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

First Public Review Draft


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
First Public Review Draft

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

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 8.118.9 and 8.128.10, 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 8.11.58.9.5.

### 7.4 Refrigerant Systems

#### 7.4.2 Nonflammable Refrigerants

Machinery rooms required by Section 7.4 shall be constructed and maintained in accordance with Section 8.11.58.9 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 8.11.58.9 and 8.11.58.10 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 8.11.58.9.1 through 8.11.58.9.5 and Section 8.13.18.11 for Group A2L and B2L refrigerants other than R-717 (ammonia).

### 7.5 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 Sections 11.2.310.1.2.

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**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 8.11.78.9.7.

#### 8.8 Refrigerant Parts in Air Duct

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 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.

8.9.11 Refrigerating Machinery Room, General Requirements

8.9.28.11.2 Each refrigerating *machinery room* shall have... With the exception of access doors and panels in air ducts and air-handling units conforming to Section 8.9.38.11.3, there shall be no openings...

8.9.58.11.5 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 8.9.78.11.7 at a set point...

Exception to 8.9.58.11.5:

2. For Group A2L and B2L other than ammonia, refer to Section 8.118.13.

8.9.68.11.6 Machinery rooms shall be vented to the outdoors, using mechanical ventilation in accordance with Sections 8.9.78.11.7 and 8.9.88.11.8.

8.9.78.11.7 Mechanical ventilation referred to in Section 8.9.68.11.6 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 8.9.88.11.8....

8.9.88.11.8 Ventilation Airflow. For Group A1, A2, A3, B1, B2, and B3 the airflow shall comply with Section 8.9.8.11.8.1. For Group A2L and B2L other than R-717 (ammonia) the airflow shall comply with Section 8.118.13.

8.9.98.11.9 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 8.9.58.11.5 is employed to automatically shut down the combustion process in the event of refrigerant leakage.

Exception to 8.9.98.11.9: ...

8.108.12 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 8.98.11: ...

8.118.13 Machinery Room, A2L and B2L Other than R-717 (Ammonia). When required by Section 7.4.2, machinery rooms shall comply with Sections 8.11.18.13.1 through 8.11.68.13.6.

8.11.18.13.1 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 8.9.98.11.9.

8.11.28.13.2

8.11.38.13.3

8.11.48.13.4

8.11.58.13.5

8.11.68.13.6 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
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 8.11.6.18.13.6.1 for ventilation and Section 8.11.6.28.13.6.2 for refrigerant detection, or shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with the National Electrical Code.

**8.11.6.18.13.6.1** The machinery room shall have a mechanical ventilation system in accordance with Section 8.11.11.18.13.11. The mechanical ventilation system shall:

b. be activated by one or more refrigerant detectors, conforming to requirements of Section 8.11.88.13.8.

**8.11.6.28.13.6.2**

**8.11.78.13.7**

**8.11.88.13.8** Each refrigerating machinery room in accordance with Section 8.11.88.13 shall contain one or more refrigerant detectors in accordance with Section 8.11.98.13.9, 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 8.11.108.13.10 for alarms and Section 8.11.118.13.11 for mechanical ventilation. Multi-port type devices shall be prohibited.

**8.11.98.13.9** Refrigerant detectors required by Section 8.11.88.13 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 8.11.108.13.10 and 8.11.118.13.11 after exposure to refrigerant concentration exceeding a limit value specified in Sections 8.11.108.13.10 and 8.11.118.13.11.

e. The refrigerant detector shall provide a means for automatic self-testing and shall be in accordance with Sections 8.11.10.48.13.10.4. 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 8.11.108.13.10 and 8.11.118.13.11.

**8.11.108.13.10** Alarms required by Section 8.11.88.13 shall comply with the following.

**8.11.108.13.10.1**

**8.11.108.13.10.2**

**8.11.108.13.10.3** 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 8.11.108.13.10. The meaning of each alarm shall be clearly marked by signage near the annunciators.

