REVISING IEC 60335-2-40 FOR A2 AND A3 REFRIGERANTS

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Li Tingxun

6th Nov,2019

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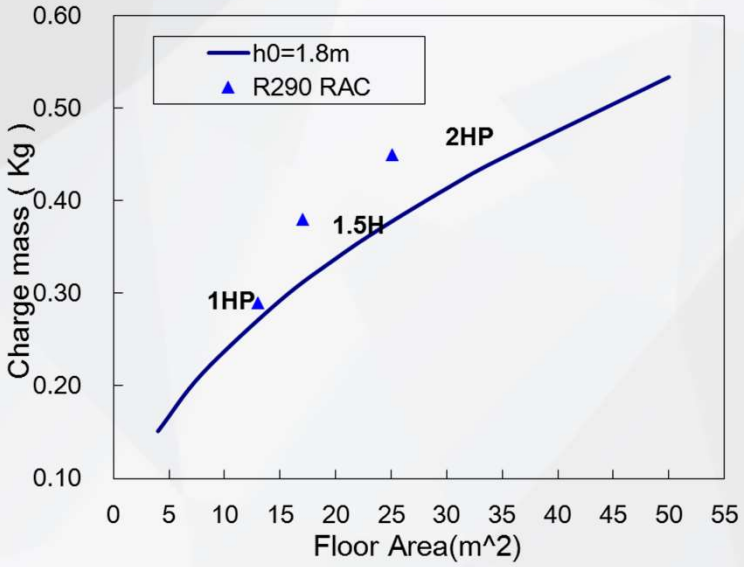
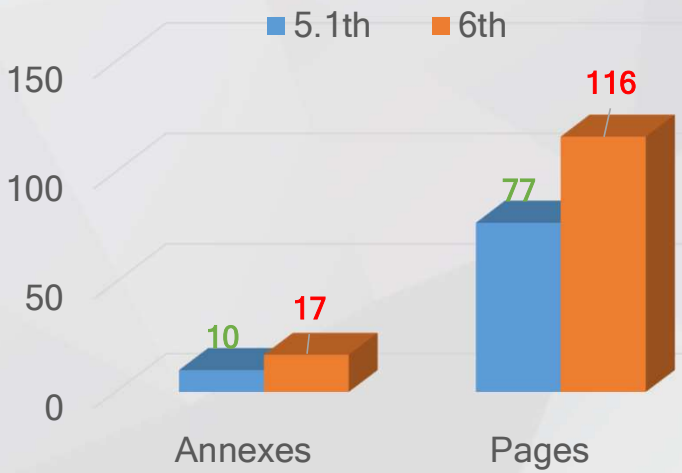
Background



	Parameter	Evaluated Condition
Refrigerant	Molecular Mass	Evaluated
	Charge Amount	Evaluated
	Temperature	Neglected
	Pressure	Neglected
	Interaction with Oil	Neglected
Leak	Velocity	Low velocity
	Rate	Leak takes 4 minutes
	Direction	Downward
	Height	Evaluated
	Location	Middle of the room
Room	Temperature	Neglected (Used approximately 25° C)
	Pressure	Neglected (Used 1 bar)
	Tightness	Tight room except door gap
	Ventilation	No ventilation except the door gap effect
	Air Flow	None.
	Shape	Rectangular
	Obstacles	None



Background

1. Ignition Source → Electrical components
2. Charge Limit Boundary → Air conditioner types（such as VRV）
3. Charge Limit Additional Formula → Charge mass(Efficiency)
4. Mechanical Structure → Tightness
5. Symbols and Marking → Marketing
6. Training → Service

Background

	IEC60335-2-40(5.1) （2/3）	ISO5149 (2L)	IEC60335-2-40(6.0) (2L)	UL 484^{9th} (2/3)	Remark
M1	4×LFL	6×LFL	**6×LFL**		<M1,no restriction
M2	26×LFL	39×LFL	**52×LFL**	**3×LFL**	M2< >M3,ventilation
M3	130×LFL	195×LFL	**260×LFL**		>M3,local regulation
M1< >M2	$m_{max}=2{,}5\times LFL^{5/4}\times h_0\times A^{1/2}$		**m_{max}=0.75×LFL×A×h_{ra}**		

Contents

Installation height

2010
London

Suggest to revise the claus
of the installation height

Rejected

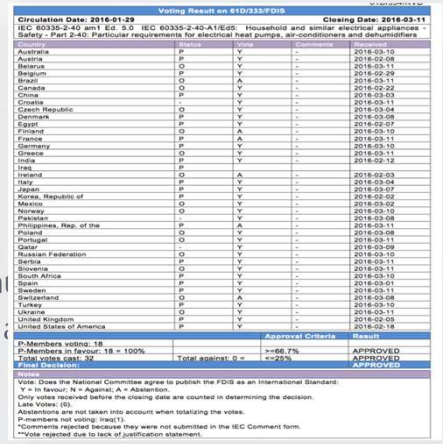
Participants

Daniel Kindblad, SE
Bill Hansen, US
Els Baert, BE (Guest)
Mary Koban, US (Guest)
Alberto Aloisi, IT
Hirochi Yamaguchi, JP
Koji Hatano, JP
Shigeharu Taira, JP
Martin Dieryckx, BE
Brian Rodgers, US (part time)
Byron Horak (part time)
Tingxun Li, CN
Dou Yanwei, CN
Daniel Colbourne UK

2013
Delhi

Propose to revise the cla
of the installation height

AHG 12



Voting Result on 61D/333/FDIS

Circulation Date: 2016-01-29 — Closing Date: 2016-03-11

IEC 60335-2-40 am1 Ed. 5.0 IEC 60335-2-40-A1/Ed5: Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

Country	Status	Vote	Comments	Received
Australia	P	Y	-	2016-03-10
Austria	P	Y	-	2016-02-08
Belarus	O	Y	-	2016-03-11
Belgium	P	Y	-	2016-02-29
Brazil	O	A	-	2016-03-11
Canada	O	Y	-	2016-02-22
China	P	Y	-	2016-03-03
Croatia	-	Y	-	2016-03-11
Czech Republic	O	Y	-	2016-03-04
Denmark	P	Y	-	2016-03-08
Egypt	P	Y	-	2016-02-07
Finland	O	A	-	2016-03-10
France	P	A	-	2016-03-11
Germany	P	Y	-	2016-03-10
Greece	O	Y	-	2016-03-11
India	P	Y	-	2016-02-12
Iraq	P	-	-	-
Ireland	O	A	-	2016-02-03
Italy	P	Y	-	2016-03-04
Japan	P	Y	-	2016-03-07
Korea, Republic of	P	Y	-	2016-02-02
Mexico	O	Y	-	2016-03-02
Norway	O	Y	-	2016-03-10
Pakistan	-	Y	-	2016-03-08
Philippines, Rep. of the	P	A	-	2016-03-11
Poland	O	Y	-	2016-03-08
Portugal	O	Y	-	2016-03-11
Qatar	-	Y	-	2016-03-09
Russian Federation	O	Y	-	2016-03-10
Serbia	P	Y	-	2016-03-11
Slovenia	O	Y	-	2016-03-11
South Africa	P	Y	-	2016-03-10
Spain	P	Y	-	2016-03-01
Sweden	P	Y	-	2016-03-11
Switzerland	O	A	-	2016-03-08
Turkey	P	Y	-	2016-03-10
Ukraine	O	Y	-	2016-03-11
United Kingdom	P	Y	-	2016-02-05
United States of America	P	Y	-	2016-02-18

Approval Criteria		Result
P-Members voting: 18		
P-Members in favour: 18 = 100%	>=66.7%	APPROVED
Total votes cast: 32 — Total against: 0 =	<=25%	APPROVED
Final Decision:		APPROVED

Vote: Does the National Committee agree to publish the FDIS as an International Standard:
Y = In favour; N = Against; A = Abstention.
Only votes received before the closing date are counted in determining the decision.
Late Votes: (0).
Abstentions are not taken into account when totalizing the votes.
P-members not voting: Iraq(1).
*Comments rejected because they were not submitted in the IEC Comment form.
**Vote rejected due to lack of justification statement.

