



TEAMSTERS **Safety & Health** **FACTS**

Safety and Health Department, International Brotherhood of Teamsters
25 Louisiana Avenue, NW, Washington, DC 20001 ♦ 202/624-6960 ♦ ibtsafety@teamster.org

AMMONIA REFRIGERATION IN WAREHOUSES

What is ammonia?

Pure ammonia (NH₃), also known as anhydrous ammonia, is a colorless gas, with a strong and pungent odor. Ammonia's odor is its greatest safety asset. Most people can smell ammonia before it reaches a hazardous level. Ammonia's odor threshold is sufficiently low to provide adequate warning of its presence. However, ammonia causes olfactory fatigue (loss of sense of smell) or adaptation, making it difficult to detect its presence when exposure is prolonged.

If the odor of ammonia is present, notify a person in authority immediately.

How is ammonia used?

More than 80% of ammonia produced is used for agricultural purposes; less than two percent is used for refrigeration. Use of ammonia is generally safe provided appropriate maintenance and operating controls are exercised.

Industrial refrigerated warehouses and food processing facilities typically use anhydrous ammonia. The ammonia used in these systems must be 99.995 percent pure to ensure the system operates efficiently.

Ammonia refrigeration systems are a series of interconnected vessels and piping that compress and pump ammonia to one or more rooms to cool, chill, or freeze them to specific temperatures. The quantity of ammonia in systems varies from less than 5,000 pounds to more than 250,000 pounds.

Are ammonia releases common?

Typically, ammonia remains contained within the pipes and components of a refrigeration system. These systems are designed and built to strict standards and codes developed to prevent accidental releases. In addition, facilities must comply with extensive federal regulations that promote the safe operation of the system to protect employees, others who visit or conduct business at a facility, or neighbors who may live near by. It should also be noted that it is

common for the smell of ammonia to be present during some routine maintenance procedures, even when the system is not operating.

Ammonia releases have occurred that caused injuries and/or fatalities. However, a release that results in serious injuries or fatalities is the exception, not the rule.

Most facilities have trained operators onsite who operate and maintain the system. Some facilities hire specialized refrigeration contractors to operate and maintain the refrigeration system. Only trained individual should operate an ammonia refrigeration system. Many ammonia systems, however, are not staffed around the clock, and warehouses may be closed at nights and on weekends.

What are the general hazards associated with exposure to ammonia?

Ammonia can cause a variety of health effects, ranging from irritation to severe respiratory injuries to death. The extent of the potential injuries varies, depending on the concentration level and the length of exposure. Above certain levels, ammonia vapor is a severe respiratory irritant.

When liquid ammonia is released it may mix with air and behave as a dense gas. Because of its strong and pungent odor, ammonia can be usually detected at concentrations in the range of about 5 to 50 parts per million (ppm). Concentrations above about 100 ppm are uncomfortable to most people; concentrations in the range of 300 to 500 ppm will cause people to leave the area immediately.

Specifically, what injuries can result from exposure to ammonia?

Generally, only those individuals in the immediate area of an accidental ammonia release are exposed to hazardous concentrations, unless it is a large release.

Exposure to a low concentration of ammonia vapor can:

- ♦ Irritate the nose, mouth, and throat;
- ♦ Irritate the lungs, causing coughing and or shortness of breath;
- ♦ Irritate the eyes and skin, causing a burning sensation;
- ♦ Cause headache, nausea and vomiting;

Exposure to higher concentrations of ammonia vapor can:

- ♦ Irritate and burn the skin, potentially leading to permanent damage;
- ♦ Cause permanent eye damage or blindness;
- ♦ Cause long-term respiratory system and lung disorders, including buildup of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath and

tightness in the chest. The symptoms of pulmonary edema (tightness in the chest and difficulty breathing) may not develop for 1-24 hours after an exposure to a high concentration;

Exposure to liquid ammonia is not common at ammonia refrigeration facilities. If it does occur, severe injury can result, including frostbite and corrosive burns. Symptoms of mild frostbite include numbness, prickling and itching in the affected area. Symptoms of more severe frostbite include a burning sensation and stiffness of the affected area. The skin may become waxy white or yellow. Blistering, tissue death and gangrene may also develop in severe cases.

