BSR/ASHRAE Addendum e
to ANSI/ASHRAE Standard 15-2019

First Public Review Draft

Proposed Addendum e to Standard 15-2019, Safety Standard for Refrigeration Systems

First Public Review (July 2020)
(Draft shows Proposed Changes to Current Standard)

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ASHRAE, 1791 Tullie Circle, NE, Atlanta GA 30329-2305

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FOREWORD

This addendum revises requirements related to refrigerant piping. The proposed requirements address many topics related to design, installation, location, and testing of refrigerant piping. In several cases, there is more than one compliance path to address the varying needs of different refrigerating system applications on vastly different scales (such as building type, occupancy type, and so on). Effort has been made to construct the requirements with format and terminology that is consistent with building codes.

Note: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.

Addendum e to Standard 15-2019

Modify Section 3 as follows. The remainder of Section 3 remains unchanged.

3. DEFINITIONS

3.5 Defined Terms

building element: a fundamental component of building construction, including walls, partitions, floor/ceiling assemblies, roof construction, and structural framing, which may or may not be of *fire-resistance-rated* construction and is constructed of materials based on the building type of construction.

exit passageway: an exit component that is separated from other interior spaces of a building or structure by *fire-resistant-rated* construction and opening protectives, and provides for a protected path of egress travel in a horizontal direction to an exit or the outside exit door.

fire-resistance-rated: the period of time a *building element*, component, or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests.

fire-resistance-rated exit access corridor: a portion of a means of egress system that is a *fire-resistance-rated* enclosed exit access component that defines and provides a path of egress travel.

machinery room: a space, meeting the requirements of Sections ~~8.11~~8.9 and ~~8.12~~8.10, that is designed to house compressors and pressure vessels.

[…]

[Note to reviewers: *existing requirements of Sections 8.9 and 8.10 were moved into other parts of Section 9; subsequent parts of Section 8 will be renumbered and section references throughout the standard are correspondingly updated; updated references are shown above and below, but for brevity not all subsection renumbering is shown.]*

Modify Section 7 as follows. The remainder of Section 7 remains unchanged.

7. RESTRICTIONS ON REFRIGERANT USE

7.2.2 Industrial Occupancies and Refrigerated Rooms

[…]

c. *Refrigerant detectors* are installed with the sensing location and alarm level as required in refrigerating *machinery rooms* in accordance with Section ~~8.11.5~~8.9.5.

7.4.2 Nonflammable Refrigerants. *Machinery rooms* required by Section 7.4 *shall* be constructed and maintained in accordance with Section ~~8.11~~8.9 for Group A1 and B1 *refrigerants*.

7.4.3 Flammable Refrigerants. *Machinery rooms* required by Section 7.4 based on flammability *shall* be constructed and maintained in accordance with Sections ~~8.11~~8.9 and ~~8.12~~8.10 for Group A2, A3, B2, and B3 *refrigerants*. *Machinery rooms* required by Section 7.4 based on flammability *shall* be constructed and maintained in accordance with Section ~~8.11.1~~8.9.1 through ~~8.11.5~~8.9.5 and Section ~~8.13~~8.11 for Group A2L and B2L *refrigerants* other than R-717 (ammonia).

[…]

7.5.1.8 Refrigerant or Lubricant Conversion. The type of *refrigerant* or lubricant in a system *shall not* be changed without evaluation for suitability, notification to the AHJ and the user, due observance of safety requirements, and replacement or addition of signs and identification as required in Section ~~11.2.3~~10.1.2.

[…]

Modify Section 8 as follows. The remainder of Section 8 remains unchanged.

8. INSTALLATION RESTRICTIONS

8.7 Air Duct Installation. *Air duct* systems of air-conditioning equipment for human comfort using mechanical refrigeration *shall* be installed in accordance with *approved* safety standards, the requirements of the AHJ, and the requirements of Section ~~8.11.7~~8.9.7.

8.8 *Refrigerant* Parts in *Air Duct*. ~~Joints and all~~All field installed refrigerant containing parts, including joints, of a refrigerating system located in an air duct carrying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F (371°C) without leakage into the airstream.

8.8.1 Installation of Piping, Joints, Valves, and Related Parts. See Sections 9.10 through 9.13 for installation restrictions and other requirements related to refrigerant piping and tubing.

~~**8.9 *Refrigerant* Pipe Joint Inspections.** *Refrigerant* pipe joints erected on the *premises shall* be exposed to view for visual inspection prior to being covered or enclosed.~~

~~**8.10 Location of Refrigerant Piping**~~

~~**8.10.1** *Refrigerant piping* crossing an open space that affords passageway in any building *shall not* be less than 7.25 ft (2.2 m) above the floor unless the *piping* is located against the ceiling of such space and is permitted by the AHJ.~~

~~**8.10.2** Passages *shall not* be obstructed by *refrigerant piping*. *Refrigerant piping shall not* be placed in any elevator, dumbwaiter, or other shaft containing a moving object or in any shaft that has openings to living quarters or to *means of egress*. *Refrigerant piping shall not* be installed in an enclosed public stairway, stair landing, or *means of egress*.~~

~~**8.10.3** *Refrigerant piping shall not* penetrate floors, ceilings, or roofs.~~

~~**Exceptions to 8.10.3:**~~

~~1. Penetrations connecting the basement and the first floor.~~

~~2. Penetrations connecting the top floor and a *machinery* penthouse or roof installation.~~

~~3. Penetrations connecting adjacent floors served by the refrigeration system.~~

~~4. Penetrations of a direct system where the *refrigerant* concentration does not exceed that listed in Table 4-1 or Table 4-2 of ASHRAE Standard 34[2] for the smallest *occupied space* through which the *refrigerant piping* passes.~~

~~5. In other than industrial *occupancies* and where the *refrigerant* concentration exceeds that listed in Table 4-1 or 4-2 of ASHRAE Standard 34 for the smallest *occupied* space, penetrations that connect separate~~

~~pieces of equipment that are~~

~~a. enclosed by an *approved* gas-tight, fire-resistive duct or shaft with openings to those floors served by the *refrigerating* system or~~

~~b. located on the exterior wall of a building when vented to the outdoors or to the space served by the system and not used as an air shaft, closed court, or similar space.~~

~~**8.10.4** *Refrigerant piping* installed in concrete floors *shall* be encased in *pipe duct*. *Refrigerant piping shall* be properly isolated and supported to prevent damaging vibration, stress, or corrosion.~~

8.9~~8.11~~ Refrigerating Machinery Room, General Requirements

[…]

8.9.2~~8.11.2~~ Each refrigerating *machinery room shall* have… With the exception of access doors and panels in air ducts and air-handling units conforming to Section 8.9.3~~8.11.3~~, there shall be no openings…

[…]

8.9.5~~8.11.5~~ Each refrigerating *machinery room shall* have 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 8.9.7~~8.11.7~~ at a set point…

Exception to 8.9.5~~8.11.5~~:

2. For Group A2L and B2L other than ammonia, refer to Section 8.11~~8.13~~.

8.9.6~~8.11.6~~ *Machinery rooms shall* be vented to the outdoors, using mechanical ventilation in accordance with Sections 8.9.7~~8.11.7~~ and 8.9.8~~8.11.8.~~

8.9.7~~8.11.7~~ Mechanical ventilation referred to in Section 8.9.6~~8.11.6~~ shall be by one or more power-driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in Section 8.9.8~~8.11.8~~….

