In Zusammenarbeit

WKO Mechatroniker **Berufsgruppe Kälte – und Klimatechnik**	ÖKKV Österreichischer Kälte- und Klimatechnischer Verein	Für Fragen, Anregungen, Wünsche und Beschwerden wenden Sie sich bitte an …. Ing. Franz Seyfried 0043 (0)664 14 16 092 fuer.mit@chello.at

dürfen wir Sie informieren über :

Formelübersicht zur Produktnorm IEC 60335-2-40 RLV, Stand 26.01.2018, vorrangig für **A2L-Kältemittel** und für ….

- ✓ **Singlesplit-Anlagen,**
- ✓ **Multisplit-Anlagen,**
- ✓ **VRF / VRF-Anlagen und für**
- ✓ **Wärmepumpen.**

Die aktuelle IEC 60335-2-40 RLV, Stand 26.01.2018, ist öffentlich zugänglich und z.B. unter https://webstore.iec.ch/searchform&q=IEC%2060335-2-40%20RLV käuflich erhältlich.

Für occupied indoor space = für Räume die dem Aufenthalt von Personen dienen, entsprechend § 12.(1) KAV wie z.B. Hotels, Büros, Arbeitsräume, öffentlich zugänglicher Supermarktsbereich etc. und gemäß der gegenständlichen Produktnorm für den Haushaltsbereich.

Anmerkung :

Ausgenommen bei der Anwendung von nachstehend d) werden die Räume **je wie ein dichtes „Aquarium" betrachtet**.

Anmerkung :

Der Verfasser bittet um Verständnis, um wortgetreu im Original zu zitieren, ist nachstehendes „denglisch".

Einleitung :

Für die Innengeräte / Verdampfer / Wärmetauscher / Außengeräte / Kondensatoren / Wärmepumpen gelten die konstruktiven Anforderungen der nachstehenden Absätze a) bis c). Die zielgerichtete Auswahl der Maßnahmen zur Produktnorm-konformen Umsetzung wird durch eine überwachte Abnahme im Herstellwerk bestätigt.

Die Kenntnis der Umsetzung der nachstehenden Absätze a) bis c) ist von Bedeutung, wenn eine mathematisch, physikalische begründete Überleitung zu gewerblichen und industriellen Kälte-, Klima- und Wärmepumpenanlagen herzustellen ist, welche …

- ✓ in Räumen von solchen Gebäuden aufgestellt sind, die nur Zwecken eines einzigen Betriebes dienen = KAV § 12.(4) und
- ✓ bei denen keine Kältemittel-Füllmengenbeschränkungen gemäß aktueller ÖNORM EN 378-1, Tabelle C.2, vorgeschrieben sind.

Anmerkung :

Die Physik ist unabhängig vom Aufstellungsort und benannten Verwendungszweck immer gleich.

Übergeordnet gilt immer nachstehend a) bis d) :

a) **22.117** Die Oberflächentemperaturen im bzw. am A2L- Innengerät / Verdampfer / Wärmetauscher / Außengerät / Kondensator und in bzw. an der Wärmepumpe dürfen nachweislich +700°C nicht übersteigen und die zugehörigen Selbstentzündungstemperaturen der A2L-Kältemittel-Luft-Gemische werden im Betrieb konstruktionsbedingt nicht erreicht und führen zu keiner weiteren Gefährdung.

b) **22.116** For **A2L refrigerants**, electrical components in compliance with Annex JJ are **not** considered a **potential ignition source**.
   - Annex JJ is applicable to electric components or devices of appliances using **A2L refrigerants**.
   - Annex JJ defines the maximum size of openings in relays and similar components that prevents flame propagation to outside. A relay and similar components that comply with the requirements of this annex are **not** considered as a **potential ignition source** for **A2L refrigerants**.

Anmerkung zu b) :
Die Ausführungen der Löschkammern bei den verwendeten elektrisch, schaltenden Komponenten wie Schalter, Leistungsselbstschalter, Schütze, Relais, FI-Schutzschalter, Leitungsschutzschalter etc. sind so gestaltet, dass das jeweilige Spaltmaß der Löschkammern eine äquivalente Öffnung „deff“ von Ø 2,59mm, entsprechend einem Fremdkörperschutz gemäß ÖNORM EN 60529 von IP 3X, (IP 3X = Schutz gegen feste Fremdkörper > Ø 2,5mm) unterschreitet.
Betriebsmittel wie z.B. Druck- oder Temperaturmessumformer, Drehzahlregler, Druckschalter, Thermostate etc. bei denen im Inneren Funken oder Lichtbogen oder unzulässige Temperaturen entstehen, sind geeignet, wenn ihre Gehäuse mindestens der Schutzart IP 3X entsprechen.
Anschlusskästen müssen mindestens der Schutzart IP 3X genügen.
Damit wird jeweils ein Herauszünden der brennbarsten Konzentration des verwendeten A2L-Kältemittels unterbunden.
Anmerkung :
Werden oben angeführte Betriebsmittel und Anschlusskästen in feuchten Räumen verwendet, so muss bei Schutz gegen ….
- **Sprühwasser**, die Schutzart zumindest **IP 33**
- **Spritzwasser**, die Schutzart zumindest **IP 34**