Available studies have not shown significant health effects in people with long-term occupational exposure to ammonia. People with repeated exposure to ammonia may develop a tolerance (or acclimatization) to the irritating effects after a few weeks. Tolerance means that higher levels of exposure are required to produce effects earlier seen at lower concentrations.

Inhalation of ammonia may, however, aggravate symptoms of chronic lung diseases such as asthma and emphysema.

What are the fire and explosion dangers associated with exposure?

Ammonia is generally not considered a serious fire or explosion hazard because ammonia-air mixtures are difficult to ignite and a relatively high concentration of the gas is required. Ignition sources such as electric discharge from a forklift, an unprotected tungsten filament lamp, a spark from a motor, or the heat of a welding or cutting torch can cause the ignition of a flammable mixture of ammonia and air.

Toxic and irritating nitrogen dioxide can form during burning in air. Containers or cylinders may rupture violently due to over-pressurization, if exposed to fire or excessive heat for a sufficient period of time.

What can be done to protect workers?

Implementing effective control measures and work practices can significantly reduce occupational exposure to ammonia:

- ♦ Before working with ammonia, workers should be trained on proper handling procedures. OSHA 1910.1200 requires employers to train workers on the safety and health hazards of chemicals; how these chemicals can be detected (such as by monitoring devices, or by smell), what the employer is going to do to protect workers, including emergency procedures (See IBT Safety and Health Fact Sheets on the *Hazard Communication Standard* and *How to Read a Material Safety Data Sheet*).
- ♦ If workers are required to clean-up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable (See IBT Safety and Health Fact Sheet on *Hazardous Waste Operations and Emergency Response*).
- ♦ To ensure worker safety from fires and other emergencies, OSHA has several standards that describe various requirements, including alarm systems and emergency exits (See

IBT Safety and Health Fact Sheets on *Emergency Plans and Fire Prevention Plans*; *Emergency Exits*; and *Employee Alarm Systems*).

- ♦ Leak-detection is a critical component in running a safe refrigeration system. If refrigerated storage systems and compressor rooms are unattended, leak detectors and automatic alarms are required. A system should be in place to notify local responders or a call-down system should be in place to ensure that a release is controlled as quickly as possible.
- ♦ An adequate ventilation system is required to ensure that the concentration of ammonia is kept below flammability levels in the event of a release.
- ♦ Alarm systems should be audible over normal background noise levels. If the system is used for other communication, the alarm should be distinctive and recognizable as a signal to evacuate or to perform necessary assigned duties under the emergency action plan.
- ♦ Ammonia equipment and piping should be properly labeled.
- ♦ Ammonia should be handled, stored, and packed to make certain it does not accidentally come in contact with other chemicals such as mercury, chlorine, hydrogen peroxide, nitric acid, iodine; hydrogen fluoride, etc to prevent violent reactions.
- ♦ Workers who work in the vicinity of ammonia equipment, particularly those operating machinery such as forklifts, may need special training.
- ♦ Ammonia refrigeration storage system units should be protected from impact and damage from forklift traffic.
- ♦ Contract employers should train their employees to safely perform their jobs, assure that they follow the facility's safety rules, and advise the worksite employer of hazards the contract work may create (See IBT Safety and Health Fact Sheet on *Contractor's Safety and Health Responsibilities*).
- ♦ Emergency eye wash and shower stations must be provided in the immediate work area for emergency use.
- ♦ On skin contact with ammonia or if splashed with ammonia, a worker should immediately wash or shower with water to remove the chemical. Eye washing and showering should be for at least 15 minutes and, if possible, in tepid water.
- ♦ Be aware that liquid ammonia could freeze and cause clothing to stick to skin, so clothing should be soaked with water before removed from the body.
- ♦ Do not apply an ointment, cream or bandages to skin exposed to ammonia.
- ♦ Workers should not eat, smoke, or drink where any chemical is handled, processed, or stored.

What should be done in case of ammonia releases and emergencies?