8.9.8~~8.11.8~~ Ventilation Airflow. For Group A1, A2, A3, B1, B2, and B3 the airflow *shall* comply with Section 8.9.8.1~~8.11.8.1~~. For Group A2L and B2L other than R-717 (ammonia) the airflow *shall* comply with Section 8.11~~8.13~~.

8.9.9~~8.11.9~~ No open flames that use combustion air from the machinery room shall be…except under one of the following conditions…

b. A refrigerant detector, conforming to Section 8.9.5~~8.11.5~~ is employed to automatically shut down the combustion process in the event of refrigerant leakage.

Exception to 8.9.9~~8.11.9~~: …

8.10~~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 8.9~~8.11~~: …

8.11~~8.13~~ *Machinery Room*, A2L and B2L Other than R-717 (Ammonia). When required by Section 7.4.2, *machinery rooms shall* comply with Sections 8.11.1~~8.13.1~~ through 8.11.6~~8.13.6~~.

8.11.1~~8.13.1~~ There *shall* be no flame-producing device or hot surface over 1290°F (700°C) in the room, other than that used for maintenance or repair, unless installed in accordance with Section 8.9.9~~8.11.9~~.

8.11.2~~8.13.2~~

8.11.3~~8.13.3~~

8.11.4~~8.13.4~~

8.11.5~~8.13.5~~

8.11.6~~8.13.6~~ When any *refrigerant* of Groups A2, A3, B2, or B3 are used, the *machinery room shall* be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with the *National Electrical*

Code[3]. When the only flammable *refrigerants* used are from Group A2L or B2L other than R-717 (ammonia), the *machinery room shall* comply with both Section 8.11.6.1~~8.13.6.1~~ for ventilation and Section 8.11.6.2~~8.13.6.2~~ for *refrigerant* detection, or *shall* be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with the *National Electrical Code*[3].

8.11.6.1~~8.13.6.1~~ The *machinery room shall* have a mechanical ventilation system in accordance with Section 8.11.11~~8.13.11~~. The mechanical ventilation system *shall*…

b. be activated by one or more *refrigerant detectors*, conforming to requirements of Section 8.11.8~~8.13.8~~.

8.11.6.2~~8.13.6.2~~

8.11.7~~8.13.7~~

8.11.8~~8.13.8~~ Each refrigerating *machinery room* in accordance with Section 8.11~~8.13~~ *shall* contain one ore more *refrigerant detectors* in accordance with Section 8.11.9~~8.13.9~~, with sensing element located in areas where *refrigerant* from a leak will concentrate, with one or more set points that activate responses in accordance with Section 8.11.10~~8.13.10~~ for alarms and Section 8.11.11~~8.13.11~~ for mechanical ventilation. Multi-port type devices *shall* be prohibited.

8.11.9~~8.13.9~~ *Refrigerant detectors* required by Section 8.11~~8.13~~ *shall* meet all of the following conditions…

b. The *refrigerant detector shall* activate responses within a time not to exceed a limit *specified* in Sections 8.11.10~~8.13.10~~ and 8.11.11~~8.13.11~~ after exposure to *refrigerant* concentration exceeding a limit value *specified* in Sections 8.11.10~~8.13.10~~ and 8.11.11~~8.13.11~~.

[…]

e. The *refrigerant detector shall* provide a means for automatic self-testing and *shall* be in accordance with Sections 8.11.10.4~~8.13.10.4~~. The *refrigerant detector shall* be tested during installation and annually thereafter, or at an interval not exceeding the *manufacturer*'s installation instructions, whichever is less. Testing *shall* verify compliance with the alarm set points and response times per Sections 8.11.10~~8.13.10~~ and 8.11.11~~8.13.11~~.

8.11.10~~8.13.10~~ Alarms required by Section 8.11.8~~8.13.8~~ *shall* comply with the following.

8.11.10.1~~8.13.10.1~~

8.11.10.2~~8.13.10.2~~

8.11.10.3~~8.13.10.3~~ Alarms set at levels other than Table 8-1 (such as *IDLH*) and automatic reset alarms are permitted in addition to those required by Section 8.11.10~~8.13.10~~. The meaning of each alarm *shall* be clearly marked by signage near the annunciators.

8.11.10.4~~8.13.10.4~~ In the event of a failure during a *refrigerant detector* self-test in accordance with Section 8.11.9(e)~~8.13.9(e)~~, a trouble alarm signal *shall* be transmitted to an *approved* monitored location.

8.11.11~~8.13.11~~ **Ventilation.** *Machinery rooms*, in accordance with Section 8.11~~8.13~~, *shall* be vented to the outdoors, using mechanical ventilation in accordance with Sections 8.11.11.1~~8.13.11.1~~, 8.11.11.2~~8.13.11.2~~, and 8.11.11.3~~8.13.11.3~~.

8.11.11.1~~8.13.11.1~~ Mechanical ventilation referred to in Section 8.11.10~~8.13.10~~ *shall* be in accordance with all of the following: …

8.11.11.2~~8.13.11.2~~ **Level 1 Ventilation.** The refrigerating *machinery room* mechanical ventilation in Section 8.11.11.1~~8.13.11.1~~ *shall* exhaust at an airflow rate not less than shown in Table 8-2.

8.11.11.3~~8.13.11.3~~ **Level 2 Ventilation.** A part of the refrigerating *machinery room* mechanical ventilation referred to in Section 8.11.11.1 ~~8.13.11.1~~ *shall* exhaust an accumulation of *refrigerant* due to leaks or a rupture of a *refrigerating system*, or portion thereof, in the *machinery room*. The *refrigerant detectors* required in accordance with Section 8.11.8 ~~8.13.8~~ *shall* activate ventilation at a set point and response time in accordance with Table 8-1, at an airflow rate not less than the value determined in accordance with Section 8.11.11.4 ~~8.13.11.4~~. …

8.11.11.4~~8.13.11.4~~ Safety Group A2L, B2L Other than Ammonia. When required by Section 8.11.11.3~~8.13.11.3~~, the total airflow for Level 2 ventilation *shall* be not less than the airflow rate determined by Figure 8-1 (I-P) or Figure 8-2 (SI).