betragen.

Dazu beispielhaft angeführt ….
Für deff max. = 7,00mm
Su …. Die Zündgeschwindigkeit des Kältemittels in [cm/s]

	Su angepasst an ISO 817				
	Berechnung von deff [mm] :			**max. zulässiger Ø**	
Ersatz für	Kältemittel	Su [cm/s]	deff [mm]	**deff [mm]**	
R-410A	R-32	6,7	2,80	**2,80**	
	R-717	7,2	2,59	**2,59**	
R-134a	R-1234yf	4,45	4,38	**4,38**	
R-134a	R-1234ze(E)	3,45	5,78	**5,78**	
R-134a	R-516A	6	3,16	**3,16**	
R-404A	R-454A	2,4	8,59	**7,00**	
R-404A	R-454C	4	4,92	**4,92**	
R-404A	R-457A	6,3	3,00	**3,00**	
R-410A	R-446A	9	2,03	**2,03**	jedoch IP**4**X
R-410A	R-447A	4,7	4,13	**4,13**	
R-410A	R-452B	4,2	4,67	**4,67**	
R-410A	R-454B	5,2	3,70	**3,70**	
	R-290	46	0,343		IP**5**X
Siehe im Besonderen die Information Nr. 46-3.					

Anmerkung :
Entsprechend Abschnitt 22.116 wurde **bei R-1234yf und R-1234ze(E) die erhöhte Zündgeschwindigkeit Su [cm/s] bei einem Taupunkt +27°C**, das entspricht z.B. +36°C 60% r.F., **zu Grunde gelegt**.
Die anderen angeführten Kältemittel weisen keine derartigen, dokumentierten Luftfeuchtigkeitsabhängigkeiten auf.

c) **22.116** For **A2L refrigerants**, switching devices in compliance with all of the following are **not** considered a **potential ignition source**:
- the switched electrical load (*Le*) in kVA is less than or equal to usw. ….

Dazu beispielhaft angeführt ….
Für Le …. Die max. geschaltete elektrische Leistung in [kVA]
Su …. Die Zündgeschwindigkeit des Kältemittels in [cm/s]

	Su angepasst an ISO 817		für 3 x 400V			
	Berechnung von Le [kVA] :			**für cos φ = 1**	für 1 x 230V	
Ersatz f	Kältemittel	Su [cm/s]	[kVA]	**bei 400V [A]**	[kVA]	**bei 230V [A]**
R-410A	R-32	6,7	5,00	**7,2**	2,50	**10,9**
	R-717	7,2	3,75	**5,4**	1,87	**8,2**
R-134a	R-1234yf	4,45	25,69	**37,1**	12,85	**55,9**
R-134a	R-1234ze(E)	3,45	71,12	**102,7**	35,56	**154,6**
R-134a	R-516A	6	7,77	**11,2**	3,89	**16,9**
R-404A	R-454A	2,4	303,69	**438,3**	151,84	**660,2**
R-404A	R-454C	4,0	39,36	**56,8**	19,68	**85,6**
R-404A	R-457A	6,3	6,40	**9,2**	3,20	**13,9**
R-410A	R-446A	9,0	1,54	**2,2**	0,77	**3,3**
R-410A	R-447A	4,7	20,65	**29,8**	10,32	**44,9**
R-410A	R-452B	4,2	32,38	**46,7**	16,19	**70,4**
R-410A	R-454B	5,2	13,78	**19,9**	6,89	**30,0**
	R-290	46	0,00225	0,00325	0,00113	0,00489
Siehe im Besonderen die Information Nr. 46-3.						

