ADDENDA

ANSI/ASHRAE Addendum a to
ANSI/ASHRAE Standard 15-2013

Safety Standard for Refrigeration Systems

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FOREWORD

This addendum modifies and clarifies the requirements for discharge of pressure-relief devices, including where refrigerant may be safely discharged in the event of a release. Systems located outdoors are now specifically addressed and include an exemption from the 15 ft (4.57 m) height requirement if meeting specified criteria. The committee reviewed results of analytical dispersion modeling to confirm that location requirements for release of refrigerant on the exterior of a building are adequate to reduce risk of unacceptable concentrations of refrigerant. Requirements for sulfur dioxide were removed because this refrigerant is generally no longer in use. The existing content of Section 9.7.8 and Appendix D were reorganized to provide better clarity.

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 a to Standard 15-2013

Modify Section 9.7.8 as shown and add new Section 9.7.9.

9.7.8 For systems in which one or more of the following conditions apply, pressure-relief devices and fusible plugs shall discharge to the atmosphere at a location not less than 15 ft (4.57 m) above the adjoining ground level and not less than 20 ft (6.1 m) from any window, ventilation opening, or exit in any building.

a. Any system containing a Group A3 or B3 refrigerant.
b. Any system containing more than 6.6 lb (3 kg) of a Group A2, B1, or B2 refrigerant.
c. Any system containing more than 110 lb (50 kg) of a Group A1 refrigerant.
d. Any system for which a machinery room is required by the provisions of Section 7.4.

The discharge shall be terminated in a manner that will prevent both the discharged refrigerant from being sprayed directly on personnel in the vicinity and foreign material or debris from entering the discharge piping. Discharge piping connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging the pipe in the event the fusible plug or rupture member functions.

Exceptions: When R-718 (water) is the only refrigerant, discharge to a floor drain is also acceptable if all of the following three conditions are met:

1. the pressure relief device set pressure does not exceed 15 psig,
2. the floor drain is sized to handle no less than the flow rate from a single broken tube in any refrigerant-containing heat exchanger, and
3. either:
   a. the AHJ finds it acceptable that the working fluid, corrosion inhibitor, and other additives used in this type of refrigeration system may infrequently be discharged to the sewer system, or
   b. a catch tank, sized to handle the expected discharge, is installed and equipped with a normally closed drain valve and an overflow line to drain.

9.7.8.1 The application of pressure-relief valves that discharge from a higher-pressure vessel into a lower-pressure vessel of the system shall comply with (a) through (c) as follows:

a. The pressure-relief valve that protects the higher-pressure vessel shall be selected to deliver capacity in accordance with Section 9.7.5 without exceeding the maximum allowable working pressure of the higher-pressure vessel accounting for the change in mass flow capacity due to the elevated back pressure.
b. The capacity of the pressure-relief valve protecting the part of the system receiving a discharge from a pressure relief valve protecting a higher-pressure vessel shall be at least the sum of the capacity required in Section 9.7.5 plus the mass flow capacity of the pressure-relief valve discharging into that part of the system.
c. The design pressure of the body of the relief valve used on the higher-pressure vessel shall be rated for operation at the design pressure of the higher-pressure vessel in both pressure-containing areas of the valve.

9.7.8.2 Ammonia Discharge. Ammonia from pressure relief valves shall be discharged into one or more of the following:

a. The atmosphere, per Section 9.7.8.
b. A tank containing one gallon of water for each pound of ammonia (8.3 liters of water for each kilogram of ammonia) that will be released in one hour from the largest relief device connected to the discharge pipe. The water shall be prevented from freezing. The discharge pipe from the pressure-relief device shall distribute ammonia in the bottom of the tank but no lower than 33 ft (10 m) below the maximum liquid level. The tank shall contain the volume of water and ammonia without overflowing.
c. Other treatment systems that meet the requirements of the AHJ.

9.7.8.3 Optional Sulfur Dioxide Discharge. When sulfur dioxide is used, the discharge shall be into a tank of absorptive solution that shall be used for no other purpose except sulfur dioxide absorption. The absorptive solution shall be one gallon of standard dichromate solution (2.5 pounds of sodium dichromate per gallon of water [300 grams of sodium dichromate per liter of water]) for each pound of sulfur dioxide in the system (8.3 liters of standard dichromate solution for each kilogram of sulfur dioxide in the system).

~~Solutions made with caustic soda or soda ash shall not be used in place of sodium dichromate unless the quantity and strength have the equivalent sulfur-dioxide-absorbing power. The tank shall be constructed of not less than 1/8 in. (3.2 mm) or No. 11 US gage iron or steel. The tank shall have a hinged cover or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure-relief valve shall discharge the sulfur dioxide in the center of the tank near the bottom.~~

~~**9.7.8.4** The size of the discharge pipe from a pressure relief device or fusible plug shall not be less than the outlet size of the pressure-relief device or fusible plug. Where outlets of two or more relief devices or fusible plugs are connected to a common line or header, the effect of back pressure that will be developed when more than one relief device or fusible plug operates shall be considered. The sizing of the common discharge header downstream from each of the two or more relief devices or fusible plugs that are expected to operate simultaneously shall be based on the sum of their outlet areas with due allowance for the pressure drop in all downstream sections.~~

~~**9.7.8.5** The maximum length of the discharge piping installed on the outlets of pressure-relief devices and fusible plugs discharging to the atmosphere shall be determined by the method in Normative Appendix E. See Table 3 for the flow capacity of various equivalent lengths of discharge piping for conventional relief valves.~~

9.7.8 Discharge from Pressure-Relief Devices. Pressure-relief systems designed for vapor shall comply with Section 9.7.8. Pressure-relief systems designed for liquid shall comply with Section 9.4.3.

