ADDENDA

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

Safety Standard for Refrigeration Systems

Approved by ASHRAE and the American National Standards Institute on January 27, 2022.

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. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum e revises requirements related to the 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: 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 e to Standard 15-2019

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

3. DEFINITIONS

3.1 Defined Terms

[. . .]

building code: the *building code* adopted by the jurisdiction.

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: a *building element* with an *approved fire-resistance rating*.

fire-resistance-rating: 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 *approved* tests or *approved* 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*.

[. . .]

Modify Section 7 as shown. 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 shown. 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 ANSI/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 ANSI/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* 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~~

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

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	[. . .]
[. . .]	[. . .]

8.11.7~~8.13.7~~

8.11.8~~8.13.8~~ Each refrigerating *machinery room* in accordance with Section 8.11~~8.13~~ *shall* contain one or 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).

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 plugs* (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 shown. 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, Fittings, 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.

9.10.1.2 *Refrigerant* Parts in *Air Duct*. All *refrigerant*-containing parts of a *refrigerating system* and joints 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.

9.10.2 Reuse of *Piping* Materials on Existing Systems. Reused pipe, fittings, valves, or other materials on existing *refrigerant* systems being renovated or modified *shall* be clean and free of foreign materials and *shall* comply with the requirements of Section 9.10.~~***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.~~

9.10.3 *Piping* Materials Standards. Pipe or tube utilized as *refrigerant piping shall* either be *listed* or demonstrate conformance to one or more of the standards in Table 9-2. The exterior of the *piping shall* be protected from corrosion and degradation.

9.10.3.1 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].

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

9.10.5 Flexible Connectors, Expansion and Vibration Compensators. Flexible connectors and expansion, vibration control devices or other similar components *shall* be *listed* to UL 207[31] or CSA C22.2 No 140.3[57] for the specific *refrigerant* of the *refrigerating system* for which the components are installed, and *shall* have *design pressure* in accordance with Section 9.2.

9.11 Joints and Connections

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]

Table 9-3 Refrigerant Pipe Fittings

Fitting Material	Standard
Aluminum	ASTM B361[32], ASME B16.52[58]
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 B16.26[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]

Table 9-4 Copper Swaged Cup Depths

Nominal Fitting Size		Brazed Cup Depths				Solder Cup Depths	
		Minimum		Maximum		Minimum	
(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
1/8	6	0.15	3.81	0.23	5.84	0.25	6.4
3/16	7	0.16	4.06	0.24	6.10	0.31	7.9
1/4	8	0.17	4.32	0.26	6.60	0.31	7.9
3/8	10	0.20	5.08	0.30	7.62	0.38	9.7
1/2	15	0.22	5.59	0.33	8.38	0.50	12.7
5/8	18	0.24	6.10	0.36	9.14	0.62	15.7
3/4	20	0.25	6.35	0.38	9.65	0.75	19.1
1	25	0.28	7.11	0.42	10.67	0.91	23.1
1 1/4	32	0.31	7.87	0.47	11.94	0.97	24.6
1 1/2	40	0.34	8.64	0.51	12.95	1.09	27.7
2	50	0.40	10.16	0.60	15.24	1.34	34.0
2 1/2	65	0.47	11.94	0.71	18.03	1.47	37.3
3	80	0.53	13.46	0.80	20.32	1.66	42.2
3 1/2	90	0.59	14.99	0.89	22.61	1.91	48.5
4	100	0.64	16.26	0.96	24.38	2.16	54.9

Table 9-5 Allowable Joints

	Brazed	Mechanical	Flared	Press-Connect	Soldered	Threaded	Welded
Applicable Section	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	●	●	●	●			●

Table 9-6 Shaft Ventilation Velocity

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

Table 9-7 Duration of Leak Test

	Pipe Length, L		Maximum Nominal Pipe Size		Minimum Period of Test
Leak Test	(ft)	(m)	NPS (in.)	DN (mm)	hours
Pressure Test	$L \leq 100$	$L \leq 30$	NPS ≤ 3/4	DN ≤ 20	0.25
			3/4 < NPS ≤ 3	20 < DN ≤ 75	1.0
			3 < NPS	75 < DN	24
	$100 < L \leq 200$	$30 < L \leq 61$	NPS ≤ 3	DN ≤ 75	1.0
			3 < NPS	75 < DN	24
	$200 < L$	$61 < L$	Any	Any	24
Vacuum Test	$L \leq 100$	$L \leq 30$	NPS ≤ 3/4	DN ≤ 20	1.0
			3/4 < NPS ≤ 3	20 < DN ≤ 75	8.0
			3 < NPS	75 < DN	24
	$100 < L \leq 200$	$30 < L \leq 61$	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.

9.11.1 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.

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 prepurged with an inert gas for a minimum time corresponding to five volume changes through the *piping* system prior to brazing. The prepurge rate *shall* be a minimum velocity of 100 ft/min (30.5 m/min). The inert gas *shall* be directly connected to the tube system being brazed to prevent the entrainment of ambient air. After the prepurge, 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. Single-flare fittings *shall not* be used in any part of a *refrigerating system* with a *lowside refrigerant* saturation temperature that is less than 35.6°F (2.0°C) under any anticipated normal operating conditions. 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*. Joint surfaces *shall* be cleaned. A flux conforming to ASTM B813[49] *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 *shall* not exceed the pressure rating *specified* in Appendix I of ASME B16.22[36].

