REFRIGERATION REVIEW

Comments Regarding IIAR Standard 2

As the only practicing design engineer charter member of IIAR, I believe I can be unbiased in my comments regarding not only the current ANSI/IIAR 2 second public review, but also on the general direction of IIAR.

IIAR was formed in 1974 in reaction to the National Electric Code (NEC) classifying ammonia machinery rooms as Class I Division 2. This, of course, would have made duPont very happy for the furtherment of “freons”. For you history buffs I have included the original cover page of the code from 1978. The 19-page document which listed the Review and Interpretation Committee, as well as the original organizers who authored standard IIAR 74-2 – the standard which permitted machinery rooms to either be continuously ventilated or have a ventilation system activated by ammonia detectors. Both these methods would be exceptions to the NEC Class I Division 2 requirement. This bulletin was accepted as a standard and approved by the American National Standard Institute (ANSI) on March 16, 1978. It also recognizes ANSI/ASHRAE Standard 15 as the basis of calculation for the cfm requirement.

It never ceases to amaze me that what was once a simple 19-page document has now become 174-page “Bible”.

While other codes and regulations have kept their simplistic approach to codes and standards, IIAR is bent on turning this code into a refrigeration bible on ammonia. It’s as though we have a guilty conscience that we have to explain everything in explicit detail and let the academicians talk about Reynolds numbers and such, which should be textbook references and not part of the safety code on the installation of ammonia systems. We have deviated significantly from our primary objective of neutralizing the effect of the NEC Class I Division 2 requirements. Not only that, we have deviated from the original standard and have required far more sophisticated elements, such as eliminating the most reliable form of protection of machinery rooms, which is continuous ventilation, by mandating ammonia detectors (which will in time fail) for the newly defined category of “Emergency Ventilation”. The NEC indicates 1000 ppm for emergency ventilation, which is by far a more practical detectable level. There are very few sensors that can reliably detect 40,000 ppm. It would be well to take note that NEC 202 still references ASHRAE 15-1994, which is a far more sensible ANSI code than we have developed.

In addition, other areas in the proposed revised code border on the impossible, such as the 104°F temperature requirement for machinery rooms, whereas the traditional way to protect from overheating is by temperature rise of more than 20°F. We seem to want to continually reinvent the wheel, where codes and regulations regarding ventilation heat rise have all been adequate for the last half century.

While our intentions are good, our aspirations are far outreaching the safety requirements for the installation of ammonia systems and are putting a death wish on our industry in its continued “Bible” rather than code format for IIAR Standard 2.

I’m sure there are those that would say, “Hank, recommend amendments.” I have done this in the past to no avail and can simply propose that the two elements in the current proposed review would be machinery room ventilation at a reasonable level, which contradicts itself. On the one hand it is based on §6.14.1.5, cubic feet per square foot, which would be more in line with the original ASHRAE 15 standard at about 15 air changes per hour, in lieu of §6.14.7.1, which requires 30 air changes per hour based on gross machinery room volume. (Noteworthy is that the NEC only requires 4 air changes per hour for a garage environment with open containers of gasoline and fuel.)

Another restriction being proposed in this review is to limit the temperature of the machinery room to 104°F. Whoever dreamed that one up has got to be on the moon. This is in lieu of the traditional 20° rise, which has been the gospel from day one. It would be near impossible without a massive air conditioning system to provide a 104° maximum temperature, when ambient design conditions are 105°F in many areas. Again, we are trying to be all things to all people, and we are just shooting ourselves in the foot – clear and simple. While those who contribute to the “Bible” mean well, they are adding to the demise of our industry. If we are going to expect recognition by other standards like the NEC, it would be well to get our act together and in line with traditional regulations so that the NEC can reference our standard in lieu of ASHRAE 15-1994.

So much for a charter member’s lament.

