

September 26-29, 2017

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# RAGAGEP: Codes, Standards, and Good Engineering Practice

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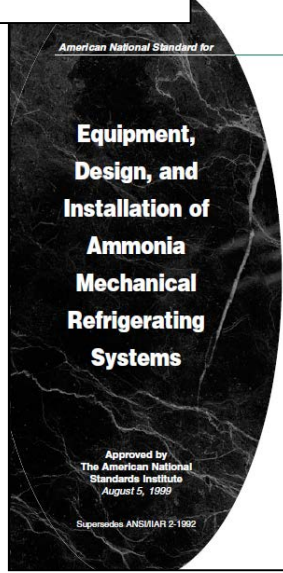
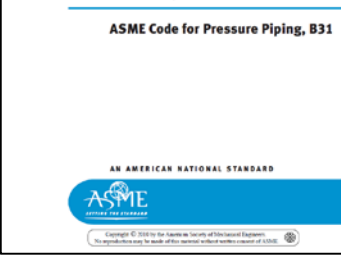
PETER THOMAS, P.E. | PRESIDENT AND ENGINEER

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# Introduction



Bulletin No. 114 March 2014



ANSI/ASHRAE 2-1999  
American National Standard For  
ANSI/ASHRAE 2-2008, (With Addendum B)  
Equipment, Design, and Installation of Closed-Circuit  
Ammonia Mechanical Refrigerating Systems



# PSM RAGAGEP References

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## Title 29 §1910.119(d)(3)(ii) Process Safety Information

- The employer shall document that equipment complies with recognized and generally accepted good engineering practices.

## Title 29 §1910.119(j)(4)(ii) Mechanical Integrity

- Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.

## Title 29 §1910.119(j)(4)(iii) Mechanical Integrity

- 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.

# RAGAGEP Citations

Citation 1 Item 2 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 (RAGAGEP's).

On or about \_\_\_\_\_, the employer did not document that is complied with recognized and generally accepted good engineering practices (RAGAGEP) exposing employees to the hazards of inhalation of toxic ammonia and/or fire/explosion in the following instances, see A through E:

A. The employer failed to document compliance with RAGAGEP, such as **IIAR Bulletin 114** "Identification of Ammonia Refrigeration Piping and System Components" Section 4.1 "Piping Markers" and Section 5.0 (a-d) "Marker Location", March 2014, as the employer failed to mark and/or label ammonia refrigeration equipment, including:

1. Engine Room 5, Evaporating Condenser, tower EC-1
2. Engine Room 6, Evaporating Condenser, tower EC-2
3. Engine Room 7, Evaporating Condenser, towers EC-1 and EC-2
4. Engine Room 8, Evaporating Condenser, towers EC-1, EC-2 and EC-3
5. Engine Room 11, Evaporating Condenser, tower EC-1, EC-2 and EC-3

B. Failure to document compliance with RAGAGEP, such as **IIAR Bulletin 110** "Guidelines for: Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems" Section 6.6 Valves and Sensing Devices Subsection 6.6.1 Shut-off Valves, as the employer failed to change out ammonia refrigeration system safety relief valves prior to their 5 year due dates from the date of installation, including:

1. Engine Room 6, Heat Exchangers 1, 2 and 3. These are dual relief systems using Hansen Valves.

**ABATEMENT DOCUMENTATION REQUIRED FOR THIS ITEM**

Date By Which Violation Must be Abated:  
Proposed Penalty:

07/29/2016  
**\$7000.00**

# OSHA RAGAGEP Memo

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## Four examples of RAGAGEP

1. Widely adopted codes
2. Consensus documents
3. Non-consensus documents
4. Internal standards

May 11, 2016

**MEMORANDUM FOR:** REGIONAL ADMINISTRATORS

**THROUGH:** DOROTHY DOUGHERTY  
Deputy Assistant Secretary

**FROM:** THOMAS M. GALASSI, Director  
Directorate of Enforcement Programs

**SUBJECT:** RAGAGEP in Process Safety Management Enforcement

# Ammonia Refrigeration Code Organizations

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# IIAR Literature

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IIAR Bulletin No. 107 *Guidelines for: Suggested Safety and Operating Procedures When Making Ammonia Refrigeration Plant Tie-ins*

IIAR Bulletin No. 108 *Guidelines for: Water Contamination in Ammonia Refrigeration Systems*

IIAR Bulletin No. 109 *Guidelines for: IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System*

IIAR Bulletin No. 110 *Guidelines for: Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems*

IIAR Bulletin No. 111 *Guidelines for: Ammonia Machinery Room Ventilation*

IIAR Bulletin No. 112 *Guidelines for: Ammonia Machinery Room Design*

IIAR Bulletin No. 114 *Guidelines for: Identification of Ammonia Refrigeration Piping and System Components*

IIAR Bulletin No. 116 *Guidelines for: Avoiding Component Failure in Industrial Refrigeration Systems Caked by Abnormal Pressure or Shock*

IIAR Bulletin No. R1 A *Guide to: Good Practices for the Operation of an Ammonia Refrigeration System*

# IIAR Literature - Bulletins

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IIAR Bulletin No. 110 §6.4.2 [emphasis mine]:

*The system should be checked regularly for the presence of non-condensable gases which should be purged as necessary from the receiver(s) and/or condenser(s), preferably into a noncondensable gas remover or purger but alternatively into water. Where an automatic purger is fitted, its correct operation should be monitored. If there is a large accumulation of noncondensable gases the reason should be investigated and the cause should be corrected.*



