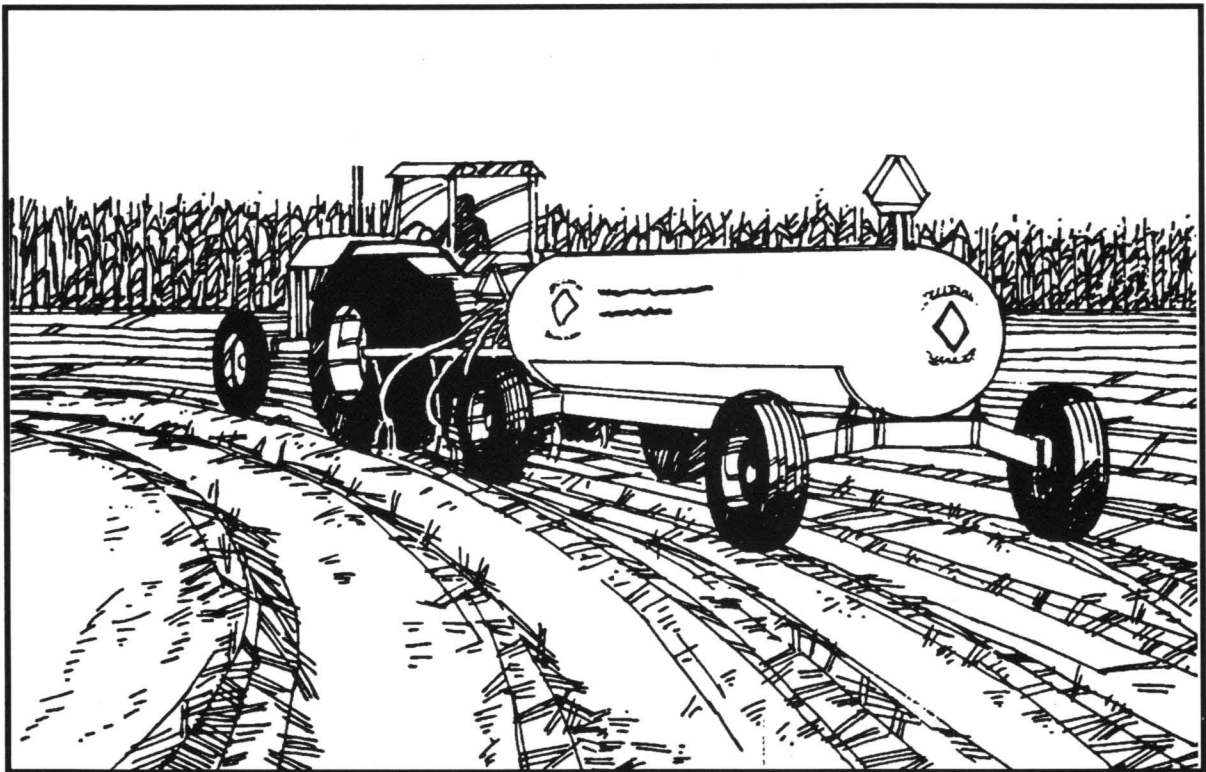


# Using Anhydrous Ammonia Safely on the Farm

John M. Shutske



UNIVERSITY OF MINNESOTA

**EXTENSION**

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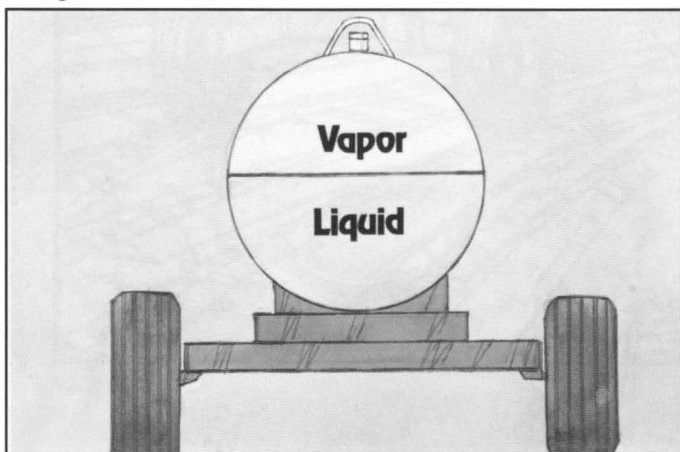
## Introduction

*Note:* The information provided in this bulletin is based on current Minnesota conditions and regulatory requirements at the time of this revision. Consult your local authorities and with your ammonia and equipment dealer for additional operational and safety information.