AMERICAN NATIONAL STANDARD
FOR

EQUIPMENT, DESIGN, AND INSTALLATION OF AMMONIA MECHANICAL REFRIGERATION SYSTEMS

ANSI/IIAR 74-2 - 1978

iiar

Sponsor

ERNATIONAL INSTITUTE OF AMMONIA REFRIGERATION

Approved by
The American National Standards Institute
March 16, 1978

INTERNATIONAL INSTITUTE
OF AMMONIA REFRIGERATION
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Cover of ANSI/IIAR 74-2

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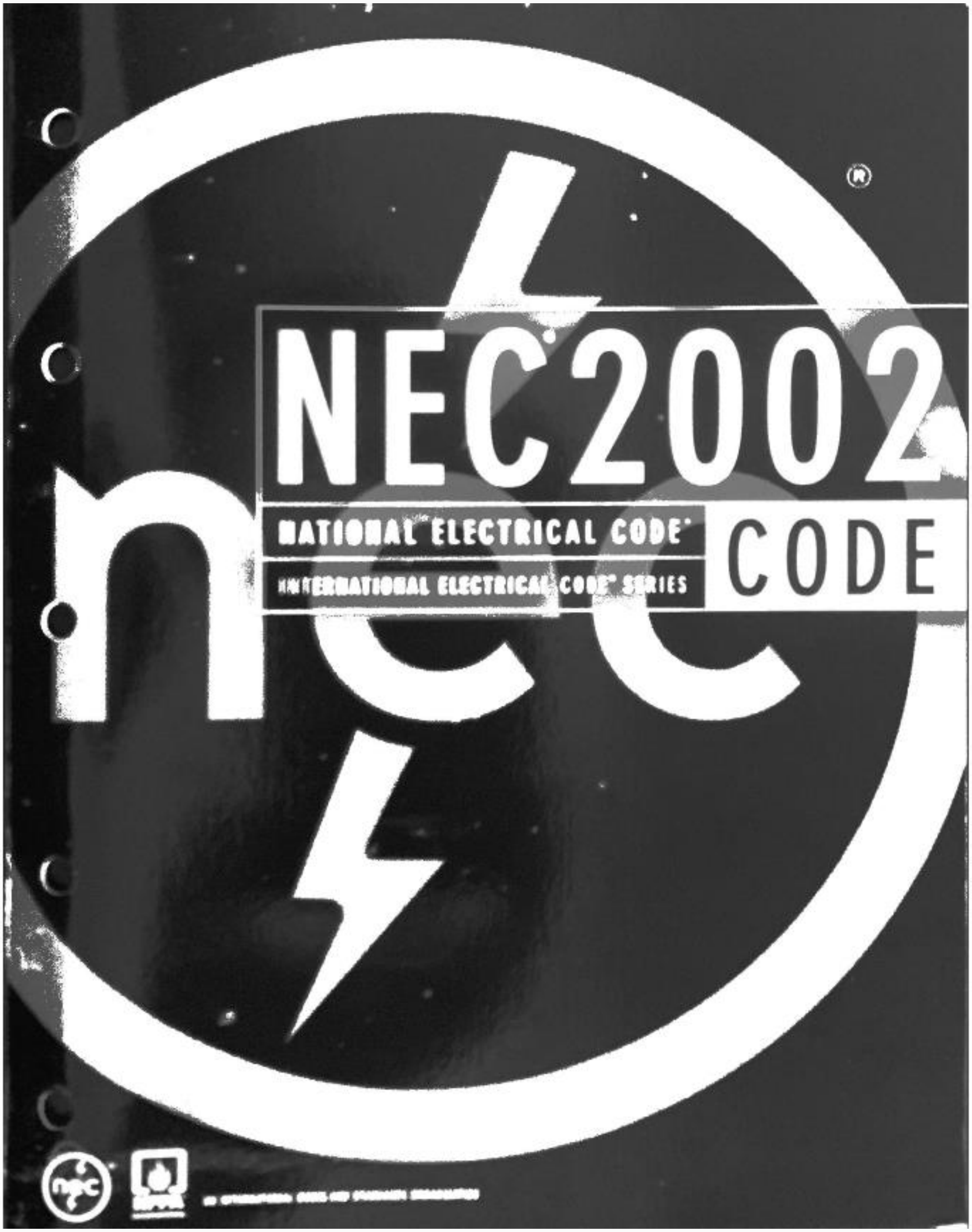

NEC 2002 Cover

Chapter 5 Special Occupancies

ARTICLE 500
Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2

FPN: Rules that are followed by a reference in brackets contain text that has been extracted from NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 1997 edition, and NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installation in Chemical Process Areas*, 1997 edition. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

500.1 Scope — Articles 500 Through 504. Articles 500 through 504 cover the requirements for electrical and electronic equipment and wiring for all voltages in Class I, Divisions 1 and 2; Class II, Divisions 1 and 2; and Class III, Divisions 1 and 2 locations where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitible fibers or flyings.

