Anhydrous Ammonia
Storage and Considerations

Storage
Ammonia is normally stored in very large spheres, or steel pressure tanks varying in size from 250 gallons up to 30-40,000 gallons. Storage tanks must have a minimum working pressure of 250 psi (17 bar) and be constructed in accordance with American Society of Mechanical Engineers pressure vessel code.

Never store gaseous chlorine containers with ammonia containers. Mixtures of chlorine and ammonia may form explosive ammoniates. Ammonia cylinders should not be permitted to reach a temperature above 125°F (34°C).

In the U.S., ammonia is shipped in specially constructed steel railroad tank cars, tractor-trailer units, and smaller tank trucks. Tractor-trailer units usually haul from 7 1/2 to 16 tons, while smaller tank trucks range from 4 to 6 tons. Ammonia is also shipped in cylinders of 100 lb., and 150 lb. sizes.

Unlike chlorine and sulfur dioxide, ammonia is not available in ton containers. Individual tanks or mother tanks are approximately the same size as a one ton chlorine container and hold approximately 800 lb. of ammonia. Gaseous withdrawal rates for an 800 lb. ammonia container is approximately 300 PPD (6 kg/h) at room temperature. Air circulation aids gaseous withdrawal.

Piping Systems for Anhydrous Ammonia
All ammonia piping should be extra heavy (Schedule 80) steel, when threaded joints are used. Standard weight (Schedule 40) steel may be used when joints are either welded or flanged. Galvanized piping must never be used. Ammonia corrodes copper, silver, zinc, and their alloys. It is essential, that iron or steel be used in piping and fittings.

Pressure regulators, gauges and other instruments having bronze parts, brass valves, bronze-seated unions and galvanized fitting and pipes are not suitable. Metallic and non-metallic gasket materials, such as compressed asbestos, lead, carbon or stainless steel, spiral-wound, asbestos-filled and aluminum are suitable for ammonia service. Ammonia forms explosive compounds with mercury. No mercury manometers, seals or devices, or electrical switches should be used.

For normal applications, a 0-400 psig (0-27 bar) gauge is recommended. For low pressure work, the range for the gauge should be one and one-half times the maximum service pressure. Only all stainless steel gauges should be used.

Provision should be made to protect pipe against the effects of expansion, contraction, jarring, vibration, and settling. All piping should be tested for leaks after assembly by introducing ammonia vapor. Do not introduce liquid ammonia. Refer to Ammonia Leaks section.

All fittings must be extra heavy and constructed from malleable metals. Forged or cast steel valves and fittings should be used where there is significant strain or vibration. Any portion of liquid piping or hose, which may at any time be closed at each end, must be provided with a hydrostatic relief valve to prevent excessive hydrostatic pressure. This hydrostatic relief valve must not have an intervening shut-off valve installed.

Ammonia Leaks
An ammonia leak is easily detected by the sharp, pungent odor of the vapor. All leaks should be approached with caution. When a leak is detected, the first step should be to determine the size of the leak and its location. Local emergency teams should be notified.

If the leak is large and continuous, personnel in the area should be evacuated and help summoned. No attempt will be made here to provide instructions covering this situation except that a plan should be formulated and all personnel should be instructed in its execution. Your ammonia supplier will assist in planning these emergency
measures. Whenever small leaks are detected, repairs can usually take place with a minimum of effort and concern. If the installation is outdoors, the leak area should be approached from upwind. Ammonia leaks can be located in a number of ways, the first being a bubble test using a soapy water solution. Ammonia gas suppliers can provide either test papers or sulfur tapers. Follow the directions on the packets for proper use. A test gas can be generated by using a plastic squeeze bottle with an angled nozzle. Fill the bottle to approximately 1/8th depth with household bleach and add an equal amount of vinegar.

**CAUTION: This will produce chlorine gas.**

Squeeze the bottle and direct the vapor at the potential leakage areas. Since ammonia gas is lighter than air and chlorine gas is heavier than air, direct the vapor only (not the solution) above the area to be tested. White smoke will appear if a leak is present. **Avoid breathing the white smoke or the chlorine gas as they are toxic.**

If an emergency develops in the United States, the Chemical Manufacturers Association in Washington, D.C. will provide advice through CHEMTREC, the Chemical Transportation Emergency Center, by calling 800-424-9300.

The leak can usually be corrected by tightening a nut or bolt as in the case of an ammonia flange or by tightening a packing nut as in the case of a valve by applying a little extra torque on the valve handle.

