BSR/ASHRAE Addendum e
to ANSI/ASHRAE Standard 15-2024

First Public Review Draft

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

First Public Review (July 2025)
(Draft shows Proposed Changes to Current Standard)

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(This foreword 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.)

FOREWORD

In response to a continuous maintenance proposal, changes are proposed to the determination of releasable charge that will harmonize requirements with Edition 4 (dated December 15, 2022) of UL 60335-2-40 and CSA C22.2 No. 60335-2-40. Equipment marked as 'ETRS' in accordance with UL/CSA 60335-2-40 meets certain construction and testing requirements that justify a lower assumed value for the worst-case refrigerant release rate when determining releasable charge. The current edition of Standard 15-2024 assumes that lower value for all equipment, which is not an appropriate assumption, and is not harmonized with other requirements of both Standard 15 and UL/CSA 60335-2-40 that assume a four minute release as the reasonable worst-case scenario. Example calculations have been added to the Informative Appendix A entry for Section 7.3.4.4.b.

Note: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (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 e 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

[…]

7.3 Refrigerant Charge Limits. […]

[…]

7.3.4* Releasable Refrigerant Charge (m_{rel}) Determination. […]

[…]

{Note to reviewers. The committee proposes to switch the sequence of Sections 7.3.4.3 and 7.3.4.4. The content of the existing Section 7.3.4.4, to be renumbered as Section 7.3.4.3, does not change as part of this addendum and is not shown for brevity. The two references, one to each of these sections, found in Figure 7-2 would also change accordingly.}

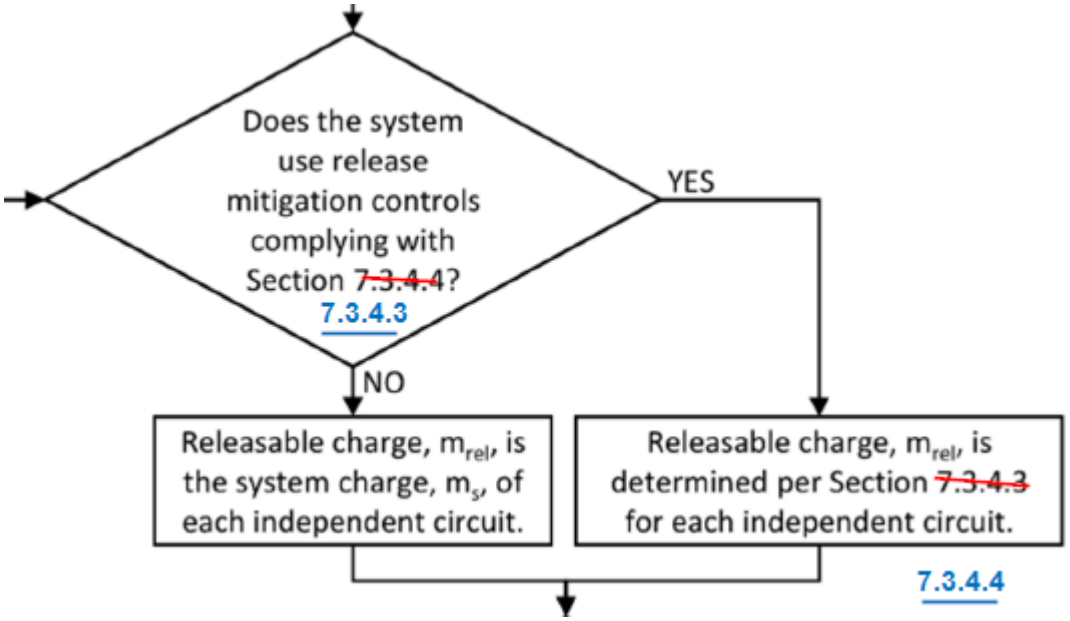

Figure 7-2 Refrigerant charge limit compliance path—Part 2.