**8.11.108.13.10.4** In the event of a failure during a refrigerant detector self-test in accordance with Section 8.11.98.13.9(e), a trouble alarm signal shall be transmitted to an approved monitored location.

**8.11.1108.13.11** Ventilation. Machinery rooms, in accordance with Section 8.11.88.13, shall be vented to the outdoors, using mechanical ventilation in accordance with Sections 8.11.11.18.13.11.4, 8.11.11.28.13.11.2, and 8.11.11.38.13.11.3.

**8.11.118.13.11.1** Mechanical ventilation referred to in Section 8.11.108.13.10 shall be in accordance with all of the following: …

**8.11.118.13.11.2** Level 1 Ventilation. The refrigerating machinery room mechanical ventilation in Section 8.11.11.18.13.11.4 shall exhaust at an airflow rate not less than shown in Table 8-2.

**8.11.118.13.11.3** Level 2 Ventilation. A part of the refrigerating machinery room mechanical ventilation referred to in Section 8.11.11.18.13.11.4 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 8.11.88.13.8 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.
8.11.48.13.48.14 Safety Group A2L, B2L Other than Ammonia. When required by Section 8.11.11.38.13.11.3, 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

<table>
<thead>
<tr>
<th>Status</th>
<th>Airflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operated when occupied, and operated when activated in accordance with Section 8.11.9(c) and Table 8-1</td>
<td>…</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
</tr>
</tbody>
</table>

8.128.44 When a refrigerating system is located outdoors more than …

8.138.45 Purge Discharge. The discharge from purge systems shall be governed by the same rules as pressure relief devices and fusible plug (see Section 9.7.8) and shall be piped in conjunction with these devices.

Exception to 8.138.45: 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 butt weld 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 B31.58 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

<table>
<thead>
<tr>
<th>Piping Material</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Tube</td>
<td>ASTM B210/B210M\textsuperscript{16}, ASTM B491/B491M\textsuperscript{17}</td>
</tr>
<tr>
<td>Brass (Copper Alloy) Pipe</td>
<td>ASTM B43\textsuperscript{18}</td>
</tr>
<tr>
<td>Copper Pipe</td>
<td>ASTM B42\textsuperscript{19}, ASTM B302\textsuperscript{20}</td>
</tr>
<tr>
<td>Copper Tube</td>
<td>ASTM B68\textsuperscript{12}, ASTM B75\textsuperscript{13}, ASTM B88\textsuperscript{10}, ASTM B280\textsuperscript{11}, ASTM B819\textsuperscript{21}</td>
</tr>
<tr>
<td>Copper Linesets</td>
<td>ASTM B100\textsuperscript{22}, ASTM B280\textsuperscript{11}</td>
</tr>
<tr>
<td>Stainless Steel Pipe</td>
<td>ASTM A312/A312M\textsuperscript{23}</td>
</tr>
<tr>
<td>Stainless Steel Tube</td>
<td>ASTM A269/A269M\textsuperscript{24}, ASTM A632\textsuperscript{25}</td>
</tr>
<tr>
<td>Steel Pipe</td>
<td>ASTM A53/A53M\textsuperscript{26}, ASTM A106/A106M\textsuperscript{27}, ASTM A333/A333M\textsuperscript{28}</td>
</tr>
<tr>
<td>Steel Tube</td>
<td>ASTM A254/A254M\textsuperscript{29}, ASTM A334/A334M\textsuperscript{30}</td>
</tr>
</tbody>
</table>

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\textsuperscript{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\textsuperscript{31}.

