



**BSR/ASHRAE Addendum f
to ANSI/ASHRAE Standard 15-2024**

First Public Review Draft

**Proposed Addendum f to
Standard 15-2024, Safety Standard
for Refrigeration Systems**

**First Public Review (May 2026)
(Draft shows Proposed
Changes to Current Standard)**

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FOREWORD

In response to a continuous maintenance proposal, changes are proposed to the required minimum ventilation airflow to mitigate the unintended release of refrigerant. These changes will harmonize requirements with Edition 4 (with revisions dated October 31, 2025) of UL 60335-2-40 and CSA C22.2 No. 60335-2-40. However, these changes deviate by making a simplification to the calculation method for minimum ventilation airflow. Further, these changes also harmonize with the capacity threshold values in Clause GG.10.1 of IEC 60335-2-40 Edition 8 (dated December 2024).

Standard 15-2024 Section 7.6.4.a includes a simplified method using tables and an alternate approach using the equations that generated the table values. The alternate equation approach is proposed to be expanded into two possible paths, based on whether or not the refrigeration system equipment is marked as ‘ETRS’. Equipment marked as ‘ETRS’ in accordance with UL/CSA 60335-2-40 meets certain construction and testing requirements that warrant a lower assumed value for the worst-case refrigerant release rate that the minimum required ventilation will mitigate. Use of the new compliance path for equipment marked ETRS is limited to a capacity threshold that is correlated with the assumed refrigerant release rate (larger equipment would be more likely to exceed to the assumed release rate). Example calculations have been added to the Informative Appendix A entry for Section 7.6.4.a.

Note: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~striking through~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard shown are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.

Addendum f to Standard 15-2024

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

3. DEFINITIONS

3.2 Acronyms, Abbreviations, and Initialisms

[...]

ETRS enhanced tightness refrigeration system

[...]

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

7. RESTRICTIONS ON REFRIGERANT USE

[...]

7.6* High-Probability Air Conditioners, Heat Pumps, and Dehumidifiers Using Group A2L Refrigerants.

[...]

[...]

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 60335-2-40⁵/CSA C22.2 No. 60335-2-40⁶ and *shall not* be required to comply with this section.

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 Equation 7-10:

$$Q_{min} = \frac{Q_{req}}{C_{LFL}} \quad (7-10)$$

where

Q_{min} = minimum mechanical ventilation airflow rate, ft³/min (m³/h)

Q_{req} = required ventilation as determined from Table 7-4

C_{LFL} = lower flammability limit conversion factor as determined from Table 7-5

When the *refrigerant* charge necessary to be removed by ventilation is known, in order to be compliant with Section 7.3, an alternative method to Table 7-4 and Table 7-5 for determination of Q_{min} ~~determine Q_{req}~~ uses one of the following two calculations ~~Equation 7-11a or 7-11b~~. This alternative method *shall* be used for all Group A2L refrigerants not listed in Table 7-5.

1. Where the *refrigeration system* is not marked ETRS, in accordance with either UL 60335-2-40⁵/CSA C22.2 No. 60335-2-40⁶ or UL 60335-2-89⁷/CSA C22.2 No. 60335-2-89⁸, or where any indoor unit exceeds 10 tons (35 kW) of rated cooling or heating capacity, Equation 7-11 *shall* be used to determine the minimum required mechanical ventilation airflow.

$$Q_{req} = \frac{m_s - EDVC}{4 \times LFL} \times SF_{vent} \quad (7-11a[I-P])$$

$$Q_{req} = \frac{m_s - EDVC}{4 \times LFL} \times SF_{vent} \times 60 \quad (7-11b[SI])$$

$$Q_{min} = \frac{m_{rel} - EDVC}{4 \times LFL} \times 2 \times K_1 \times K_2 \times K_3 \quad (7-11)$$

where

Q_{req} = ~~required~~ minimum mechanical ventilation airflow rate, ft³/min (m³/h)

Q_{min}

m_s ≠ largest system refrigerant charge from independent circuit, lb (kg)

m_{rel} ≡ releasable refrigerant charge, lb (kg)

