RESOURCE COMPLIANCE

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Providing Solutions. Simplifying Regulation

Ammonia Refrigeration *RAGAGEP*

Recognized and Generally Accepted Good Engineering Practice

Peter Thomas, P.E., CSP – Resource Compliance, Inc.

Introduction

- Where does the term ***RAGAGEP*** come from?

CalARP RAGAGEP

- Process Safety Information 2760.1(d)(2)
  - The owner or operator shall document that equipment complies with **recognized and generally accepted good engineering practices**.

CalARP RAGAGEP

- Mechanical Integrity 2760.5(d)(3) - (4)
  - Inspection and testing procedures shall follow **recognized and generally accepted good engineering practices**.
  - The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and **good engineering practices**, and more frequently if determined to be necessary by prior operating experience.

CalARP RAGAGEP

- Pre-Startup Safety Review 2760.7(b)(1)
  - Construction and equipment is **in accordance with design specifications**;

RAGAGEP Citations

Citation 1 Item 1 Type of Violation: **Serious**

29 CFR 1910.119(d)(3)(ii): The employer did not document that equipment complies with recognized and generally accepted good engineering practices.

On or about 20 July 2013, and at times prior thereto, the employer did not document that the ventilation system complies with recognized and generally accepted good engineering practices (RAGAGEP) within the Engine Room, when the electrical system for the room does not meet Class I, Group D, Division 2. Failure to verify and document that the system complies with the RAGAGEP in the Engine Room for both normal and emergency mechanical ventilation exposed the workers within to the hazard of anhydrous ammonia liquid or vapor.

ABATEMENT DOCUMENTATION REQUIRED FOR THIS ITEM

Date By Which Violation Must be Abated:	03/07/2014
Proposed Penalty:	$7000.00

RAGAGEP Citations

Citation 1 Item 4 Type of Violation: **Serious**

29 CFR 1910.119(d)(3)(ii): The employer did not document that equipment complies with recognized and generally accepted good engineering practices:

For the Commercial Warehousing ammonia refrigeration facility located at 101 and 102 Industrial Blvd. in Winter Haven, FL as observed on or about 1/15/2015:

a) Pressure vessels in the engine rooms such as, but not limited to, the T6-North were operated at temperatures below their minimum design metal temperature.

b) Ammonia detectors were not interlocked to ventilation fans in engine rooms, and ventilation fans in engine rooms did not have an interlocked supervisory alarm that would sound if the ventilation fans shut off.

c) Remote actuation of ventilation system, outside of engine room, was not available. The only way to turn on fans was from a breaker inside the engine rooms.

d) Ammonia relief vent discharge was located at a height of 19-20 ft. above ground and only 9-12 ft. from the T6 north engine room's ventilation intake while the employer's process safety information stated that the relief discharge shall not be within 20 feet of a ventilation intake. This location exposed employees working outside in the area around the high pressure receiver, the condensers, and at the engine room entrance door to potential ammonia concentrations above ammonia's IDLH, 300 ppm. The relief discharge's location also resulted in the potential for ammonia vapors to be pulled back into the engine room from the ventilation intake.

Date By Which Violation Must be Abated:	08/07/2015
Proposed Penalty:	$4500.00

RAGAGEP Citations

Citation 1 Item 3 Type of Violation: **Serious**

29 CFR 1910.119(d)(3)(ii): The employer did not document that equipment complies with recognized and generally accepted good engineering practices:

In the ammonia engine room, the engine room access door and a garage door leading into the engine room were not each equipped with a tight-fitting seal, exposing employees outside the room to potential leaks of ammonia. The doors did not comply with the employers accepted engineering practice, ANSI/ASHRAE Standard 15 requirements.

Date By Which Violation Must be Abated: Corrected During Inspection

Proposed Penalty: $ 6,300.00

Millard reaches $3 mil deal over ammonia release that sickened workers

Investing.com | Politics | Jun 02, 2015 11:25PM GMT | Add a Comment

64. COUNT 18 - 40 C.F.R. § 68.73(d)(2) required Defendant to follow recognized and generally accepted good engineering practices for its inspections and testing procedures in order to maintain the mechanical integrity of its process equipment. Defendant failed, in violation of 40 C.F.R. § 68.73(d)(2), in at least four ways to follow recognized and generally accepted good engineering practices: (a) Failed to show that it conducted the IIAR Bulletin No. 109 inspections for all pressure vessels to help identify cracked and damaged vessels; (b) Failed to mark/label its piping to meet the ammonia pipe labeling requirements of IIAR's Bulletin No. 14, Guidelines for Identification of Ammonia Refrigeration Piping and Safety Components; (c) Failed to show that it performed the annual test on its emergency ventilation system in July 2010 (just before the August 2010 Release). A testing schedule for the mechanical ventilation systems is required by IIAR 2 - 2008 Section 13.3.12.1; (d) Failed to provide material certification documents (U-1, U-1A, U-2) for all the screw compressor oil filter housings, screw compressor cooler thermosyphon oil coolers, intercoolers, accumulators, and oil pots.

Citation 1 Item 1 Type of Violation: **Serious**

29 CFR 1910.119(d)(3)(ii): The employer did not document that equipment complies with recognized and generally accepted good engineering practices:

Employees engaged in production activities throughout the facility were exposed to chemical hazards associated with the catastrophic release of ammonia in that the employer had not documented and implemented compliance with recognized and generally accepted good engineering practices for the marking of Ammonia refrigeration piping and system components to comply with IIAR Bulletin # 114 09/1991; and ANSI A13.1, 2007. Missing Valve Tag Identifications include but are not limited to 5 sets of the High Gas NH3 Valves; and 2 sets of the Defrost Release Valves.

29 CFR 1903.19(d)(1) requires certification and documentation that the abatement of the above violation is completed.

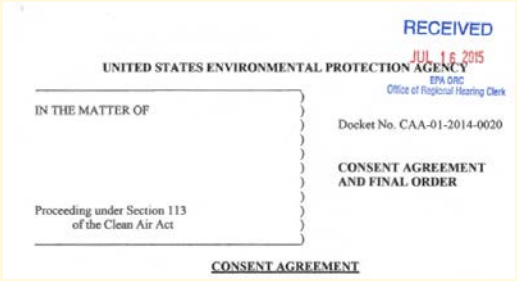
ABATEMENT DOCUMENTATION REQUIRED FOR THIS ITEM

Date By Which Violation Must be Abated:	09/25/2015
Proposed Penalty:	$5500.00

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

IN THE MATTER OF	Docket No. CAA-01-2014-0020
	CONSENT AGREEMENT AND FINAL ORDER
Proceeding under Section 113 of the Clean Air Act	

CONSENT AGREEMENT



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JUL 16 2015
EPA ORC
Office of Regional Hearing Clerk

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

IN THE MATTER OF

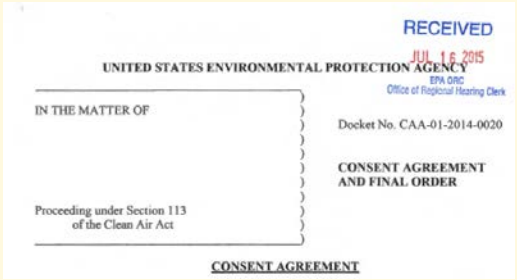
Docket No. CAA-01-2014-0020

CONSENT AGREEMENT AND FINAL ORDER

Proceeding under Section 113 of the Clean Air Act

CONSENT AGREEMENT

48. Pursuant to 40 C.F.R. § 68.65, the owner or operator of a Program 3 process is required, among other things, to compile written process safety information before completing the PHA, in order to perform an adequate PHA and to enable proper maintenance of process equipment. This includes documenting information pertaining to the hazards of the RMP chemical in the process; information pertaining to the technology and equipment of the process, including that the equipment complies with RAGAGEP; and information showing that any equipment that was designed according to outdated standards is designed, maintained, inspected, tested, and operated in a safe manner. This compilation enables appropriate identification and understanding of hazards posed by regulated substances in the process and the technology and equipment of the process.



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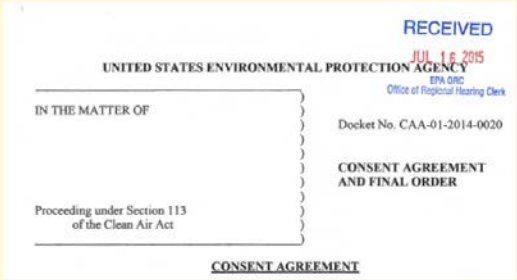
57. By failing to compile the necessary information about the technology and equipment of the Processes, including by documenting that the Processes comply with RAGAGEP, Respondent violated 40 C.F.R. § 68.65 and Section 112(r)(7)(E) of the CAA, 42 U.S.C. § 7412(r)(7)(E).



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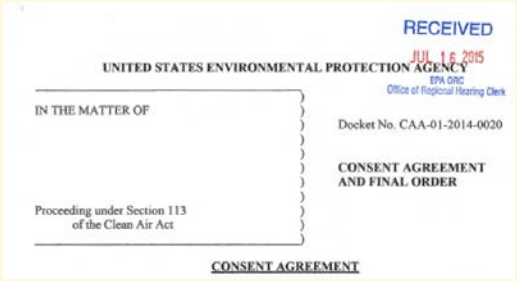
CONSENT AGREEMENT

Facility Safety Upgrades to Prevent and Minimize Ammonia Releases

90. Respondent shall make safety improvements to the Facility according to the requirements and deadlines described in Exhibit A. The purpose of this SEP is to protect workers, emergency responders, and the community by preventing ammonia releases at the Facility and by limiting the effects of any releases that do occur. Hereinafter, this SEP will be referred to as the "Safety Upgrade SEP."

91. Respondent represents that, to the best of its knowledge after thorough review of the most current industry standards by Respondent or its agents, the safety upgrades described in Exhibit A exceed the requirements of the most current industry standards.

92. The Safety Upgrade SEP is anticipated to cost approximately $308,600. "Satisfactory completion" of the SEPs shall mean: (a) making safety improvements to the Facility according to



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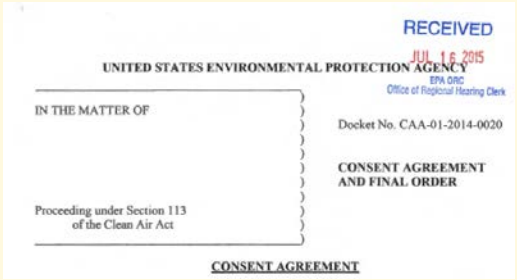
CONSENT AGREEMENT

Local Emergency Response Enhancements

95. Respondent shall provide emergency response equipment and a calibration contract to the Fire Department of the City of Chicopee, which Respondent has selected to be the SEP Recipient, according to the requirements and deadlines described in Exhibit A. The purpose of this SEP is to enhance the emergency planning and chemical spill response capabilities for local first responders. Hereinafter this SEP shall be referred to as the "Emergency Response SEP."

96. The SEP is anticipated to cost approximately $13,500. "Satisfactory completion" of the SEP shall mean: (a) providing the Chicopee Fire Department with emergency response equipment and an associated calibration contract, according to the requirements and deadlines



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CONSENT AGREEMENT

STIPULATED PENALTIES

109. In the event that Respondent fails to satisfactorily complete the SEPs as outlined in Exhibit A, Respondent shall be liable for stipulated penalties in accordance with the provisions set forth below. The determination of whether the SEP has been satisfactorily completed shall be in the sole discretion of EPA.

a. If EPA determines that Respondent completely or substantially failed to implement the Safety Upgrade SEP in accordance with this CAFO, Respondent shall pay a stipulated penalty to the United States in the amount of $385,750, plus interest from the effective date of the CAFO;8

b. If EPA determines that Respondent completely or substantially failed to implement the Equipment Purchase SEP in accordance with this CAFO, Respondent shall pay a stipulated penalty to the United States in the amount of $16,875, plus interest from the effective date of the CAFO;9

c. If Respondent spends less than $322,100 on the two SEPs but EPA determines that Respondent otherwise satisfactorily completes each SEP, Respondent shall only be required to pay a stipulated penalty to the United States in the amount equal to the

OSHA RAGAGEP Memo

June 5, 2015

MEMORANDUM FOR: REGIONAL ADMINISTRATORS AND STATE PLAN DESIGNEES

THROUGH: DOROTHY DOUGHERTY
Deputy Assistant Secretary

FROM: THOMAS GALASSI Director
Directorate of Enforcement Programs

SUBJECT: RAGAGEP in Process Safety Management Enforcement

This memorandum provides guidance on the enforcement of the Process Safety Management (PSM) Standard's recognized and generally accepted good engineering practices (RAGAGEP) requirements, including how to interpret "shall" and "should" language in published codes, standards, published technical reports, recommended practices (RP) or similar documents, and on the use of internal employer documents as RAGAGEP. Enforcement activity, including the *Petroleum Refinery Process Safety Management National Emphasis Program* (Refinery NEP), and requests for assistance from the field, revealed the need for guidance on the PSM standard's RAGAGEP provisions.