Took 6 years to achieve a simple/minor but logical change

2016

FDIS approved with no against

2013
Stuttgart

China submitted the proposal

IEC SC61D WG 9 Doc. 2013-079
Source: Dou Yanwei

China Proposal on h_0 for calculation of m_{max} and A_{min}

Statement:

Fundamentally we think that the standard should play the role to conduct the technology development and product design. The standard should not support one technology or [illegible] technology. However, the proposed language at the meeting WG9, attached at the end of the proposal, tries to generalize the barriers to number of product development. A standard should provide the minimum requirements for safety, and avoid limiting the technology and product development without unnecessarily limiting the product design or application.

The reasons to China proposal:

Rejected

2015
Vienna

CD

6.4 Annex GG - Charge limits, ventilation requirements and requirements for secondary circuits

Installation height

The convenor reported that SC61D discussed the installation height at its London meeting (notes page 6). SC61D had decided not to change the requirement in the CDV stage.

61D/204/RM

GG.2

Replace the definition of h_0 by the following:

h_{ac} is the vertical distance [m] from the floor to the point of release when the appliance is installed (see Figure GG.5).

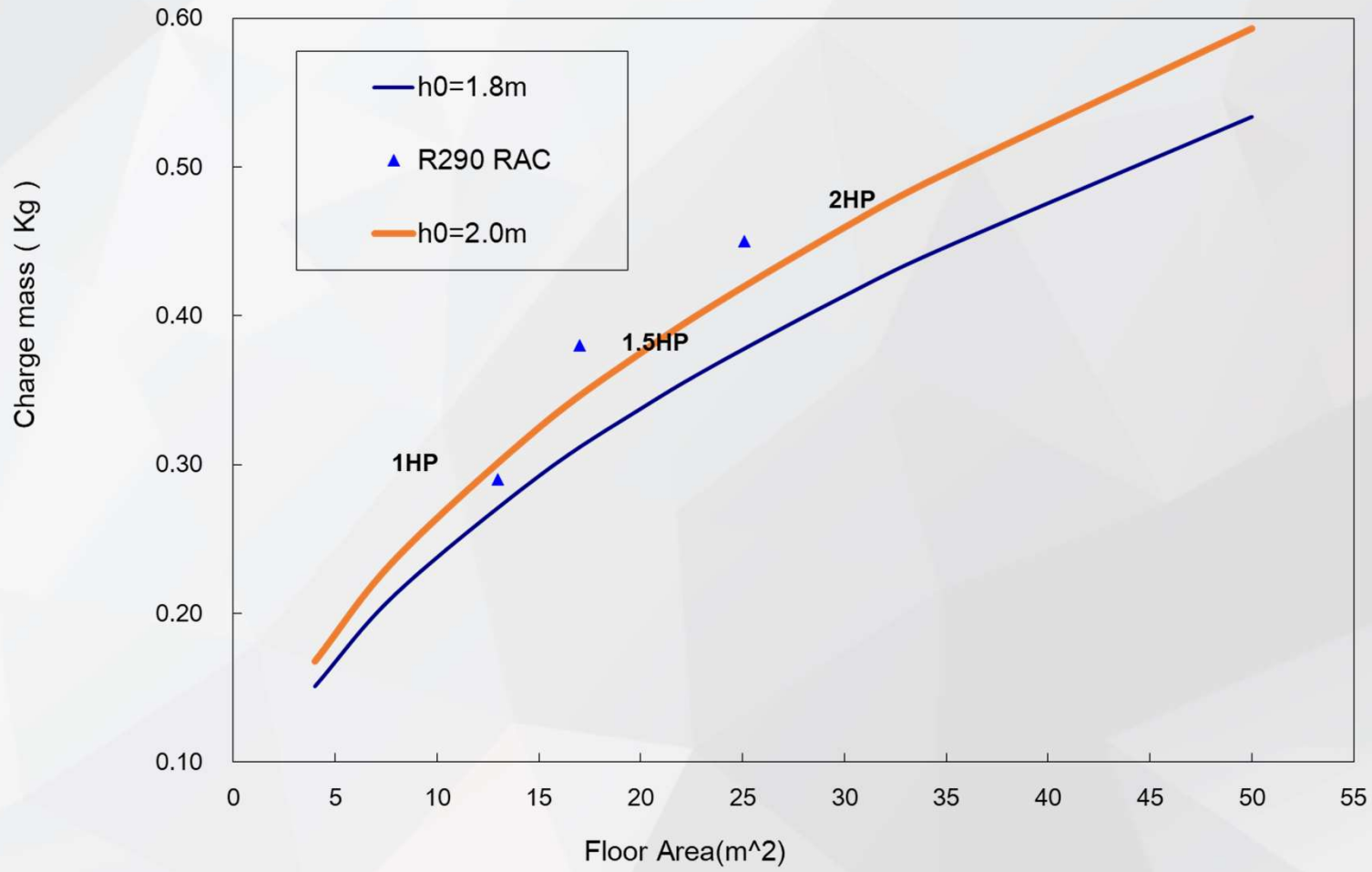
$h_0 = (h_{rout} + h_{iout})$ or 0,6m whichever is higher.

h_{rout} is the **release height** [m] from the bottom of the appliance to the point of release(see Figure GG.5). Cumulative openings smaller than 5cm² and openings with a single dimension of not more than 0.1mm 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.

h_{iout} is the **installed height** [m] of the unit (see Figure GG.5). Reference **installed heights** are given below:

h_{iout} = 0,0m for Portable and Floor mounted
h_{iout} = 1,0m for Window mounted
h_{iout} = 1,8m for Wall mounted
h_{iout} = 2,2m for Ceiling mounted

If the minimum **installed height** given by the manufacturer is higher than the reference **installed height**, then in addition A_{min} and m_{max} for the reference **installed height** have to be given by the manufacturer. An appliance may have multiple reference **installed heights**. In this case A_{min} and m_{max} calculations shall be provided for all applicable reference installed heights.


0.60
0.50
0.40
0.30
0.20
0.10
Charge mass (Kg)
h0=1.8m
R290 RAC
h0=2.0m
2HP
1.5HP
1HP
0
5
10
15
20
25
30
35
40
45
50
55
Floor Area(m^2)

WG for A2/A3

2014
New York

Proposed establishment of WG for A2 and A3

Rejected

6g. Group to address A2 and A3 refrigerants.