**Note: Ammonia cylinder valve packing nuts have left handed threads.** Valve stem packing glands are usually downstream of the valve seat and if tightening the packing nut does not stop the leak, closing the valve will. This, of course, is a temporary repair and the valve packing will require attention.

Escaping ammonia vapors can be conveniently disposed of by taking advantage of ammonia’s great affinity for water. A spray of water will absorb large quantities of gas and reduce vapor concentrations to tolerable levels. All electrical power in the area should be turned off and care must be taken to avoid spraying electrical equipment.

In the open, ammonia is not considered flammable. The Interstate Commerce Commission classifies it as a non-flammable compressed gas. However, in a confined area, with concentrations of 16 to 25 volume percent AND a high ignition temperature of approximately 1562°F (850°C), ammonia is combustible. The National Code (NEC 1999) makes an exemption of ammonia as a Group “D” flammable gas, leaving the classification of the location up to the local enforcement authority. The CGA states that electrical equipment and wiring can be general purpose or weather resistant as appropriate. The exception taken by CGA is where atmospheric concentrations in excess of 16% are LIKELY.

Liquid ammonia released to the atmosphere will vaporize. One pound of liquid will expand to nearly 45 cubic feet of ammonia vapor at atmospheric pressure.

Anhydrous ammonia is lighter than air (specific gravity 0.588). When the air is dry, the vapor will rise. When the air is heavy from dampness, the ammonia vapor will combine with the moisture in the air and form a white cloud (diluted ammonium hydroxide) that may hug the ground, particularly if there is no wind.

If a small leak occurs, the person making repairs should seek help and put on all safety equipment, close valves, and if possible, stop the leak. Mechanical leaks should only be repaired by experienced personnel. If a large leak occurs, such as a broken hose or piping, clear the area and turn off all electrical equipment. Spray the affected area with large volumes of water. When entering the contaminated area, use full safety equipment. Shut off valves and/or repair leak if practical. Do not spray water directly on an ammonia tank vapor leak.

**Safety**

Ammonia vapor is not toxic, but due to its high solubility in water, it does have a very irritating action on the mucous membrane of the eyes, nose, throat, and lungs. Fortunately, since its sharp pungent odor serves as a warning signal, very small concentrations of ammonia in air are readily detected (3 ppm). Prolonged exposure to air containing 100 parts per million of ammonia is not harmful, but breathing air containing from 5,000 to 10,000 ppm of ammonia may cause sudden death from spasm of inflammation of the larynx. Concentrations exceeding 700 ppm of ammonia vapor will cause irritation of the eyes and permanent injury may result if immediate remedial measures are not taken. Ammonia’s high solubility in water causes it to irritate any skin surface where moisture has accumulated. Since liquid ammonia vaporizes readily and has a great affinity for water, it may cause severe injury to the skin by freezing the tissue and subjecting it to caustic type action. The symptoms are similar to those of a burn. Persons having chronic lung disease, heart disease, or who have shown evidence of hypersensitivity to ammonia should not be working where there is a chance of exposure. The odor makes it impossible for a conscious, mobile person to voluntarily remain dangerously long in a seriously contaminated area.

Any person who has been burned or overcome by ammonia should be placed under a physician’s care immediately. Persons responsible for first aid services should be familiar with the special procedures in cases of ammonia exposure.
Safety and First Aid Equipment

The following safety and first aid equipment is necessary where ammonia is used and stored:

1. Easily accessible shower and eye-wash and/or 50 gallons or more of clean water in an open-top container.
2. OSHA requires at least two full face gas masks with ammonia-type canisters, or a self-contained air breathing apparatus.
3. Tight-fitting safety goggles or full face shield.
4. Protective gloves made of rubber or other material impervious to ammonia.
5. Slicker and/or pants and jacket made of rubber or other material impervious to ammonia.
6. Boots made of rubber or other material impervious to ammonia.

If a person comes in contact with liquid or heavily concentrated ammonia vapor, submerge the person in water immediately or thoroughly wet them down with water. Continue the wetting for at least 15 minutes, then immediately call a physician. Water is the best first aid for ammonia exposure.

Ointments, salves, or other medication should not be applied to ammonia burns. Apply only clean water for at least 15 minutes and do not apply any medication for at least 24 hours unless prescribed by a physician.

Note: Portions of information contained in this text have been extracted from The National Electrical Code "NEC 1999" and pamphlet G-2, "American National Standard Safety Requirements for the Storage and Handling of Anyhydrous Ammonia" dated March, 1999 published by the Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202. Refer to these publications for further details.