



ADDENDA

**ANSI/ASHRAE Addendum h to
ANSI/ASHRAE Standard 15-2016**

Safety Standard for Refrigeration Systems

Approved by the ASHRAE Standards Committee on September 14, 2018; by the ASHRAE Technology Council on September 28, 2018; and by the American National Standards Institute on October 1, 2018.

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FOREWORD

The 2010 edition of ASHRAE Standard 34 added an optional Subclass 2L to the existing Class 2 flammability classification of refrigerants. Since that time, several refrigerants, including single-component fluids and blends, have been classified as Subclass 2L (refer to ANSI/ASHRAE Standard 34-2016 and addenda). Use of Subclass 2L refrigerants currently requires following Class 2 requirements per ASHRAE Standard 15 (2010, 2013, or 2016 edition, as applicable to any given jurisdiction).

In July of 2011, ASHRAE SSPC 15 published the first Advisory Public Review draft with proposed changes related to Subclass 2L. In October of 2015, a second Advisory Public Review draft was published. In August of 2016, a first Publication Public Review draft was published as Addendum h to Standard 15-2013, with the scope of that proposed addendum limited to machinery room applications using 2L refrigerants. In March of 2018, a second Publication Public Review draft was published as Addendum h to Standard 15-2016. In July of 2018 a third public review was conducted for an independent substantive change. The committee appreciates the many comments that were received.

This addendum modifies portions of Standard 15 to incorporate Class 2L flammability classification as defined in ASHRAE Standard 34-2016. Addendum g to ASHRAE Standard 34-2016 has been published, making 2L a flammability class rather than a subclass and defining A2L and B2L as safety groups.

This addendum allows Group A2L refrigerants in applications requiring machinery rooms. The addendum does not change how ASHRAE Standard 15 deals with Group A2L refrigerants in high-probability systems for human comfort, industrial applications, or refrigerated rooms. Those topics are addressed in Addendum d.

Also see Addendum c to Standard 15-2016 for related changes to Section 8.11.2.1 (the section that Addendum h renumbers to Section 8.11.5 for the next edition of the standard).

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strike through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum h to Standard 15-2016

Modify Section 3 as shown.

3. DEFINITIONS

refrigerant designation: the unique identifying alphanumeric value or refrigerant number assigned to an individual refrigerant and published in ASHRAE Standard 34¹.

Modify Section 7 as shown.

7. RESTRICTIONS ON REFRIGERANT USE

[. . .]

7.4 Location in a Machinery Room or Outdoors. All components containing refrigerant shall be located either in a machinery room or outdoors, where

a. the quantity of refrigerant needed exceeds the limits defined by Section 7.2 and Section 7.3 or where direct-fired absorption equipment is used.

Exception to Section 7.4: ~~b. direct-fired absorption equipment, other than sealed absorption systems not exceeding the refrigerant quantity limits indicated in Table 7.4, is used.~~

7.4.1 Nonflammable Refrigerants. Machinery rooms required by Section 7.4 shall be constructed and maintained in accordance with Section 8.11 for Group A1 and B1 refrigerants.

7.4.2 Flammable Refrigerants. Machinery rooms required by Section 7.4 based on flammability be constructed and maintained in accordance with Sections 8.11 and 8.12 for Group A2, B2, A3, and B3 refrigerants. Machinery rooms required by Section 7.4 based on flammability shall be constructed and maintained in accordance with Sections 8.11.1 through 8.11.5 and Section 8.13 for Group A2L and B2L refrigerants other than R-717 (ammonia).

Modify Section 8 as shown.

8. INSTALLATION RESTRICTIONS

[. . .]

8.11 Refrigerating Machinery Room, General Requirements. When a refrigerating system is located indoors and a machinery room is required by Section 7.4, the machinery room shall be in accordance with the following provisions.

8.11.1 Machinery rooms are not prohibited from housing other mechanical equipment unless specifically prohibited elsewhere in this standard. A machinery room shall be so dimensioned that parts are accessible with space for service, maintenance, and operations. There shall be clear head room of not less than 7.25 ft (2.2 m) below equipment situated over passageways.