7.3.4.1 Single Circuit. For single-circuit *refrigeration systems*, the *releasable refrigerant charge* (m_{rel}) *shall* be the *system refrigerant charge*, unless release mitigation controls are provided in accordance with Section ~~7.3.4.4~~ 7.3.4.3.

7.3.4.2 Multiple Independent Circuits. For *refrigeration systems* with multiple *independent circuits*, the *releasable refrigerant charges shall* be the *refrigerant charges* in each *independent circuit*, unless release mitigation controls are provided in accordance with Section ~~7.3.4.4~~ 7.3.4.3.

~~**7.3.4.4**~~ **7.3.4.3 Release Mitigation Controls**. […]

~~**7.3.4.3**~~ **7.3.4.4* Calculating Releasable Refrigerant Charge**. For *releasable refrigerant charge*, release mitigation controls complying with Section ~~7.3.4.4~~ 7.3.4.3 *shall* be provided to limit a release by automatically isolating leaking *piping* or equipment. The *releasable refrigerant charge* (m_{rel}) *shall* be in accordance with one of the following:

a.* The quantity provided in the product instruction manual per UL 60335-2-40 [5] /CSA C22.2 No. 60335-2-40 [6] or UL 60335-2-89 [7]/CSA C22.2 No. 60335-2-89 [8].

b.* ~~determined~~ Determined based on a release of the volume of *refrigerant* that will occur prior to operation of the release mitigation control plus the volume of *refrigerant* ~~contained downstream of a release mitigation control~~ isolated by activation of *safety shutoff valves*, in accordance with ~~Equation 7-4a or 7-4b~~ the equations of Table 7-1. The *refrigerant* density, ρ_{ref}, for the evaluated portion of the *refrigeration system shall* be determined for each operating mode, cooling or heating as applicable, using the maximum density of each section in accordance with all of the following:

1. For liquid *piping*, the density of saturated liquid at 50 °F (10 °C).
2. For vapor *piping*, the density of saturated vapor at 107.6 °F (42 °C).
3. For *piping* containing mixture of vapor and liquid, the density of saturated liquid at 50 °F (10 °C).
4. For indoor *heat exchanger coils*, the density of saturated liquid at 50 °F (10°C).

~~$m_{rel} = (t_{r1} \times 0.0062) + m_{r2} + m_{r3}$ (7-4a[I-P])~~

~~$m_{rel} = (t_{r1} \times 0.0028) + m_{r2} + m_{r3}$ (7-4b[SI])~~

~~where~~

~~t_{r1} = time before the leak is detected per Section 7.6.2.4~~
~~0.0062 = leakage rate in lb/s~~
~~0.0028 = leakage rate in kg/s~~
~~m_{r2} = leakage between the detection of the leak and the closing of the *safety shutoff valve*, lb (kg)~~
~~m_{r3} = leakage in the *piping* downstream of the *safety shutoff valve* after the valve is closed, lb (kg)~~

~~$m_{r2} = t_{close} \times 0.0062$ (7-5a[I-P])~~

~~$m_{r2} = t_{close} \times 0.0028$ (7-5b[SI])~~

~~where~~

~~t_{close} = time from when a leak is detected until the *safety shutoff valve* closes~~
~~0.0062 = leakage rate in lb/s~~
~~0.0028 = leakage rate in kg/s~~

~~$m_{r3} = \sum V_{pipe} \times \rho_{ref}$ (7-6)~~

~~where~~

~~V_{pipe} = internal volume of each section of the *piping* and *heat exchanger coil* downstream of the *safety shutoff valve*, ft³ (m³)~~
~~ρ_{ref} = density of the *refrigerant* in each section of pipe downstream of the *safety shutoff valve*, lb/ft³ (kg/m³)~~

{Note to reviewers: insert new Table 7-1 and renumber all subsequent tables and equations in Section 7}

