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REFRIGERATION CODES AND STANDARDS

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REFRIGERATION CODES AND STANDARDS

1.0 What is a Standard?

A Standard can be defined as a set of technical definitions and guidelines – or simply a "how to" instructions for engineers and manufacturers. It gives all the necessary requirements for the product, service, and operation.

While an engineer uses the standard to design the system, a manufacturer uses the standard for the manufacturing of operational equipment.

Standard serves as a common language for defining quality and establishing safety criteria for products. ASTM, API, ISO, ASHRAE and IIAR are some examples of the organizations that create standard. ASTM has more than 12,000 standards that cover almost everything. Whereas IIAR, ASHRAE, and ASME predominantly develop the standards for the ammonia refrigeration industry.

1.1 Why are Standards required?

Standards help to ensure requirements are met. For instance, in ammonia refrigeration industries, piping components are sourced from different parts of the world and irrespective of their originating country, all these materials are expected to perfectly fit with their corresponding parts at the point of construction.

Consequently, Standards are required for the following reasons:

1.1.1. They establish common engineering or technical requirements for equipment, practices, methods or operations that manufacturers, engineers, contractors and end users follow to manufacture equipment, design systems, build refrigeration facilities and operate the systems respectively.

1.1.2. They build and boost the user's confidence in the product quality.

1.1.3. With standardization, cost of production decreases since it enables bulk production for global markets.

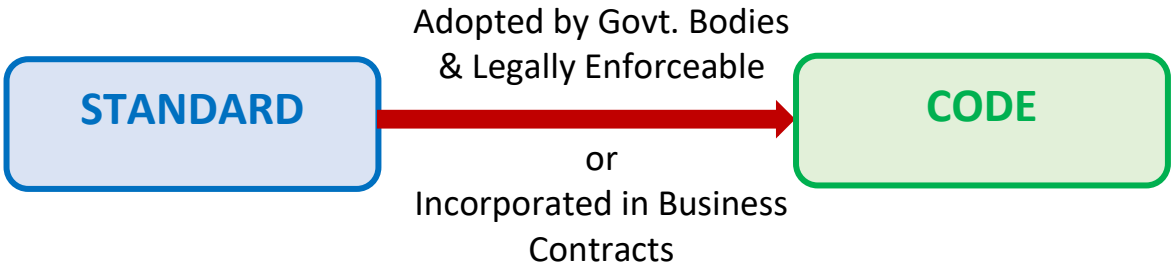


Figure 1: Schematic Representation of the Relationship between Codes and Standards

2.0 What is a Code?

When a standard is adopted by governmental bodies and has become legally enforceable, or when it is incorporated into a business contract, it becomes a code.

While ASME Codes are legally enforceable in the United States, they are not in other parts of the world. However, other countries have their respective similar codes. Although, most process facilities adhere to various American Codes and Standards, in addition to their national standards.

Requirements stated in codes will **only be mandatory** if

1. the code is adopted as a law by a regulatory body (example: State or City).
2. it is part of a business contract.

Otherwise, Codes will serve as generally accepted guidelines for design, fabrication, construction, and installation.

2.1 Why are Codes required?

2.1.1 Codes provide sets of rules that specify the minimum acceptable level of safety and quality for manufactured, fabricated or constructed equipment.

2.1.2 Codes also refer out to standards or specifications for the specific details on additional requirements that are not identified in the Code.

