ADDENDA

ANSI/ASHRAE Addendum m to
ANSI/ASHRAE Standard 15-2019

Safety Standard for Refrigeration Systems

Approved by ASHRAE and the American National Standards Institute on June 30, 2022.

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 m to ANSI/ASHRAE Standard 15-2019 modifies allowances for the use of mechanical ventilation to expand this mitigation strategy for human comfort applications using A2L refrigerants. Presently, Section 7.6.4 restricts the use of mechanical ventilation solely to systems that have compressors and pressure vessels located indoors. This allowance, and requirements if the allowance is used, in ANSI/ASHRAE Standard 15-2019 matches the allowance/requirements in the third edition of UL 60335-2-40/CSA C22.2 No. 60335-2-40 product safety standard (refer to Annex GG.4). Notably, this same domestic product safety standard allows the use of mechanical ventilation in other human comfort applications—those with compressors and pressure vessels located outdoors (refer to Annex GG.8). Further, the international version of the product safety standard (IEC 60335-2-40, 6th edition) has the same requirements/allowances as the North American version.

Addendum m rectifies the difference by largely harmonizing ANSI/ASHRAE Standard 15 with the allowance for broader application of ventilation, and requirements if the allowance is used, in UL 60335-2-40/CSA C22.2 No. 60335-2-40, 3rd edition. This change would allow for mechanical ventilation in ANSI/ASHRAE Standard 15 when meeting stringent requirements for either continuous operation or operation initiated by a refrigerant detector, using an approach similar to the product safety standard. This approach begins with a simplified table method for determining required ventilation rates but also includes a detailed calculation method.

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 m to Standard 15-2019

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

3. DEFINITIONS

3.1 Defined Terms

[. . .]

exhaust air: air removed from a space and discharged outside of the space by means of mechanical ventilation.

[. . .]

makeup air: air added to a space from outside the building or from other indoor spaces by means of mechanical or natural ventilation.

[. . .]

ventilated enclosure: a type of equipment enclosure that includes an integral ventilation system that will prevent *refrigerant* leaked inside the equipment enclosure from escaping into the space surrounding the equipment enclosure.

[. . .]

Modify Section 7 as shown. The remainder of Section 7 remains unchanged.

7. RESTRICTIONS ON REFRIGERANT USE

[. . .]

7.2 ***Refrigerant Concentration Limits.*** The concentration of *refrigerant* in a complete discharge of each *independent circuit* of high-probability systems *shall not* exceed the amounts shown in ASHRAE Standard 34[2], Table 4-1 or 4-2, except as provided in Sections 7.2.1, ~~and~~ 7.2.2, and 7.6.4. ~~of this standard.~~ The volume of *occupied space shall* be determined in accordance with Section 7.3.

[. . .]

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.~~

7.6.1 *Refrigerant* Quantity Limits. All spaces to which *refrigerant* has potential to leak *shall* comply with Section 7.2, except as permitted by Section 7.6.4.

[. . .]

~~**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:~~

$$\dot{Q}_{min} = 1000 \times M/LFL \quad \text{(I-P)}$$

$$\dot{Q}_{min} = 60{,}000 \times M/LFL \quad \text{(SI)}$$

~~where~~

~~$\dot{Q}_{min}$ = 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)~~

~~d. The *exhaust air 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 *makeup air* to replace that being exhausted. Openings for the *makeup 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.~~

7.6.4 Mechanical Ventilation. Mechanical ventilation for *refrigerant* safety mitigation *shall* comply with this section. Where a *ventilated enclosure* is provided to control a *refrigerant* leak, the refrigeration system and *ventilated enclosure shall* be *listed* and installed in accordance with UL 60335-2-40^{XX}/CSA C22.2 No. 60335-2-40^{XX} and *shall not* be required to comply with this section.

Table 7-1 Required Ventilation for A2L Systems [a]