Anmerkung :
Entsprechend Abschnitt 22.116 wurde **bei R-1234yf und R-1234ze(E) die erhöhte Zündgeschwindigkeit Su [cm/s] bei einem Taupunkt +27°C**, das entspricht z.B. +36°C 60% r.F., **zu Grunde gelegt**.
Die anderen angeführten Kältemittel weisen keine derartigen, dokumentierten Luftfeuchtigkeitsabhängigkeiten auf.

d) Für die gemeinsame Raum-Volumensbetrachtung bzw. für den rechentechnischen Zusammenschluss von Räumen gilt :

GG.1.3 Determination of unventilated room area for appliances using A2L refrigerants
For the purpose of determination of room area (*A*) when used to calculate the **maximum** allowable **refrigerant charge** (*mmax*) in an unventilated space, the following shall apply.
Anmerkung :
Gültig für GG.2.1, GG.2.2, GG.10.4 und GG.10.5 “Natural ventilation to occupied indoor space”, nicht jedoch für GG.8.2.3 “Natural ventilation to outdoor or unoccupied indoor space“.

For **fixed appliances**, the area of the adjacent rooms, on the same floor, connected by permanent opening in the walls and/or doors between occupied spaces, including gaps between the wall and the floor, can be considered a single room when determining compliance to *Amin*, provided all of the following are met.
- The space shall have appropriate openings according to GG.1.4.
- The minimum opening area for natural ventilation *Anvmin* [m²] shall not be less than the following (Formel GG.7) :

$$Anvmin[m^2] = \frac{mc - mmax}{LFL \times 104} \times \sqrt{\frac{A}{g \times mmax} \times \frac{M}{M - 29}}$$

Gemäß **GG.1.4** gilt für die raumverbindenden, dauerhaft offenen Lüftungsöffnungen *Amin* [m²], je oben und unten im Raum ….

- At least 50 % of the required opening area *Anv*min shall be below 200 mm from the floor.
- A second higher opening shall be provided. The total size of the second opening shall not be less than 50 % of minimum opening area for *Anv*min and shall be at least 1,5 m above the floor.

$$Amin[m^2] \geq 50\% \times Anvmin$$

Anvmin is the minimum opening for natural ventilation in m^2;
mc is the actual **refrigerant charge** of refrigerant in the system in kg;
mmax is the allowable **maximum refrigerant charge** in the system in kg, calculated according to Clause GG.2 or *m2*, whichever is lower;
LFL is the **lower flammability limit** in kg/m^3;
A is the room area in m^2;
M is the molar mass of the refrigerant;
g is the gravity acceleration of $9{,}81 m/s^2$
29 is the average molar mass of air in kg.

Vorwort zu den Kältemittel-Füllmengenbeschränkungen gemäß Anhang GG :
Der Anhang GG beurteilt mit seinen Beschränkungen und Ausführungsauflagen die Aufstellung von Kälte-, Klima- und Wärmepumpenanlagen in Räumen die dem Aufenthalt von Personen dienen. Erfüllen Kälte-, Klima- und Wärmepumpenanlagen die Beschränkungen und Ausführungsauflagen im Raum, so ist die Aufstellung grundsätzlich sicher.

- In **Österreich** ist jedoch zu bedenken, dass die Explosionsschutzverordnung 2015, ExSV 2015, und die VEXAT dann zutreffend werden, wenn 50% der unteren Explosionsgrenze (UEG bzw. LFL) erreicht werden können. **Damit sind Kältemittel-Füllmengen bei den die Konzentration im Raum ≥ 50% x LFL erreichen kann, tunlichst zu vermeiden**. Ansonst werden die Bestimmungen der ExSV 2015 und VEXAT unmittelbar zutreffend.

Tabelle GG.1, informative Zusammenfassung zum Anhang GG

Refrigerant charge	**Direct system** [a.]				**Indirect system** [b.]
	Indoor space			**Outdoors**	
	Refrigerant charge and room area (Ohne additional requirements)	**Refrigerant charge, room area and additional requirements**	**Additional ventilation**		
mc ≤ *m1*	No room size restriction			No room size restriction	No room size restriction, GG.6
m1 < *mc* ≤ 2 × *m1* (**non-fixed appliance**)	Not allowed	GG.7	not allowed		
m1 < *mc* ≤ *m2*	GG.2.1	GG.2.2[c.], GG.9[c.], GG.10[c.,d.]	GG.3, GG.8[c.], GG.10[c.,d.]		
m2 < *mc* ≤ *m3*	Not allowed	GG.9[c.], GG.10[c.,d.]	GG.3, GG.8[c.], GG.10[c.,d.]		
mc > *m3*	Beyond the scope of this standard. National standards apply				

a. direct system means a **refrigerating system** in which a single rupture of the refrigerant circuit results in a refrigerant release to a space, irrespective of the location of the refrigerant circuit.
b. indirect system means a **refrigerating system** in which a single rupture of the refrigerant circuit does not leak into an indoor space, irrespective of the location of the refrigerant circuit
c. These clauses are only applicable to appliances with **A2L refrigerant**.
d. **Refrigerant charge** is limited to *m*1 < *mc* ≤ 4 x *m*2 #)