3.0 What is Specification?

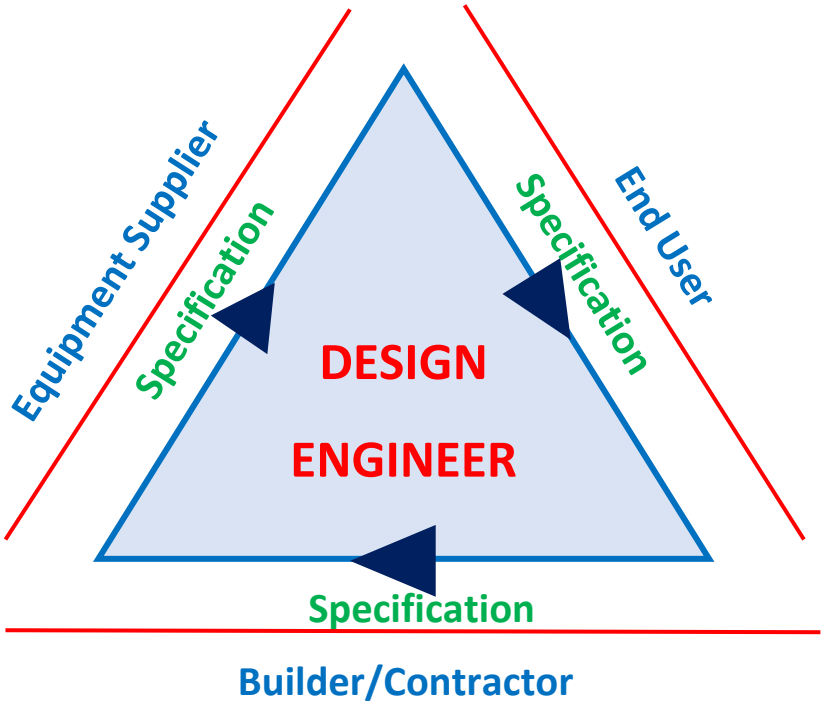
Specifications provide specific and/or additional requirements for the materials, components or services that are beyond the code or standard requirements. For instance, Food Company ABC requires **seamless** Stainless-Steel pipe for their refrigeration facilities in their specification or Purchase Order.

Specification is generated by private companies to address additional requirements applicable to a specific product or method of construction.

3.1 Why are Specifications required?

3.1.1 Specification allows purchasers to include special requirements as per design and service condition.

3.1.2 It allows the customizing of equipment, system design or construction.



4.0 Differences between Code, Standard and Specification in Piping (Table 1)

S/N	CODE	STANDARD	SPECIFICATION
1.	Enforceable by Law or by contract, for example: International Mechanical Codes (IMC), ASME	Globally accepted guidelines established by Subject Matter Experts of an	Must meet requirements by contracts, for example: Kraft Food Specification.

S/N	CODE	STANDARD	SPECIFICATION
	B31.5 Refrigeration Piping Codes, etc.	Organization, such as IIAR.	
2.	Written by government or government approved bodies.	Written by public organizations.	Written by private companies.
3.	Guidelines for design, fabrication, construction and installation.	Set of technical definitions and guidelines for manufacturing.	Additional requirements, beyond the codes and standards.

5.0 AUTHORITY HAVING JURISDICTION (AHJ)

According to the American National Electrical Code (NEC), Authority Having Jurisdiction (AHJ) is defined as “an organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, installations or procedure” (Article 100 of 2014 NEC)[11].

Codes and standards issues arise in the course of carrying out engineering or construction projects. These issues often demand the attention of governing authorities and/or subject matter expert. Consequently, it is important to identify

the AHJ(s) by agency/organization and preferably by the person's name at the beginning of any project. While the AHJs for small commercial and residential projects can be easily recognized, identifying the AHJs for large industrial facilities located outside governmental jurisdictions can be quite challenging.

It is important to note that local AHJs, despite their authority, can be overruled by OSHA inspectors and OSHA regulators. Therefore, it is important to be familiar with the OSHA program in construction sites and adhere to the laid down regulations especially in the design phase of any project.

Some guidelines that can help in developing communication with AHJ and conforming with local codes are listed below.

5.1 Understand the Applicable Standards and Codes to your Facility

It is important to understand what an AHJ is. Based on the NFPA definition provided above, the AHJ serves primarily as an official responsible for code interpretation, enforcement, and implementation.

The United States' codes and standards development process can be confusing. Unlike many other countries, there is no federal government code, so your AHJ requirements may differ depending on where your facility is located. Furthermore, the codes your AHJ is employed to enforce can differ depending on which edition of the code your jurisdiction has adopted. It is crucial to recognize the codes that are adopted by a jurisdiction, it ultimately should be noted as **law** for that jurisdiction.