Anhydrous ammonia is a widely used source of nitrogen fertilizer. Anhydrous ammonia has several advantages, including its relatively easy application and ready availability.

However, there are also disadvantages and potential dangers involved in handling anhydrous ammonia. It must be stored and handled under high pressure, requiring specially designed and well-maintained equipment. In addition, to ensure their safety, workers must be adequately educated about the procedures and personal protective equipment required to safely handle this product.

What is anhydrous ammonia, and why is it so risky to handle? It is a chemical made up of one part nitrogen and three parts hydrogen. The properties of this fertilizer make it one of the most potentially dangerous chemicals used in agriculture. Ammonia gas is colorless and has a sharp, penetrating odor. When used as an agricultural fertilizer, it is compressed into a liquid. In the liquid state, it is stored in specially designed tanks strong enough to withstand internal pressures of at least 250 pounds per square inch (psi). As the outside temperature increases, the temperature of the liquid in the tank increases and the liquid expands, causing the vapor pressure in the tank to increase. For example, at 60°F, the pressure is 93 psi and at 100°F, the pressure is nearly 200 psi.



Anhydrous ammonia is compressed into a clear, colorless liquid when used for an agricultural fertilizer.

If a hose ruptures or a valve is unintentionally opened, the high pressure from the tank can cause ammonia to spray into your eyes, face, and other parts of your body before you can react. When pressure is released, liquid anhydrous ammonia quickly converts to a gas.

Temperature of Ammonia	Vapor Pressure
60°F	93 psi
100°F	197 psi

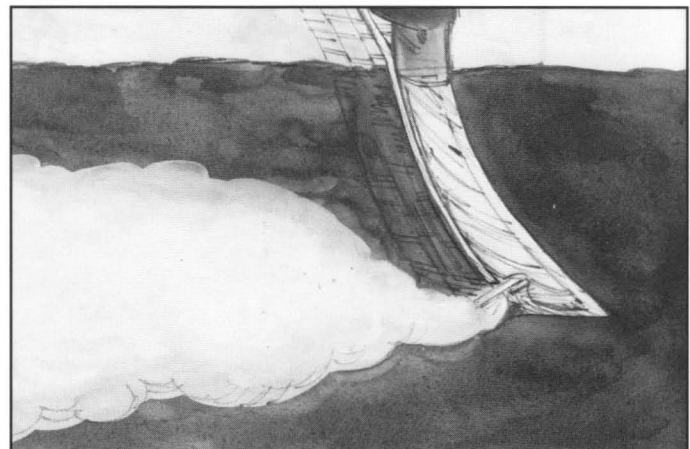
During warm weather the temperature of the liquid anhydrous ammonia increases, causing it to expand and increasing the vapor pressure in the tank.

To protect yourself and other workers, you must be aware of the hazardous properties of anhydrous ammonia. The word "anhydrous" means without water. Consequently, when anhydrous ammonia comes in contact with any moisture, the water and ammonia rapidly combine. When injected into the soil, the liquid ammonia expands into a gas and is readily absorbed in the soil moisture. Similarly, in contact with your eyes, skin, or mucous membranes, ammonia will cause rapid dehydration and severe burns as it combines with the moisture of the body.

Anhydrous ammonia boils at minus 28°F. It must be kept under pressure to be stored as a liquid above this temperature. Thus, when liquid ammonia strikes the skin, it instantly freezes exposed tissue.