Table 8-2 Level 1 Ventilation Rate for Class 2L *Refrigerants*

Status	Airflow
Operated when occupied, and operated when activated in accordance with Section 8.11.9(c)~~8.13.9(c)~~ and Table 8-1	…
…	…

8.12~~8.14~~ When a *refrigerating system* is located outdoors more than …

8.13~~8.15~~ Purge Discharge. The discharge from purse systems shall be governed by the same rules as pressure relief devices and fusible plus (see Section 9.7.8) and shall be piped in conjunction with these devices.

Exception to 8.13~~8.15~~: When R-718 (water) is the refrigerant.

Modify Section 9 as follows. The remainder of Section 9 remains unchanged.

9. DESIGN AND CONSTRUCTION OF EQUIPMENT AND SYSTEMS

9.1 Materials

9.1.1 General. 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.

9.1.1.1 Refrigerant Piping, Valves, and Fittings. Refrigerant piping, valves, and fittings shall comply with the requirements of Section 9.10 through 9.13.

9.1.2 Alloy Restriction. 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 Discharge Line. *Piping* material used in the discharge line of a *pressure relief device* or *fusible plug shall* ~~be the same as required for *refrigerants*~~ comply with Section 9.10.

~~**Exception to 9.1.3:** When discharging to atmosphere, Type F buttweld pipe is allowed.~~

[…]

9.10 Refrigerant Piping, Valves, and Related Parts

9.10.1 General. *Refrigerant piping*, valves, fittings, and related parts shall conform to the requirements of Sections 9.10 through 9.13.

9.10.1.1 *Refrigerant piping*, valves, fittings, and related parts having a maximum internal or external *design pressure* greater than 15 psig (103.4 kPa gage) *shall* be *listed* either individually or as part of an assembly or a system by an *approved, nationally recognized laboratory,* or *shall* comply with ASME B31.5[8] where applicable.

9.10.2 ~~Refrigerant Parts in Air Ducts.~~ ~~Joints and all refrigerants containing parts of a *refrigerating system* located in an *air* duct carrying conditioned air to and from an *occupied space* shall be constructed to withstand a temperature of 700°F (371°C) without leaking into the airstream.~~**Reuse of Piping Materials on Existing Systems.** Reused pipe, fittings, valves, or other materials on existing refrigerant systems being renovated or modified shall comply with the requirements of Section 9.10.

9.10.3 Piping Materials Standards. Refrigerant pipe shall either be listed or demonstrate conformance to one or more of the standards in Table 9-2. The exterior of the pipe shall be protected from corrosion and degradation.

Table 9-2 Refrigerant Piping Materials

Piping Material	Standard
Aluminum Tube	ASTM B210/B210M[16], ASTM B491/B491M[17]
Brass (Copper Alloy) Pipe	ASTM B43[18]
Copper Pipe	ASTM B42[19], ASTM B302[20]
Copper Tube	ASTM B68[12], ASTM B75[13], ASTM B88[10], ASTM B280[11], ASTM B819[21]
Copper Linesets	ASTM B1003[22], ASTM B280[11]
Stainless Steel Pipe	ASTM A312/A312M[23]
Stainless Steel Tube	ASTM A269/A269M[24], ASTM A632[25]
Steel Pipe	ASTM A53/A53M[26], ASTM A106/A106M[27], ASTM A333/A333M[28]
Steel Tube	ASTM A254/A254M[29], ASTM A334/A334M[30]

9.10.3.1 Annealed Copper Tube Limitation. Soft annealed copper tubing larger than 1-3/8 in. (35 mm) O.D. shall not be used for field assembled refrigerant piping, unless it is protected from mechanical damage.

9.10.3.2 Type F Steel Pipe Limitation. ASTM A53/A53M[26], Type F steel pipe shall only be permitted for discharge lines in pressure relief systems.

9.10.4 Pipe Fittings. Refrigerant pipe fittings shall be approved for installation with the piping materials to be installed and shall demonstrate conformance to one or more of the standards in Table 9-3 or shall be listed as complying with UL 207[31].

Table 9-3 Refrigerant Pipe Fittings

Fitting Material	Standard
Aluminum	ASTM B361[32]
Brass (Copper Alloy)	ASME B16.15[33], ASME B16.24[34]
Copper	ASME B16.15[33], ASME B16.18[35], ASME B16.22[36], ASME B16.24[34], ASME B16.26[37], ASME B16.50[38]
Stainless Steel	ASTM A403/A403M[39], ASME B16.11[40]
Steel	ASTM A105/A105M[41], ASTM A181/A181M[42], ASTM A193/A193M[43], ASTM A234/A234M[44], ASTM A4204/A420M[45], ASTM A707/A707M[46]

9.10.4.1 Copper Brazed Field Swaged. The minimum and maximum cup depth of field fabricated copper brazed swaged fitting connections shall comply with Table 9-4.

Table 9-4 Copper Brazed Swaged Cup Depths

Nominal Fitting Size		Minimum		Maximum	
(in)	(mm)	(in)	(mm)	(in)	(mm)
1/8	6	0.15	3.81	0.23	5.84
3/16	7	0.16	4.06	0.24	6.10
1/4	8	0.17	4.32	0.26	6.60
3/8	10	0.20	5.08	0.30	7.62
1/2	15	0.22	5.59	0.33	8.38
5/8	18	0.24	6.10	0.36	9.14
3/4	20	0.25	6.35	0.38	9.65
1	25	0.28	7.11	0.42	10.67
1 1/4	32	0.31	7.87	0.47	11.94
1 1/2	40	0.34	8.64	0.51	12.95
2	50	0.40	10.16	0.60	15.24
2 1/2	65	0.47	11.94	0.71	18.03
3	80	0.53	13.46	0.80	20.32
3 1/2	90	0.59	14.99	0.89	22.61
4	100	0.64	16.26	0.96	24.38

9.10.5 Valve, Flexible Connectors, Expansion and Vibration Compensators. Valves, flexible connectors and expansion, vibration control devices or other similar components shall be listed to UL 207[31] for the refrigerant systems, and pressures for which the components are installed.

9.11 Joints and Connections

9.11.1 Approvals. Joints and connections shall be either *listed* or an *approved* type. Joints and connections *shall* be tight for the pressure of the *refrigerating system* when tested in accordance with Section 9.13.

9.11.1.1 Joints Between Different Piping Materials. Joints between different *piping* materials *shall* be made with either *listed* or *approved* adapter fittings. Joints between dissimilar metallic *piping* materials *shall* be designed to prevent galvanic action which includes but is not limited to the use of a dielectric fitting or a dielectric union conforming to dielectric tests of ASSE 1079[47]. Adapter fittings with threaded ends between different materials *shall* be lubricated in accordance with Section 9.11.4.4.

