DualTemp clauger

ENGINEERING BULLETIN NO. 4

DTC ENGINEERING

AMMONIA MACHINERY ROOM VENTILATION REQUIREMENTS

PUBLISHED BY DTC ENGINEERS

January 2020

DUALTEMP CLAUGER
4301 S. PACKERS AVE, CHICAGO, IL 60609
www.dualtempclauger.com

AMMONIA MACHINERY ROOM VENTILATION REQUIREMENTS

OBJECTIVE

To ensure safety by checking and preventing the accumulation of refrigerant in the machinery room due to a leak to a concentration that would be flammable, harmful or result to oxygen deprivation

REQUIREMENTS

Based on the ANSI/IIAR-2 2014, the requirements for the machinery room is broken down into three categories:

1. Design and installation
2. Control
3. Testing

1. DESIGN AND INSTALLATION

1.1 Machinery Room

1.1.1 All components containing more than 320 ppm of Ammonia per occupied space should be in the machinery room.

1.1.2 The rooms should be mechanically ventilated to the outdoors both under normal and emergency conditions.

- Unless, the refrigerating system is located outdoors, at least 20-ft from the building opening and is enclosed by a penthouse, lean to or other open structure, natural or mechanical ventilation shall be provided.
- Location of the opening shall be based on the relative density of the refrigerant to air.

- The free-aperture cross section for the ventilation of the machinery room should not be less than:

$$F = \sqrt{G}$$

Where:

F = The free opening area in square feet (m^2)

G = The mass of the refrigerant in pounds (kg) in the largest system, any part of which is in the machinery room.

1.1.3 The room ventilation requires detection to activate at 25 ppm, 150 ppm, and when a concentration exceeds the sensor's upper detection limit or 40,000 ppm (25% Lower Flammability Limit (LFL)).

1.2 Exhaust Discharge and Fan Requirement

1.2.1 The exhaust air from mechanical ventilation systems should be discharged to the outdoors at a point where it will not cause public nuisance. [6.14.3]

1.2.2 The discharge location should be at least 20-ft from the property line or openings to a building. [6.14.3.4]

1.2.3 Despite the function, exhaust fans must have non-sparking blades and be the totally enclosed type. [6.14.3.6, 6.14.3.7]

1.2.4 The ventilation fans must have a minimum discharge velocity of 2,500 ft/min

1.3 Make-up Air

1.3.1 Make-up air should be provided from the outdoors to replace the exhaust air and maintain a negative pressure in the room. [6.14.5.1]

1.3.2 Ventilation must not cause the negative pressure in the room to exceed 0.25 inches water column. [6.14.5.1]

1.3.3 Make-up intakes must serve **ONLY** the machinery room.

1.3.4 The openings for the make-up air should be positioned cautiously to avoid short-circuiting and the intake of the exhaust(contaminated) air. [6.14.5.2, 6.14.5.4]

1.3.5 Motorized louvers or dampers, where utilized, should **fail to the open position** during a loss of power.

1.3.6 Where direct openings are not provided, make-up should be provided by fans. [6.14.5.6]

1.4 Air Ducts

1.4.1 The ducts for the make-up and exhaust air should serve **ONLY** the machinery room. [6.14.3.3, 6.14.5.5]

1.4.2 Make-up air duct must be covered with a corrosion-resistant screen of not less than ¼ inch mesh. [6.14.5.3]

1.5 Ventilation Rate

1.5.1 Ventilation for Occupancy

When occupied, the machinery room should be ventilated with outside air at a rate of at least 0.5 cfm/ft^2 of machinery room area or 20 cfm per person. Whichever of the two rates is greater should be used. [6.14.1]

1.5.2 Emergency Ventilation

On the activation of the refrigerant detector, the mechanical ventilation system should exhaust air from the machinery room in the following quantity:

$$\boldsymbol{Q = 100 * \sqrt{G}}$$

Where:

Q = The airflow in cubic feet per minute

G = The design mass of refrigerant in pounds (kg) in the largest system, any part of which is in the machinery room.

1.5.3 According to IIAR-2 [2014], the minimum required emergency ventilation rate for Ammonia must be 30 air changes per hour based on the gross machinery room volume.
Except if analysis indicates that a release of the entire system charge will not result in the room concentration exceeding 40,000 ppm (25% LFL). [6.14.7.1]

1.5.4 Ventilation fans should discharge upwards at a minimum velocity of at least 2,500 fpm at the required emergency ventilation (capacity) flow rate. [6.14.3.5]

1.5.5 Multiple fans or multispeed fans are permitted to produce the emergency ventilation rate and temperature control. They can also be used to minimize the airflow for normal ventilation. [6.14.4]

1.6 Temperature control

1.6.1 Temperature control ventilation should be activated before 104°F

1.6.2 Considering the heat load of the machinery and the make-up air entering the room at 1% design, the temperature control ventilation must limit the dry bulb temperature to 104°F.
Temperature control ventilation can be supplemented with the emergency ventilation.
If supported by engineering design, such as external means of cooling or electrical wiring rated for higher temperatures, reduced temperature control ventilation rate can be used. [6.14.6.1]

1.6.3 Temperature control ventilation should be continuous and activated both automatically with a thermostat and manually with a control switch. Multiple fan or multispeed fan systems can be partially operated to deliver the temperature control ventilation. [6.14.6.2]

1.7 Emergency Control Switch

1.7.1 A clearly identified control switch for emergency ventilation with a tamper-resistant cover must be located outside the machinery room and adjacent to the designated principal machinery room door.