# IIAR Suite of Standards

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- **ANSI/IIAR 1** Definitions and Terminology Used in IIAR Standards
- **ANSI/IIAR 2** Standard for Safe Design of Closed-Circuit Ammonia Refrigeration 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
- **IIAR 6** Standard for Inspection, Testing, and Maintenance of Safe Closed-Circuit Ammonia 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
- **IIAR 9** RAGAGEP Standard

# IIAR Bulletins Currently in Publication

Bulletin No. 114 March 2014

Guidelines for:

Identification of  
Ammonia Refrigeration  
Piping and  
System Components

International Institute of  
Ammonia Refrigeration  
**iiar**<sup>®</sup>

Bulletin No. 109 10/97

Guidelines for:

IIAR Minimum  
Safety Criteria for  
a Safe Ammonia  
Refrigeration  
System

International Institute of  
Ammonia Refrigeration  
**iiar**<sup>®</sup>

Bulletin No. 110 3/93

Guidelines for:

Start-up, Inspection  
and Maintenance of  
Ammonia Mechanical  
Refrigerating Systems

International Institute of  
Ammonia Refrigeration  
**iiar**<sup>®</sup>

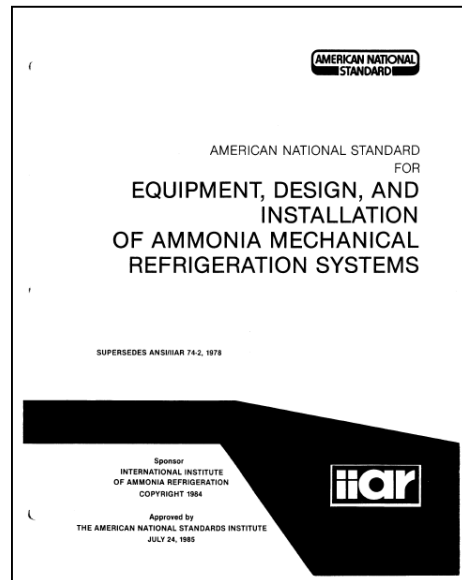
# IIAR Standard 2

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

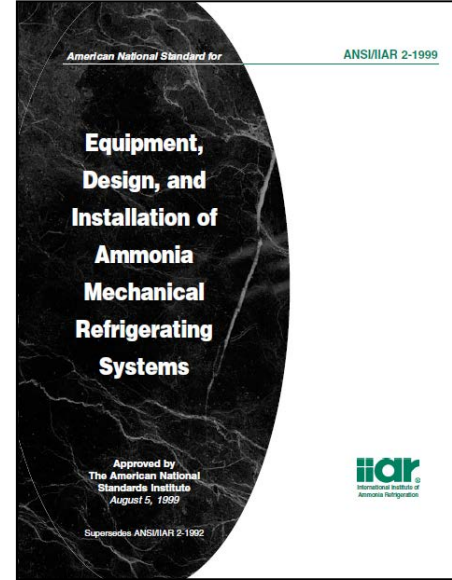
1974-78



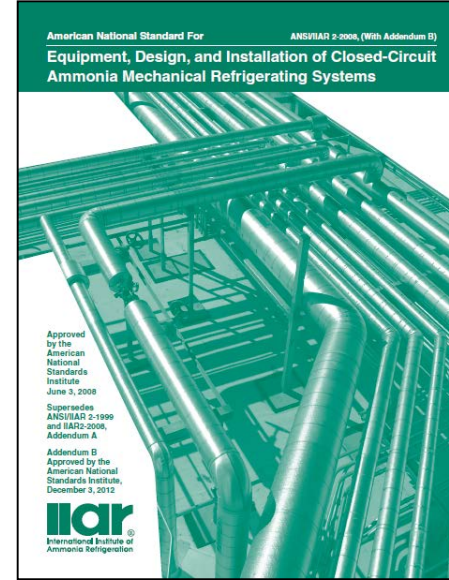
1984



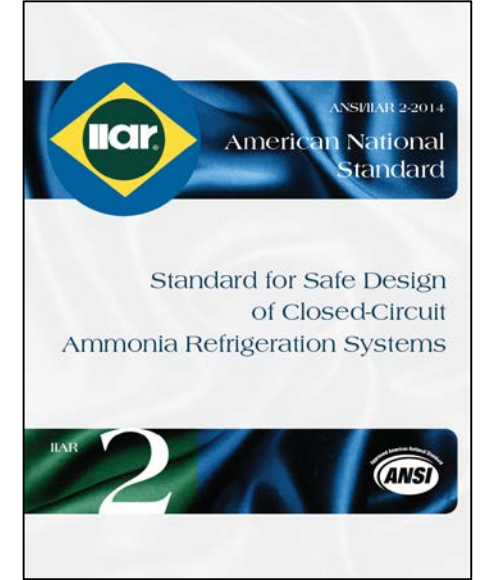