Anmerkung :
GG.3, GG.8 und GG.9 sind Abschnitte für „Luftkanal“-Systeme, siehe Figur GG.2, bzw. im weitesten Sinn Systeme mit Fremdlüftung, welche hier nicht betrachtet werden.
Anmerkung zu #) :
Das ist in der Norm nicht „sauber”. In GG.10.3.1 werden Spielregeln für GG.10.5 angegeben.
Siehe nachstehende Tabelle, GG.10.5 kann rechnerisch größer sein als 4 x *m2*.

Beispiele für die A2L-Grenzwerte *m1*, *m2*, *m3* und Zusatzgrenzwerte je in [kg] ….

R-	LFL [kg/m³]	GWP	Ersatz für	*m1* [kg]	*m2* [kg]	*m3* [kg]	GG.10.1 „4 x *m2*“ [kg]	GG.10.4 „0,25xLFL“ 250m² + ho=2,2m [kg]	GG.10.5 „0,50xLFL“ 250m² + ho=2,2m [kg]
1234ze	0,303	7	R-134a	1,82	15,76	78,78	63,02	41,66	83,33
1234yf	0,289	4	R-134a	1,73	15,03	75,14	60,11	39,74	79,48
516A	0,491	142	R-134a	2,95	25,53	127,66	102,13	67,51	135,03
454A	0,278	239	R-404A	1,67	14,46	72,28	57,82	38,23	76,45
454C	0,293	148	R-404A	1,76	15,24	76,18	60,94	40,29	80,58
457A	0,216	139	R-404A	1,31	11,39	56,94	45,55	30,11	60,23
32	0,307	675	R-410A	1,84	15,96	79,82	63,86	42,21	84,43
446A	0,237	461	R-410A	1,42	12,32	61,62	49,30	32,59	65,18
447A	0,330	584	R-410A	1,98	17,16	85,80	68,64	45,38	90,75
452B	0,310	698	R-410A	1,86	16,12	80,60	64,48	42,63	85,25
454B	0,303	466	R-410A	1,82	15,76	78,78	63,02	41,66	83,33

m1 = 6 x LFL Formel (GG.4)
m2 = 52 x LFL Formel (GG.5)
m3 = 260 x LFL Formel (GG.6)
Für *m1*, *m2* und *m3* je die Dimensionsgleichung …. $kg = m^3 \times \frac{kg}{m^3}$

Dazu die Formelübersicht der Abschnitte :