Anhydrous ammonia is caustic and causes severe chemical burns. Body tissues that contain a high percentage of water, such as the eyes, skin, and respiratory tract, are very easily burned. Victims exposed to even small amounts of ammonia require immediate flushing with large quantities of water to minimize the damage.

Ammonia is also corrosive to certain metals, such as copper, zinc, and their alloys. Galvanized

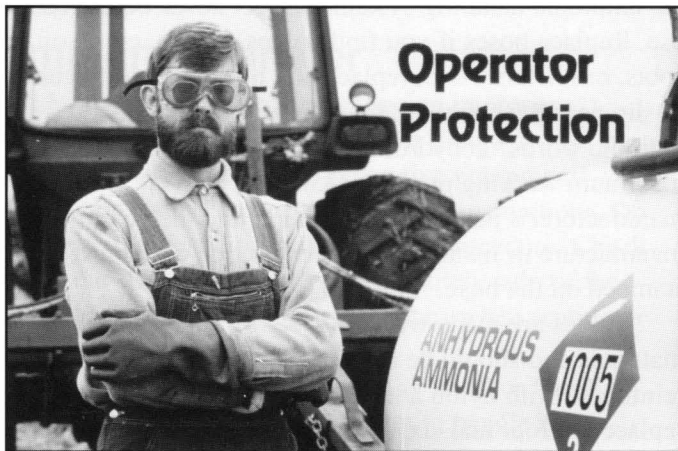


Anhydrous ammonia expands into a gas as it is injected into the soil where it rapidly combines with soil moisture.

pipe must not be used for storing or applying ammonia because it contains zinc. Containers must be made of special high-strength steel or other approved material.

## Operator protection

Because of the hazards associated with handling anhydrous ammonia, operator protection must receive top priority at all times. Chemical-proof goggles, rubber gloves, and a long-sleeved shirt are required for anyone handling anhydrous ammonia. In case of exposure, first aid must be administered immediately. Plenty of water for flushing a person who has been accidentally exposed to ammonia should be available at all times.



Personal protective equipment such as goggles, rubber gloves, and long-sleeved shirts are essential when handling anhydrous ammonia.

It is important to wear tight-fitting, chemical-proof goggles when handling ammonia. Regular glasses provide no protection. Another option is to wear an approved full-face respirator that combines eye and lung protection. Never wear contact lenses when working with ammonia. Anhydrous ammonia can get under the lens and cause permanent eye damage before the lens can be removed.

Rubber gloves that are impervious to ammonia are required for handling anhydrous. The gloves should have an extended cuff that can be turned down at the elbow to prevent the chemical from running down your sleeve when your arms are raised. Gloves should have a fairly loose fit so they can be removed quickly in an emergency, but should fit tightly enough to provide adequate protection.

You can further protect your arms from ammonia spray by wearing coveralls. Thin dress shirts or short sleeves do not provide protection.

Regulations require that each anhydrous ammonia applicator and nurse tank carry at least one five-gallon container of clean water. This must be readily available for flushing the eyes and skin in case of exposure. The

water should be changed daily to ensure a clean supply. It is also recommended that a second five-gallon container of water be kept on the tractor. This will provide the operator with another source of water for first aid in case the operator is unable to reach the one on the nurse or applicator tank. Handlers of ammonia should also carry an eight-ounce eye wash plastic water bottle at all times in case an accidental exposure occurs.



Be sure the emergency first aid water tank is full of clean water.

For an anhydrous ammonia bulk storage facility, additional protective equipment is required. A rainsuit and two full-face gas masks with four currently dated ammonia canisters must be available for emergency work. The protection from a gas mask is limited, and a mask should only be used in low concentrations. If a serious leak occurs, call your local fire department for assistance. Firefighters have the proper training and equipment, including a self-contained breathing apparatus and protective suit, to deal with major leaks.

The operator's manual for anhydrous ammonia equipment should include instructions on proper procedures to follow when handling the product. Review this information before operating the equipment.

