Ammonia Refrigeration

Emergency Engine Room Exhaust Systems

Ammonia Refrigeration System Summary

Ammonia refrigeration systems are utilized in large scale cooling and freezing operations found in the food and beverage industry and even in ice rinks. The advantages of ammonia as a refrigerant are its overall thermodynamic efficiencies, as well as being less harmful to the environment than traditional refrigerants if leaked out of the system. Additionally, in the event of a leak in the refrigeration system, ammonia provides a natural alarm to humans through a strong odor (humans will detect at 20 parts per million (ppm)), whereas other refrigerants may be odorless.

When a refrigerant leak does occur, it can be very hazardous to humans as it is irritating and corrosive to skin, eyes, lungs and potentially lethal due to the high concentration of pure anhydrous ammonia (anhydrous means without water). OSHA considers anhydrous ammonia to be immediately dangerous to life and health at concentrations of 300 ppm. Lesser concentrations, while still potentially harmful, can be endured. Anhydrous ammonia is explosive when concentrations in air exceed 15%. For this reason, it is critical to have a reliable and safe ventilation system to detect a leak and safely ventilate the refrigeration system engine room.

Applicable Codes and Requirements

There are multiple agencies working to create safe and effective environments in ammonia refrigeration systems including:

- Occupational Safety and Health Association (OSHA) Standard 29 CFR 1910.199, Process Safety Management of Highly Hazardous Chemicals
- International Institution of Ammonia Refrigeration (IIAR) 2-2014, Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems
- American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) Standard 15-2013, Safety Standard for Refrigeration Systems
- Environmental Protection Agency (EPA) 40 CFR Part 68, Accidental Release Prevention
- American National Standards Institute (ANSI)
- American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation: A Manual of Recommended Practice for Design, 27th Edition (Feb 2010), Chapter 4, Section 4.5
- International Mechanical Code (IMC)
- Refrigeration Engineers & Technicians Association (RETA)
- Facility insurance providers

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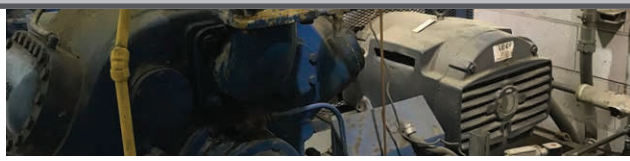
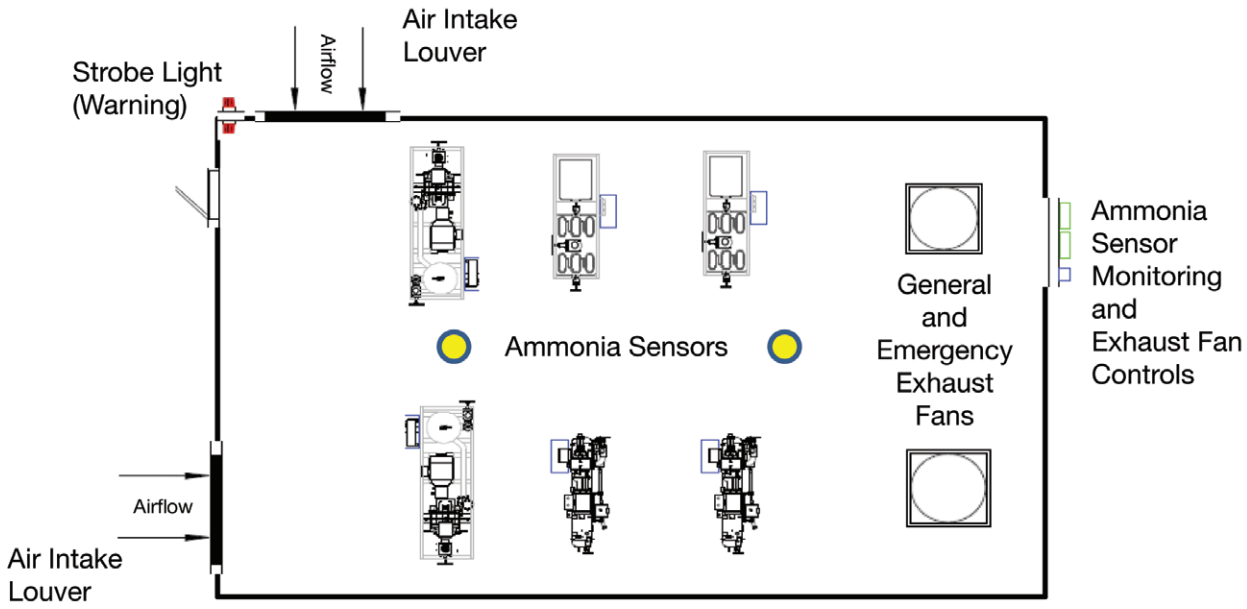


Typical Engine Room Layout and Sequence of Operation

The engine room is the primary area of focus for both general and emergency exhaust. This space will be isolated from other areas of the facility and any supply and exhaust air needs to be from outdoors. General ventilation design of this space requires that the room dry bulb temperature is limited to 104°F (40°C) when taking into account heat from the machinery and incoming make-up air. Fan static pressures are typically less than 0.5 in. wg (125 Pa) as there is limited, if any, ductwork. Additionally, emergency mode typically includes opening dampers/louvers to allow a significant supply of fresh air which further keeps system pressure lower.