Table 9-3  Refrigerant Pipe Fittings

<table>
<thead>
<tr>
<th>Fitting Material</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>ASTM B36\textsuperscript{32}</td>
</tr>
<tr>
<td>Brass (Copper Alloy)</td>
<td>ASME B16.15\textsuperscript{33}, ASME B16.24\textsuperscript{34}</td>
</tr>
<tr>
<td>Copper</td>
<td>ASME B16.15\textsuperscript{33}, ASME B16.18\textsuperscript{35}, ASME B16.24\textsuperscript{36}, ASME B16.24\textsuperscript{34}, ASME B16.26\textsuperscript{37}, ASME B16.50\textsuperscript{38}</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>ASTM A403/A403M\textsuperscript{39}, ASME B16.11\textsuperscript{40}</td>
</tr>
<tr>
<td>Steel</td>
<td>ASTM A105/A105M\textsuperscript{41}, ASTM A181/A181M\textsuperscript{42}, ASTM A193/A193M\textsuperscript{43}, ASTM A234/A234M\textsuperscript{44}, ASTM A420/A420M\textsuperscript{45}, ASTM A707/A707M\textsuperscript{46}</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Nominal Fitting Size</th>
<th>Minimum (in)</th>
<th>Minimum (mm)</th>
<th>Maximum (in)</th>
<th>Maximum (mm)</th>
</tr>
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<tbody>
<tr>
<td>1/8</td>
<td>0.15</td>
<td>3.81</td>
<td>0.23</td>
<td>5.84</td>
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<tr>
<td>3/16</td>
<td>0.16</td>
<td>4.06</td>
<td>0.24</td>
<td>6.10</td>
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<tr>
<td>1/4</td>
<td>0.17</td>
<td>4.32</td>
<td>0.26</td>
<td>6.60</td>
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<tr>
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<td>5.08</td>
<td>0.30</td>
<td>7.62</td>
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<tr>
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<td>5.59</td>
<td>0.33</td>
<td>8.38</td>
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<tr>
<td>5/8</td>
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<td>6.10</td>
<td>0.36</td>
<td>9.14</td>
</tr>
<tr>
<td>3/4</td>
<td>0.25</td>
<td>6.35</td>
<td>0.38</td>
<td>9.65</td>
</tr>
<tr>
<td>1</td>
<td>0.28</td>
<td>7.11</td>
<td>0.42</td>
<td>10.67</td>
</tr>
<tr>
<td>1 1/4</td>
<td>0.31</td>
<td>7.87</td>
<td>0.47</td>
<td>11.94</td>
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<tr>
<td>1 1/2</td>
<td>0.34</td>
<td>8.64</td>
<td>0.51</td>
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<td>2</td>
<td>0.40</td>
<td>10.16</td>
<td>0.60</td>
<td>15.24</td>
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<td>2 1/2</td>
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<td>0.71</td>
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<tr>
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<td>16.26</td>
<td>0.96</td>
<td>24.38</td>
</tr>
</tbody>
</table>

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 20731 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 107947. 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

<table>
<thead>
<tr>
<th>Applicable Section</th>
<th>Brazed</th>
<th>Mechanical</th>
<th>Flared</th>
<th>Press-Connect</th>
<th>Soldered</th>
<th>Threaded</th>
<th>Welded</th>
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</tbody>
</table>

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 B81343 shall be applied. The joint shall be soldered with a solder conforming to ASTM B3250. 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 B1.20.151, ASME B1.20.352, ASME B1.13M53, or ASME B1.154. 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,
   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 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.

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 Systems. 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>
<thead>
<tr>
<th>Shaft Cross-Sectional Area, A</th>
<th>Minimum Ventilation Velocity, V</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in²)</td>
<td>(m²)</td>
</tr>
<tr>
<td>A ≤ 20</td>
<td>A ≤ 0.0129</td>
</tr>
<tr>
<td>20 &lt; A ≤ 250</td>
<td>0.0129 &lt; A ≤ 0.161</td>
</tr>
<tr>
<td>250 &lt; A ≤ 1250</td>
<td>0.161 &lt; A ≤ 0.806</td>
</tr>
<tr>
<td>1250 &lt; A</td>
<td>0.806 &lt; A</td>
</tr>
</tbody>
</table>

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
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 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 refrigerating systems, carbon dioxide shall be allowed as the test medium. For R-718 refrigerating 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 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 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

