ANSI/ASHRAE Addendum b to
ANSI/ASHRAE Standard 15-2022

Safety Standard for
Refrigeration Systems

Approved by ASHRAE and by the American National Standards Institute on June 28, 2024.

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 (www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum b revises Section 9.7.5 to clarify intent and requirements and makes editorial changes related to pressure relief devices.

Informative 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.

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

3.1 Defined Terms

[...]

bubble point: see ASHRAE Standard 34.3.

[...]

overpressure: the allowed pressure increase over the pressure relief device set pressure to enable the pressure relief device to fully open and deliver its rated flow, usually expressed as a fraction or percentage of the pressure relief device set pressure.

[...]

relieving pressure: the pressure at the inlet of a pressure relief device when fully open and delivering its rated flow. It is the set pressure plus the permitted overpressure.

[...]

superimposed back pressure: the static pressure existing at the outlet of a pressure relief device at the time the device is required to operate.

[...]

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

9. DESIGN AND CONSTRUCTION OF EQUIPMENT AND SYSTEMS

[...]

9.6 Marking of Relief Devices and Fusible Plugs

[...]

9.6.3 Fusible plugs shall be marked with the melting temperatures in Fahrenheit or Celsius.

[...]

9.7 Pressure Vessel Protection

[...]

9.7.5* Where used for overpressure protection of pressure vessels or other equipment, the minimum required discharge capacity (C) of the pressure relief device or fusible plug for each pressure vessel shall be determined using the methods in this section.

The minimum required discharge capacity (C) shall be the largest value determined by consideration of potential thermal exposure from both external heat sources in accordance with Section 9.7.5.6 and internal heat sources in accordance with Section 9.7.5.7, with each case calculated using Equation 9-2. The calculated value of the minimum required relief device discharge capacity shall be rounded up to not less than two (2) significant figures.

When one pressure relief device or fusible plug is used to protect more than one pressure vessel, the required capacity shall be the sum of the capacities required for each pressure vessel.

\[ C = f \times A \] (9-2)

where

\[ C = \text{minimum required discharge capacity of the relief device expressed as mass flow of air, lb/min (kg/s)} \]
The pressure relief device set pressure shall be in accordance with Section 9.5, and the relieving pressure for calculations in this section shall be 1.1 times the pressure relief device set pressure determined in accordance with Section 9.7.5.2.3. For fusible plugs, the relieving pressure for calculations in this section shall be determined in accordance with Section 9.7.5.2.3. When the relieving pressure exceeds 90% of the refrigerant’s critical pressure, an engineering analysis shall determine the value of the pressure relief capacity factor \( f \) as calculated using Equation 9-2:

\[ f = \frac{P_r}{P_{cr}} \times 1.1 \]

where

\[ P_r = \text{relieving pressure, psig (kPa gage)} \]
\[ P_{cr} = \text{pressure relief device set pressure, which is equal to the vessel’s design pressure, psig (kPa gage)} \]

9.7.5.2.2 When the pressure relief device set pressure is less than the vessel’s design pressure, the relieving pressure shall be calculated using Equation 9-4:

\[ P_r = (P_{cr} + P_{SIP}) \times 1.1 \]

where

\[ P_{SIP} = \text{superimposed back pressure standing at the outlet of the pressure relief device, psig (kPa gage)} \]
\[ P_r = \text{relieving pressure, psig (kPa)} \]
\[ P_{cr} = \text{pressure relief device set pressure, which is equal to the vessel’s design pressure, psig (kPa)} \]

9.7.5.2.3 For fusible plugs, the relieving pressure shall be determined using Equation 9-5:

\[ P_r = (P_{cr} - 14.70) \times 1.1 \]
\[ P_r = (P_{cr} - 101.3) \times 1.1 \]

where

\[ P_{cr} = \text{bubble point absolute pressure corresponding to the stamped melting temperature on the fusible plug for the applicable refrigerant designation, psia (kPa)} \]
\[ P_r = \text{relieving pressure, psig (kPa)} \]

9.7.5.3 The area \( A \) shall be calculated in accordance with Section 9.7.5.6 and Section 9.7.5.7.

9.7.5.4 Tables 9-1 through 9-6 provide values of pressure relief device capacity factors \( f \) for specific refrigerants and pressure vessel design pressures their corresponding relieving pressures calculated in accordance with this section and using the following basis: set pressure is equal to design pressure, the maximum heat flux \( H \) is from an external source with the minimum permissible value, and combustible materials are not within 20 ft (6.1 m) of a pressure vessel. The tables are arranged according to the refrigerant designation and the design relieving pressure of the pressure relief device vessel or protected equipment. Capacity factors \( f \) shall only be used from Tables 9-1 through 9-6 where meeting the basis of the tables; otherwise the capacity factors shall be calculated per the method in Section 9.7.5.5. Linear interpolation shall be used for determining capacity factors for intermediate design relieving pressure values between tabulated values. Capacity factor values from Tables 9-1 through 9-6 shall not be extrapolated. Capacity factor values for other refrigerant-refrigerant designations or design relieving pressure outside the range of the tables or other heat flux values shall be calculated per the method in Section 9.7.5.5.