Note all decals on the equipment that identify valves and gauges involved in transferring ammonia. Decals should clearly identify the first aid water and other protective measures.

## Container and system requirements

The specially fabricated and designed equipment for handling the high pressures encountered with anhydrous ammonia should meet the appropriate design guidelines provided by the American National Standards Institute (ANSI). All parts and contact surfaces must withstand a minimum working pressure of 250 psi. This includes such things as pressure welds, safety valves, gauges, fittings, hoses, and



**Paint anhydrous ammonia tanks white to prevent rusting and to help keep the temperature and pressure down inside the tank during warm weather.**

metering devices. Any repair or service work on tanks must be done by a firm with a repair stamp certification authorized by the National Board of Boiler and Pressure Vessel Inspectors organization. Fitting, valve, and other component repairs must be done by a qualified technician with training and experience in repairing anhydrous ammonia piping equipment. All welding on anhydrous ammonia piping must be done by a welder with the appropriate ASME, Section 9 welding qualifications, using qualified welding procedures.

All tanks used for storing ammonia must be painted white or other light-reflecting color. Light-reflective colors reflect heat, helping keep the temperature and pressure inside a tank at an acceptable level during warm weather.

Regularly scheduled maintenance is necessary to ensure that the tank and other components are ready for ammonia service. As nurse and applicator tanks become older, the hazards increase. Before using ammonia equipment, perform a walk-around inspection to locate



**The safety relief valve is designed to relieve excess pressure from the vapor space of the tank at a predetermined start-to-discharge setting.**

any defects. Safety checklists are available from many anhydrous ammonia suppliers. Any parts found defective must be replaced or repaired. If this is not possible, the unit must be taken out of service.

Proper care of the pressure relief valve is an important part of maintenance. This valve is designed to relieve excess pressure from the vapor space of the tank at a predetermined pressure setting. Pressure relief valves must be replaced within five years of the date of installation, or if you discover corrosion, leakage or other defects during an installation. Pressure relief valves must be free of paint and other foreign matter. The weep hole integral to the pressure relief valve must be kept open for elimination of condensate. An adequate rain cap is also required.

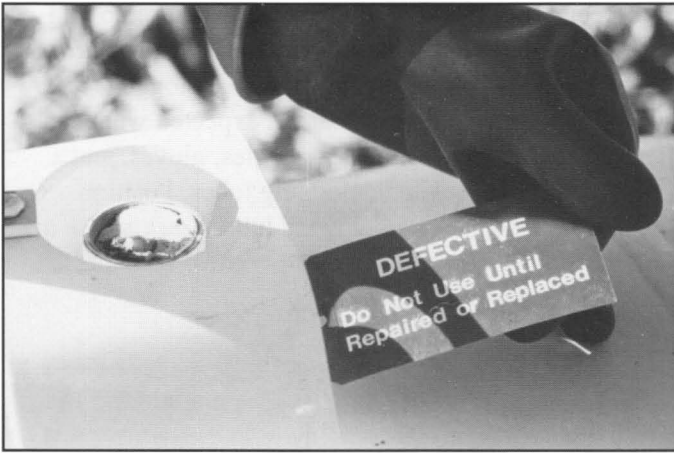
Ammonia hoses are considered the weakest link in the ammonia handling system. Inspect hoses before each use. Replace hoses if you find bulges, cracks, cuts, soft spots, or blisters. Also, replace any hose that has begun to slip near the coupling. Each hose should be marked with the words "anhydrous ammonia." In addition, the maximum working pressure (350 psi), the manufacturer's name and trademark, and the year of manufacture or manufacturer's expiration date must be stamped on the hose.

Hoses are made with a variety of reinforcement materials and should be replaced accordingly. Hoses reinforced with nylon and stainless steel should be replaced at four and six years respectively, from the date of manufacture, unless defects show up before this time.