1999



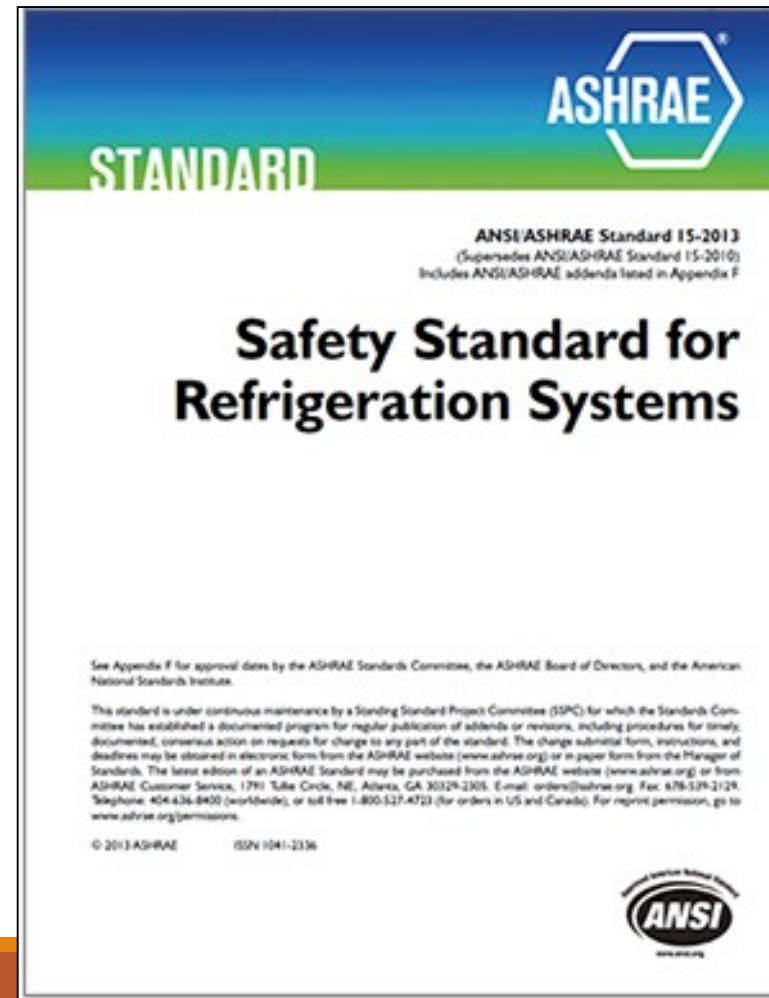
2008



2014

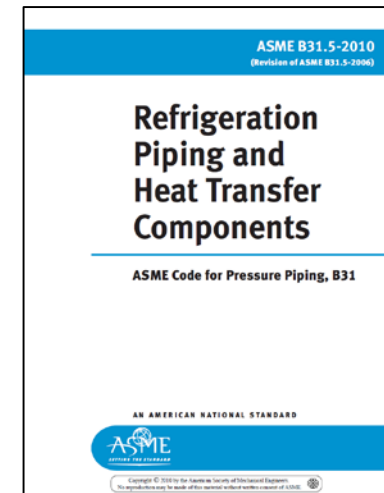
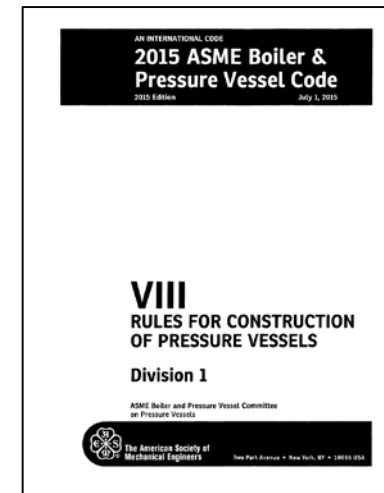
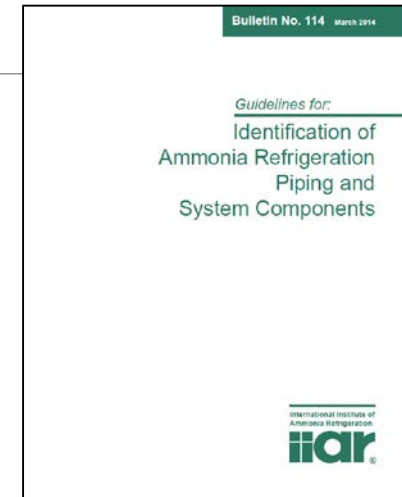


# IIAR 2 vs. ASHRAE 15



# Other RAGAGEP Documents

- IIAR Bulletin No. 114 *Guidelines for: Identification of Ammonia Refrigeration Piping and System Components*
- International Mechanical/Fire Code
- ASME B31.5 *Refrigeration Piping and Heat Transfer Components*
- ASME Boiler and Pressure Vessel Code Section VIII *Rules for the Construction of Pressure Vessels*
- ANSI/ISEA Z358.1-2014 *Emergency Eyewash and Shower Equipment*



# RAGAGEP Confusion

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- **2015 IMC §1101.6**
  - Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, **ASHRAE 15** and **IIAR 2**.
- **ANSI/IIAR 2-2014 §5.7.2.1**
  - Cast iron, malleable iron, nodular iron, steel, cast steel, and alloy steel shall be permitted in accordance with **ASME B31.5** or **ASME B&PVC, Section VIII, Division 1**. Other metallic materials, including but not limited to aluminum, aluminum alloys, lead, tin, and lead-tin alloys shall be permitted in accordance with Section 5.7.1. Where tin and tin-lead alloys are used, the alloy composition shall be verified as suitable for temperature exposures, as specified in Section 5.6.