9.11.2 Allowable Joints. The allowable joints for a specific *piping* material *shall* be in accordance with Table 9-5.

Table 9-5 Allowable Joints

Applicable Section	Brazed	Mechanical	Flared	Press-Connect	Soldered	Threaded	Welded
	9.11.4.1	9.11.4.2	9.11.4.2.1	9.11.4.2.2	9.11.4.3	9.11.4.4	9.11.4.5
Material							
Aluminum Tube	●	●		●			●
Brass Pipe	●	●		●		●	●
Copper Pipe	●	●		●	●	●	●
Copper Tube	●	●	●	●	●		
Stainless Steel Pipe		●		●		●	●
Stainless Steel Tube		●	●	●			●
Steel Pipe		●		●		●	●
Steel Tube		●	●	●			●

9.11.3 Preparation of Pipe Ends. Pipe shall be cut square, reamed and chamfered, and shall be free of burrs and obstructions. Pipe ends shall not be undercut to reduce pipe wall below the minimum thickness as required for the application.

9.11.4 Joint Preparation and Installation. The preparation and installation of brazed, flared, mechanical, press-connect, soldered, threaded, and welded joints shall comply with Sections 9.11.4.1 through 9.11.4.5.

9.11.4.1 Brazed Joints. Surfaces of *brazed joints shall* be cleaned prior to brazing. An approved flux *shall* be applied where required by the braze filler metal manufacturer. The piping being brazed *shall* be purged of air to remove the oxygen and filled with one of the following inert gases: oxygen-free nitrogen, helium, or argon. The *piping* system *shall* be pre-purged with an inert gas for a minimum time corresponding to five volume changes through the *piping* system prior to brazing. The pre-purge rate shall be a minimum velocity of 100 feet per minute (30.5 meters per minute). The inert gas *shall* be directly connected to the tube system being brazed to prevent the entrainment of ambient air. After the pre-purge, the inert gas supply shall be maintained through the *piping* during the brazing operation at a minimum gage pressure of 1.0 psi (6.9 kPa) and a maximum gage pressure of 3.0 psi (21 kPa). The joint shall be brazed with a filler metal conforming to AWS A5.8M/A5.8[48].

9.11.4.2 Mechanical Joints. *Mechanical joints shall* be installed in accordance with the manufacturer's instructions.

9.11.4.2.1 Flared Joints. Flared fittings *shall* be installed in accordance with the manufacturer's instructions. The flared fitting *shall* be used with the tube material specified by the fitting manufacturer. The flared tube end *shall* be made by a tool designed for that operation.

9.11.4.2.2 Press-Connect Joints. Press-connect joints *shall* be installed in accordance with the manufacturer's instructions.

9.11.4.3 Soldered Joints. Surfaces of *soldered joints* shall be cleaned prior to soldering. A flux conforming to ASTM B813[43] shall be applied. The joint *shall* be soldered with a solder conforming to ASTM B32[50]. Solder joints *shall* be limited to refrigerant systems using Group A1 *refrigerant* and having a maximum *design pressure* not exceeding gage pressure of 200 psi (1.379 MPa).

9.11.4.4 Threaded Joints. Threads *shall* conform to ASME B1.20.1[51], ASME B1.20.3[52], ASME B1.13M[53], or ASME B1.1[54]. Thread lubricant, pipe-joint compound, or tape *shall* be applied on the external threads only and *shall* be *approved* for application on the *piping* material.

9.11.4.5 Welded Joints. Welded joints shall utilize qualified and *approved* weld procedure specifications that include operator qualifications, surface preparation requirements, and when required for the application the filler metal specifications.

9.12 Refrigerant Pipe Installation

9.12.1 Piping Location. *Refrigerant piping shall* comply with the installation location requirements of Sections 9.12.1.1 through 9.12.1.8. *Refrigerant piping* for Group A2L, A2, A3, B2L other than R-717 (ammonia), B2, and B3 shall also comply with the requirements of Section 9.12.2.

9.12.1.1 Minimum Height. Exposed refrigerant piping installed in open spaces that afford passage *shall* be not less than 7 feet 3 inches (2.2 m) above the finished floor.

9.12.1.2 Pipe Protection. Refrigerant piping *shall* be located:

1. Within either the *building elements* or protective enclosure. In concealed locations where aluminum tube, copper tube, or steel tube is installed through holes or notches in studs, joists, or similar members less than 1.5 inches (38 mm) from the nearest edge of the member, the tube *shall* be protected by steel shield plates having a minimum thickness of 0.0575 inches (1.461 mm). Protective steel shield plates shall cover the area of the tube where the member is notched or bored, and *shall* not extend not less than 2.0 inches (51 mm) above sole plates and below top plates, or

   Informative Note: Considering ASTM dimensional tolerances, number 16 gage galvanized steel meets the minimum thickness requirement, and number 15 gage plain steel meets the minimum thickness requirement.

2. More than 7 feet 3 inches (2.21 m) above the finished floor, or

3. Inside the building exposed within 6 feet 0 inches (1.83 m) of the refrigerant unit or appliance, or
4. In a machinery room complying with Section 8.9 or 8.10, or
5. In an attic or crawl space, aluminum tube, copper tube, or steel tube shall be protected in accordance with Item 1 when located within 1.5 inches (38 mm) from the nearest edge of the member, or
6. Outside the building:
   a. Protected from damage from the weather, including, but not limited to, hail, ice, and snow loads, and
   b. Protected from damage within the expected foot or traffic path
   c. Outside underground installed not less than 8 inches (200 mm) below finished grade and protected against corrosion.

9.12.1.3 Prohibited Locations. *Refrigerant piping shall not* be installed in any of the following locations:

1. Exposed within a *fire-resistance-rated exit access corridor*,
2. Exposed within an interior exit stairway,
3. Interior exit ramp,
4. *Exit passageway*, or
5. Elevator, dumbwaiter, or other shaft containing a moving object.

9.12.1.4 Piping in Concrete Floors. *Refrigerant piping* installed in concrete floors shall be encased in pipe, conduit, or ducts. The *piping shall* be protected to prevent damage from vibration, stress, and corrosion.

9.12.1.5 Refrigerant Pipe Shafts. *Refrigerant piping* that penetrates two or more floor/ceiling assemblies *shall* be enclosed in a *fire-resistance-rated* shaft enclosure. The *fire-resistance-rated* shaft enclosure *shall* comply with the requirements of the AHJ. Other building utilities or piping systems *shall* be allowed in the refrigerant piping shaft.

9.12.1.5.1 Shaft Alternative. A shaft enclosure *shall not* be required for the *refrigerant piping* for any of the following *refrigerating systems*:

1. For systems using R-718 (water) *refrigerant.*
2. *Piping* in a direct system using Group A1 *refrigerant* where the *refrigerant* quantity does not exceed the amounts shown in Table 4-1 or 4-2 of ASHRAE Standard 34[2] for the smallest *occupied space* through which the *piping* passes.
3. *Piping* located on the exterior of the building where vented to the outdoors.

