AMMONIA REFRIGERATION CODES AND STANDARDS

March 29, 2022

24th California Unified Program Annual Training Conference

March 22, 23, 24, 29, 30, 31 - 2022

Introduction

CALIFORNIA CUPA FORUM

24th California Unified Program Annual Training Conference

March 22, 23, 24, 29, 30, 31 - 2022

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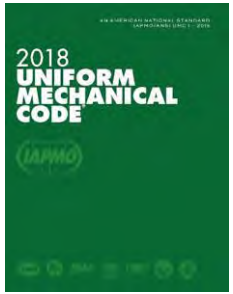
2018 CALIFORNIA
MECHANICAL CODE
CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 4
Access


2018
IMC
INTERNATIONAL
MECHANICAL CODE


NFPA 1
Fire Code
2018
1


2018
IFC
INTERNATIONAL
FIRE CODE


2018
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NFPA 70
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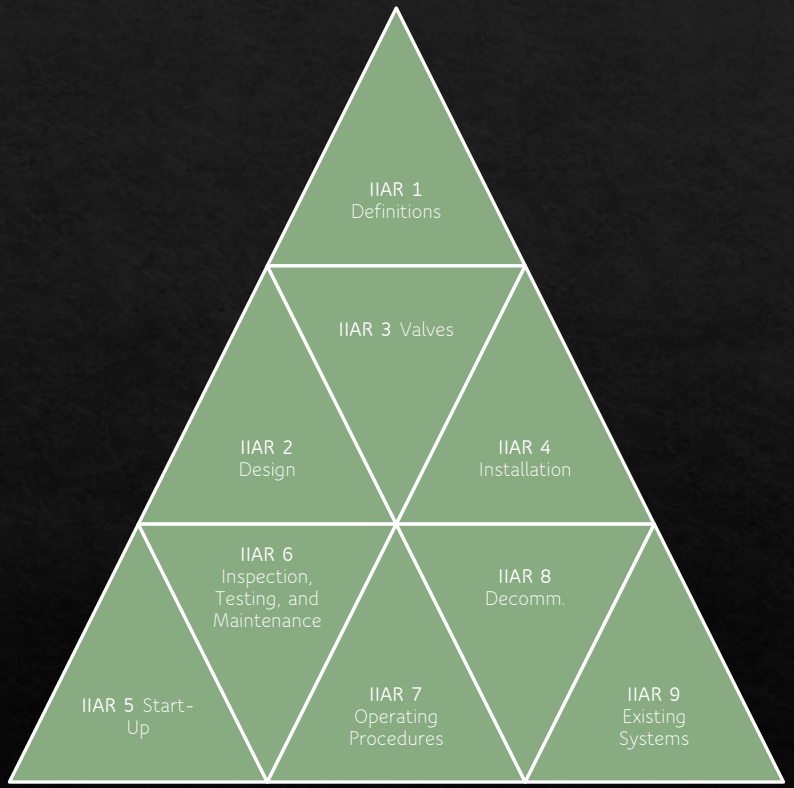
National Electrical Code
2017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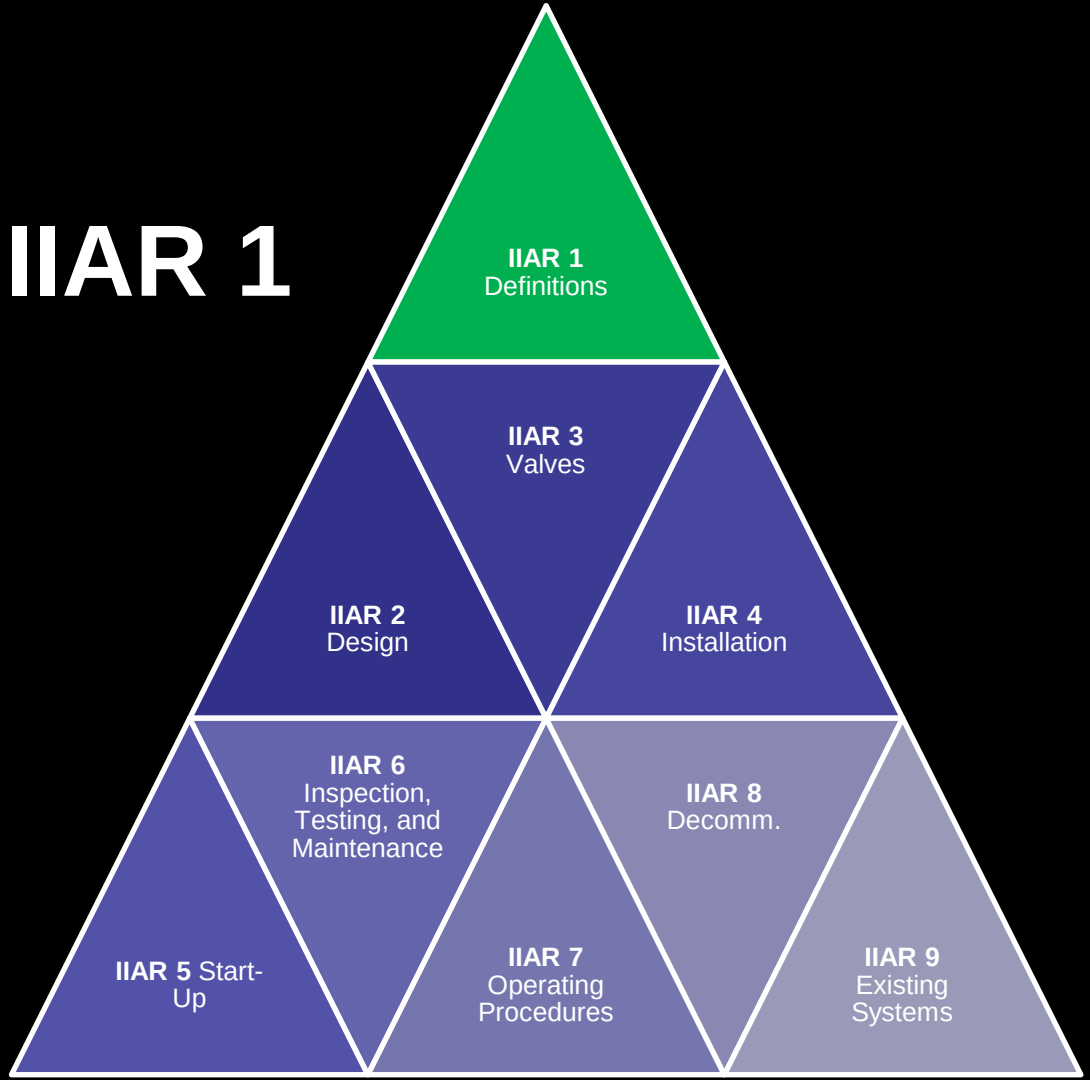
IIAR 1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Inspection, Testing, and Maintenance
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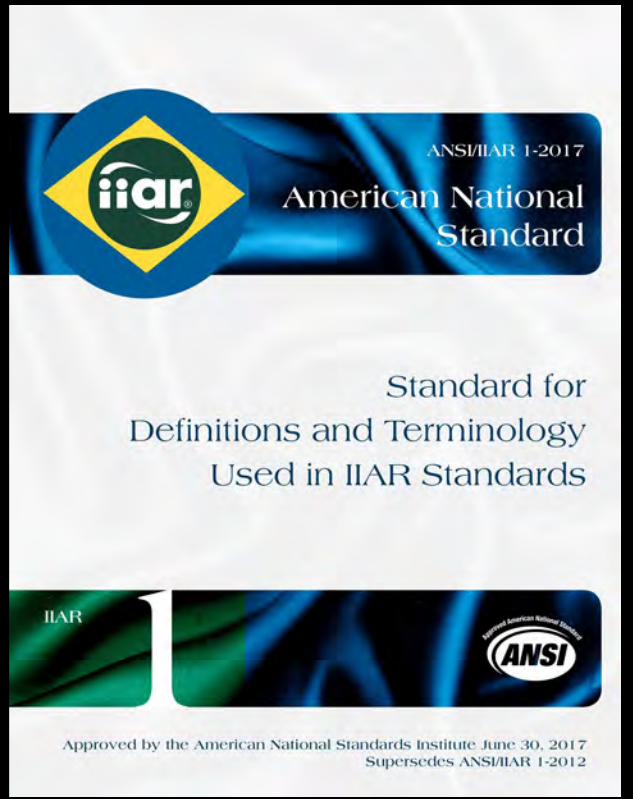
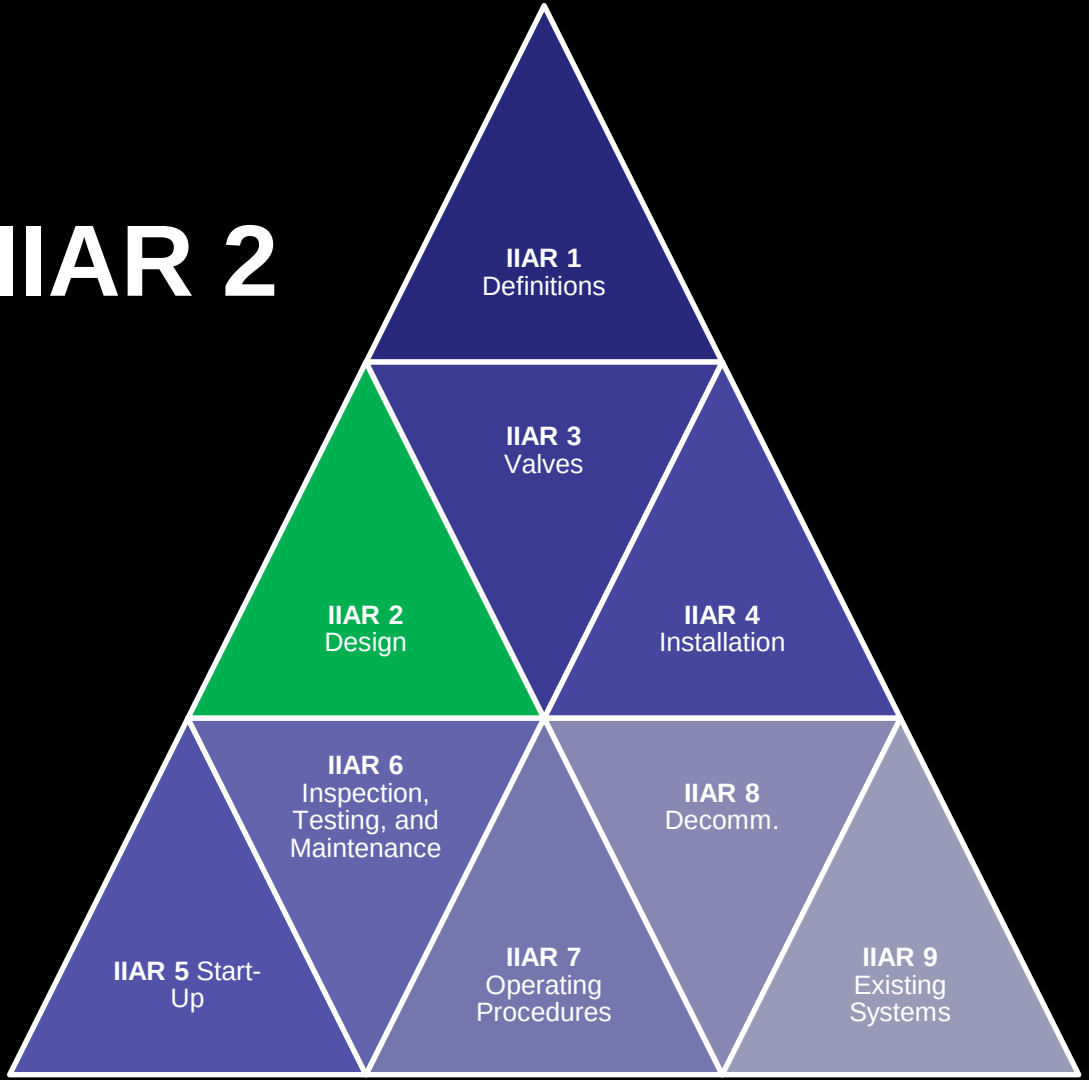

ANSI/IIAR 1-2017
American National Standard
Standard for
Definitions and Terminology
Used in IIAR Standards
IIAR
1
ANSI
Approved by the American National Standards Institute June 30, 2017
Supersedes ANSI/IIAR 1-2012

IIAR 2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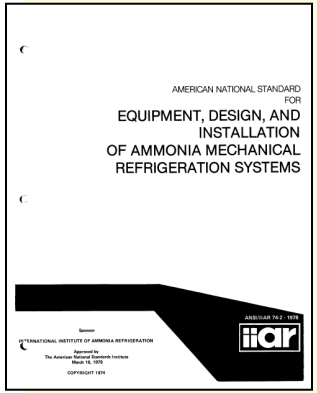
ANSI/IIAR 2-2014
American National Standard
Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems
IIAR
2
ANSI

IIAR Standard 2

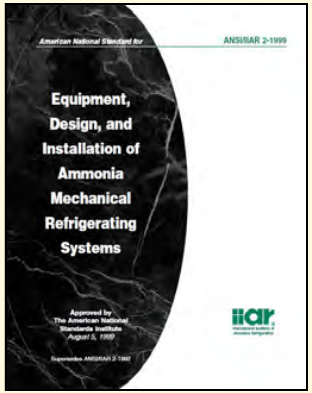
- ANSI/IIAR 2 Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems

1974-78

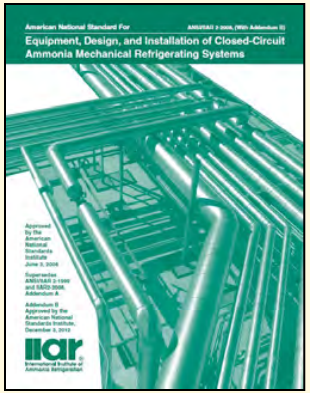


1984

1999



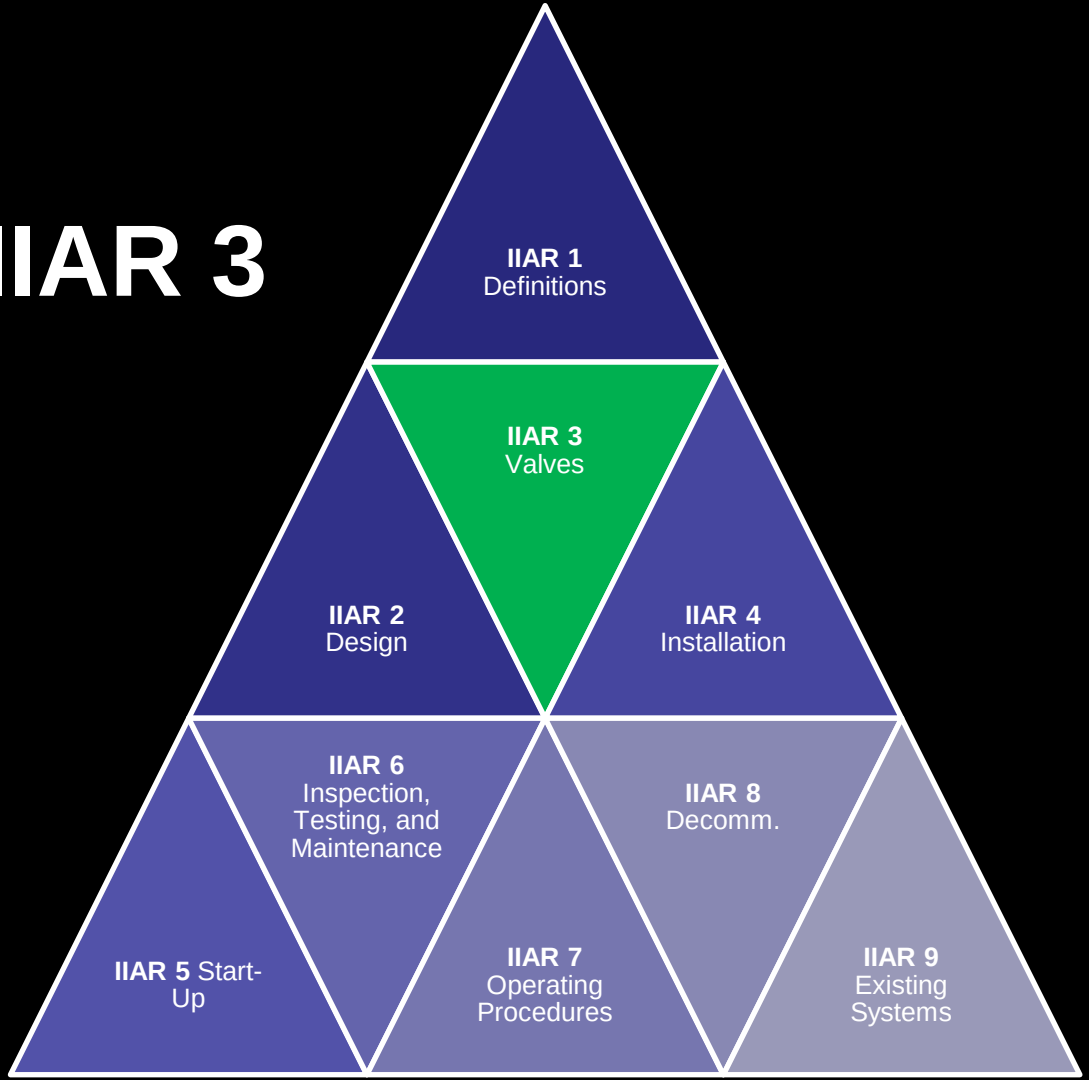
2008



2014

2021

IIAR 3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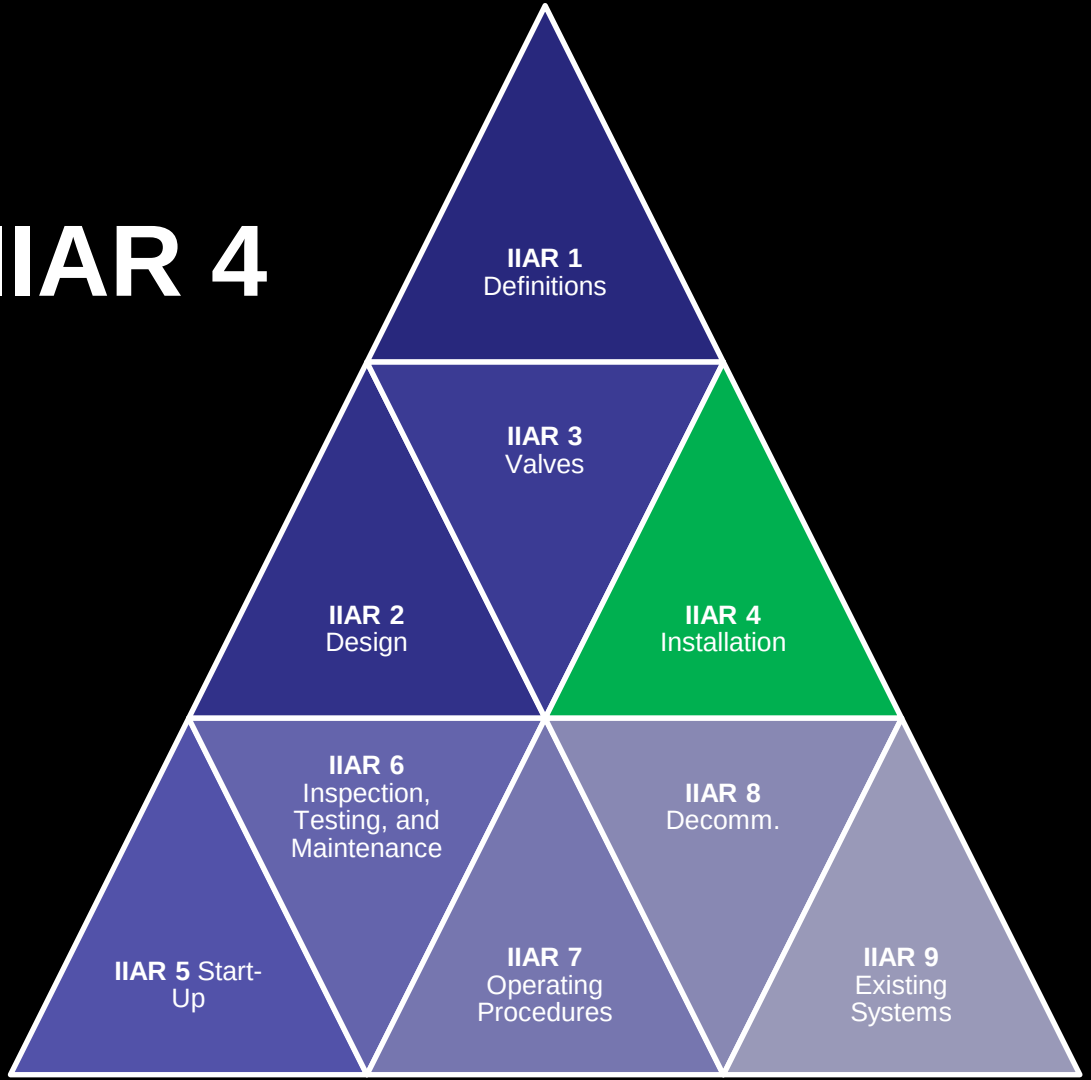
ANSI/IIAR 3-2017
American National Standard
Standard for
Ammonia Refrigeration
Valves
IIAR
3
ANSI
Approved by the American National Standards Institute June 30, 2017
Supersedes ANSI/IIAR 3-2012


R/S
2 1/2

IIAR 4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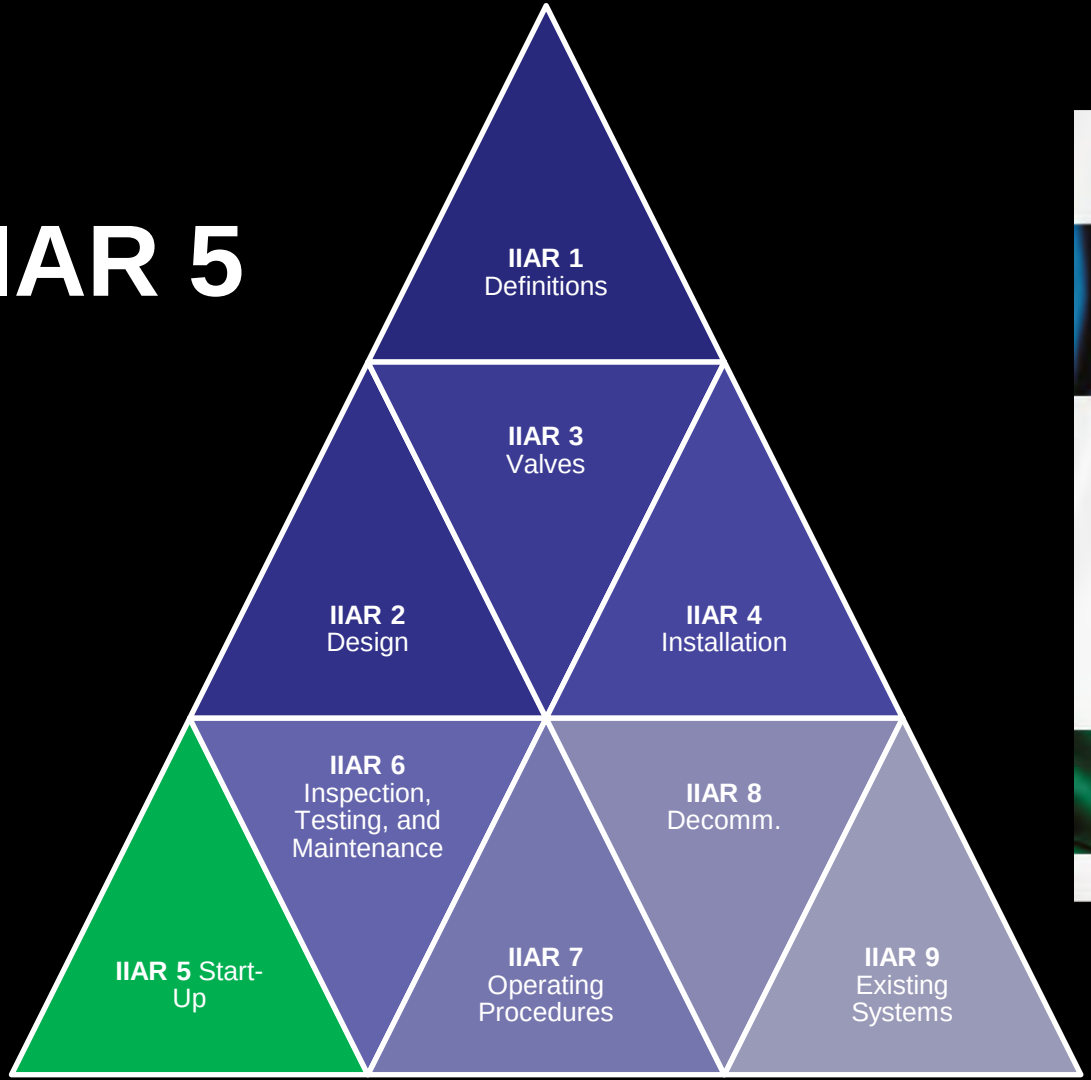
American National Standard for
ANSI/IIAR 4-2015
Installation of Closed-Circuit Ammonia Refrigeration Systems
Approved by the American National Standards Institute January 26, 2015
iiar
International Institute of Ammonia Refrigeration