OSHA RAGAGEP Memo

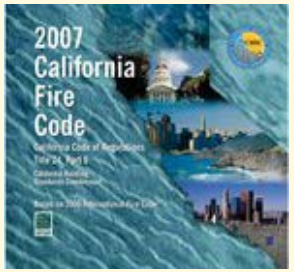
- *Shall* vs. *Should*
- *Normative* vs. *Informative*
- Primary Sources of RAGAGEPs
- Use of Internal Standards

Ammonia Refrigeration RAGAGEP

- American National Standards Institute (ANSI)
- International Code Council® (ICC)
- International Association of Plumbing and Mechanical Officials (IAPMO)
- California Building Standards Commission (CBSC)
- American Society of Mechanical Engineers
- ASHRAE (formerly American Society of Heating Refrigeration and Air-Conditioning Engineers)
- International Institute of Ammonia Refrigeration (IIAR)

Ammonia Refrig. RAGAGEP Documents

- California Mechanical Code (CMC)
- Uniform Mechanical Code (UMC)
- California Fire Code (CFC)
- Fire Code (NFPA 1)
- ANSI/ASHRAE 15 Safety Standard for Refrigeration Systems



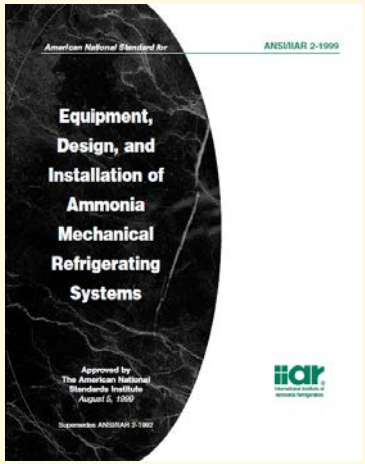
IIAR RAGAGEP Documents

- ANSI/IIAR 2 *Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems*

1974-78

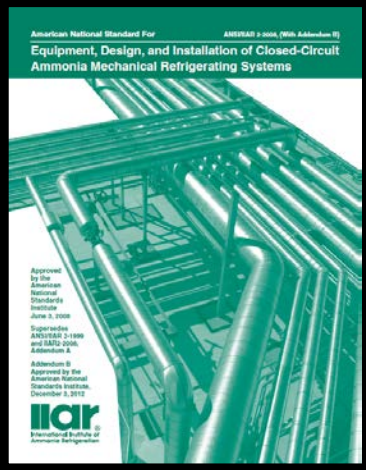
1984

1999



2008

2015



The Future of IIAR Standards

- **ANSI/IIAR 1** Definitions and Terminology Used in IIAR Standards
- **ANSI/IIAR 2** Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems
- **ANSI/IIAR 3** Ammonia Refrigeration Valves
- **ANSI/IIAR 4** Installation of Closed-Circuit Ammonia Mechanical Refrigeration Systems
- **ANSI/IIAR 5** Start-up and Commissioning of Closed-Circuit Ammonia Refrigeration Systems
- **ANSI/IIAR 6** Maintenance and Inspection of Closed-Circuit Ammonia Mechanical Refrigeration Systems
- **ANSI/IIAR 7** Developing Operating Procedures for Closed-Circuit Ammonia Mechanical Refrigerating Systems
- **ANSI/IIAR 8** Decommissioning of Closed-Circuit Ammonia Mechanical Refrigeration Systems

RAGAGEP Confusion

- 2013 CMC §1102.1
  - Except as modified by this code, refrigeration system shall comply with **ASHRAE 15.** In addition, ammonia refrigeration systems shall comply with **IIAR 2**.
- ANSI/IIAR 2-2008 Addendum B §5.4.2
  - Cast iron, malleable iron, nodular iron, steel, cast steel, and alloy steel may be used as governed by **ASME B31.5-2006** or the governing edition of **Section VIII, Division 1, ASME Boiler and Pressure Vessel Code**, as applicable.

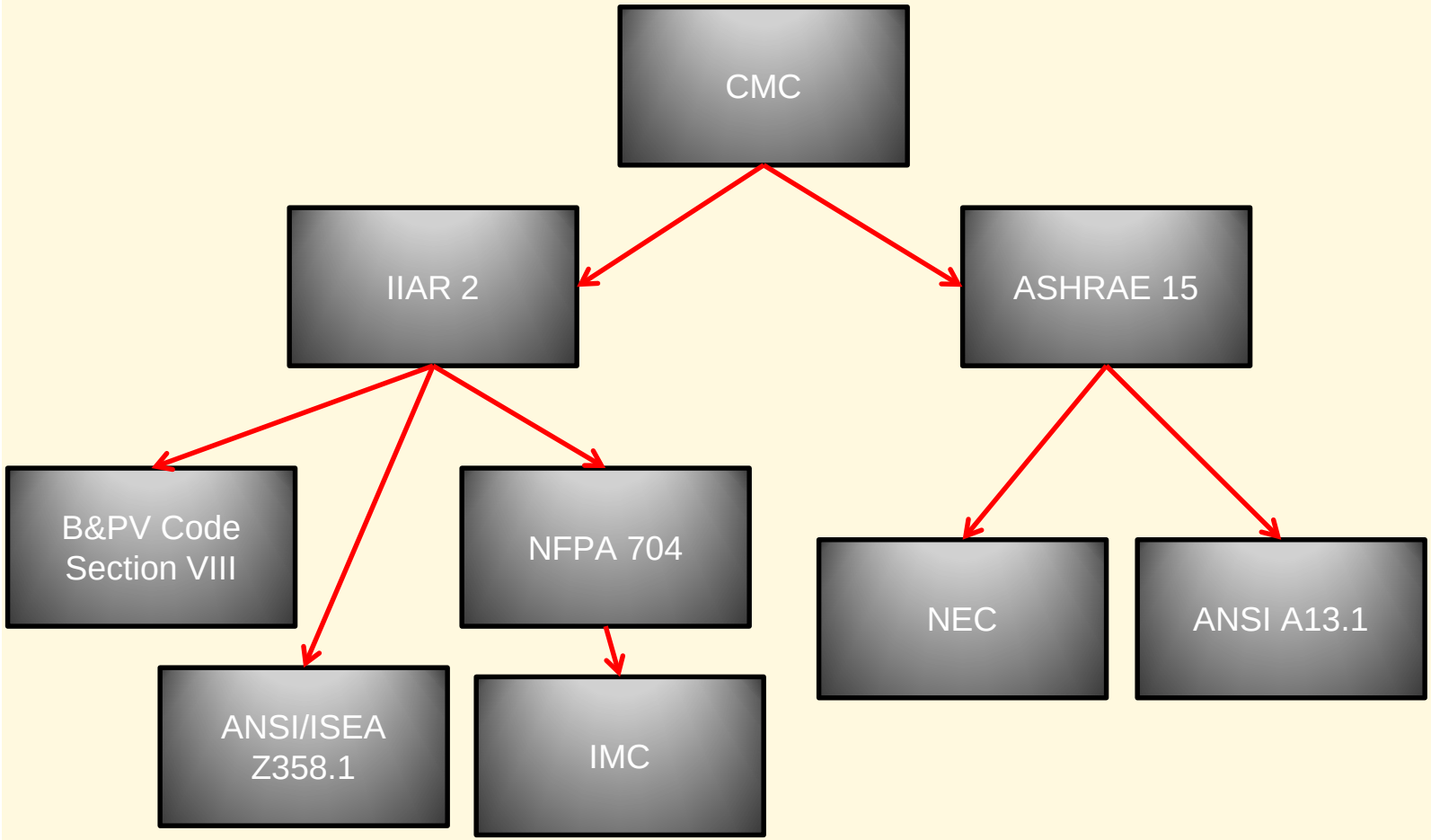
RAGAGEP Confusion

- ANSI/IIAR 2-2008 §13.1.6
  - It is recommended that additional such units be located accessibly inside or outside the machinery room such that no unit is further than 10 seconds or 55 feet [16.8 m] from a hazard. Refer to **ANSI/ISEA Z358.1 – 2009** for eyewash equipment guidelines.
- ANSI/IIAR 2-2008 §13.1.10.4
  - Refrigerating systems shall be provided with approved informative signs, emergency signs, charts and labels in accordance with **NFPA 704**. Hazard signs shall be in accordance with the **International Mechanical Code.**

RAGAGEP Confusion

- ANSI/ASHRAE 15-2013 §11.2.2
  - the kind of refrigerant or secondary coolant contained in exposed piping outside the machinery room. Valves or piping adjacent to valves shall be identified in accordance with **ANSI A13.1, Scheme for Identification of Piping Systems**.
- ANSI/ASHRAE 15-2013 §8.5
  - Electrical Safety. Electrical equipment and wiring shall be installed in accordance with the **National Electrical Code** and the requirements of the AHJ.

RAGAGEP Confusion



Implications of RAGAGEP

Safe Access

- **Equipment**
  - An unobstructed readily accessible opening and passageway not less than 36 inches in width and 80 inches in height shall be provided and maintained to the compressor, valves required by this chapter, or other portions of the system requiring routine maintenance. [2013 CMC §1106.3]
  - A clear and unobstructed approach and space shall be provided to refrigerating machinery for inspection, service, and emergency shutdown with adequate clearances for maintenance of equipment. There shall be clear headroom of not less than 7.25 ft below equipment situated over passageways. [ANSI/IIAR 2-2008 §13.1.2.3]

Safe Access

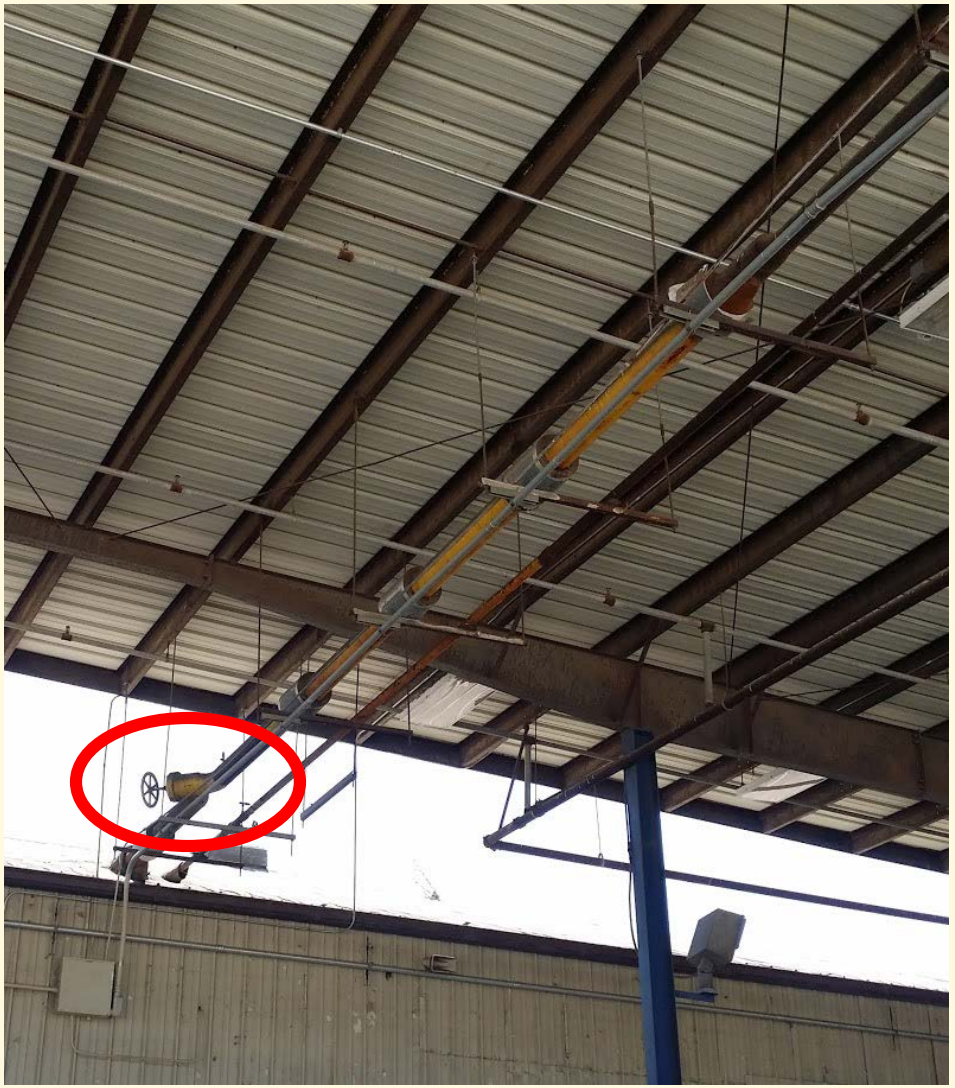
Safe Access

Safe Access

- **Valves**
  - Stop valves shall be readily accessible from the machinery room floor or a level platform [2013 CMC §1112.3]
  - All manually operated valves inaccessible from floor level shall be operable from portable platforms, fixed platforms, ladders, or shall be chain-operated. Isolation valve(s) identified as being part of an emergency shutdown procedure shall be directly operable or chain-operated from a permanent work surface. [ANSI/IIAR 2-2008 §13.1.2.2]
  - Similar requirement dating back to 1978

