ADDENDA

ANSI/ASHRAE Addendum d 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 23, 2018.

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. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE® website (www.ashrae.org) or in paper form from the Senior Manager of Standards.

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FOREWORD

Addendum d modifies portions of Standard 15 to incorporate refrigerants with a Class 2L flammability classification, as defined in ASHRAE Standard 34-2016. The 2010 edition of ASHRAE Standard 34 added optional Subclass 2L to the Class 2 flammability classification. A number of refrigerants have been classified as Subclass 2L (refer to ANSI/ASHRAE Standard 34-2016 and addenda). Use of Subclass 2L refrigerants currently requires compliance with Class 2 requirements per ASHRAE Standard 15-2016 (or earlier editions). A broader use of Class 2L refrigerants requires a new set of alternative application requirements. Addendum d proposes new requirements for high-probability systems used for human comfort applications. This proposal does not change how ASHRAE Standard 15 deals with Class 2L refrigerants in industrial or commercial applications or machinery rooms. Those applications are expected to be handled in separate addenda.

In August 2016, Addendum d was published for purposes of a first Publication Public Review draft. In April 2017 a second public review was conducted. A third public review was completed in April, 2018. The committee appreciates the many comments that were received during these reviews, and the technical issues identified. The committee reviewed each comment and provided responses to the commenters. At the same time, research has been conducted that gives a technical basis for some provisions in this addendum. This fourth public review draft incorporates changes that are responsive to the public review comments and research results where appropriate.

This addendum is contingent on the publication of Addendum g to ASHRAE Standard 34-2016 to make 2L a flammability class rather than a subclass, and to define A2L and B2L as safety groups. Also, this addendum makes use of lower flammability limit (LFL) values that will be published in an addendum to ASHRAE Standard 34.

Rapid refrigerant leak detection of Class 2L flammable refrigerants, and air movement to enable rapid mixing of leaked refrigerant, are at the core of the requirements presented in this addendum. Recall that the refrigerant concentration limit (RCL) has a factor of safety of 4 for flammable refrigerants. That is, when leaked refrigerant is fully mixed in a space, the maximum refrigerant concentration is 25% of the LFL and cannot ignite. Basic requirements for refrigerant leak detectors have been included in this draft. However, research and development of refrigerant leak detectors is continuing, and additional requirements to specify robust and reliable refrigerant leak detection may occur in the future.

There was a considerable amount of research into the use of flammable refrigerants that occurred in 2016 and 2017. The research is continuing. Standard 15 must rely on published research at the time any addendum is published, and, as such, future changes may be expected.

Finally, Addendum d relies on product standards for listed products that use Class 2L flammable refrigerants. This addendum does not intend to repeat the detailed requirements contained in product standards. Product standards are under development and subject to change. This addendum makes a reasonable attempt to correlate its requirements with the details provided in the product standards as they are presently written.

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 d to Standard 15-2016

Revise Section 7.5.2 as shown.

7. RESTRICTIONS ON REFRIGERANT USE

[. . .]

7.5 Additional Restrictions

[. . .]

7.5.2 Applications for Human Comfort. Group A2, A3, B1, B2, B2L and B3 refrigerants shall not be used in high-probability systems for human comfort. Use of Group A2L refrigerants shall be in accordance with Section 7.6.

Exceptions to Section 7.5.2:

1. ~~This~~ These restrictions do ~~does~~ not apply to sealed absorption and unit systems having refrigerant quantities less than or equal to those indicated in Table 7.4.
2. ~~This~~ These restrictions do ~~does~~ not apply to industrial occupancies.

Add the following new sections.

7.6 Group A2L Refrigerants for Human Comfort. High-probability systems using Group A2L refrigerants for human comfort applications shall comply with this section.

7.6.1 Refrigerant Concentration Limits.

7.6.1.1 Occupied spaces shall comply with Section 7.2.

7.6.1.2 Unoccupied spaces with refrigerant containing equipment, including but not limited to piping or tubing, shall comply with Section 7.2 except as permitted by Section 7.6.4.

7.6.2 Listing and Installation Requirements. Refrigeration systems shall be *listed* and shall be installed in accordance with listing, the manufacturer's instructions, and any markings on the equipment restricting the installation.

7.6.2.1 The nameplate required by Section 9.15 shall include a symbol indicating that a flammable refrigerant is used, as specified by the product listing.

7.6.2.2 A label indicating a flammable refrigerant is used shall be placed adjacent to service ports and other locations where service involving components containing refrigerant is performed, as specified by the product listing.

7.6.2.3 A *refrigerant detector* shall be provided in accordance with Section 7.6.5 where any of the following apply:

a. For commercial, public assembly, and large mercantile occupancies, when the refrigerant charge of any independent circuit exceeds 0.212 × LFL (lb), where LFL is in pounds per 1000 ft^3 (6 × LFL [kg] where LFL is in kg/m^3), unless the concentration of refrigerant in a complete discharge from any independent circuit will not exceed 50% of the RCL.
b. For residential occupancies, when the refrigerant charge of any independent circuit exceeds 0.212 × LFL (lb), where LFL is in pounds per 1000 ft^3 (6 × LFL [kg] where LFL is in kg/m^3).
c. When the occupancy classification is institutional.
d. When required by the product listing.
e. When using the provisions of Section 7.6.4.