The engine room is required to include at least one ammonia sensor which will be positioned based on manufacturer specifications. The sensor(s) will be tied to a control center that has three levels of alarms.

1. Upon detecting concentrations up to or exceeding 25 ppm of ammonia within the environment, visual indicators and audible alarms will activate. These alarms can automatically reset when the concentrations drop below 25 ppm.
2. When concentrations meet or exceed 150 ppm, the emergency ventilation mode will be engaged by the ammonia sensor control system or with a manual control switch. This will further open the make-up air dampers/louvers to accommodate the make-up air as normal ventilation ACH's (air changes per hour) will increase to a minimum of 30 ACH's. Without this low pressure make-up air, the engine room would be subject to high negative static pressures that could potentially damage the space or make opening doors difficult.
3. For even higher concentrations of ammonia in the air (the lower of 40,000 ppm or beyond the sensor's upper detection limit), additional emergency mode requirements will occur including disengaging power to compressors and pumps.

Emergency Ventilation System Guidelines

The ventilation can be managed with a single fan with a variable frequency drive, but the preferred approach is multiple fans to ensure redundancy in case of an emergency. Specific ventilation requirements are listed as follows in IIAR-2-2014.

- Emergency ventilation fans must discharge upwards with a minimum velocity of not less than 2,500 fpm (12.7 m/s) at the required emergency ventilation flow rate.
- Fans shall be a minimum height of 7 ft. 3 in. (2.2m) and the exhaust termination of the fan shall not be within 20 ft. (6.1m) from any air intake on the facility or a property line.
- Emergency exhaust fans must have non-sparking blades (AMCA Spark B Construction).
- Emergency exhaust fan motors located in the airstream or inside the machinery room must be totally enclosed.
- Multiple fans or multi-speed fans are permitted to provide both temperature control (normal operation) and emergency ventilation.
- Make-up air and exhaust must be positioned to avoid re-entrainment of contaminated air.
- Negative pressure within the engine room shall not exceed 0.25 in. wg (62 Pa) relative to adjacent spaces or the outdoors.
- Motorized louvers or dampers (actuators) shall fail open in the event of loss of power.

Greenheck Product Solutions

Greenheck's FumeJet® and Vektor® pre-engineered exhaust systems are suited for the critical nature of emergency ammonia exhaust. Selection comes down to providing the best value per individual owner. The FumeJet provides the most economical price point flexibility while Vektors offer a broader overall performance range, fan styles, stack extensions and other industrial options. Both are easy to select, install and maintain.

Per the code requirements, the exhaust systems are roof deck mounted. Greenheck's roof curb mounting options make install easy while providing windload capabilities without the use of guy wires.

A common option is an isolation damper for controlling backflow when fans are not energized. FumeJet isolation dampers are accessible from the roof deck on curb cap and inlet box options. Vektor's inclusion of an inlet plenum allows for roof deck access to the isolation damper. Flow monitoring stations with integral piezometer rings allow for verification of the overall exhaust system performance for facility compliance documentation.

Applicable Product Features

- Spark Resistance Type B (aluminum impellers)
- Meet or exceed the 2,500 ft/min. (12.7 m/s) nozzle velocity requirement
- Certified performance data including the nozzle
- No guy wires for windloads up to 115 mph (185 km/hr) (FumeJet) and 125 mph (200 km/hr) (Vektor)
- Variable frequency drive packages for general and emergency mode requirements
- Heavy duty service disconnects

FumeJet® with
Curb Cap and Inlet Box

Vektor®-CH
Free Inlet Installation

Vektor®-MH shown with Inlet Box,
Curb and Isolation Damper

Other Applicable Greenheck Products

To balance the exhaust air requirements, Greenheck offers motorized dampers and louvers that modulate open or close if the system is in emergency or general exhaust mode. Model VCD control dampers provide low pressure drops due to efficient blade profiles and more overall free area. Dampers are a good choice for air intake ducts when it is convenient to have an interior mounted damper. The exterior wall opening may utilize a basic architectural louver or a weatherhood with birdscreen. An alternative solution is to utilize a combination louver damper mounted to the exterior of the building and eliminate any interior ductwork. Greenheck's model EAH-690 accommodates high volumes of make-up air required during emergency mode. In a fully open position, the EAH-690 provides 70% free area to limit pressure drop while the exhaust system ramps up to 30 air changes per hour while evacuating the machine room.

Model VCD

Model EAH

To learn more about Greenheck's ammonia refrigeration exhaust systems, please visit www.greenheck.com where you can configure your own system using Greenheck's eCAPS® application-based selection software. This provides fan selection details, budget pricing and Revit® content as well.

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