Abschnitt	Hauptformel	-1. Zusatzbedingung	-2. Zusatzbedingung
GG.2.	Clause GG.2 is applicable for appliances with a **refrigerant charge** of *m1* < *mc* **≤ *m2*** :		
	Refrigerant charge and room area (Ohne additional requirements)		
GG.2.1	$mmax[kg] = 2{,}5 \times LFL^{\frac{5}{4}} \times ho \times \sqrt{A}$	jedoch nicht mehr als $mmax[kg] = 0{,}75 \times LFL \times ho \times A$ in Österreich jedoch $mmax[kg] < 0{,}50 \times LFL \times ho \times A$	----
	Refrigerant charge, room area and additional requirements		
GG.2.2	Appliances using A2L refrigerants **with incorporated circulation airflow**		
GG.2.2	$mmax[kg] = 0{,}75 \times LFL \times hra \times A$	…. the fan **continuously operated** or operation is initiated by a **refrigerant detection system** with a sufficient **circulation airflow** rate usw.	in Österreich jedoch $mmax[kg] < 0{,}50 \times LFL \times hra \times A$
GG.10	**Allowable charge for enhanced tightness refrigerating systems according to 3.143 and 22.125** for appliances with a **refrigerant charge** *m1* < *mc* **≤ *m3*** ##) Anmerkung zu ##) : Grundsätzlich gilt **≤ *m3***, siehe die Anmerkung zu #).		
	Clause GG.10 is applicable to **enhanced tightness refrigerating systems** using **A2L refrigerants** with **refrigerant charge** *m1* < *mc* ≤ number of indoor units × *m2*, not to exceed 4 x *m2*.		
GG.10.3	**GG.10.3 Required measures for allowable refrigerant charge**		
GG.10.3.1	**Spaces except lowest underground floor of the building**		
	Where the **refrigerant charge** does not exceed **maximum refrigerant charge** in **GG.10.4**, **no additional** measures are required. Where the charge exceeds the **maximum refrigerant charge** in **GG.10.4** but is less than or equal to the **maximum refrigerant charge** in **GG.10.5**, then at **least one additional** measure shall be taken in accordance with Clause GG.11, GG.12, or GG.13. Where the **refrigerant charge** exceeds the **maximum refrigerant charge** in **GG.10.5**, at **least two additional** measures are taken in accordance with Clause GG.11, GG.12, or GG.13.		
GG.10.3.2	**Lowest underground floor of the building**		
	Where the **refrigerant charge** exceeds the **maximum refrigerant charge** in GG.10.4, two additional measures shall be taken in accordance with Clause GG.11, GG.12, or GG.13. The **refrigerant charge** shall not exceed the **maximum refrigerant charge** in GG.10.5.		
GG.10.4	$mmax[kg] = 0{,}25 \times LFL \times H \times A$	enhanced tightness; H is the room height in m but not more than 2,2 m unless *h*o as determined in GG.2 is higher than 2,2 m; Amax [m²] = 250m²	----
GG.10.5	$mmax[kg] = 0{,}50 \times LFL \times H \times A$	enhanced tightness; H is the room height in m but not more than 2,2 m unless *h*o as determined in GG.2 is higher than 2,2 m; Amax [m²] = 250m²	According to GG.10.3.1 and GG.10.3.2 Clause GG.11, GG.12, or GG.13 is necessary. in Österreich jedoch $mmax[kg] < 0{,}50 \times LFL \times hra \times A$

*m*max is the allowable **maximum refrigerant charge** in a room, in kg;
mc is the **refrigerant charge** in appliance, in kg;
A is the room area, in m^2;
LFL is the **lower flammability limit**, in kg/m^3;
SF is a safety factor with a value of 0,75; Siehe die Anmerkung für Österreich bei GG.2.1.
ho is the release height, the vertical distance in metres from the floor to the point of release when the appliance is installed (see Figure GG.5).
ho = (*hinst+hrel*) or 0,6 m whichever is higher.
hrel is the **release offset** in metres from the bottom of the appliance to the point of release (see Figure GG.5). Cumulative openings smaller than 5 cm² and openings with a single dimension of not more than 0,1 mm are not considered as openings where leaking refrigerant can escape. Openings for routing of wires and tubing which are not sealed openings shall include the total area of the opening without consideration of the area occupied by the tubing or wire.
hinst is the **installed height** in metres of the unit (see Figure GG.5).
Reference **installed heights** are given below:
hinst = 0,0 m for portable and floor mounted
hinst = 1,0 m for window mounted
hinst = 1,8 m for wall mounted
hinst = 2,2 m for ceiling mounted

hra is the estimate reaching height of airflow in m;
H is the room height in m but not more than 2,2 m unless *ho* as determined in GG.2 is higher than 2,2 m;

GG.2.2 Appliances using A2L refrigerants with incorporated circulation airflow
GG.2.2.1 General
Incorporated **circulation airflow** applies to fixed appliances only.
When the fan incorporated to an appliance is continuously operated or operation is initiated by a **refrigerant detection system** with a sufficient **circulation airflow** rate, the **maximum refrigerant charge** can be increased or minimum room area can be reduced according to ….