5.2 Know what your Authority Having Jurisdiction requires

For one's benefit, it is important to be aware one's authority having jurisdiction's role could very well be several organizations, offices or other municipalities given

authority. The requirements your AHJ is employed to enforce depends mostly on the type of building or property. Their main objective is to evaluate the overall condition of fire, life, and electric safety performance on your property and to confirm or request that they meet those up-to-date expectations.

The AHJ may be a federal, state, local, or other regional department or individual, such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having a statuary authority. Assuming your property is insured, the insurance company may also serve as the authority having jurisdiction.

The most common AHJ is usually the "property owner or his or her designated agent" who takes on the AHJ role. Specifically, for government installations, the commanding officer or departmental official can also assume the AHJ role. The Building Operating Management & Facility Maintenance Decisions (BOMFMD) [12] magazine provides a clear example, for instance, a commercial building, such as a hospital, would likely be subjected to multiple AHJ sectors' approvals primarily because of the high-rate safety services they provide. The BOMFMD Magazine breaks down what all of this means for the AHJ relation on a local, state, federal, and private level here:

- Local government: city building department, fire department
- State government: state fire marshal, state health department
- Federal government: Centers for Medicare & Medicaid Services
- Private sector: insurance company, third party certification/accreditation organizations

5.3 Compliance is Key when working with the Authority Having Jurisdiction

Keep in mind that the main objective of AHJ is not to burden your business, rather it is their duty to verify that your facility is safe for all employees and neighboring people. If your AHJ expects you to make changes, it is wholly intended for your best interest as an owner, your occupants, and the community.

In case of an emergency, any requested modifications also benefit the first responders. For instance, if a fire was to start in your building, first responders are going to assume your life safety systems are up to date. If you have failed to follow AHJ instructions, a first responders' ability to take control of a possibly dangerous situation could be compromised. Not only is this a disservice in respect to overall safety, but a potential legal ramification may follow, in which case, you may already be out of luck.

To reiterate, your AHJ has your best interests in mind as well as the interests of other involved parties.

5.4 Get to Know your AHJ and Keep them around

Generally, if you are a facility owner of a food manufacturing operation, your AHJ is an ally, so, it is important to treat them as such and take them seriously when they perform inspections. Keeping an open mind and providing the utmost transparency when relaying information pertaining to the building is crucial in maintaining a positive relationship with your AHJ, as well as the safety of anyone who goes into that building.

Sustaining a positive relationship with your AHJ(s) additionally provides you the opportunity to know your building inside and out in a way that will help you to conserve the integrity of the building, and therefore your business. It will also help you in case something goes wrong – you will be able to effectively communicate

where the issue is to provide the persons in charge of fixing or inspecting the issue all the facts. Good for you, but also good for your AHJ to know too.

Preserving this close relationship with your AHJ will also help to ensure they uphold that allied bond as well. Remember, your AHJ is not your enemy, your AHJ is your friend! It is up to you to maintain a good rapport, no matter the condition of your building(s), a good relationship with the AHJ can only improve the situation.

5.5 Document Inspections/Correspondences and Follow Up

Finally, to ensure a consistent positive relationship with your AHJ, document, document, document! Again, it is as beneficial for you as it is to the AHJ when you both are on (literally) the same page. Take notes during inspections, save all paperwork, and do not be afraid to ask questions.

6.0 REGULATORY LANGUAGE AND PROPER USE OF WORDS

Words have power and value, as a result, they are used with care and economy. Sometimes words come out easily, but they are like arrows from a bow, once out, they are not retractable. When with friends and associates in the industry, it may be acceptable to be a little careless with words. However, with regulators and code authorities, expressed thoughts may take on a whole new meaning, or be misinterpreted. Consequently, there is a need to exercise caution to ensure what is said is what is meant.

Why do we need to be concerned about words in refrigeration? Being too informal with words could get one in trouble. It may be allowed to mix up words to describe equipment, for example: slop tank, knock out drum, accumulator; or evaporator, evap., air unit, AHU, or heat exchanger, etc. What is meant in this case is usually known and understood.

However, mixing words such as codes, standards, and guidelines may be an entirely different story. These words are specific and different documents that should not be confused. They may provide support for each other, but they are not the same, and **they are not all codes**.