Safe Access

Safe Access

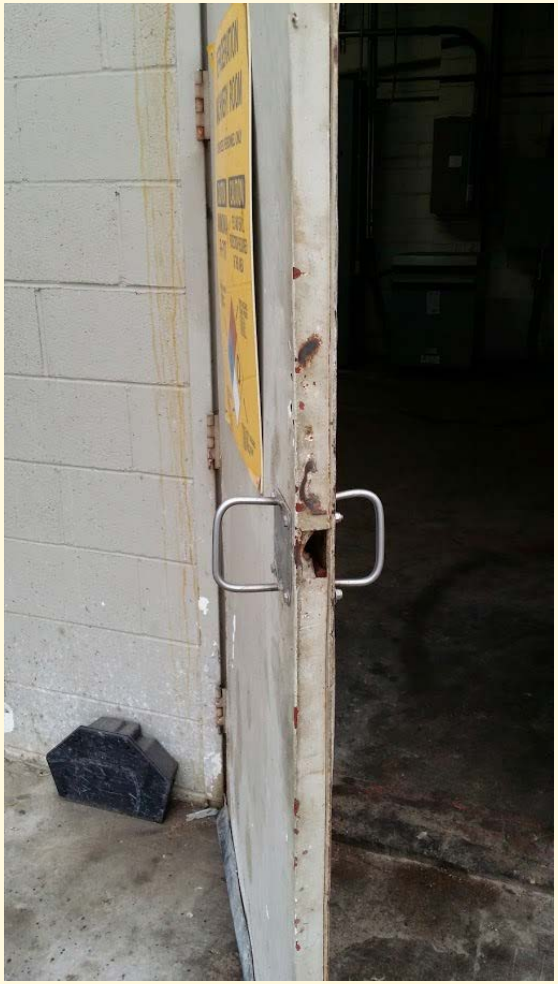


Restricted Access

- **Machinery Room**
  - Access to the refrigerating machinery room shall be restricted to authorized personnel. Doors shall be clearly marked and permanent signs shall be posted at each entrance to indicate this restriction. [ANSI/IIAR 2-2008 §13.1.2.4]
  - Access to the refrigerating machinery room shall be restricted to authorized personnel. Doors shall be clearly marked or permanent signs shall be posted at each entrance to indicate this restriction. [ANSI/ASHRAE 15-2013 §8.11.8]

Restricted Access

Restricted Access



Nameplates

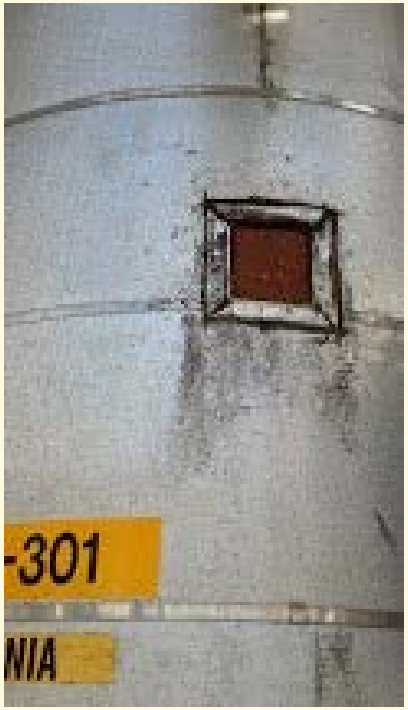
- Sections 6.1.4, 6.2.3, 7.1.3, 7.2.3, 7.3.3, 7.4.3, 8.1.3, 8.2.3, 8.4.3, and 9.3.1 of ANSI/IIAR 2-2008 address nameplate requirements for various types of equipment

Nameplates

- The nameplate shall be attached to the vessel or to a pad, bracket, or structure that is welded, brazed, soldered, or attached with mechanical fasteners directly to the vessel. Mechanical fasteners shall be of a material and design that is compatible with the vessel, bracket materials, and the vessel service. After installation of the pad, bracket, or structure, the heads of the fasteners shall be welded, brazed, or soldered to the pad, bracket, or structure that supports the nameplate. The nameplate shall be located within 30 in. (760 mm) of the vessel. Removal shall require the willful destruction of the nameplate, or its attachment system. [2013 B&PV Code Section VIII UG-119(e)]

Nameplates

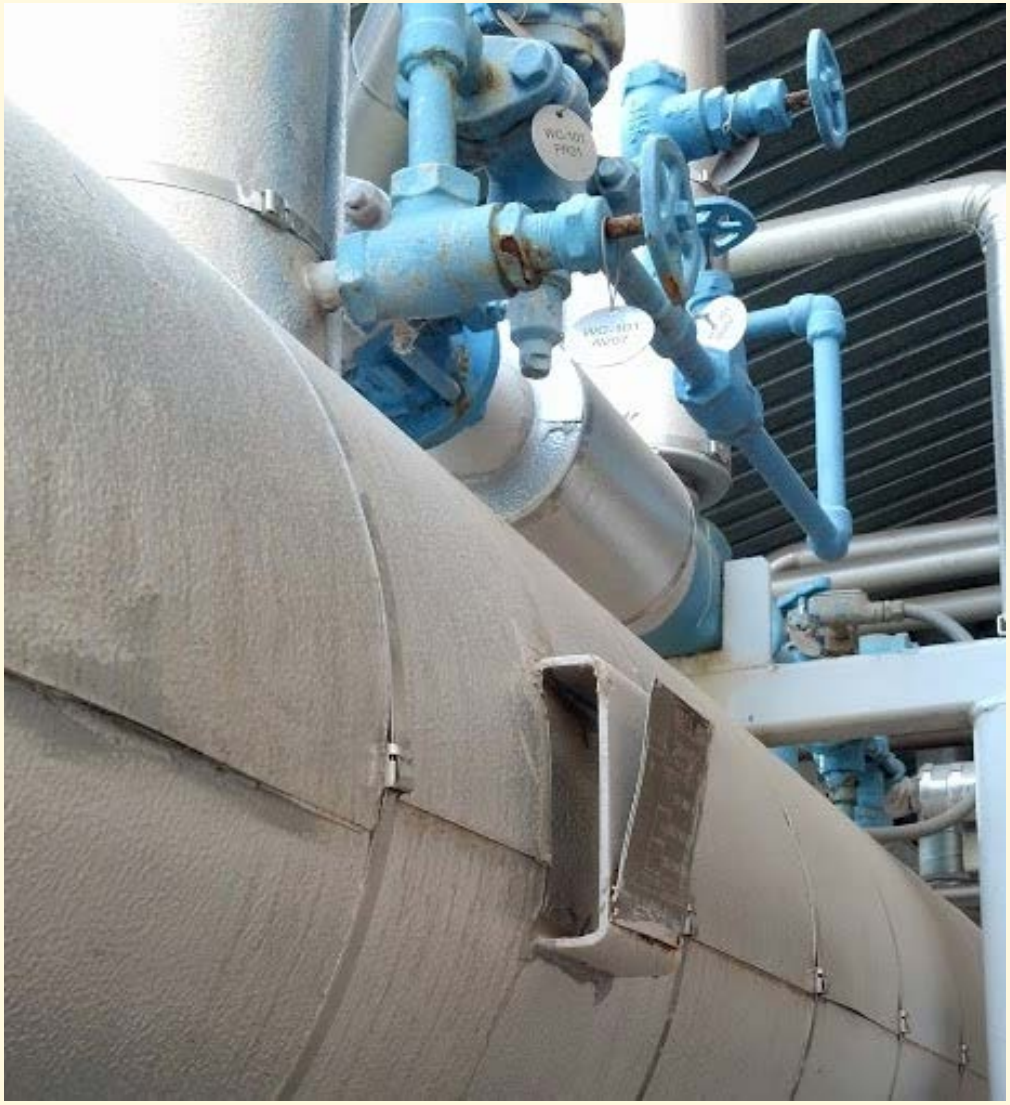

S/N
YEAR
SHELL THK
HEAD THK
U.S. GAL
SQ. FT. SURF
RVS
evapco


-301
NIA


22091
2004
596
42
109
112
25
SA455
258
SA455
NONE
SPOT
ONLY

Nameplates

Nameplates



Relief Valve Installation

- **Areas Required**
  - Positive-Displacement Compressors [2013 CMC §1114.2]
  - Liquid-Containing Portions of Systems [2013 CMC §1114.3]
  - Evaporators (located within 18 inches of a heating element) [2013 CMC §1114.4]
  - Pressure Vessels (exceeding 6” diameter) 2013 CMC §1114.5]
  - ASME Equipment [2013 B&PV Code Section VIII UG-125]

Relief Valve Installation

- **Areas Required**




Relief Valve Installation

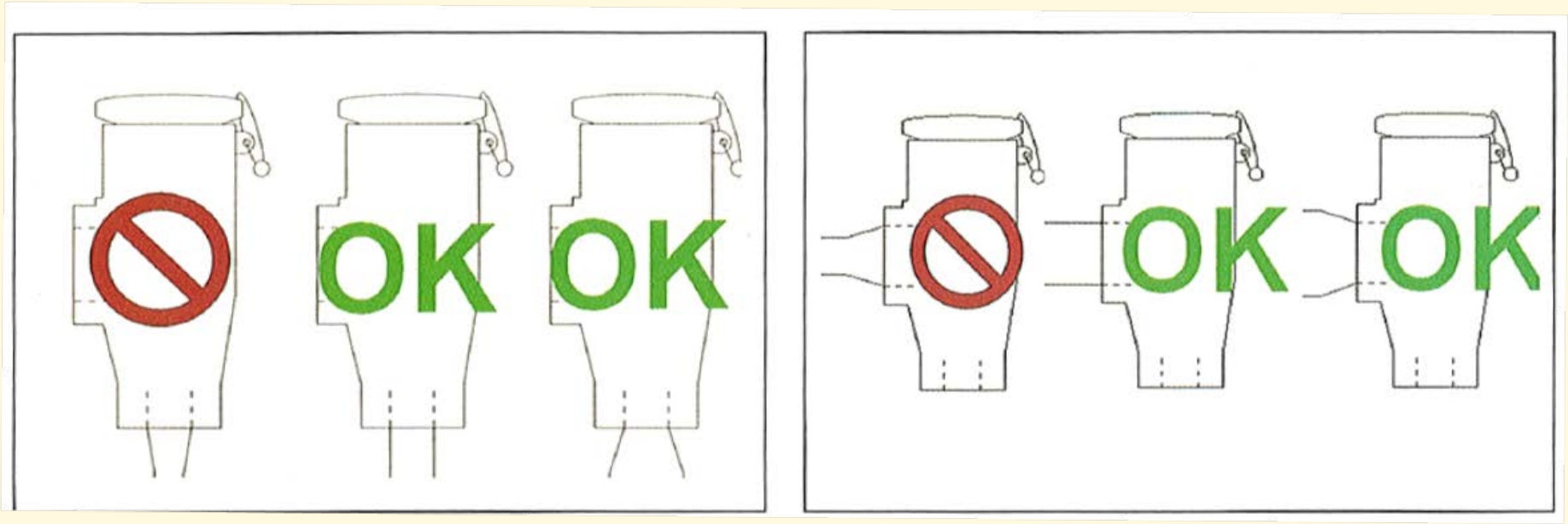
- **Single vs. Dual [2013 CMC §1117.2]**
  - Pressure vessels between 3ft^3 and 10ft^3 are permitted to use a single relief valve
  - Pressure vessels greater than 10ft^3 must use a dual relief assembly

Relief Valve Installation

- **Piping [ANSI/IIAR 2-2008 §11.3]**
  - No stop valves on inlet or outlet piping
  - The size of inlet piping must be greater than or equal to the inlet connection size of the relief valve
  - The size of the discharge pipe must not be less than the outlet size of the relief valve

Relief Valve Installation

- **Piping [ANSI/IIAR 2-2008 §11.3]**



Relief Valve Installation

- **Piping [ANSI/IIAR 2-2008 §11.3]**

Relief Valve Installation

- **Piping [ANSI/IIAR 2-2008 §11.3]**

Relief Valve Installation

- **Other Requirements**
  - ASME equipment must be protected by relief devices with ASME nameplates [2013 B&PV Code Section VIII UG-129]
  - 5-Year replacement [IIAR Bulletin No. 109 §4.9.7]