Abschnitt	Hauptformel	-1. Zusatzbedingung	-2. Zusatzbedingung
GG.11	**Ventilation for enhanced tightness refrigerating systems using A2L refrigerants**		
GG.11.2	**Natural ventilation** $Anvmin[m^2] = \frac{1}{720 \times LFL} \times \sqrt{\frac{M}{LFL \times (M-29)}}$	For natural ventilation opening provided to an occupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation **shall have a room area more than *A*min according to Clause GG.2** for *mc*. If the total room area **is not large enough**, the measure of GG.11.3 shall be taken.	Openings for natural ventilation shall comply with Clause GG.1.4.
GG.11.3	**Mechanical ventilation**		
GG.11.3.2	Required airflow		
	Für $\frac{Q \times 0{,}25 \times LFL}{10} < 1$	the airflow of the mechanical ventilation shall be at least the quantity that satisfies the following formula: $mc[kg] = -\frac{10 \times V}{Q} \times \ln(1 - \frac{Q \times 0{,}25 \times LFL}{10})$	*mc* is the refrigerant charge, expressed in kg; V is the room volume in m^3; 10 is the expected maximum leak rate in kg/h; Q is the ventilation airflow in m^3/h; LFL is the lower flammability limit in kg/m^3.
	Für $\frac{Q \times 0{,}25 \times LFL}{10} \geq 1$	the airflow shall be determined according the following formula: $Q[\frac{m^3}{h}] = \frac{10}{0{,}25 \times LFL}$	
GG.12	**Safety shut-off valves for enhanced tightness refrigerating systems using A2L refrigerants**		
	GG.12.1 Safety shut-off valves shall be located in a space with a room volume large enough so that the **maximum refrigerant charge** comply with GG.10.4, GG.10.5 or outside. Safety shut-off valve shall be positioned to enable access for maintenance by an authorized person.	GG.12.2 **If safety shut-off valves are used to comply with GG.10.4 or GG.10.5, then the released amount of refrigerant shall be limited to 0,5 × *LFL* × room volume**.	
GG.13	**Safety alarms for enhanced tightness refrigerating systems using A2L refrigerants**		
GG.13.1	If an alarm is employed to warn of a leak in the occupied space, the alarm shall warn of a refrigerant leak in accordance with GG.13.2. The alarm shall be turned on by the signal from the **refrigerant detection system**. The alarm shall also alert an authorized person to take appropriate action.		

GG.11 Ventilation for enhanced tightness refrigerating systems using A2L refrigerants
GG.11.1 General
Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant such as outdoors or a large space. The indoor place used to provide ventilation air shall have sufficient volume, including the volume of the room in which the indoor unit is installed, to ensure that the **maximum refrigerant charge** specified in GG.10.4 is not exceeded.
GG.11.2 Natural ventilation
If natural ventilation is applied, all of the followings shall be met.
- Natural ventilation from an occupied space shall not be made to outdoors.

NOTE : User may block the natural ventilation to the outside if it is cold outside
- For natural ventilation opening provided to an occupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation shall have a room area more than *A*min according to Clause GG.2 for *mc*. If the total room area is not large enough, the measure of GG.11.3 shall be taken.
- Openings for natural ventilation shall comply with Clause GG.1.4.

GG.11.3 Mechanical ventilation
GG.11.3.1 Operation of mechanical ventilation
Operation shall be according to GG.8.3.1, and for all indoor units in the same space which are served by a single **refrigerating system**, the fan shall be switched on to provide the minimum **circulation airflow** per GG.10.2.
GG.11.3.3 Mechanical ventilation openings
The upper edge of the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, openings shall be according to GG.8.3.3.
GG.11.3.4 Operation of mechanical ventilation
Mechanical ventilation shall be operated continuously or shall be switched on by a **refrigerant detection system**.

GG.12 Safety shut-off valves for enhanced tightness refrigerating systems using A2L refrigerants
GG.12.1 Location
Safety shut-off valves shall be located in a space with a room volume large enough so that the **maximum refrigerant charge** comply with GG.10.4, GG.10.5 or outside. Safety shut-off valve shall be positioned to enable access for maintenance by an authorized person.
GG.12.2 Design
Safety shut-off valves shall be designed to close in the event of an electric power failure, e.g. spring return solenoid valves.
If safety shut-off valves are used to comply with GG.10.4 or GG.10.5, then the released amount of refrigerant shall be limited to 0,5 × *LFL* × room volume.
The amount of refrigerant that can be leaked shall consider the response time of the sensor and the controller that activates the valves and the remaining amount of refrigerant that is contained in each section of the **refrigerating system** after the valves are closed.
NOTE : Liquid migration in the off cycle may be the worst case condition for determination of the charge contained in the systems after closing of the safety shut-off valves.

GG.13 Safety alarms for enhanced tightness refrigerating systems using A2L refrigerants
GG.13.1 General
If an alarm is employed to warn of a leak in the occupied space, the alarm shall warn of a refrigerant leak in accordance with GG.13.2. The alarm shall be turned on by the signal from the **refrigerant detection system**. The alarm shall also alert an authorized person to take appropriate action.
GG.13.2 Alarm system warning
GG.13.2.1 General
The alarm system shall warn both audibly and visibly, such as both a loud (15 dBA above the background level) buzzer and a flashing light.
GG.13.2.2 Alarm for general occupancy
At least one alarm inside the occupied space shall be installed. For the occupancy listed below, the alarm system shall also warn at a supervised location, such as the night porter's location, as well as the occupied space.
Rooms, parts of buildings, building where

- sleeping facilities are provided,
- people are restricted in their movement,
- an uncontrolled number of people are present, or
- to which any person has access without being personally acquainted with the necessary safety precautions.