Guidelines and Standards are valuable documents at our industry that ensure proper installation and promote safety, but Guidelines and Standards should not be called codes. Each has its own language. Codes have “will” and “shall” which denote ‘mandatory’. Standards will also include this language and words like “may”, which denotes ‘recommended’. Guidelines have suggestive languages such as “may”, “it is suggested or recommended”, etc. Mandatory words are not used in guidelines. It is important to correctly identify each document type and use the appropriate words when referring to them.

When talking about codes, it is important to know that they are enforceable and legislated by Cities, Counties, States and National authorities. Codes set a minimum required level of quality for materials and the construction of various buildings and systems.

In our industry, several codes apply: International Mechanical Code (IMC); International Fire Code (IFC); Uniform Mechanical Code (UMC); Uniform Fire Code (UFC); American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BVP); and ASME B31.5 Refrigeration Piping and Heat Transfer Components – part of the ASME Code for Pressure Piping B31.

Codes are discipline specific, but they often refer to other codes such as the fire codes, electrical codes, etc. This helps to maintain the continuity between the disciplines to prevent conflicts.

Codes are to a degree an abridgment of the standards; they emphasize the most significant points. Standards are generally produced by various Trade organizations

such as American Society of Heating, Refrigerating, Air Conditioning Engineers (ASHRAE); and International Institute of Ammonia Refrigeration (IIAR). Examples of the standards of the industrial refrigeration industry are the American National Standards Institute (ANSI)/ASHRAE 15 Standard for Refrigeration Systems; and ANSI/IIAR 2 Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigeration Systems.

Standards are not codes and should not be referred to as the ASHRAE Codes or the IIAR Codes. They are not enforceable, but may be interpreted as best industry practice, and are referred to by codes. This is the case for both the ANSI/ASHRAE 15 and ANSI/IIAR 2, which are referenced in the IMC.

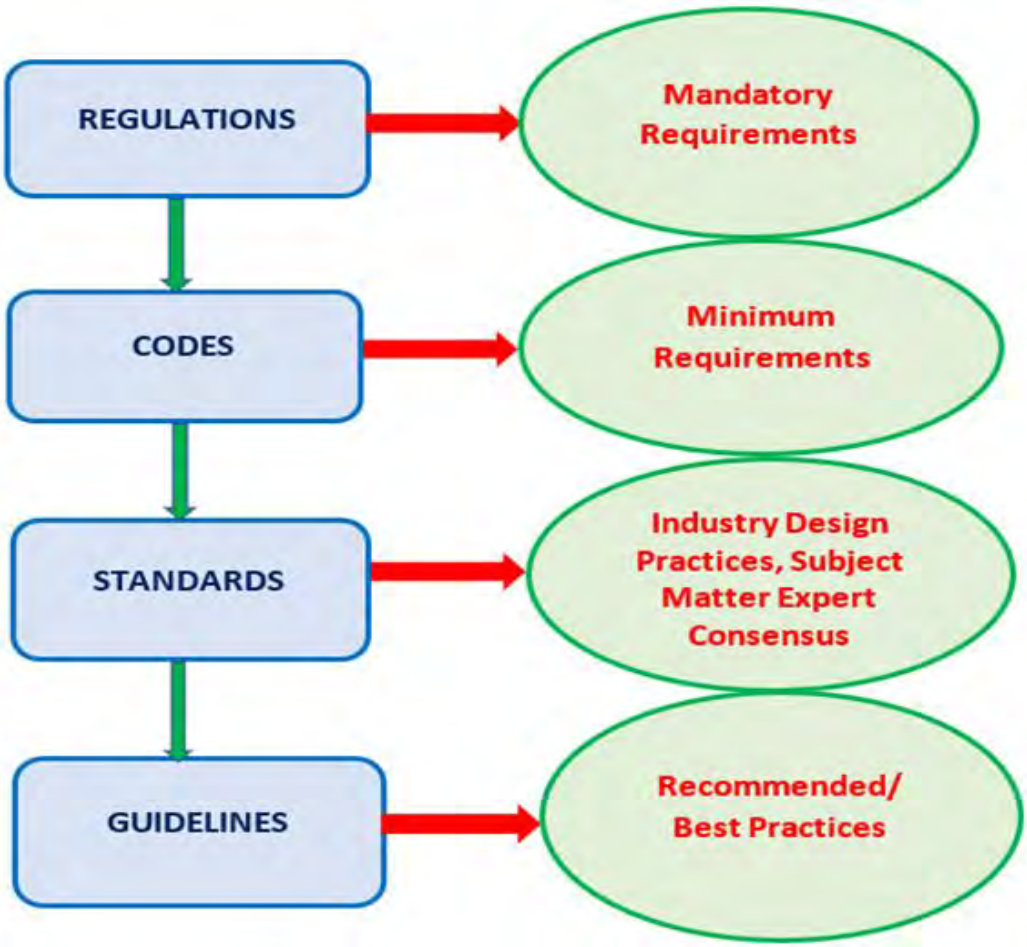
Guidelines are mostly recommendations and are task oriented. An example of a guideline is IIAR Bulletin 114, Guideline for: Identification of Ammonia Refrigeration Piping and System Components. This is a suggested method of marking pipes, valves, and system components.