8.11.2 Each refrigerating machinery room shall have a tight-fitting door or doors opening outward, self-closing if they open into the building and adequate in number to ensure freedom for persons to escape in an emergency. With the exception of access doors and panels in air ducts and air-handling units conforming to Section ~~8.11.7~~ 8.11.3, there shall be no openings that will permit passage of escaping refrigerant to other parts of the building.

~~8.11.7~~ 8.11.3 There shall be no airflow to or from an occupied space through a machinery room unless the air is ducted and sealed in such a manner as to prevent any refrigerant leakage from entering the airstream. Access doors and panels

in duct-work and air-handling units shall be gasketed and tight fitting.

8.11.8-8.11.4 Access. Access to the refrigerating machinery room shall be restricted to authorized personnel. Doors shall be clearly marked, or permanent signs shall be posted at each entrance to indicate this restriction.

8.11.2.1-8.11.5 Each refrigerating machinery room shall contain a detector, located in an area where refrigerant from a leak will concentrate, that actuates an alarm and mechanical ventilation in accordance with Section 8.11.4 8.11.7 at a value not greater than the corresponding TLV-TWA (or toxicity measure consistent therewith) The alarm shall annunciate visual and audible alarms inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room. The alarms required in this section shall be of the manual reset type with the reset located inside the refrigerating machinery room. Alarms set at other levels (such as IDLH) and automatic reset alarms are permitted in addition to those required by this section. The meaning of each alarm shall be clearly marked by signage near the annunciators.

Exceptions to Section 8.11.5:

1. For ammonia, refer to Section 8.12(h).
2. Detectors are not required when only systems using R-718 (water) are located in the refrigerating machinery room.
3. For Group A2L and Group B2L other than ammonia, refer to Section 8.13.

8.11.3-8.11.6 Machinery rooms shall be vented to the outdoors, utilizing mechanical ventilation in accordance with Sections 8.11.4 8.11.7 and 8.11.5 8.11.8.

8.11.4-8.11.7 Mechanical ventilation referred to in Section 8.11.3 8.11.6 shall be by one or more power-driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in Section 8.11.5 8.11.8. To obtain a reduced airflow for normal ventilation, multiple fans or multi-speed fans shall be used. Provision shall be made for inlet air to replace that being exhausted. Openings for inlet air shall be positioned to avoid recirculation. Air supply and exhaust ducts to the machinery room shall serve no other area. The discharge of the air shall be to the outdoors in such a manner as not to cause a nuisance or danger. The mechanical exhaust inlet(s) shall be located in an area where refrigerant from a leak is likely to concentrate, in consideration of the location of the replacement air path(s), refrigerating machine(s), and the density of the refrigerant relative to air.

8.11.5-8.11.8 Ventilation Airflow. For Group A1, B1, A2, B2, A3, and B3 the airflow shall comply with Section 8.11.8.1. For Group A2L and B2L other than R-717 (ammonia) the airflow shall comply with Section 8.13.

8.11.8.1 The mechanical ventilation required to exhaust an accumulation of refrigerant due to leaks or a rupture of the system shall be capable of removing air from the machinery room in not less than the following quantity:

$$Q = 100 \times G^{0.5} \quad (\text{I-P})$$

$$Q = 70 \times G^{0.5} \quad (\text{SI})$$

where

Q = airflow, cfm (L/s)

G = mass of refrigerant in the largest system, any part of which is located in the machinery room, lb (kg)

A part of the refrigerating machinery room mechanical ventilation shall be

- a. operated, when occupied, to supply at least 0.5 cfm/ft² (2.54 L/s/m²) of machinery room area or 20 cfm (9.44 L/s) per person and
- b. operable, when occupied at a volume required to not exceed the higher of a temperature rise of 18°F (10°C) above inlet air temperature or a maximum temperature of 122°F (50°C).

8.11.6-8.11.9 No open flames that use combustion air from the machinery room shall be installed where any refrigerant is used. Combustion equipment shall not be installed in the same machinery room with refrigerant containing equipment except under one of the following conditions:

- a. Combustion air is ducted from outside the machinery room and sealed in such a manner as to prevent any refrigerant leakage from entering the combustion chamber.
- b. A refrigerant detector, conforming to Section 8.11.2.1 8.11.5, is employed to automatically shut down the combustion process in the event of refrigerant leakage.