IIAR 5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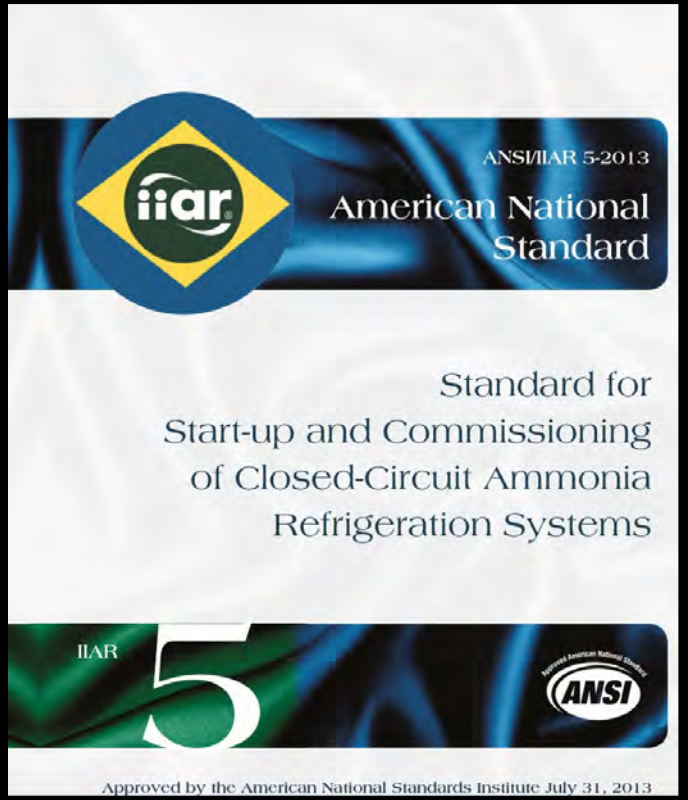
iiar
ANSI/IIAR 5-2013
American National Standard
Standard for
Start-up and Commissioning
of Closed-Circuit Ammonia
Refrigeration Systems
IIAR
5
ANSI
Approved by the American National Standards Institute July 31, 2013

▼ **Category 1** - Pre-Charging: To be completed before ammonia is brought onsite

Delete

Category # 1 Category Name Pre-Charging: To be completed before ammonia is brought onsite

Add new question | Toggle Unanswered | Show Questions

+ 1. Has a startup team been organized to perform the startup of the new system or additions/modifications to an existing system? [ANSI/IIAR 5-2019 §5.1]	YES	NO	N/A
+ 2. Has a startup plan been prepared? [ANSI/IIAR 5-2019 §5.2]	YES	NO	N/A
+ 3. Has all system documentation from the planning, design, and installation phases of the project been assembled and readily available? [ANSI/IIAR 5-2019 §5.3]	YES	NO	N/A
+ 4. For new facilities, has a Hazard Review or Process Hazard Analysis been performed? [ANSI/IIAR 5-2019 §5.4.1-5.4.2, 5.11.4]	YES	NO	N/A
+ 5. Have all Hazard Review or Process Hazard Analysis recommendations requiring closure prior to start-up been resolved? [ANSI/IIAR 5-2019 §5.4.1]	YES	NO	N/A

IIAR 6


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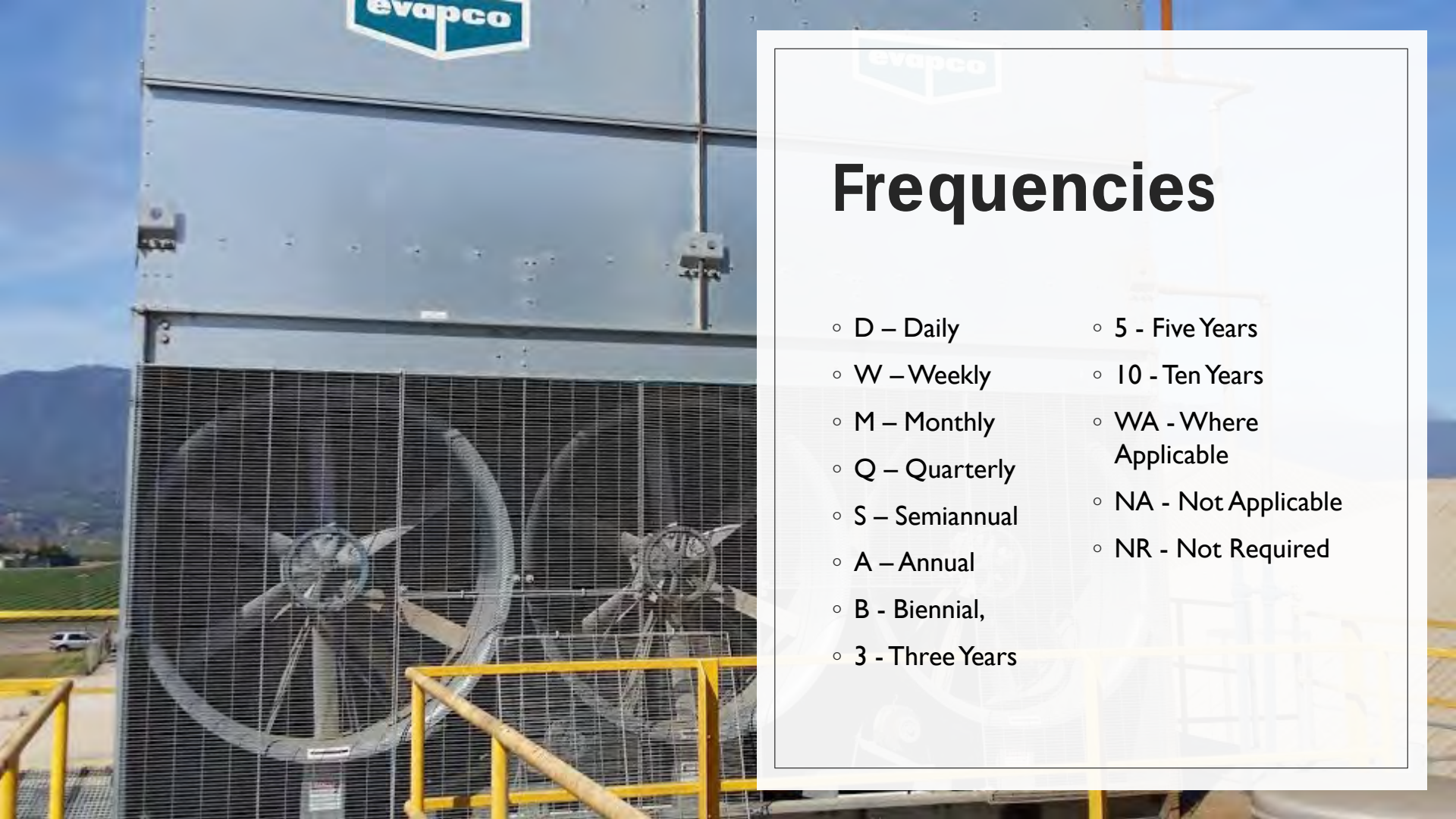
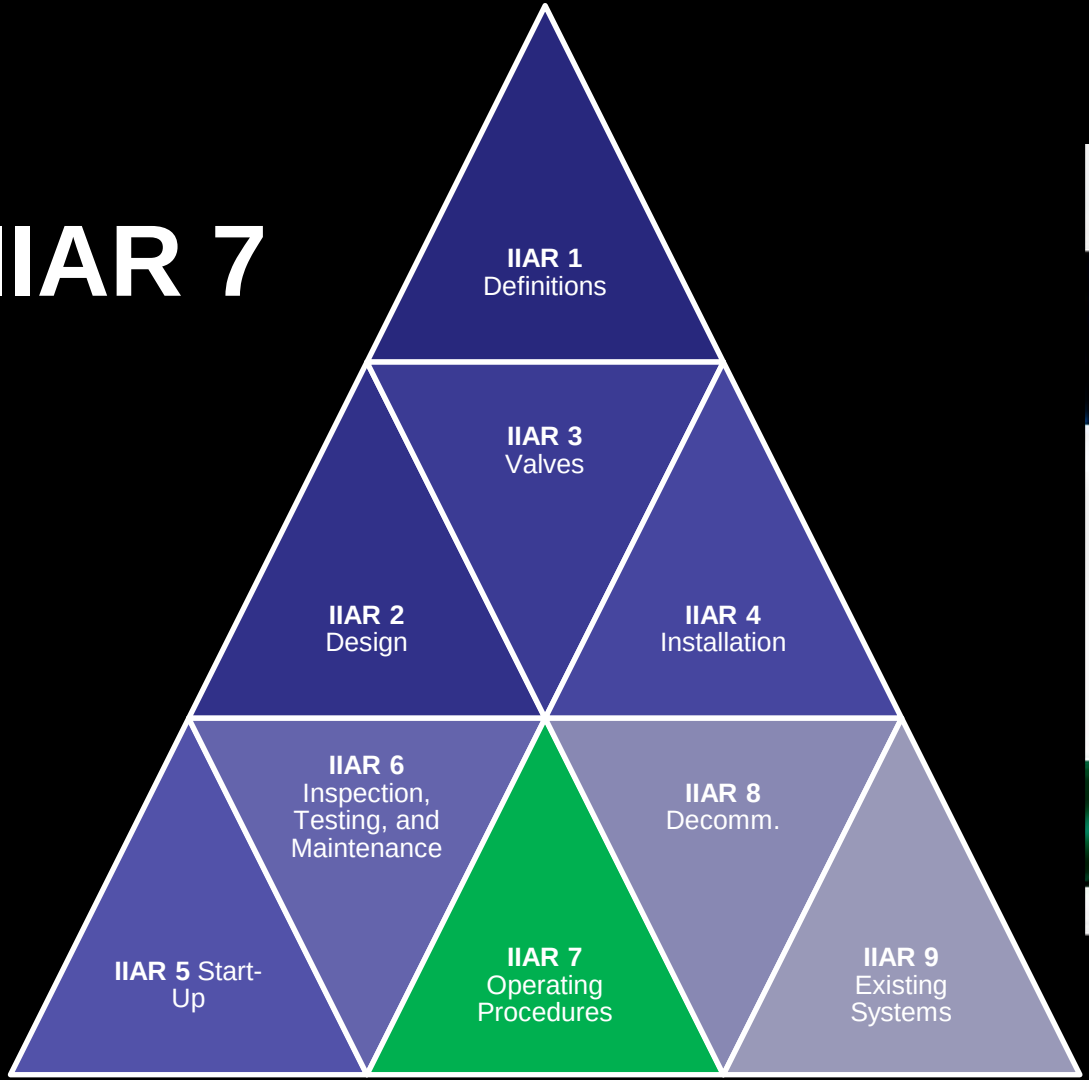


Frequencies

- D – Daily
- W – Weekly
- M – Monthly
- Q – Quarterly
- S – Semiannual
- A – Annual
- B - Biennial,
- 3 - Three Years
- 5 - Five Years
- 10 - Ten Years
- WA - Where Applicable
- NA - Not Applicable
- NR - Not Required

IIAR 7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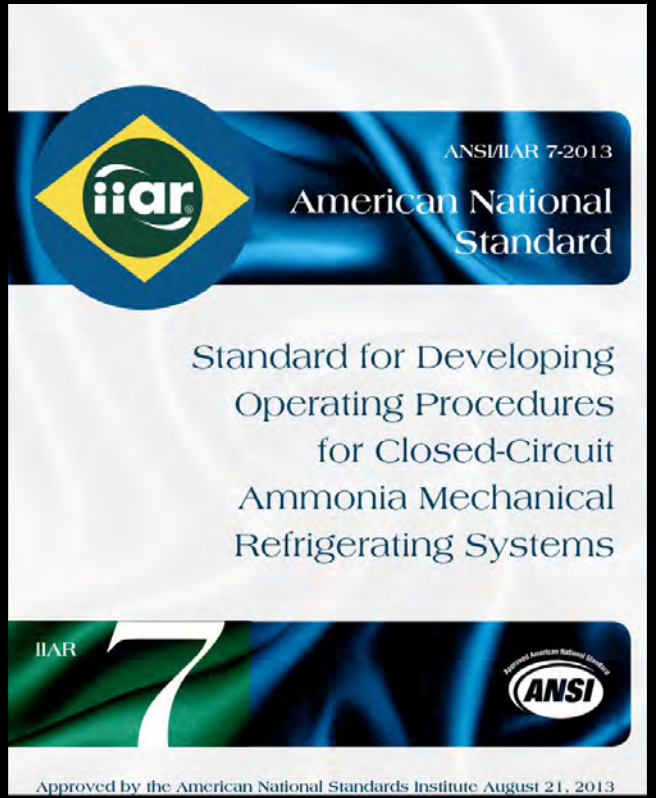
ANSI/IIAR 7-2013
American National Standard
Standard for Developing Operating Procedures for Closed-Circuit Ammonia Mechanical Refrigerating Systems
IIAR
7
ANSI
Approved by the American National Standards Institute August 21, 2013

IIAR 8


IIAR 1
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American National Standard for
ANSI/IIAR 8-2015
Decommissioning of Closed-Circuit Ammonia Refrigeration Systems
iiar
International Institute of Ammonia Refrigeration
Approved by the American National Standards Institute
January 26, 2015

▾ Category 1 - Preparation

Delete

Category # 1 Category Name Preparation

Add new question | Toggle Unanswered | Show Questions

+	1. Has the reason or reasons that the system or parts there-of are to be decommissioned been clearly stated and found adequate? [ANSI/IIAR 8-2015 §5.1.1.1]	YES	NO	N/A
+	2. Has a competent person been designated for coordination of all decommissioning activities? [ANSI/IIAR 8-2015 §5.1.1.2]	YES	NO	N/A
+	3. Has an initial plan been developed for the decommissioning activities? [ANSI/IIAR 8-2015 §5.1.1]	YES	NO	N/A
+	4. Have documents relevant to the decommissioning activities been obtained and made available to all necessary personnel involved in decommissioning? [ANSI/IIAR 8-2015 §5.2.1]	YES	NO	N/A


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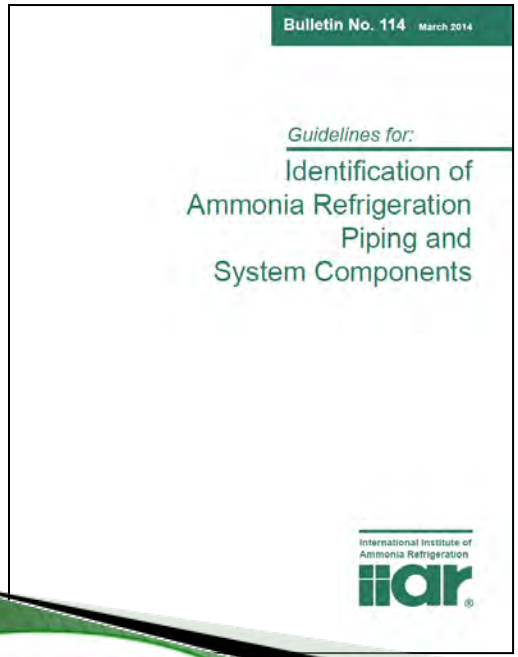
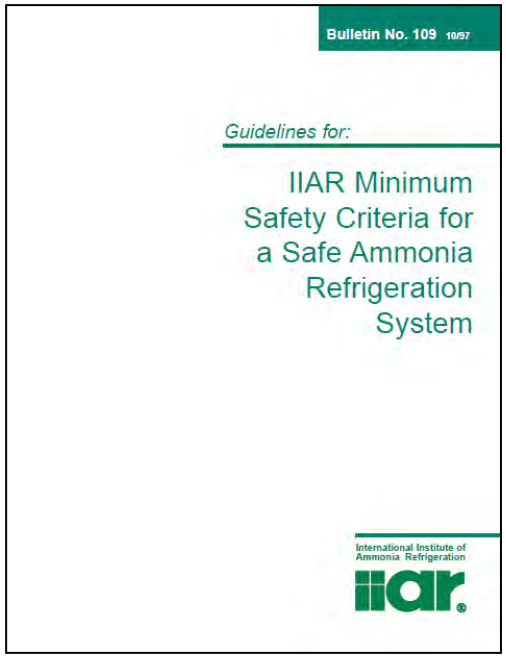
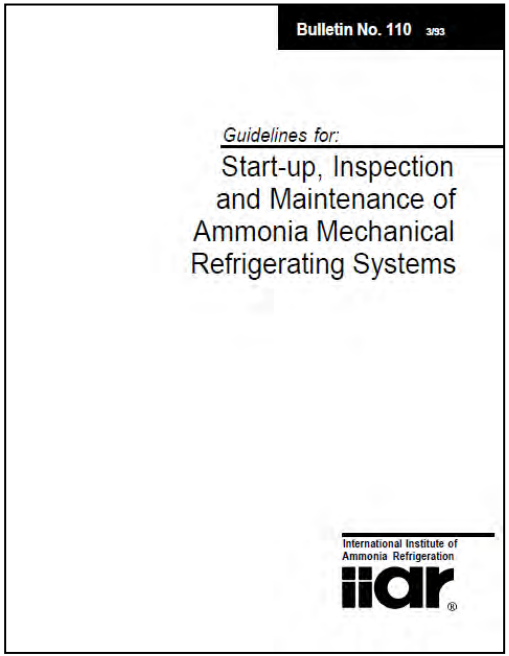
IIAR Bulletins – Historical RAGAGEP







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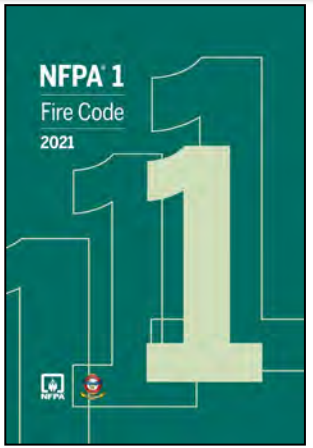
IIAR Literature - Bulletins

- IIAR Bulletin No. 110 §6.4.2 [emphasis mine]:
- *The system <u>should</u> be checked regularly for the presence of non-condensable gases which <u>should</u> be purged as necessary from the receiver(s) and/or condenser(s), <u>preferably</u> into a noncondensable gas remover or purger but <u>alternatively</u> into water. Where an automatic purger is fitted, its correct operation <u>should</u> be monitored. If there is a large accumulation of noncondensable gases the reason <u>should</u> be investigated and the cause <u>should</u> be corrected.*

IIAR and Model Codes

- **2021 IFC §608.1.2 Ammonia refrigeration.** Refrigeration systems using ammonia refrigerant and the buildings in which such systems are installed shall comply with **IIAR 2** for system design; **IIAR 6** for inspection, testing and maintenance; and **IIAR 7** for operating procedures. Decommissioning of ammonia refrigeration systems shall comply with **IIAR 8**, and engineering practices for existing ammonia refrigeration systems shall be in accordance with **IIAR 9**.
- **2021 NFPA 1 §53.1.3.2** Refrigeration systems using ammonia as the refrigerant shall comply with **ANSI/IIAR 2**… **ANSI/IIAR 6**…**ANSI/IIAR 7**…and **ANSI/IIAR 9**



IIAR and Model Codes

- **2021 UMC §1102.2 Ammonia Refrigeration Systems.** Refrigeration systems using ammonia as the refrigerant shall comply with **IIAR 2**, **IIAR 3**, **IIAR 4** and **IIAR 5** and shall not be required to comply with this chapter.
- **2021 IMC §1101.1.2 Ammonia refrigerant.** Refrigeration systems using ammonia as the refrigerant shall comply with **IIAR 2**, **IIAR 3**, **IIAR 4** and **IIAR 5** and shall not be required to comply with this chapter.

ANSI/IIAR 2-2021

Standard for Design of Safe Closed-Circuit Ammonia Refrigeration Systems

Overview

- **Part 1** – General (Chapters 1-3)
- **Part 2** – Design and Installation Considerations (Chapters 4-7)
- **Part 3** – Equipment (Chapters 8-18)
- **Part 4** – Appendices (Appendix A – Appendix R)

Normative vs. Informative

Normative	Informative
Parts 1-3 (Chapters 1-18)	Part 4 (Appendices)
Prescriptive	Descriptive
Required	Supplemental
Shall	Should
Must	May
Will	Could/Can

Scope [§1.2]

- Stationary closed-circuit vapor compression and absorption refrigeration systems utilizing anhydrous ammonia as the refrigerant shall comply with this standard. This standard shall not apply to:
  - 1. Replacement in-kind;
  - 2. Equipment and systems and the buildings or facilities in which they are installed that existed prior to the legal effective date of this standard. Such equipment, systems, and building and facilities shall remain in accordance with the codes and standards that applied at the time of installation or construction and in accordance with IIAR 9.

Alternative Materials and Methods [§1.3.2]

- Use of alternatives outside IIAR 2 are acceptable when approved and shown to be equivalent in quality, strength, effectiveness, durability, and safety.

Chapter 4

Part 2. Design and Installation Considerations Affecting Construction

Chapter 4. Chapter 4. Location of Ammonia Refrigeration

4.1 **General.** The location of ammonia refrigeration equipment shall comply with this chapter. Ammonia refrigeration equipment located in a machinery room complying with Chapter 6 or located outdoors in accordance with Section 4.2.2 shall be permitted in conjunction with a secondary coolant that serves any occupancy in accordance with Section 5.4.

4.2 ***Permissible Equipment Locations.** Ammonia refrigeration equipment shall be located in a machinery room that complies with Chapter 6 unless otherwise permitted by this section.

4.2.1 **Listed Equipment.** Listed equipment containing not more than 6.6 lbs. (3 kg) of ammonia and installed in accordance with the listing and the manufacturer's instructions shall be permitted in any occupancy without a machinery room. Listed equipment for use in laboratories with more than 100 ft2 (9.3 m2) of floor area is permitted to contain any amount of ammonia if the equipment is installed in accordance with the listing and the manufacturer's installation instructions.

4.2.2 ***Outdoor Installations.** Ammonia refrigeration equipment shall be permitted to be installed outdoors when installed in accordance with Sections 7.2.2, 7.2.4, 7.2.5, 7.2.6, 7.2.7, 7.2.10 and 7.3.2. Ammonia refrigeration equipment, other than piping, installed outdoors shall be located not less than 20 ft from building openings, except for openings to a machinery room or openings to an industrial occupancy complying with Section 7.2.

EXCEPTIONS:

1. Packaged absorption or vapor compression systems for residential and commercial occupancies with refrigerant quantities not exceeding 22 lbs. (10 kg) are permitted to be installed within 20 ft of building openings.
2. Packaged absorption or vapor compression systems with refrigerant quantities such that a complete discharge would not exceed a concentration of 300 ppm in any room or area in which the refrigerant could enter are permitted to be installed within 20 ft. of building openings. The calculation procedure shall be in accordance with Section 5.3.

4.2.3 ***Industrial Occupancies.** The following ammonia refrigeration equipment shall be permitted to be installed indoors in areas other than a machinery room in industrial occupancies complying with Chapter 7.