Excluded Charge $(M - M_{VOL})$ [b]		Q_{REQ}		Excluded Charge $(M - M_{VOL})$ [b]		Q_{REQ}	
lb	kg	ft^3/min	m^3/h	lb	kg	ft^3/min	m^3/h
3.8	1.7	100	170	91.8	41.6	2400	4080
7.6	3.5	200	340	95.6	43.4	2500	4250
11.5	5.2	300	510	99.4	45.1	2600	4420
15.3	6.9	400	680	103.2	46.8	2700	4590
19.1	8.7	500	850	107.1	48.6	2800	4760
22.9	10.4	600	1020	110.9	50.3	2900	4930
26.8	12.1	700	1190	114.7	52.0	3000	5100
30.6	13.9	800	1360	118.5	53.8	3100	5270
34.4	15.6	900	1530	122.4	55.5	3200	5440
38.2	17.3	1000	1700	126.2	57.2	3300	5610
42.1	19.1	1100	1870	130.0	59.0	3400	5780
45.9	20.8	1200	2040	133.8	60.7	3500	5950
49.7	22.5	1300	2210	137.6	62.4	3600	6120
53.5	24.3	1400	2380	141.5	64.2	3700	6290
57.4	26.0	1500	2550	145.3	65.9	3800	6460
61.2	27.7	1600	2720	149.1	67.6	3900	6630
65.0	29.5	1700	2890	152.9	69.4	4000	6800
68.8	31.2	1800	3060	156.8	71.1	4100	6970
72.6	32.9	1900	3230	160.6	72.8	4200	7140
76.5	34.7	2000	3400	164.4	74.6	4300	7310
80.3	36.4	2100	3570	168.2	76.3	4400	7480
84.1	38.1	2200	3740	172.1	78.0	4500	7650
87.9	39.9	2300	3910	175.5	79.6	4590	7803

a. Charge sizes and ventilation rates shown in this table are based on R-32.

b. $(M - M_{VOL})$ is the amount of *refrigerant* charge that is removed by mechanical ventilation and is therefore not included in calculations to determine compliance with Section 7.2. M and M_{VOL} as defined in Section 7.6.4(a).

Table 7-2 *Lower Flammability Limit* Conversion Factor

Refrigerant Number	C_{LFL}
R-32	1.00
R-452B	1.02
R-454A	0.92
R-454B	0.97
R-454C	0.95
R-457A	0.71

a. Mechanical ventilation *shall* be provided that will remove leaked *refrigerant* from the space where *refrigerant* leaking from the refrigeration system is expected to accumulate. The space *shall* be provided with an exhaust or transfer fan. Fans used to exhaust air from the space or transfer air to a separate indoor space *shall* comply with the following equation:

$$Q_{min} = Q_{req}/C_{LFL}$$

where

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

Q_{req} = required ventilation as determined from Table 7-1

C_{LFL} = lower flammability limit conversion factor as determined from Table 7-2

When the *refrigerant* charge necessary to be removed by ventilation is known, in order to be compliant with Section 7.2, an alternative method to determine Q_{req} uses the following equations. This alternative method *shall* be used for all A2L *refrigerants* not *listed* in Table 7-2.

$$Q_{req} = \frac{M - M_{vol}}{4 \times LFL} \times \mathrm{SF}_{vent} \quad \text{(I-P)}$$

$$Q_{req} = \frac{M - M_{vol}}{4 \times LFL} \times \mathrm{SF}_{vent} \times 60 \quad \text{(SI)}$$

$$M_{vol} = RCL \times V \times F_{occ}$$

where

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

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

M_{vol} = refrigerant charge permitted in the space

RCL = *refrigerant concentration limit*, lb/ft^3 (kg/m^3)

V = volume of space established in accordance with Section 7.3, ft^3 (m^3)

F_{occ} = occupancy adjustment factor. (For all occupancies other than institutional, F_{occ} has a value of 1. For institutional occupancies, F_{occ} has a value of 0.5.

LFL = *lower flammability limit*, lb/ft^3 (kg/m^3)

4 = assumed leak time (4 minutes)

SF_{vent} = safety factor, value of 2

60 = conversion of minutes to hours

b*. Mechanical ventilation *shall* be permitted to be continuous or activated by a *refrigerant detector*. Building fire and smoke systems *shall* be permitted to override this function.

1. **Continuous Ventilation.** Where continuous ventilation is provided, ventilation function *shall* be continuously verified per Section 7.6.4(b)(3).
2. ***Refrigerant Detector* Activated Ventilation.** Where ventilation is activated by a *refrigerant detector*, the *refrigerant detector shall* be in accordance with Section 7.6.5. Upon *refrigerant detector* activation, the mechanical ventilation *shall* be activated and *shall* continue to operate for at least 5 min after the *refrigerant detector* has sensed a drop in the *refrigerant* concentration below the set point value. For mechanical ventilation systems used solely for *refrigerant* safety mitigation, ventilation function of *refrigerant detector* activated ventilation *shall* be verified in accordance with Section 7.6.4(b)(3) by a monthly self test.
3. **Verification of Ventilation Function.** Ventilation function *shall* be verified by a method that confirms operation of the required fans. On detection of a ventilation system failure, *compressor* operation *shall* be stopped, and a notification *shall* be provided. The notification *shall* be to an operator workstation through a building automation system or by a local audible alarm.

c. While the ventilation system is operating, *makeup air shall* be provided, and the volume of *makeup air shall not* exceed the volume of air being exhausted or transferred out of the space.