Guidelines are not standards, and they are certainly not codes.

7.0 AMMONIA REFRIGERATION CODES & STANDARDS

Codes & Standards Change Log are outlined in the table below

DATE (M/D/YR.)	REVISION MADE
08/06/2019	IIAR 2 was updated for 2014 Addendum A- Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems. It was published in July 2019.
06/03/2019	IIAR 7 was updated for new edition. Notes on state and local building codes were added.
05/20/2019	IIAR 6 was updated for first edition.
12/18/2017	• Entry for Wisconsin Commercial Building Code was added. • The following entries were updated: SPS 345 (website URL changed), IMC, ASME Boiler and Pressure Vessel Code, ASME B31.5, IIAR 2, proposed IIAR 6, IIAR 7 and proposed IIAR 9.
11/03/2017	• The edition years for the following was updated: IIAR 1, IIAR3, and IIAR Bulletin 114. • The status of IIAR 6 and IIAR 9 was updated. • The clarification that IIAR Bulletin 107,111, and 112 have been superseded by IIAR Standards was made.
01/26/2017	• Entry for the proposed IIAR 9 was added. • The following entries were updated: ASME B31.5, IIAR 2, IIAR 6 (proposed), and IIAR Bulletins.



The list of Ammonia refrigeration regulations, codes, and industry standards (rules & standards) with their publication history is outlined below.

7.1 29 CFR 1910.119 – Title 29, Code of Federal Regulations (CFR), Section 1910.119

This is the Process Safety Management Plan (PSM) regulation administered by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA).

Federal Register (FR) publication and amendments: 57 FR 6403, February 24, 1992; 57 FR 7847, March 4, 1992, as amended at 61 FR 9238, March 7, 1996; 67 FR 67964, November 7, 2002; 76 FR 80738, December 27, 2011; 77 FR 17776, March 26, 2012; 78 FR 9313, February 8, 2013; 84 FR 15102, April 15, 2019. Available from http://gpo.gov or http://osha.gov [1 - 3].

7.2 40 CFR 68 -- Title 40, Code of Federal Regulations, Part 68.

This is the Chemical Accident Prevention/Risk Management Plan (RMP) regulation administered by the U.S. Environmental Protection Agency (EPA). Subpart D is the Program 3 Prevention Program.

Federal Register (FR) publication and amendments: 59 FR 4493, January 31, 1994. Re-designated at 61 FR 31717, June 20, 1996; 61 FR 31729, June 20, 1996; as amended at 62 FR 45132, August 25, 1997; 63 FR 645, January 6, 1998; 64 FR 980, January 6, 1999; 64 FR 28700, May 26, 1999; 65 FR 13250, March 13, 2000; 69 FR 18832, April 9, 2004. Available from http://gpo.gov or http://osha.gov [2 - 4].

7.3 International Mechanical Code (IMC)

The IMC has been published every 3 years since 2000. IMC 2000 was adopted, in part by Comm 45, Wisconsin Administrative Code, from November 1, 2003 to August 31, 2020. As regards Ammonia refrigeration, it is commonly referenced and

has been most consistent with ASHRAE 15 and IIAR 2, alongside additional requirements. The IMC may be purchased from the International Code Council [5].