1. Heat exchangers and associated surge drums (if equipped) used for space cooling, space heating, space dehumidification, process cooling, or process heating;
2. Low-probability pumps;
3. Piping, including but not limited to control and pressure-relief valves;
4. An ammonia refrigeration system with a total connected compressor drive power not exceeding 100 HP (74.6 kW).

4.2.4 ***Public Assembly, Commercial, Residential, and Large Mercantile Occupancies.** Where not prohibited by the AHJ, ammonia refrigeration equipment shall be permitted outside of a machinery room for applications in a public assembly occupancy, commercial occupancy, or large mercantile occupancy. The quantity of ammonia shall be limited such that a complete discharge from any independent refrigerant circuit will not result in an ammonia concentration exceeding 300 ppm in any room or area where equipment containing ammonia is located. The calculation procedure for determining the concentration level shall comply with Section 5.3.

EXCEPTIONS:

1. Listed packaged vapor compression or absorption systems, with no refrigerant-containing parts that are joined in the field by other than mating valves that permit sections of the system to be joined before opening the valves, installed in areas or rooms that are not public hallways or lobbies and with refrigerant quantities no greater than 6.6 lbs. (3 kg) are permitted for residential occupancies.
2. Listed packaged vapor compression or absorption systems, with no refrigerant-containing parts that are joined in the field by other than mating valves that permit sections of the system to be joined before opening the valves, installed in areas or rooms that are not public hallways or lobbies and with refrigerant quantities no greater than 22 lbs. (10 kg) are permitted for commercial occupancies.
3. Listed, sealed packaged vapor compression or absorption systems with no refrigerant-containing parts that are joined in the field by other than mating valves that permit sections of the system to be joined before opening the valves, installed in public hallways or lobbies and with refrigerant quantities no greater than 3.3 lbs. (1.5 kg) are permitted for residential and commercial occupancies.

Permissible Equipment Locations [§4.2]

Machinery Room


Outdoors

Industrial Occupancies

- Public Assembly, Commercial, Residential, and Large Mercantile Occupancies

Chapter 5

Chapter 5. General System Design Requirements

5.1 **General.** The design of closed-circuit ammonia refrigeration systems shall comply with this chapter.

5.2 ***Anhydrous Ammonia Specifications**

5.2.1 ***Purity.** Anhydrous ammonia used for the initial and subsequent charging of ammonia refrigeration systems using mechanical compression shall meet the purity requirements shown in Table 5.2.1.

Table 5.2.12 Purity Requirements

Ammonia Content	99.5% minimum
Water	50 ppm minimum 5,000 ppm maximum
Oil	50 ppm maximum
Salt (calculated as NaCl)	None
Pyridine, hydrogen sulfide, naphthalene	None

System Design Pressure [§5.5]

Important Section – Referenced in most future chapters

General [§5.5.1]

- Allowance for Pressure-Limiting and Pressure-Relief Devices [5.5.1.1]
- Equipment Connected to a Pressure Vessel [5.5.1.2]
- Piping Connected to a Pressure Vessel [5.5.1.3]
- Compressors Used as Boosters [5.5.1.4]
- Connecting to Existing Low-Pressure Equipment [5.5.1.5]

Minimum Permissible Design Pressure [§5.5.3]

Examples

Location	1% Wet Bulb	1% Dry Bulb	Minimum Design Pressure Low-Side	Minimum Design Pressure High-Side (Water Cooled)	Minimum Design Pressure High-Side (Evap Cooled)	Minimum Design Pressure High Side (Air-Cooled)
Fresno, CA	69.3	100.8	~~247 psig~~ 250 psig	~~212 psig~~ 250 psig	~~212 psig~~ 250 psig	330 psig ~~300 psig~~
Yuma, AZ	72.8	108.8	282 psig ~~250 psig~~	~~228 psig~~ 250 psig	~~228 psig~~ 250 psig	375 psig ~~300 psig~~

Materials [§5.7]

- Must be suitable at the temperature and pressure which the system will be subjected [§5.7.1.1]
- Must not deteriorate because of ammonia or oil [§5.7.1.2]
- Metallic materials must comply with ASME B31.5 or ASME B&PVC Section VIII [§5.7.2.1]
- Zinc, copper, and copper alloys must not be used [§5.7.2.2]
- Nonmetallic materials are permitted in accordance with §5.7.1, ASME B31.5 and ASME B&BVC Section VIII, Division 1 [§5.7.3]

Materials [§5.7]

Signage, Labels, and Pipe Marking [§5.14]

- System Signage
- NFPA 704 Placards
- Equipment Labels
- Emergency Shut-Off Valve Identification and Tagging
- Nameplates

Facility Address:
150 Lee Summer
Arvin, CA 93203

Grimmway Enterprises, Inc.
Location: Arvin
Emergency Contact List
Revision Date 01/1/22

EMERGENCY CONTACT LIST

Emergency Services & Law Enforcement:

Arvin Fire Department	9-1-1 or (661) 854-5517 *Dispatch*
Ambulance:	9-1-1 or (661) 324-6551 *Dispatch*
Kern County Sheriff's Department:	9-1-1 or (661) 861-3110 *Dispatch*
Arvin Police Department:	(661) 854-5517
California Hwy Patrol (CHP):	(661) 864-4400 *Dispatch*
Tel Tec	(661) 832-8204

Regulatory Agency's

Kern County Environmental Health (CUPA)	(661) 862-8700 / After Hours (661) 549-9927
State Office of Emergency Services (Cal OES)	1-800-852-7550 Or (916) 282-1612
National Response Center *Will be notified in the event of an accidental release of anhydrous ammonia in excess of 100 lbs. over a 24-hr period.* *Will be notified in the event of an accidental release of chlorine in excess of 10 lbs. over a 24-hr period.*	1-800-424-8802
Chemical Safety Board (CSB) *Will be notified within eight hours of an accidental release that results in fatality, serious injury, or >$1,000,000 property damage.*	(202) 261-7600 reports@csb.gov
Pyles & Kee	661-868-7000 *if enters sewage*

Non-Emergency Physicians:

Location	Address	Phone Number
Irene Sanchez M.D.	4200 Buck Owens Blvd. Bakersfield, CA 93308	(661) 633-2125 *Non-critical medical evaluation / After Hrs. Care*
AIH Occupational Medical Center	8501 Brimhall Rd. #100, Suite A Bakersfield, CA 93313	(661) 861-1800 *Non-critical medical evaluation / After Hrs. Care*

Facility Management / Safety - Primary Contacts:

Coordinators	Building	Name	Phone Number	Radio Channel
EAP Coordinator	All Buildings	Guzman Ibarra	(661) 557-1712	CH9 1
EAP Coordinator	All Buildings	Cliff Gines	(661) 301-7921	
Critical Plant Operations	All Buildings	Omar Vargas	(661) 378-8161	CH 4 1
Evacuation Coordinator	1 & 2	Dahyll Osorio	NA	CH#4
Evacuation Coordinator	3 & 4 – 1st Shift	Alex Melendrez	(661) 246-5138	CH# 1
Evacuation Coordinator	3 & 4 – 3rd Shift	Diego Camacho	(661) 444-7690	CH# 1
Evacuation Coordinator	5	Martin Ruiz	(661) 817-5331	CH# 1

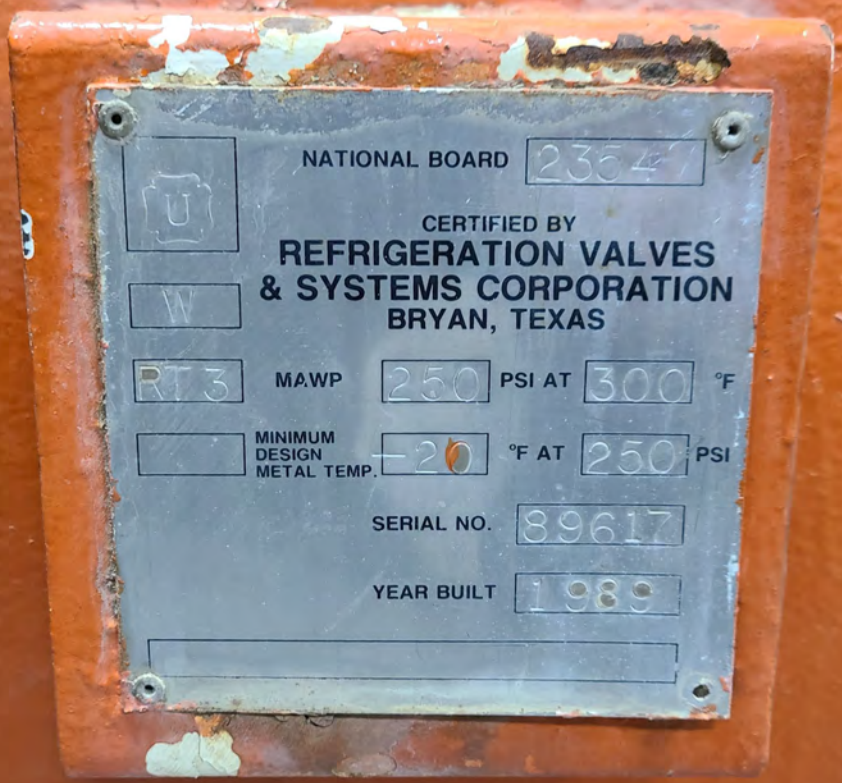
Key Facility Staff

Position	Name	Phone Number
Security Office	Security on Duty	(661) 835-5844
Safety Office	N/A	(661) 363-4732 Main Office
V.P. of Safety	Ray George	(661) 747-0043 Cell
Safety Manager	David Flores	(661) 304-0101 Cell
FSM Manager	Anicki Gomez	(661) 303-5774 Cell
Eng. Comp. Manager	Rob Wright	(661) 302-8539


WARNING
6
IN CASE OF EMERGENCY
REFRIGERATION MACHINERY ROOM
CAUTION
AMMONIA
R-717
CAUTION
EYE AND EAR PROTECTION REQUIRED IN THIS AREA
3
3
0
BOUFFANT CAPS
REFRIGERATION MACHINERY ROOM


ENGINE ROOM 3
DEPARTMENT
REFRIGERATION
MACHINERY ROOM
SHUT DOWN
EMERGENCY USE ONLY
REFRIGERATION
MACHINERY ROOM
VENTILATION
EMERGENCY USE
ONLY
RESTRICTE
AREA
ENGINE RM EXHAUST FAN
AUTO
FLOW
NO FLOW


AMMONIA
AMMONIA ANHYDROUS
HPL AMMONIA
4HL 325
King Valve
4HL 323
LIQUID INJECTION MAIN
ISOLATION VALVE

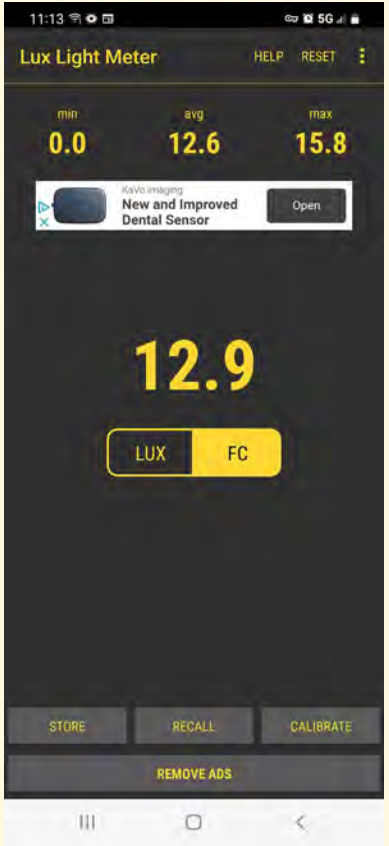

NATIONAL BOARD 2364
U
W
CERTIFIED BY
REFRIGERATION VALVES
& SYSTEMS CORPORATION
BRYAN, TEXAS
RT 3
MAWP 250 PSI AT 300 °F
MINIMUM DESIGN METAL TEMP. -20 °F AT 250 PSI
SERIAL NO. 89617
YEAR BUILT 1989

Eyewash/Safety Shower [§6.7]

- §6.7.1 Inside Machinery Room
- §6.7.2 Outside Machinery Room
- §6.7.3 Installation Standard

Lighting [§6.11]

- **§6.11.1 General.** Machinery rooms shall be equipped with light fixtures delivering a minimum of 30 foot-candles (320 lumens/m^2) at the working level, 36 in. (0.91 m) above a floor or platform.
- **§6.11.2 Light Control**. A manual control for the illumination source shall be provided. Occupancy sensors shall be permitted as an additional control for lighting, but not in lieu of a manual control.



Emergency Control Switches [§6.12]

- **§6.12.1 Emergency Stop Switch.** A clearly identified emergency shut-off switch shall be located outside and adjacent to the designated principal machinery room door. The switch shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally closed automatic refrigerant valves that are not part of an emergency control system, located in the machinery room. The function of the switch shall be clearly marked by signage near the controls. The switch shall be readily operable and protected from inadvertent operation and require manual reset.

Emergency Control Switches [§6.12]

- **§6.12.2 Emergency Ventilation Control Switch.** A clearly identified control switch for emergency ventilation that is not operated continuously shall be located outside the machinery room and adjacent to the designated principal machinery room door. The switch shall provide "ON/AUTO" override capability for emergency ventilation. The function of the switch shall be clearly marked by signage near the controls. The switch shall be readily operable.

Ammonia Detection and Alarm [§6.13]

- **§6.13.1 General.**
  - 1. At least two detectors having identical sensing ranges.
  - 2. Audible/visual alarms inside the room and outside each entrance to the room.

Ammonia Detection and Alarm [§6.13]

- **§6.13.2 Alarm Response**
  - 6.13.2.1 Detection of ammonia concentrations less than 25 ppm requires no alarm.
  - 6.13.2.2 *Detection of ammonia concentrations equal to or exceeding 25 ppm shall activate visual indicators and audible alarms as specified in Section 6.13.1. The visual indicator and audible alarm shall be permitted to automatically reset if the ammonia concentration drops below 25 ppm.
    - A.6.13.2.2 Visual alarms can be provided by strobes or other distinctive visual signaling devices.

Ammonia Detection and Alarm [§6.13]

- **§6.13.2 Alarm Response**
  - 6.13.2.3 Detection of ammonia concentrations equal to or exceeding 150 ppm (1/2 IDLH) shall activate visual indicators and an audible alarm and shall activate emergency ventilation, where such is required in accordance with Section 6.14. 7. Once activated, emergency ventilation, and visual indicators shall continue to operate until manually reset by a switch located in the machinery room. Audible alarms shall continue to operate until they are manually reset by a switch located in the machinery room or alternatively in an area remote from the machinery room.

Ammonia Detection and Alarm [§6.13]

- **§6.13.2 Alarm Response**
  - 6.13.2.4 Detection of ammonia concentrations that exceed a detector's upper detection limit or 40,000 ppm (25% LFL), whichever is lower, shall activate visual indicators and an audible alarm and shall activate emergency ventilation where such is required in accordance with Section 6.14. 7. If the detectors within the machinery room have more than one sensing range the detector with the highest range of detection capability is permitted to be used to activate this alarm response. Once activated, emergency ventilation, and visual indicators shall continue to operate until being manually reset by a switch located in the machinery room. Audible alarms shall continue to operate until they are manually reset by a switch located in the machinery room or alternatively in an area remote from the machinery room. In addition, the following equipment in the machinery room shall be automatically de-energized and shall remain de-energized until being manually reset:
    - 1. Refrigerant compressors.
    - 2. Refrigerant pumps.
    - 3. Normally closed automatic refrigerant valves that are not part of an emergency control system.

Ventilation [§6.14]

§6.14.7 Emergency Ventilation

- 30 ACH is the required airflow

$$Q\left[\frac{ft^3}{min}, cfm\right] = \frac{V[ft^3] \times 30}{1\ hr} \times \frac{1\ hr}{60\ min} = 0.5 \times V[ft^3]$$

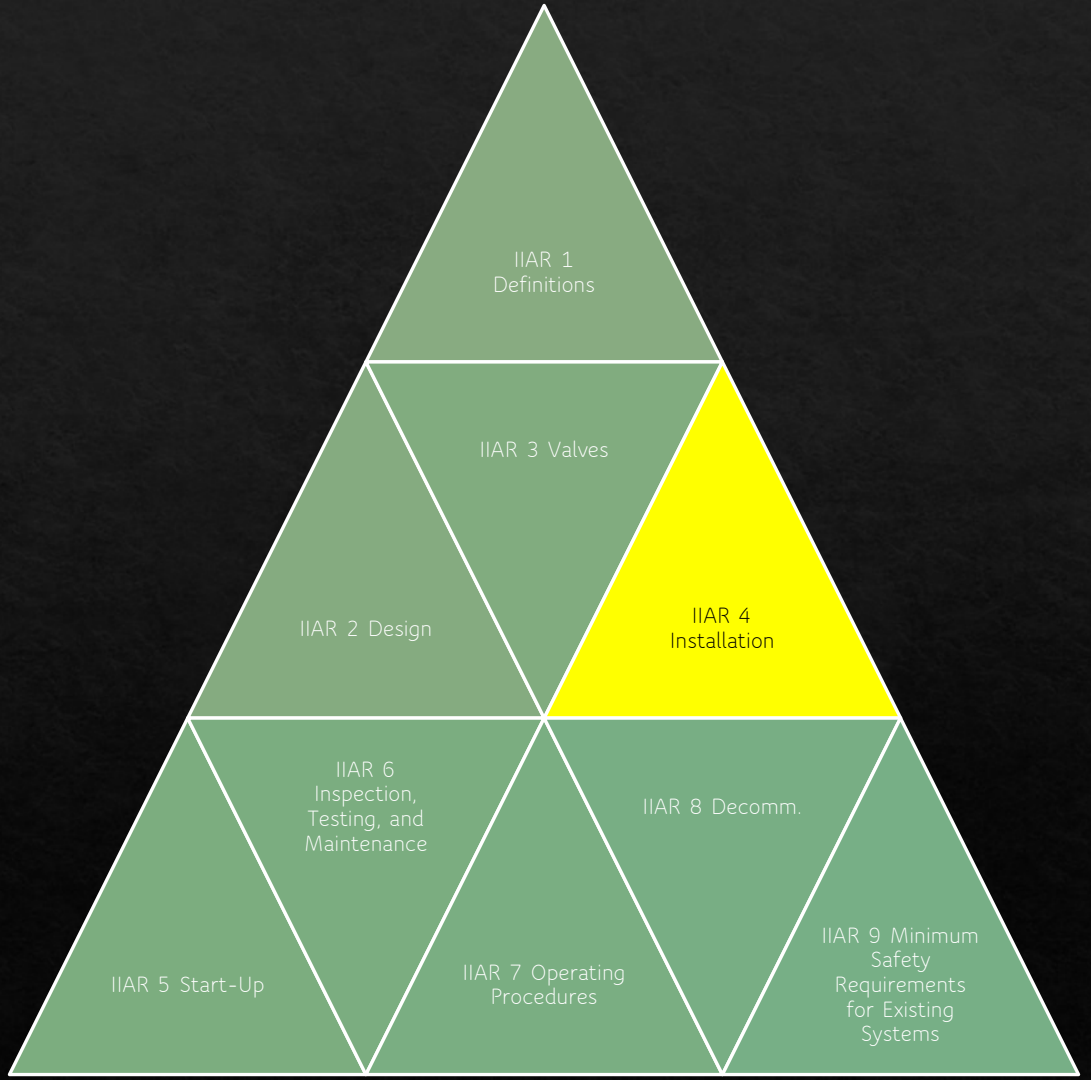
General [§7.2.10]

Eyewash/Safety Shower/Supplemental Drenching/Flushing. A permanent or portable means shall be provided for the provision of quick drenching or flushing of the eyes and body within or directly adjacent to the work area for immediate emergency use when maintenance occurs that involves the deliberate opening of an ammonia refrigeration system. Such means shall be indicated in the design documents, and shall comply with the temperature, flow and duration specifications of ANSI/ISEA Z358. I.

ANSI/IIAR 4-2020

Installation of Closed-Circuit Ammonia Refrigeration Systems

Standard 4


IIAR 1
Definitions
IIAR 3 Valves
IIAR 2 Design
IIAR 4
Installation
IIAR 6
Inspection,
Testing, and
Maintenance
IIAR 8 Decomm.
IIAR 5 Start-Up
IIAR 7 Operating
Procedures
IIAR 9 Minimum
Safety
Requirements
for Existing
Systems

IIAR 4

Normative Chapters

- 1 – Purpose
- 2 – Definitions
- 3 – References
- 4 – Installation Requirements – General Requirements
- 5 – Equipment Installation General Requirements
- 6 – Piping Installation
- 7 – Components and Controls Installation
- 8 – Insulation Systems

Informative Appendices

- A – Explanatory Materials
- B – Installation Documentation
- C – Safety Concerns Related to Insulation
- D – Insulation System Design & Material
- E – References and Sources of References

Chapter 1: Purpose

- § 1.1 Purpose
  - This standard specifies minimum requirements for the installation of safe closed-circuit ammonia refrigeration systems

4.2 – Installer Qualifications

- Installation shall be accomplished by individuals that can safely receive/transport/ assemble/install the components of a refrigeration system.
- Installing contractors shall provide the owner with documentation of employees' and subcontractor employee qualifications (certifications, training, etc.)
- Employees in training may still participate if they are directly supervised by a qualified employee.

4.3 – Safety Training

- Prior to installation, applicable individuals shall be provided with an orientation on safety procedures by the owner and installer.
- This should include:
  - Safety rules of the facility
  - Required safe work practices
  - PPE requirements and usage

4.5 – Welding of Pressure-Containing Components

- Welding must be performed in accordance with the following:
  - ASME B&PVC, Section VIII-IX (2019)
  - ASME B31.5 (2019)
  - Welding Process Specifications (WPS)
  - Procedure Qualification Record (PQR)
  - Welding and Welding Operator Performance Qualification Record (WPQR)

QW-484 SUGGESTED FORMAT FOR WELDER/WELDING OPERATOR PERFORMANCE QUALIFICATIONS (WPQ)

(See QW-301, Section IX, ASME Boiler and Pressure Vessel Code)

elder's name _____ Clock number _____ Stamp no. _____
lding process(es) used _____ Type _____
ntification of WPS followed by welder during welding of test coupon _____
se material(s) welded _____ Thickness _____

Manual or Semiautomatic Variables for Each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)		
ASME P-No. _____ to ASME P-No. (QW-403)		
) Plate ( ) Pipe (enter diameter, if pipe)		
Filler metal specification (SFA): _____ Classification (QW-404)		
Filler metal F-No.		
Filler metal variety for GTAW, PAW (QW-404)		
Consumable insert for GTAW or PAW		
Weld deposit thickness for each welding process		
Welding position (1G, 5G, etc.) (QW-405)		
Progression (uphill/downhill)		
Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408)		
GMAW transfer mode (QW-409)		
GTAW welding current type/polarity		

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control		
Automatic voltage control (GTAW)		
Automatic joint tracking		
Welding position (1G, 5G, etc.)		
Consumable insert		
Backing (metal, weld metal, welded from both sides, flux, etc.)		

Guided Bend Test Results

Guided Bend Tests Type	( ) QW-462.2 (Side) Results	( ) QW-462.3(a) (Trans. R & F) Type	( ) QW-462.3(b) (Long. R & F) Results

examination results (QW-302.4) _____
graphic test results (QW-304 and QW-305) _____
ternative qualification of groove welds by radiography)
Weld — Fracture test _____ Length and percent of defects _____ in.
test fusion _____ Fillet leg size _____ in. × _____ in. Concavity/convexity _____ in.
g test conducted by _____
nical tests conducted by _____ Laboratory test no. _____

tify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements ion IX of the ASME Code.

Organization _____

_____ By _____

This form (E00008) may be obtained from the Order Dept., ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

E00008

Welding Procedures

TECHNICON
ENGINEERING SERVICES, INC.