This group has not been set up. At the previous meeting SC61D had decided to consider again the start of the work at the next meeting.

UK gave an introduction on their proposal that is 61D/303/DC. This DC received 13 comments (Doc. 13). The comments indicate a WG should be formed to address this topic. The US NC supports the formation of a WG but would like to define the scope of the WG clearly (terms of reference). China also supports the formation of a WG.

SC61D set up a WG with the following Terms of Reference –

Evaluate the work of WG9 (e.g.61D/257/DC; 61D/285/INF) with respect to A2 and A3 refrigerants;

Review 61D/303/DC and the national comments submitted;

Develop additional requirements for A2 and A3 refrigerants -

- Charge Limits,
- Dilution, circulation, ventilation requirements,
- Additional mitigation measures.

Mr. Vonsild of Denmark will convene the WG.

2015
Washington

UK submitted the proposal and WG16 was established

WG9 confirmed the decision of the n
items are out of scope. When A2
separately.

IEC

61D/303/DC

For IEC use only

2015-04-24

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TECHNICAL COMMITTEE No. TC61: SAFETY OF HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES

SUBCOMMITTEE NO. SC61D: APPLIANCES FOR AIR-CONDITIONING FOR HOUSEHOLD AND SIMILAR PURPOSES

Proposal of the GB National Committee for an amendment to IEC 60335-2-40 Edition 5.0 (2013-12-03) - Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air conditioners and dehumidifiers

Comments/proposals should be submitted using the IEC Electronic voting system by the National Committees. (See AC/3/2011)

Comments/proposals to be returned by 2014-06-05

PROPOSAL FOR MODIFYING IEC 60335-2-40 Ed. 5.0 FOR A2 AND A3 REFRIGERANTS

INTRODUCTION

In terms of the requirements for flammable refrigerants the current standard has not changed for more than 10 years.

Currently the standard is being revised specifically for A2L refrigerants.

2019

WG9 and AG16 were combined

C. Brief statement of the results achieved during the meeting (other than those included in A and B), such as setting-up or disbanding of WGs, changes to the tasks of WGs, or membership modifications in the SC..

WG9 and WG 16 had worked in parallel to speed up the revision of the standard. Decision to combine WG9 and WG 16 to combine the working results. Decided to form one new WGs to tackle urgent issue and not to delay the revision regarding global warming impact. Created 2 new AHGs to address ad hoc issue. decision to dissolve WG 17 as their work is complete.

WG 16

Address A2L, A2 and A3 refrigerants

To develop additional requirements for A2L, A2 and A3 refrigerants: charge limits, dilution,