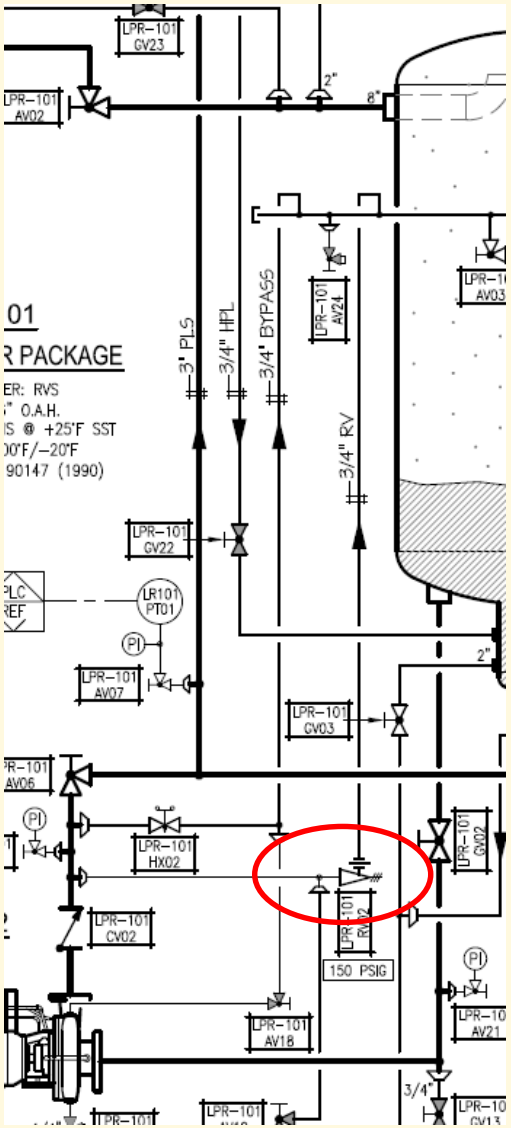



Relief Valve Installation

- **Hydrostatic Expansion [ANSI/ASHRAE 15-2013 §9.4.3.1]**
  - If trapping of liquid with subsequent hydrostatic expansion can occur automatically during normal operation or during standby, shipping, or power failure, engineering control(s) shall be used that is (are) capable of preventing the pressure from exceeding the design pressure. Acceptable engineering controls include but are not limited to a
    - a. pressure-relief device to relieve hydrostatic pressure to another part of the system and
    - b. reseating pressure-relief valve to relieve the hydrostatic pressure to an approved treatment system.

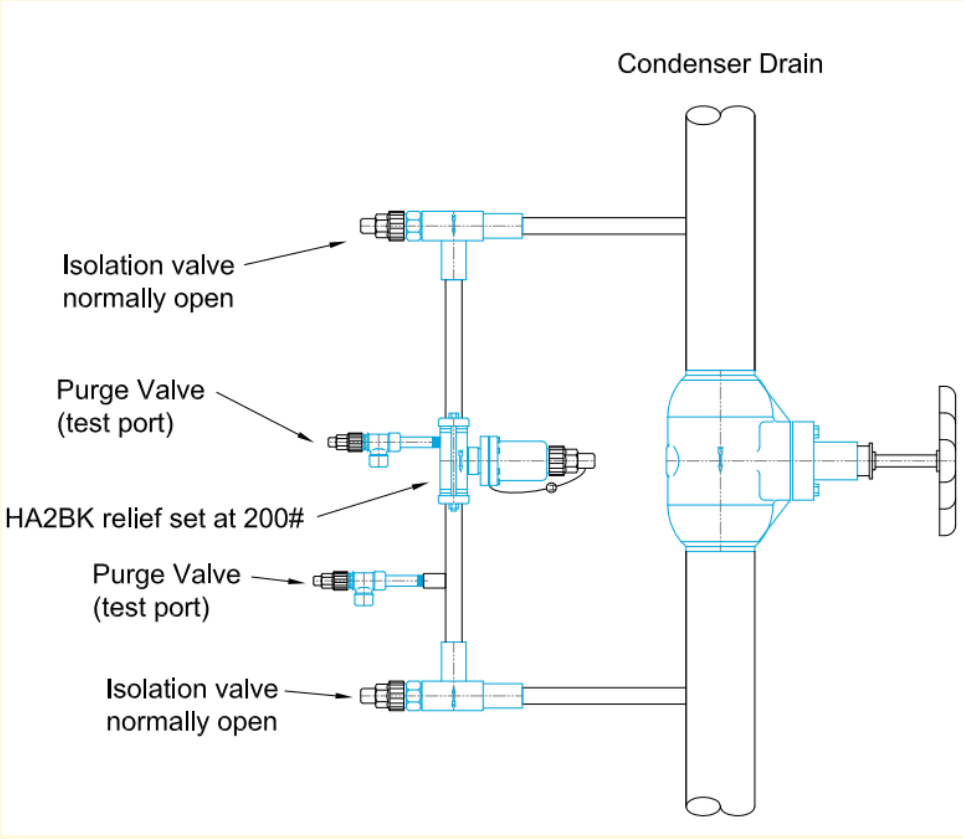
Relief Valve Installation

- **Hydrostatic Expansion**



Relief Valve Installation

- **Hydrostatic Expansion**



Relief Valve Termination

- **Ammonia Discharge [2013 CMC §1120.1]**
  - Ammonia shall discharge into a tank of water that shall be used for no purpose except ammonia absorption. Not less than 1 gallon (4 L) of fresh water shall be provided for each pound (kg) of ammonia that will be released in 1 hour from the largest relief device connected to the discharge pipe…

Relief Valve Termination

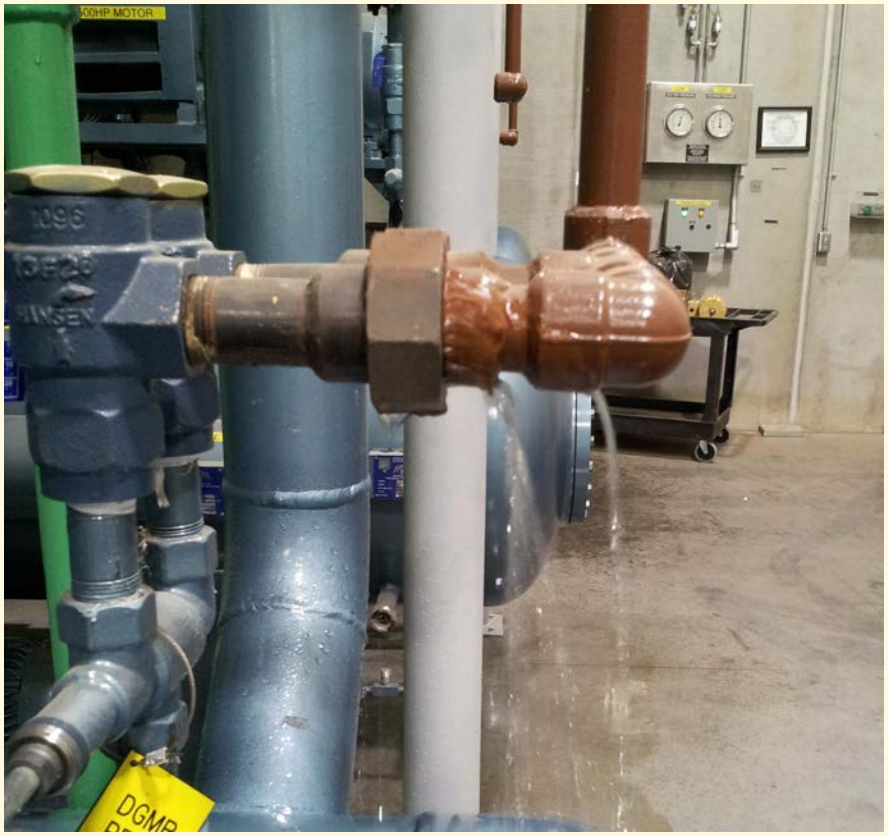
- **Ammonia Discharge [2013 CMC §1120.1]**

Relief Valve Termination

- **Ammonia Discharge [2013 CMC §1120.1]**

Relief Valve Termination

- **Ammonia Discharge [2013 CMC §1120.1]**



Relief Valve Termination

- **Ammonia Discharge [2013 ANSI/ASHRAE §9.7.8.2]**
  - Ammonia Discharge. Ammonia from pressure relief valves shall be discharged into one or more of the following:
    - a. The atmosphere, per Section 9.7.8
    - b. A tank containing one gallon of water for each pound of ammonia that will be released in one hour from the largest relief device connected to the discharge pipe. The water shall be prevented from freezing. The discharge pipe from the pressure-relief device shall distribute ammonia in the bottom of the tank but no lower than 33 ft (10 m) below the maximum liquid level. The tank shall contain the volume of water and ammonia without overflowing.
    - c. Other treatment systems that meet the requirements of the AHJ

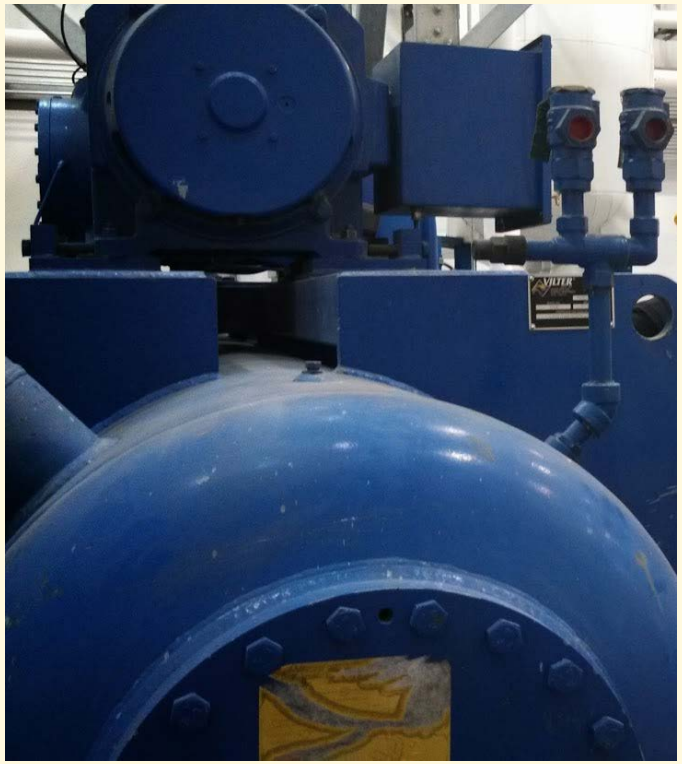
Relief Valve Termination

- **Atmospheric Discharge [ANSI/IIAR 2-2008 §11.3.6]**
  - Pipe sizing requirements [ANSI/IIAR 2-2008 §11.3.6.1]
  - Provision of draining moisture [ANSI/IIAR 2-2008 §11.3.6.2]
  - 20 ft from any window, ventilation intake, or personnel exit [ANSI/IIAR 2-2008 §11.3.6.3]
  - Not less than 15 feet above the adjacent grade or roof level and arranged to avoid spraying of refrigerant on persons in the vicinity [ANSI/IIAR 2-2008 §11.3.6.4]

- ***2015 Uniform Mechanical Code does not require diffusion tanks for ammonia refrigeration systems.***

Relief Valve Termination

- **Atmospheric Discharge [ANSI/IIAR 2-2008 §11.3.6]**



Relief Valve Termination

- **Atmospheric Discharge [ANSI/IIAR 2-2008 §11.3.6]**

Relief Valve Termination

- **Atmospheric Discharge [ANSI/IIAR 2-2008 §11.3.6]**

Relief Valve Termination

Provision for Refrigerant Removal

- ***ANSI/IIAR 2-2008 Addendum B §10.3.3***
  - Strainers shall be fitted with provision for refrigerant removal to facilitate maintenance

Provision for Refrigerant Removal

Housekeeping

- Refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept accessible at all times. [ANSI/ASHRAE 15-2013 §11.6]
- Machinery room floor clean of oil, grease and water? [IIAR Bulletin No. 109 General Safety Checklist Item L]

Housekeeping

Housekeeping

Maintenance and Corrosion

- Uninsulated refrigerant piping should be examined for signs of corrosion. If corrosion exists, the pipe should be cleaned down to bare metal and painted with a rust preventive paint. Badly corroded pipe should be replaced. [IIAR Bulletin No. 109 §4.7.4]
- Mechanical refrigeration systems shall be maintained in proper operating condition, free from accumulations of oil dirt, waste, excessive corrosion, other debris and leaks. [2012 IMC §1101.7]
- Refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept accessible at all times. [ANSI/ASHRAE 15-2013 §11.6]