Auszugsweise Nachträge :

7 Marking and instructions
For appliances using **flammable refrigerants**, the flame symbol ISO 7010-W021 (2011-05) and the operator's manual symbol described in 7.6 shall be visible when viewing the appliance after it has been installed. The marking may be behind a detachable part that has to be detached before maintenance or repair work. The perpendicular height of the triangle used for the symbol shall be at least 30 mm. **For appliances that are not single packaged units, the required markings shall be provided on all indoor and outdoor units which complete the refrigerating system when installed.** When an **A2L refrigerant** is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

If a **flammable refrigerant** is used, an additional warning symbol (flame symbol:
ISO 7010-W021 (2011-05)) shall be placed on the nameplate of the unit near the declaration of the refrigerant type and charge information. The perpendicular height of the symbol shall be at least 10 mm, and the symbol need not be in colour. When an **A2L refrigerant** is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

If not already visible when accessing a **service port** and if a **service port** is provided, the **service port** shall be marked to identify the type of refrigerant. If the refrigerant is flammable, symbol ISO 7010-W021 (2011-05) shall be included, without specifying the colour. When an **A2L refrigerant** is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

7.108 For appliances using **flammable refrigerants**, the flame symbol described in 7.6 shall be visible in each of the following conditions:
- on the packaging of the appliance if the appliance is charged with refrigerant excluding appliances with **A2L refrigerant charge** not exceeding *m*1;
- when viewing the appliance on display for sale. This does not apply to appliances using

A2L refrigerants.
For appliances that are not **factory sealed single packaged units**, the required markings shall be provided on all indoor and outdoor units which complete the **refrigerating system**.

Anmerkung :
Die Handhabung bei drohender „Verwechslung" schwingt in diesen Zitaten mit.

7.6 Symbole für A2L und A3-Kältemittel

A2L Symbol mit dem A2L-Geräte und Anlagen zu Kennzeichen sind :	Im Vergleich dazu das A3 Symbol :
	
warning; Low burning velocity material	warning; Flammable materials

22.115 The **refrigerant charge** (*mc*) in each **refrigerating system** employing **A2L refrigerant** shall not exceed *m3* as defined in Annex GG.
The construction of the **refrigerating system** using **flammable refrigerants** shall comply with the requirements in Annex GG.

22.116
Refrigerant pipes containing **A2L refrigerant** which connect refrigerating system components **shall not be considered a source of leaked refrigerant for the purpose of evaluating potential** for fire or explosion hazard relative to potential ignition sources within the appliance if the piping within the area of the appliance to be evaluated complies with all of the following;

- no connecting joints; Anmerkung : Im Sinne Flansch, Verschraubung oder Bördel.
- no bends with centreline bend radius less than 2,5 times the external pipe diameter;
- protected from potential damage during normal operation, service or maintenance.

22.116
The burning velocity **shall be the highest of**

- as specified in ISO 817; or
- as measured in humid air at 27 °C +/- 0,5 C dew point at 101,3 kPa containing 21,0 +/- 0,1 % O2 excluding water vapour.

Note : The 27 °C dew point equates to an absolute humidity of 0,0227 kg water vapour per 1 kg dry air.

22.121 For the installation condition of appliances using an **A2L refrigerant** and where a **refrigerant detection system** is applied to fulfil the requirements of Annex GG, the **refrigerant sensor of the system shall be located** where leaking refrigerant is likely to stagnate. The sensor location shall be located usw.
Anmerkung :
Details siehe Abschnitt 22.121.

22.122 Refrigerant detection systems that are required by this standard for **A2L refrigerants** shall comply with Annex **LL**.

3.143 enhanced tightness refrigerating system
refrigerating system in which the indoor units are designed and fabricated to ensure a high level of confidence that large refrigerant leak rates will not occur in normal and abnormal operation

22.125 Refrigerating systems that fulfil all of the following conditions shall be considered **enhanced tightness refrigerating systems**:
a) the compressor, pressure relief device or pressure vessel type refrigerant containing components of the **refrigerating system** shall be located in locations other than the occupied space,

NOTE: Pressure vessel means any refrigerant-containing part of a **refrigerating system** other than