READ MORE

DOCUMENTS 536

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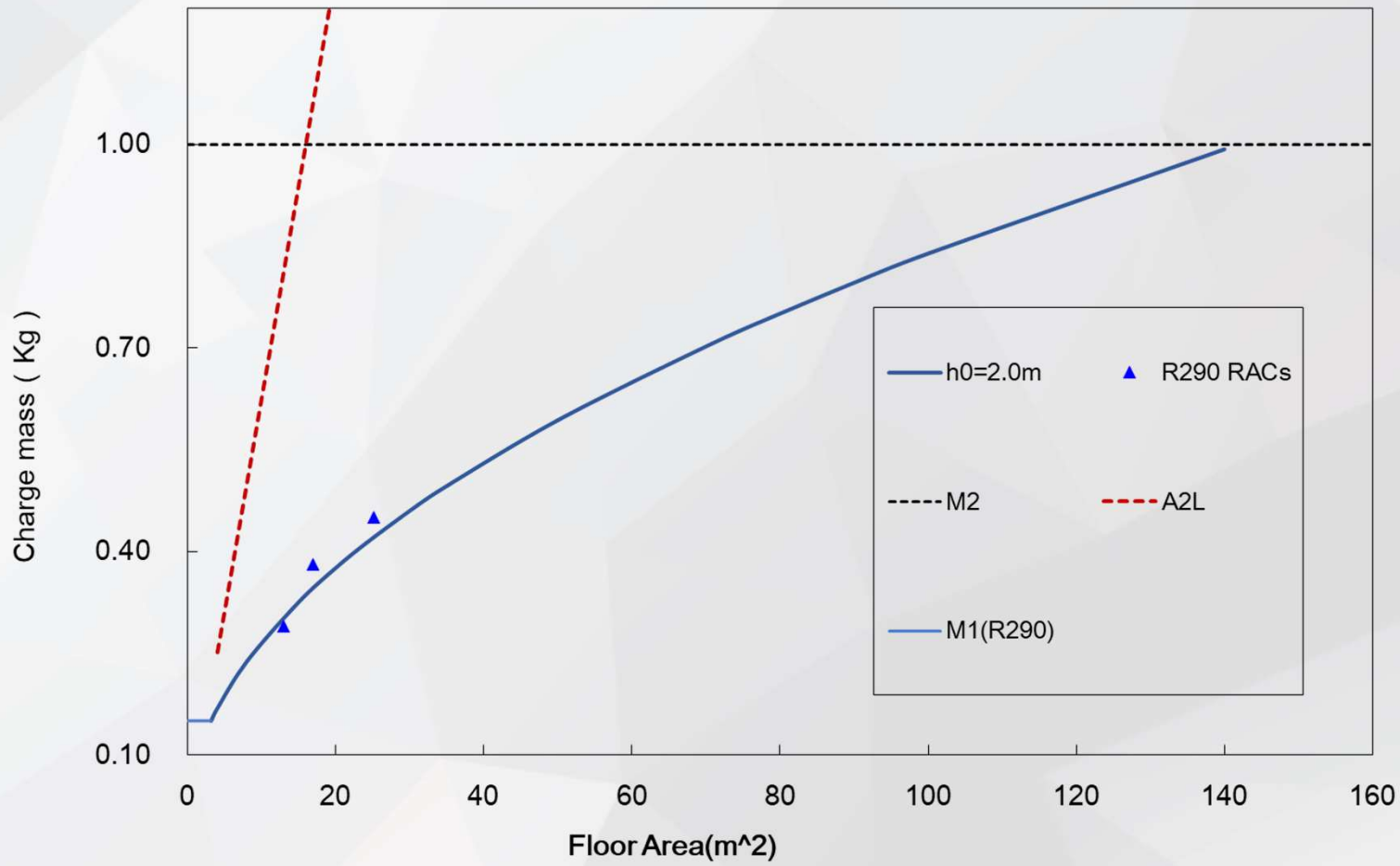
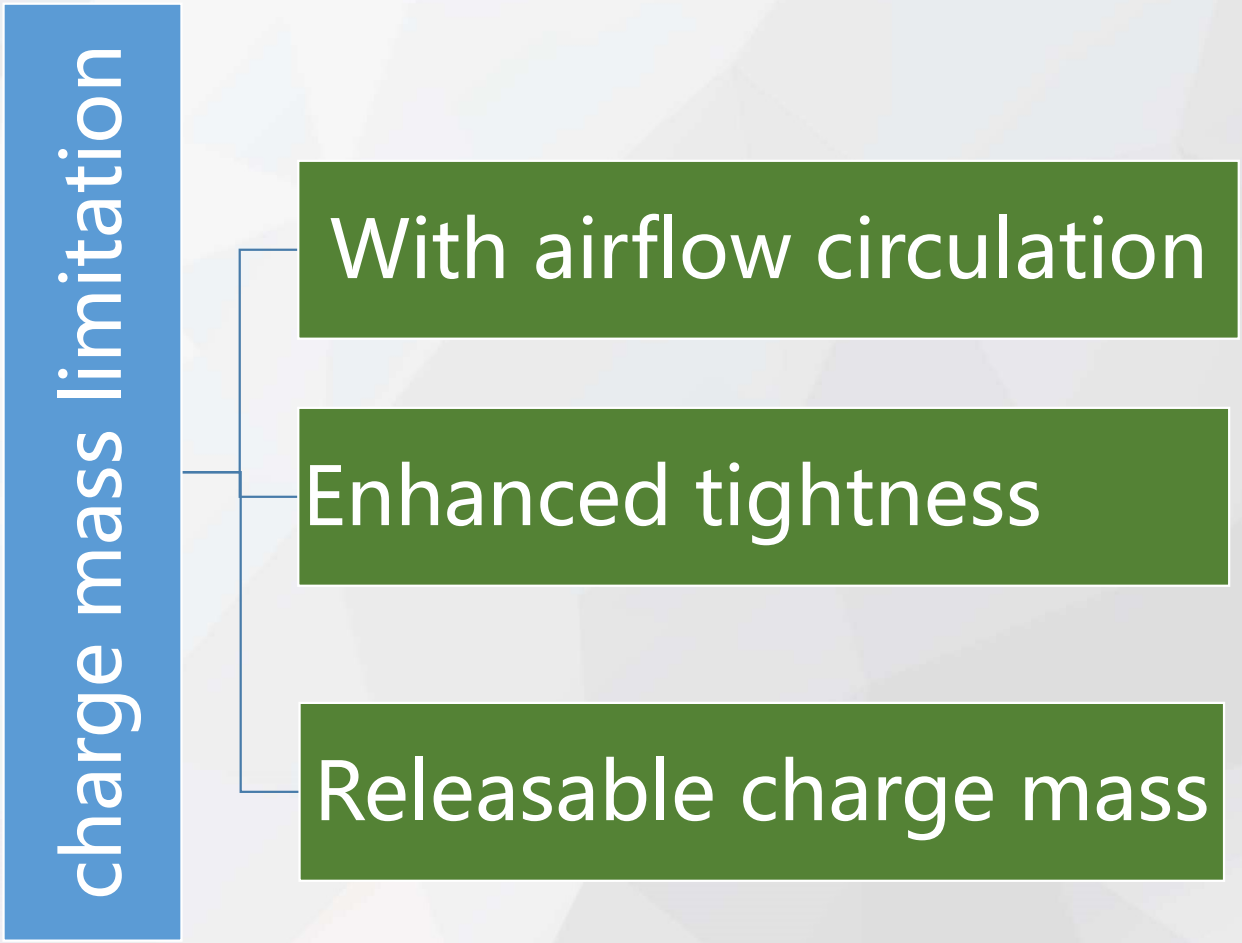
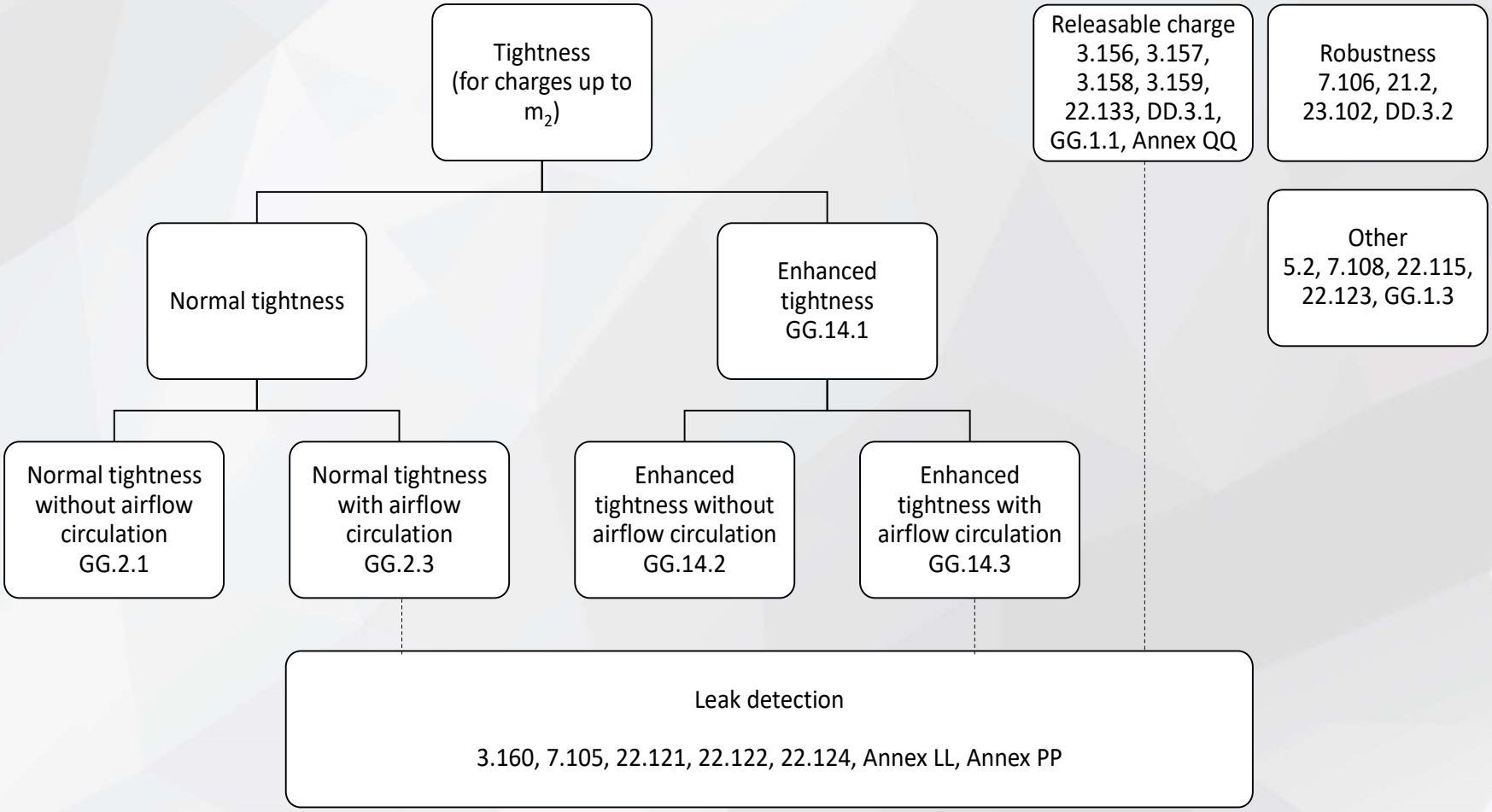
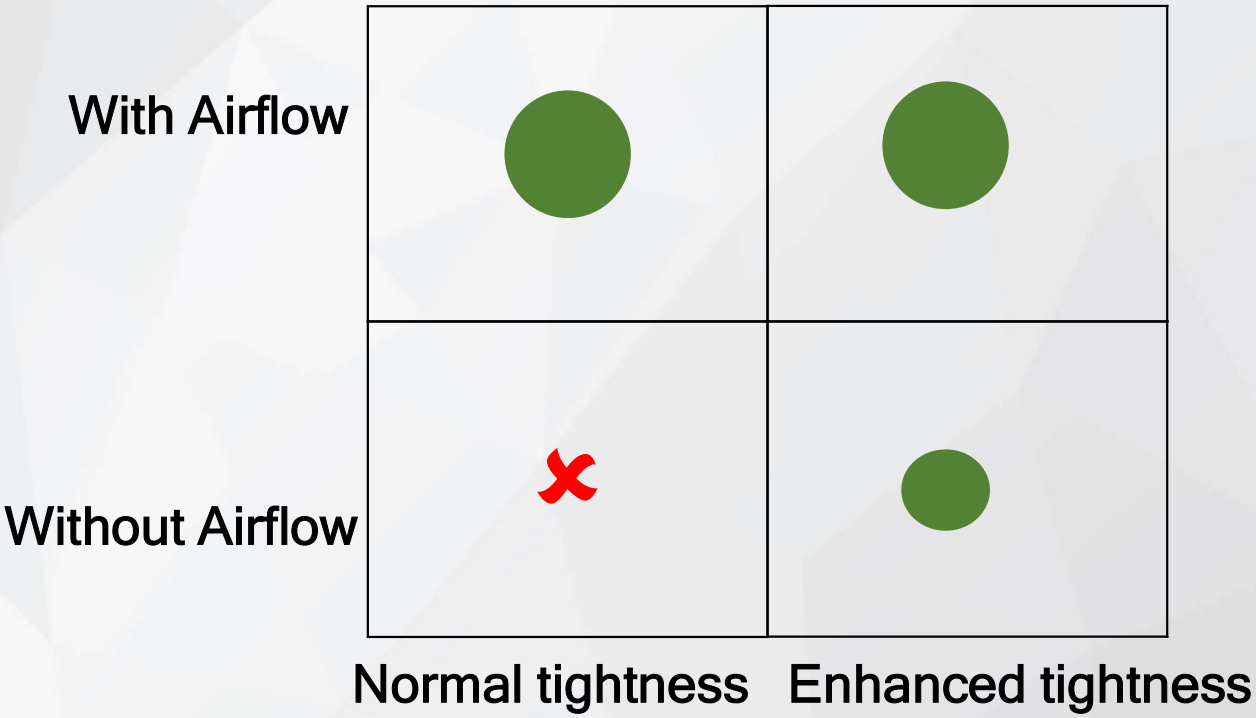