Maintenance and Corrosion

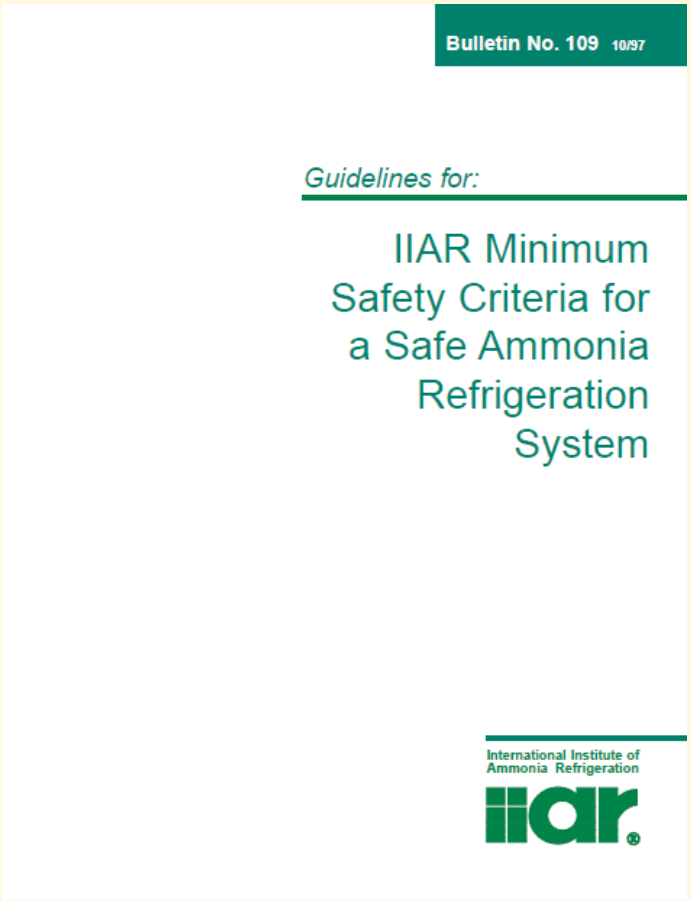
Maintenance and Corrosion

Maintenance and Corrosion

5-Year Independent Inspection

- At least every five years, the annual inspection of the vessels and heat exchangers shall be carried out by a competent person independent of immediate commercial and production pressures for that installation, who shall carry out whatever examinations and tests he may consider necessary in order to determine that the equipment is safe for further use or in order to specify such repairs that may be necessary. [IIAR Bulletin No. 110 §6.4.4.1]

5-Year Independent Inspection



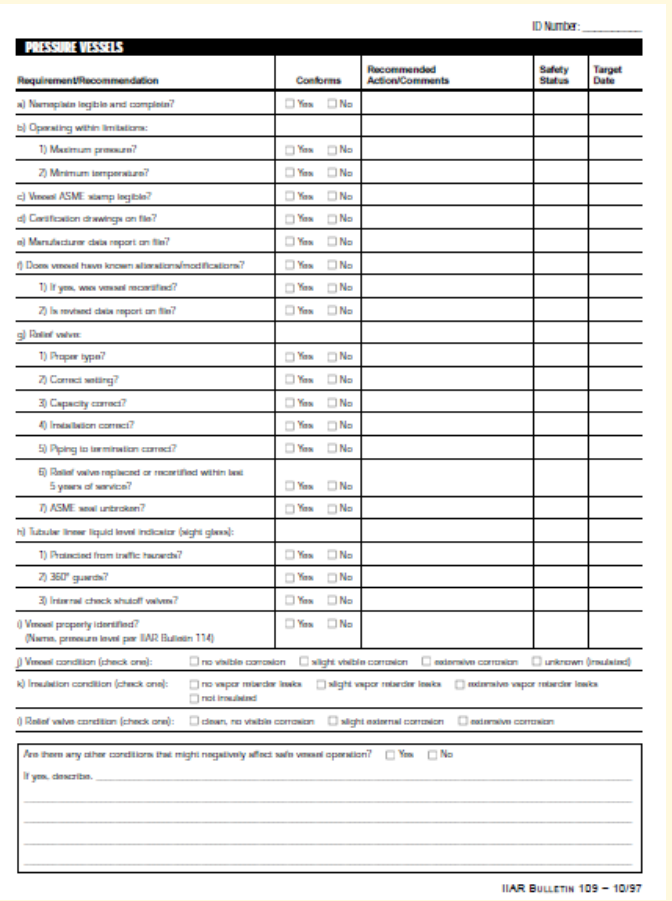
Bulletin No. 109 10/97

Guidelines for:

IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System

International Institute of Ammonia Refrigeration

iiar



ID Number: _____

PRESSURE VESSELS

Requirement/Recommendation	Conforms	Recommended Action/Comments	Safety Status	Target Date
a) Nameplate legible and complete?	☐ Yes ☐ No			
b) Operating within limitations:				
1) Maximum pressure?	☐ Yes ☐ No			
2) Minimum temperature?	☐ Yes ☐ No			
c) Vessel ASME stamp legible?	☐ Yes ☐ No			
d) Certification drawings on file?	☐ Yes ☐ No			
e) Manufacturer data report on file?	☐ Yes ☐ No			
f) Does vessel have known alterations/modifications?	☐ Yes ☐ No			
1) If yes, was vessel recertified?	☐ Yes ☐ No			
2) Is revised data report on file?	☐ Yes ☐ No			
g) Relief valve:				
1) Proper type?	☐ Yes ☐ No			
2) Correct setting?	☐ Yes ☐ No			
3) Capacity correct?	☐ Yes ☐ No			
4) Installation correct?	☐ Yes ☐ No			
5) Piping to termination correct?	☐ Yes ☐ No			
6) Relief valve replaced or recertified within last 5 years of service?	☐ Yes ☐ No			
7) ASME seal unbroken?	☐ Yes ☐ No			
h) Tubular linear liquid level indicator (sight glass):				
1) Protected from traffic hazards?	☐ Yes ☐ No			
2) 360° guards?	☐ Yes ☐ No			
3) Internal check shutoff valves?	☐ Yes ☐ No			
i) Vessel properly identified? (Name, pressure level per IIAR Bulletin 114)	☐ Yes ☐ No			

j) Vessel condition (check one): ☐ no visible corrosion ☐ slight visible corrosion ☐ extensive corrosion ☐ unknown (insulated)

k) Insulation condition (check one): ☐ no vapor retarder leaks ☐ slight vapor retarder leaks ☐ extensive vapor retarder leaks ☐ not insulated

l) Relief valve condition (check one): ☐ clean, no visible corrosion ☐ slight external corrosion ☐ extensive corrosion

Are there any other conditions that might negatively affect safe vessel operation? ☐ Yes ☐ No

If yes, describe. _____

IIAR Bulletin 109 – 10/97

Labeling

- **NFPA 704 Placards**
  - Refrigeration units or systems having a refrigerant circuit containing more than 220 pounds (100 kg) of Group A1 or 30 pounds (14 kg) of any other group refrigerant shall be provided with approved emergency signs, charts and labels in accordance with NFPA 704. Hazard signs shall be in accordance with the California Mechanical Code for the classification of refrigerants listed therein. [2013 CFC §606.7]
  - Refrigerating systems shall be provided with approved informative signs, emergency signs, charts and labels in accordance with NFPA 704. Hazard signs shall be in accordance with the International Mechanical Code. [ANSI/IIAR 2-2008 §13.1.10.4]

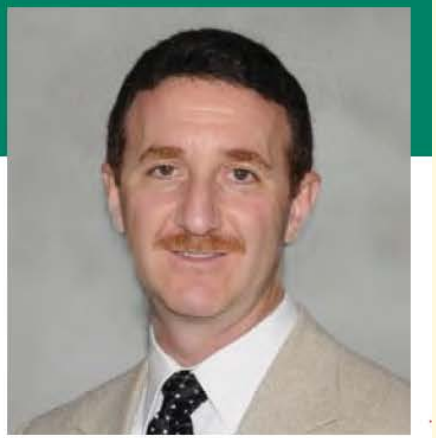
Labeling

- **NFPA 704 Placards**

Labeling

- **NFPA 704 Placards**

IIAR Code Advocacy Update



By Jeffrey M. Shapiro, PE., FSFPE

Understanding NFPA 704 Placards and Their Use at Ammonia Refrigeration Facilities

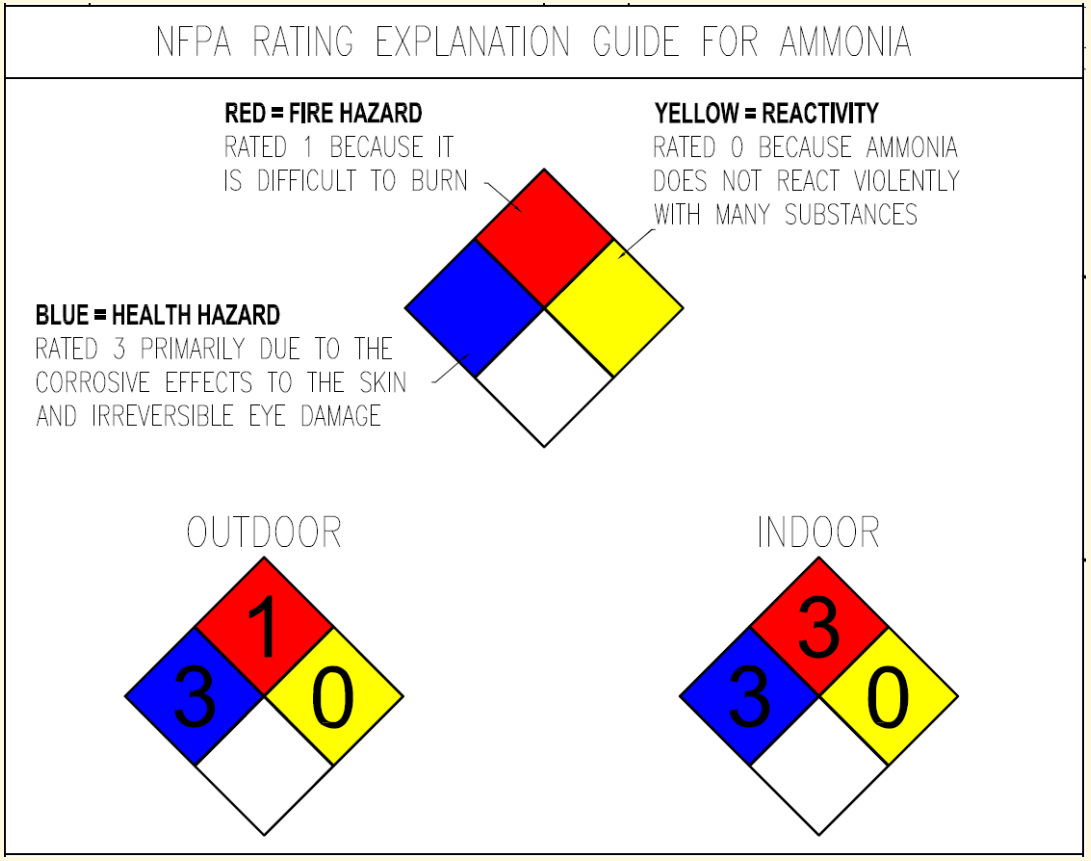
Put yourself in the position of a firefighter. You've been

The purpose statement is enhanced by several stated objectives, two of which are:

(1) To provide an appropriate signal or

Labeling

- **NFPA 704 Placards**



Labeling

- **Piping**
  - All piping mains, headers and branches shall be identified as to the physical state of the refrigerant (that is, vapor, liquid, etc.), the relative pressure level of the refrigerant, and the direction of flow. The identification system used shall either be one established as a standard by a recognized code or standards body or one described and documented by the facility owner. [ANSI/IIAR 2-2008 §10.5]
  - IIAR Bulletin No. 114 §4.1
  - Similar requirements in 2013 CMC §1111.8 and ANSI/ASHRAE 15-2013 §11.2.2.

