

Ammonia (NH₃)

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This publication provides practical workplace safety and health information to assist you in making your place of work safer. It is not legal advice. SAIF has made every effort to bring significant Oregon Occupational Safety and Health Administration (Oregon OSHA) regulations to your attention. Nonetheless, compliance with Oregon OSHA remains your responsibility. You should read and understand all relevant Oregon OSHA regulations that apply to your job site(s). You may want to consult with your own attorney regarding aspects of Oregon OSHA that may affect you.

Note: The information in this publication is time sensitive. Do not rely upon this document if its publication date is more than three years old. Please check the "Safety and health" section of our web site at saif.com/safetyandhealth for a more recent, printable copy. You'll also find a variety of other valuable safety information designed to help your business prevent injuries and control costs.

What is it?

Ammonia (NH₃) is a colorless liquid or gas having a distinct pungent, irritating odor which serves as a warning signal. It is available as "anhydrous" NH₃, shipped and stored as a liquid under moderate pressure, or it may be distributed dissolved in water (ammonium hydroxide or aqua NH₃). NH₃ gas is slightly lighter than air and NH₃ in ammonium hydroxide is very likely to become airborne. The odor threshold range is 5-50 parts per million (ppm).

Uses and where ammonia is found

Uses

- Farm fertilizers and commercial refrigeration
- Water purification, chemical plants, and high-technology manufacturing
- Household cleaners and waterless hand cleaners

Where ammonia is found

- Farm fertilizer distributors
- Meat, poultry, and fish processing facilities
- Water treatment plants
- Chemical plants and cold storage lockers

Health effects of ammonia exposure

The liquid or gas may cause severe irritation and/or burns to the eyes, nose, throat, and the skin. NH₃ has an odor threshold of 5-50 ppm and can cause eye irritation at 20 ppm; therefore, its presence may be sensed in concentrations below the exposure limits. High concentrations can cause permanent injury to the eyes, extensive damage to the throat and upper respiratory tract, and may affect heart action or cause cessation of respiration by reflex action. Anhydrous NH₃ gas is explosive in concentrations between 15% and 28% volume in air. NH₃ is considered a basic (alkaline) corrosive.

Occupational exposure limits

The Oregon OSHA permissible exposure limit (PEL) for NH₃ is 25 parts per million (ppm) as an eight-hour time-weighted average (TWA). Excursions in the worker levels may exceed three times the PEL for no more than a total of 30 minutes during an eight-hour workday. Under no circumstances should exposure exceed five times the PEL, or 125 ppm, even when the eight-hour TWA is not exceeded.

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an eight-hour TWA of 25 ppm to control potential health hazards. The ACGIH also recommends a short-term exposure limit (STEL) of 35 ppm as a 15-minute average. The National Institute for Occupational Safety and Health (NIOSH) has also set a recommended exposure limit (REL) of 25 ppm for up to a 10-hour work day during a 40-hour work week. They also recommend not exceeding a STEL of 35 ppm.

Testing for ammonia exposure levels

Monitoring for NH₃ can be done primarily in several ways:

1. Colorimetric tubes or direct reading tubes can be used to get an estimate of the eight-hour averages and for the excursion limits. It is important to note the limitations of this method. Colorimetric tubes are regarded as +/- 35% accurate, with measurements down to one-half the exposure limit and +/- 25% accurate up to five times the exposure limit.
2. Passive badge personal monitors are a simple way to measure occupational exposure to NH₃. The badge is uncapped and snapped into a holder which is attached to the collar or lapel. When the sampling is complete, it is removed, capped, and returned to the laboratory for analysis. This technology meets or exceeds OSHA requirements for accuracy.
3. Silica gel tubes designed for sampling NH₃ in line with an air sampling pump can be worn by employees to measure NH₃ levels. This can be done for the eight-hour exposure readings or the excursion limits. After sampling, the silica gel tube is analyzed by a laboratory and the levels are reported. Careful calibration of air sampling pumps is necessary when utilizing this method.
4. Direct reading instruments (portable or fixed) with NH₃ sensors on a person or in an area. These instruments record NH₃ levels over longer time periods and can estimate the eight-hour TWA exposures and short-term or peak exposure levels.

Recommendations

Storage

- Permanent storage containers should be at least 50 feet from a dug well or water source, unless the container is used for water treatment.
- Containers are to be located outside of buildings, or in a building or section of a building especially provided for that purpose.
- Storage areas are to be kept free of readily ignitable materials such as waste or weeds.
- NH₃ tanks and fittings are to be protected against tampering and physical damage, including vehicles.

Emergency procedures

- Personnel handling NH₃ should be informed of its properties and trained in safe operating procedures.
- If splashed into eyes, flush with copious amounts of water for at least 15 minutes. Lift the upper and lower eyelids frequently to ensure complete washing. Call a physician.
- If splashed on skin or clothing, wash under a safety shower for at least 15 minutes. Remove contaminated clothing if necessary.
- If breathing has slowed or ceased, remove the worker from the exposure and activate the emergency medical system (in many cases by dialing 911). If breathing has stopped completely, begin cardio pulmonary resuscitation (CPR).

Protective and safety equipment

- When handling anhydrous NH₃, or if there is a chance of a large spill of ammonium hydroxide, a chemical-type safety goggle, rubber or plastic gloves, and impervious clothing are recommended. Depending upon the concentration or potential for airborne exposure, respiratory protection may be necessary.
- Stationary storage installations need at least two suitable gas masks readily accessible. Respiratory equipment must be certified by the National Institute for Occupational Safety and Health (NIOSH). Self-contained breathing apparatus with a full face piece in pressure demand or other positive pressure mode is preferable for emergency use.
- Stationary storage installations shall have an easily accessible shower or a 50 gallon drum of water.
- Each vehicle transporting NH₃ in bulk needs five gallons of water and a full face mask. All farm vehicles transporting anhydrous NH₃ are required to carry a can with five gallons or more of water. Farm trailers transporting NH₃ are to be securely attached to the vehicle drawing them by means of drawbars supplemented by suitable safety chains.

Additional requirements

There are a variety of specific requirements dealing with NH₃ that go beyond the scope of this guide. Two of the more notable requirements are inclusion in OSHA's Process Safety Management Program (PSM) and the Environmental Protection Agency's Risk Management Program (RMP) for NH₃ systems containing 10,000 pounds (1,943 gallons of anhydrous ammonia) or greater. See the **Resources** section below to obtain more information about these requirements.

Resources

Copies of the Oregon Occupational Safety and Health Division (Oregon OSHA) regulations are available on the web at:

<https://osha.oregon.gov/Pages/topics/ammonia.aspx>

Safety and health topics: Ammonia refrigeration (Federal OSHA)

<https://www.osha.gov/ammonia-refrigeration>

Pocket guide to chemical hazards (NIOSH)

<https://www.cdc.gov/niosh/npg/npgd0028.html>

Guidance for facilities on risk management programs (EPA)

<https://www.epa.gov/rmp/guidance-facilities-risk-management-programs-rmp>