9.12.1.6 Exposed Piping Surface Temperature. Exposed *piping* with ready access to nonauthorized personnel having temperatures greater than 120°F (49°C) or less than +5°F (–15°C) *shall* be protected from contact or have thermal insulation which limits the exposed insulation surface temperature to a range of +5°F (–15°C) to 120°F (49°C).

9.12.1.7 Pipe Support. Piping *shall* be supported in accordance with ANSI/MSS SP-58[55].

9.12.1.8 Pipe Identification. *Refrigerant pipe* located in areas other than the room or space where the refrigerating equipment is located *shall* be identified in accordance with ANSI/ASME A13.1, *Scheme for Identification of Piping Sysetms*[9]. The pipe identification *shall* be located at intervals not exceeding 20 feet (6.1 m) on the refrigerant piping or pipe insulation. The minimum height of lettering of the identification label *shall* be 0.50 inch (12.7 mm). The identification *shall* indicate the *refrigerant designation* and safety group classification of *refrigerant* used in the *piping* system.

a. For Group A2L and B2L refrigerants the identification *shall* also include the following statement: "DANGER – Risk of Fire. Flammable Refrigerant."
b. For Group A2, A3, B2, and B3 refrigerants the identification *shall* also include the following statement: "DANGER – Risk of Fire or Explosion. Flammable Refrigerant."
c. For any Group B refrigerant, the identification *shall* also include the following statement: "DANGER – Toxic Refrigerant."

9.12.2 Installation Requirements for Flammable Refrigerants. *Refrigerant piping* for *refrigerating systems*

using Group A2L, A2, A3, B2L other than R-717 (ammonia), B2, or B3 *refrigerant shall* comply with the requirements of Section 9.12.2.1 through 9.12.2.2.

9.12.2.1 Pipe Protection. In addition to the requirements in Section 9.12.1.2, aluminum tube, copper tube, or steel tube for Group A2L, A2, A3, B2L, B2, and B3 refrigerants located in concealed locations where tubing is installed in studs, joists, rafters, or similar member spaces and located less than 1.50 inches (38 mm) from the nearest edge of the member, shall be continuously protected by shield plates. Protective steel shield plates having a minimum thickness of 0.0575 inch (1.461 mm) shall cover the area of the tube, and shall extend a minimum of 2.0 inches (51 mm) beyond the outside edge of the tube.

Informative Note: Considering ASTM dimensional tolerances, number 16 gage galvanized steel meets the minimum thickness requirement, and number 15 gage plain steel meets the minimum thickness requirement.

9.12.2.2 Shaft Ventilation. Refrigerant pipe shafts with systems using only Group A2L or B2L refrigerants other than R-717 (ammonia) *shall* be naturally or mechanically ventilated. Refrigerant pipe shafts with one or more systems using any Group A2, A3, B2, or B3 refrigerant *shall* be continuously mechanically ventilated and *shall* include a *refrigerant detector*. The shaft ventilation exhaust outlet *shall* comply with the discharge location requirement specified in Section 9.7.8.2.

a. Naturally ventilated shafts *shall* have a minimum of a 4.0 inch (102 mm) diameter pipe, duct, or conduit that connects at the lowest point of the shaft and connects to the outdoors. The pipe, duct, or conduit *shall* be level or pitched down to the outdoors. A makeup air opening *shall* be provided at the top of the shaft.

b. When active, mechanically ventilated shafts *shall* have a minimum air velocity in accordance with Table 9-6. Makeup air *shall* be provided at the inlet to the shaft for mechanically ventilated shafts. The mechanical ventilation *shall* either be continuously operated, or for pipe shafts containing only systems using Group A2L or B2L refrigerants other than R-717 (ammonia) activated by a *refrigerant detector*. Refrigerant pipe shafts utilizing a *refrigerant detector shall* have a set point not exceeding the *OEL* of the *refrigerant*. The detector, or a sampling tube that draws air to the detector, *shall* be located in an area where refrigerant from a leak will concentrate. The *refrigerant detector shall* signal a trouble alarm in accordance with Section 8.11.10.2.

c. The shaft *shall not* be required to be ventilated for double wall *refrigerant* pipe where the interstitial space of the double wall pipe is vented to the outdoors in accordance with the discharge location requirements specified in Section 9.7.8.2.

Table 9-6 Shaft Ventilation Velocity

Shaft Cross-Sectional Area, A		Minimum Ventilation Velocity, V	
(in^2)	(m^2)	(ft/min)	(m/min)
$A \leq 20$	$A \leq 0.0129$	$100 \leq V$	$30.5 \leq V$
$20 < A \leq 250$	$0.0129 < A \leq 0.161$	$200 \leq V$	$61 \leq V$
$250 < A \leq 1250$	$0.161 < A \leq 0.806$	$300 \leq V$	$91 \leq V$
$1250 < A$	$0.806 < A$	$400 \leq V$	$122 \leq V$

9.12.3 Refrigerant Pipe Penetrations. In other than industrial occupancies, the annular space between the outside of a refrigerant pipe and the inside of a pipe sleeve or opening in a building envelope, wall, floor, or ceiling assembly penetrated by a refrigerant pipe *shall* be sealed in an *approved* manner with caulking material, foam sealant, or closed with a gasketing system. The caulking material, foam sealant, or gasketing system *shall* be designed for the conditions at the penetration location and *shall* be compatible with the pipe, sleeve and building materials in contact with the sealing materials. Refrigerant pipes penetrating required *fire-resistance-rated* assemblies or membranes of *fire-resistance-rated* assemblies *shall* be sealed or closed in accordance with the AHJ.

9.12.4 Stress and Strain. *Refrigerant piping shall* be installed so as to prevent strains and stresses that exceed the

structural strength of the pipe. Where necessary, provisions *shall* be made to protect *piping* from damage resulting from vibration, expansion, contraction, and structural settlement.

9.12.5 Stop Valves. *Stop valves shall* be installed in specified locations when required in accordance with 9.12.5.1 and 9.12.5.2. *Stop valves shall* be identified in accordance with 9.12.5.3. This requirement *shall not* apply to the following:

1. Systems that have a refrigerant pump out function capable of storing the entire *refrigerant* charge in a receiver or heat exchanger.
2. Systems that are equipped with provisions for pump out of the *refrigerant* using either portable or permanently installed refrigerant recovery equipment.
3. *Self-contained listed* systems.

9.12.5.1 Refrigerating Systems Containing More Than 6.6 lb (3.0 kg) of Refrigerant. *Stop valves shall* be installed in the following locations on *refrigerating systems* containing more than 6.6 lb (3.0 kg) of *refrigerant*:

1. The suction inlet of each *compressor*, *compressor unit*, or *condensing unit*.
2. The discharge outlet of each *compressor*, *compressor unit*, or *condensing unit*.
3. The outlet of each *liquid receiver*.