# RAGAGEP Confusion

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- **ANSI/IIAR 2-2014 §6.7.3**
  - Emergency eyewash/safety shower unit installations shall comply with **ANSI/ISEA Z358.1**.
- **ANSI/IIAR 2-2014 §6.15.1**
  - Buildings and facilities with refrigeration systems shall be provided with placards accordance with **NFPA 704** and the **Mechanical Code**.

# RAGAGEP Confusion

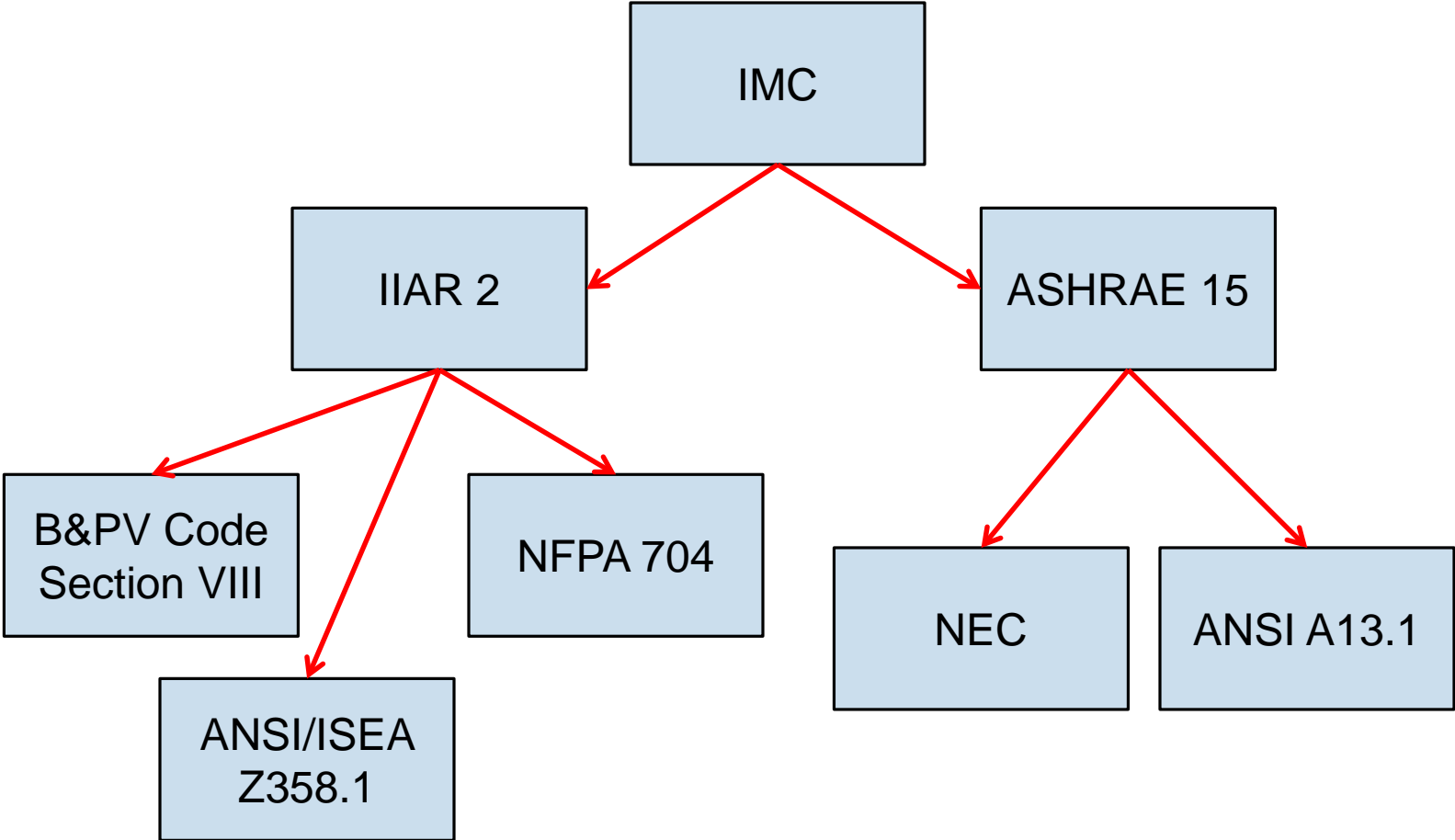
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- **ANSI/ASHRAE 15-2013 §11.2.2**
  - the kind of refrigerant or secondary coolant contained in exposed piping outside the machinery room. Valves or piping adjacent to valves shall be identified in accordance with **ANSI A13.1, Scheme for Identification 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

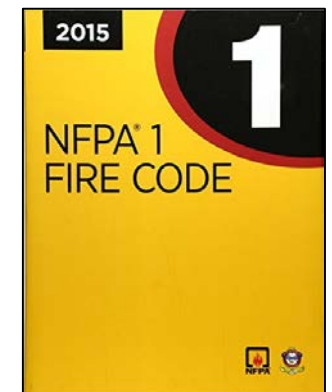
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# IIAR and Model Codes