9.7.8.1 Discharging Location Interior to Building. Pressure-relief devices, including fusible plugs, serving refrigeration systems shall be permitted to discharge to the interior of a building only when all of the following apply:

a. The system contains less than 110 lb (50 kg) of a Group A1 refrigerant.
b. The system contains less than 6.6 lb (3 kg) of a Group A2, B1 or B2 refrigerant.
c. The system does not contain any quantity of a Group A3 or B3 refrigerant.
d. The system is not required to be installed in a machinery room as required by Section 7.4.
e. The refrigerant concentration limits in Section 7.2 are not exceeded.

Refrigeration systems that do not meet the above requirements shall meet the requirements of Sections 9.7.8.2, 9.7.8.3, and 9.7.8.4.

9.7.8.2 Discharging Location Exterior to Building. Pressure-relief devices designed to discharge external to the refrigeration system shall be arranged to discharge outside of a building and comply with the all of the following:

a. The point of vent discharge shall be located not less than 15 ft (4.57 m) above the adjoining ground level.

Exception: Outdoor systems containing Group A1 refrigerant shall be permitted to discharge at any elevation where the point of discharge is located in an access-controlled area accessible to authorized personnel only.

b. The point of vent discharge shall be located not less than 20 ft (6.1 m) from windows, building ventilation openings, pedestrian walkways, or building exits.
c. For heavier-than-air refrigerants, the point of vent discharge shall be located not less than 20 ft (6.1 m) horizontally from below-grade walkways, entrances, pits or ramps if a release of the entire system charge into such a space would yield a concentration of refrigerant in excess of the RCL. The direct discharge of a relief vent into enclosed outdoor spaces, such as a courtyard with walls on all sides, shall not be permitted if a release of the entire system charge into such a space would yield a concentration of refrigerant in excess of the RCL. The volume for the refrigerant concentration calculation shall be determined using the gross area of the space and a height of 8.2 ft (2.5m), regardless of the actual height of the enclosed space.
d. The termination point of a vent discharge line shall be made in a manner that prevents discharged refrigerant from spraying directly onto personnel that might be in the vicinity.
e. The termination point of vent discharge line shall be made in a manner that prevents foreign material or debris from entering the discharge piping.
f. Relief vent lines that terminate vertically upward and are subject to moisture entry shall be provided with a drip pocket having a minimum of 24 in. (0.6 m) in length and having the size of the vent discharge pipe. The drip pocket shall be installed to extend below the first change in vent pipe direction and shall be fitted with a valve or drain plug to permit removal of accumulated moisture.

9.7.8.3 Internal Relief. Pressure-relief valves designed to discharge from a higher-pressure vessel into a lower pressure vessel internal to the system shall comply with all of the following:

a. The pressure-relief valve that protects the higher-pressure vessel shall be selected to deliver capacity in accordance with Section 9.7.5 without exceeding the maximum allowable working pressure of the higher-pressure vessel accounting for the change in mass flow capacity due to the elevated backpressure.
b. The capacity of the pressure-relief valve protecting the part of the system receiving a discharge from a pressure-relief valve protecting a higher-pressure vessel shall be at least the sum of the capacity required in Section 9.7.5 plus the mass flow capacity of the pressure-relief valve discharging into that part of the system.
c. The design pressure of the body of the relief valve used on the higher-pressure vessel shall be rated for operation at the design pressure of the higher-pressure vessel in both pressure-containing areas of the valve.

9.7.8.4 Discharge Location, Special Requirements. Additional requirements for relief device discharge location

and allowances shall apply for specific refrigerants as listed in this section.

9.7.8.4.1 Water (R-718). Where water is the only refrigerant, discharge to a floor drain shall be permitted where all of the following conditions are met:

a. The pressure-relief device set pressure does not exceed 15 psig.
b. The floor drain is sized to handle the flow rate from a single broken tube in any refrigerant-containing heat exchanger.
c. Either
   1. the authority having jurisdiction finds it acceptable that the working fluid, corrosion inhibitor, and other additives used in this type of refrigeration system may infrequently be discharged to the sewer system or
   2. a catch tank, sized to handle the expected discharge, is installed and equipped with a normally closed drain valve and an overflow line to drain.

9.7.8.4.2 Ammonia (R-717). Pressure-relief valves serving systems using ammonia as a refrigerant shall discharge in accordance with one of the following:

a. To atmosphere in accordance with Section 9.7.8.2
b. Internally in accordance with Section 9.7.8.3
c. To a treatment system approved by the authority having jurisdiction

9.7.9 Relief Discharge Piping. The piping used for pressure-relief device discharge shall meet the requirements of the following subsections.