<table>
<thead>
<tr>
<th>Leak Test</th>
<th>Pipe Length, L</th>
<th>Maximum Nominal Pipe Size</th>
<th>Minimum Period of Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ft)</td>
<td>(m)</td>
<td>NPS (in)</td>
</tr>
<tr>
<td>Pressure Test</td>
<td></td>
<td></td>
<td>NPS ≤ ¾</td>
</tr>
<tr>
<td>L ≤ 100</td>
<td>L ≤ 30</td>
<td>¾ &lt; NPS ≤ 3</td>
<td>20 ≤ DN ≤ 75</td>
</tr>
<tr>
<td>100 &lt; L ≤ 200</td>
<td>30 &lt; L ≤ 61</td>
<td>NPS ≤ 3</td>
<td>DN ≤ 75</td>
</tr>
<tr>
<td>200 &lt; L</td>
<td>61 &lt; L</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>Vacuum Test</td>
<td></td>
<td></td>
<td>NPS ≤ ¾</td>
</tr>
<tr>
<td>L ≤ 100</td>
<td>L ≤ 30</td>
<td>¾ &lt; NPS ≤ 3</td>
<td>20 ≤ DN ≤ 75</td>
</tr>
<tr>
<td>100 &lt; L ≤ 200</td>
<td>30 &lt; L ≤ 61</td>
<td>NPS ≤ 3</td>
<td>DN ≤ 75</td>
</tr>
<tr>
<td>200 &lt; L</td>
<td>61 &lt; L</td>
<td>Any</td>
<td>Any</td>
</tr>
</tbody>
</table>

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 part of the public record.

9.14.11.4 Components Other than Pressure Vessels and Piping

9.14.19.11.1 Every pressure containing component...

Exception to 9.14.19.11.1: ...

9.14.29.11.2 Liquid-level-gage glass columns...

Exception to 9.14.29.11.2: ...

9.14.39.11.3 When a pressure gage is...

9.14.49.11.4 Liquid receivers, if used, or parts...

9.15.1 Service Provisions

9.15.5 Service Provisions

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;

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. 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: B8810 types K or L or B280. Where ASTM B6812 and B6813 tubing is used, the tube wall thickness shall meet or exceed the requirements of ASTM B280 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.

9.16.14 Factory Tests

9.16.14.1 All refrigerant containing parts or unit systems shall be tested…

9.16.14.1.1 Testing Procedure. Tests shall be performed…

Exceptions to 9.16.14.1.1:

[ […] ]

9.16.14.2 The test pressure applied…

9.16.14.3 Units with…

9.17.45 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.

10.11.2 Signs and Identification

10.1.11.2.1 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 in accordance with ANSI A13.1, Scheme for Identification of Piping Systems.²

10.1.211.2.2 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 10.1.11.2.1 and 9.12.1.811.2.2 shall be replaced, or added if not present, to identify the refrigerant and lubricant used.

10.1.311.2.4 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 10.6.2 when the refrigerant alarm, required by Section 8.9.58.11.5, has been activated.

10.211.3 Charging Withdrawal, and Disposition of Refrigerants. ...
   10.2.111.3.1 Refrigerant Access. ...

10.311.4 Containers. ...

10.411.5 Storing Refrigerant. ...

10.511.6 Maintenance. ...
   10.5.111.6.1 Stop Valves. ...
   10.5.211.6.2 Calibration of Pressure Measuring Equipment. ...
   10.5.311.6.3 Periodic Tests. ...

10.611.7 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 8.9.58.11.5 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.

11.42. PRECEDENCE WITH CONFLICTING REQUIREMENTS

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

12.43. 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.

[ ... ]


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 8.9.58.11.5 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 8.9.58.11.5 or 8.11.8. … The refrigerant detector required by Section 8.9.58.11.5 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 8.9.58.11.5 or 8.11.10.2…

F4. ALTERNATE REFRIGERANT LEVEL MEASUREMENTS

…The facility

a. provides the refrigerant alarm required by Section 8.9.58.11.5 or 8.11.10, along with signage…

b. …A sign distinguishes the current-reading indicator from the alarm-activation indicator required by Section 8.9.58.11.5 or 8.11.10.