7.6.2.4 When the *refrigerant detector* senses a rise in refrigerant concentration above the value specified in Section 7.6.5 b), the following actions shall be taken:

a. The minimum airflow rate of the supply air fan shall be in accordance with the following equation.

$$Q_{min} = 1000 \times M/\text{LFL (I-P)}$$

$$Q_{min} = 60{,}000 \times M/\text{LFL (SI)}$$

where

Q_{min} = minimum airflow rate, ft^3/min (m^3/h)

M = refrigerant charge of the largest independent refrigerating circuit of the system, lb (kg)

LFL = lower flammability limit, lb per 1000 ft^3 (g/m^3)

b. Turn off the compressor and all other electrical devices, excluding the control power transformers, control systems, and the supply air fan. The supply air fan shall continue to operate for at least five minutes after the *refrigerant detector* has sensed a drop in the refrigerant concentration below the value specified in Section 7.6.5(b)
c. Any device that controls airflow located within the product or in ductwork that supplies air to the occupied space shall be fully open. Any device that controls airflow shall be *listed*.
d. Turn off any heaters and electrical devices located in the ductwork. The heaters and electrical devices shall remain off for at least five minutes after the *refrigerant detector* has sensed a drop in the refrigerant concentration below the value specified in Section 7.6.5(b)

7.6.3 Ignition Sources Located in Ductwork

7.6.3.1 Open-flame producing devices shall not be permanently installed in the ductwork that serves the space.

7.6.3.2 Unclassified electrical devices shall not be located within the ductwork that serves the space.

7.6.3.3 Devices containing hot surfaces exceeding 1290°F (700°C) shall not be located in the ductwork that serves the space unless there is a minimum airflow of 200 ft/min (1.0 m/s) across the heating device(s) and there is proof of airflow before the heating device(s) is energized.

7.6.4 Compressors and Pressure Vessel Located Indoors. For refrigeration compressors and pressure vessels located in an indoor space that is accessible only during service and maintenance, it shall be permissible to exceed the RCL if all of the following provisions are met:

a. The refrigerant charge of largest independent refrigerating circuit shall not exceed
   1. 6.6 lb (3 kg) for residential and institutional occupancies and
   2. 22 lb (10 kg) for commercial and public/large mercantile occupancies.
b. The space where the equipment is located shall be provided with a mechanical ventilation system in accordance with Section 7.6.4(c) and a *refrigerant detector* in accordance with Section 7.6.5. The mechanical ventilation system shall be started when the *refrigerant detector* senses refrigerant in accordance with Section 7.6.5. The mechanical ventilation system shall continue to operate for at least five minutes after the refrigerant detector has sensed a drop in the refrigerant concentration below the value specified in Section 7.6.5(b).
c. A mechanical ventilation system shall be provided that will mix air with leaked refrigerant and remove it from the space where the equipment is located. The space shall be provided with an exhaust fan. The exhaust fan shall remove air from the space where the equipment is located in accordance with the following equation.

$$Q_{min} = 1000 \times M/\text{LFL (I-P)}$$

$$Q_{min} = 60{,}000 \times M/\text{LFL (SI)}$$

where

Q_{min} = minimum airflow rate, ft^3/min (m^3/h)

M = refrigerant charge of the largest independent refrigerating circuit of the system, lb (kg)

LFL = lower flammability limit in lb per 1000 ft^3 (g/m^3)

d. The exhaust air inlet shall be located where refrigerant from a leak is expected to accumulate. The bottom of the air inlet elevation shall be within 12 in. (30 cm) of the lowest elevation in the space where the compressor or pressure vessel is located. Provision shall be made for make-up air to replace that being exhausted. Openings for the make-up air shall be positioned such that air will mix with leaked refrigerant.
e. Air that is exhausted from the ventilation system shall be either
   1. discharged outside of the building envelope or
   2. discharged to an indoor space, provided that the refrigerant concentration will not exceed the limit specified in Section 7.6.1.
f. In addition to the requirements of Section 7.6.3, there shall be no open-flame producing devices that do not contain a flame arrestor, or hot surfaces exceeding 1290°F (700 °C) that are installed within space where the equipment is located.

7.6.5 Refrigerant Detectors. *Refrigerant detectors* required by Section 7.6.2 shall meet the following requirements:

a. *Refrigerant detectors* that are part of the listing shall be evaluated by the testing laboratory as part of the equipment listing.
b. *Refrigerant detectors* as installed shall activate the functions required by Section 7.6.2.4 within a time not to exceed 15 seconds when the refrigerant concentration reaches 25% of the lower flammability limit (LFL).
c. *Refrigerant detectors* shall be located such that refrigerant will be detected if the refrigerating system is operating or not operating. Use of more than one *refrigerant detector* shall be permitted.
    1. For refrigerating systems that are connected to the occupied space through ductwork, *refrigerant detectors* shall be located within the *listed* equipment.
    2. For refrigerating systems that are directly connected to the occupied space without ductwork, the *refrigerant detector* shall be located in the equipment, or shall be located in the occupied space at a height of not more than 12 in. (30 cm) above the floor and within a horizontal distance of not more 3.3 ft (1.0 m) with a direct line of sight of the unit.
d. *Refrigerant detectors* shall provide a means for an automatic operational self test as provided in the product listing. Use of a refrigerant test gas is not required. If a failure is detected, a trouble alarm shall be activated, and the actions required by Section 7.6.2.4 shall be initiated.
e. *Refrigerant detectors* shall be tested during installation to verify the set point and response time as required by Section 7.6.5(b). After installation, the *refrigerant detector* shall be tested to verify the set point and response time annually or at an interval not exceeding the manufacturer's installation instructions, whichever is less.

Revise Section 9 as shown.

9. DESIGN AND CONSTRUCTION OF EQUIPMENT AND SYSTEMS

[. . .]

9.13.1 The following are requirements for unprotected refrigerant containing copper pipe or tubing:

[. . .]

c. For Group A2L, A2, A3, B1, B2L, B2, and B3 refrigerants, protective ~~metal~~ enclosures or covers shall be provided for annealed copper tube erected on the premises.

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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