- compressors,
- pumps,
- component parts of sealed absorption systems,
- evaporators, each separate section of which does not exceed 15 l of refrigerant containing volume,
- coils,
- piping and its valves, joints, and fittings,
- control devices, and
- pressure-containing components (including headers)

having an internal diameter or largest cross-sectional dimension not greater than 152 mm.

b) refrigerant distribution assemblies shall meet all applicable requirements of this standard,
c) refrigerating systems shall use only permanent joints indoors except for site-made joints directly connecting the indoor unit to the refrigerant piping, or factory mechanical joints in compliance with ISO 14903,

d) refrigerant containing parts in indoor units shall be protected from damage in the event of catastrophic failure of moving parts, e.g. fans, belts,
e) systems where the equipment pipes in the occupied space in question are installed in such a way that it is protected against accidental damage,
f) the refrigerating system of each indoor unit shall be tightness tested at the factory with detection equipment with a capability of 3 grams per year of refrigerant or better under a pressure of at least 0,25 times the maximum allowable pressure. No leak shall be detected,

Compliance for bullet a to bullet f is checked by inspection.

g) vibrations exceeding 0,30 G RMS, when measured with a low pass filter at 200 Hz, are not allowed in the refrigerant containing parts in the occupied space under normal operation.

Compliance is checked by testing:

- *The equipment shall be mounted per installation instructions. The outdoor unit shall be directly connected to the indoor unit by the shortest line set per the installation instructions. Testing shall be conducted in fan only mode, the heating mode and cooling mode if applicable.*
- *Vibration level shall be measured over the full range of the compressor and indoor fan speeds as allowed by the controls in consideration of the operation modes. Care shall be taken that the measurement sensors do not influence the line vibration level, and that the rate of change of speed is sufficiently slow that the maximum vibration is captured.*

h) Indoor heat exchangers shall be protected from damage in the event of freezing

Compliance is checked as follows:

- *Coils protected by controls. Compliance is checked by inspection, if in doubt, the test for non-freezing coils shall be executed.*
- *Non-freezing coils. Compliance is checked by conducting the minimum cooling performance test as described in ISO 5151, ISO 13253, ISO 15042, or ISO 13256.*
- *Freezing coils. Compliance is checked on 3 samples by testing as follows. Cycling testing of the **heat exchanger** under frosting conditions confirms that the **heat exchanger** has adequate strength to withstand freezing without failure. The appliance shall cycle as intended by the controls for 10 days. At the end of the test, the **heat exchanger** shall withstand the strength requirements of Annex EE,*

i) the maximum speed of the fan, in normal operation, shall be less than 90 % of the maximum allowable fan speed as specified by the manufacturer of the fan wheel. If the manufacturer does not specify a maximum allowable fan speed then the fan wheel shall be tested as follows:
   - The maximum allowable fan speed shall be established by running continuously at 120% of maximum speed for 10 days. There shall be no structural failure of the fan.
   - If non-metallic fan wheels have a minimum thermal index rating of 65ºC per UL 746B, preconditioning is not required.
   - If no thermal index rating for the material is available, specimens shall be aged at 90°C for 168 hours. The samples shall not have more than a 50-percent reduction of the unconditioned property values for items (a) – (d) below when tested in accordance with CAN/CSA-C22.2 No. 0.17 and UL 746A:
     (a) Tensile strength,
     (b) Flexural strength,
     (c) Izod impact,
     (d) Tensile impact.

Compliance is checked by inspection.

DD.3 Information in manual
DD.3.1 General

The following information requirements apply **for enhanced tightness refrigerating systems** using **A2L refrigerants**:

- Equipment piping in the occupied space shall be installed in such a way to protect against accidental damage in operation and service.
- Precautions shall be taken to avoid excessive vibration or pulsation to refrigerating piping.
- Protection devices, piping and fittings shall be protected as far as possible against adverse environmental effects, for example, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.
- Provision shall be made for expansion and contraction of long runs of piping.
- Piping in **refrigerating systems** shall be so designed and installed to minimize the likelihood hydraulic shock damaging the system.
- Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock.
- Solenoid valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.
- Steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation.
- Flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces. They should be checked for mechanical damage annually.
- The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment cannot occur from such events as moving furniture or reconstruction activities.
- Where safety shut off valves are specified, the minimum room area may be determined based on the maximum amount of refrigerant that can be leaked as determined in GG.12.2.
- Where safety shut off valves are specified, the location of the valve in the **refrigerating system** relative to the occupied spaces shall be as described in GG.12.1.
- Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 5 grams per year of refrigerant or better under a pressure of at least 0,25 times the **maximum allowable pressure**. No leak shall be detected.