9.12.5.2 Refrigerating Systems Containing More Than 110 lb (50 kg) of Refrigerant. In addition to *stop valves* required by 9.12.5.1, systems containing more than 100 lb (50 kg) of *refrigerant shall* have *stop valves* installed in the following locations:

1. Each inlet of each *liquid receiver*.
2. Each inlet and each outlet of each *condenser*, when more than one *condenser* is used in parallel.

Stop valves shall not be required on the inlet of a receiver in a *condensing unit*, nor on the inlet of a receiver which is an integral part of the *condenser* or systems utilizing nonpositive displacement compressors.

9.12.5.3 Identification. *Stop valves shall* be labeled if the components regulated by the valve are not in view at the valve location. Numbering or lettering labels *shall* be a minimum of 0.50 inch (12.7 mm) in height. When valves numbers or lettering system are used, the key *shall* be located in accordance with the requirements of the AHJ.

9.13 Refrigerating System Testing

9.13.1 General. *Refrigerating systems* fabricated, assembled, or erected in the field *shall* be tested to the applicable requirements of this section. Tests *shall* include both the *high-sides* and *low-sides* of each system. System components that have been strength tested under pressure by the component manufacturer, fabricator, or assembler are not required to be strength tested again in the field unless modified or repaired. *Listed* equipment not modified or repaired *shall not* be required to be strength tested in the field. After installation and before being placed in operation, system components not previously strength tested *shall* be strength tested under pressure in accordance with Section 9.13.5. After successful completion of the required strength tests and before being placed in operation, system components and field installed connections *shall* be leak tested for tightness in accordance with Section 9.13.6.

Informative Note: System components that are strength tested prior to field assembly include, but are not limited to, *compressors*, *condensers*, precharged linesets, *pressure vessels*, *evaporators*, refrigerant bulk storage tanks, safety devices, pressure gauges, and control mechanisms.

9.13.2 Exposure of Refrigerant Piping System. *Refrigerant piping* and joints installed in the field shall be exposed for visual inspection and testing prior to being covered or enclosed.

9.13.3 Test Gases. The medium used for pressure testing the refrigerant system *shall* be one of the following inert gases: oxygen-free nitrogen, helium, argon, or premixed nonflammable oxygen-free nitrogen with a tracer gas of hydrogen or helium. For R-744 refrigerant systems, carbon dioxide *shall* be allowed as the test medium. For R-718 refrigerant systems, water *shall* be allowed as the test medium.

9.13.3.1 Test Gases Not Permitted. Oxygen, air, *refrigerants* other than those identified in Section 9.13.3, combustible gases and mixtures containing such gases *shall not* be used as the pressure test medium.

9.13.4 Field Test Apparatus. The means used to pressurize the *refrigerant piping* system shall have either a pressure-limiting device or a pressure-reducing device and a test pressure measuring device on the outlet side. The test pressure measuring device *shall* have an accuracy of ±3% or less of the test pressure, and *shall* have a resolution of 3% or less of the test pressure.

9.13.5 Piping System Strength Test. *Refrigerating system* components and *refrigerant piping shall* be tested in accordance with ASME B31.5[8] or this section. Separate tests for isolated portions of the system are permitted provided that all required portions are tested at least once. Pressurize with test gas for a minimum of 10 minutes to not less than the lower of (a) the lowest *design pressure* for any system component, or (b) the lowest value of *set pressure* for any pressure relief devices in the system. The *design pressures* for determination of test pressure *shall* be the pressure identified on the label nameplate of the *condensing unit*, *compressor*, *compressor unit*, *pressure vessel*, or other system component with a nameplate. A passing test result *shall* have no rupture or structural failure of any system component or *refrigerant piping*.

Informative Note: Stored energy due to pressure is hazardous and sudden release of that energy can cause serious damage. Take appropriate safety measures to protect life, limb, health, and property in the event of a test failure.

Pressure relief devices may need to be temporarily removed and replaced with plugs during the strength test.

9.13.5.1 Joints and Refrigerant-Containing Parts in Air Ducts. Joints and all refrigerant-containing parts of a *refrigerating system* located in an air duct of an air-conditioning system carrying conditioned air to and from human-occupied space *shall* be tested at a pressure of 150% of the higher of the *design pressure* or *pressure relief device* setting.

9.13.6 Leakage Test. The leak test *shall* be in accordance with ASHRAE Standard 147[56] or this section.

9.13.6.1 Leak Testing Protocol. After the time to complete of the strength test, continue to pressure test in accordance with Section 9.13.5 for a minimum period as specified in Table 9-7. The system *shall* show no loss in pressure on the pressure measuring device during the pressure test. Calculation of the pressure differential based on a change in ambient temperature *shall* be permitted. A vacuum of 0.0097 psi (67 Pa) absolute or lower *shall* be achieved [0.0197 in Hg (32°F); 500 µm Hg (0°C); 500 “microns”]. After achieving a vacuum, the system *shall* be isolated from the vacuum pump. The system pressure *shall* not rise above 0.029 psi (200 Pa) absolute [0.059 in Hg (32°F); 1500 µ, Hg (0°C); 1500 “microns”] for a minimum period as specified in Table 9-7.

Informative Note: The vacuum pump should gradually create a vacuum to avoid freezing of any moisture in the piping system.

Table 9-7 Duration of Leak Test

Leak Test	Pipe Length, L (ft)	Pipe Length, L (m)	Maximum Nominal Pipe Size NPS (in)	Maximum Nominal Pipe Size DN (mm)	Minimum Period of Test (hr)
Pressure Test	L ≤ 100	L ≤ 30	NPS ≤ ¾	DN ≤ 20	0.25
			¾ < NPS ≤ 3	20 < DN ≤ 75	1.0
			3 < NPS	75 < DN	24
	100 < L ≤ 200	30 < L ≤ 61	NPS ≤ 3	DN ≤ 75	1.0
			3 < NPS	75 < DN	24
	200 < L	61 < L	Any	Any	24
Vacuum Test	L ≤ 100	L ≤ 30	NPS ≤ ¾	DN ≤ 20	1.0
			¾ < NPS ≤ 3	20 < DN ≤ 75	8.0
			3 < NPS	75 < DN	24
	100 < L ≤ 200	30 < L ≤ 61	NPS ≤ 3	DN ≤ 75	8.0
			3 < NPS	75 < DN	24
	200 < L	61 < L	Any	Any	24

Informative Note: The maximum nominal pipe size is the largest interconnecting field piping installed.

9.13.7 Contractor or Engineer Declaration. The installing contractor or registered design professional of record *shall* issue a certificate of test to the AHJ for all systems containing 55 lb (25 kg) or more of refrigerant. The certificate *shall* give the test date, photograph of the pressure gage at the test pressure, *refrigerant designation*, test medium, and the field test pressure applied to the *high-side* and the *low-side* of the system. The certification of test *shall* be signed by the installing contractor or registered design professional and *shall* be made part of the public record.

