ADDENDA

ANSI/ASHRAE Addendum a to
ANSI/ASHRAE Standard 15-2016

Safety Standard for Refrigeration Systems

Approved by the ASHRAE Standards Committee on June 23, 2018; by the ASHRAE Technology Council on June 27, 2018; and by the American National Standards Institute on June 28, 2018.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE® website (www.ashrae.org) or in paper form from the Senior Manager of Standards.

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FOREWORD

This addendum modifies ASHRAE Standard 15 by making necessary changes to defer regulation of ammonia refrigeration systems to ANSI/IIAR 2. Standard 15 and ANSI/IIAR 2 have historically served as additive standards for regulation of ammonia systems, with ASHRAE addressing general design and IIAR addressing ammonia-specific topics. The arrangement has burdened Standard 15 with a variety of ammonia-specific exceptions, and it challenges designers, engineers, operators, and regulators with the task of deciphering regulations from overlapping standards. These stakeholder groups, which include OSHA and USEPA, have questioned the need for two independent standards for ammonia refrigeration systems and have encouraged the elimination of this unnecessary complexity.

In response, a comprehensive rewrite of ANSI/IIAR 2 was completed to consolidate necessary regulations for safe design of ammonia systems into ANSI/IIAR 2. Following publication of the resulting edition of ANSI/IIAR 2-2014, a gap analysis with ASHRAE Standard 15 was conducted to validate ANSI/IIAR 2's suitability to serve as a standalone design standard for ammonia refrigeration.

ANSI/IIAR 2-2014 has since been adopted as a reference standard by all U.S. model fire and mechanical codes. In addition, based on the comprehensive nature of ANSI/IIAR 2-2014, the 2018 International Fire Code no longer references ASHRAE Standard 15 for ammonia systems, and the 2018 Uniform Mechanical Code (UMC) is proposing to entirely drop requirements for ammonia refrigeration in favor of a mandatory reference to ANSI/IIAR 2. The UMC change recognizes that ANSI/IIAR 2 now includes content necessary to serve as both a code and a standard. The changes made by this addendum delete requirements and exceptions that are unique to ammonia and R-717 and refer users to ANSI/IIAR 2 for ammonia refrigeration systems.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum a to Standard 15-2016

Modify Section 2 as follows.

2. SCOPE

[. . .]

2.3 This standard shall not apply to refrigeration systems using ammonia (R-717) as the refrigerant.

Informative Note: See ANSI/IIAR 2^{XX} for systems using ammonia (R-717).

Modify Section 3 as follows.

3. DEFINITIONS

~~***sealed ammonia/water absorption system:*** an absorption system where ammonia (R-717) is the refrigerant and water (R-718) is the absorbent, and all refrigerant-containing parts are made permanently tight by welding or brazing.~~

Modify Section 7 as follows.

7. RESTRICTIONS ON REFRIGERANT USE

[. . .]

7.2.2 Industrial Occupancies and Refrigerated Rooms.
[. . .]

e. Open flames and surfaces exceeding 800°F (426.7°C) are not permitted where any Group A2, B2, A3, or B3 refrigerant ~~other than R-717 (ammonia)~~ is used.

f. All electrical equipment conforms to Class 1, Division 2, of NFPA 705 where the quantity of any Group A2, B2, A3, or B3 ~~other than R-717 (ammonia)~~ in an independent circuit would exceed 25% of the lower flammability limit (LFL) upon release to the space based on the volume determined by Section 7.3.

[. . .]

7.4 Location in a Machinery Room or Outdoors. All components containing refrigerant shall be located either in a machinery room or outdoors, where the quantity of refrigerant needed exceeds the limits defined by Sections 7.2 and 7.3

Exception to 7.4: Self-contained systems are permitted outside of a machinery room, provided that such systems are not located in public hallways or lobbies and are limited to the following occupancies and refrigerant quantities:

1. 6.6 pounds (3 kg) of refrigerant where located in residential occupancies or
2. 22 pounds (10 kg) of refrigerant where located in commercial occupancies.

~~a. the quantity of refrigerant needed exceeds the limits defined by Section 7.2 and Section 7.3, or~~

~~b. direct fired absorption equipment, other than sealed absorption systems not exceeding the refrigerant quantity limits indicated in Table 7.4 is used.~~

7.4.1 Direct fired absorption equipment shall be located in a machinery room or outdoors.

7.4.~~1~~2

7.4.~~2~~3

7.5 Additional Restrictions

[. . .]

7.5.1.1 Flammable Refrigerants. The total of all Group A2, B2, A3, and B3 refrigerants ~~other than R-717 (ammonia)~~ shall not exceed 1100 lb (500 kg) without approval by the AHJ.