Charge mass (Kg)
1.00
0.70
0.40
0.10
0
20
40
60
80
100
120
140
160
Floor Area(m^2)
h0=2.0m
R290 RACs
M2
A2L
M1(R290)

Charge mass


charge mass limitation
With airflow circulation
Enhanced tightness
Releasable charge mass


Tightness
(for charges up to
m_2)
Releasable charge
3.156, 3.157,
3.158, 3.159,
22.133, DD.3.1,
GG.1.1, Annex QQ
Robustness
7.106, 21.2,
23.102, DD.3.2
Other
5.2, 7.108, 22.115,
22.123, GG.1.3
Normal tightness
Enhanced
tightness
GG.14.1
Normal tightness
without airflow
circulation
GG.2.1
Normal tightness
with airflow
circulation
GG.2.3
Enhanced
tightness without
airflow circulation
GG.14.2
Enhanced
tightness with
airflow circulation
GG.14.3
Leak detection
3.160, 7.105, 22.121, 22.122, 22.124, Annex LL, Annex PP

Charge mass



‘ensure that the flammability risk does not exceed that which may be associated with existing charge limits for unventilated “normal tightness” systems’

Enhanced tightness

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

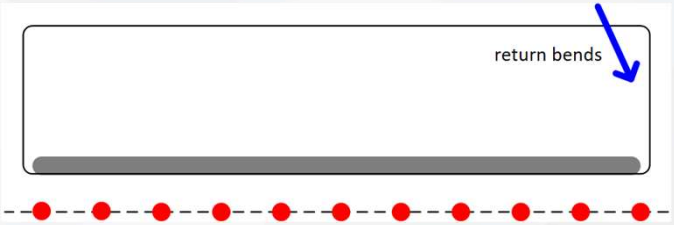
- compressors, pressure relief devices and pressure vessels of the refrigerating system shall be located in locations other than the occupied
- refrigerant distribution assemblies shall meet all applicable requirements of this standard
- refrigerating systems shall use only permanent joints indoors except for site-made or factory made mechanical joints in compliance with ISO 14903
- refrigerant containing parts in indoor units shall be protected from damage in the event of catastrophic failure of moving parts
- pipes in the occupied space in question are installed in such a way that it is protected against accidental damage
- indoor unit shall be tightness tested at the factory with detection equipment with a capability of 3 grams per year

