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ADDENDA

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.

Addendum b to Standard 15-2022

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 temperature~~s~~ in Fahrenheit or Celsius.

[. . .]

9.7 Pressure Vessel Protection

[. . .]

9.7.5* Where used for *overpressure* protection of *pressure vessels* or other equipment, the ~~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.

9.7.5.1 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~~9.7.5.1~~ and internal heat sources in accordance with Section 9.7.5.7~~9.7.5.2~~, 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*.

$$C = f \times A \quad (9\text{-}2)$$

where

C = minimum required discharge capacity of the relief device expressed as mass flow of air, lb/min (kg/s)

f = pressure relief capacity factor (per Section 9.7.5.4 or, as applicable, per Section 9.7.5.5) that is dependent on type of *refrigerant* and relief device *relieving pressure* ~~*vessel design pressure* or protected equipment,~~ lb/(ft²·min) [kg/(m²·s)]

A = area of the *pressure vessel* or protected equipment (per Section 9.7.5.6~~9.7.5.1~~ or 9.7.5.7~~9.7.5.2~~), ft² (m²)

9.7.5.2 The *pressure relief device set pressure shall* be in accordance with Section 9.5, and the ~~relieving pressure~~ *relieving pressure* for calculations in this section *shall* be ~~1.1 times the *pressure relief device set pressure*.~~ determined in accordance with Section 9.7.5.2.1 through 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:~~

9.7.5.2.1 When the *pressure relief device set pressure* is equal to the vessel's *design pressure*, the *relieving pressure shall* be calculated using Equation 9-3.

$$P_r = P_s \times 1.1 \qquad (9\text{-}3)$$

where

P_r = relieving pressure, psig (kPa gage)

P_s = *pressure relief device set pressure*, which is equal to the vessel's *design pressure*, psig (kPa gage)

1.1 = allowed *overpressure*

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.

$$P_r = (P_s + P_b) \times 1.1 \qquad (9\text{-}4)$$

where

P_b = *superimposed back pressure* standing at the outlet of the *pressure relief device*, psig (kPa gage)

P_r = *relieving pressure*, psig (kPa)

P_s = *pressure relief device set pressure*, which is equal to the vessel's *design pressure*, psig (kPa)

1.1 = allowed *overpressure*

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

$$P_r = (P_{bp} - 14.70) \times 1.1 \qquad (9\text{-}5a\ [\text{I-P}])$$

$$P_r = (P_{bp} - 101.3) \times 1.1 \qquad (9\text{-}5b\ [\text{SI}])$$

where

P_{bp} = *bubble point* absolute pressure corresponding to the stamped melting temperature on the *fusible plug* for the applicable *refrigerant designation*, psia (kPa)

P_r = *relieving pressure*, psig (kPa)

1.1 = allowed *overpressure*

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 ~~*refrigerants*~~ *refrigerant designations* or ~~*design*~~ *relieving pressure* outside the range of the tables or other heat flux values *shall* be calculated per the method in ~~this section~~ 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 9-6~~9-3~~ 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).

$$f = \frac{H}{h_{fg}} \times r_w \qquad (9\text{-}6\cancel{9\text{-}3})$$

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~~9.7.5.1~~ and 9.7.5.7~~9.7.5.2~~, respectively, Btu/(ft^2·min) [kW/m^2]

h_{fg} = the *refrigerant*'s latent heat of vaporization evaluated at the ~~relieving pressure~~*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~~9-4~~ and 9-8~~9-5~~.

$$r_w = \frac{C_a}{C_r}\sqrt{\frac{T_r}{T_a}}\sqrt{\frac{M_a}{M_r}} \qquad (9\text{-}7\cancel{9\text{-}4})$$

$$C_r = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}} \qquad (9\text{-}8\cancel{9\text{-}5})$$

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 ~~a~~ the ~~relieving pressure~~*relieving pressure* ~~of 1.1 times the relief device *set 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 [3]

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 ~~a~~ the ~~relieving pressure~~*relieving pressure* ~~of 1.1 times the relief device *set pressure*~~

9.7.5.6~~9.7.5.1~~ External Heat Sources. [. . .]

9.7.5.7~~9.7.5.2~~ 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 Btu/(ft^2·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 = (rated pressure psig [kPa gage] × 1.1) + 14.70 (101.3~~3~~)

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/[ft^2·min] (I-P)

Refrigerant	~~Design Pressure~~Relieving Pressure (psi, gage)							
	55~~50~~	110~~100~~	165~~150~~	220~~200~~	330~~300~~	440~~400~~	550~~500~~	660~~600~~
R12	1.24	1.38	1.51	1.64	1.91	2.3	—	—
[. . .]								
R1270	0.75	0.84	0.91	0.98	1.13	1.31	1.58	—

Table 9-2 Relief Device Refrigerant Capacity Factors (*f*) kg/[m^2·s] (SI)

Refrigerant	~~Design Pressure~~Relieving Pressure (kPa, gage)							
	385~~350~~	770~~700~~	1100~~1000~~	1650~~1500~~	2200~~2000~~	2750~~2500~~	3300~~3000~~	4400~~4000~~
R12	0.101	0.113	0.122	0.137	0.153	0.173	0.199	—
[. . .]								
R1270	0.061	0.068	0.074	0.082	0.091	0.101	0.113	—

Table 9-3 Relief Device Refrigerant Capacity Factors (*f*) lb/[ft^2·min] (I-P)

Refrigerant	~~Design Pressure~~Relieving Pressure (psi, gage)			
	16.5~~15~~	55~~50~~	110~~100~~	165~~150~~
R11	1.05	1.18	1.32	1.44
[. . .]				
R1336mzz(Z)	1.12	1.29	1.49	1.68

Table 9-4 Relief Device Refrigerant Capacity Factors (*f*) kg/[m^2·s] (SI)

Refrigerant	~~Design Pressure~~Relieving Pressure (kPa, gage)			
	110~~100~~	385~~350~~	770~~700~~	1100~~1000~~
R11	0.086	0.096	0.107	0.116
[. . .]				
R1336mzz(Z)	0.91	0.105	0.121	0.135

Table 9-5 Relief Device Refrigerant Capacity Factors (*f*) lb/[ft^2·min] (I-P)

Refrigerant	~~Design Pressure~~Relieving Pressure (psi, gage)							
	110~~100~~	330~~300~~	440~~400~~	550~~500~~	660~~600~~	770~~700~~	880~~800~~	935~~850~~
R744	0.75	0.93	1.01	1.09	1.18	1.30	1.48	1.63

Table 9-6 Relief Device Refrigerant Capacity Factors (*f*) kg/[m^2·s] (SI)

Refrigerant	~~Design Pressure~~Relieving Pressure (kPa, gage)											
	770 ~~700~~	1100 ~~1000~~	1650 ~~1500~~	2200 ~~2000~~	2750 ~~2500~~	3300 ~~3000~~	3850 ~~3500~~	4400 ~~4000~~	4950 ~~4500~~	5500 ~~5000~~	6050 ~~5500~~	6490 ~~5900~~
R744	0.061	0.065	0.070	0.075	0.080	0.084	0.089	0.095	0.101	0.109	0.120	0.134

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 Btu/[min·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.

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6/24