**Hoses are considered the weakest link in the ammonia handling system and should be checked carefully before each use.**

Remember, safety while using ammonia is controlled by the judgement of the operator. If you find a defect, call your distributor for advice. Do not try to undertake a repair yourself. Again, only trained and qualified personnel should make repairs on anhydrous ammonia equipment.



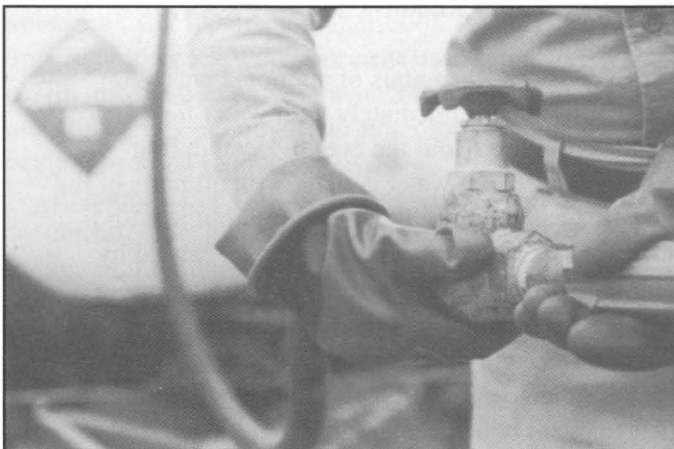
Safety in the field is under the control of the operator. Defective equipment should be tagged and taken out of service until repaired by qualified personnel.

## Ammonia transfer

Many ammonia accidents involve improper handling procedures. Your first step should always be to wear the proper personal protective equipment! Read your owner's manual and follow instructions. Do not leave the area during the transfer procedure. Check with your dealer if you are not absolutely sure of the correct procedure. Ask for instructions when renting or borrowing equipment.

Review the procedures with any hired or family farm workers before allowing them to handle equipment to assure their safety. Make sure they fully understand the importance of protective equipment. Note that it is against federal law to hire any person below the age of 16 to transport, transfer or apply anhydrous ammonia. If you are a fertilizer dealer, provide information such as safety instructions and procedures to your customers.

When filling a nurse or applicator tank, be thoroughly familiar with the equipment and procedures prior to transfer. Because most accidents occur when transferring ammonia, it is very important to wear



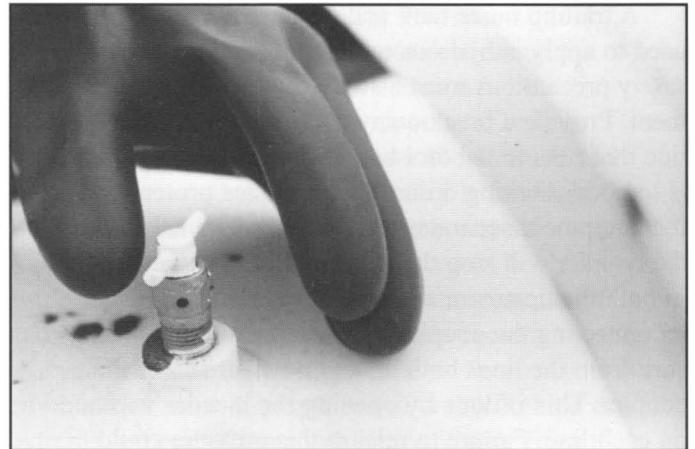
Carry the hose by the valve body or coupling. This reduces the chance of the valve wheel opening by accident and spraying ammonia.

goggles and rubber gloves during these procedures. Make sure the five-gallon container is full of clean water and that you have a small squirt bottle in your shirt pocket.

Park the nurse tank on level ground, downwind from the filling operation. Locate the nurse tank close to the source tank to eliminate stretching or bending the hose. Avoid parking too close to obstacles that would make evacuation difficult, such as fences, buildings, or ditches. Block the wagon's wheels and set the parking brake of the towing vehicle to prevent movement of the nurse tank. A serious situation could develop if the tank moves and a hose tears loose during the filling operation.