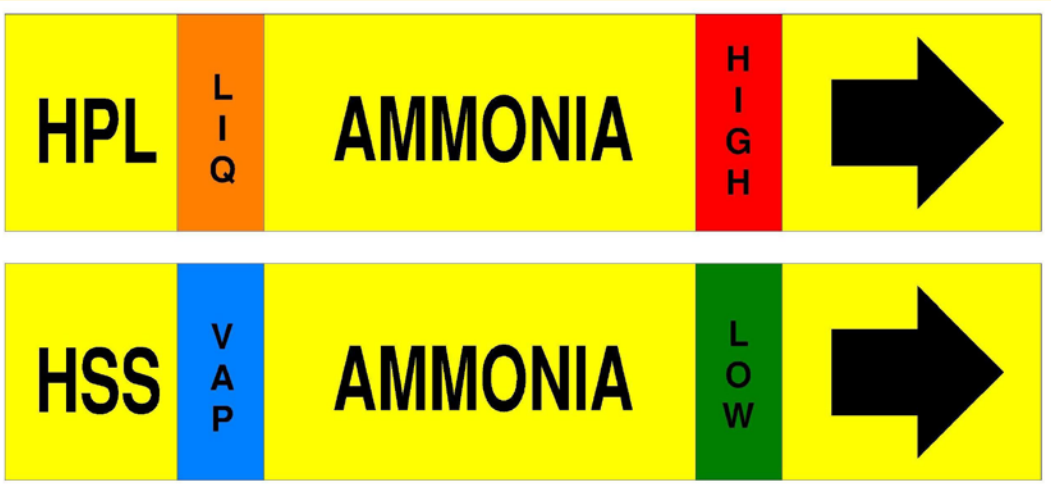
Labeling

- **Piping**

Labeling

- **Piping**

Pre-March 2014



Post-March 2014

Labeling

- **Piping**

Labeling

- **Piping**

A Guide to Bulletin 114: Piping Colors

In its updated form, IIAR Bulletin 114 will provide a method for expanding color identification guidelines, and will serve as a recommendation for an expanded piping color scheme.

The guideline will address: un-insulated line finishes; insulated lines with insulation jacketing; and intermittent markers. The colors specified by the guideline have been designated by Pantone color numbers, from the Pantone Color Matching System, and are identified by the document as "targets" for shade, tone, and color.

The bulletin makes an allowance for slight variations that are expected as a result of variance in manufacturing, UV deterioration, dust and other unforeseen factors that may alter the appearance of color either at installation or after the jacketing or markers have been in service.

According to the draft bulletin, facilities may select an alternate color scheme as long as that color scheme is consistent throughout a facility. Regardless of the color scheme selected, Bulletin 114 specifies that a legend or key to the meaning of the colors should be posted in a conspicuous area. Listed below are the eight Pantone colors recommended under IIAR's piping color scheme, which is slated for release as an update to IIAR Bulletin 114 early next year.

High Pressure Liquid Piping

Ammonia high pressure liquid piping should be **Ammonia Refrigeration Orange (PANTONE® Color 152 C)** for services > 70 psig as follows:

- High Pressure Liquid (HPL)
- Sub Cooled Liquid (SCL)
- Thermosyphon Supply (TSS)
- Thermosyphon Return (TSR)
- Condenser Drain (CD)
- Liquid Injection Cooling (LIC)
- Intermediate Pressure Liquid (IPL)

Ammonia High Pressure Vapor Piping

Ammonia high pressure vapor piping should be **Ammonia Refrigeration Yellow (PANTONE® Color 109 C)** for services > 70 psig as follows:

- Booster Discharge (BD)
- High Stage Discharge (HSD)
- Hot Gas Defrost (HGD)
- Foul Gas (FG)

Low Pressure, High Temperature Liquid and Vapor Piping

Low pressure, high temperature liquid and vapor piping should be **Ammonia Refrigeration Light Blue (PANTONE® Color 298C)** for the services within the 0°F to +45°F range (saturated pressure 66.3 psig>P>15.7 psig).

If more than one temperature or pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the low pressure, high temperature range are as follows:

- High Temperature Recirculated Liquid (HTRL)
- Booster Suction (BS)
- Economizer Suction (ES)
- High Stage Suction (HSS)
- Medium Temperature Suction (MTS)
- Medium Temperature Recirculated Suction (MTRS)
- High Temperature Suction (HTS)
- High Temperature Recirculated Suction (HTRS)
- Defrost Relief (DR)

Low Pressure, Low Temperature Liquid and Vapor Piping

Low pressure, low temperature liquid and vapor piping should be **Ammonia Refrigeration Dark Blue (PANTONE® Color 3015c)** for the services within the -1°F to -20°F range (saturated pressure 15.7 psig>P>3.6 psig).

If more than one temperature or pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the low pressure, low temperature range are as follows:

- Low Temperature Recirculated Suction (LTRS)
- Low Temperature Suction (LTS)
- Low Temperature Recirculated Liquid (LTRL)
- Low Temperature Liquid(LTL)

Low Pressure, Low-Low Temperature Liquid and Vapor Piping

Low pressure, low-low temperature liquid and vapor piping should be **Ammonia Refrigeration Purple (PANTONE® Color 2617 C)** for the services within the -21°F to -60°F range (saturated pressure P< 3.6 psig).

If more than one temperature or pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the low Pressure, low-low temperature range are as follows:

- Low-Low Temperature Recirculated Suction (LLTRS)
- Low-Low Temperature Suction (LLTS)
- Low-Low Temperature Recirculated Liquid (LLTRL)
- Low-Low Temperature Liquid(LLTL)

Non-Pressurized Refrigeration Piping and Related Process Piping:

Pressure Relief Vent Grey (PANTONE® Color 430 C) for:

- Pressure Relief Vent Piping (RV)

Water Green (PANTONE® Color 3415 C) for:

- Water Piping

Sprinkler Red (PANTONE® 485 C) for:

- Fire Sprinkler Piping

Labeling

- **ANSI A13.1**

Table 2 Designation of Colors

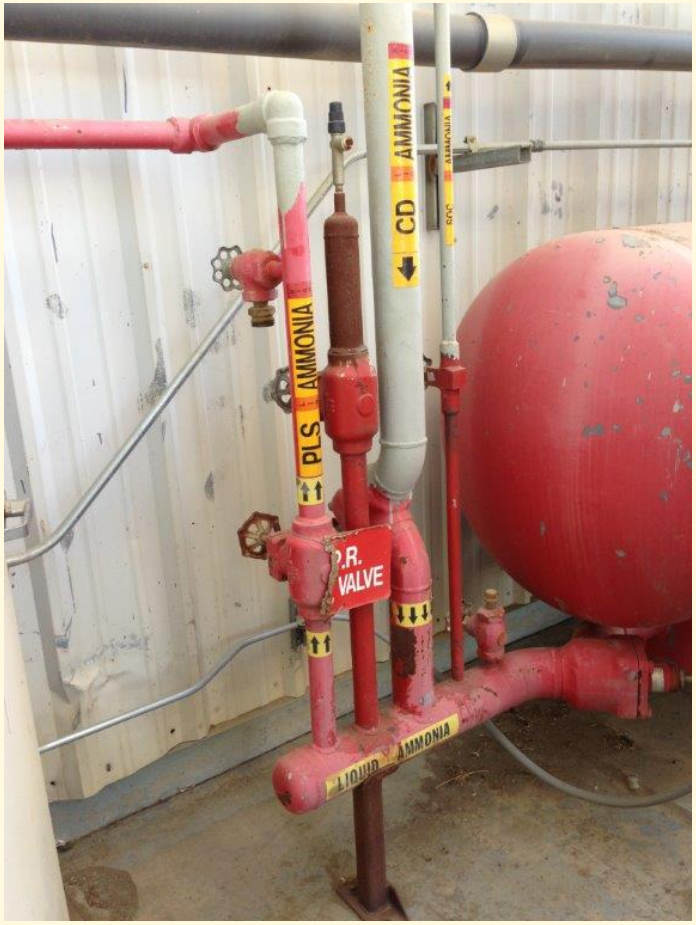
Fluid Service	Background Color	Letter Color	Color and Letter Sample
Fire quenching fluids	Safety red	White	Letters
Toxic and corrosive fluids	Safety orange	Black	Letters
Flammable fluids	Safety yellow	Black	Letters
Combustible fluids	Safety brown	White	Letters
Potable, cooling, boiler feed, and other water	Safety green	White	Letters
Compressed Air	Safety blue	White	Letters
To be defined by the user	Safety purple	White	Letters
To be defined by the user	Safety white	Black	Letters
To be defined by the user	Safety gray	White	Letters
To be defined by the user	Safety black	White	Letters

Labeling

- **Valves**
  - Stop valves shall be suitably labeled if the components to and from which the valve regulates flow are not in view at the valve location. Valves or piping adjacent to the valves shall be identified in accordance with ANSI A13.1 When numbers are used to label the valves, there shall be a key to the numbers located within sight of the valves with letters at least 0.5 in. (12.7 mm) high. [ANSI/ASHRAE 15-2013 §9.12.6]
  - Stop valves shall be identified by tagging in accordance with the reference standard for identification. A valve chart shall be mounted under glass at an approved location near the principal entrance to the machinery room. [2013 CMC §1112.4]

Labeling

- **Valves**



Labeling

- **Valves**

Labeling

- **Machinery Room**
  - Each refrigerating system erected on the premises shall be provided with a legible permanent sign, securely attached and easily accessible, indicating
    - a. the name and address of the installer,
    - b. the refrigerant number and amount of refrigerant,
    - c. the lubricant identity and amount, and
    - d. the field test pressure applied.
  - ANSI/IIAR 2-2008 Appendix L

Labeling

- **Machinery Room**

Insulation

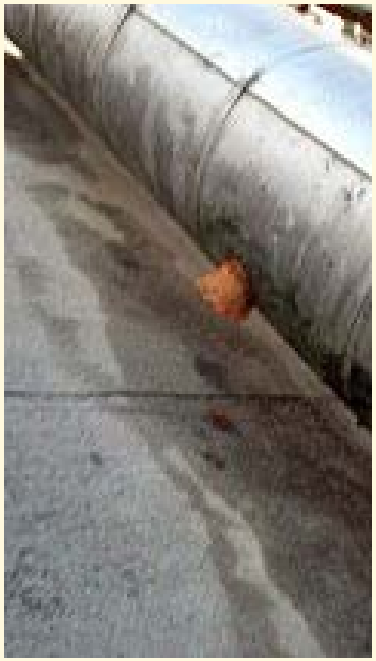
- Suction lines, low-temperature liquid lines, accumulators, surge drums and similar cold surfaces shall be insulated to prevent condensation and corrosion. [ANSI/IIAR 2-2008 §14.3.1]
- The types of insulation commonly used in industrial refrigeration are: extruded polystyrene insulation, cellular glass, polyisocyanurate insulation, and closed-cell phenolic [ANSI/IIAR 2-2008 Appendix H.7]
- For piping that is insulated, supports must be designed and/or the insulation must be selected to avoid damage to the insulation from compression. [ANSI/IIAR 2-2008 §10.4.5]

Insulation

- Insulated piping showing signs of vapor barrier failure should have the insulation removed and the pipe inspected. [IIAR Bulletin No. 109 §4.7.5]

Insulation

Insulation



Insulation

Pipe Supports

- …piping and tubing shall be securely fastened to a permanent support within 6 feet (1829 mm) following the first bend in such tubing from the compressor and within 2 feet (610 mm) of each subsequent bend or angle. Piping and tubing shall be supported at points not more than 15 feet (4572 mm) apart. [2013 CMC §1111.2]

Pipe Supports

- ANSI/IIAR 2-2008 Appendix F

Nominal Pipe Size	Maximum Span	Minimum Rod Diameter
Up to 1	7	1/8
1-¼ - 1-1/2	9	3/8
2	10	3/8
2-1/2	10	1/2
3	12	1/2
4	14	5/8
5	16	5/8
6	17	3/4
8	19	7/8
10	22	7/8
12	23	7/8