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING ▬ CONSTRUCTION TESTING & INSPECTION

WELDER QUALIFICATION TEST RECORD (WQTR)

(Section IX, QW-484, ASME Boiler and Pressure Vessel Code)

Date:	November 14, 2016	**Test #**	QW-463.2(d)	**Job #**	160942
To:	CCA	**WPS #**	CCA-G6-2.375A	**Code:**	ASME Section IX
	39138 Road 56	**Witnessed by:**	Brad A. Bosworth		
	Dinuba, CA 93618	**Test Date**	November 14, 2016		
Welder:	Rodrigo Herrera	**Welders ID:**	B7		

Testing Conditions and Range Qualified

Welding Variables	Actual Values	Range Qualified
Welding Processes:	SMAW	SMAW
Type of Welding, (Manual, semi-auto):	Manual	Manual
(QW-403)		
Base Metal, P number to P number:	P-1	P-1
☐ **Plate** ☒ **Pipe (Pipe Diameter):**	2"	1" & above
(QW-404)		
Filler Metal (SFA) Specifications	A5.1/A5.5	A5.1/A5.5
Filler Classification:	E6010	E6010/E6011
Filler Metal / F-Number:	F3	F3
Consumable Insert:	N/A	N/A
Weld Deposit Thickness:	.350"	.350"-.700"
(QW-405)		
Welding Position:	6G	All
Progression:	Downhill	Downhill
Backing:	None	None

Guide Bend Test

Visual Examination of Completed Joint: **Date of Test:**

☐ **Mechanical** ☐ **Peel (QB-462.3)** ☐ **Section (QB-462.4 0** ☐ **Tension (QB-462.1 (e)**

Root Bend	Face Bend	Root Bend	Face Bend		
PASS	PASS	PASS	PASS		

We, the undersigned, certify that the statements in this record are correct and that the tests were prepared, welded, and tested in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code.

Interpreted By:	Brad A. Bosworth	**CWI STAMP** Brad A Bosworth CWI 92030091 QC1 EXP. 3/1/2019	**Lab Test Number**	5451
Organization:	TECHNICON Engineering Services, Inc.		**Date:**	November 14, 2016
Manufacture Or Contractor:	California Controlled Atmosphere		**Certified By:**	
Authorized by:		**Date:**	**CWI Number:**	92030091

CORPORATE OFFICE ▬ 4539 N. Brawley Avenue #108, Fresno, CA 93722 ▬ P 559.276.9311 ▬ F 559.276.9344
VISALIA OFFICE ▬ 151 S. Dunworth Avenue, Visalia, CA 93292 ▬ P 559.732.0200 ▬ F 559.732.0830
MERCED OFFICE ▬ 2345 Jetway Drive, Atwater, CA 95301 ▬ P 209.384.9300 ▬ F 209.384.0891
www.technicon.net

Chapter 6: Piping Installation

- § 6.1 General
- § 6.2 Pipe and Tubing
- § 6.3 Refrigerant Valves
- § 6.4 Piping Fabrication and Assembly
- § 6.5 Flanges
- § 6.6 Threaded Joints
- § 6.7 Welded Joints

7.1 – Visual Liquid Level Indicators

Visual liquid level indicators shall be:

- Inspected prior to installation.
  - Where a scratch, chip or defect is found, the liquid level indicator shall not be installed.
- Installed in accordance with the manufacturer's instructions.
- Equipped with gaskets recommended by the manufacturer.

IIAR 4

Normative Chapters

- 1 – Purpose
- 2 – Definitions
- 3 – References
- 4 – Installation Requirements – General Requirements
- 5 – Equipment Installation General Requirements
- 6 – Piping Installation
- 7 – Components and Controls Installation
- 8 – Insulation Systems

Informative Appendices

- A – Explanatory Materials
- B – Installation Documentation
- C – Safety Concerns Related to Insulation
- D – Insulation System Design & Material
- E – References and Sources of References

Chapter 8: Insulation Systems

- § 8.1 General

8.1 – General

Delivery

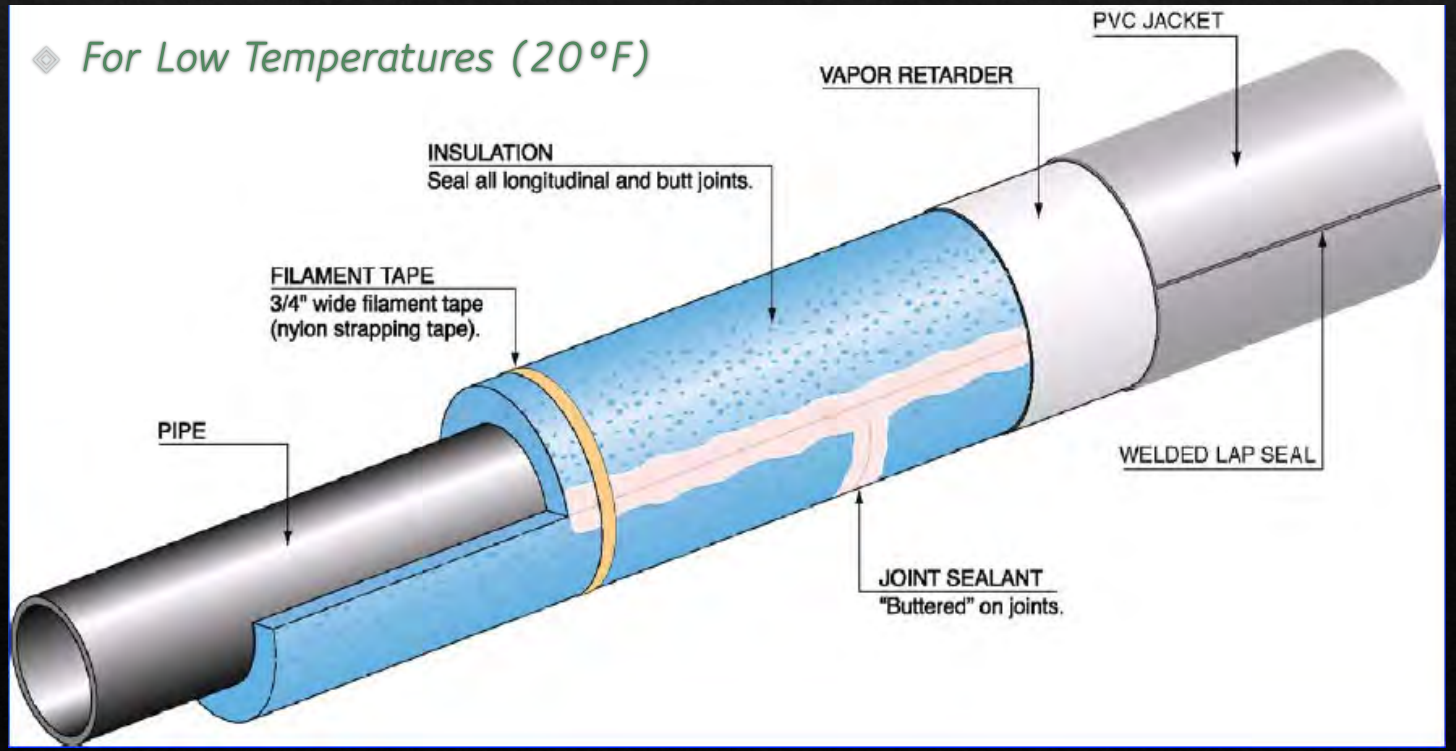
- Insulation materials shall be delivered to the job site in clean, marked, and previously unused containers.

Storage

- Insulation materials shall be stored indoors, or in closed containers to prevent environmental factors from damaging the materials.

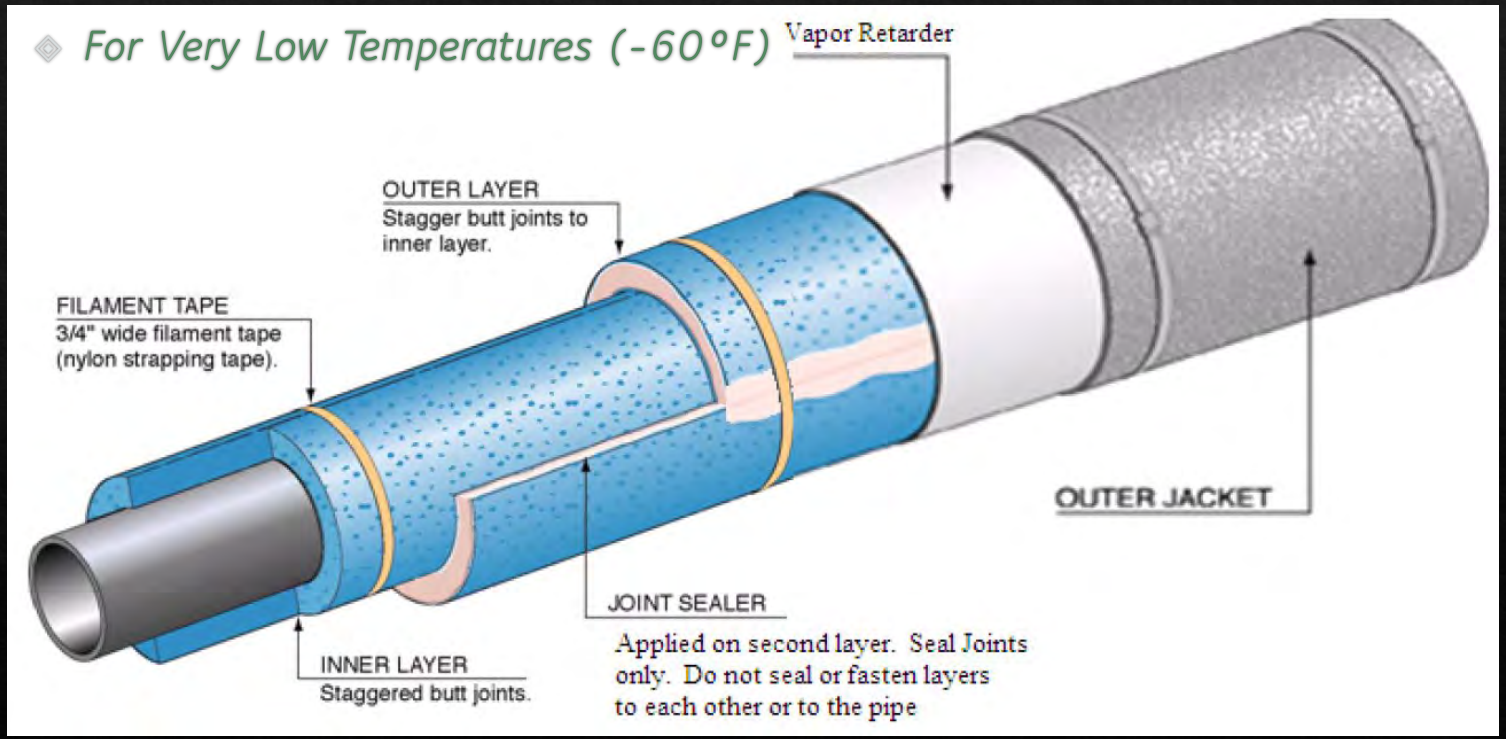
Insulation Materials

- *For Low Temperatures (20°F)*



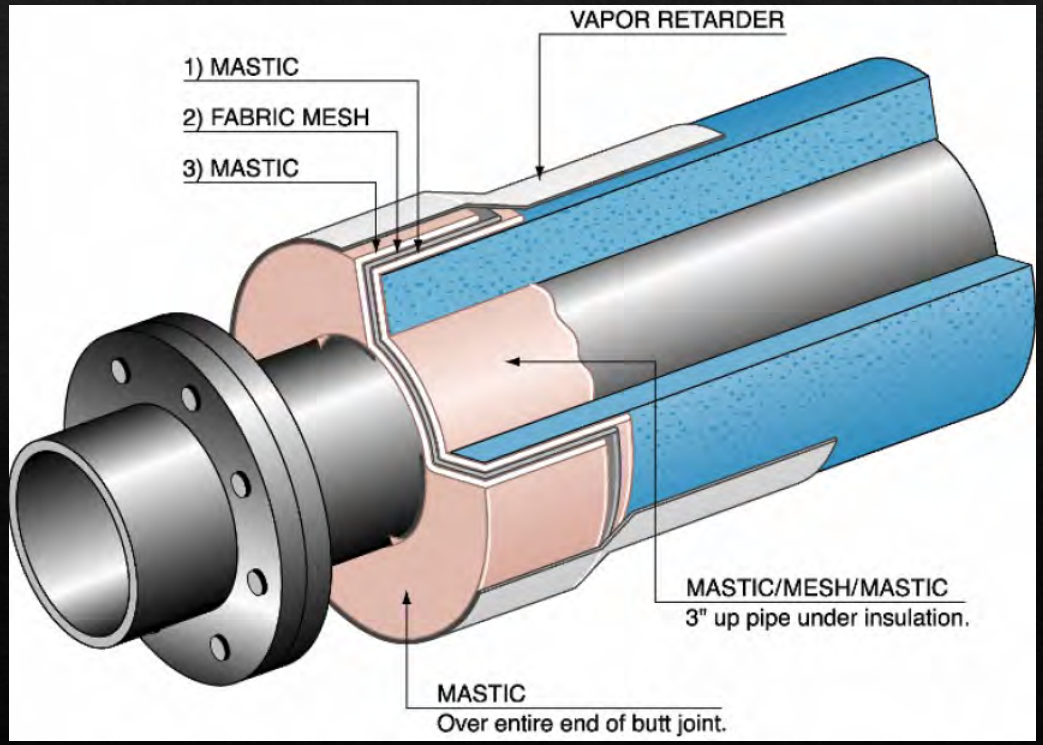
Insulation Materials

- *For Very Low Temperatures (-60°F)*

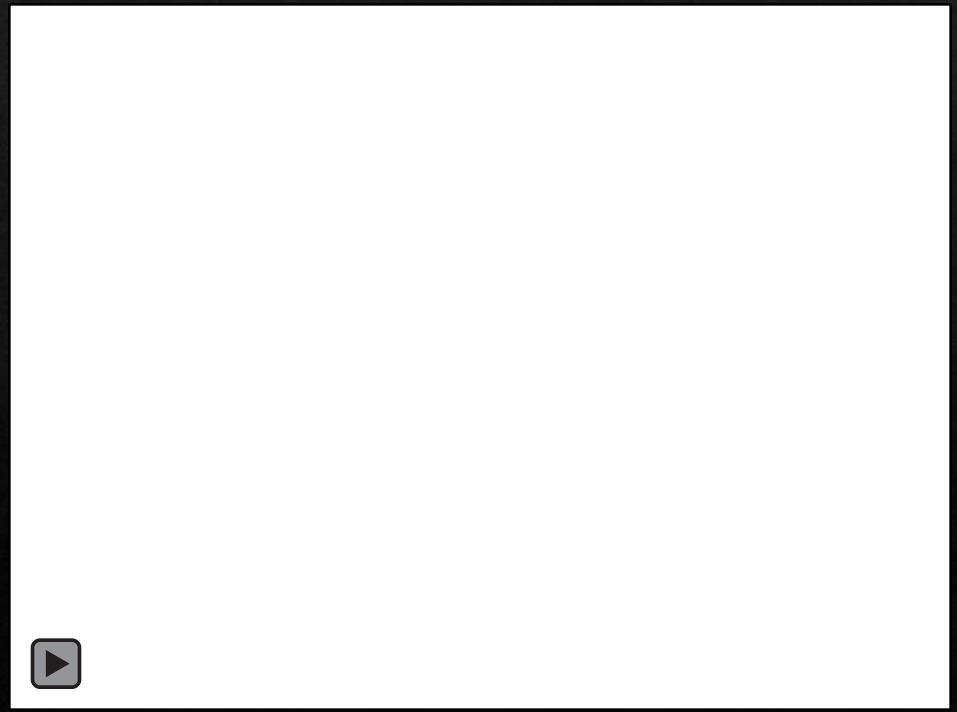


Insulation Materials

- *Vapor Stop*



Insulation Materials – Corrosion Inhibiting Gel



Appendix C: Safety Concerns Related to Insulation

Appendix C: Safety Concerns Related to Insulation

A

- **Cause**: Insulation damage.
- **Effect**: Corrosion of pipes/vessels under insulation.

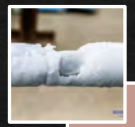
B

- **Cause**: Condensation on the outer surface of *indoor* insulation.
- **Effect**: Slips, contaminated food/beverage, electrical shorts, corrosion, and mold/fungal growth.

C

- **Cause**: Condensation on the outer surface of *outdoor* insulation (non-rooftop).
- **Effect**: Slips.

D



- **Cause**: Saturated insulation or excessive ice buildup on or in the insulation.
- **Effect**: Weight changes adversely affecting the support structure.

◈ Commonality: Water collecting in or on the insulation system.

Overview of ANSI/IIAR 6-2019

Standard for Inspection, Testing, and Maintenance of Closed-Circuit Ammonia Refrigeration Systems

Presented by: Peter Thomas, P.E.

IIAR 6

Part 1 – General

- 1 – Purpose, Scope, and Applic.
- 2 – Definitions
- 3 – Reference Standards
- 4 – Program Administration

Part 2 – Program Requirement

- 5 – General
- 6 – Compressors
- 7 – Pumps
- 8 – Condensers
- 9 – Evaporators
- 10 – Vessels
- 11 – Piping
- 12 – Safety Systems
- 13 – Overpressure Protection Devices
- 14 - Purgers
- 15 – Ammonia and Secondary Coolants

Part 3 Appendices

- A – Explanatory Material
- B – Safety Checklists
- C – Water Contamination
- D – Avoiding Abnormal Pressure/Shock
- E – Risk-Based ITM
- F - References

Compliance Schedule [§4.1.3]

- An owner shall be in compliance with this standard when it is adopted by the authority having jurisdiction (AHJ) or when it is adopted by the owner, whichever is first.

IIAR 6

Part 1 – General

- 1 – Purpose, Scope, and Applic.
- 2 – Definitions
- 3 – Reference Standards
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Part 2 – Program Requirement

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- A – Explanatory Material
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International Institute of Ammonia Refrigeration

iar

Ammonia Refrigeration Safety Inspection Checklist

ID Number: _____

AIR-COOLING EVAPORATORS

Plant Owner: _____

Address: _____

Contact: _____ Telephone: _____

Inspector: _____ Date: _____

Air Cooling Evaporators

Air Cooling Evaporator Location: _____

Air Cooling Identification Mark/No.: _____

Application

☐ Blast Freezer ☐ Storage Freezer

☐ Process Room ☐ Dock

☐ Storage Cooler

☐ Other *(Describe)*: _____

Type of Refrigerant Feed

☐ Liquid Recirculation ☐ Dry Expansion (DX)

☐ Flooded *(Surge Drum)*

☐ Other *(Describe)*: _____

Application Data

Tube and Fin Material: ☐ carbon steel ☐ stainless steel ☐ aluminum

Defrost Type: ☐ air ☐ water ☐ hot gas ☐ other _____

Design Room Air Temperature *(°F)*: _____ Normal Refrigerant Temperature *(°F)*: _____

Design Capacity *(TR)*: _____ Design Air Flow *(CFM)*: _____

Total Internal Vol. *(cubic ft)*: _____

Normal Ammonia Inventory *(Volume/Weight)*: ☐ cubic ft: _____ ☐ lb: _____

Air Cooling Evaporator Nameplate Data

Manufacturer, Name, Model, Serial No.: _____

Year Manufactured: _____ Design Pressure *(psig)*: _____

Fan Motor Nameplate Data

Manufacturer, Name, Model, Serial No., Year Manufactured: _____

Frame Size: _____ Type: _____ Speed *(rpm)*: _____ Power *(hp)*: _____

Voltage: _____ FLA *(amps)*: _____ Phase: ☐ 1 ☐ 3

Frequency *(Hz)*: _____ Belt size and number: _____

IIAR Bulletin No. 109

Ammonia Refrigeration Safety Inspection Checklist

AIR-COOLING EVAPORATOR

Location: _____ ID/Tag No.: _____

Facility Owner: _____

Address: _____

Contact: _____ Phone: _____

Inspector: _____ Date: _____

Application: Type of Refrigerant Feed:

Blast Freezer	☐	Liquid Recirculation (Top Feed)	☐
Storage Freezer	☐	Liquid Recirculation (Bottom Feed)	☐
Storage Cooler	☐	Flooded (Surge Drum)	☐
Dock	☐	Direct Expansion (DX)	☐
Process Room	☐	Ammonia Absorption System	☐
Other (Describe)	☐	Other (Describe)	☐

_____ _____

Equipment Data and Limits:

Manufacturer: _____ Model: _____ Serial Number: _____

Year Manufactured: _____ Design Pressure (psig): _____

Room Air Temp (°F): _____ Suction (psig /°F): _____ / _____

Total Internal Vol: _____ Cu. Ft. Normal Ammonia Inventory (lbs.): _____

Tube and Fin Material: ☐ Galv. Steel, ☐ All Stainless Steel, ☐ Aluminum, ☐ Stainless tube/Aluminum Fin

Defrost Type: ☐ Air, ☐ Water, ☐ Hot Gas, ☐ Other: _____

Fan Motor Data:

Manufacturer: _____ hp: _____ rpm: _____ FLA: _____

Frequency (Hz): _____ Voltage: _____ Phase: _____ Service Factor: _____

Frame Size: _____ Belt Qty: _____ Belt Size: _____ Motor Qty: _____

IIAR Standard 6

ID Number: _____

AIR-COOLING EVAPORATORS

Requirement/Recommendation	Conforms	Recommended Action/Comments	Safety Status	Target Date
a) Nameplate legible & complete?	☐ Yes ☐ No			
b) Suitable for ammonia?	☐ Yes ☐ No			
c) Operation within limits?	☐ Yes ☐ No			
d) Adequately anchored and supported?	☐ Yes ☐ No			
e) Safe access for service & maintenance?	☐ Yes ☐ No			
f) Free from excessive vibration?	☐ Yes ☐ No			
g) Adequate protection against traffic hazards?	☐ Yes ☐ No			
h) Evaporator free from excessive ice buildup and clean of dirt?	☐ Yes ☐ No			
i) Drive properly guarded & protected?	☐ Yes ☐ No			
j) Evaporator condition (check one)	☐ clean, no visible corrosion ☐ slight visible corrosion ☐ extensive corrosion			

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

If yes, describe. _____

IIAR Bulletin No. 109

Ammonia Refrigeration Safety Inspection Checklist

AIR-COOLING EVAPORATOR

Location: ID/Tag No.:

Inspection Items	Conforms	Safety Status	Recommended Action, or Comments	Target Date
a) Equipment labeled and nameplate legible per ANSI/IIAR 2?	Yes ☐ No ☐ N/A ☐			
b) Suitable for ammonia?	Yes ☐ No ☐ N/A ☐			
c) Operating within limits?	Yes ☐ No ☐ N/A ☐			
d) Fasteners tight, adequately anchored, and supported?	Yes ☐ No ☐ N/A ☐			
e) Safe access for Inspection, Testing and Maintenance (ITM)?	Yes ☐ No ☐ N/A ☐			
f) Free of excessive ice buildup?	Yes ☐ No ☐ N/A ☐			
g) Free of abnormal sounds/vibration?	Yes ☐ No ☐ N/A ☐			
h) Free of ammonia leaks?	Yes ☐ No ☐ N/A ☐			
i) All piping has markers per ANSI/IIAR 2?	Yes ☐ No ☐ N/A ☐			
j) Are valves in good condition?	Yes ☐ No ☐ N/A ☐			
k) Are critical manual and control valves tagged, exercised, and stems lubricated?	Yes ☐ No ☐ N/A ☐			
l) Sufficient pressure/temperature gauges and/or transducers are present and functioning adequately?	Yes ☐ No ☐ N/A ☐			
m) Belts, sheaves, coupling, etc., in good working order and adequately guarded?	Yes ☐ No ☐ N/A ☐			
n) Free of pitting and surface damage and coils free of dirt? a. If No, note damage level:	Yes ☐ No ☐ N/A ☐ Slight ☐ Extensive ☐			
o) Free of any other conditions that negatively affect safe operation?	Yes ☐ No ☐ N/A ☐			

If No, describe:

IIAR Standard 6

ID Number: _____

AIR-COOLING EVAPORATORS

Requirement/Recommendation	Conforms	Recommended Action/Comments	Safety Status	Target Date
a) Nameplate legible & complete?	☐ Yes ☐ No			
b) Suitable for ammonia?	☐ Yes ☐ No			
c) Operation within limits?	☐ Yes ☐ No			
d) Adequately anchored and supported?	☐ Yes ☐ No			
e) Safe access for service & maintenance?	☐ Yes ☐ No			
f) Free from excessive vibration?	☐ Yes ☐ No			
g) Adequate protection against traffic hazards?	☐ Yes ☐ No			
h) Evaporator free from excessive ice buildup and clean of dirt?	☐ Yes ☐ No			
i) Drive properly guarded & protected?	☐ Yes ☐ No			
j) Evaporator condition (check one)	☐ clean, no visible corrosion ☐ slight visible corrosion ☐ extensive corrosion			

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

If yes, describe. _____

IIAR Bulletin No. 109

Ammonia Refrigeration Safety Inspection Checklist

AIR-COOLING EVAPORATOR

Location: ID/Tag No.:

Inspection Items	Conforms	Safety Status	Recommended Action, or Comments	Target Date
a) Equipment labeled and nameplate legible per ANSI/IIAR 2?	Yes ☐ No ☐ N/A ☐			
b) Suitable for ammonia?	Yes ☐ No ☐ N/A ☐			
c) Operating within limits?	Yes ☐ No ☐ N/A ☐			
d) Fasteners tight, adequately anchored, and supported?	Yes ☐ No ☐ N/A ☐			
e) Safe access for Inspection, Testing and Maintenance (ITM)?	Yes ☐ No ☐ N/A ☐			
f) Free of excessive ice buildup?	Yes ☐ No ☐ N/A ☐			
g) Free of abnormal sounds/vibration?	Yes ☐ No ☐ N/A ☐			
h) Free of ammonia leaks?	Yes ☐ No ☐ N/A ☐			
i) All piping has markers per ANSI/IIAR 2?	Yes ☐ No ☐ N/A ☐			
j) Are valves in good condition?	Yes ☐ No ☐ N/A ☐			
k) Are critical manual and control valves tagged, exercised, and stems lubricated?	Yes ☐ No ☐ N/A ☐			
l) Sufficient pressure/temperature gauges and/or transducers are present and functioning adequately?	Yes ☐ No ☐ N/A ☐			
m) Belts, sheaves, coupling, etc., in good working order and adequately guarded?	Yes ☐ No ☐ N/A ☐			
n) Free of pitting and surface damage and coils free of dirt? a. If No, note damage level:	Yes ☐ No ☐ N/A ☐ Slight ☐ Extensive ☐			
o) Free of any other conditions that negatively affect safe operation?	Yes ☐ No ☐ N/A ☐			

If No, describe:

_____

IIAR Standard 6

	and Maintenance (ITM)?				
	f) Free of excessive ice buildup?	Yes ☐ No ☐ N/A ☐			
	g) Free of abnormal sounds/vibration?	Yes ☐ No ☐ N/A ☐			
→	h) Free of ammonia leaks?	Yes ☐ No ☐ N/A ☐			
→	i) All piping has markers per ANSI/IIAR 2?	Yes ☐ No ☐ N/A ☐			
→	j) Are valves in good condition?	Yes ☐ No ☐ N/A ☐			
→	k) Are critical manual and control valves tagged, exercised, and stems lubricated?	Yes ☐ No ☐ N/A ☐			
→	l) Sufficient pressure/temperature gauges and/or transducers are present and functioning adequately?	Yes ☐ No ☐ N/A ☐			
	m) Belts, sheaves, coupling, etc., in good working order and adequately	Yes ☐ No ☐ N/A ☐			


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Period	Calendar Basis	Runtime Basis (hours)
Daily	Occurring once per 24 hours.	24
Weekly	Occurring once per calendar week.	168
Monthly	Occurring once per calendar month.	730
Quarterly	Occurring four times per year. The minimum period between ITM tasks is 2 months. The maximum is 4 months.	2,190
Semiannual	Occurring twice per 12 consecutive months. The minimum period between ITM tasks is 4 months. The maximum is 8 months.	4,380
Annual	Occurring once per year. The minimum period between ITM tasks is 9 months. The maximum is 15 months.	8,760
Biennial (Two Years)	Occurring once every other year. The minimum period between ITM tasks is 21 months. The maximum is 27 months.	17,520
Three Years	Occurring once every 36 months. The minimum period between ITM tasks is 30 months. The maximum is 42 months.	26,280
Five Years	Occurring once every 60 months. The minimum period between ITM tasks is 54 months. The maximum is 66 months.	43,800
Ten Years	Occurring once every 120 months. The minimum period between ITM tasks is 108 months. The maximum is 132 months.	87,600

Period	Calendar Basis	Runtime Basis (hours)
Daily	Occurring once per 24 hours.	24
Weekly	Occurring once per calendar week.	168
Monthly	Occurring once per calendar month.	730
Quarterly	Occurring four times per year. The minimum period between ITM tasks is 2 months. The maximum is 4 months.	2,190
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Biennial (Two Years)	Occurring once every other year. The minimum period between ITM tasks is 21 months. The maximum is 27 months.	17,520
Three Years	Occurring once every 36 months. The minimum period between ITM tasks is 30 months. The maximum is 42 months.	26,280
Five Years	Occurring once every 60 months. The minimum period between ITM tasks is 54 months. The maximum is 66 months.	43,800
Ten Years	Occurring once every 120 months. The minimum period between ITM tasks is 108 months. The maximum is 132 months.	87,600

ITM Task Description	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
a) Runtime hours	WA-D	WA-D	WA-D
b) Suction pressure	D	D	D
c) Discharge pressure	D	D	D
d) Oil pressure	D	D	D
e) Oil temperature	D	WA-D	D
f) Discharge temperature	D	WA-D	D
g) Verify oil levels are adequate	D	D	D
h) Oil filter differential pressure	D	WA-D	NA
i) Oil leaks	D	D	D
j) Lubricator oil level and drip rate	NA	NA	D
k) Jacket cooling oil level	NA	NA	D
l) Determine shaft seal leak rate	WA-W	WA-W	WA-W
m) Indicator of Compressor Capacity	D	WA-D	WA-D
n) Motor amperage (current)	D	WA-D	WA-D
o) Recorded Alarms and Shutdowns	D	WA-D	WA-D
p) Free from abnormal sounds and excessive vibration	D	D	D

ITM Task	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
q) Drive guard in place	D	D	D
r) Foundation solid, in place, and free from evidence of deterioration	A	A	A
s) Visually inspect mounting bolts are in place	A	A	A
t) Visually inspect metal surfaces for pitting or surface damage	A	A	A
u) Visually inspect coupling for wear	A	WA-A	WA-A
v) Visually inspect starter connections and associated timers and relays	A	A	A
w) Operation of oil heaters	A	A	A
x) Operation of unloader	M	M	M
y) Visually inspect alignment of compressor-motor drive shaft	A	A	A
Testing	**Screw**	**Recip**	**Rotary Vane**
Test safety shutdowns:			
a) Low suction pressure cutout	A	A	A
b) High discharge pressure cutout (HPCO) See Section 6.1.1	A	A	A

ITM Task Description	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
a) Runtime hours	WA-D	WA-D	WA-D
b) Suction pressure	D	D	D
c) Discharge pressure	D	D	D
d) Oil pressure	D	D	D
e) Oil temperature	D	WA-D	D
f) Discharge temperature	D	WA-D	D
g) Verify oil levels are adequate	D	D	D
h) Oil filter differential pressure	D	WA-D	NA
i) Oil leaks	D	D	D
j) Lubricator oil level and drip rate	NA	NA	D
k) Jacket cooling oil level	NA	NA	D
l) Determine shaft seal leak rate	WA-W	WA-W	WA-W
m) Indicator of Compressor Capacity	D	WA-D	WA-D
n) Motor amperage (current)	D	WA-D	WA-D
o) Recorded Alarms and Shutdowns	D	WA-D	WA-D
p) Free from abnormal sounds and excessive vibration	D	D	D

ITM Task	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
q) Drive guard in place	D	D	D
r) Foundation solid, in place, and free from evidence of deterioration	A	A	A
s) Visually inspect mounting bolts are in place	A	A	A
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u) Visually inspect coupling for wear	A	WA-A	WA-A
v) Visually inspect starter connections and associated timers and relays	A	A	A
w) Operation of oil heaters	A	A	A
x) Operation of unloader	M	M	M
y) Visually inspect alignment of compressor-motor drive shaft	A	A	A
Testing	**Screw**	**Recip**	**Rotary Vane**
Test safety shutdowns:			
a) Low suction pressure cutout	A	A	A
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See Section 6.1.1

ITM Task Description	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
a) Runtime hours	WA-D	WA-D	WA-D
b) Suction pressure	D	D	D
c) Discharge pressure	D	D	D
d) Oil pressure	D	D	D
e) Oil temperature	D	WA-D	D
f) Discharge temperature	D	WA-D	D
g) Verify oil levels are adequate	D	D	D
h) Oil filter differential pressure	D	WA-D	NA
i) Oil leaks	D	D	D
j) Lubricator oil level and drip rate	NA	NA	D
k) Jacket cooling oil level	NA	NA	D
l) Determine shaft seal leak rate	WA-W	WA-W	WA-W
m) Indicator of Compressor Capacity	D	WA-D	WA-D
n) Motor amperage (current)	D	WA-D	WA-D
o) Recorded Alarms and Shutdowns	D	WA-D	WA-D
p) Free from abnormal sounds and excessive vibration	D	D	D

ITM Task	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
q) Drive guard in place	D	D	D
r) Foundation solid, in place, and free from evidence of deterioration	A	A	A
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u) Visually inspect coupling for wear	A	WA-A	WA-A
v) Visually inspect starter connections and associated timers and relays	A	A	A
w) Operation of oil heaters	A	A	A
x) Operation of unloader	M	M	M
y) Visually inspect alignment of compressor-motor drive shaft	A	A	A
Testing	**Screw**	**Recip**	**Rotary Vane**
Test safety shutdowns:			
a) Low suction pressure cutout	A	A	A
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ITM Task Description	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
a) Runtime hours	WA-D	WA-D	WA-D
b) Suction pressure	D	D	D
c) Discharge pressure	D	D	D
d) Oil pressure	D	D	D
e) Oil temperature	D	WA-D	D
f) Discharge temperature	D	WA-D	D
g) Verify oil levels are adequate	D	D	D
h) Oil filter differential pressure	D	WA-D	NA
i) Oil leaks	D	D	D
j) Lubricator oil level and drip rate	NA	NA	D
k) Jacket cooling oil level	NA	NA	D
l) Determine shaft seal leak rate	WA-W	WA-W	WA-W
m) Indicator of Compressor Capacity	D	WA-D	WA-D
n) Motor amperage (current)	D	WA-D	WA-D
o) Recorded Alarms and Shutdowns	D	WA-D	WA-D
p) Free from abnormal sounds and excessive vibration	D	D	D

ITM Task	Frequency		
Inspection	**Screw**	**Recip**	**Rotary Vane**
q) Drive guard in place	D	D	D
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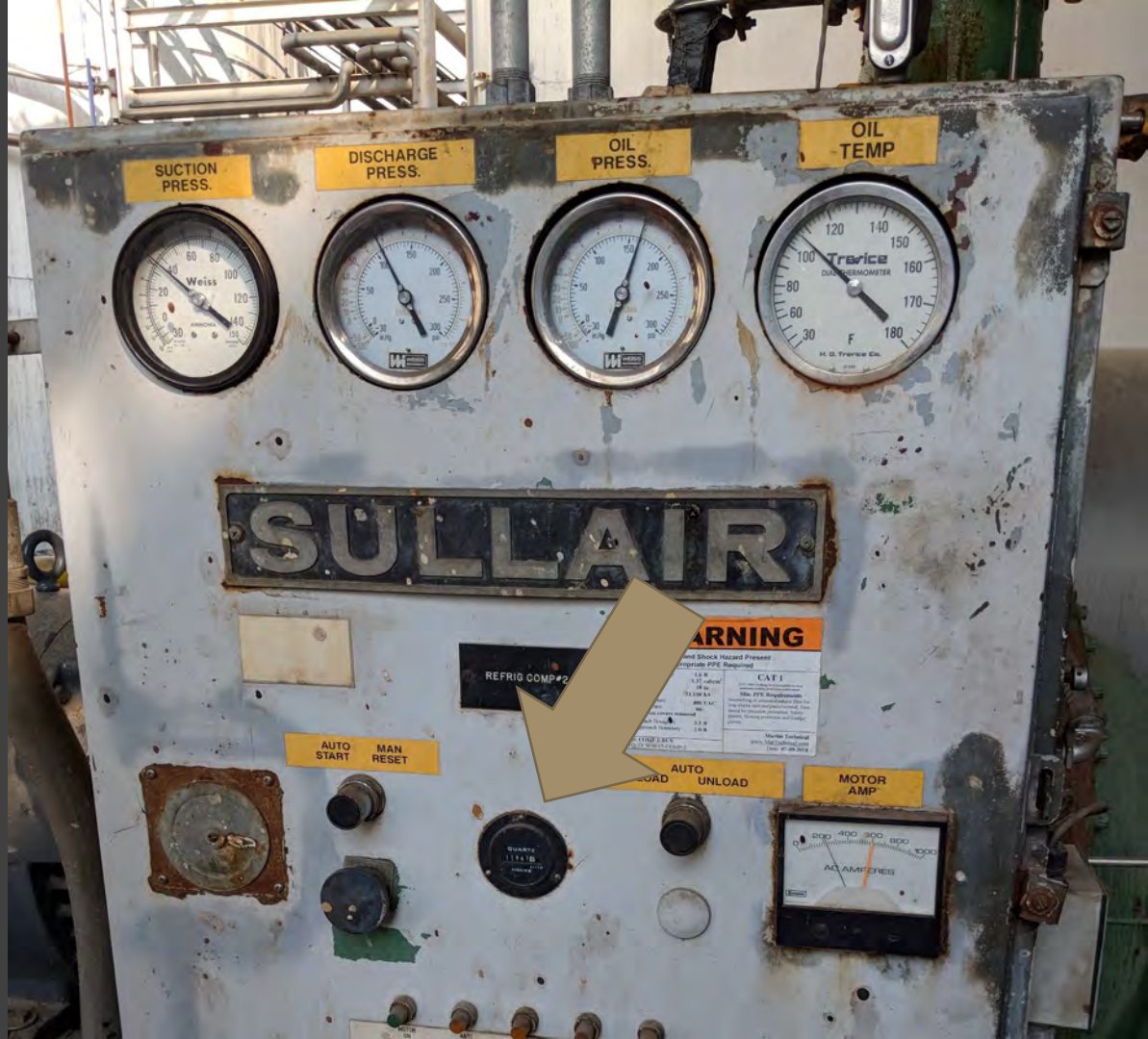
Testing	**Screw**	**Recip**	**Rotary Vane**
Test safety shutdowns:			
a) Low suction pressure cutout	A	A	A
b) High discharge pressure cutout (HPCO) See Section 6.1.1	A	A	A

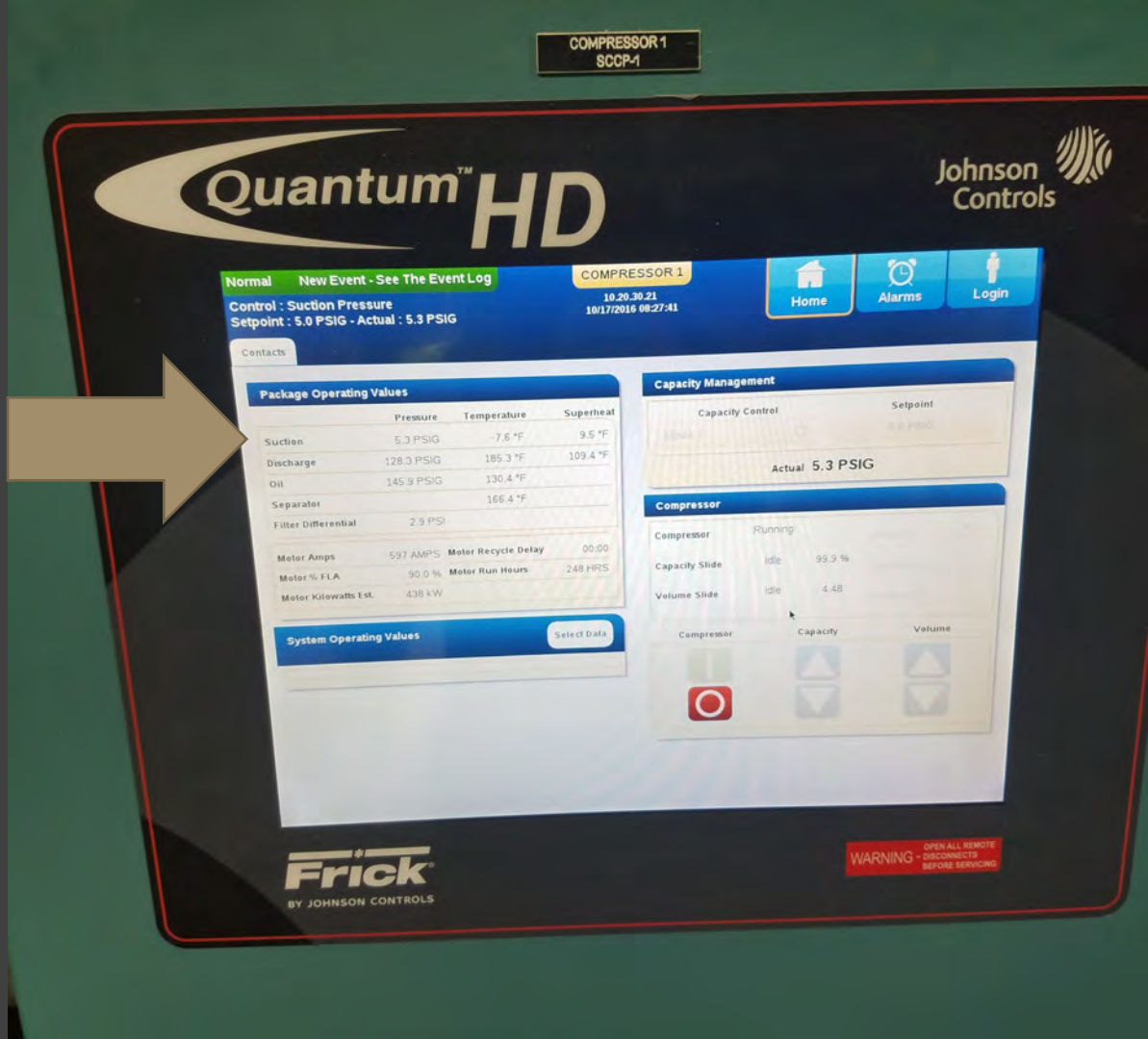
DAILY INSPECTIONS

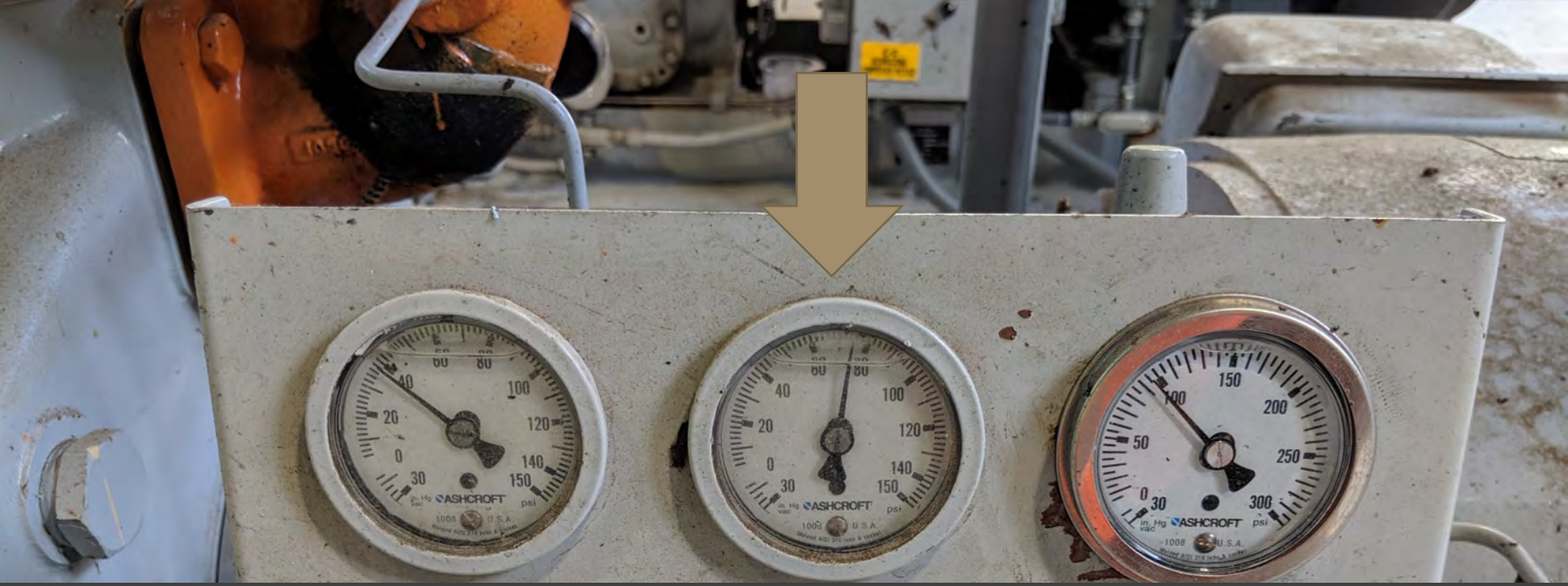
Record compressor runtime (hours)