7.4 ASHRAE 15

American National Standards Institute (ANSI)/American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), Standard 15, "Safety Standard for Mechanical Refrigeration." ASHRAE 15 has been published every 3 years since 2001, with more frequent addenda and interpretations available [6 – 7].

The forward of the 2013 edition describes, "The first Safety Code for Mechanical Refrigeration and was recognized as American Standard B9 in October 1930. It appeared in the first edition, 1932-1933, of the American Society of Refrigerating Engineers, ASRE Refrigerating Handbook and Catalog. ASRE revisions designated ASA B9 appeared in 1933 and 1939. ASRE revisions designated ASA B9.1 appeared in 1950, 1953, and 1958. After the formation of ASHRAE, editions appeared as ASA B9.1-1964, ANSI B9.1-1971, ANSI/ASHRAE 15-1978, ANSI/ASHRAE 15-1989, ANSI/ASHRAE 15-1992, ANSI/ASHRAE 15-1994, ANSI/ASHRAE 15-2001, ANSI/ASHRAE 15-2004, ANSI/ASHRAE 15-2007, and ANSI/ASHRAE 15-2010." ASHRAE publications may be purchased from http://ashrae.org [8]

7.5 ASME Boiler and Pressure Vessel Code

The American Society of Mechanical Engineers (ASME) has published this code since 1914. Recent editions include 2010, 2013, 2015, 2017, and scheduled for every two years going forward -- possibly with more recent interpretations or code cases. ASME publications may be purchased from https://www.asme.org [9].

7.6 ASME B31.5, “Refrigeration Piping and Heat Transfer Components”

This code was separated from the power-piping code (B31.1) in 1962, and revised in 1966, 1974, 1978, 1983, 1987, 1989, 1992, 2001, 2006, and every three years since 2010, possibly with more frequent addenda and interpretations. ASME B31.5 covers materials, design, fabrication, assembly, erection, testing, and inspection. ASME publications may be purchased from https://www.asme.org [9].

7.7 IIAR 1, ANSI/International Institute of Ammonia Refrigeration (IIAR), Standard 1, “Definitions and Terminology Used in IIAR Standards”

The first edition was published in 2010. The next and latest editions was published in 2017. IIAR publications may be purchased from http://iiar.org [10].

7.8 IIAR 2, ANSI/IIAR, Standard 2, “Safe Design of Closed-Circuit Ammonia Refrigeration Systems”.

The first edition was published in March 1974 as IIAR 74-2. Revised editions (or addenda) were published in 1984, December 1992, August 1999, October 2005, June 2008, August 2010, December 2012, November 2015 (named the 2014 edition), and July 2019 (named 2014 Addendum A). This standard was named "Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems" prior to the 2014 edition.

7.9 IIAR 3, ANSI/IIAR, Standard 3, “Ammonia Refrigeration Valves”

IIAR 3-2005 was an "Informative Reference" of IIAR 2-2008. The first edition was published in 2005. Revised editions were published in 2012 and 2017.

7.10 IIAR 4, ANSI/IIAR, Standard 4, "Installation of Closed-Circuit Ammonia Refrigeration Systems"

The first edition was published in 2015. This is the latest edition.

7.11 IIAR 5, ANSI/IIAR, Standard 5, "Start-up and Commissioning of Closed-Circuit Ammonia Refrigeration Systems"

The first edition was published in 2013. This is the latest edition.

7.12 IIAR 6, ANSI/IIAR, Standard 6, "Inspection, Testing, and Maintenance of Closed-Circuit Ammonia Refrigeration Systems".

The first edition was published in May 2019.

7.13 IIAR 7, ANSI/IIAR, Standard 7, "Developing Operating Procedures for Closed-Circuit Ammonia Mechanical Refrigerating Systems".

The first edition was published in 2013. The next and latest edition was published in 2019.

7.14 IIAR 8, ANSI/IIAR, Standard 8, "Decommissioning of Closed-Circuit Ammonia Refrigeration Systems".

The first edition was published in 2015. It is also the latest edition.