FPN: For the requirements for electrical and electronic equipment and wiring for all voltages in Class I, Zone 0, Zone 1, and Zone 2 hazardous (classified) locations where fire or explosion hazards may exist due to flammable gases or vapors or flammable liquids, refer to Article 505.

500.2 Definitions. For purposes of Articles 500 through 504 and Articles 510 through 516, the following definitions apply.

Associated Nonincendive Field Wiring Apparatus. Apparatus in which the circuits are not necessarily nonincendive themselves but that affect the energy in nonincendive field wiring circuits and are relied upon to maintain nonincendive energy levels. Associated nonincendive field wiring apparatus may be either of the following:

(1) Electrical apparatus that has an alternative type of protection for use in the appropriate hazardous (classified) location
(2) Electrical apparatus not so protected that shall not be used in a hazardous (classified) location

FPN: Associated nonincendive field wiring apparatus has designated associated nonincendive field wiring apparatus connections for nonincendive field wiring apparatus and may also have connections for other electrical apparatus.

Combustible Gas Detection System. A protection technique utilizing stationary gas detectors in industrial establishments.

Control Drawing. A drawing or other document provided by the manufacturer of the intrinsically safe or associated apparatus, or of the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus, that details the allowed interconnections between the intrinsically safe and associated apparatus or between the nonincendive field wiring apparatus or associated nonincendive field wiring apparatus.

Dust-Ignitionproof. Equipment enclosed in a manner that excludes dusts and does not permit arcs, sparks, or heat otherwise generated or liberated inside of the enclosure to cause ignition of exterior accumulations or atmospheric suspensions of a specified dust on or in the vicinity of the enclosure.

FPN: For further information on dust-ignitionproof enclosures, see Type 9 enclosure in ANSI/NEMA 250-1991, *Enclosures for Electrical Equipment*, and ANSI/UL 1203-1994, *Explosionproof and Dust-Ignitionproof Electrical Equipment for Hazardous (Classified) Locations*.

Dusttight. Enclosures constructed so that dust will not enter under specified test conditions.

FPN: See ANSI/ISA 12.12.01-2000, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2, and Class III, Divisions 1 and 2 Hazardous (Classified) Locations* , and UL 1604-1994, *Electrical Equipment for Use in Class I and II, Division 2 and Class III Hazardous (Classified) Locations*.

Electrical and Electronic Equipment. Materials, fittings, devices, appliances, and the like that are part of, or in connection with, an electrical installation.

FPN: Portable or transportable equipment having self-contained power supplies, such as battery-operated equipment, could potentially become an ignition source in hazardous (classified) locations.

Explosionproof Apparatus. Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

FPN: For further information, see ANSI/UL 1203-1994, *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*.

Hermetically Sealed. Equipment sealed against the entrance of an external atmosphere where the seal is made by fusion, for example, soldering, brazing, welding, or the fusion of glass to metal.

NEC 2002 CHAPTER 5 - SPECIAL OCCUPANCIES

(1) Class III, Division 1. A Class III, Division 1 location is a location in which easily ignitible fibers or materials producing combustible flyings are handled, manufactured, or used.

FPN No. 1: Such locations usually include some parts of rayon, cotton, and other textile mills; combustible fiber manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

FPN No. 2: Easily ignitible fibers and flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.

(2) Class III, Division 2. A Class III, Division 2 location is a location in which easily ignitible fibers are stored or handled other than in the process of manufacture.

500.6 Material Groups. For purposes of testing, approval, and area classification, various air mixtures (not oxygen-enriched) shall be grouped in accordance with 500.6(A) and 500.6(B).

Exception: Equipment identified for a specific gas, vapor, or dust.

FPN: This grouping is based on the characteristics of the materials. Facilities are available for testing and identifying equipment for use in the various atmospheric groups.