9.7.5.5 The area \( A \) shall be calculated in accordance with Section 9.7.5.1 and 9.7.5.2. The capacity factor \( f \) shall be calculated using Equation 9-69-3 when the relieving pressure of the vessel does not exceed 90% of the refrigerant critical pressure. Where the relieving pressure exceeds 90% of the refrigerant’s critical pressure, an engineering analysis shall determine the value of the pressure relief capacity factor \( f \).
where

\( H = \) the heat flux from a thermal energy source originating from an external source or internal source in accordance with Section 9.7.5.6 and 9.7.5.7.2, respectively, Btu/(ft^2 min) [kW/m^2]

\( h_{fg} = \) the refrigerant’s latent heat of vaporization evaluated at the relieving pressure (1.1 times the component design pressure), Btu/lb (kJ/kg)

\( r_w = \) refrigerant to air mass flow rate conversion factor, dimensionless

The refrigerant to air mass flow rate conversion factor \( r_w \) shall be calculated using Equations 9-7-9 and 9-8-5.

\[
r_w = \frac{C_a}{C_r} \text{Tr} \left( \frac{M_a}{M_r} \right)
\]

\[
C_r = 520 \left( \frac{k}{k+1} \right) \left( \frac{1}{k+1} \right)
\]

where

\( C_a = 356, \) a dimensionless constant for air, 356

\( C_r = \) constant for refrigerant as determined from Equation 9-8

\( T_r = \) the absolute dew-point temperature of refrigerant evaluated at the relieving pressure, °R (K)

\( T_a = \) the absolute temperature of standard air, 520°R (289 K)

\( M_r = \) the relative molar mass of the refrigerant in accordance with ASHRAE Standard 34

\( M_a = \) the relative molar mass of air, 28.97

\( k = \) the ratio of specific heats \( (c_p/c_v) \) for saturated refrigerant vapor evaluated at the relieving pressure, of 1.1 times the relief device set pressure.

9.7.5.6, 9.7.5.7 Internal Heat Sources. [ . . . ]

9.7.5.7.5.1 External Heat Sources. [ . . . ]

9.7.5.7.5.2 Internal Heat Sources. The area \( (A) \) shall be the applicable refrigerant-containing area for the pressure vessel or pressure-protected equipment that corresponds to the greatest internal heat flux \( (H) \) expected during operating conditions or standby conditions as defined in Sections 9.2.1 and 9.2.1.2.

Informative Note: Tables 9-1 through 9-6 are based on \( H = 150 \text{ Btu/(ft}^2 \text{ min)} \) [kW/m^2]. As stated in Section 9.7.5.4, the relieving pressures are based on the pressure relief device set pressure is equal to design pressure.

[ . . . ]

9.7.7 The rated discharge capacity of a rupture member or fusible plug discharging to the atmosphere under critical flow conditions in pounds of air per minute lb of air/min (kilograms of air per second kg of air/s) shall be determined using Equation 9-6a or 9-6b:

[ . . . ]

where for rupture members,

\( P_1 = (\text{rated pressure psig} [\text{kPa gage}] \times 1.1) + 14.70 (101.33) \)

and where for fusible plugs,

\( P_1 = \) absolute saturation pressure corresponding to the stamped melting temperature melting point of the fusible plug or the critical pressure of the applicable refrigerant used designation, whichever is smaller, psia (kPa).

[ . . . ]

9.7.9.3.2 Unless the maximum allowable back pressure \( (P_0) \) is specified by the relief valve manufacturer, the following maximum allowable back pressure values shall be used for \( P_0 \), where \( P \) is the set pressure and \( P_a \) is atmospheric pressure at the nominal elevation of the installation (Informative Table 9-7):

[ . . . ]

For fusible plugs, \( P \) shall be the saturated absolute pressure absolute saturation pressure for the corresponding to the stamped melting temperature melting point of the fusible plug or the critical pressure of the applicable refrigerant designation used, whichever is smaller, psia (kPa).
### Table 9-1 Relief Device Refrigerant Capacity Factors (f) lb/[ft²·min] (I-P)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>5500</th>
<th>110400</th>
<th>165450</th>
<th>220200</th>
<th>3303400</th>
<th>4404000</th>
<th>5505600</th>
<th>6606600</th>
</tr>
</thead>
<tbody>
<tr>
<td>R12</td>
<td>1.24</td>
<td>1.38</td>
<td>1.51</td>
<td>1.64</td>
<td>1.91</td>
<td>2.3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>R1270</td>
<td>0.75</td>
<td>0.84</td>
<td>0.91</td>
<td>0.98</td>
<td>1.13</td>
<td>1.31</td>
<td>1.58</td>
<td>—</td>
</tr>
</tbody>
</table>