$EDVC$ = effective dispersal volume charge, lb (kg)

- LFL = lower flammability limit, lb/ft³ lb/1000 ft³ (kg/m³ g/m³)
- 4 = a constant corresponding to assumed leak time, min (min) (4 minutes)
- $\frac{SF_{vent}}{2}$ = a safety factor, value of 2, dimensionless
- 60 ≠ ~~conversion of minutes to hours~~
- K_1 ≡ a conversion factor, 1000 [ft³/1000 ft³] (1 m³/m³)
- K_2 ≡ a conversion factor, 1 min/min (60 min/h)
- K_3 ≡ a conversion factor, 1 lb/lb (1000 g/kg)

Informative Note: Where not using release mitigation controls per Section 7.3.4.4, releasable refrigerant charge (m_{rel}) is equal to system refrigerant charge (m_s).

2. Where the refrigeration system is marked as ETRS, in accordance with either UL 60335-2-40⁵ /CSA C22.2 No. 60335-2-40⁶ or UL 60335-2-89⁷/CSA C22.2 No. 60335-2-89⁸, and where any indoor unit does not exceed 10 tons (35 kW) of rated cooling or heating capacity, Equation 7-12 shall be used to determine the minimum required mechanical ventilation airflow.

$$Q_{min} = \frac{K_1 \times K_3 \times K_4 \times 4}{LFL} \tag{7-12}$$

where

- Q_{min} ≡ minimum mechanical ventilation airflow rate, ft³/min (m³/h)
- LFL ≡ lower flammability limit, lb/1000 ft³ (g/m³)
- 4 ≡ a safety factor, dimensionless
- K_1 ≡ a conversion factor, 1000 [ft³/1000 ft³] (1 m³/m³)
- K_3 ≡ a conversion factor, 1 lb/lb (1000 g/kg)
- K_4 ≡ a constant corresponding to a leak rate, 0.367 lb/min (10.0 kg/h)

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. [...]

[...]

Modify Informative Appendix A as follows. The remainder of the appendix 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 7.6.4

Note that in Equations 7-11a and 7-11b, *LFL* is specified as lb/ft³ (kg/m³), while ASHRAE Standard 34³ specifies *LFL* in Table 4-1 and Table 4-2 as lb/1000 ft³ (g/m³). Appropriate conversion is necessary. The user should refer to the most current addenda to ASHRAE Standard 34 for the most current values of *LFL*.

Section 7.6.4(a)(1 and 2): UL 60335-2-40⁵ and CSA C22.2 No. 60335-2-40⁶ require all indoor units meeting requirements as “ENHANCED TIGHTNESS REFRIGERATING SYSTEM” be marked with “ETRS” (e.g. label or name plate).

Example calculations for mechanical ventilation. Assume that a space served by a *refrigeration system* using R-32 has parameters shown below. The equipment design includes *air circulation* initiated by a *refrigerant detection system*. The space is not an *institutional occupancy*. The *effective dispersal volume charge (EDVC)* for this space is calculated per Section 7.6.1. The *refrigeration system* also serves other spaces that are not *connected spaces* with this space, and do not contribute to the *effective dispersal volume* of this space.

| | | | | |
|--|-----------|------------------------------|----------------------|--------------------------------------|
| <i>effective dispersal volume</i> | V_{eff} | 6080 ft ³ | 172.2 m ³ | |
| <i>lower flammability limit</i> | LFL | 19.1 lb/1000 ft ³ | 306 g/m ³ | from ASHRAE Standard 34 ³ |
| <i>system refrigerant charge</i> | m_s | 138.7 lb | 62.9 kg | |
| <i>occupancy adjustment factor</i> | F_{occ} | 1 | 1 | |
| <i>effective dispersal volume charge</i> | $EDVC$ | 58.1 lb | 26.3 kg | |

The *system refrigerant charge* exceeds the EDVC so mitigation is required. For further insight, consider that whole space average *refrigerant* concentration would potentially be the values shown below, assuming complete and uniform mixing of released *refrigerant*, which without any mitigation would exceed 100% of *LFL* throughout the space.