Openings for *makeup air shall* be positioned to facilitate mixing of *makeup air* with leaked *refrigerant*. Inlets for *exhaust air*, and inlets used to mechanically transfer air to a separate indoor space, *shall* be located such that the bottom of the inlet is within 12 in. (30 cm) of the lowest elevation in the space where leaked *refrigerant* would be expected to accumulate.

d. The *refrigerant* concentration of an indoor *effective dispersal volume shall not* exceed the limit *specified* in Section 7.6.1.

e. 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), installed within the space where the equipment is located.

f. Electric motors larger than 1 *hp* (0.7 kW) driving fans located in the airstream of the discharge side of the ventilation system *shall* be of the totally enclosed or hermetically sealed type.

g. Fan rotating elements *shall* be nonferrous or nonsparking, or the casing *shall* consist of or be lined with such material.

h. Ventilation fans *shall* be *listed* in accordance with UL 507XX or UL 705XX.

i. The discharge air openings of the ventilation system *shall* be located so as to prevent recirculation of *exhaust air* back into the space.

[. . .]

Modify Section 14 as shown. The remainder of Section 14 remains unchanged. (Note: This addendum reflects changes previously made by Addendum k to Standard 15-2019, which can be downloaded from the ASHRAE website at https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda.)

14. NORMATIVE REFERENCES

[. . .]

~~17. UL. 2019. UL/CSA 60335-2-40. *Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers*, 3rd Edition. Northbrook, IL: Underwriters Laboratories, Inc.~~

XX. UL. 2019. UL 60335-2-40, *Standard for Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers*. Northbrook, IL: UL, LLC.

XX. CSA. 2019. CSA C22.2 No. 60335-2-40, *Household and Similar Electrical Appliances—Safety—Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers*. Toronto, Canada: CSA Group.

XX. UL. 2017. UL 507, *Standard for Electric Fans*, 10th edition. Northbrook, IL: UL, LLC.

XX. UL. 2017. UL 705, *Power Ventilators*, 7th edition. Northbrook, IL: UL, LLC.

[. . .]

Modify Informative Appendix A as shown. The remainder of Informative Appendix A remains unchanged. (Note: This addendum reflects changes previously made by Addenda f and g to Standard 15-2019, which can be downloaded from the ASHRAE website at https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda.)

(This appendix is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

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~~, and the associated appendix information is located in a corresponding section number preceded by "A"~~.

[. . .]

Section 7.3.2

When a refrigeration system does not have a *refrigerant detector*, there will not necessarily be circulation (or ventilation) airflow. Thus, systems in accordance with Section 7.3.2 (no *refrigerant* detection and/or no continuous airflow), must use the worst-case distribution of leaked *refrigerant*.

Section 7.3.3

For refrigeration systems that do have a *refrigerant detector* but do not have ventilation, the airflow will mix leaked *refrigerant* throughout the spaces connected to ductwork; therefore, the volume of all rooms connected by ductwork is used.

Section 7.3.4

For refrigeration systems with *refrigerant* detection and ventilation, circulation will distribute leaked *refrigerant* throughout the rooms connected to the ductwork as well as locations connected to the ventilation.

Section 7.6.4

Note that in the equation, *LFL* is specified as pounds per cubic foot (kilogram per cubic metre), while ANSI/ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants*, specifies *LFL* in Table 4-1 and Table 4-2 as pounds per 1000 cubic feet (lb/1000 ft^3) (grams per cubic member [g/m^3]). Appropriate conversion is necessary. The user should refer to the most current addenda to ANSI/ASHRAE Standard 34 for the most current values of *LFL*.

Section 7.6.4(b)

The continuous ventilation system can be shut down for short periods of time during service and maintenance of the ventilation system. Fan failure switches can be used to determine that the ventilation fan is not operating properly. Examples of fan failure switches include the following:

a. Hall effect switch on the fan shaft or blade pass
b. Pressure switch across the fan
c. Sail switch on the outlet of the fan
d. On direct drive, a Hall effect switch on the motor shaft
e. On direct drive ECM and similar, a digital output indicating the motor is not turning, current draw, etc.

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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