9.14~~9.11~~ Components Other than Pressure Vessels and Piping

9.14.1~~9.11.1~~ Every pressure containing component…

Exception to 9.14.1~~9.11.1~~: …

9.14.2~~9.11.2~~ Liquid-level-gage glass columns…

Exception to 9.14.2~~9.11.2~~: …

9.14.3~~9.11.3~~ When a pressure gage is…

9.14.4~~9.11.4~~ Liquid receivers, if used, or parts…

9.15~~9.12~~ Service Provisions

9.15.1~~9.12.1~~ All serviceable components of *refrigerating systems shall* be provided with safe access.

9.15.2~~9.12.2~~ *Condensing units* or *compressor units* with enclosures *shall* be provided with safe access without the need to climb over or remove any obstacles or to use portable access devices to get to the equipment.

9.15.3~~9.12.3~~ All systems *shall* have provisions to handle the refrigerant charge for service purposes. When required, there *shall* be liquid and vapor transfer valves, a transfer *compressor* or pump, and *refrigerant* storage tanks or appropriate valved connections for removal by reclaim, recycle, or recovery device.

~~**9.12.4** Systems containing more than 6.6 lb (3 kg) of *refrigerant shall* have *stop valves* installed at~~

~~a. the suction inlet of each *compressor*, *compressor unit*, or *condensing unit*;~~

~~b. the discharge of each *compressor*, *compressor unit*, or *condensing unit*; and~~

~~c. the outlet of each *liquid receiver*.~~

~~**Exception to 9.12.4:** Systems that have a *refrigerant* pumpout function capable of storing the entire *refrigerant* charge, systems that are equipped with the provisions for pumpout of the *refrigerant*, or *self-contained systems*.~~

~~**9.12.5** Systems containing more than 110 lb (50 kg) of *refrigerant shall* have *stop valves* installed at~~

~~a. the suction inlet of each *compressor*, *compressor unit*, or *condensing unit*;~~

~~b. the discharge of each *compressor*, *compressor unit*, or *condensing unit*;~~

~~c. the outlet of each *liquid receiver*, except for *self-contained systems* or where the receiver is an integral part of the *condenser* or *condensing unit*;~~

~~d. the outlet of each *liquid receiver*; and~~

~~e. the inlets and outlets of *condensers* when more than one *condenser* is used in parallel in the system.~~

~~**Exception to 9.12.5:** Systems that have a *refrigerant* pumpout function capable of storing the entire *refrigerant* charge, systems that are equipped with the provisions for pumpout of the *refrigerant*, or *self-contained systems*.~~

~~**9.12.6** *Stop valves shall* be suitably labeled if the components to and from which the valve regulates flow are not in view at the valve location. Valves or *piping* adjacent to the valves *shall* be identified in accordance with ANSI A13.1[9]. When numbers are used to label the valves, there *shall* be a key to the numbers located within sight of the valves with letters at least 0.5 in. (12.7 mm) high.~~

~~**9.13 Fabrication**~~

~~**9.13.1** The following are requirements for unprotected *refrigerant* containing copper pipe or tubing:~~

~~a. Copper tubing used for *refrigerant piping shall* conform to one of the following ASTM specifications: B88[10] types K or L or B280[11]. Where ASTM B68[12] and B68[13] tubing is used, the tube wall thickness shall meet or exceed the requirements of ASTM B280[11] for the given outside diameter.~~

~~b. Copper tube *shall* be connected by *brazed joints*, *soldered joints*, or compression fittings or fittings *listed* for refrigeration use.~~

~~c. For Group A2L, A2, A3, B1, B2L, B2, and B3 *refrigerants*, protective enclosures or covers *shall* be provided for annealed copper tube erected on the *premises*.~~

~~**Exception to 9.13.1:** No enclosures *shall* be required for connections between a *condensing unit* and the nearest protected riser if such connections are not longer than 6.6 ft (2 m) in length.~~

~~**9.13.2** Joints on *refrigerant* containing copper tube that are made by the addition of filler metal shall be brazed.~~

~~**Exception to 9.13.2:** A1 *refrigerants*.~~

9.16~~9.14~~ Factory Tests

9.16.1~~9.14.1~~ All *refrigerant* containing parts or *unit systems shall* be tested…

9.16.1.1~~9.14.1.1~~ Testing Procedure. Tests *shall* be performed…

Exceptions to 9.16.1.1~~9.14.1.1~~:

[…]

9.16.2~~9.14.2~~ The test pressure applied…

9.16.3~~9.14.3~~ Units with…

9.17~~9.15~~ Nameplate. …

*[**Note to Reviewers:** existing requirements of Section 10 were moved into other parts of Section 9; subsequent sections will be renumbered and section references correspondingly updated.]*

~~10. OPERATION AND TESTING~~

~~**10.1 Field Tests**~~

~~**10.1.1** Every refrigerant containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms, and systems that are factory tested, shall be tested and proved tight after complete installation and before operation. The highside and lowside of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure relief device protecting the highside or lowside of the system, respectively.~~

~~**10.1.2 Testing Procedure.** Tests shall be performed with dry nitrogen or another nonflammable, nonreactive, dried gas. Oxygen, air, or mixtures containing them shall not be used. The means used to build up the test pressure shall have either a pressure limiting device or a pressure reducing device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system's components.~~

~~**Exceptions to 10.1.2:**~~

~~1. Mixtures of dry nitrogen, inert gases, or a combination of such with nonflammable refrigerants in concentrations of a refrigerant weight fraction (mass fraction) not exceeding 5% are allowed for tests.~~

~~2. Mixtures of dry nitrogen, inert gases, or a combination of such with flammable refrigerants in concentrations not exceeding the lesser of a refrigerant weight fraction (mass fraction) of 5% or 25% of the LFL are allowed for tests.~~

~~3. Compressed air without added refrigerant is allowed for tests, provided the system is subsequently evacuated to less than 1000 microns (132 Pa) before charging with refrigerant. The required evacuation level is atmospheric pressure for systems using R-718 (water) or R-744 (carbon dioxide) as the refrigerant.~~

~~4. Systems erected on the premises using Group A1 refrigerant and with copper tubing not exceeding 0.62 in. (16 mm) outside diameter shall be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68°F (20°C) minimum.~~

~~**10.1 Declaration.** A dated declaration of test shall be provided for all systems containing 55 lb (25 kg) or more of refrigerant. The declaration shall give the name of the refrigerant and the field test pressure applied to the highside and the lowside of the system. The declaration of test shall be signed by the installer and, if an inspector is present at the tests, the inspector shall also sign the declaration. When requested, copies of this declaration shall be furnished to the AHJ.~~

Modify Section 10 as follows. The remainder of Section 10 remains unchanged.