(A) Class I Group Classifications. Class I groups shall be according to 500.6(A)(1) through (A)(4).

FPN No. 1: FPN Nos. 2 and 3 apply to 500.6(A).

FPN No. 2: The explosion characteristics of air mixtures of gases or vapors vary with the specific material involved. For Class I locations, Groups A, B, C, and D, the classification involves determinations of maximum explosion pressure and maximum safe clearance between parts of a clamped joint in an enclosure. It is necessary, therefore, that equipment be identified not only for class but also for the specific group of the gas or vapor that will be present.

FPN No. 3: Certain chemical atmospheres may have characteristics that require safeguards beyond those required for any of the Class I groups. Carbon disulfide is one of these chemicals because of its low ignition temperature [100°C (212°F)] and the small joint clearance permitted to arrest its flame.

(1) Group A. Acetylene. [NFPA 497, 1-3]

(2) Group B. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.45 mm or a minimum igniting current ratio (MIC ratio) less than or equal to 0.40. [NFPA 497, 1-3]

FPN: A typical Class I, Group B material is hydrogen.

Exception No. 1: Group D equipment shall be permitted to be used for atmospheres containing butadiene, provided all conduit runs into explosionproof equipment are provided with explosionproof seals installed within 450 mm (18 in.) of the enclosure.

Exception No. 2: Group C equipment shall be permitted to be used for atmospheres containing allyl glycidyl ether, n-butyl glycidyl ether, ethylene oxide, propylene oxide, and acrolein, provided all conduit runs into explosionproof equipment are provided with explosionproof seals installed within 450 mm (18 in.) of the enclosure.

(3) Group C. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.45 mm and less than or equal to 0.75 mm, or a minimum igniting current ratio (MIC ratio) greater than 0.40 and less than or equal to 0.80. [NFPA 497, 1-3]

FPN: A typical Class I, Group C material is ethylene.

(4) Group D. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.75 mm or a minimum igniting current ratio (MIC ratio) greater than 0.80. [NFPA 497, 1-3]

FPN No. 1: A typical Class I, Group D material is propane.

FPN No. 2: For classification of areas involving ammonia atmospheres, see ANSI/ASHRAE 15-1994, *Safety Code for Mechanical Refrigeration*, and ANSI/CGA G2.1-1989, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*.

(B) Class II Group Classifications. Class II groups shall be according to 500.6(B)(1) through (B)(3).

(1) Group E. Atmospheres containing combustible metal dusts, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment. [NFPA 499, 1-3]

FPN: Certain metal dusts may have characteristics that require safeguards beyond those required for atmospheres containing the dusts of aluminum, magnesium, and their commercial alloys. For example, zirconium, thorium, and uranium dusts have extremely low ignition temperatures [as low as 20°C (68°F)] and minimum ignition energies lower than any material classified in any of the Class I or Class II groups.

NEC CLASS I CLASSIFICATIONS

Exception: When ammonia is used, the requirements of Class 1, Division 2, of the National Electrical Code shall not apply providing the requirements of 8.14(h) are met.

(h) When ammonia is used, the machinery room is not required to meet Class 1, Division 2, of the National Electrical Code providing (1) the mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm or (2) the machinery room is equipped with a vapor detector that will automatically start the mechanical ventilation system and actuate an alarm at a detection level not to exceed 1,000 ppm.

(i) Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.

NEC AMMONIA EXCEPTION

(4) Group D. Flammable gas, flammable liquid–produced vapor, or combustible liquid–produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value greater than 0.75 mm or a minimum igniting current ratio (MIC ratio) greater than 0.80. [NFPA 497, 1-3]

FPN No. 1: A typical Class I, Group D material is propane.

FPN No. 2: For classification of areas involving ammonia atmospheres, see ANSI/ASHRAE 15-1994, *Safety Code for Mechanical Refrigeration*, and ANSI/CGA G2.1-1989, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*.