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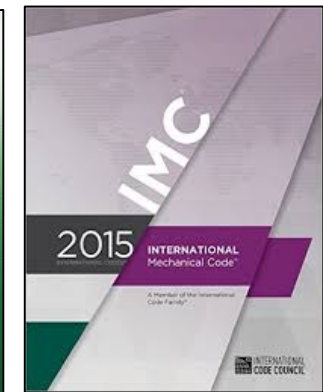
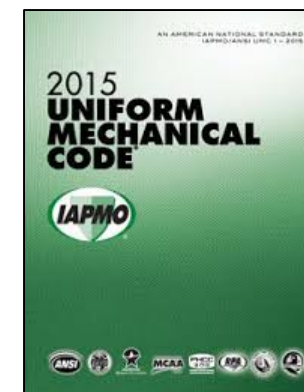
- **2015 IFC §606.12.1.1 Ammonia refrigeration.** Refrigeration systems using ammonia refrigerant and the buildings in which such systems are installed shall comply with **IIAR-2** for system design and installation and **IIAR-7** for operating procedures.
- **2015 NFPA 1 §53.1.3 Reference Codes and Standards.** Refrigeration systems shall be in accordance with ASHRAE 15 and the mechanical code. Refrigeration systems using ammonia as a refrigerant shall also comply with **ANSI/IIAR 2**, Standard for Equipment, Design and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems.



# IIAR and Model Codes

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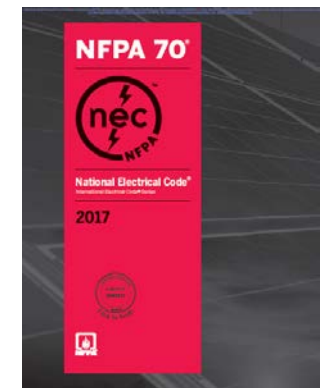
- **2015 UMC §1102.1 General.** Refrigeration systems shall comply with this chapter and ASHRAE 15.  
Exception: Ammonia refrigeration systems shall comply with **IIAR 2**, **IIAR 3**, and **IIAR 5**.
- **2015 IMC §1101.6 General.** Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15. Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15 and **IIAR 2**.



# IIAR and Model Codes

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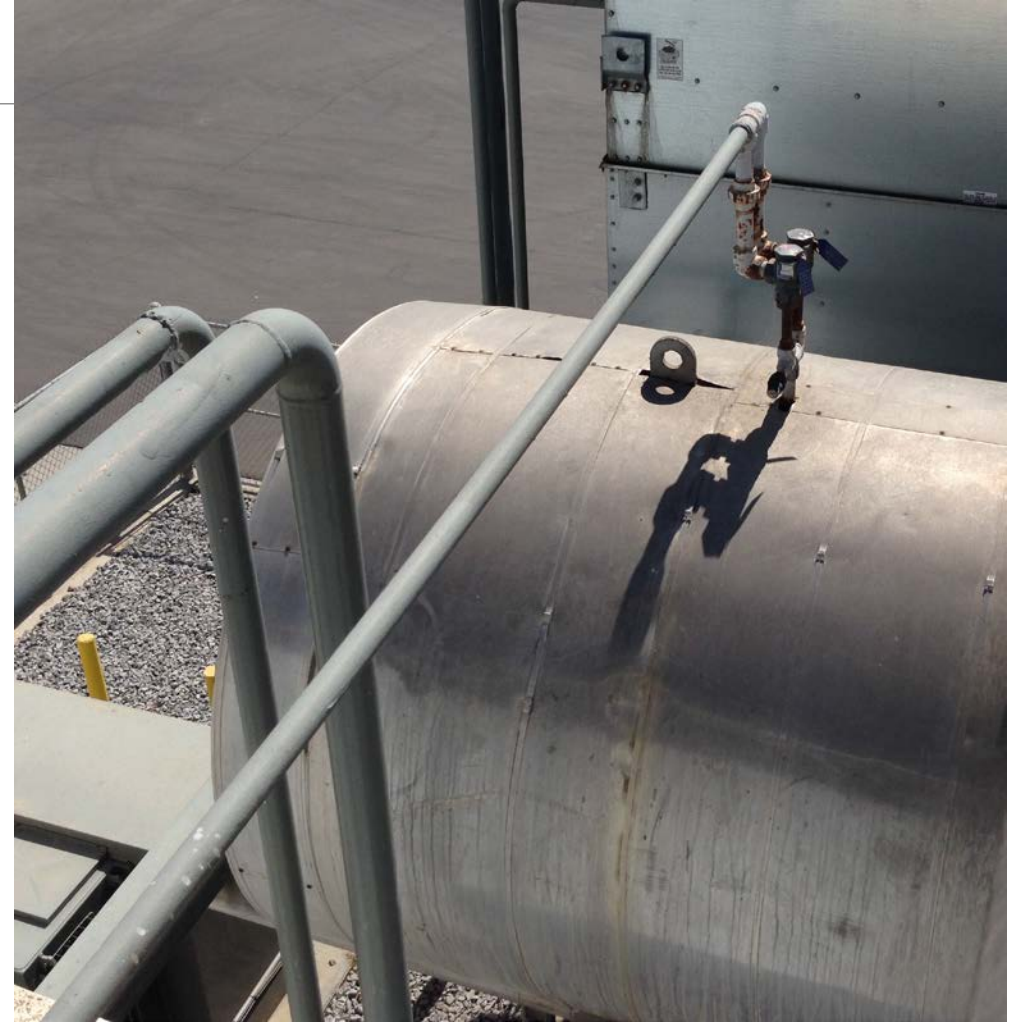
- **NFPA 70-2017 §505.5** Refrigerant machinery rooms that contain ammonia refrigeration systems and are equipped with adequate mechanical ventilation that operates continuously or is initiated by a detection system at a concentration not exceeding 150 ppm shall be permitted to be classified as “unclassified” locations. Informational Note: For further information regarding classification and ventilation of areas involving closed-circuit ammonia refrigeration systems, see ANSI/ASHRAE 15-2013, Safety Standard for Refrigeration Systems, and **ANSI/IIAR 2-2014**, Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems.