Before connecting the hose, make sure the coupling and connections are free from dirt and other foreign material. Visually check to make sure that the threads are not damaged. This will reduce the chance of an ammonia leak under pressure.

Workers should carry the filler hose only by the valve body or coupling, not the valve wheel. This will reduce the chance of the valve wheel opening and spraying ammonia. Remember that the valve wheel and fitting are designed to be closed by hand pressure only. Do not use a wrench to close the valve wheel, since this can easily damage the fitting.



The 85 percent fill bleeder valve should be open to keep a check on the liquid level when filling.



Fill only to the 85 percent level of the liquid capacity of the tank.

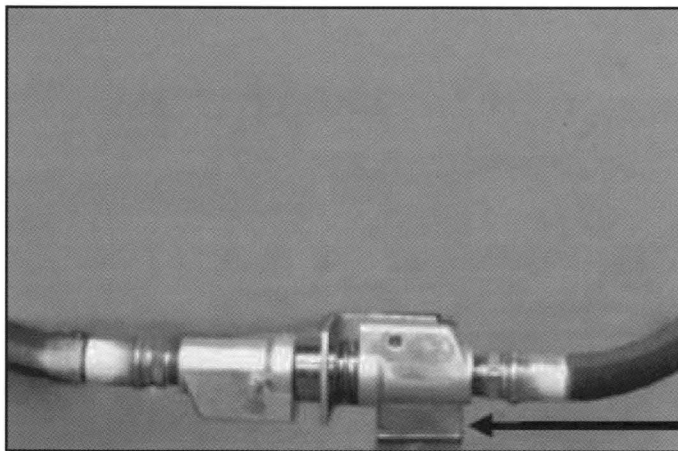
If you are using a compressor to transfer ammonia, follow recommended instructions in your operator's manual. Generally, these include maintaining a vapor pressure of five to ten pounds lower in the tank being filled to keep a forward flow.

Do not overfill the nurse or applicator tank. Carefully monitor the liquid level by opening the 85 percent fill bleeder valve. A white fog of liquid will appear coming from the bleeder valve when it reaches this level. As a part of the normal loading procedure, check the liquid level float gauge accuracy by comparing it with the fixed liquid level gauge.

It is important to fill only to 85 percent or less of the total liquid capacity of the tank. Otherwise, as the outside temperature increases, the temperature of the liquid increases, causing the liquid to expand. This causes the vapor pressure in the tank to rise to a potentially dangerous level. If the tank is overfilled and no vapor space is available, the safety relief valve might fail, causing the tank to rupture or explode.

After the filling operation is completed, secure the hose in its storage position for transit. Take a final walk around the nurse or applicator tank to confirm that all steps have been taken.

A trailing nurse tank and tool bar are commonly used to apply anhydrous ammonia. Recommended safety precautions must also be used for this equipment. Provide a break-away coupler in the ammonia line that runs to the tool bar. Make sure this coupler is in good working order. This provides protection if the equipment separates accidentally. The valves in the coupler will stop the ammonia gas from escaping in both the upstream and downstream lines. Before reconnecting the coupler, remove the internal pressure from the lines both up and downstream of the coupler. This is done by opening the bleeder valves on each line. Failure to release this pressure could expose you to pressurized ammonia.

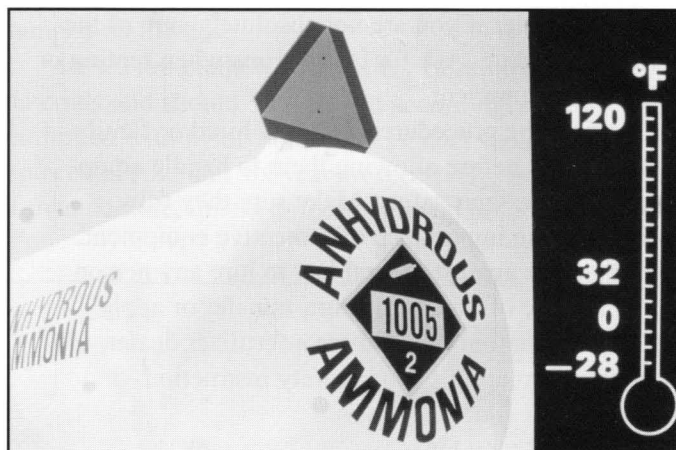


Maintain break-away couplers in good condition, as they provide protection if the equipment separates accidentally.