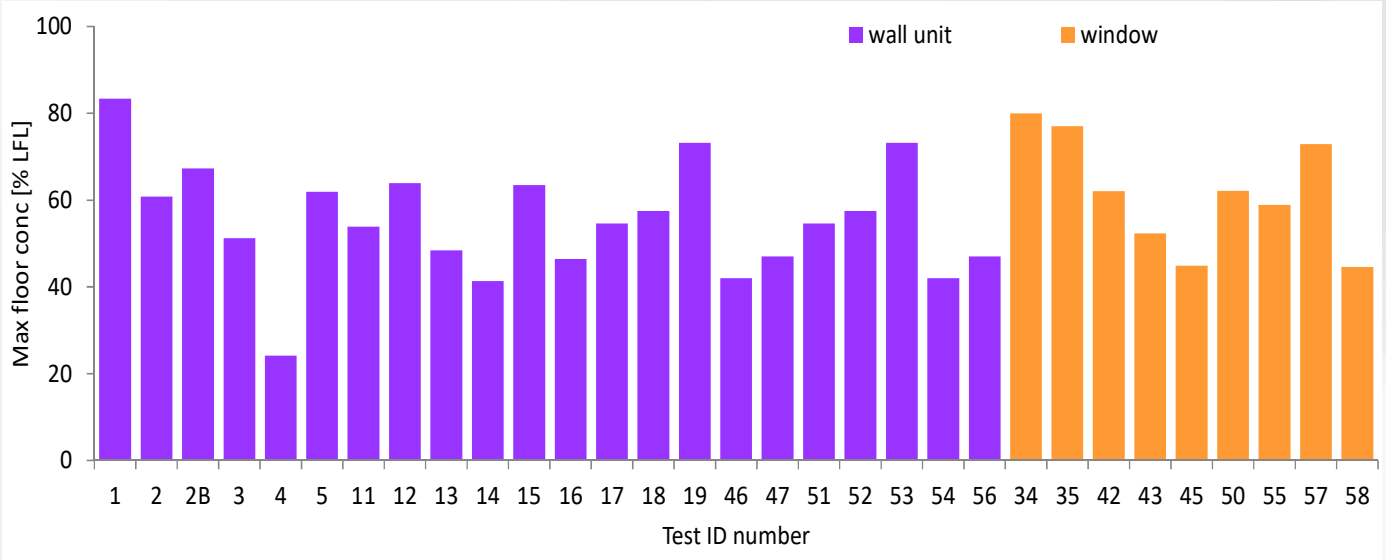
Charge mass

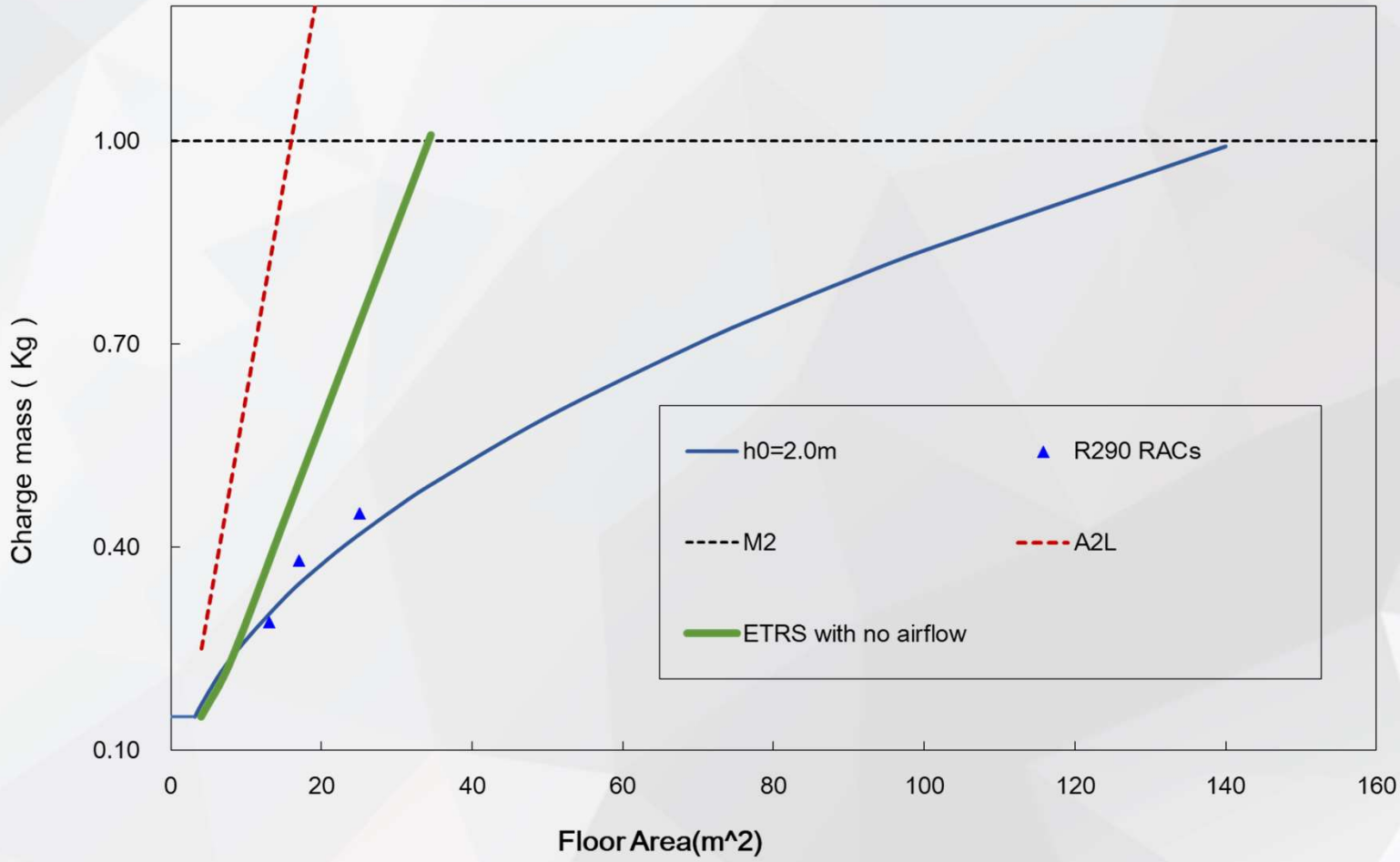
No airflow circulation + Enhanced tightness

$$m_{max} = \mathrm{F} \times LFL \times A \times h_o$$

F=0.2×Cexit-1/2 and *F≤0.5 such as* *0.35*



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Floor Area(m^2)
h0=2.0m
R290 RACs
M2
A2L
ETRS with no airflow