Table 7-1 Calculation Method Equations

Equations and Variables	Equation Number
$m_{rel} = m_{r1} + m_{r2} + m_{r3}$	(7-4a)
$m_{r1} = t_{r1} \times K_m$	(7-4b)
$m_{r2} = t_{close} \times K_m$	(7-4c)
$m_{r3} = \sum (V_{pipe} \times \rho_{ref})$	(7-4d)

where

m_{r1} = leakage during time before leak is detected, lb (kg)

m_{r2}	=	leakage between the detection of the leak and the closing of the *safety shutoff valve*, lb (kg)
m_{r3}	=	leakage in the *piping* downstream of the *safety shutoff valve* after the valve is closed, lb (kg)
t_{r1}	=	a constant corresponding to maximum time before detecting the leak, 120 s
t_{close}	=	a constant corresponding to maximum time from when a leak is detected until the *safety shutoff valve* closes, s
K_m	=	a constant corresponding to leakage rate, for *refrigeration systems* marked ETRS and where any indoor unit does not exceed 10 tons (35 kW) of rated cooling or heating capacity: 0.00612 lb/s (0.00278 kg/s) for *refrigeration systems* not marked ETRS or where any indoor unit exceeds 10 tons (35 kW) of rated cooling or heating capacity: $\frac{m_s}{240}$ lb/s ($\frac{m_s}{240}$ kg/s)
m_s	=	*system refrigerant charge*, lb (kg)
V_{pipe}	=	internal volume of each section of the *piping* and *heat exchanger coils* isolated by activation of one or more *safety shutoff valves*, ft^3 (m^3)
ρ_{ref}	=	density of the *refrigerant* corresponding to each section of the *piping* and *heat exchanger coils* isolated by activation of one or more *safety shutoff valves*, lb/ft^3 (kg/m^3)

[…]

Modify Section 9 as follows. The remainder of Section 9 remains unchanged.

9. DESIGN AND CONSTRUCTION OF REFRIGERATION EQUIPMENT AND SYSTEMS

[…]

9.11 Joints and Connections

[…]

9.11.2 Allowable Joints. The allowable joints for a specific *piping* material *shall* be in accordance with Table 9-11.

9.11.2.1 Allowable Joints for ETRS refrigeration systems. The allowable field-installed joints for *refrigeration systems* marked as ETRS *shall* be one or more of the following:

a. Field-fabricated or field-connected *brazed joints* in compliance with the qualification requirements of Paragraph 528.2.4 of ASME B31.5 [17].

b. Field-fabricated or field-connected welded joints in compliance with the responsibility and qualification requirements of Paragraph 527.4 of ASME B31.5 [17].

c.* Field installation and connection of factory-made *mechanical joints* in compliance with ISO 14903, UL 207, or ASME B31.5 [17].

[…]

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 7.3.4.4(a)

Determination of m_{rel} is based upon requirements in the product listing standards – namely UL 60335-2-40 [5]/CSA C22.2 No. 60335-2-40 [6] or UL 60335-2-89 [7]/CSA C22.2 No. 60335-2-89 [8].

For *refrigeration systems* listed to UL 60335-2-40 [5]/CSA C22.2 No. 60335-2-40 [6], *refrigeration systems* marked as ETRS will use either a calculation method (Annex GG.12.7) with default values for mitigation response times, a test method (Annex GG.12.3.2 and 12.3.3) that determines *releasable refrigerant charge* through simulation, or a combination of calculation and testing (Annex GG.12.4). For *refrigeration systems* not marked as ETRS, Annex 101.DVQ will be used to test the worst-case *releasable refrigerant charge* through simulation of a leak.

For *refrigeration systems* listed to UL 60335-2-89 [7]/CSA C22.2 No. 60335-2-89 [8], a calculation method (Annex 101.DVU.1.2) is used with default values for mitigation response times to determine *releasable refrigerant charge*.