Special precautions are necessary when removing dirt from clogged applicator tubes. Because pressure can build up in the tubes if they become clogged, a rush of anhydrous ammonia can be expected when they are unclogged. Wear your goggles, gloves, and a long-sleeved shirt while unclogging tubes. Position yourself upwind from the clogged tube. You can use a long piece of heavy-gauge wire to remove soil and other debris from the tube.

## First aid

Even a small blast of anhydrous ammonia can be extremely harmful to the skin, eyes, and mucous membranes in the nose, mouth, and throat. When ammonia contacts the skin or eyes, tissue damage occurs rapidly. This damage results from a combination of dehydration, freezing, and caustic action. If a person's skin has been exposed to ammonia, move the victim to a safe area, and flush the exposed area immediately with clean water for at least 15 minutes. Remove contaminated clothing as soon as possible. Do not apply salves, creams, or ointments, since these may seal residual ammonia in the skin

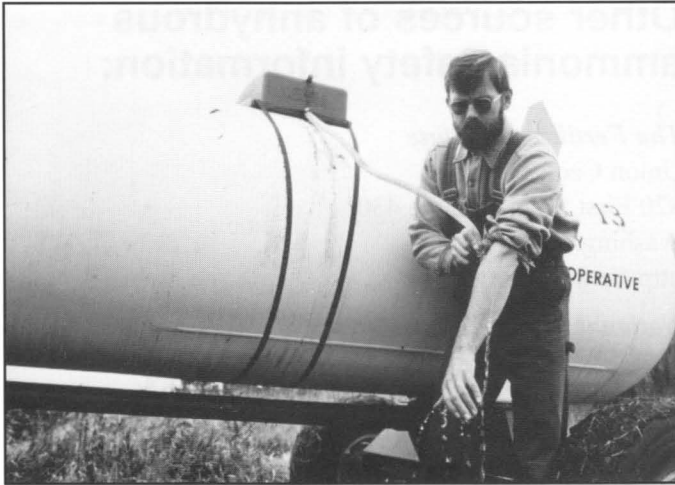


The subzero temperatures of anhydrous ammonia can freeze exposed skin instantly when sprayed accidentally.

and contribute to further damage. Contact a doctor immediately after administering emergency first aid treatment.

Even if small amounts of ammonia enter the eyes, flush them immediately with water for 15 minutes or more. Hold the eyelids open during irrigation to ensure water contact with all parts of the eye. This can be difficult and painful, but it is an important step to minimize the damage caused by ammonia. Immediate first aid is very important to avoid partial or total loss of vision. Again, consult a doctor after giving emergency first aid.

Ammonia vapors are easily detected because of their pungent odor, allowing them to be detected even in low concentrations. Inhalation of ammonia can irritate the respiratory tract and lungs. At high-concentrations, ammonia that combines with



**Skin exposed to ammonia must be flushed immediately with water. Remove contaminated clothes as soon as possible.**

moisture in the lungs will damage the lung lining. This can dramatically reduce the lungs' ability to transfer oxygen to the bloodstream.

If a person has inhaled ammonia, move the victim to a safe area. Exposures to low concentrations of ammonia for a short period of time may not require treatment. Exposure to higher concentrations may cause convulsive coughing and respiratory spasms. Provide cardiopulmonary resuscitation if the victim is not breathing, and summon emergency medical assistance.

If ammonia is swallowed, contact a doctor immediately. If the person is conscious, have him/her drink large amounts of water to dilute the chemical. Never give fluids to or induce vomiting in a victim who is in shock or unconscious. If vomiting occurs, keep the head lower than the hips to prevent vomitus from entering the lungs.