# Conflicts in RAGAGEP

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- **Maximum Length of Relief Valve Discharge Piping**



# Conflicts in RAGAGEP

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## Maximum Length of Relief Valve Discharge Piping

$$\text{2012 UMC: } L = \frac{9P^2 d^5}{16C^2}$$

*VS.*

$$\text{2012 IMC: } L = \frac{0.2146d^5(P_0^2 - P_2^2)}{fC_r^2} - \frac{d \times \ln(P_0/P_2)}{6f}$$

# Conflicts in RAGAGEP

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## Relief Valve Discharge Termination



# RAGAGEP Conflicts – Best Practices

- **Documentation** - Clearly document the RAGAGEP(s) used in design and installation
- **Communication**
  - Role of the AHJ
  - Role of the Design Engineer
  - Role of the Contractor
  - Role of Consultant / PHA Team



## Design and Installation Codes and Standards Employed

To the best of the undersigned's knowledge, the *Ammonia Refrigeration Project* at ACME Cold Storage was designed and installed in accordance with the following codes and standards:

- 2016 International Mechanical Code Chapter 11 *Refrigeration*
- 2016 International Fire Code Section 606 *Mechanical Refrigeration*
- ANSI/IIAR 2-2014 *Standard for Safe Design of Closed Circuit Ammonia Refrigeration Systems*
- ANSI/IIAR 4-2015 *Installation of Closed-Circuit Ammonia Refrigeration Systems*
- ANSI/ASHRAE 15-2013 *Safety Standard for Refrigeration Systems*
- ASME B31.5-2016 *Refrigeration Piping and Heat Transfer Components*
- 2015 ASME Boiler & Pressure Vessel Code Section VIII *Rules for Construction of Pressure Vessels, Division 1*

Print Name \_\_\_\_\_

Signature \_\_\_\_\_

Date \_\_\_\_\_



# Grandfathering

## Scenario:

- Cold Storage Facility was built in 1969 in accordance with the 1967 UMC.