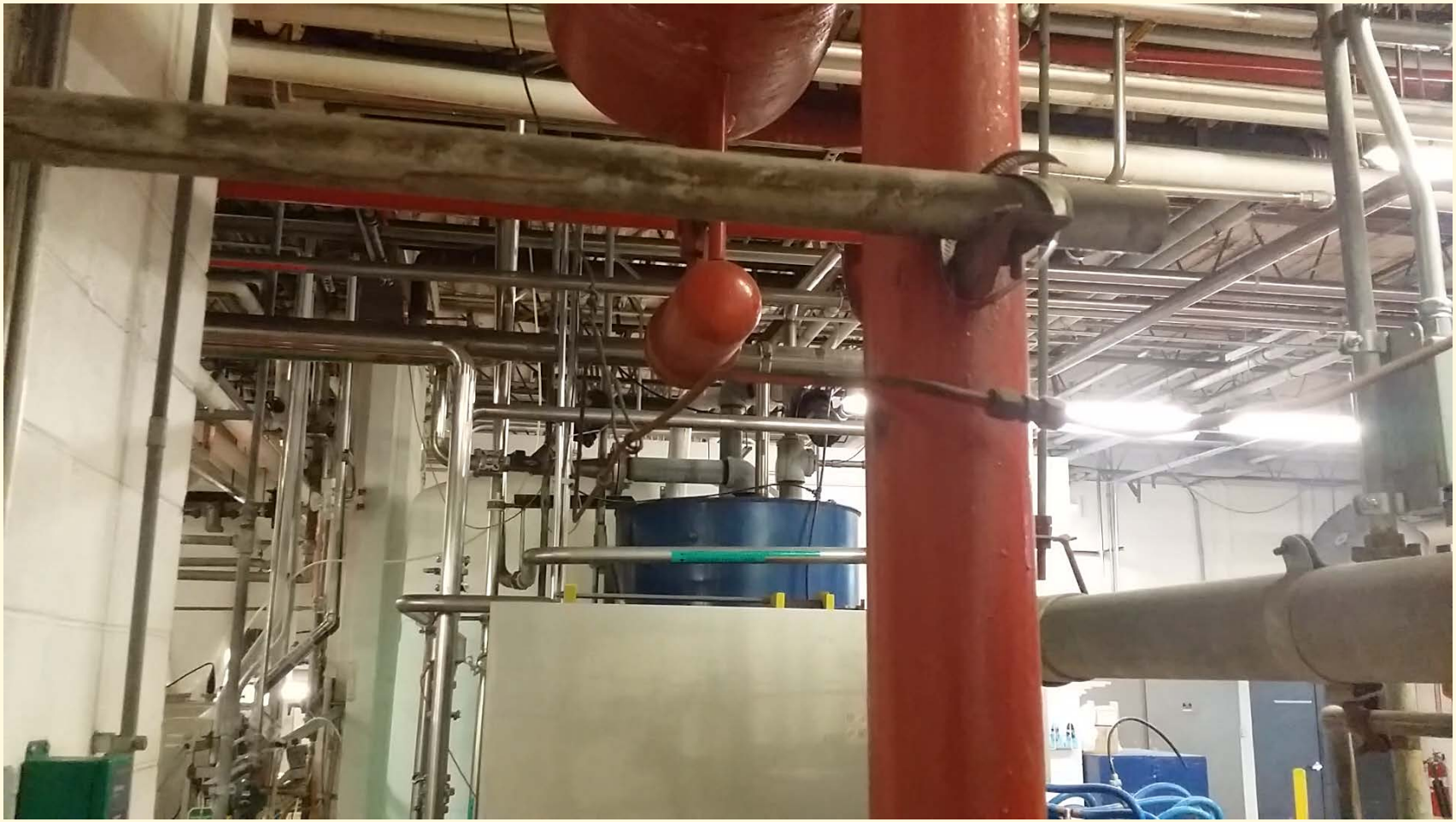
Pipe Supports

Pipe Supports

Pipe Supports

Pipe Supports

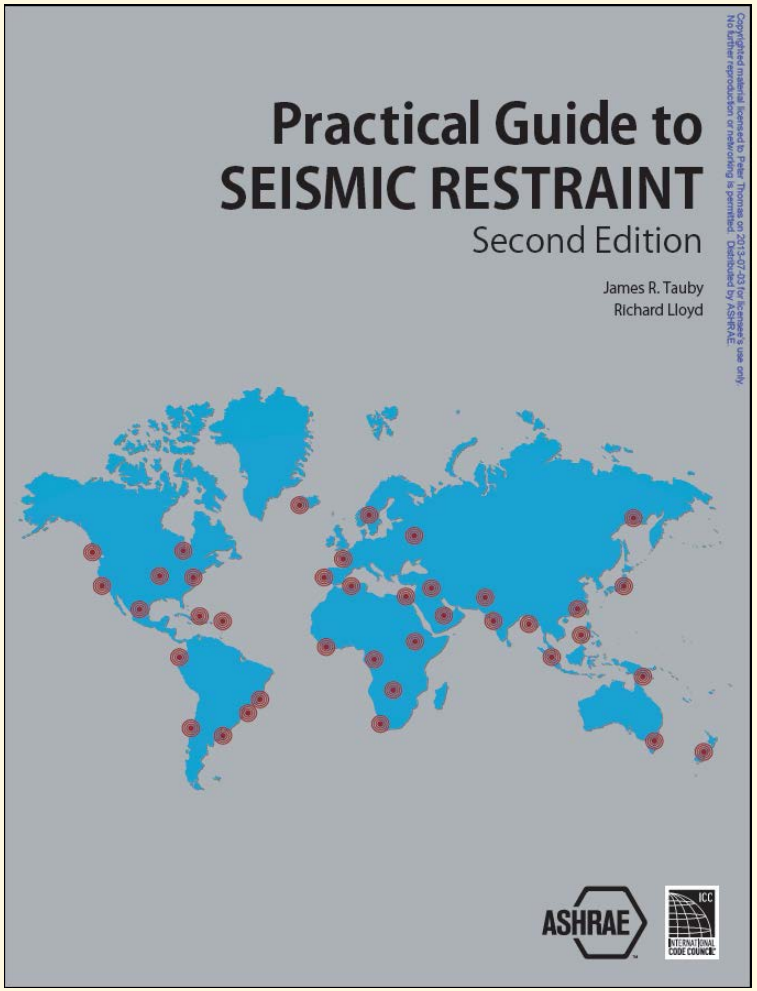
Pipe Supports



Supports and Anchorage

- …A compressor or portion of a condensing unit supported from the ground shall rest on a concrete or other approved base extending not less than 3 inches (76 mm) above the adjoining ground level. [2013 CMC §1106.2]

Supports and Anchorage



Ammonia Detection

- When ammonia (R-717) is used, the machinery room is not required to meet Class 1, Division 2, of the National Electrical Code, provided (a) the mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm or (b) the machinery room is equipped with a detector, conforming to Section 8.11.2.1, except the detector shall alarm at 1000 ppm. [ANSI/ASHRAE 15-2013 §8.12(h.)]

Ammonia Detection

- Each refrigerating machinery room shall contain at least two refrigerant detectors that actuate an alarm and mechanical ventilation. [ANSI/IIAR 2-2008 §13.2]
- The room shall be provided with an independent mechanical ventilation system actuated automatically by vapor detector(s) when concentration of ammonia in the room exceeds 40,000 parts per million…[ANSI/IIAR 74-2 - 1978 §4.3.3.2]

Ammonia Detection – Other Than Machinery Rooms

- The concentration of refrigerant in a complete discharge of each independent circuit of high-probability systems shall not exceed the amounts shown in Table 4-1 or 4-2 of ASHRAE Standard 34…[ANSI/ASHRAE 15-2013 §7.2]
- Section 7.2 does not apply in industrial occupancies and refrigerated rooms where the following seven conditions are met:
  - d. Refrigerant detectors are installed with the sensing location and alarm level as required in refrigerating machinery rooms in accordance with Section 8.11.2.1.

  [ANSI/ASHRAE 15-2013 §7.2.2]

Ammonia Detection

Ammonia Detection

Ventilation

- Every machinery room shall be provided with means of ventilation to the outer air. [1982 UMC §1508]
- Machinery room ventilation required in IIAR 2 (1974, 1978, 1984, 1999, 2008)
- Machinery room ventilation required in ASHRAE 15

Ventilation

Ventilation

Ventilation

Ventilation

Citation 1 Item 5 Type of Violation: **Serious**

29 CFR 1910.119(j)(4)(i): Inspections and tests were not performed on process equipment.

On or about 20 July 2013, and at times prior thereto, the employer did not conduct testing of the ventilation system for the Engine Room to ensure it was still performing at the rated capacity from the original install in 1999. The system was designed to meet the requirements of ANSI/IIAR 2-1992, which has been superseded by ANSI/IIAR 2-1999 and currently with ANSI/IIAR 2-2008, Addendum A. Failure to ensure the ventilation system performs to the rated capacity exposed the workers within the Engine Room to the hazard of anhydrous ammonia liquid or vapor.

ABATEMENT DOCUMENTATION REQUIRED FOR THIS ITEM

Date By Which Violation Must be Abated:	03/07/2014
Proposed Penalty:	$7000.00

Emergency Shutoff

- A clearly identified switch of the break-glass type or with an approved tamper-resistant cover shall provide off-only control of refrigerant compressors, refrigerant pumps and normally closed automatic refrigerant valves located in the machinery room. Additionally, this equipment shall be automatically shut off whenever the refrigerant vapor concentration in the machinery room exceeds the vapor detector's upper detection limit or 25 percent of the LEL, whichever is lower. [2013 CFC §606.9.1]
- Same requirement in 2013 CMC §1109.4, ANSI/IIAR 2-2008 §13.1.13.2

Emergency Shutoff

- Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door. [ANSI/ASHRAE 15-2013 §8.12(i)]
- Similar requirement has existed since 1982 UMC

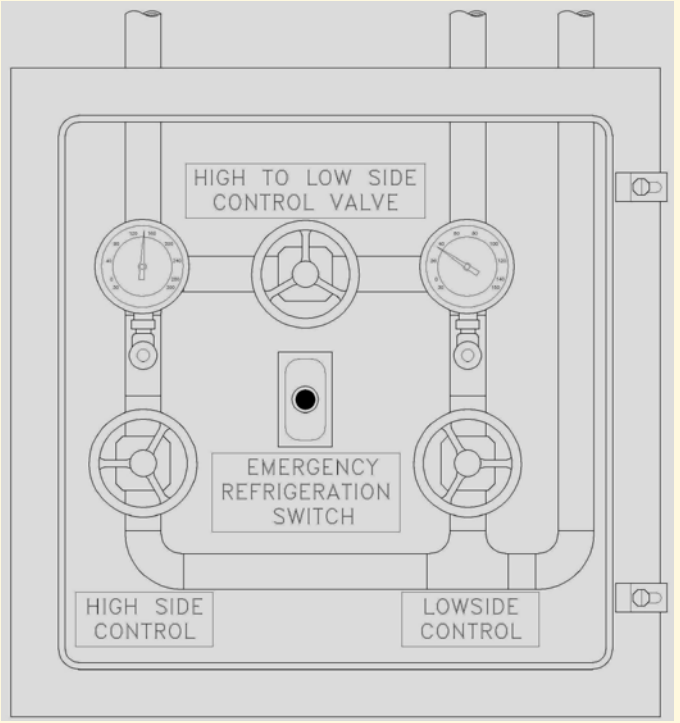
Emergency Shutoff

Emergency Shutoff

Emergency Shutoff

Emergency Control Box

- Fire/Mechanical Code requirement since *at least* 1982
- Some mechanical codes and fire codes require manual emergency discharge or diffusion arrangements for refrigerants. While these provisions are not recommended nor required by this Standard, Appendix B has been included to aid in the safe accomplishment of this purpose when required. [ANSI/ASHRAE 15-1989 §10.15]



Emergency Control Box

Emergency Control Box

Emergency Pressure Control System

- Refrigeration systems containing more than 6.6 pounds (3 kg) of flammable, toxic or highly toxic refrigerant or ammonia shall be provided with an emergency pressure control system in accordance with Sections 606.10.1 and 606.10.2. [2013 CFC §606.10]
- ANSI/IIAR 2-2008 Appendix K

Emergency Pressure Control System

Emergency Pressure Control System

Emergency Eyewash/Shower

- Be in accessible locations that require no more than 10 seconds to reach [Title 8 CCR §5162, ANSI/ISEA Z358.1-2009 §7.4.2]
- An emergency eye wash station and deluge body shower shall be located just outside the machine room exit door. An additional emergency eye wash station and deluge body shower should be readily accessible inside the machinery room. [IIAR Bulletin No. 109 §4.10.10]

Emergency Eyewash/Shower

- Be located in an area identified with a highly visible sign positioned so the sign shall be visible within the area served by the combination unit. The area around the combination unit shall be well-lit. [ANSI/ISEA Z358.1-2009 §7.4.3]
- Plumbed eyewash and shower equipment shall be activated at least monthly to flush the line and to verify proper operation. Other units shall be maintained in accordance with the manufacturer's instructions. [Title 8 CCR §5162(e)]

Emergency Eyewash/Shower

- Deliver tepid flushing fluid. In circumstances where chemical reaction is accelerated by flushing fluid temperature, a facilities safety/health advisor should be consulted for the optimum temperature for each application. (See Appendix B6). [ANSI/ISEA Z358.1-2009 §7.4.5]
- Temperatures in excess of 38°C (100°F) have proven to be harmful to the eyes and can enhance chemical interaction with the skin and eye tissue…Colder ambient temperature might require an enclosure for added protection…[ANSI/ISEA Z358.1-2009 §B6]

Emergency Eyewash/Shower

Emergency Eyewash/Shower

Emergency Instructions

- It shall be the duty of the person in charge of the premises on which a refrigerating system containing more than 55 lb (25 kg) of refrigerant is installed to provide a schematic drawing or panel giving directions for the operation of the system at a location that is convenient to the operators of the equipment. [ANSI/ASHRAE 15-2013 §11.7]

Emergency Instructions

Emergency Instructions

- Emergency shutdown procedures, including precautions to be observed in case of a breakdown or leak, shall be displayed on a conspicuous card located as near as possible to the refrigerant compressor. These precautions shall address
  - a. instructions for shutting down the system in case of emergency;
  - b. the name, address, and day and night telephone numbers for obtaining service; and
  - c. the names, addresses, and telephone numbers of all corporate, local, state, and federal agencies to be contacted as required in the event of a reportable incident.