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* use 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* fabricated, assembled, installed, or erected on the *refrigerating system's premises 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 ft 3 in. (2.2 m) above the finished floor.

9.12.1.2 Pipe Protection. *Refrigerant piping shall* be located in one or more of the following:

a. 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 in. (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 in. (1.461 mm). Protective steel shield plates *shall* cover the area of the tube where the member is notched or bored, and *shall* extend not less than 2.0 in. (51 mm) above sole plates and below top plates. (***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.)
b. More than 7 ft 3 in. (2.21 m) above the finished floor.
c. Inside the building exposed within 6 ft 0 in. (1.83 m) of the *refrigerant* unit or appliance.
d. In a *machinery room* complying with Section 8.9, and as applicable, Section 8.10 or 8.11.
e. In an attic or crawl space, aluminum tube, copper tube, or steel tube *shall* be protected in accordance with Item (a) when located within 1.5 in. (38 mm) from the nearest edge of the member.
f. Outside the building,
    1. protected from damage from the weather, including, but not limited to, hail, ice, and snow loads,
    2. protected from damage within the expected foot or traffic path, and
    3. if underground, installed not less than 8 in. (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:

a. Exposed within a *fire-resistance-rated exit access corridor*
b. Exposed within an interior exit stairway
c. Interior exit ramp
d. *Exit passageway*
e. 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 *building code*. 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*:

a. Systems using R-718 (water) *refrigerant*
b. *Piping* in a high-probability system where the *refrigerant* concentration 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
c. *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 that 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 piping* 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 Systems*[9]. The pipe identification *shall* be located at intervals not exceeding 20 ft (6.1 m) on the *refrigerant piping* or pipe insulation. The minimum height of lettering of the identification label *shall* be 0.50 in. (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: "WARNING—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 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 in. (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 in. (1.461 mm) *shall* cover the area of the tube and *shall* extend a minimum of 2.0 in. (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 in. (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.
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.

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 *building code*.

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 Sections 9.12.5.1 and 9.12.5.2. *Stop valves shall* be identified in accordance with Section 9.12.5.3. This requirement *shall not* apply to the following:

a. Systems that have a *refrigerant* pump-out function capable of storing the entire *refrigerant* charge in a receiver or heat exchanger
b. Systems that are equipped with provisions for pump out of the *refrigerant* using either portable or permanently installed *refrigerant* recovery equipment
c. *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*:

a. The suction inlet of each *compressor*, *compressor unit*, or *condensing unit*
b. The discharge outlet of each *compressor*, *compressor unit*, or *condensing unit*
c. 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 Section 9.12.5.1, systems containing more than 110 lb (50 kg) of *refrigerant shall* have *stop valves* installed in the following locations:

a. Each inlet of each *liquid receiver*
b. 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* or on the inlet of a receiver that 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 in. (12.7 mm) in height. When valve numbering or lettering systems 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 on the *premises 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 on the *premises* unless modified or repaired. *Listed* equipment not modified or repaired *shall not* be required to be strength tested on the *premises*. 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 on the *premises 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.

9.13.6 Leakage Test. The leak test *shall* be in accordance with ANSI/ASHRAE Standard 147-56, ASME B31.5-8, or this section.

9.13.6.1 Leak Testing Protocol. After the time to complete 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 µm 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.

9.13.7 Contractor or Engineer Declaration. The installing contractor or registered design professional of record *shall* issue a certificate of test, verifying strength test in accordance with Section 9.13.5 and leakage test in accordance with Section 9.13.6, 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 gauge 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. [. . .]

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.~~

~~**10.2 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 11 as shown. The remainder of Section 11 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.

~~**11.2.2 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 shown. The remainder of Section 12 remains unchanged.

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

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

12.~~13.~~LISTED EQUIPMENT

Modify Informative Appendix A as shown. The remainder of Informative Appendix A remains unchanged.

INFORMATIVE APPENDIX A EXPLANATORY MATERIAL

Sections of the standard with associated explanatory material in this appendix are marked with an asterisk "*" after the section number, and the associated appendix information is located in a corresponding section number preceded by "A".

A9.1.2 The restriction on magnesium alloys for halogenated *refrigerants* applies to alloys where the principal component metal is magnesium. The requirement does not apply to aluminum, copper, and steel alloys that contain magnesium.

A9.11.4.2.1 Double flare fittings are not restricted by the *lowside refrigerant* saturation temperature limit.

A9.13.2 Reused *piping shall not* be required to be exposed.

Modify Normative Appendix B as shown. 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.

[. . .]

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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.
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36. ASME. 2018. ANSI/ASME B16.22, *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*. New York, NY: American Society of Mechanical Engineers.
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Modify Informative Appendix F as shown. The remainder of Informative Appendix B remains unchanged.

INFORMATIVE 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.

[. . .]

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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.

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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.

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