7.15 IIAR 9 (proposed), ANSI/IIAR, Standard 9, "Recognized and Generally Accepted Good Engineering Practices (RAGAGEP) for Existing Closed-Circuit Ammonia Refrigeration Systems".

The first edition has not yet been published. As of December 18, 2017, the IIAR Standards Review webpage states, "This proposed standard will help companies ascertain whether or not their existing systems should be updated to reflect new requirements from newly published and revised standards. This standard provides a method of evaluating existing systems against requirements that should apply to all closed-circuit ammonia refrigeration systems regardless of age and will help determine what can or cannot be "grandfathered" regarding system design."

7.16 IIAR Bulletins

These provide recommendations that are meant to be voluntary and non-binding, but which may become "good engineering practice" and therefore required under PSM and RMP regulations if they are widely followed. A partial list is outlined below:

7.16.1 IIAR Bulletin 107 (1997 – Superseded), “Guidelines for: Suggested Safety and Operating Procedures When Making Ammonia Refrigeration Plant Tie-ins.” It was superseded by IIAR 5.

7.16.2 IIAR Bulletin 108 (1986), “Guidelines for: Water Contamination in Ammonia Refrigeration Systems." It includes water-content test method.

7.16.3 IIAR Bulletin 109 (1997), "Guidelines for: IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System." It contains sample inspection forms.

7.16.4 IIAR Bulletin 110 (2002, revised in 2004 and 2007), "Guidelines for: Start-up, Inspection and Maintenance of Ammonia Mechanical

Refrigerating Systems." Section 6.0, Inspection and Maintenance contains information on mechanical integrity. Section 6.4 was revised in February 4, 2004 while Section 6.6.3 was revised in May 24, 2007.

7.16.5 IIAR Bulletin 111 (2002 -- superseded), "Guidelines for: Ammonia Machinery Room Ventilation." It was superseded by the ventilation requirements in the 2010 Addendum A of IIAR 2-2008 and IIAR 2-2014. However, it, provides diagrams of suggested air flow that are not in these standards.

7.16.6 IIAR Bulletin 112 (1998 -- superseded), "Guidelines for: Ammonia Machinery Room Design." Superseded by the 2010 Addendum A of IIAR 2-2008 and by IIAR 2-2014.

7.16.7 IIAR Bulletin 114 (1991, revised in 2014 and 2017), "Guidelines for: Identification of Ammonia Refrigeration Piping and System Components."

7.16.8 IIAR Bulletin 116 (1992), "Guidelines for: Avoiding Component Failure in Industrial Refrigeration Systems Caused by Abnormal Pressure or Shock."

7.16.9 IIAR updates and interpretations are available at the IIAR website http://iiar.org, under the "Technology and Standards" menu select "Standards Review" and then select "ANSI/IIAR Standards Interpretations". For the latest editions, under the "Store" menu select "Bulletins" or "Standards".

7.16.10 IIAR Bulletin 107 (1997 – Superseded), “Guidelines for: Suggested Safety and Operating Procedures When Making Ammonia Refrigeration Plant Tie-ins.” It was superseded by IIAR 5**.**

7.16.11 IIAR Bulletin 108 (1986), “Guidelines for: Water Contamination in Ammonia Refrigeration Systems." It includes water-content test method.

7.16.12 IIAR Bulletin 109 (1997), "Guidelines for: IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System." It contains sample inspection forms.

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7.16.15 IIAR Bulletin 112 (1998 -- superseded), "Guidelines for: Ammonia Machinery Room Design." Superseded by the 2010 Addendum A of IIAR 2-2008 and by IIAR 2-2014.

7.16.16 IIAR Bulletin 114 (1991, revised in 2014 and 2017), "Guidelines for: Identification of Ammonia Refrigeration Piping and System Components."

7.16.17 IIAR Bulletin 116 (1992), "Guidelines for: Avoiding Component Failure in Industrial Refrigeration Systems Caused by Abnormal Pressure or Shock."

7.16.18 IIAR updates and interpretations are available at the IIAR website http://iiar.org, under the "Technology and Standards" menu select "Standards Review" and then select "ANSI/IIAR Standards Interpretations". For the latest editions, under the "Store" menu select "Bulletins" or "Standards".

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