Exceptions to Section 8.11.9:

1. Machinery rooms where only carbon dioxide (R-744) or water (R-718) is the refrigerant.
2. Machinery rooms where only ammonia (R-717) is the refrigerant and internal combustion engines are used as the prime mover for the compressors.

[. . .]

8.13 Machinery Room, A2L and B2L Other than R-717 (Ammonia). When required by Section 7.4.2, machinery rooms shall comply with Sections 8.13.1 through 8.13.6.

8.13.1 There shall be no flame-producing device or hot surface over 1290°F (700°C) in the room, other than that used for maintenance or repair, unless installed in accordance with Section 8.11.9.

8.13.2 Doors communicating with the building shall be approved, self-closing, tight-fitting fire doors.

8.13.3 Walls, floor, and ceiling shall be tight and of non-combustible construction. Walls, floor, and ceiling separating the refrigerating machinery room from other occupied spaces shall be of at least one-hour fire-resistive construction.

8.13.4 Exterior openings, if present, shall not be under any fire escape or any open stairway.

8.13.5 All pipes piercing the interior walls, ceiling, or floor of such rooms shall be tightly sealed to the walls, ceiling, or floor through which they pass.

8.13.6 When any refrigerant of Groups A2, A3, B2, or B3 are used, the machinery room shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with the *National Electrical Code*⁵. 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 8.13.6.1 for ventilation and Section 8.13.6.2 for refrigerant detection, or shall be designated as Class I, Division 2 hazardous (classified) electrical location in accordance with the *National Electrical Code*⁵.

8.13.6.1 The machinery room shall have a mechanical ventilation system in accordance with Section 8.13.11. The mechanical ventilation system shall

- a. run continuously, and failure of the mechanical ventilation system actuates an alarm, or
- b. be activated by one or more *refrigerant detectors*, conforming to requirements of Section 8.13.8.

8.13.6.2 Detection of refrigerant concentration that exceeds 25% of the LFL or the upper detection limit of the refrigerant detector, whichever is lower, shall automatically de-energize the following equipment in the machinery room:

- a. Refrigerant compressors
- b. Refrigerant pumps
- c. Normally closed automatic refrigerant valves
- d. Other unclassified electrical sources of ignition with apparent power rating greater than 1 kVA, where the apparent power is the product of the circuit voltage and current rating.

8.13.7 Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.

8.13.8 Each refrigerating machinery room in accordance with Section 8.13 shall contain one or more *refrigerant detectors* in accordance with Section 8.13.9, with sensing element located in areas where refrigerant from a leak will concentrate, with one or more set points that activate responses in accordance with Section 8.13.10 for alarms and Section 8.13.11 for mechanical ventilation. Multipoint type devices shall be prohibited.

8.13.9 *Refrigerant detectors* required by Section 8.13 shall meet all of the following conditions:

- a. A *refrigerant detector* shall be capable of detecting each of the specific *refrigerant designations* in the machinery room.
- b. The *refrigerant detector* shall activate responses within a time not to exceed a limit specified in Sections 8.13.10 and 8.13.11 after exposure to refrigerant concentration exceeding a limit value specified in Sections 8.13.10 and 8.13.11.
- c. The refrigerant detector shall have a set point not greater than the applicable Occupational Exposure Limit (OEL) value as published in ASHRAE Standard 34¹. The applicable OEL value shall be the lowest OEL value for any *refrigerant designation* in the machinery room. For refrigerants that do not have a published OEL value in Standard

34, use a value determined in accordance with the OEL as defined by Standard 34 where *approved* by the AHJ.

- d. The *refrigerant detector* shall have a set point not greater than the applicable Refrigerant Concentration Limit (RCL) value as published in ASHRAE Standard 34¹. The applicable RCL value shall be the lowest RCL value for any *refrigerant designation* in the machinery room. For refrigerants that do not have a published RCL value in Standard 34, use a value determined in accordance with the RCL as defined by Standard 34 where *approved* by the AHJ.
- e. The refrigerant detector shall provide a means for automatic self testing and shall be in accordance with Section 8.13.10.4. The refrigerant detector shall be tested during installation and annually thereafter, or at an interval not exceeding the manufacturer's installation instructions, whichever is less. Testing shall verify compliance with the alarm set points and response times per Sections 8.13.10 and 8.13.11.