1.7.2 The switch must provide ON/AUTO override capability and be distinctly labeled. [6.12.2]

1.8 Mechanical Ventilation Power System

1.8.1 The system should be powered independent of the equipment in the machinery room and be unaffected by the emergency shut down controls. [6.14.7.3]

2. CONTROL

In addition to the requirements stated in the design and installation section, the following should be strictly adhered to in order to ensure safety.

2.1 Ammonia Detection Thresholds

2.1.1 The sensor should be located where a leak is most likely to occur

2.1.2 Detection of **less than 25 ppm** of ammonia concentrations requires **no alarm**.

2.1.3 Detection of ammonia concentrations of **25 ppm or more** should activate audible alarms and visual indicators, located inside the room, to warn that,

when the alarm is activated, access to the room is restricted to **ONLY** authorized personnel and emergency responders.

2.1.4 The detection should also activate an alarm that reports to a monitored location to ensure a corrective action is taken at an indicated concentration of **≥ 25 ppm**. [ANSI/IIAR 2-2014 & 17.7.1]

2.1.5 Emergency ventilation must be automatically activated by the ammonia detection system at a concentration of **150 ppm** and by a manual control switch with manual reset required. [6.12.2, 6.13.2.3, 6.14.3.1, 6.14.7.2]

2.1.6 Detection of 40,000 ppm or vapor detector's upper limit must cause the following equipment to automatically de-energize:

a. Refrigerant compressor
b. Refrigerant pumps
c. Normally closed automatic refrigerant valves that are not part of the emergency control system. [ANSI/IIAR 2-2014 & 6.13.2]

2.1.7 In the event of a concentration above **150 ppm**, general exhaust fans not used to provide emergency ventilation or temperature control must be shut off with refrigeration machinery. [6.14.2]

2.1.8 In the event of power failure, a means of monitoring the ammonia release concentration should be provided. [ANSI/IIAR 2-2014 & 16.1.4]

2.2 Power loss and Emergency Ventilation Failure

2.2.1 The events of power loss or ventilation failure must result in the sending of a signal to a monitored location. [6.14.7.4].

2.3 Signage

2.3.1 Machinery Room Door Signs

2.3.1.1 The entrances to the machinery room should be provided with signage which firstly, restricts the area to authorized personnel only and secondly, indicates the proper NFPA 704 designation. [ANSI/IIAR 2-2014 6.15.1]

2.3.1.2 The details of the door signage, as recommended in the informative section of IIAR 2-2014, Appendix J, are shown in Figure 1 and outlined below:

Refrigeration Machinery Room

Authorized Personnel Only

Caution – Ammonia R-717

Caution – Eye and Ear Protection Required

NFPA 704 – Ammonia Fire Diamond (Blue-3, Red-3, Yellow-0)

2.3.2 Alarm Signs

2.3.2.1 Signage should be placed next to the actual audio/visual alarms that identify these alarms as part of the ammonia detection system. An example is shown in Figure 2 below [ANSI/IIAR 2-2014 17.6]

2.3.2.2 IIAR 2-2014 recommends the following details on the alarm signage:

Warning

When alarms are activated, Ammonia has been detected:

1. **Leave room immediately**
2. **Do not enter except by Trained and Authorized personnel**
3. **Do not enter without Personal Protective Equipment**

2.4 Switch Signs

2.4.1 It is highly recommended that the Refrigeration Stop Switch and Emergency Ventilation Switch be labelled like the alarm signs as shown in Figure 3 below.

Figure 1: Machinery Room Door Required Signage

Figure 2: An Illustration of the Alarm Signage with the Audio/Visual System

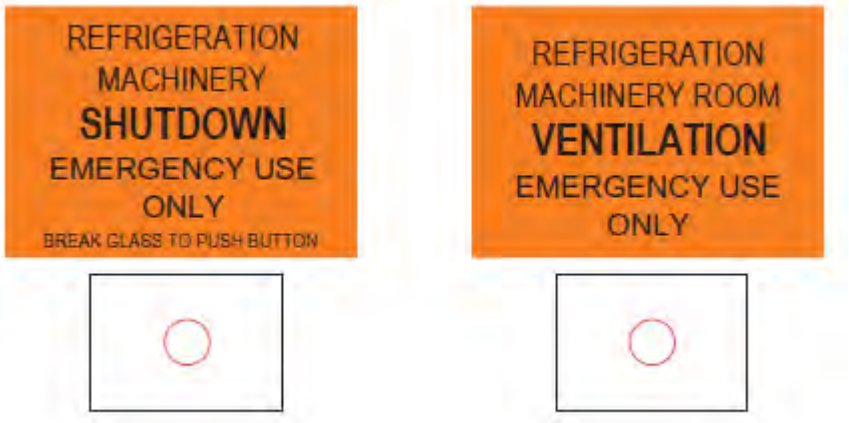

Figure 3: Schematic Representation of the Stop Switch and Emergency Ventilation Switch