U.M.C. STANDARD 15-1-67

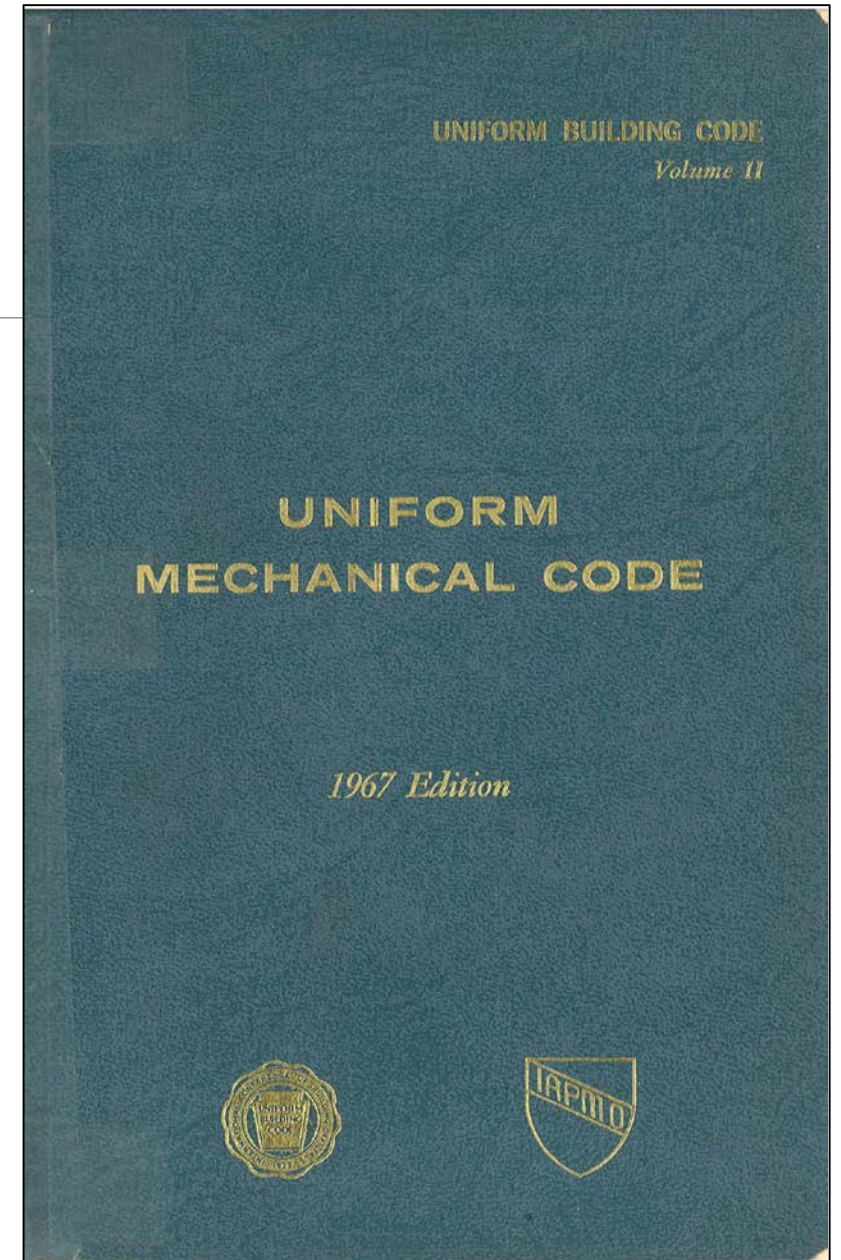
UNIFORM MECHANICAL CODE

UNIFORM MECHANICAL CODE STANDARD NO. 15-1-67

MECHANICAL REFRIGERATION

Based on Standard B9.1-1964 of the United States of America Standards Institute

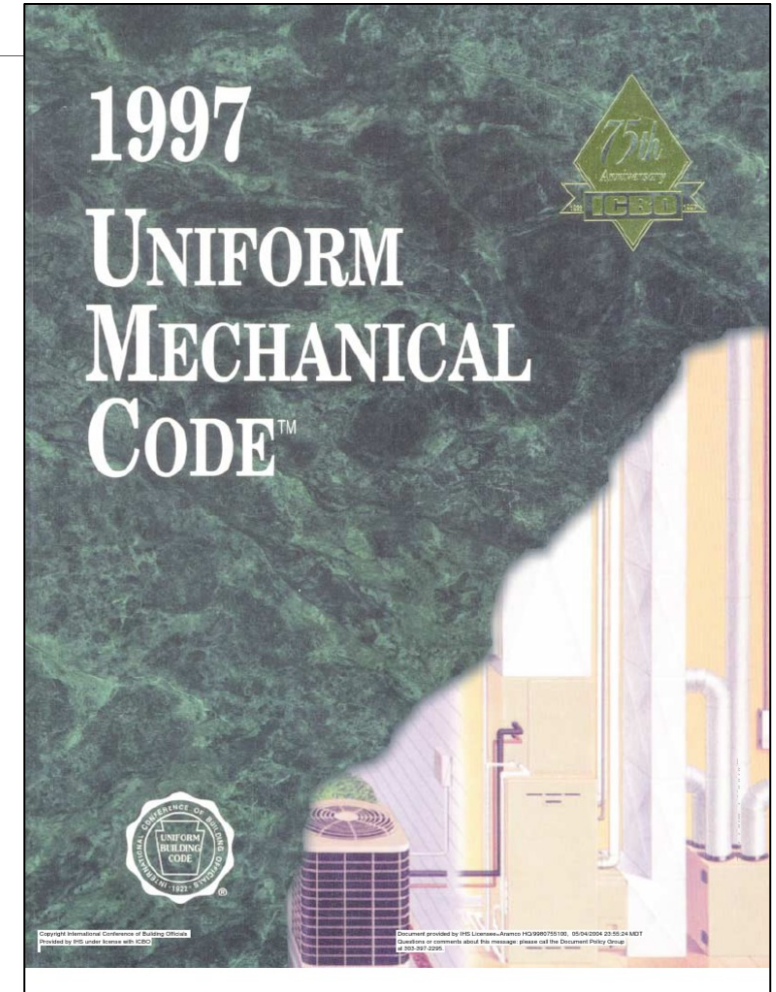
See Section 1501, Uniform Mechanical Code



# Grandfathering

## Scenario:

- In 1998, modifications were made to the machinery room
  - New compressor installed
  - AHJ required ventilation and detection to be upgraded
  - All changes performed in accordance with 1997 UMC



# Grandfathering

## Scenario:

- In 2014, facility hired a contractor to construct a new cold storage room
  - No machinery room modifications required
  - New room must comply with 2012 IMC and ANSI/IIAR 2-2008 Addendum B
  - Facility elected to upgrade detection for entire facility to comply with 2012 IMC



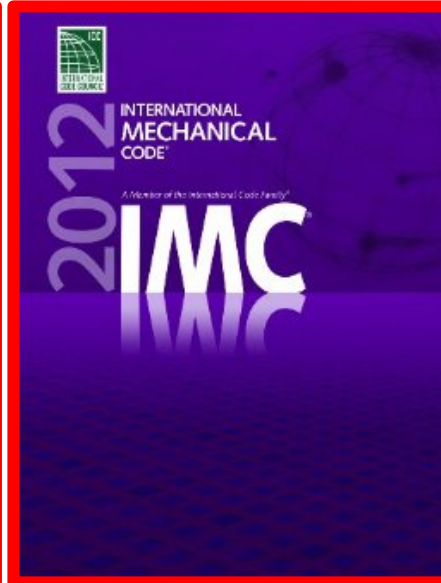
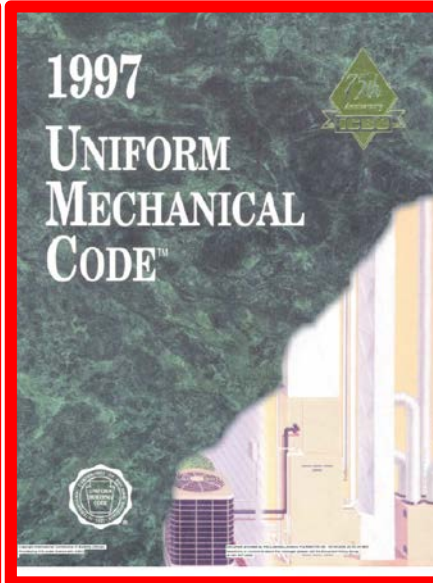
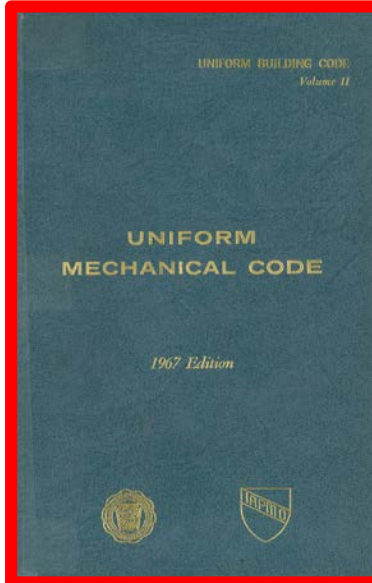
# Grandfathering