DAILY INSPECTIONS

Record compressor suction pressure



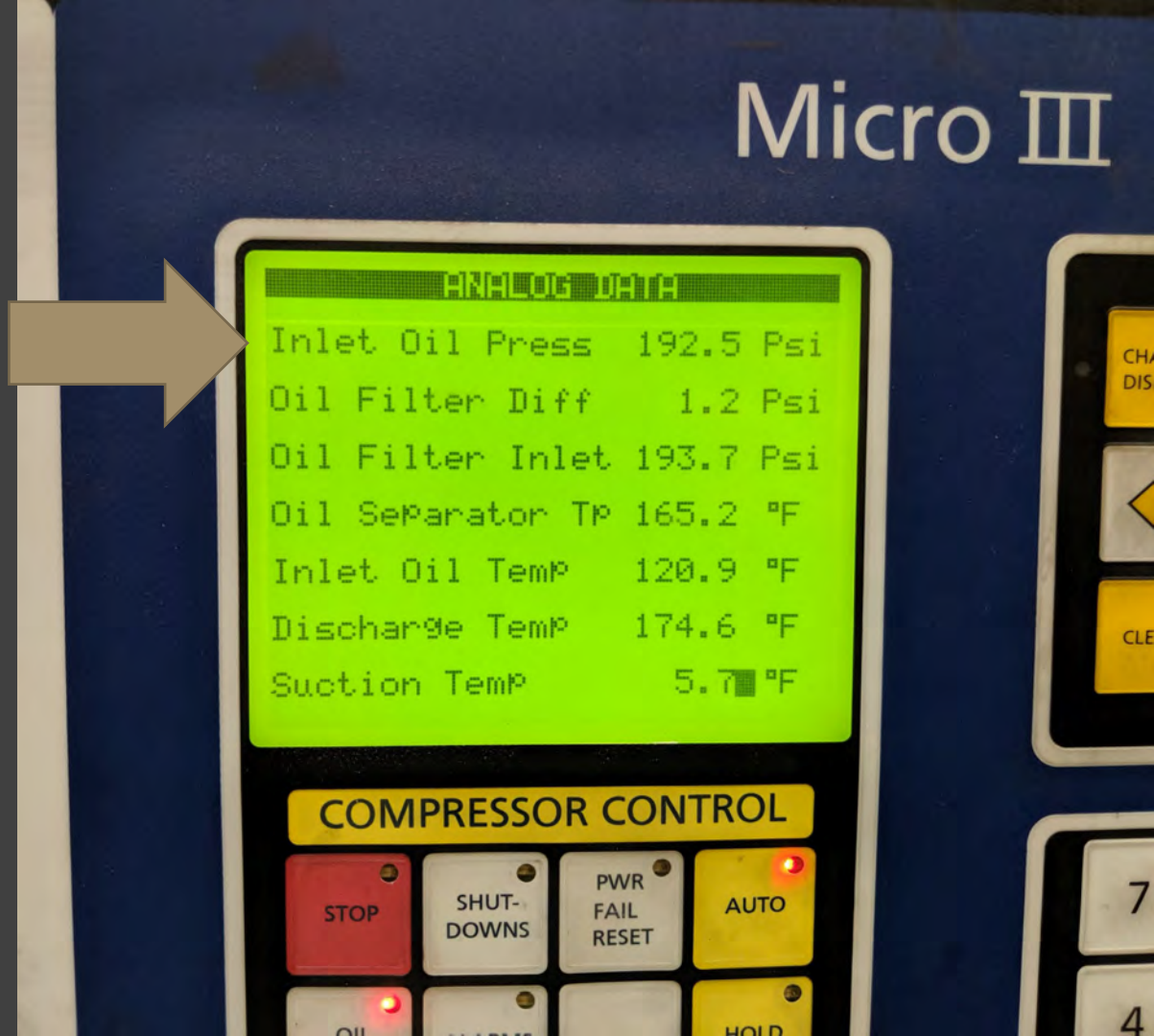


DAILY INSPECTIONS

Record compressor discharge pressure

DAILY INSPECTIONS

Record compressor oil pressure

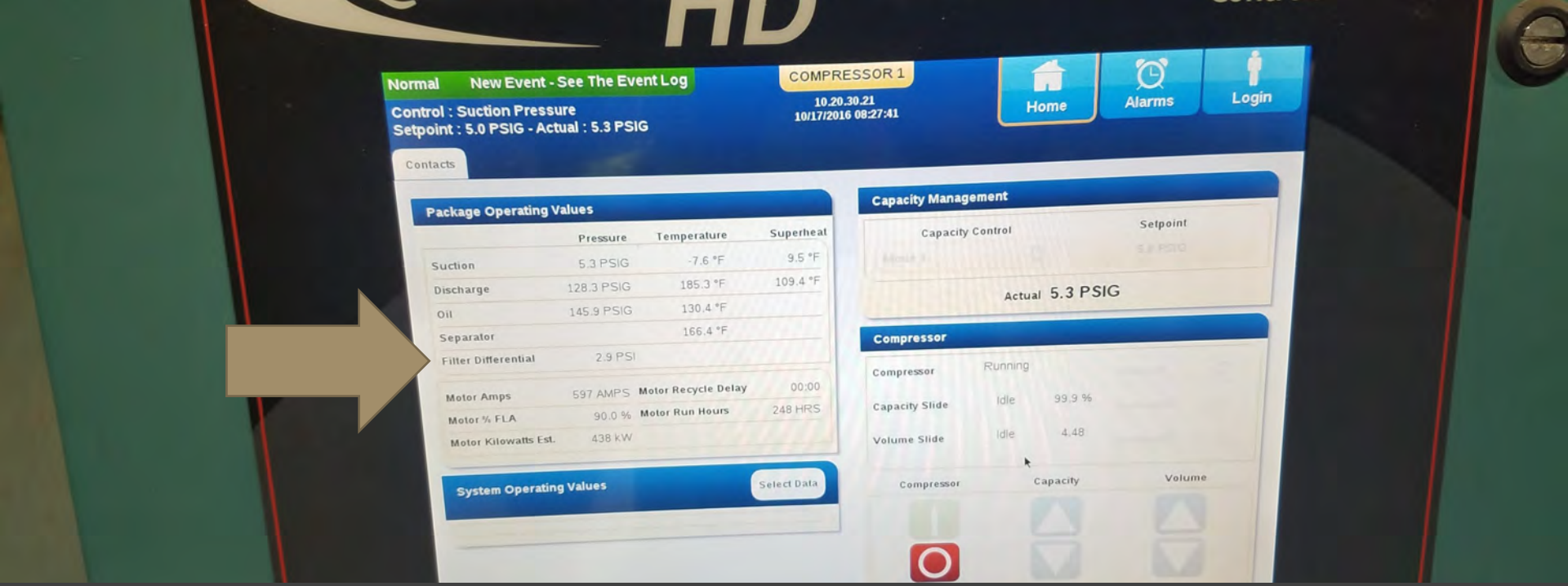


DAILY INSPECTIONS

Record compressor oil temperature

DAILY INSPECTIONS

Record compressor discharge temperature



DAILY INSPECTIONS

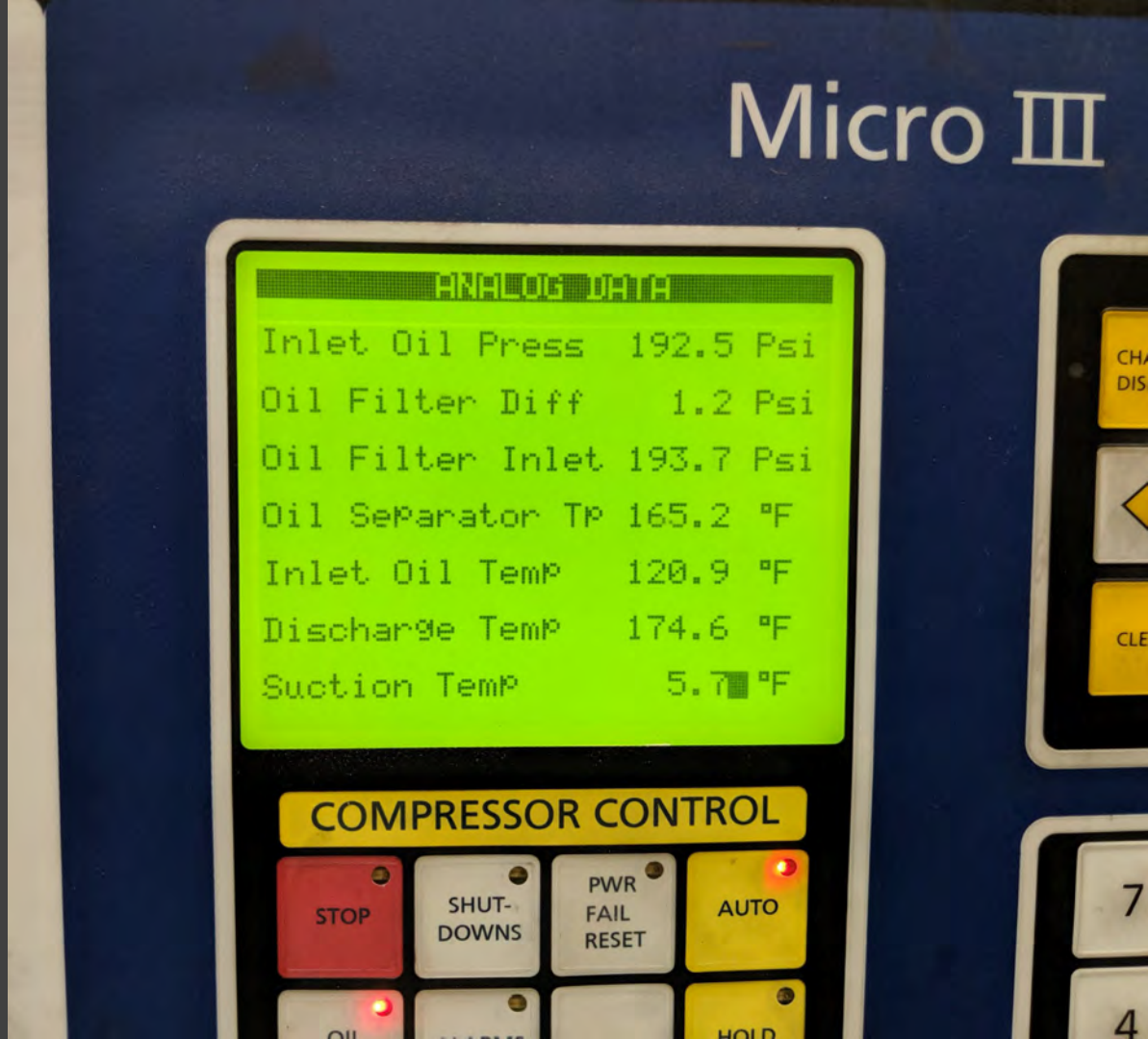
Record compressor oil filter differential pressure

DAILY INSPECTIONS

Record compressor motor amperage

DAILY INSPECTIONS

Record compressor alarms and shutdowns

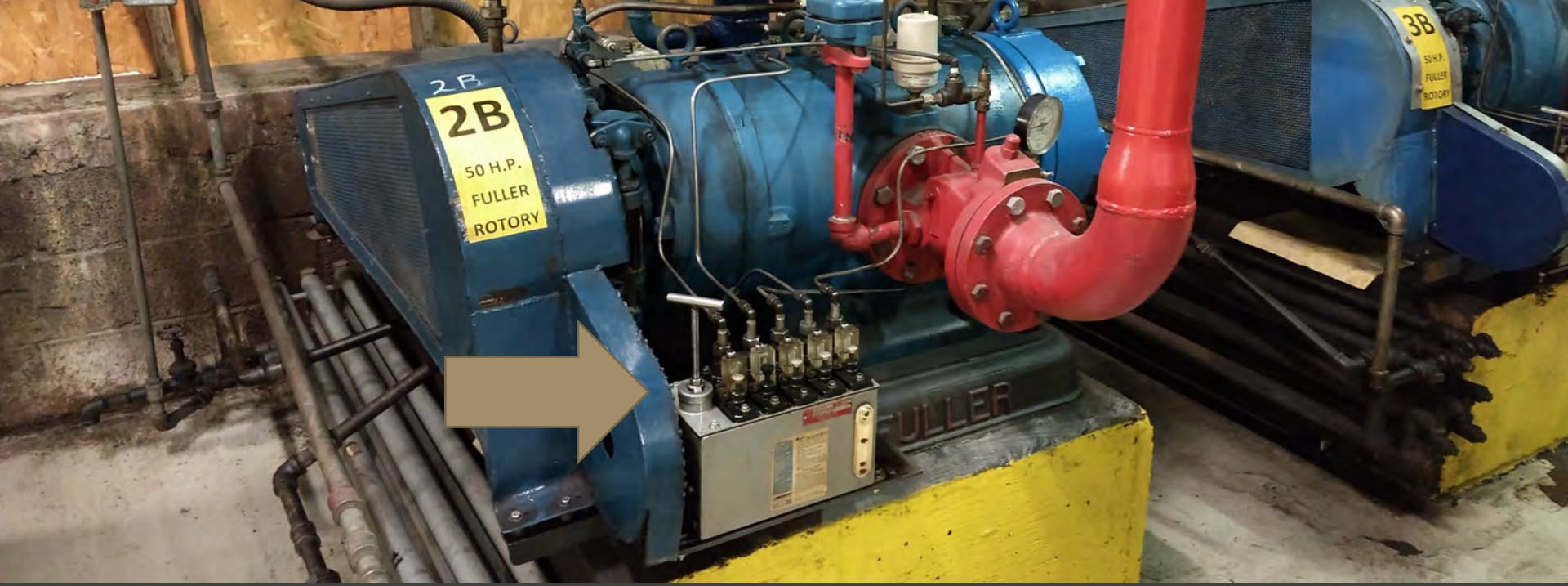


DAILY INSPECTIONS

Verify oil levels are adequate

DAILY INSPECTIONS

Check for oil leaks



DAILY INSPECTIONS

Check lubricator oil level and drip rate

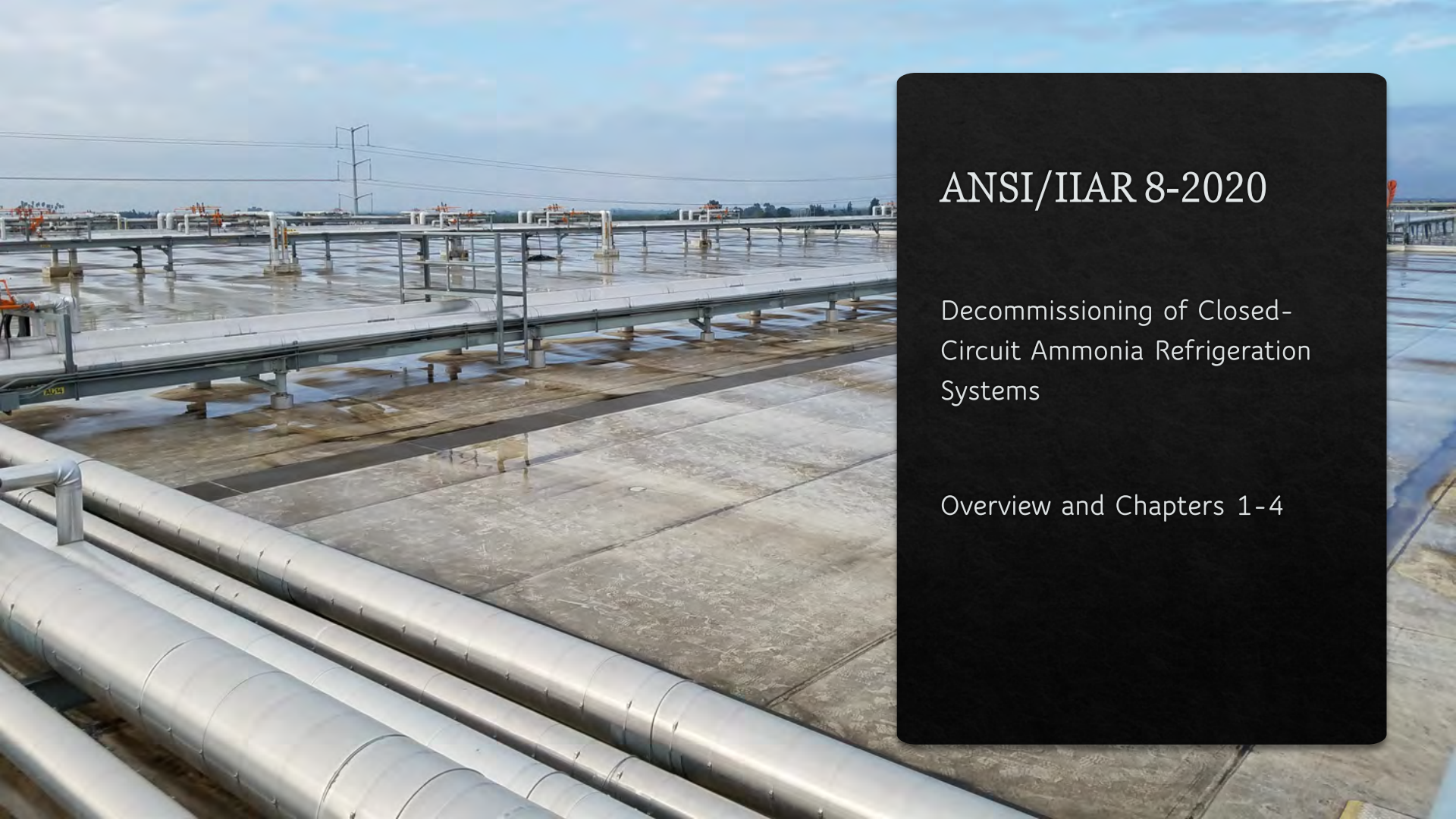
DAILY INSPECTIONS

Check compressor for unusual vibration

Type of Record	Retention Duration
Daily Inspection Records	Most current 12 months
Daily Testing Records	Most current 12 months
Daily Maintenance Records	Most current 12 months
Annual Inspection Records	Most current 5 years
Annual Testing Records	Most current 5 years
Annual Maintenance Records	Most current 5 years
Five Year Inspection Records	Two (2) most current
Five Year Testing Records	Two (2) most current
Five Year Maintenance Records	Two (2) most current
Ten Year Maintenance Records	Two (2) most current

Type of Record	Retention Duration
Engineering Design Documentation	Life of the process
Pressure Vessel U-1, U-1A, U-3, UM Reports	Equipment life
Log (Operator Transfer of Information)	Most current 12 months
Secondary Coolant Records	Most current 12 months
Ammonia Refrigerant Records	Most current 5 years
Refrigeration Oil Records	Most current 5 years
Lubrication Records	Most current 5 years
Pressure Relief Valve (PRV) Records	PRV life
Current System Records listed in Section 5.3.3	Life of the process
Instrument and Device Testing and Calibration	Most current 5 years

Type of Record	Retention Duration
Engineering Design Documentation	Life of the process
Pressure Vessel U-1, U-1A, U-3, UM Reports	Equipment life
Log (Operator Transfer of Information)	Most current 12 months
Secondary Coolant Records	Most current 12 months
Ammonia Refrigerant Records	Most current 5 years
Refrigeration Oil Records	Most current 5 years
Lubrication Records	Most current 5 years
Pressure Relief Valve (PRV) Records	PRV life
Current System Records listed in Section 5.3.3	Life of the process
Instrument and Device Testing and Calibration	Most current 5 years

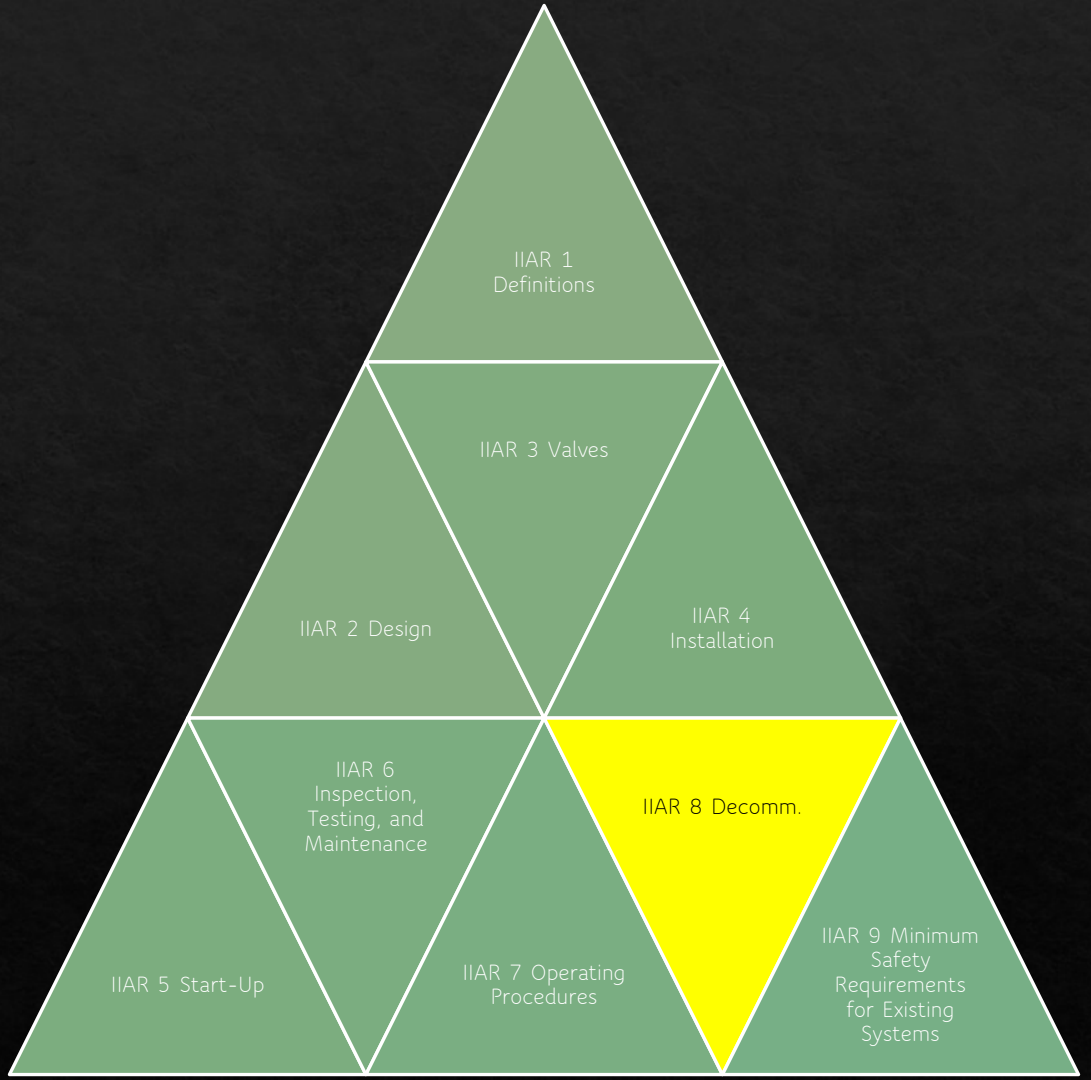


ANSI/IIAR 8-2020

Decommissioning of Closed-Circuit Ammonia Refrigeration Systems

Overview and Chapters 1-4

Standard 8


IIAR 1
Definitions
IIAR 3 Valves
IIAR 2 Design
IIAR 4
Installation
IIAR 6
Inspection,
Testing, and
Maintenance
IIAR 8 Decomm.
IIAR 5 Start-Up
IIAR 7 Operating
Procedures
IIAR 9 Minimum
Safety
Requirements
for Existing
Systems

Publication History

2015

2020

IIAR 8

Normative Chapters

- 1 – Purpose and Scope
- 2 – Definitions
- 3 – References
- 4 – Preparation
- 5 – Decommissioning Activities

Informative Appendices

- A – Explanatory Material
- B – Example of a Decommissioning Checklist
- C – Example of a Final Review Checklist
- D – Potential Impacts on Safety and Health
- E – References and Sources of References

IIAR 8

Normative Chapters

- 1 – Purpose and Scope
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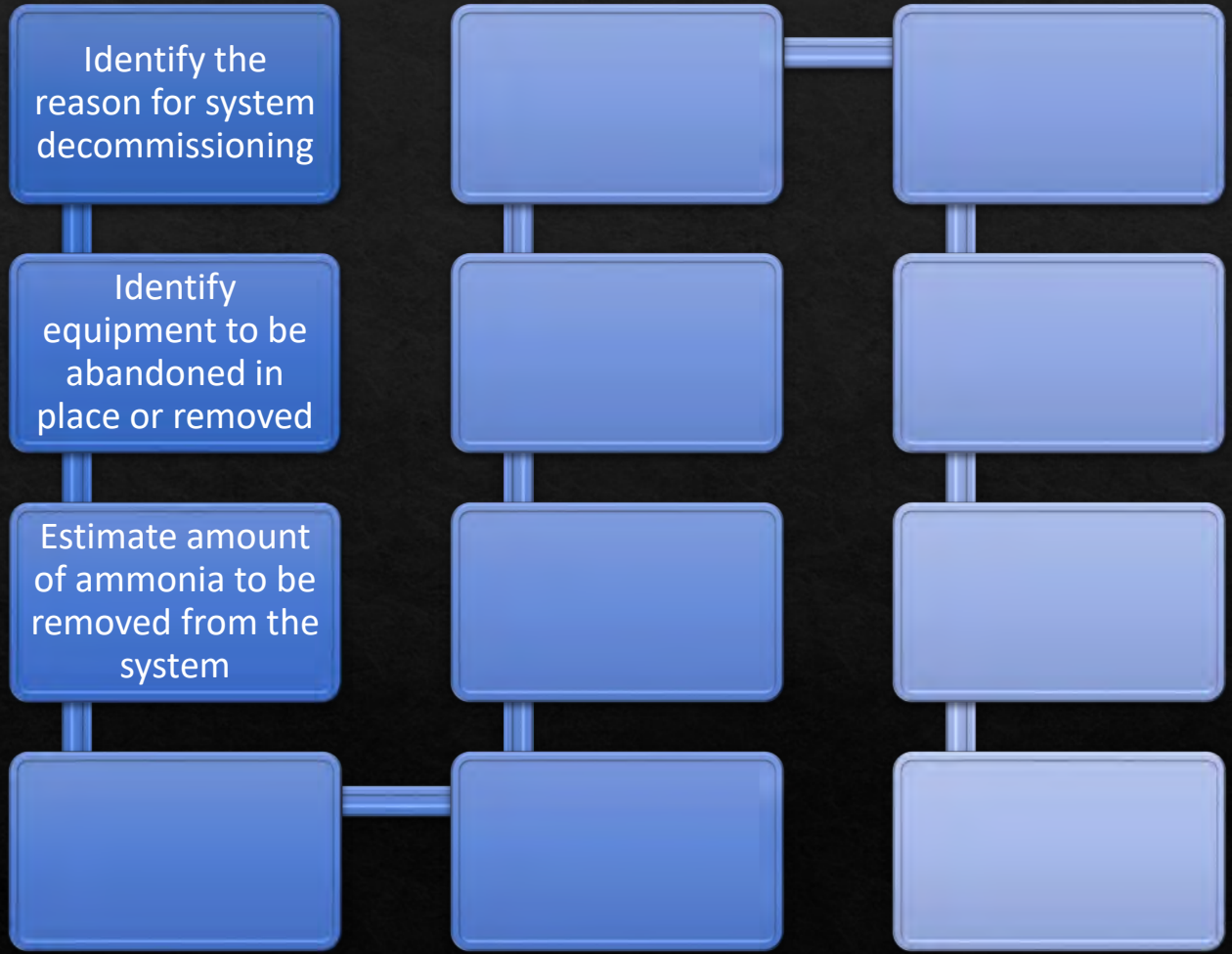
- E – References and Sources of References