2.5 System Installation Signage

2.5.1 This is required by the California Mechanical Code [2016 CMC 1115.3].

2.5.2 A system installation sign, as shown in Figure 4, should be permanently placed and indicate the following details:

2.5.2.1 Name of installing contractor

2.5.2.2 Name and number designation of refrigerant in the system (e.g. Ammonia 717)

2.5.2.3 Pounds of refrigerant in the system

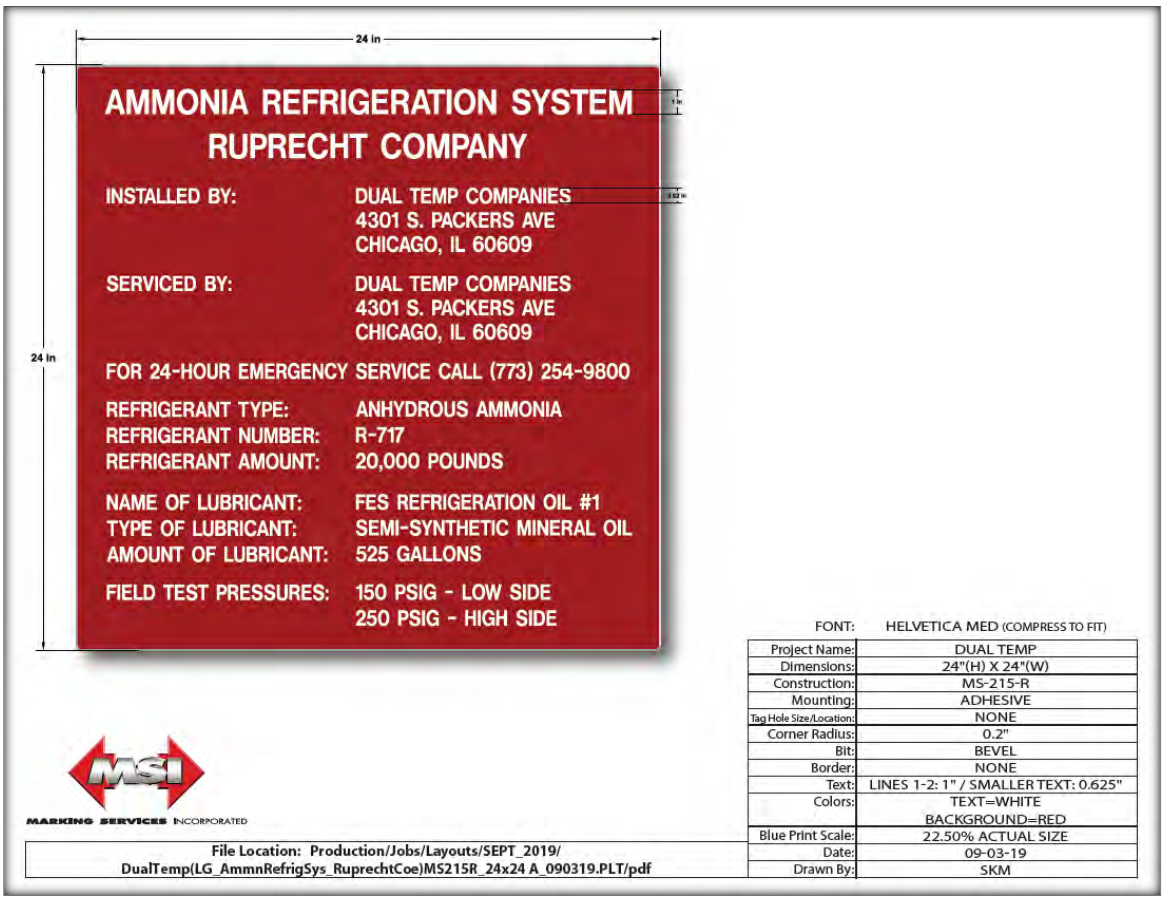

Figure 4: An Example of a System Installation Signage

3. TESTING

3.1 The testing schedule for ammonia detectors, alarms and the ventilation system should be established based on the manufacturer's recommendation and/or a documented experience.

3.2 Alternatively, the ventilation system should be tested at least twice a year if no recommendation is given. [6.14.8]