~~Table 7.4 Special Quantity Limits for Sealed Ammonia/Water Absorption and Self-Contained Systems~~

~~Type of Refrigeration System~~	~~Maximum lb (kg) for Various Occupancies~~			
	~~Institutional~~	~~Public/Large Mercantile~~	~~Residential~~	~~Commercial~~
~~**Sealed Ammonia/Water Absorption System**~~				
~~In public hallways or lobbies~~	~~0 (0)~~	~~0 (0)~~	~~3.3 (1.5)~~	~~3.3 (1.5)~~
~~In adjacent outdoor locations~~	~~0 (0)~~	~~0 (0)~~	~~22 (10)~~	~~22 (10)~~
~~In other than public hallways or lobbies~~	~~0 (0)~~	~~6.6 (3)~~	~~6.6 (3)~~	~~22 (10)~~
~~**Unit Systems**~~				
~~In other than public hallways or lobbies~~	~~0 (0)~~	~~0 (0)~~	~~6.6 (3)~~	~~22 (10)~~

7.5.1.2 Corridors and Lobbies. Refrigerating systems installed in a public corridor or lobby shall be limited to unit systems containing not more than the quantities of Group A1 or B1 refrigerant indicated in Table 4-1 or 4-2 of ASHRAE Standard 34. ~~either~~

~~a. unit systems containing not more than the quantities of Group A1 or B1 refrigerant indicated in Table 4-1 or 4-2 of ASHRAE Standard 34 or~~

~~b. sealed absorption and unit systems having refrigerant quantities less than or equal to those indicated in Table 7.4.~~

[. . .]

7.5.2 Applications for Human Comfort. Group A2, A3, B1, B2, and B3 refrigerants shall not be used in high-probability systems for human comfort.

Exceptions to 7.5.2:

1. This restriction does not apply to ~~sealed absorption and~~ unit systems having refrigerant quantities less than ~~or equal to those indicated in Table 7.4.~~
   a. 6.6 pounds (3 kg) of refrigerant where located in residential occupancies or
   b. 22 pounds (10 kg) of refrigerant where located in commercial occupancies.
2. This restriction does not apply to industrial occupancies.

Modify Section 8 as follows.

8. INSTALLATION RESTRICTIONS

[. . .]

8.11.2.1 Each refrigerating machinery room shall contain a detector, located in an area where refrigerant from a leak will concentrate, that actuates an alarm and mechanical ventilation in accordance with Section 8.11.4 at a value not greater than the corresponding TLV-TWA (or toxicity measure consistent therewith). The alarm shall annunciate visual and audible alarms inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room. The alarms required in this section shall be of the manual reset type with the reset located inside the refrigerating machinery room.

Alarms set at other levels (such as IDLH) and automatic reset alarms are permitted in addition to those required by this section. The meaning of each alarm shall be clearly marked by signage near the annunciators.

Exceptions to 8.11.2.1:

~~1. For ammonia, refer to Section 8.12(g).~~

~~2.~~ Detectors are not required when only systems using R-718 (water) are located in the refrigerating machinery room.

[. . .]

8.11.6 No open flames that use combustion air from the machinery room shall be installed where any refrigerant is used. 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.
b. A refrigerant detector, conforming to Section 8.11.2.1, is employed to automatically shut down the combustion process in the event of refrigerant leakage.

Exceptions to 8.11.6:

~~1.~~ Machinery rooms where only carbon dioxide (R-744) or water (R-718) 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.~~

[. . .]

8.12 Machinery Room, Special Requirements. In cases specified in the rules of Section 7.4, a refrigerating machinery room shall meet the following special requirements in addition to those in Section 8.11:

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

e. All pipes piercing the interior walls, ceiling, or floor of such rooms shall be tightly sealed to the walls, ceiling, or floor through which they pass.

f. 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.5 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 Section 8.12(h) are met.~~

~~g. When ammonia (R-717) is used, the machinery room is not required to meet Class 1, Division 2, of the National Electrical Code!' provided (a) the mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm or (b) the machinery room is equipped with a detector, conforming to Section 8.11.2.1, except the detector shall alarm at 1000 ppm.~~

g. ~~h.~~ 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.

9. DESIGN AND CONSTRUCTION OF EQUIPMENT AND SYSTEMS

9.1 Materials

~~**9.1.1** 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.~~

~~**9.1.2** Aluminum and its alloys are suitable for use in ammonia systems.~~

[. . .]

~~**9.7.8.4.1 Ammonia (R-717).** Pressure relief valves serving systems using ammonia as a refrigerant shall discharge in accordance with one of the following:~~

~~a. To atmosphere in accordance with Section 9.7.8.2~~

~~b. Internally in accordance with Section 9.7.8.3~~

~~c. To a treatment system approved by the authority having jurisdiction~~

Modify Appendix A as follows.

INFORMATIVE APPENDIX A INFORMATIVE REFERENCES

~~14. IIAR. 2014. IIAR Bulletin 114, *Guidelines for Identification of Ammonia Refrigeration Piping and System Components*. Arlington, VA: International Institute of Ammonia Refrigeration.~~

XX. IIAR. 2014. ANSI/IIAR 2, *American National Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems*. Arlington, VA: International Institute of Ammonia Refrigeration.