8.13.10 Alarms required by Section 8.13.8 shall comply with the following.

8.13.10.1 The alarm shall have visual and audible annunciation inside the refrigerating machinery room and outside each entrance to the refrigerating machinery room.

8.13.10.2 The *refrigerant detector* set points shall activate an alarm in accordance with the type of reset in Table 8.13.10.2. Manual reset type alarms shall have the reset located inside the refrigerating machinery room.

8.13.10.3 Alarms set at levels other than Table 8.13.10.2 (such as *IDLH*) and automatic reset alarms are permitted in addition to those required by Section 8.13.10. The meaning of each alarm shall be clearly marked by signage near the annunciators.

8.13.10.4 In the event of a failure during a *refrigerant detector* self test in accordance with Section 8.13.9(e), a trouble alarm signal shall be transmitted to an *approved* monitored location.

8.13.11 Ventilation. Machinery rooms, in accordance with Section 8.13, shall be vented to the outdoors, using mechanical ventilation in accordance with Sections 8.13.11.1, 8.13.11.2, and 8.13.11.3.

8.13.11.1 Mechanical ventilation referred to in Section 8.13.11 shall be in accordance with all of the following:

- a. Include one or more power-driven fans capable of exhausting air from the machinery room; multispeed fans shall be permitted.
- b. Electric motors driving fans shall not be placed inside ducts; fan rotating elements shall be nonferrous or non-sparking, or the casing shall consist of or be lined with such material.
- c. Include provision to supply make-up air to replace that being exhausted; ducts for supply to and exhaust from the machinery room shall serve no other area; the makeup air supply locations shall be positioned relative to the exhaust air locations to avoid short circuiting

Table 8.13.10.2 Safety Groups: A2L, B2L Other than R-717 (Ammonia)

Limit Value	Response Time, s	Alarm Type	Alarm Reset Type	Ventilation Rate	Ventilation Reset Type
Set point ≤ OEL	≤300	Trouble alarm	Automatic	Level 1	Automatic
Set point ≤ RCL	≤15	Emergency alarm	Manual	Level 2	Manual

Table 8.13.11.2 Level 1 Ventilation Rate for Class 2L Refrigerants

Status	Airflow
Operated when occupied and operated when activated in accordance with Section 8.13.9(c) and Table 8.13.10.2	The greater of a. 0.5 ft ³ /min per ft ³ (2.54 L/s per m ³) of machinery room area, or b. 20 ft ³ /min (9.44 L/s) per person
Operable when occupied	With or without mechanical cooling of the machinery room, the greater of a. the airflow rate required to not exceed a temperature rise of 18°F (10°C) above inlet air temperature or b. the airflow rate required to not exceed a maximum air temperature of 122°F (50°C) in the machinery room

- d. inlets to the exhaust ducts shall be located in an area where refrigerant from a leak will concentrate, in consideration of the location of the replacement supply air paths, refrigerating machines, and the density of the refrigerant relative to air.
- e. Inlets to exhaust ducts shall be within 1 ft (0.3 m) of the lowest point of the machinery room for refrigerants that are heavier than air and shall be within 1 ft (0.3 m) of the highest point for refrigerants that are lighter than air.
- f. The discharge of the exhaust air shall be to the outdoors in such a manner as not to cause a nuisance or danger.

8.13.11.2 Level 1 Ventilation. The refrigerating machinery room mechanical ventilation in Section 8.13.11.1 shall exhaust at an airflow rate not less than shown in Table 8.13.11.2.

8.13.11.3 Level 2 Ventilation. A part of the refrigerating machinery room mechanical ventilation referred to in Section 8.13.11.1 shall exhaust an accumulation of refrigerant due to leaks or a rupture of a refrigerating system or portion thereof in the machinery room. The refrigerant detectors required in accordance with Section 8.13.8 shall activate ventilation at a set point and response time in accordance with Table 8.13.10.2, at an airflow rate not less than the value determined in accordance with Section 8.13.11.4.

