

# Anhydrous Ammonia Regulatory and Safety Guidelines

## Comprehensive Guide



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# ANHYDROUS AMMONIA (NH<sub>3</sub>)

## Physical Properties, Safety Guidelines, and Regulatory Compliance

[Image Placeholder: Industrial Ammonia Tank or Chemical Molecule Structure]

### A Guide for Industrial Safety & Management

- Understanding the Properties
- Personal Protection Equipment
- OSHA & EPA Regulatory Standards

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## PHYSICAL PROPERTIES

What is Anhydrous Ammonia?

Anhydrous Ammonia (NH<sub>3</sub>) is a chemical compound comprised of one part Nitrogen and three parts Hydrogen. The term "Anhydrous" signifies "without water." Because ammonia has a high affinity for water, it seeks out moisture, making it hazardous to the human body (which is 80% water).

Origins & Production

While it occurs naturally through decomposition, it is commercially produced using the Haber-Bosch Process. This combines nitrogen from the air and hydrogen from natural gas using heat, pressure, and a catalyst. It has been widely used as a refrigerant since the late 1800s.

### Critical Characteristics

- **State of Matter:** Exists as a vapor at atmospheric conditions but is stored and transported as a liquid under pressure.
- **Appearance:** Vapor is colorless with a pungent odor. Liquid released into the atmosphere creates white smoke (water vapor cloud).
- **Weight:** Vapor is lighter than air and rises when released. One gallon of liquid weighs approximately 5 lbs (varies with temperature).
- **Expansion:** Liquid ammonia has a very high coefficient of expansion. Tanks must never be filled beyond **85% capacity**.
- **Boiling Point:** -28°F.
- **Latent Heat:** High latent heat of vaporization means it absorbs massive amounts of heat when changing from liquid to vapor. Frost on piping indicates the presence of liquid.

### Reactivity & Flammability

- **Material Compatibility:** Compatible with carbon steel and iron. **NOT compatible** with copper, brass, bronze, zinc, or mercury. Corroded copper turns bluish green.
- **Flammability:** Classified by DOT as a non-flammable gas; however, it *will* burn in air at concentrations of 16% to 25% by volume.

# PERSONAL PROTECTION & HANDLING

## Health Hazards

Ammonia seeks water. Contact with the eyes, lungs, or skin can be devastating.

- **Skin Contact:** Results in both chemical (alkaline) burns and thermal freeze burns.
- **Inhalation:** Pungent odor serves as a warning, but high concentrations are toxic.

## Required PPE (29 CFR 1910.132-134)

Employers are responsible for providing, maintaining & training the proper use of PPE.

- **Eyes/Face:** Goggles and Full-Face Shield. Eyes are the most vulnerable point of entry.
- **Respiratory:** Full-face gas masks (effective up to 3% concentration for 15 mins) or SCBA. Two full-face respirators must be mandatory on-site (per 1910.111).
- **Body:** Long-sleeved shirts, pants, rain gear/slicker suits, and chemical-resistant gloves (impervious to ammonia).

## Emergency Procedures

1. **Approach:** Always approach leaks from upwind.
2. **Safety Stations:** Emergency showers and eyewash stations must be located within **50 feet** of the process.
3. **Response Plan:** Facilities must have defined escape routes, headcount procedures, and designated "Shelter-In-Place" areas.

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# OSHA REGULATORY STANDARDS

Process Safety Management (PSM)

Applies to processes involving  $\geq 10,000$  lbs. of NH<sub>3</sub>.

A comprehensive 14-point program including:

- Process Hazard Analysis (PHA)
- Operating Procedures & Employee Training
- Mechanical Integrity & Pre-Startup Reviews
- Management of Change (MOC)
- Incident Investigation & Compliance Audits

## Storage & Handling (29 CFR 1910.111)

- **Location:** Containers must be away from fire hazards and 50 feet from water.
- **Markings:** Proper hazard warning labels.
- **Hardware:** All valves, piping, and hoses must be ammonia-compatible and rated for specific pressures.
- **First Aid:** Water must be immediately accessible.

## Hazard Communication (29 CFR 1910.1200)

- **MSDS/SDS:** Must be available for every chemical on site.
- **Labeling:** All containers (site and transport) must be legibly labeled with identification and hazard warnings.

- **Training:** Required initially, upon job change, and when new hazards are introduced.

Fire Prevention Plan: Facilities must maintain a list of fire hazards, ignition sources, and protection equipment, alongside specific shutdown procedures for critical equipment during emergencies.

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## EPA REPORTING & COMPLIANCE

### Risk Management Plan (RMP)

Purpose: Prevent accidental releases and minimize community impact.

- **Threshold:** 10,000 lbs. (Anhydrous) or 20,000 lbs. (Aqua NH<sub>3</sub> @ ≥20%).
- **Requirements:** Hazard assessments (worst-case scenarios), accident prevention plans, and coordination with local emergency responders.

### SARA Title III (EPCRA)

- **Planning (Section 302):** Notification to SERC, LEPC, and Fire Dept. of Extremely Hazardous Substances (EHS) on site.
- **Releases (Section 304):** Unintentional releases over the Reportable Quantity (**100 lbs** for NH<sub>3</sub>) require *immediate* notification to the NRC, SERC, and LEPC.

### Reporting Inventories

- **Tier II Reports:** Required if EHS on-site exceeds **500 lbs** (or 10,000 lbs for other hazardous materials).
- **Toxic Release Inventory (Form "R"):** Required for manufacturers using ≥25,000 lbs or others using ≥10,000 lbs. Tracks annual releases to help reduce future emissions.

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## SAFETY SUMMARY

### The "Always" Checklist:

1. **Always** respect the wind direction (move upwind).
2. **Always** protect your eyes and lungs.
3. **Always** know the location of the nearest water source/shower.
4. **Always** assume piping contains trapped liquid.

### Regulatory Threshold Quick Reference:

- **100 lbs:** Reportable Quantity for Spills/Releases.
- **500 lbs:** Tier II Reporting Threshold.
- **10,000 lbs:** Threshold for OSHA PSM and EPA RMP.

### Emergency Contact Numbers:

- Fire/Rescue: 911
- Facility Safety Officer: [Insert Number]
- National Response Center: [Insert Number]