### Table 9-2 Relief Device Refrigerant Capacity Factors (f) kg/[m²·s] (SI)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>385250</th>
<th>770700</th>
<th>1101400</th>
<th>1651500</th>
<th>2202000</th>
<th>2752500</th>
<th>3303300</th>
<th>4404000</th>
</tr>
</thead>
<tbody>
<tr>
<td>R12</td>
<td>0.101</td>
<td>0.113</td>
<td>0.122</td>
<td>0.137</td>
<td>0.153</td>
<td>0.173</td>
<td>0.199</td>
<td>—</td>
</tr>
<tr>
<td>R1270</td>
<td>0.061</td>
<td>0.068</td>
<td>0.074</td>
<td>0.082</td>
<td>0.091</td>
<td>0.101</td>
<td>0.113</td>
<td>—</td>
</tr>
</tbody>
</table>

### Table 9-3 Relief Device Refrigerant Capacity Factors (f) lb/[ft²·min] (I-P)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>16.545</th>
<th>5550</th>
<th>110400</th>
<th>165450</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11</td>
<td>1.05</td>
<td>1.18</td>
<td>1.32</td>
<td>1.44</td>
</tr>
<tr>
<td>R1336mzz(Z)</td>
<td>1.12</td>
<td>1.29</td>
<td>1.49</td>
<td>1.68</td>
</tr>
</tbody>
</table>

### Table 9-4 Relief Device Refrigerant Capacity Factors (f) kg/[m²·s] (SI)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>1101400</th>
<th>385250</th>
<th>770700</th>
<th>1101400</th>
</tr>
</thead>
<tbody>
<tr>
<td>R11</td>
<td>0.086</td>
<td>0.096</td>
<td>0.107</td>
<td>0.116</td>
</tr>
<tr>
<td>R1336mzz(Z)</td>
<td>0.91</td>
<td>0.105</td>
<td>0.121</td>
<td>0.135</td>
</tr>
</tbody>
</table>

### Table 9-5 Relief Device Refrigerant Capacity Factors (f) lb/[ft²·min] (I-P)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>110400</th>
<th>3303300</th>
<th>420400</th>
<th>5505600</th>
<th>6606600</th>
<th>770700</th>
<th>8808800</th>
<th>935850</th>
</tr>
</thead>
<tbody>
<tr>
<td>R744</td>
<td>0.75</td>
<td>0.93</td>
<td>1.01</td>
<td>1.09</td>
<td>1.18</td>
<td>1.30</td>
<td>1.48</td>
<td>1.63</td>
</tr>
</tbody>
</table>

### Table 9-6 Relief Device Refrigerant Capacity Factors (f) kg/[m²·s] (SI)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>770</th>
<th>1100</th>
<th>1650</th>
<th>2200</th>
<th>2750</th>
<th>3300</th>
<th>3850</th>
<th>4400</th>
<th>4950</th>
<th>5500</th>
<th>6050</th>
<th>6490</th>
<th>5500</th>
<th>5900</th>
</tr>
</thead>
<tbody>
<tr>
<td>R744</td>
<td>0.061</td>
<td>0.065</td>
<td>0.070</td>
<td>0.075</td>
<td>0.080</td>
<td>0.084</td>
<td>0.089</td>
<td>0.095</td>
<td>0.101</td>
<td>0.109</td>
<td>0.120</td>
<td>0.134</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 information in this appendix are marked with an asterisk “*” after the section number.

[ . . . ]

Section 9.7.5

The concept behind the pressure relief device is that through venting a portion of the refrigerant vapor, the pressure is controlled to a safe value, preventing failure of the pressure vessel or system protected. The normal pressure imposing element in vapor compression refrigeration is the compressor. Refrigeration systems are protected from pressure excursions due to the compressor (see Sections 9.8 and 9.9). Pressure relief safety devices are sized to provide protection in case of fire or other pressure imposing source of heat.

Tables 9-1 through 9-6 are based on heat flux $H = 150 \text{ Btu/}[\text{min} \cdot \text{ft}^2]$ (28.4 kW/m$^2$), assuming typical fire conditions. Typical fire conditions are assumed to have a one-hour flame temperature of 1700°F (1200 K), with flame exposed to only one side of the pressure vessel (no more than half of the surface area exposed), with flame emissivity of 0.30 and pressure vessel absorptivity of 0.80. Where combustible materials are stored within 20 ft (6.1 m), multiply tables values by 2.5 in accordance with Section 9.7.5.6 to account for potential to have heat radiated from more than one side of the pressure vessel (i.e., completely surrounded by extremely hot flames). Where other internal or external sources of thermal energy may exceed these values of heat flux, use the calculation method of Equation 9-6.
ASHRAE is concerned with the impact of its members’ activities on both the indoor and outdoor environment. ASHRAE’s members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

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

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

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

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