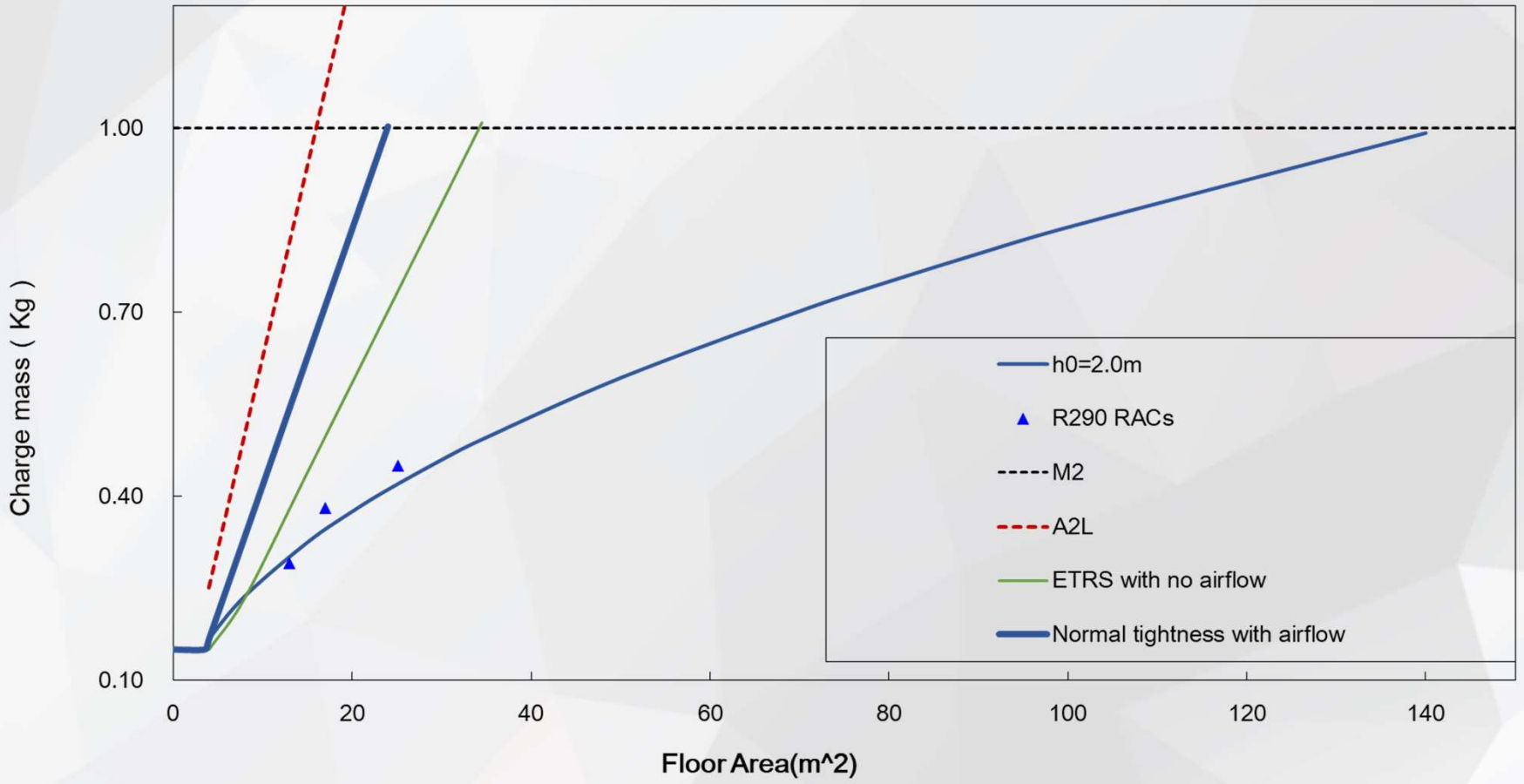
Charge mass

Normal tightness +Airflow circulation

$$m_{max} = F \times LFL \times A \times 2.2$$

F is a factor not exceeding 0.5. The value shall be the value as used in the equation for calculating Q_{min}

$$Q_{min} = 3600 \frac{8\,Y\sqrt{A_o}}{240} \left(\frac{m_c}{LFL}\right)^{3/4} \left(\frac{F^{1/4}}{1-F}\right)$$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Normal tightness with airflow

Charge mass

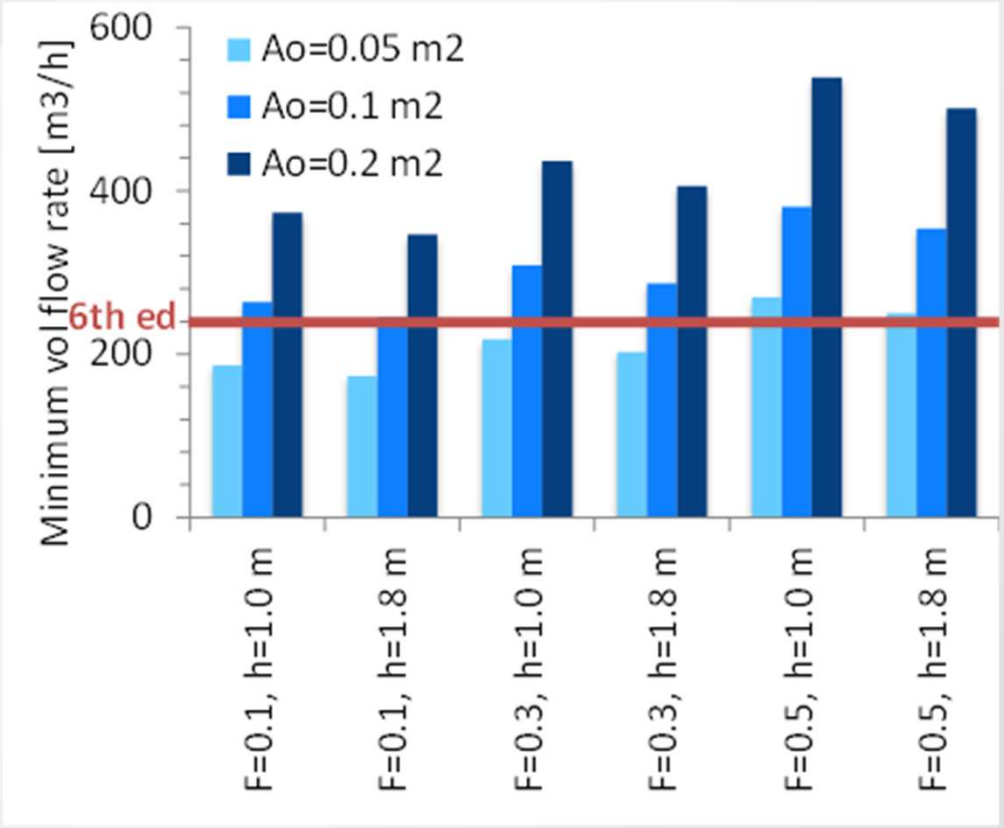
Enhanced tightness +Airflow circulation

$$m_{max} = F \times LFL \times A \times 2.2$$

F is a factor not exceeding 0.5. The value shall be the value as used in the equation for calculating Q_{min}

$$Q_{min} = 3600 \frac{5\,Y\sqrt{A_o}\dot{m}_{leak}^{3/4}}{h_o^{1/8}[LFL(1-F)]^{5/8}}$$

$$\dot{m}_{leak} = \left(\frac{167}{432}\right)\dot{M}_s \qquad \dot{M}_s = 0,61\sqrt{k\rho_o(p_o - p_{atm})\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$$



Example comparison of minimum airflow rates for R290 according to 6th edition of IEC 60335-2-40 and the present CD for Enhanced Tightness Refrigeration System (ETRS) with incorporated circulation airflow

Charge mass

Releasable charge

The **releasable charge** m_{rl} shall be determined in each **operating state**

Operating mode	Shut-down valves	Sensing method	Mitigation action	Leak hole (mm)	Leak mass (kg)	Leak (% of charge)	Time to p→ ~0 bar (mins)
Off	Open	None	None	1.0	0.67	74%	10
				1.6	0.75	83%	5½
On	Open	None	None	1.0	0.66	73%	13½
				2.5	0.76	84%	3½
Off	Closed	None	None	1	0.25	28%	3
				2.5	0.21	23%	1
On	Open	IDU Conc	Close valve(s)	1	0.12	13%	2
				1.6	0.13	14%	1
				2.5	0.12	13%	½

	Indoor T （℃）	Outdoor T （℃）	Compressor	Fan
Standby	27	35	off	on
	27	35	off	off
Cooling	Highest	Highest	Highest speed	Highest speed
Heating	Highest	Highest	Highest speed	Highest speed

Leak detection

the fan incorporated to an appliance is continuously operated or operation is initiated by a **leak detection system**

- Be activated before the refrigerant concentration reaches 25% of the LFL
- Response time<20 seconds (20%-25%LFL)
- Directly to the refrigerant or a representative surrogate gas
- Confirmation tests

  — *Leak rate (vapor) : $m_r = 7.6 \times h_0 \times LFL$ (low)* $m_r = \frac{1000}{240} m_c$ *(high)*