10.~~11.~~ GENERAL REQUIREMENTS

~~**11.1 General Restrictions—Safeguards.** Means shall be taken to adequately safeguard piping, controls, and other refrigerating equipment to minimize possible accidental damage or rupture by external sources.~~

10.1~~11.2~~ Signs and Identification

10.1.1~~11.2.1~~ Installation Identification. Each *refrigerating system* erected on the *premises shall* be provided with a legible permanent sign, securely attached and easily accessible, indicating

a. the name and address of the installer,
b. the *refrigerant* number and amount of *refrigerant*,
c. the lubricant identity and amount, and
d. the field test pressure applied.

~~**11.2.1 Controls and Piping Identification.** Systems containing more than 110 lb (50 kg) of refrigerant shall be provided with durable signs having letters not less than 0.5 in (12.7 mm) in height designating~~

~~a. valves or switches for controlling the refrigerant flow, the ventilation, and the refrigeration compressors; and~~

~~b. the kind of *refrigerant* or secondary coolant contained in exposed piping outside the machinery room.~~

~~Valves or piping adjacent to valves shall be identified 14 in accordance with ANSI A13.1, *Scheme for Identification of Piping Systems*[9].~~

10.1.2~~11.2.3~~ Changes in Refrigerant or Lubricant. When the kind of *refrigerating* or lubricant is changed as provided in Section 7.5.1.8, the signs required by Sections 10.1.1~~11.2.1~~ and 9.12.1.8~~11.2.2~~ *shall* be replaced, or added if not present, to identify the *refrigerant* and lubricant used.

10.1.3~~11.2.4~~ Each entrance to a refrigerating *machinery room shall* be provided with a legible permanent sign, securely attached and easily accessible, reading "Machinery Room—Authorized Personnel Only." The sign

shall further communicate that entry is forbidden except by those personnel trained in the emergency procedures required by Section 10.6~~11.7~~ when the *refrigerant* alarm, required by Section 8.9.5~~8.11.5~~, has been activated.

10.2~~11.3~~ Charging Withdrawal, and Disposition of Refrigerants. ...

10.2.1~~11.3.1~~ Refrigerant Access. …

10.3~~11.4~~ Containers. ...

10.4~~11.5~~ Storing Refrigerant. ...

10.5~~11.6~~ Maintenance. ...

10.5.1~~11.6.1~~ Stop Valves. …

10.5.2~~11.6.2~~ Calibration of Pressure Measuring Equipment. …

10.5.3~~11.6.3~~ Periodic Tests. …

10.6~~11.7~~ Responsibility for Operation and Emergency Shutdown. It shall be the duty… The emergency procedures *shall* forbid entry into the refrigerating *machinery room* when the *refrigerant* alarm required by Section 8.9.5~~8.11.5~~ has been activated except by persons provided with the appropriate respiratory and other protective equipment and trained in accordance with jurisdictional requirements.

Modify Section 12 as follows. The remainder of Section 12 remains unchanged.

11.~~12.~~ PRECEDENCE WITH CONFLICTING REQUIREMENTS

Modify Section 13 as follows. The remainder of Section 13 remains unchanged.

12.~~13.~~ LISTED EQUIPMENT

Modify Normative Appendix B as follows. The remainder of Normative Appendix B remains unchanged.

NORMATIVE APPENDIX B—NORMATIVE REFERENCES

This appendix contains a complete list of normative references. A complete list of references that are solely informative are included in Informative Appendix A. References in this standard are numbered in the order in which they appear in the document, so the numbers for the informative references are shown for the convenience of the user.

[…]

16. ASTM. 2019. ASTM B210/B210M, *Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes*. West Conshohocken, PA: American Society for Testing and Materials.

17. ASTM. 2015. ASTM B491/B491M, *Standard Specification for Aluminum and Aluminum-Alloy Extruded Round Tubes for General-Purpose Applications*. West Conshohocken, PA: American Society for Testing and Materials.

18. ASTM. 2015. ASTM B43, *Standard Specification for Seamless Red Brass Pipe, Standard Sizes*. West Conshohocken, PA: American Society for Testing and Materials.

19. ASTM. 2015. ASTM B42 (Rev A), *Standard Specification for Seamless Copper Pipe, Standard Sizes*. West Conshohocken, PA: American Society for Testing and Materials.

20. ASTM. 2017. ASTM B302, *Standard Specification for Threadless Copper Pipe, Standard Sizes*. West Conshohocken, PA: American Society for Testing and Materials.

21. ASTM. 2018. ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*. West Conshohocken, PA: American Society for Testing and Materials.

22. ASTM. 2016. ASTM B1003, *Standard Specification for Seamless Copper Tube for Linesets*. West Conshohocken, PA: American Society for Testing and Materials.

23. ASTM. 2018. ASTM A312/A312M (Rev A), *Standard Specification for Seamless, Welded, and Heavily Cold*

Worked Austenitic Stainless Steel Pipes. West Conshohocken, PA: American Society for Testing and Materials.

24. ASTM. 2015. ASTM A269/A269M (Rev A), *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*. West Conshohocken, PA: American Society for Testing and Materials.

25. ASTM. 2014. ASTM A632 (Rev A), *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service*. West Conshohocken, PA: American Society for Testing and Materials.

26. ASTM. 2018. ASTM A53/A53M, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*. West Conshohocken, PA: American Society for Testing and Materials.

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Modify Informative Appendix F as follows. The remainder of Informative Appendix B remains unchanged.

NORMATIVE APPENDIX F—EMERGENCIES IN REFRIGERATING MACHINERY ROOMS

This standard specifies refrigerating *machinery rooms* under some conditions… The *refrigerant detector* required by Section 8.9.5~~8.11.5~~ or 8.11.8 triggers alarms inside and outside the refrigerating *machinery room*…

[…]

F1. ALARM LEVELS

A *refrigerant* level above the *OEL* activates the alarms required by Section 8.9.5~~8.11.5~~ or 8.11.10. …

…The *refrigerant detector* required by Section 8.9.5~~8.11.5~~ or 8.11.8 activates the *machinery room* ventilation automatically.

[…]

F2. ALTERNATE REFRIGERANT LEVEL MEASUREMENTS

[…]

…The main alarm must be a manual-reset type as required per Section 8.9.5~~8.11.5~~or 8.11.10.2…

[…]

F4. ALTERNATE REFRIGERANT LEVEL MEASUREMENTS

[…]

…The facility

a. provides the *refrigerant* alarm required by Section 8.9.5~~8.11.5~~ or 8.11.10, along with signage…
b. …A sign distinguishes the current-reading indicator from the alarm-activation indicator required by Section 8.9.5~~8.11.5~~ or 8.11.10.

[…]