Emergency Instructions

- When a refrigerating machinery room is used, the emergency procedures shall be posted outside the room, immediately adjacent to each door.
- The emergency procedures shall forbid entry into the refrigerating machinery room when the refrigerant alarm required by Section 8.11.2.1 has been activated except by persons provided with the appropriate respiratory and other protective equipment and trained in accordance with jurisdictional requirements.

  [ANSI/ASHRAE 15-2013 §11.7]

General Safety

- **Access Ports**
  - Air conditioning refrigerant circuit access ports located outdoors shall be protected from unauthorized access with locking-type tamper resistant caps or in a manner approved by the Authority Having Jurisdiction. [2013 CMC §1106.14]
  - Stop valves connecting refrigerant containing parts to atmosphere during shipping, testing, operating, servicing, or standby conditions shall be capped, plugged, blanked, or locked closed when not in use. [ANSI/ASHRAE 15-2013 §11.6.1]

Restricted Access

- **Access Ports**

Restricted Access

- **Access Ports**

Electrical

- Electrically energized components of refrigeration systems shall comply with the electrical code. [2013 CMC §1106.6]
- Electrical equipment and wiring shall be installed in accordance with the National Electrical Code and the requirements of the AHJ. [ANSI/ASHRAE 15-2013 §8.5]

Electrical

- ANSI/IIAR 2-2008 §13.1.7 Electrical Safety
  - 13.1.7.1 Electrical equipment and wiring shall be installed in accordance with the National Electrical Code.
  - 13.1.7.2 A machinery room shall be classified per the National Electric Code as a “Non-Hazardous (Unclassified) Location,” when the machinery room is provided with an independent mechanical ventilation system operated according to 13.3 Ventilation.
  - 13.1.7.3 Per the National Electric Code Where a mechanical ventilation system is not provided in accordance with 13.3, the room shall be classified as Class I, Group D, Division 2 location

Electrical

Testing Safety Devices

- Detection and alarm systems shall be installed, maintained, and tested in accordance with the Fire Code and with equipment manufacturers' specifications [2013 CMC §1121.4]
- The following emergency devices or systems shall be periodically tested… [2013 CFC §606.1]
  - 1. Treatment and flaring systems.
  - 2. Valves and appurtenances necessary to the operation of emergency refrigeration control boxes.
  - 3. Fans and associated equipment intended to operate emergency ventilation systems.
  - 4. Detection and alarm systems.

Testing Safety Devices

- Detector(s), alarm(s), and mechanical ventilating systems shall be tested in accordance with manufacturers' specifications and the requirements of the jurisdiction having authority. [ANSI/ASHRAE 15-2013 §11.6.3]
- The facility shall establish a time schedule for testing of the ammonia detectors and the alarm system. The manufacturer's recommendations shall be followed or modified based on documented experience. Where no recommendations are provided, these devices shall be functionally tested on an annual basis. [ANSI/IIAR 2-2008 §13.2.5.1 - §13.2.5.2]

Testing Safety Devices

- The facility shall establish a time schedule for testing of the mechanical ventilation systems and the alarm system. The manufacturer's recommendations shall be followed or modified based on documented experience. Where no recommendations are provided, these devices shall be scheduled for functional tests on an annual basis. [ANSI/IIAR 2-2008 §13.2.12.1 - §13.2.12.2]
- Accumulators or interstage coolers should be equipped with high level float switches which should actuate a high level alarm, and where practical, should cause the associated compressor(s) to shut down when a high refrigerant level is detected. [IIAR Bulletin No. 109 §4.10.2]

Testing Safety Devices

Dräger

DrägerSensor® NH_3 LC – 68 09 680

Calibration interval	
default	6 months
Adjustment range min/max	1 day/12 months
Warm-up time	
ready for operation after max.	120 minutes
ready for calibration after max.	660 minutes
when using SensorReady®	<5 minutes
Measurement accuracy *	
measurement uncertainly (of meas. value) or	≤ ±5 %
minimum (whichever is the greater value)	≤ ±1.5 ppm
Loss of sensitivity, per year	≤ -15 %
Expected service life, in ambient air	>24 months
Environmental conditions	
Temperature, min./max.	-40/65 °C (-40/149 °F)
Rel. humidity, min./max.	15/95 %
Ambient pressure	±3 %
Storage conditions	
packed, min./max.	0/40 °C (32/104 °F)
Cross-sensitivities	existing, for information contact Dräger
Order Nos.:	
DrägerSensor NH_3 LC	68 09 680
Dust filter	68 09 595
Calibration adapter V	68 10 536
Calibration cylinder for ampoule calibr.	68 03 407
Test gas ampoule 50 ppm NH_3	68 07 924

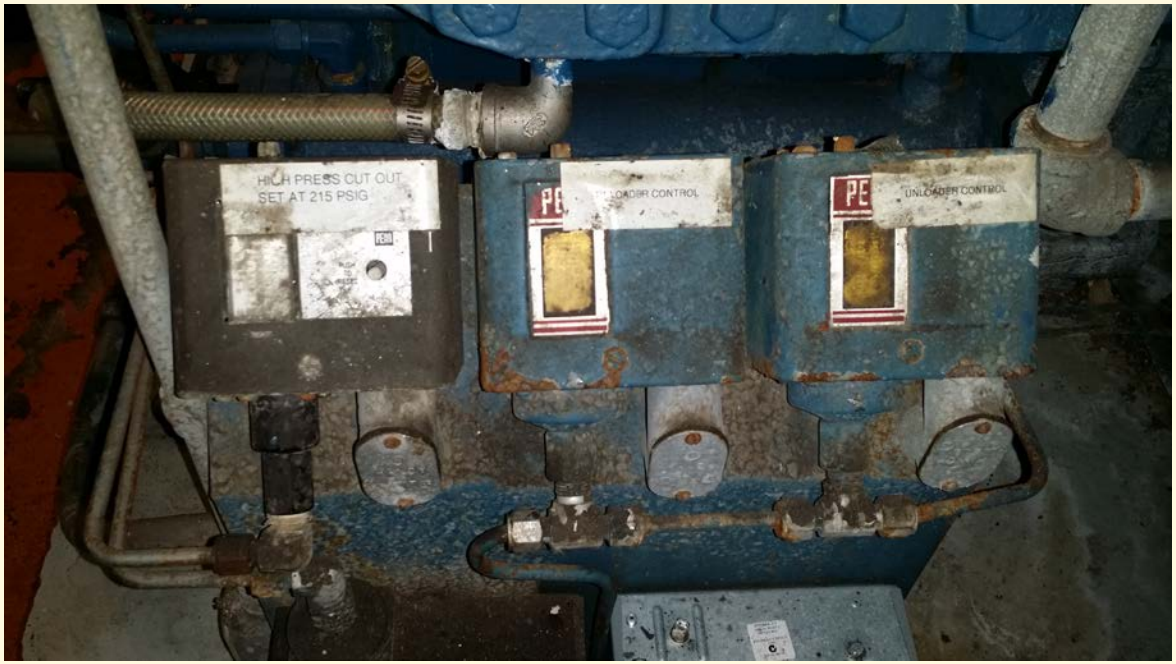
Testing Safety Devices

- Each compressor shall be equipped with the following operable safety controls as a minimum: [IIAR Bulletin No. 109 §4.1.7]
  - a) Low pressure cutout switch
  - b) High pressure cutout switch
  - c) Low oil pressure cutout switch (if the compressor uses forced feed lubrication)

Testing Safety Devices

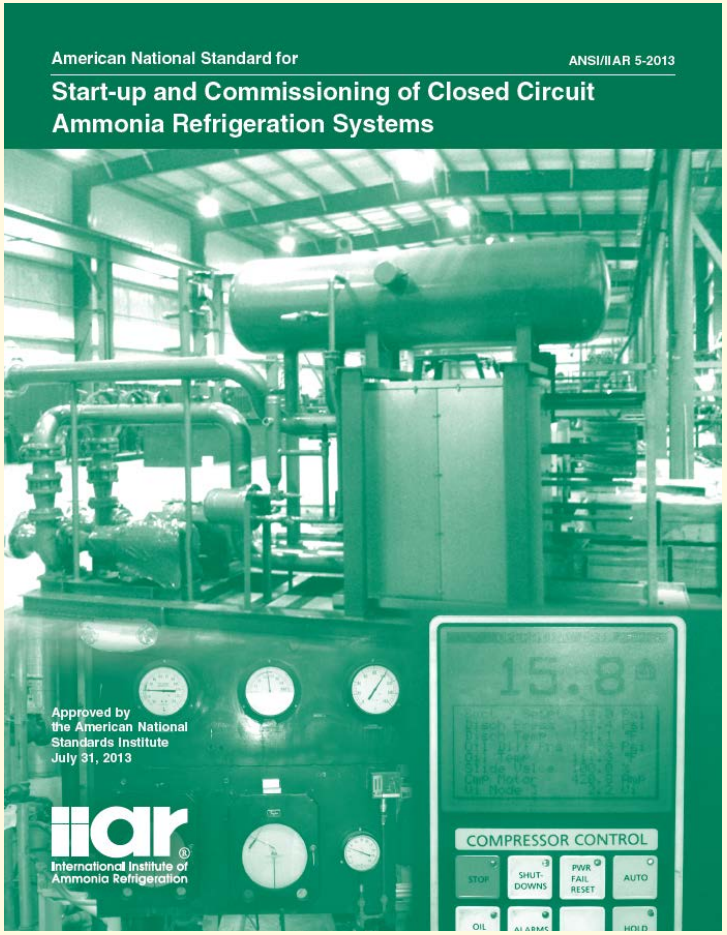
Gauges and Instruments

- ***IIAR Bulletin No. 109 §4.10.1***
  - All installed instruments should be in working order. Inaccurate or broken instruments should be replaced



Design Records and Record Keeping

- **ANSI/IIAR 5-2013**, Start-up and Commissioning of Closed Circuit Ammonia Refrigeration Systems



Design Records and Record Keeping

- **Foreword**
  - This Standard specifies minimum criteria for the start-up and commissioning of ammonia mechanical refrigerating systems. Additional requirements may be imposed by particular circumstances, system design, or jurisdictional considerations. This document reflects the consensus reached by ammonia refrigeration industry representatives and is not a comprehensive task list for start-up and should not be used in that manner.

Design Records and Record Keeping

- **ANSI/IIAR 5-2013 §6.1.1**
  - The ammonia refrigerating system shall have been designed by, and installed under the supervision of, persons who by reason of knowledge, training and experience are competent for the tasks.
- **ANSI/IIAR 5-2013 §6.1.2**
  - Records and documentation relevant to the system shall be obtained and maintained by the owner in a safe place and be readily available for examination so that the standards and details to which the system was designed are available to those concerned with inspection, maintenance and operation.

Design Records and Record Keeping

- **ANSI/IIAR 5-2013 §6.1.3**
  - The records shall contain a schematic refrigeration circuit P&ID and/or a refrigeration flow diagram for the refrigerating system. The system designer, contractor and/or owner shall determine which controls and valves may be the most likely to be of importance in an emergency. These controls and valves shall be clearly identified on the diagram which shall be updated when changes are made to the system. These controls and valves shall also be uniquely identified on the actual system.

Design Records and Record Keeping

- **ANSI/IIAR 5-2013 §6.2.1**
  - A system component inventory list shall be prepared. The list shall include the major components of the ammonia refrigerating system, including: compressors, condensers, evaporators, pressure vessels, liquid ammonia pumps, piping, valves and fittings, ammonia machinery room ventilation system, and other control and safety devices.

Design Records and Record Keeping

- **ANSI/IIAR 5-2013 §7.7.1**
  - Prior to initial start-up and commissioning of the system, the supplier of the equipment, the design firm and the installing contractor shall deliver to the owner or the owner's representative all documentation and records relevant to the design, maintenance, working pressure and safety aspects of the system. (Cont'd)

Design Records and Record Keeping

- **ANSI/IIAR 5-2013 §7.7.1**
  - (Cont'd) Such information may include:
    - a. a manual containing operating instructions, recommended spare parts list, etc.
    - b. a refrigerating system drawing
    - c. a starting and stopping procedure, including emergency stop instructions
    - d. stopping procedure for prolonged shut-down
    - e. details of safety procedures to be used in the event of an emergency
    - f. recommended list of oils and lubricants to be used and recommended frequency of change.

Questions?

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