When multiple refrigerant designations are in the machinery room, evaluate the required airflow according to each refrigerating system, and the highest airflow quantity shall apply.

Ventilation reset shall be in accordance with the type of reset in Table 8.13.10.2. Manual-type ventilation reset shall have the reset located inside the refrigerating machinery room.

8.13.11.4 Safety group A2L, B2L Other than Ammonia. When required by Section 8.13.11.3, the total airflow for Level 2 Ventilation shall be not less than the airflow rate determined by Figure 8.13.11.4-1 (I-P) or Figure 8.13.11.4-2 (SI).

8.14 When a refrigerating system is located outdoors more than 20 ft (6.1 m) from building openings and is enclosed by a penthouse, lean-to, or other open structure, natural or

mechanical ventilation shall be provided. The requirements for such natural ventilation are as follows:

- a. The free-aperture cross section for the ventilation of a machinery room shall be at least

$$F = G^{0.5} \quad (I-P)$$

$$F = 0.138 \times G^{0.5} \quad (SI)$$

where

F = the free opening area, ft² (m²)

G = the mass of refrigerant in the largest system, any part of which is located in the machinery room, lb (kg)

- b. Locations of the gravity ventilation openings shall be based on the relative density of the refrigerant to air.

8.13–8.15 Purge Discharge. The discharge from purge systems shall be governed by the same rules as pressure relief devices and fusible plugs (see Section 9.7.8) and shall be piped in conjunction with these devices.

Exception to Section 8.15: When R-718 (water) is the refrigerant.

Modify Section 9 as shown.