9.7.9.1 Discharge Piping, General. Piping connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging of the pipe upon operation of a fusible plug or rupture member.

9.7.9.2 The size of the discharge pipe from a pressure-relief device or fusible plug shall not be less than the outlet size of the pressure-relief device or fusible plug.

9.7.9.3 The maximum length of the discharge piping installed on the outlet of pressure-relief devices and fusible plugs discharging to the atmosphere shall be determined using the method in this section. See Table 9.7.9.3 for the allowable flow capacity of various equivalent lengths of single discharge piping vents for conventional pressure-relief valves.

9.7.9.3.1 The design back pressure due to flow in the discharge piping at the outlet of pressure-relief devices and fusible plugs, discharging to atmosphere, shall be limited by the allowable equivalent length of piping determined by the following equations:

$$L = \frac{0.2146 d^5 (P_0^2 - P_2^2)}{f C_r^2} - \frac{d \ln\left(\frac{P_0}{P_2}\right)}{6f} \qquad \text{(I-P)}$$

$$L = \frac{7.4381 \times 10^{-15} d^5 (P_0^2 - P_2^2)}{f C_r^2} - \frac{d \ln\left(\frac{P_0}{P_2}\right)}{500 f} \qquad \text{(SI)}$$

where

INFORMATIVE TABLE 9.7.9.3.2 Atmospheric Pressure at Nominal Installation Elevation (Pa)

Elevation above Sea Level (ft)	P_a (psia)	Elevation above Sea Level (m)	P_a (kPa)
0	14.7	0	101
500	14.4	150	99.5
1000	14.2	300	97.8
1500	13.9	450	96.0
2000	13.7	600	94.3
2500	13.4	750	92.6
3000	13.2	900	91.0
3500	12.9	1050	89.3
4000	12.7	1200	87.7
4500	12.5	1350	86.1
5000	12.2	1500	84.6
6000	11.8	1800	81.5
7000	11.3	2100	78.5
8000	10.9	2400	75.6
9000	10.5	2700	72.8
10000	10.1	3000	70.1

L = equivalent length of discharge piping, ft (m)

C_r = rated capacity as stamped on the relief device in lb/min (kg/s), or in SCFM multiplied by 0.0764, or as calculated in Section 9.7.7 for a rupture member or fusible plug, or as adjusted for reduced capacity due to piping as specified by the manufacturer of the device, or as adjusted for reduced capacity due to piping as estimated by an approved method

f = Moody friction factor in fully turbulent flow (see typical values in Informative Appendix D)

d = inside diameter of pipe or tube, in. (mm)

ln = natural logarithm

P_2 = absolute pressure at outlet of discharge piping, psia (kPa)

P_0 = allowed back pressure (absolute) at the outlet of pressure-relief device (see Section 9.7.9.3.2), 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 9.7.9.3.2):

a. For conventional relief valves: 15% of set pressure

$$P_0 = (0.15 \times P) + P_a$$

b. For balanced relief valves: 25% of set pressure

$$P_0 = (0.25 \times P) + P_a$$

c. For rupture disks alone, fusible plugs, or pilot operated relief devices: 50% of set pressure

$$P_0 = (0.5 \times P) + P_a$$

For fusible plugs, P shall be the saturated absolute pressure for the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller.

9.7.9.3.3 When outlets of two or more relief devices or fusible plugs, which are expected to operate simultaneously, connect to a common discharge pipe, the common pipe shall be sized large enough to prevent the outlet pressure at each relief device from exceeding the maximum allowable outlet pressure in accordance with Section 9.7.9.3.2.

Update the table number for Table 9.7.8.5 to Table 9.7.9.3.

Table 9.7.8.59.3 Pressure-Relief Valve Discharge Line Capacity (lb/min of air) of Various Discharge Line Lengths

Delete current Normative Appendix D and replace with the following.

INFORMATIVE APPENDIX D
TYPICAL MOODY FRICTION FACTORS FOR USE IN RELIEF PIPING LINE LENGTH LIMIT

TABLE D-1 Typical Moody Friction Factors (*f*) for Fully Turbulent Flow

Tubing OD (in.	DN	ID (in.)	*f*	Piping NPS	DN	ID (in.)	*f*
3/8	8	0.315	0.0136	1/2	15	0.622	0.0259
1/2	10	0.430	0.0128	3/4	20	0.824	0.0240
5/8	13	0.545	0.0122	1	25	1.049	0.0225
3/4	16	0.666	0.0117	1 1/4	32	1.380	0.0209
7/8	20	0.785	0.0114	1 1/2	40	1.610	0.0202
1 1/8	25	1.025	0.0108	2	50	2.067	0.0190
1 3/8	32	1.265	0.0104	2 1/2	65	2.469	0.0182
1 5/8	40	1.505	0.0101	3	80	3.068	0.0173
				4	100	4.026	0.0163
				5	125	5.047	0.0155
				6	150	6.065	0.0149

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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.

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.

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.