  — *be simulated at the most unfavourable potential leak point*

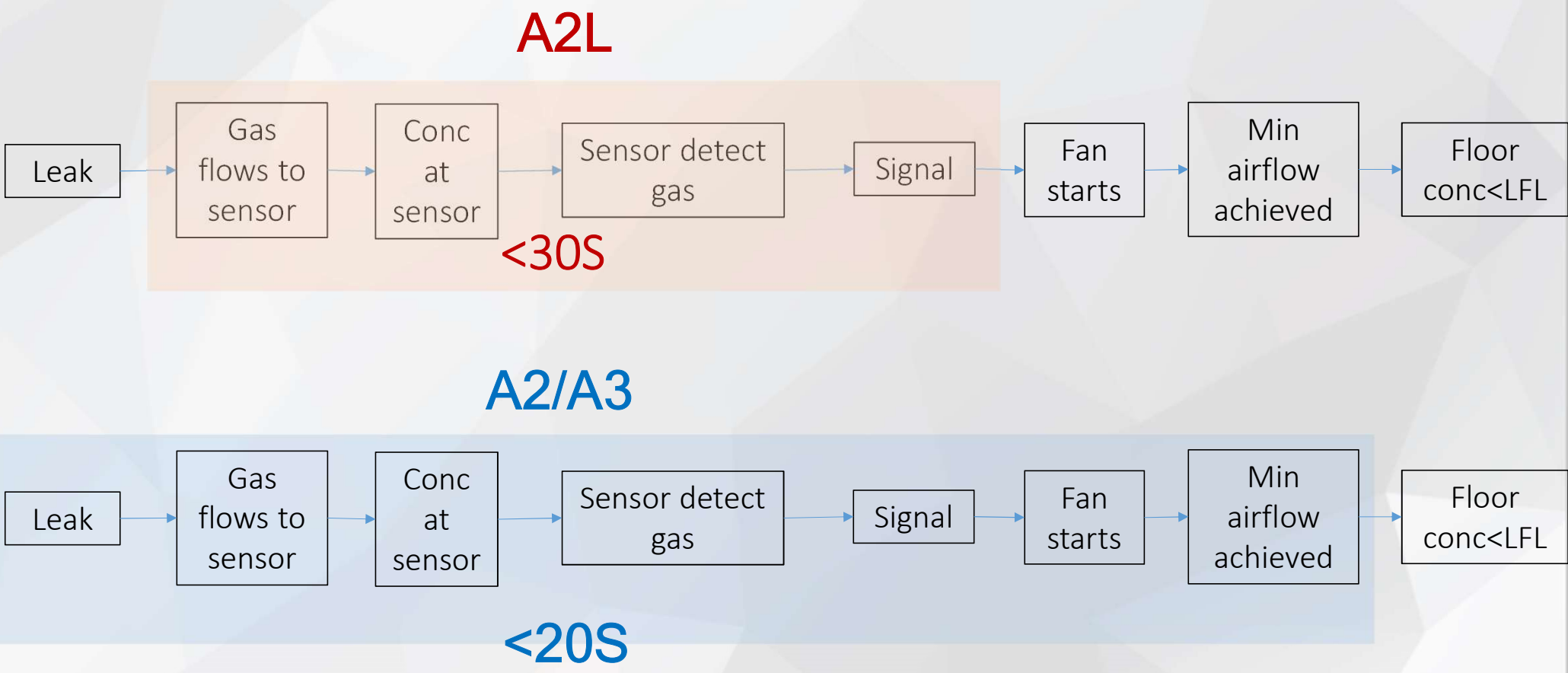
  — *the pressure at the inlet to release orifice is not less than 300 kPa (gauge)*

  — Room area $A_t \geq \frac{2{,}4 \times m_r}{LFL \times h_t}$

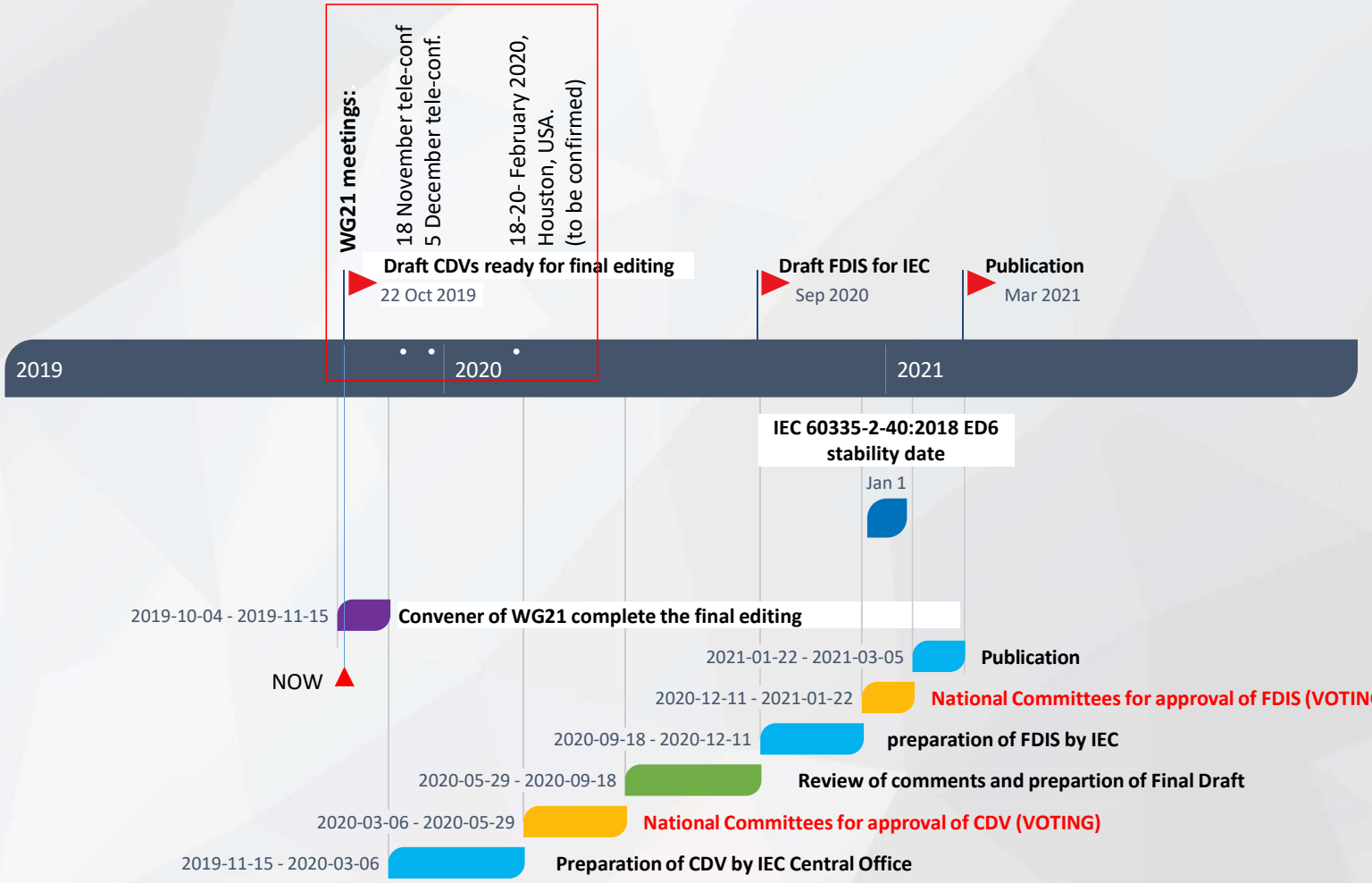
Sensor

- IEC 60079-29-1 shall be applied
- Might ot considered ignition sources
- Not depend on the location
- with a tolerance of ±15%
- Be selective for environments where non-refrigerant gases are present
- Self-testing
- Be accessible for inspection and replacement

Sensor location



Plan



WG21 did not reach concensus on the meeting in Shanghai

Telephone conference calls planned

THANK FOR YOUR ATTENTION