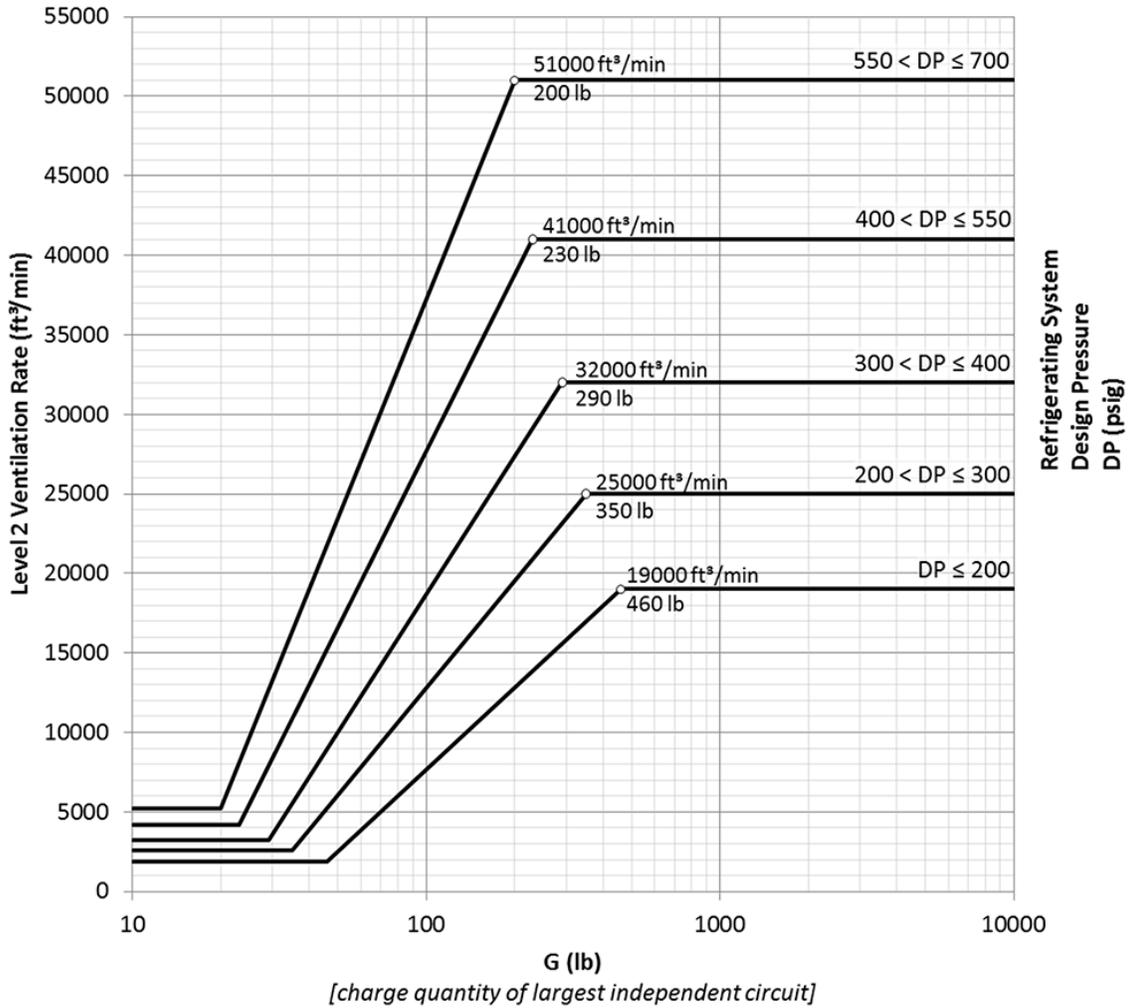
9. DESIGN AND CONSTRUCTION OF EQUIPMENT AND SYSTEMS

[. . .]

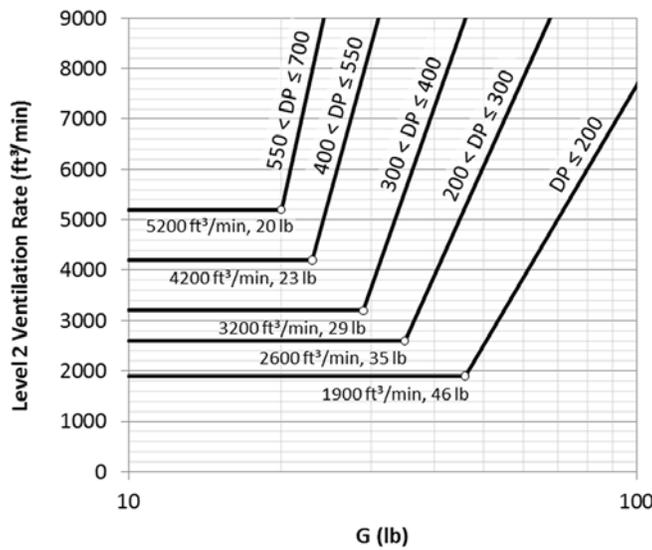
9.7 Pressure Vessel Protection

[. . .]

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.



(a)



(b)

Figure 8.13.11.4-1 (a) Level 2 ventilation rate for Class 2L refrigerants (I-P) with (b) detail.

Different refrigerants shall not be vented into a common relief piping system unless the refrigerants are included in a blend that is recognized by ASHRAE Standard 34 ¹.