In the event of an ammonia release:

- ♦ Untrained individuals, who smell ammonia in a facility, should immediately notify a person in authority who has been trained to activate the facility's Emergency Action Plan or Emergency Response Plan;
- ♦ Only appropriately trained individuals wearing the appropriate level of personal protective equipment may enter an area to respond to a release; and
- ♦ A visible cloud of ammonia or an unknown concentration of ammonia should not be entered, regardless of the level of personal protective equipment being worn.

Which regulations and guidelines apply to ammonia use and exposure?

- ♦ The Occupational Safety and Health Administration's (OSHA) permissible exposure limit (PEL) is 50 parts per million (ppm) (or 35 milligrams per cubic meter of air-mg/m³) averaged over a conventional 8-hour workday and a 40-hour workweek.
- ♦ The National Institute for Occupational Safety and Health (NIOSH), a federal research agency, has established an "immediately dangerous to life or health" (IDLH) limit of 300 ppm for ammonia based on its acute inhalation toxicity. An IDLH condition is defined as a situation "that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment." The purpose of establishing an IDLH is to "ensure that the worker can escape from a given contaminated environment in the event of failure of the respiratory protection equipment."
- ♦ NIOSH has set a recommended exposure limit (REL) of 25 parts per million (ppm) averaged up to a 10-hour workday during a 40-hour workweek and a short-term exposure limit (STEL) of 35 ppm which is a 15-minute time-weighted average (TWA) concentration that should not be exceeded at any time during a workday even if the 8-hour TWA is within the acceptable range.
- ♦ The American Conference of Governmental Industrial Hygienists (ACGIH), a professional organization, recommends an airborne exposure limit (Threshold Limit Value or TLV) of 25 ppm averaged over a conventional 8-hour workday and a 40-hour workweek and 35 ppm as a short-term exposure limit (STEL). These limits have been set at levels that might prevent irritation for nearly all workers.
- ♦ The OSHA standard on *Process Safety Management (PSM) of Highly Hazardous Chemicals* (1910.119) regulates the catastrophic release of toxic and reactive highly hazardous chemicals, including anhydrous ammonia. The standard applies to a threshold quantity (TQ) at or above 10,000 pounds for anhydrous ammonia and 15,000 pounds for ammonia solutions (greater than 44% ammonia by weight). (See IBT Safety and Health Fact Sheet on *Process Safety Management of Highly Hazardous Chemicals*).

- ♦ The OSHA standard on *Hazardous Waste Operations and Emergency Response* (1910.120) regulates emergency response operations for releases of hazardous substances. The employer should develop a written emergency response plan for emergencies. If plant maintenance personnel would be expected to respond, they must receive training in accordance with 29 CFR 1910.120(q)(6). (See IBT Safety and Health Fact Sheet on *Hazardous Waste Operations and Emergency Response*).
- ♦ According to OSHA's standard on *Emergency Plans and Fire Prevention Plans*, (1910.38) employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements described in *Hazardous Waste Operations and Emergency Response* (1910.120). The requirements of 29 CFR 1910.38 (a) cover those designated actions employers and employees must take to ensure employee safety from fire and other emergencies. (See IBT Safety and Health Fact Sheet on *Emergency Plans and Fire Prevention Plans*).
- ♦ According to OSHA's *Personal Protective Equipment* standard (1910.132), employers should determine the appropriate personal protective equipment for each hazard and train workers on how and when to use them. (See IBT Safety and Health Fact Sheet on *Personal Protective Equipment*).
- ♦ OSHA's *Respiratory Protection* standard (1910.134) prohibits untrained individuals from using respirators. The standard describes legal requirements for an employer's respiratory protection program. (See IBT Safety and Health Fact Sheet on *Respiratory Protection*).
- ♦ OSHA's *Medical Services and First Aid* standard (1910.151) requires that in the absence of a clinic or hospital near the workplace, a person or persons should be adequately trained to offer first aid. Adequate first aid supplies should also be readily available. (See IBT Safety and Health Fact Sheet on *Medical Services and First Aid*).
- ♦ OSHA's standard on *Access to Employee Exposure and Medical Records* (1910.1020) allows workers and their designated representatives to examine and copy employee exposure records including personal and environmental sampling results. (See IBT Safety and Health Fact Sheet on *Access to Employee Exposure and Medical Records*).

For more information, please contact the Safety and Health Department at (202) 624-6960.