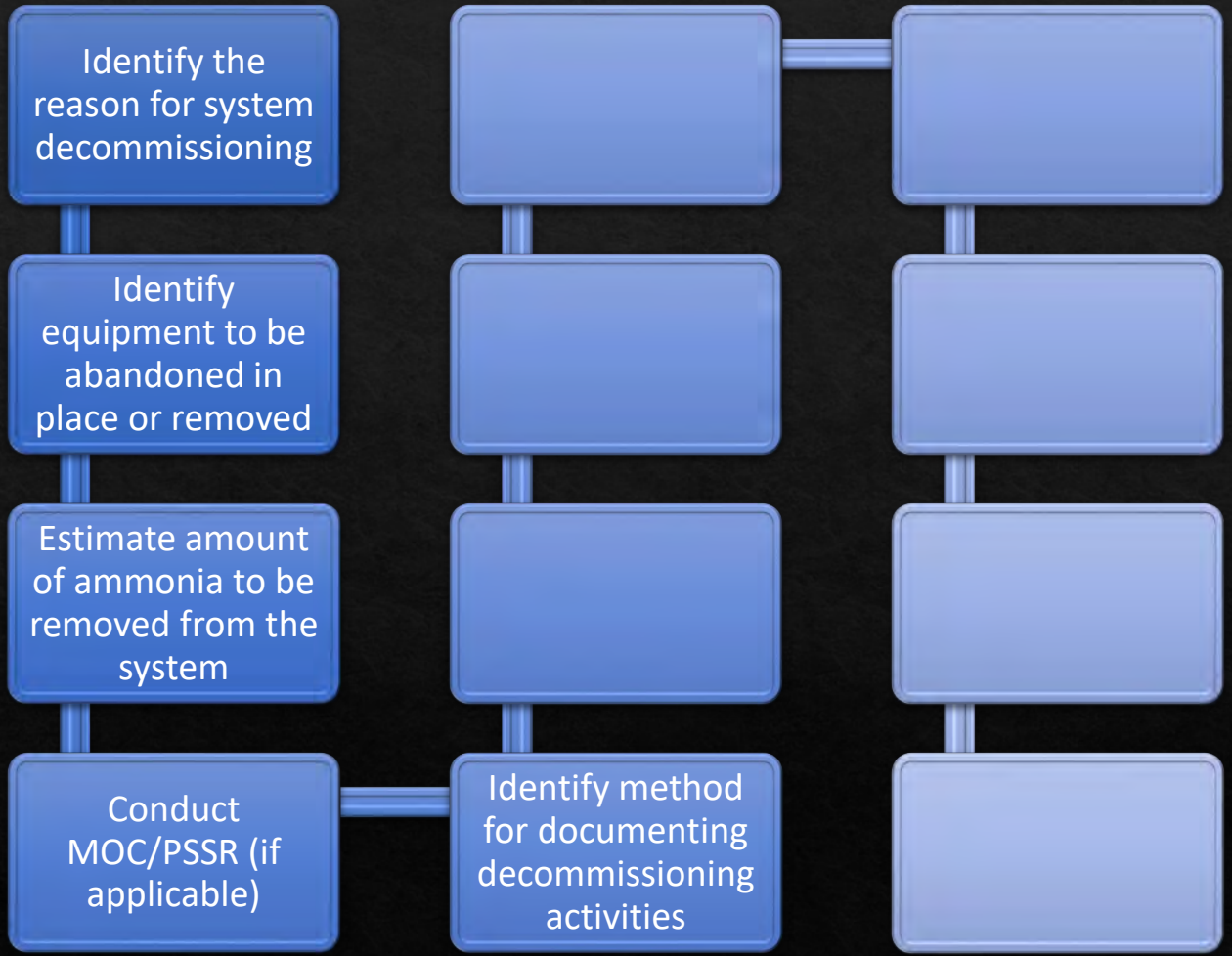
1.1 – Purpose

- This standard specifies the minimum requirements for the safe decommissioning of closed-circuit ammonia refrigeration systems.

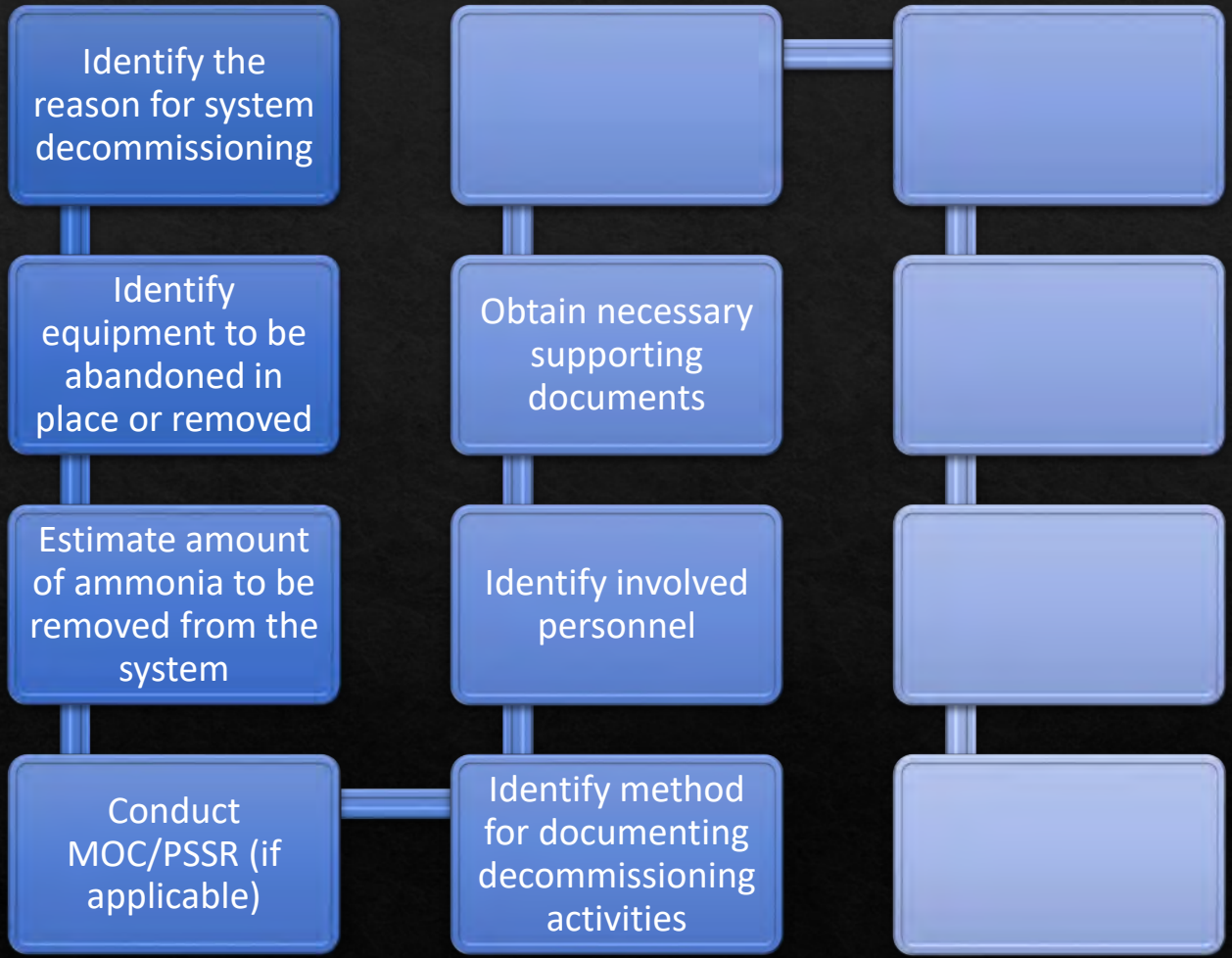
Decommissioning Process



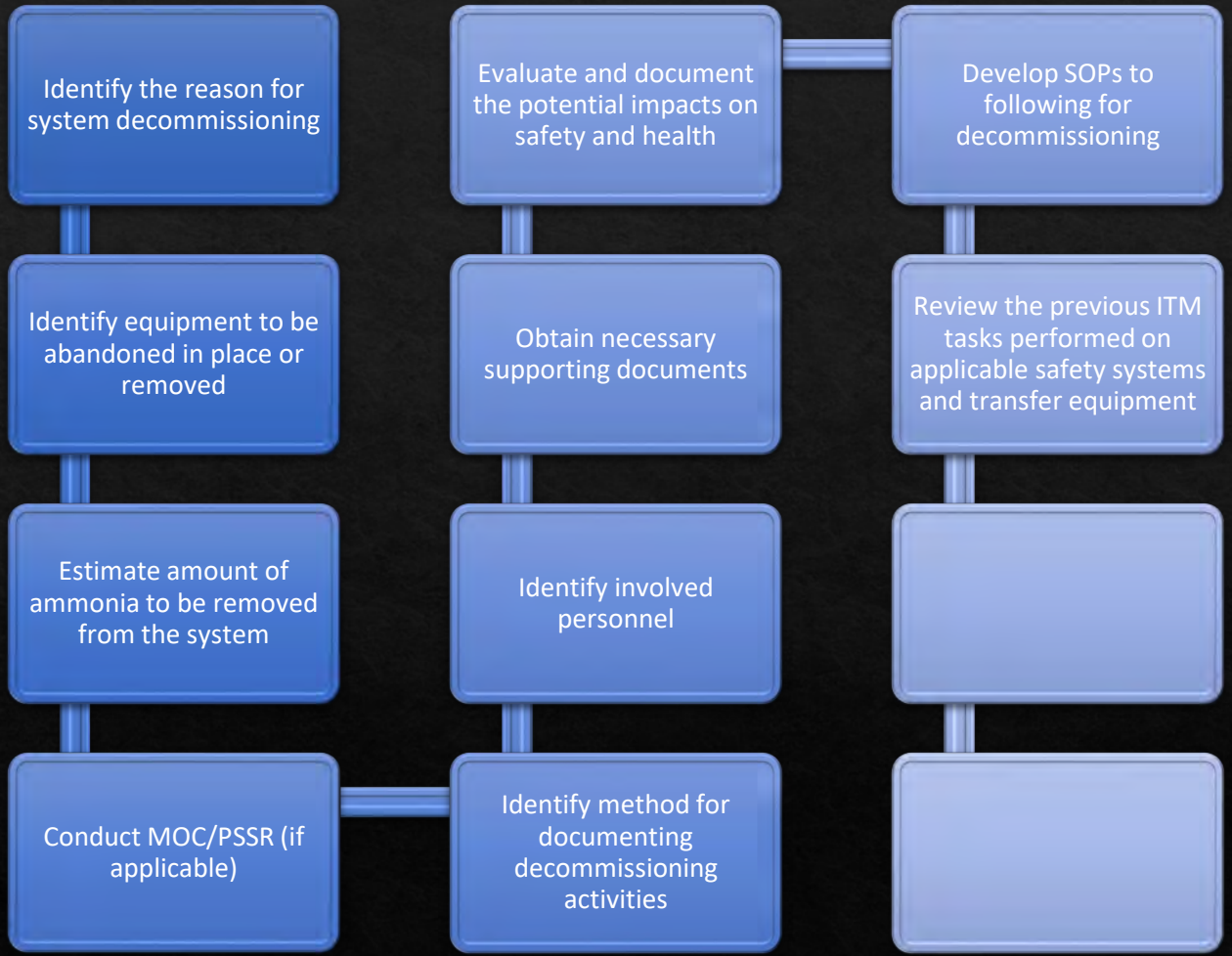
Decommissioning Process



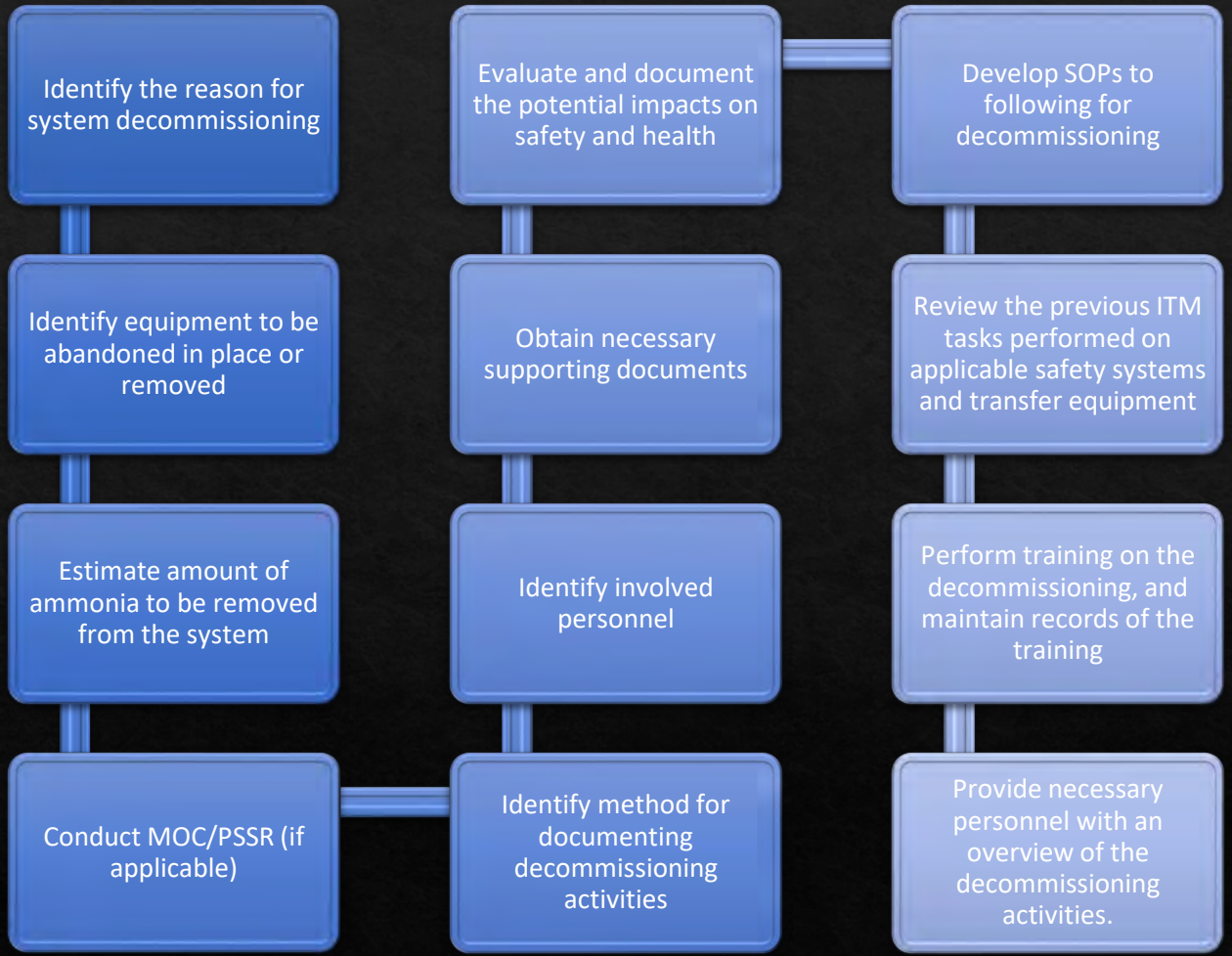
Decommissioning Process



Decommissioning Process



Decommissioning Process



IIAR 8

Normative Chapters

- 1 – Purpose and Scope
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- 3 – References
- 4 – Preparation
- 5 – Decommissioning Activities

Informative Appendices

- A – Explanatory Material
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- C – Example of a Final Review Checklist
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- E – References and Sources of References

Chapter 5: Decommissioning Activities

- § 5.1 Final Review
- § 5.2 Conduct Decommissioning Activities
- § 5.3 Follow-Up Activities

5.1 – Final Review

- Conduct a final review prior to the start of the decommissioning activities to ensure that the requirements in Chapter 4 have been addressed.
- Informative checklist in Appendix C

Decommissioning Checklist

Final Review	Person Responsible	Date Comp
Final Review Person Responsible Date Completed		
Has the purpose of the decommission been identified?		
Has the equipment that will be decommissioned been identified?		
Has the amount of ammonia that will be removed been estimated?		
Have the regulatory requirements been identified?		
Have the steps taken during decommissioning activities been documented?		
Have the personnel involved in decommissioning activities been identified?		
Have the supporting documents been obtained?		
Have the impacts on safety and health been evaluated and documented?		
Have the operating procedures been documented?		
Have the inspections, tests and maintenance been completed?		
Has the training been conducted and documented		
Have response personnel been provided with an overview of the decommissioning tivities?		

Appendix B: Example of a Decommissioning Checklist

Decommissioning Checklist

Facility Information	
Date of Decommissioning:	
Facility Name:	
Location:	
Description of Decommissioning Activities:	

Decommissioning Checklist				
Preparation	**Comments**	**Action Items**	**Person Responsible**	**Date Completed**
What is the purpose of the decommissioning?				
What equipment will be decommissioned?				
How much ammonia will be removed?				
What regulatory requirements must be met?				
What method(s) will be used to document the decommissioning activities?				
How long will the documentation be retained?				

Example Checklist Items

- Who will coordinate the decommissioning activities?
- What system diagrams are available?
- How will the impacts on safety and health be evaluated and documented?
- How will ammonia releases be detected?

Appendix C: Example of a Final Review Checklist

Final Review Checklist

Facility Information	
Date of Decommissioning:	
Facility Name:	
Location:	
Description of Decommissioning Activities:	

Decommissioning Checklist		
Final Review	**Person Responsible**	**Date Comp**
Final Review Person Responsible Date Completed		
Has the purpose of the decommission been identified?		
Has the equipment that will be decommissioned been identified?		
Has the amount of ammonia that will be removed been estimated?		
Have the regulatory requirements been identified?		
Have the steps taken during decommissioning activities been documented?		

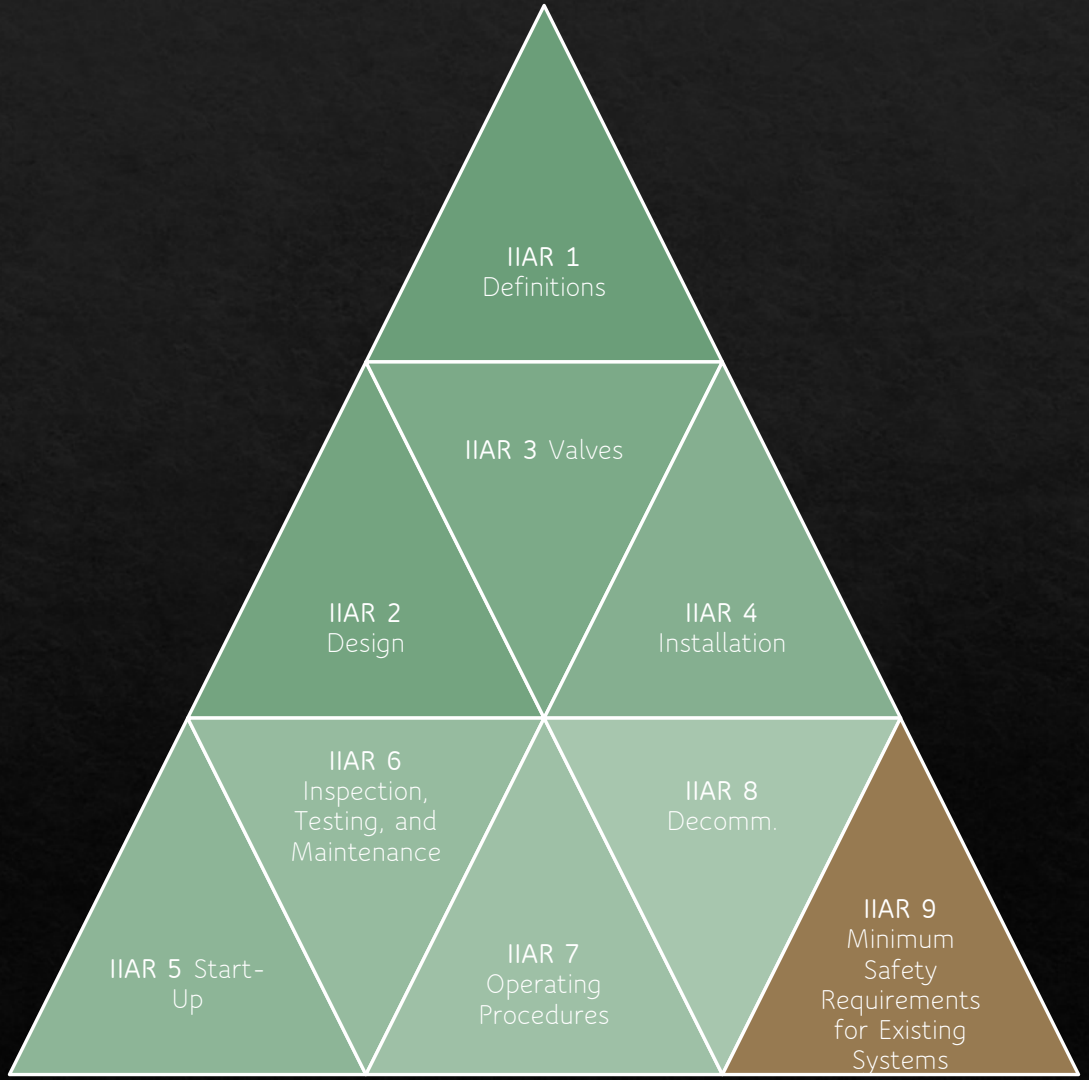
Example Checklist Items

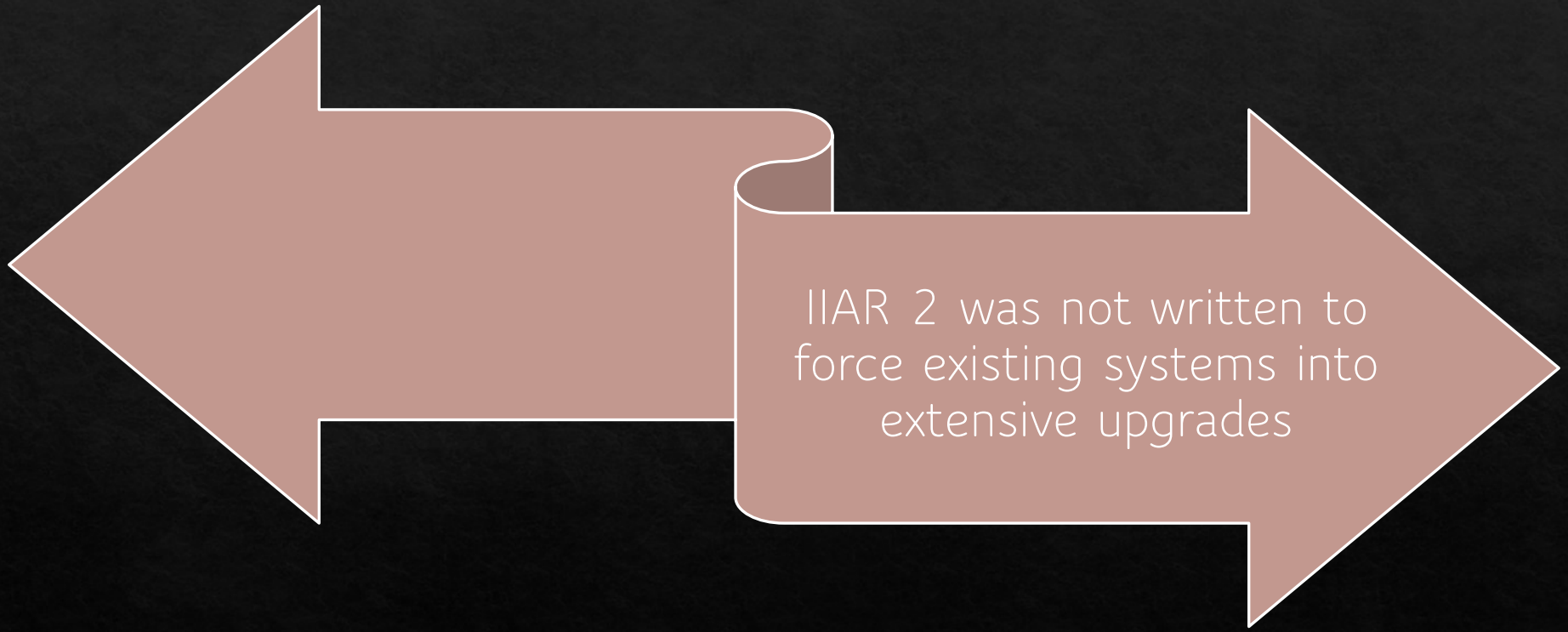
- Has the amount of ammonia that will be removed been estimated?
- Have the regulatory requirements been identified?
- Have the operating procedures been documented?
- Has the training been conducted and documented?