What RAGAGEP is applicable at the facility?

Originally  
Installed  
System

New Compressor  
and Ventilation  
System

New Room and Detection System

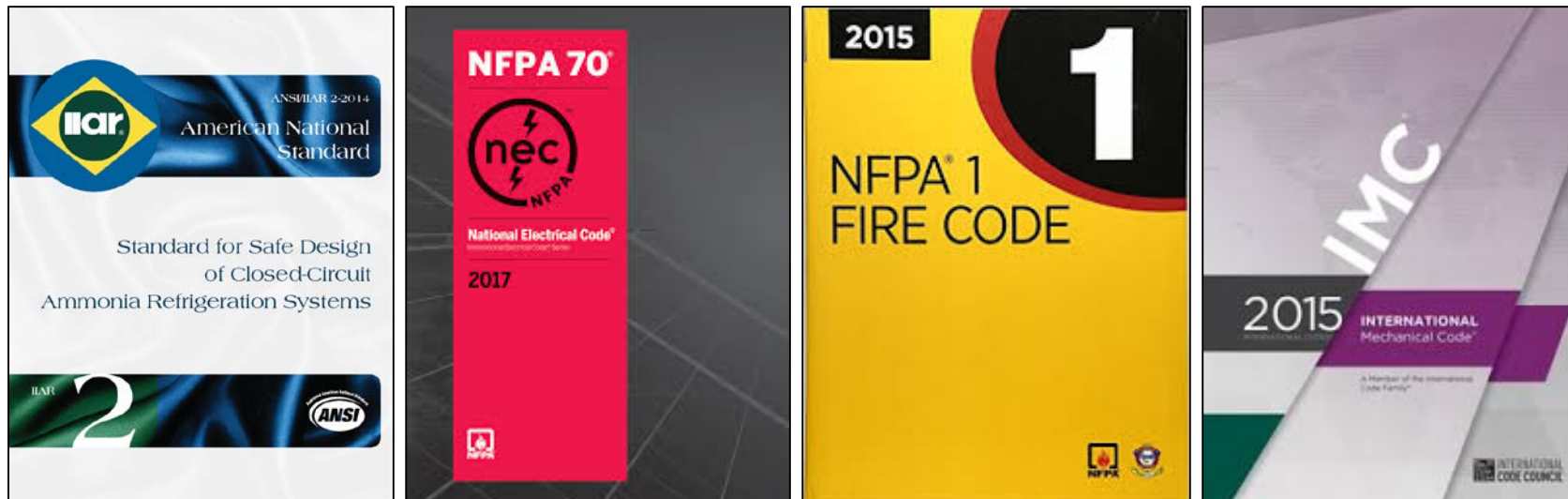


# Consideration of New RAGAGEPs

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When a new code/standard is released, what do I do?

- Role of Process Safety Information
  - Title 29 CFR §1910.119(d)(3)(ii) *The owner or operator shall document that equipment complies with recognized and generally accepted good engineering practices.*



# Addressing New Codes/Standards

When a new code/standard is released, what do I do?

- Role of PHA



| 1: Flooded Accumulator (Surge Drum)  |  |  |   |  |
|--|--|--|---|--|
| What If  | Scenarios  | Consequences   | Severity<br>Likelihood<br>Risk Rankings | Safeguards   |
| 1: What if the equipment or associated components is damaged by nearby activity? | A forklift driver accidentally hits this piece of equipment. | <ol style="list-style-type: none"> <li>1. Death</li> <li>2. Injury</li> <li>3. Low pressure liquid ammonia release</li> <li>4. Reactive maintenance</li> </ol> | 4 1 C                                   | <ol style="list-style-type: none"> <li>1. The flooded accumulators are located behind bunker walls which provide some protection from forklift impact.</li> <li>2. Facility forklift drivers have been trained to take extra care when driving around the refrigeration equipment.</li> <li>3. The flooded accumulators are located on the roof which is inaccessible to vehicle traffic.</li> </ol> |
| 2: What if the back pressure   | Actuator sticks in the                                       | 1. Product damage  | 2 3 C                                   | 1. Each room/zone is   |

# Addressing New Codes/Standards

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**When a new RAGAGEP is released, what do I do?**

- Role of Mechanical Integrity
  - Title 29 CFR §1910.119(j)(4)(ii) Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.



# Questions?

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