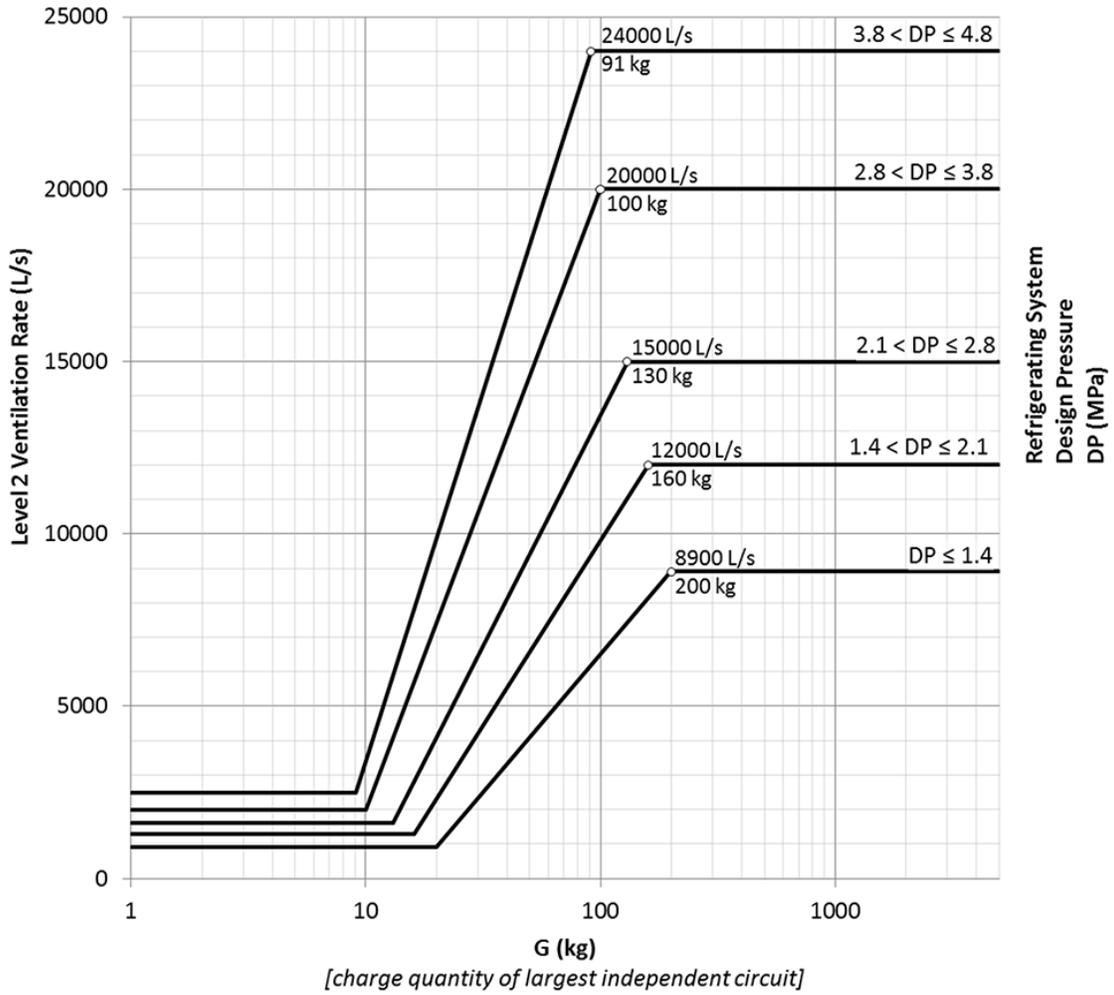
9.7.8.1 Discharging Location Interior to Building.

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:

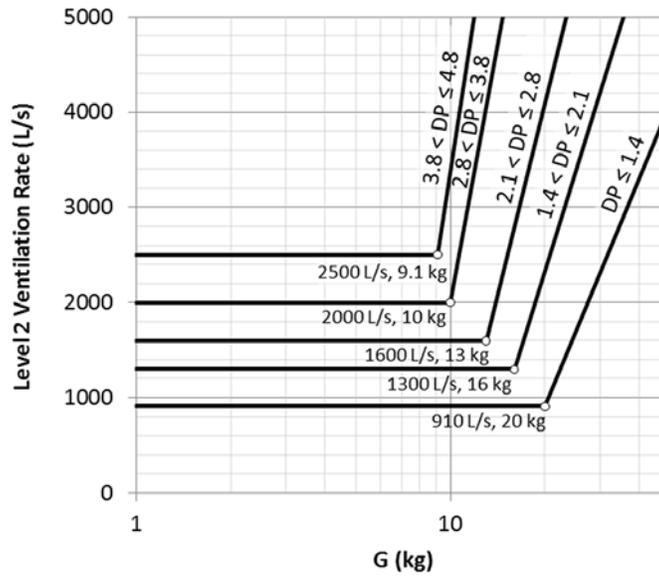
- a. The system contains less than 110 lb (50 kg) of a Group A1 or A2L refrigerant.

- b. The system contains less than 6.6 lb (3 kg) of a Group A2, B1, ~~or B2~~, or B2L refrigerant.
- c. The system does not contain any quantity of a Group A3 or B3 refrigerant.
- d. The system 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.



(a)



(b)

Figure 8.13.11.4-2 (a) Level 2 ventilation rate for Class 2L refrigerants (SI) with (b) detail.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

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.

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