ANSI/IIAR 9-2020

Standard for Minimum System Safety Requirements for Existing Closed-Circuit Ammonia Refrigeration Systems

Standard 9


IIAR 1
Definitions
IIAR 3 Valves
IIAR 2
Design
IIAR 4
Installation
IIAR 6
Inspection, Testing, and Maintenance
IIAR 8
Decomm.
IIAR 5 Start-Up
IIAR 7
Operating Procedures
IIAR 9
Minimum Safety Requirements for Existing Systems


IIAR 2 was not written to force existing systems into extensive upgrades

ANSI/IIAR 2-2014 Addendum A §5.5.3(1)

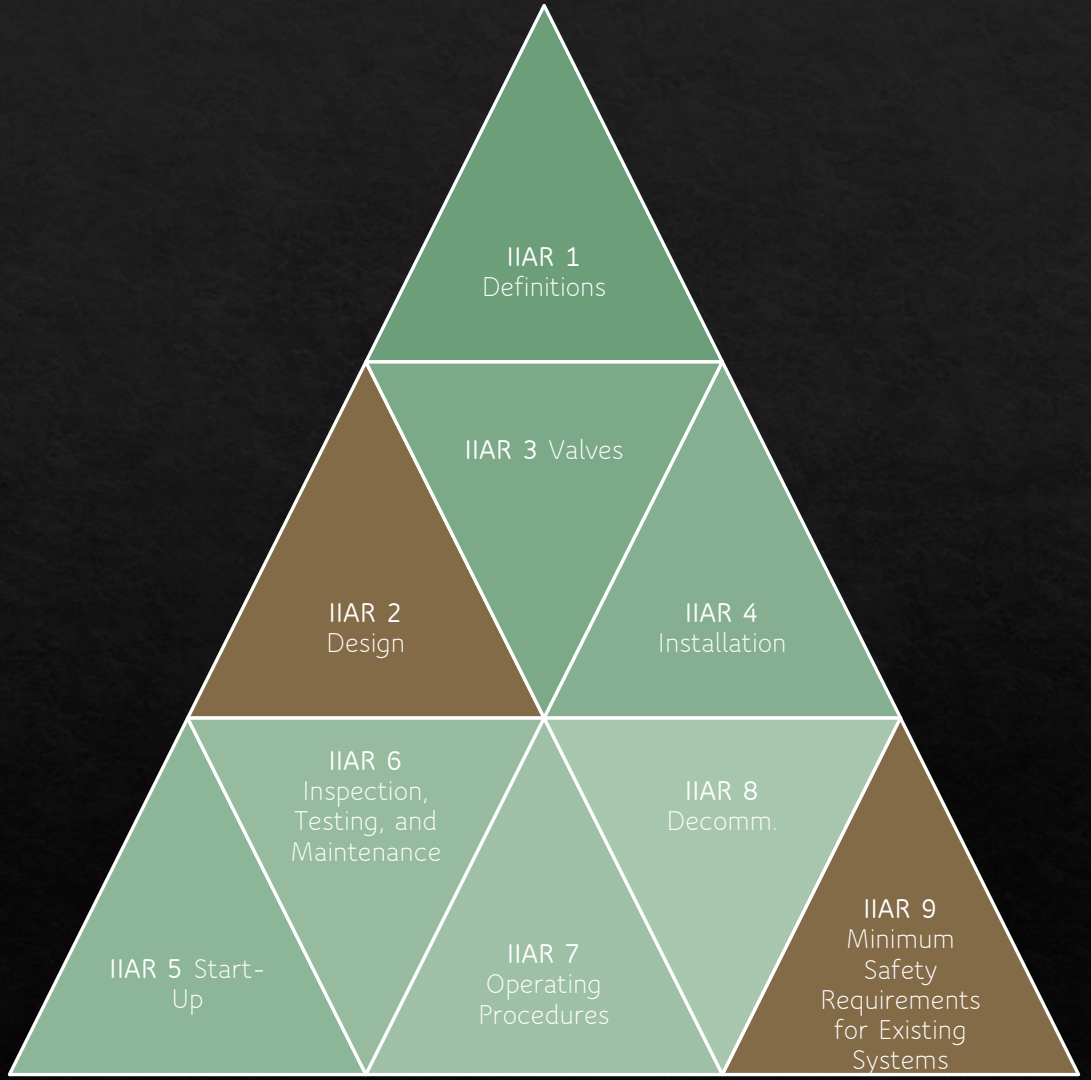
- 1. Low-pressure side: 10°F (5.6°C) higher than the 1% ambient dry-bulb temperature for the installation location or 114.6°F (45.9°C), whichever is greater. The minimum design pressure shall be 250 psig (1,724 kPa).

IIAR 2 was not written to force existing systems into extensive upgrades

Existing systems have risks that could impact employees and the community at large

IIAR 2 was not written to force existing systems into extensive upgrades

Standard 9


IIAR 1
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IIAR 5 Start-
Up
IIAR 7
Operating
Procedures
IIAR 9
Minimum
Safety
Requirements
for Existing
Systems

IIAR 9

Normative Chapters

- 1 – Purpose
- 2 – Definitions
- 3 – References
- 4 – Equipment and System Documentation
- 5 – Inspection, Testing, and Maintenance
- 6 – System and Equipment Operation
- 7 – Minimum System Safety Requirements Applicable to All Systems
- 8 – Minimum System Safety Evaluation Methodology

Informative Appendices

- A – Explanatory Materials
- B – Equipment/System Component Documentation
- C – Additional Equipment/System Component Documentation
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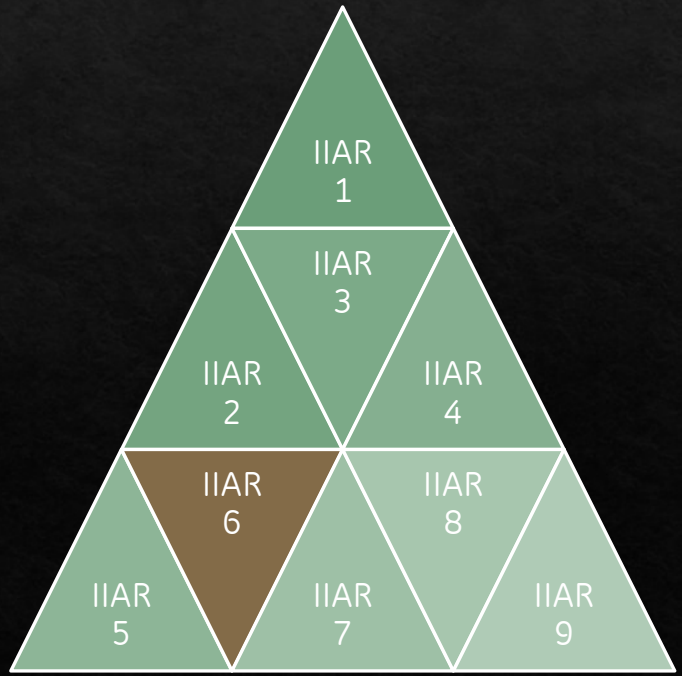
Chapter 1: Purpose

- § 1.1 Purpose
  - § 1.1.1 This standard provides the minimum safety requirements for existing closed-circuit ammonia refrigeration systems.

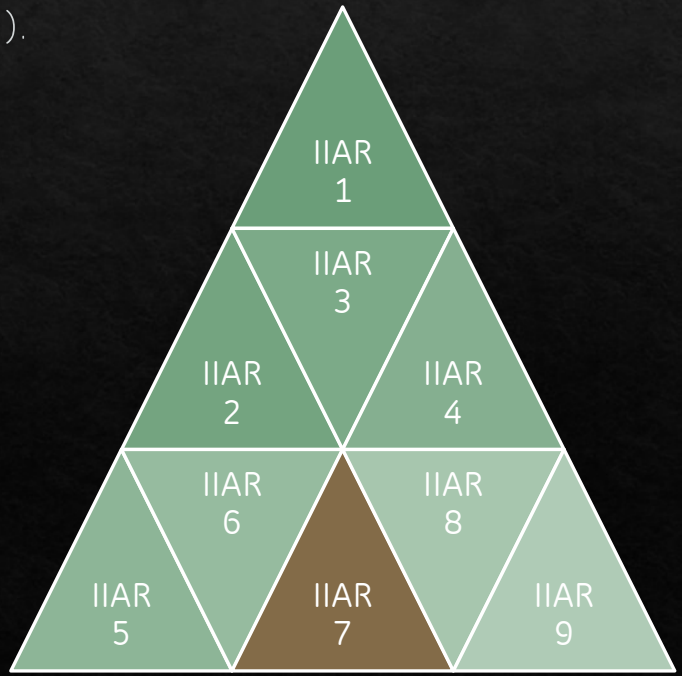
Chapter 5: Inspection, Testing, and Maintenance

- §5.1 All equipment and system components shall be inspected, tested, and maintained in accordance with ANSI/IIAR 6 (2019).



Chapter 6: System and Equipment Operation

- §6.1 Operating procedures shall be developed in accordance with the requirements of ANSI/IIAR 7 (2019).



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Normative Chapters

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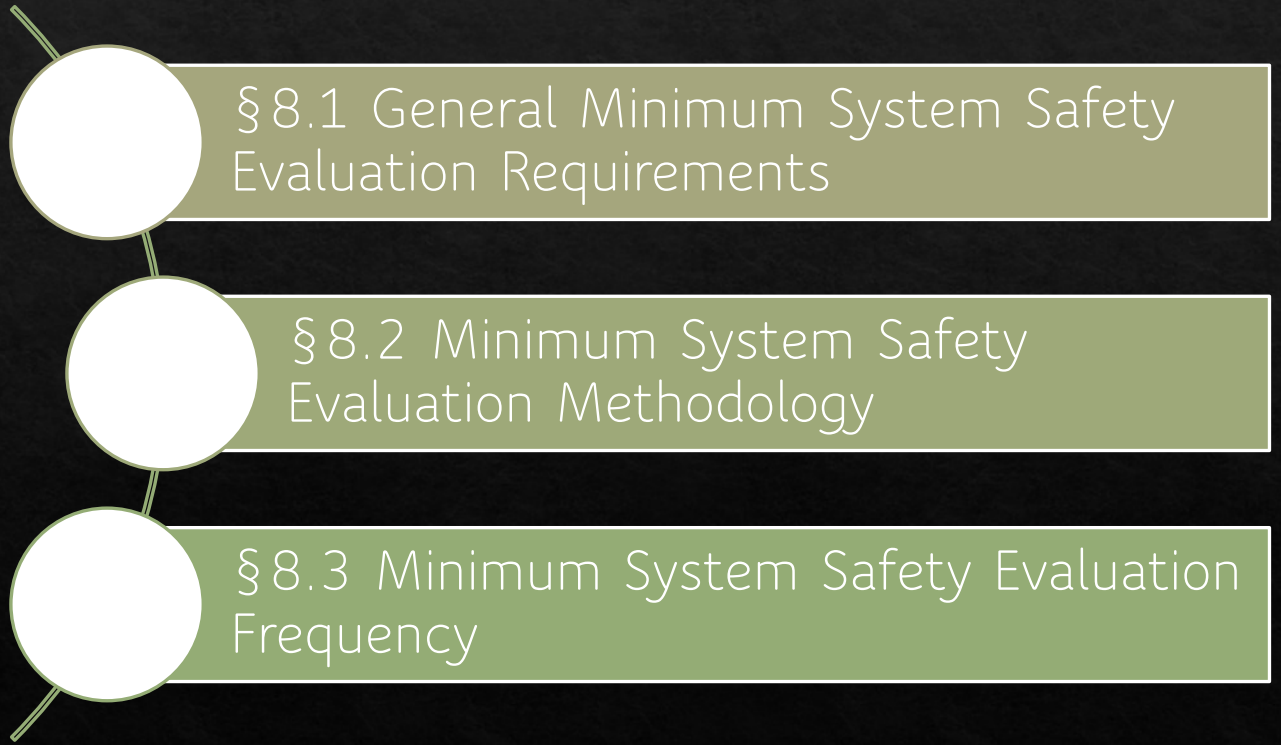

MSSE Frequency

- Initial evaluation is required within five years of the date of publication (~March 18, 2020)
- Evaluations must be revalidated at least every five years

Appendix E

Table E.1

BSR/IIAR 9-2019 Detection System Requirements	Existing Machinery Room Ammonia Detection System	Gaps Identified	Method Used to Address Gaps
7.3.12.1 (1): At least one ammonia detector shall be provided in the room or area.	The machinery room contains two ammonia detectors.	None	N/A
7.3.12.1 (2): The detector shall activate an alarm that reports to a monitored location so that corrective action can be taken.	The machinery room ammonia detectors activate alarms at 25 ppm on the facility call-down system.	None	N/A
7.3.12.1 (3) (Part 1): Audible and visual alarms shall be provided inside the room for alarm response.	Audible and visual alarms are provided inside the machinery room.	None	N/A
7.3.12.1 (3) (Part 2): Additional audible and visual alarms shall be located outside of each entrance to the machinery room for alarm response.	An audible and visual alarm has been provided outside the main entrance to the machinery room.	There is no audible and visual alarm outside the secondary entrance to the machinery room.	Install an audible and visual alarm outside the secondary entrance to the machinery room. This action item will be tracked in the facility's PSM on-line tracking system.

IIAR 9

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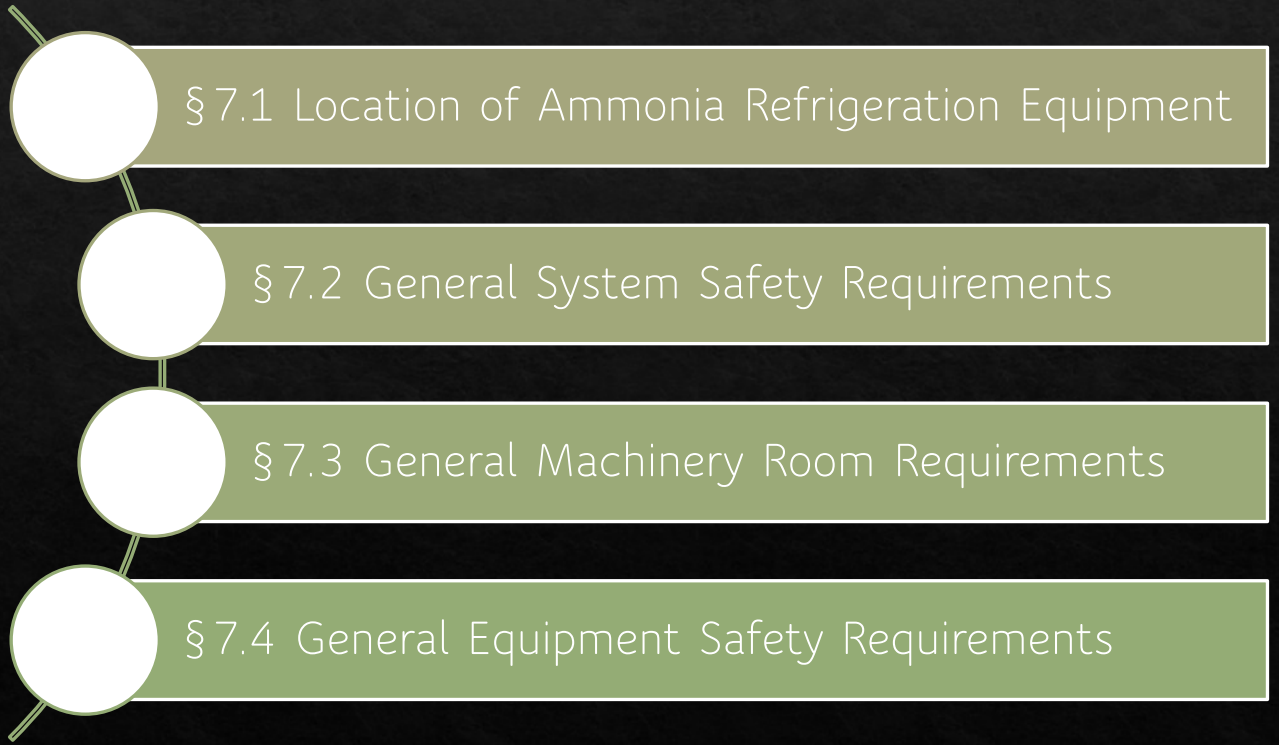


Location of Ammonia Refrigeration Equipment

- Permissible Locations
  - Machinery Rooms
  - Outdoors
  - Select equipment can be installed indoors, in the areas other than machinery rooms:
    - Evaporators
    - Condensers
    - Low-probability pumps
    - Valves
    - Any system or portion thereof with total connected drive power not exceeding 100 HP

Minimum System Pressure Ratings

Area of System	Design Pressure
Low-pressure side	150 psig
High-pressure side (water-cooled)	250 psig
High-pressure side (evaporative-cooled)	250 psig
High-pressure side (air-cooled)	300 psig

System Temperature

(Spec. no., grade) (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	ENDS	0.563	None	N/A	N/A	2:1	N/A	N/A	N/A	CONCAVE

Body Flanges on Heads

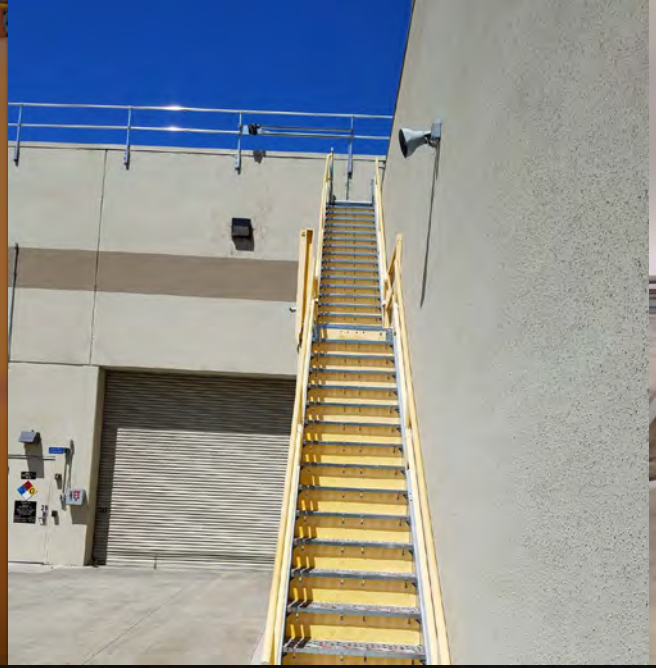
	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Bolting			
									Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
(a)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A

9. MAWP 250 psi (Internal) FV (External) at max. temp. 250 °F (Internal) 250 °F (External)

Min. design metal temp. -20 °F at 250/FV Hydro, pneu., or comb. test pressure HYDRO at 325 psi

Proof test N/A

Oil Management




Service Provisions

Signage, Labels, Pipe Marking, and Wind Indicators

Access and Egress


Access to Valves

Restricted Access

Combustible Materials

Pipe Marking

ISEA
INTERNATIONAL
SAFETY EQUIPMENT
ASSOCIATION

ANSI/ISEA Z358.1-2014

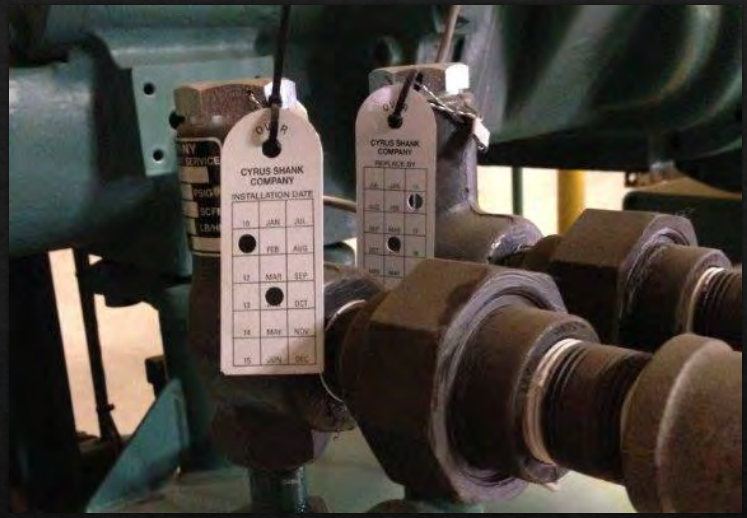
American National Standard
for Emergency Eyewash and

Eyewash and Safety Shower

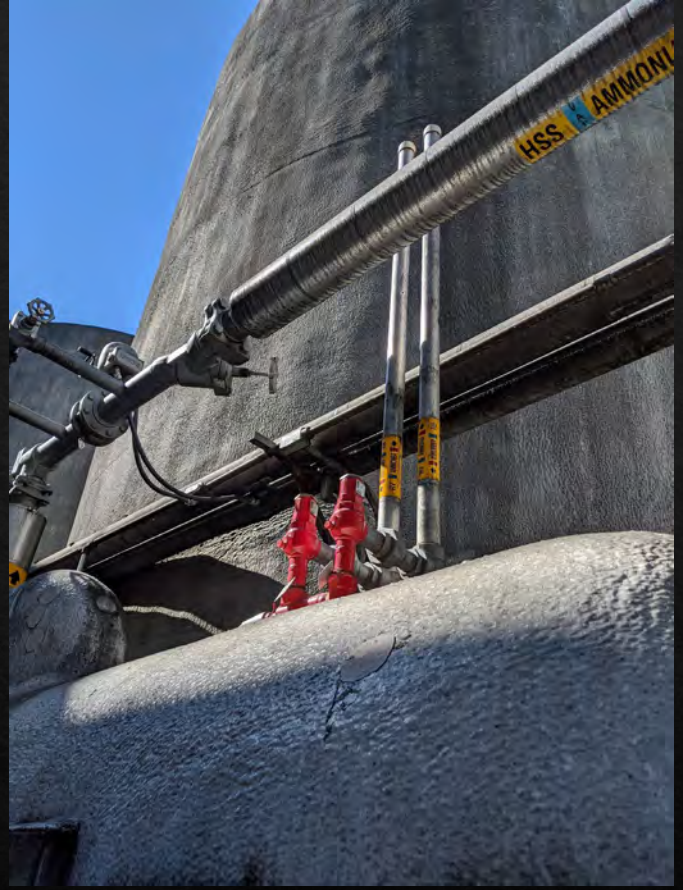
Ammonia Detection and Alarms



Ventilation



Pressure Relief Protection



Atmospheric Discharge

High Liquid Level Shutdown

Ammonia Monitoring During a Power Failure

Any Questions?

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