Reference to ANSI/ASHRAE 15-1994 For Ammonia

ANSI/ASHRAE 15-1994

Supersedes ANSI/ASHRAE 15-1992

ASHRAE® STANDARD

AN AMERICAN NATIONAL STANDARD

Safety Code for Mechanical Refrigeration

Approved by the ASHRAE Standards Committee June 29, 1994; by the ASHRAE Board of Directors June 30, 1994; and by the American National Standards Institute August 23, 1994.

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ASHRAE 15-1994 COVER PAGE

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

(d) Locations of the gravity ventilation openings shall be based on the relative density of the refrigerant to air.

8.13.6 No open flames that use combustion air from the machinery room shall be installed where any refrigerant is used. The use of matches, lighters, halide leak detectors, and similar devices shall not be considered a violation of 8.13.6. Combustion equipment shall not be installed in the same machinery room with refrigerant-containing equipment except under one of the following conditions:

(a) combustion air is ducted from outside the machinery room and sealed in such a manner as to prevent any refrigerant leakage from entering the combustion chamber, or

(b) a refrigerant vapor detector is employed to automatically shut down the combustion process in the event of refrigerant leakage.

Exceptions:

(1) Machinery rooms where only carbon dioxide (R-744) is the refrigerant.

(2) Machinery rooms where only ammonia (R-717) is the refrigerant and internal combustion engines are used as the prime mover for the compressors.

8.13.7 There shall be no airflow to or from an occupied space through a machinery room unless the air is ducted and sealed in such a manner as to prevent any refrigerant leakage from entering the airstream. Access doors and panels in ductwork and air-handling units shall be gasketed and tight fitting.

8.14 Machinery Room, Special Requirements. In cases specified in the rules of 7.4.2, a refrigerating machinery room shall meet the following special requirements in addition to those in 8.13:

(a) There shall be no flame-producing device or continuously operating hot surface over 800°F (427°C) permanently installed in the room.

(b) Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors.

(c) Walls, floor, and ceiling shall be tight and of noncombustible construction. Walls, floor, and ceiling separating the refrigerating machinery room from other occupied spaces shall be of at least one-hour fire-resistive construction.

(d) The refrigerating machinery room shall have a door that opens directly to the outside air or through a vestibule equipped with self-closing, tight-fitting doors.

(e) Exterior openings, if present, shall not be under any fire escape or any open stairway.

(f) [illegible] piercing the interior walls, ceiling, or floor of such rooms shall be tightly sealed to the walls, ceiling, or floor through which they pass.

(g) When refrigerants of Groups A2, A3, B2, and B3 are used, the machinery room shall conform to Class 1, Division 2, of the National Electrical Code.[9] When refrigerant Groups A1 and B1 are used, the machinery room is not required to meet Class 1, Division 2, of the National Electrical Code

Exception: When ammonia is used, the requirements of Class 1, Division 2, of the National Electrical Code shall not apply providing the requirements of 8.14(h) are met.

(h) When ammonia is used, the machinery room is not required to meet Class 1, Division 2, of the National Electrical Code providing (1) the mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm or (2) the machinery room is equipped with a vapor detector that will automatically start the mechanical ventilation system and actuate an alarm at a detection level not to exceed 1,000 ppm.

(i) Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.

8.15 Manual Emergency Discharge of Ammonia Refrigerant. When required by the authority having jurisdiction, manual emergency discharge or diffusion arrangements for ammonia refrigerants shall be provided. Appendix B contains information on emergency discharge of ammonia refrigerants.

8.16 Purge Discharge. The discharge of purge systems shall be governed by the same rules as pressure-relief devices and fusible plugs (see 9.7.8) and shall be piped in conjunction with these devices.

9. DESIGN AND CONSTRUCTION OF EQUIPMENT AND SYSTEMS

9.1 Materials

9.1.1 Materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Materials shall not be used that will deteriorate because of the refrigerant, the lubricant, or their combination in the presence of air or moisture to a degree that poses a safety hazard.

9.1.2 Aluminum, zinc, magnesium, or their alloys shall not be used in contact with methyl chloride. Magnesium alloys shall not be used in contact with any halogenated refrigerants.

9.1.3 Copper and its alloys shall not be used in contact with ammonia except as a component of bronze alloys for bearings or other non-refrigerant-containing uses.

ASHRAE 15-1994 SECTION 8.14 Machinery Room, Special Requirements