without any mitigation:

| | | | |
|--|---------------------------|------------------------------|----------------------|
| <i>average refrigerant concentration</i> | m_s/V_{eff} | 22.8 lb/1000 ft ³ | 365 g/m ³ |
| <i>normalized as percent of LFL</i> | $\frac{m_s/V_{eff}}{LFL}$ | 119% of <i>LFL</i> | 119% of <i>LFL</i> |

One possible mitigation method is use of release mitigation controls meeting the requirements of Section 7.3.4.4. With use of *safety shutoff valves* placed in chosen locations, the *releasable refrigerant charge* for the space is calculated per Section 7.3.4.3. With just one mitigation, the whole space average *refrigerant* concentration would potentially be the values shown below, assuming complete and uniform mixing of released *refrigerant*, which would exceed 50% of the *LFL* (i.e. would exceed the concentration factor CF in Equation 7-8).

with one mitigation using *SSOV*:

| | | | |
|--|-----------|----------------------|----------------------|
| <i>effective dispersal volume</i> | V_{eff} | 6080 ft ³ | 172.2 m ³ |
| <i>system refrigerant charge</i> | m_s | 138.7 lb | 62.9 kg |
| <i>releasable refrigerant charge</i> | m_{rel} | 80.0 lb | 36.3 kg |
| <i>effective dispersal volume charge</i> | $EDVC$ | 58.1 lb | 26.3 kg |

| | | | |
|--|-------------------------------|-------------------------------------|----------------------------|
| <u>average refrigerant concentration</u> | $\frac{m_{rel}}{V_{eff}}$ | <u>13.16 lb/1000 ft³</u> | <u>211 g/m³</u> |
| <u>normalized as percent of LFL</u> | $\frac{m_{rel}/V_{eff}}{LFL}$ | <u>69% of LFL</u> | <u>69% of LFL</u> |

As the releasable refrigerant charge still exceeds the EDVC, further mitigation is required and mechanical ventilation is chosen as the method. The user elects to use the alternative method of Equations 7-11 or 7-12 instead of the table method of Equation 7-10.

This example considers the two cases of whether or not the refrigeration system is marked as ETRS.

| | <u>Case 1</u> <u>(not marked ETRS)</u> | | <u>Case 2</u> <u>(marked ETRS)</u> | |
|---|--|--|--|--|
| | <u>IP</u> | <u>SI</u> | <u>IP</u> | <u>SI</u> |
| m_{rel} | <u>80.0 lb</u> | <u>36.3 kg</u> | <u>80.0 lb</u> | <u>36.3 kg</u> |
| $EDVC$ | <u>58.1 lb</u> | <u>26.3 kg</u> | <u>58.1 lb</u> | <u>26.3 kg</u> |
| LFL_{R-32} | <u>19.1 lb / 1000 ft³</u> | <u>306 g /m³</u> | <u>19.1 lb / 1000 ft³</u> | <u>306 g /m³</u> |
| | <u>Equation 7-11</u> | | <u>Equation 7-12</u> | |
| | $Q_{min} = \frac{m_{rel} - EDVC}{4 \times LFL} \times 2 \times K_1 \times K_2 \times K_3$ | | $Q_{min} = \frac{K_1 \times K_3 \times K_4 \times 4}{LFL}$ | |
| Q_{min} <small>(before rounding)</small> | $= \frac{80.0 - 58.1}{4 \times 19.1} \times 2 \times 1000 \times 1 \times 1$ = 573.2984 | $= \frac{36.3 - 26.3}{4 \times 306} \times 2 \times 1 \times 60 \times 1000$ = 980.3922 | $= \frac{1000 \times 1 \times 0.367 \times 4}{19.1}$ = 76.85864 | $= \frac{1 \times 1000 \times 10.0 \times 4}{306}$ = 130.7190 |
| Q_{min} | = 573 $\frac{ft^3}{min}$ | = 980 $\frac{m^3}{h}$ | = 76.9 $\frac{ft^3}{min}$ | = 130.7 $\frac{m^3}{h}$ |

Section 7.6.4(b): [...]
