @ 101.321 kpa = - 33.4°C

VAPOR PRESSURE @ 21.1°C - 8.88 bar

EXPANSION RATION: Not applicable.

STABILITY AND REACTIVITY

STABILITY: Stable.

CONDITIONS TO AVOID: Ammonia does not decompose, but reacts with water to form ammonium hydroxide.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Ammonia is not compatible with most metals, acids, or oxidizers. Ammonia can form explosive compounds with mercury, gold or silver compounds or the elements. Ammonia reacts violently with tellurium tetrabromide 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.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Extreme heat, fire or contact with incompatible chemicals.

TOXICOLOGICAL INFORMATION

SUSPECTED CANCER AGENT: Ammonia is not considered to be, nor suspected to be a cancer-causing agent.

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

SENSITIZATION OF PRODUCT: Ammonia contains no known sensitizer with repeated or prolonged contact.

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

Mutagenicity: Ammonia has not been reported to cause mutagenicity effects in humans. Ammonia has been reported to cause mutagenic effects in specific animal tissues during experimental studies with exposures at relatively high doses.

Embryo toxicity: Ammonia has not been reported to cause embryo toxic effects

Teratogenicity: Ammonia has not been reported to cause teratogenic effects

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

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines.

An embryo toxin is a chemical which 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 which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Conditions relating to the target organs may be aggravated by overexposure to ammonia.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms, administer lung function tests and possible chest x-rays. Reduce overexposures.

Delayed pulmonary edema may occur, following overexposure by inhalation

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

ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Ammonia is stable and found naturally in the environment (sources include volcanoes). All work practices should be aimed at eliminating environmental contamination. Additional environmental information for ammonia is available as follows:

AMMONIA: Water Solubility: 47% in water at 0 C; 34% in water at 20 C; 28% in water at 31 C. BIOCONCENTRATION: Plants have a high affinity for gaseous ammonia when leaf stomata are open in daylight. BIODEGRADATION: Ammonia is rapidly converted to nitrate by nitrification.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Due to the corrosive nature of ammonia, animals exposed to this product will experience tissue damage, burns and may be killed. Oxygen displacement can also be a factor in the toxicity of ammonia. Plants contaminated with ammonia may be adversely affected or destroyed.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Ammonia is very soluble in water, and even low concentrations of ammonia in water is detrimental to aquatic life. If a release of ammonia occurs near a river or other body of water, the release has the potential to kill fish and other aquatic life.

DISPOSAL INFORMATION

PREPARING WASTES FOR DISPOSAL: Product removed from the cylinder must be disposed. Do not dispose locally.

TRANSPORT INFORMATION

PROPER SHIPPING NAME: Ammonia, anhydrous
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)

PACKING GROUP: Not Applicable

DOT LABEL(S) REQUIRED: Non-Flammable Gas

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above following for the preparation of Canadian Shipments.

PROPER SHIPPING NAME: Ammonia, anhydrous

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Corrosive Gas); 9.2 (Substance hazardous to the environment)

PACKING GROUP: Not Applicable

DOT LABEL(S) REQUIRED: Poison Gas, Corrosive

REGULATORY INFORMATION

DANGER: CORROSIVE LIQUID AND GAS UNDER PRESSURE
CAN CAUSE EYE, SKIN AND RESPIRATORY TRACT BURNS

Avoid breathing gas.

Store and use with adequate ventilation.

Keep away from heat, flames and sparks.

Do not get in eyes, on skin or clothing.

Use only with equipment of compatible material and construction.

Cylinder temperature should not exceed 52°C (125°F).

Close valve after each use and when empty.

Use in accordance with the Material Safety Data Sheet.

NOTE: Suck-back into cylinder may cause rupture.

Always use a back flow preventative device in piping.

FIRST-AID **IF INHALED**, removed to fresh air. If not breathing, give artificial respiration. (Rescuer may receive chemical burns as a result of giving mouth to mouth).

If breathing is difficult, give oxygen. Call a physician. Keep under medical observation

IN CASE OF CONTACT, immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. wash clothing before reuse. (Discard contaminated shoes). **DO NOT REMOVE THE PRODUCT LABEL**