Table 9.7.5 Relief Devices Capacity Factor

Refrigerant	Value of *f*
When Used on the Lowside of a Limited-Charge Cascade System	
R-23, R-170, R-744, R-1150, R-508A, R-508B	1.0 (0.082)
R-13, R-13B1, R-503	2.0 (0.163)
R-14	2.5 (0.203)
Other Applications	
R-718	0.2 (0.016)
~~R-717~~	~~0.5 (0.041)~~
R-11, R-32, R-113, R-123, R-142b, R-152a, R-290, R-600, R-600a, R-764	1.0 (0.082)
R-12, R-22, R-114, R-124, R-134a, R-401A, R-401B, R-401C, R-405A, R-406A, R-407C, R-407D, R-407E, R-409A, R-409B, R-411A, R-411B, R-411C, R-412A, R-414A, R-414B, R-500, R-1270	1.6 (0.131)
R-143a, R-402B, R-403A, R-407A, R-408A, R-413A	2.0 (0.163)
R-115, R-402A, R-403B, R-404A, R-407B, R-410A, R-410B, R-502, R-507A, R-509A	2.5 (0.203)

Modify Appendix C as follows. Delete the current example in its entirety and replace it with the new text as shown.

INFORMATIVE APPENDIX C METHOD FOR CALCULATING DISCHARGE CAPACITY OF POSITIVE DISPLACEMENT COMPRESSOR PRESSURE RELIEF DEVICE

[. . .]

Example

Determine the flow capacity of a relief device for a R-410A compressor with a swept volume (Q) of 341 ft^3/min (0.1609 m^3/s). The compressor is equipped with capacity control that is actuated at 90% of the pressure relief device set pressure and has a minimum regulated flow of 10%.

Q = 341 ft^3/min

Q = 0.16095 m^3/s

η_v = 0.90, assumed

PL = 0.1

$v_{g@50°F}$ = 1.1979 ft3/lbm (I-P)

$v_{g@10°C}$ = 0.0748 m^3/kg (SI)

Table C-1 Constants for Calculating Discharge Capacity

Refrigerant	k^*	Molar Mass†	C_r	r_w
R-11	1.137	137.4	330.7	0.49
R-12	1.205	120.9	337.7	0.51
R-13	2.053	104.5	403.6	0.46
R-22	1.319	86.5	348.8	0.59
R-23	2.742	70.0	439.3	0.52
R-113	1.081	187.4	324.7	0.43
R-114	1.094	170.9	326.1	0.45
R-123	1.104	152.9	327.1	0.47
R-134a	1.196	102.0	336.8	0.56
R-236fa	1.101	152.0	326.8	0.47
R-245fa	1.107	134.0	327.5	0.50
R-290	1.235	44.1	340.8	0.84
R-404A	1.279	97.6	345.0	0.56
R-407C	1.270	86.2	344.1	0.59
R-410A	1.434	72.6	359.0	0.62
R-500	1.236	99.3	340.8	0.56
R-502	1.264	111.6	343.6	0.52
R-507A	1.284	98.9	345.5	0.55
R-600	1.122	58.1	329.2	0.76
~~R-717~~	~~1.422~~	~~17.0~~	~~358.0~~	~~1.28~~
R-718	1.328	18.0	349.6	1.28
R-744	2.690	44.0	437.0	0.65

* Source: NIST Refprop, Standard Reference Database 23, Version 7, 2002[15]
† Source: IUPAC Atomic Weights, 2003 [16]

$$W_r = \frac{341\frac{\text{ft}^3}{\text{min}} \times 0.1 \times 0.9}{1.1979\frac{\text{ft}^3}{\text{lb}_\text{m}}} = 25.62\frac{\text{lb}_\text{m}}{\text{min}} \quad \text{(I-P [see C-1])}$$

$$W_r = \frac{0.1609\frac{\text{m}^3}{\text{s}} \times 0.1 \times 0.9}{0.0748\frac{\text{m}^3}{\text{kg}}} = 0.1936\frac{\text{kg}}{\text{s}} \quad \text{(SI [see C-1])}$$

$$W_a = W_r \times r_w = 25.62 \times 0.62 = 15.88\frac{\text{lb}_\text{m}}{\text{min}} \text{ of air} \quad \text{(I-P [see C-2])}$$

$$W_a = W_r \times r_w = 0.1936 \times 0.62 = 0.12\frac{\text{kg}}{\text{s}} \text{ of air} \quad \text{(SI [see C-2])}$$

Converting to standard cubic feet per minute (scfm), where V_a = specific volume of air = 13.1 $\text{ft}^3/\text{lb}_\text{m}$ (0.818 m^3/kg) for dry air at 60°F (15.6°C):

SCFM = 13.1 (15.88) = 208.02 ft^3/min (I-P)

SCFM = 0.818 (0.12) = 0.098 m^3/s (SI)

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ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

ASHRAE · 1791 Tullie Circle NE · Atlanta, GA 30329 · www.ashrae.org

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