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Refrigerating systems and heat pumps — Safety and environmental requirements —

Part 1: Definitions, classification and selection criteria

AMENDMENT 1: Correction of QLAV, QLMV

Systèmes frigorifiques et pompes à chaleur — Exigences de sécurité et d'environnement —

Partie 1: Définitions, classification et critères de choix

AMENDEMENT 1: Correction de QLAV, QLMV

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The committee responsible for this document is ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 1, *Safety and environmental requirements for refrigerating systems*.

Refrigerating systems and heat pumps — Safety and environmental requirements —

Part 1: Definitions, classification and selection criteria

AMENDMENT 1: Correction of QLAV, QLMV

Page 11, 3.10.3 and 3.10.4

Replace definitions 3.10.3 and 3.10.4 with the following:

3.10.3
quantity limit with additional ventilation
charge density of refrigerant that when exceeded creates an instantaneous dangerous situation, if the total charge leaked within the occupied space

Note 1 to entry See A.5 for the use of Quantity Limit with Additional Ventilation (QLAV) to manage risk for systems in occupied spaces where the level of ventilation is sufficient to disperse the leaked refrigerant within 15 min.

3.10.4
quantity limit with minimum ventilation
charge density of refrigerant that results in a concentration equal to the RCL in a room of non-airtight construction with a moderately severe refrigerant leak

Note 1 to entry See A.5 for the use of Quantity Limit with Minimum Ventilation (QLMV) to manage risk for systems in occupied spaces not below ground level where the level of ventilation is not sufficient to disperse the leaked refrigerant within 15 min. The calculation is based on an opening of 0,003 2 m^2 and a leak rate of 2,78 g s^{-1}.

Page 27, A.5.2.1

Replace the entire subclause with the following:

A.5.2.1 General

For occupied spaces exceeding 250 m^2, the charge limits calculation shall use 250 m^2 as the room floor area for determination of the room volume.

The total charge of the system divided by the room volume shall not exceed the QLMV value specified in Table A.3 (or if the lowest floor is underground, the RCL value in Table A.3) unless appropriate measures are taken. If the value exceeds the QLMV or RCL, appropriate measures shall be taken in accordance with A.5.2.2 or A.5.2.3. The appropriate measure shall be ventilation (natural or mechanical), safety shut-off valves and safety alarm, in conjunction with a gas detection device. See ISO 5149-3:2014, Clauses 6, 8, 9 and 10. A safety alarm alone shall not be considered as an appropriate measure where occupants are restricted in their movement (see ISO 5149-3:2014, 8.1).

NOTE 1 For systems that are installed and operated within the constraints of A.5.1 the risk of rapid release of refrigerant through a major leak has been minimized. The calculation of ventilation rate in Annex A has therefore been based on a maximum leakage rate of 10 kg/h.

NOTE 2 QLMV is based on a room height of 2,2 m and an opening of 0,003 2 m^2 (0,8 m width door and 4 mm gap) that can be expected in rooms without designed ventilation.

Table A.3 — Allowable refrigerant charge density

Refrigerant	Allowable concentration ($kg\ m^{-3}$) RCL	QLMV ($kg\ m^{-3}$)	QLAV ($kg\ m^{-3}$)
R22	0,21	0,28	0,50 [a]
R134a	0,21	0,28	0,58 [a]
R407C	0,27	0,44	0,49 [a]
R410A	0,39	0,42	0,42 [a]
R744	0,072	0,074	0,18 [b]
R32	0,061	0,063	0,15 [c]
R1234yf	0,058	0,060	0,14 [c]
R1234ze	0,061	0,063	0,15 [c]

[a] Based on ODL

[b] Based on 10 % v/v

[c] Based on 50 % LFL

For refrigerants not listed in Table A.3, QLAV shall be the lower of:

— For R-744 10 %v/v (due to acute anaesthetic effect);

— ODL;

— 50 % of LFL for class 2L refrigerants.

For refrigerants not listed in Table A.3, Formula (A.6) shall be used for the calculation of QLMV:

$$QLMV = s\big|_{x=RCL} \times \dot{m} \tag{A.6}$$

where $s\big|_{x=RCL}$ is the point in normalized time s, when the concentration x = RCL, and is found by solving

$$\frac{dx}{ds} = \dot{m} - x \times A \times c \times \sqrt{2 \times \left(1 - \frac{\rho_a}{\rho}\right) \times h \times g}$$

where

x is the refrigerant concentration in the room ($kg\ m^{-3}$);

s is the time since the leak started divided by the room volume ($s\ m^{-3}$);

$\dot{m}$ is the leak rate from refrigerating system (0,002 78 $kg\ s^{-1}$);

A is the opening area (m^2) to give the minimum ventilation rate typical of rooms without designed ventilation, 0,004 m × 0,8 m = 0,003 2 m^2;

c is the flow coefficient equal to 1;

ρ is the density of refrigerant air mixture ($kg\ m^{-3}$); where $\rho = x + \rho_a - x\frac{\rho_a}{\rho_r}$

ρ_a is the air density ($kg\ m^{-3}$) (calculated based on molar mass of air = 29 and ISO 817);

ρ_r is the refrigerant density (kg m^{-3}) (calculated based on molar mass and ISO 817);

h is the height of ceiling (m);

g is the acceleration due to gravity (9,81 m s^{-2}).

The QLMV of refrigerants with a relative molar mass between 50 g/mol and 125 g/mol can be determined by linear interpolation of the values given in Table A.4.

Where the above gives an undefined QLMV or QLMV above QLAV, QLMV equal to QLAV shall be used.

Table A.4 — Interpolation table for calculating QLMV

RCL	Molecular mass			
	50	**75**	**100**	**125**
0,05	0,051	0,051	0,051	0,051
0,10	0,106	0,108	0,108	0,109
0,15	0,168	0,173	0,175	0,176
0,20	0,242	0,254	0,260	0,264
0,25	0,336	0,367	0,383	0,394
0,30	0,470	0,564	0,633	0,689
0,35	0,724	-	-	-

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