Section 7.3.4.4(b)

Example calculations for determining *releasable refrigerant charge* (m_{rel}). Assume that a space served by a *refrigeration system* using R-32 has parameters shown below. The closing time is obtained from the valve manufacturer's technical specifications. Refrigerant density values are obtained from the ASHRAE Fundamentals Handbook, chapter title "Thermophysical Properties of Refrigerants".

system refrigerant charge	m_s	138.7 lb	62.9 kg
a constant corresponding to maximum time before detecting the leak	t_{r1}	120 s	120 s
a constant corresponding to maximum time from when a leak is detected until the *safety shutoff valve* closes	t_{close}	10 s	10 s
density of saturated liquid at 50 °F (10 °C)	$\rho_{R\text{-}32,liq}$	63.7 lb/ ft³	1020 kg/m³
density of saturated vapor at 107.6 °F (42 °C)	$\rho_{R\text{-}32,vap}$	4.85 lb/ ft³	77.7 kg/m³
internal volume of liquid piping, section 1	V_{pipe1}	3.32×10^{-2} ft³	9.41×10^{-4} m³
internal volume of vapor piping, section 2	V_{pipe2}	5.32×10^{-1} ft³	1.506×10^{-2} m³
internal volume of piping with liquid & vapor, section 3	V_{pipe3}	2.73×10^{-3} ft³	7.72×10^{-5} m³

	Case 1 (not marked ETRS)		Case 2 (marked ETRS)	
	IP	SI	IP	SI
K_m	$= \frac{m_s}{240}$ $= \frac{138.7}{240}$ $= 0.578$ lb/s	$= \frac{m_s}{240}$ $= \frac{62.9}{240}$ $= 0.262$ kg/s	= 0.00612 lb/s	= 0.00278 kg/s
m_{r1}	Equation 7-4b $m_{r1} = t_{r1} \times K_m$			
	$= 120 \times 0.578$ $= 69.4$ lb	$= 120 \times 0.262$ $= 31.5$ kg	$= 120 \times 0.00612$ $= 0.734$ lb	$= 120 \times 0.00278$ $= 0.334$ kg
m_{r2}	Equation 7-4c $m_{r2} = t_{close} \times K_m$			
	$= 10 \times 0.578$ $= 5.78$ lb	$= 10 \times 0.262$ $= 2.62$ kg	$= 10 \times 0.00612$ $= 0.0612$ lb	$= 10 \times 0.262$ $= 0.0278$ kg
m_{r3}	Equation 7-4d $m_{r3} = \sum (V_{pipe} \times \rho_{ref})$			
	$= 3.32 \times 10^{-2} \times 63.7$ $+5.32 \times 10^{-1} \times 4.85$ $+2.73 \times 10^{-3} \times 63.7$ $= 4.87$ lb	$= 9.41 \times 10^{-4} \times 1020$ $+1.506 \times 10^{-2} \times 77.7$ $+7.72 \times 10^{-5} \times 1020$ $= 2.21$ kg	$= 3.32 \times 10^{-2} \times 63.7$ $+5.32 \times 10^{-1} \times 4.85$ $+2.73 \times 10^{-3} \times 63.7$ $= 4.87$ lb	$= 9.41 \times 10^{-4} \times 1020$ $+1.506 \times 10^{-2} \times 77.7$ $+7.72 \times 10^{-5} \times 1020$ $= 2.21$ kg
m_{rel}	Equation 7-4a $m_{rel} = m_{r1} + m_{r2} + m_{r3}$			
	$= 69.4 + 5.78 + 4.87$ $= 80.0$ lb	$= 31.5 + 2.62 + 2.21$ $= 36.3$ kg	$= 0.734 + 0.0612 + 4.87$ $= 5.66$ lb	$= 0.334 + 0.0278 + 2.21$ $= 2.57$ kg

Section 9.11.2.1(c)

Factory-made *mechanical joints* exclude field-fabricated flared copper (even with a factory-made brass flare fitting as part of the joint).