## Road safety

Towing a nurse tank presents problems different from normal highway travel because anhydrous ammonia is a hazardous material. An accident with a nurse tank on the highway could result in serious injuries, costly repairs, and liabilities. It is very important to check with your state authorities to obtain information on your state's rules and regulations that apply to anhydrous ammonia equipment being moved on roadways.

In many states, nurse tanks mounted for transport are considered "implements of husbandry" when used for agricultural purposes. They must conform to state regulations for travel on public roads. Nurse tanks must have the words "anhydrous ammonia" and "nonflammable" in large green lettering on both sides and on each end. All four sides of the tank must also have a placard displaying the "1005" identification number, and must have the words "inhalation hazard" on two sides. Applicator tanks must have markings identical to those on nurse tanks. These markings

allow other motorists to easily identify an ammonia tank. Anhydrous ammonia tanks should also display a triangular slow-moving vehicle sign clearly visible from the rear.

All anhydrous tank wagons must be securely attached to the towing vehicle by a drawbar, hitch pin and safety clip, and suitable safety chains. Be sure to check these parts to see that they are secure before each trip on the highway.

Anhydrous ammonia wagons are designed to follow smoothly in the path of the towing vehicle. Tanks can readily overturn or collide with another vehicle if the wagon swerves from side to side. Make sure your tank wagon is hitched properly to prevent swaying. Check to see that wheel lug nuts are tight and tires are in good shape and properly inflated.

When towing a nurse tank, drive at speeds of 25 mph or less. In Minnesota, anhydrous ammonia tanks and other implements of husbandry with a gross weight exceeding 6,000 pounds must not be towed faster than 25 mph, unless the wagon is equipped with brakes. The potential for a serious accident increases at higher speeds because the operator may lack sufficient braking capacity to safely control the wagon. Hauling more than one loaded nurse tank is a violation of the law in most states. Because farm implement tires are designed for low-speed travel, allow sufficient time to reach your destination.

In most states, the law has additional requirements if a nurse tank or applicator tank is towed between the hours of sunset and sunrise, and any other times when driver visibility is impaired. For example, in Minnesota, state law currently requires that anhydrous ammonia wagons be equipped with two red reflectors at the extreme left and right rear sides of the end of the wagon. Also, the widest portion of the towing vehicle/wagon combination must display a red or amber light at the extreme left end of the combination visible from the rear, and an amber or white light visible



**Anhydrous ammonia wagons towed on highways must be equipped with an approved slow-moving vehicle emblem.**

from the front. This means that if the wagon is wider than the towing vehicle, the wagon must be equipped with lights during low-light conditions. Ideally, all anhydrous ammonia wagons should be equipped with lights when towed on the highway regardless of the lights present on the towing vehicle.

## Summary

Anhydrous ammonia is one of the more dangerous chemicals handled on the farm. It can be handled safely when proper procedures are followed. Make sure you wear personal protective equipment and provide plenty of clean water for first aid. Keep equipment in good condition and observe proper procedures when transferring ammonia. When transporting ammonia on the highway, travel at a safe speed, and have a safety chain and a safety clip on the hitch pin. By following recommended procedures you can reduce your chance of having an accident.

## Other sources of anhydrous ammonia safety information:

### *The Fertilizer Institute*

Union Center Plaza  
820 First St. N.E. Suite 430  
Washington, DC 20002  
<http://www.tfi.org>

### *National Safety Council*

1121 Spring Lake Drive  
Itasca, IL 60143-3201  
<http://www.nsc.org>

### *Minnesota Department of Agriculture*

Agronomy Services Division  
90 West Plato Boulevard  
St. Paul, MN 55107  
<http://www.mda.state.mn.us>

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**Author: John M. Shutske, Extension Agricultural Health and Safety Specialist**

**Editor: Joseph Kurtz**

**Desktop technician: Kathleen Cleberg**

**Photographers: Dave Hansen, Don Breneman**

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