



# New A2L refrigerants: the balanced approach

*Good practice*  
**GUIDE**

**climalife<sup>®</sup>**



## Context



**Under European legislation, very low-GWP fluids must be used for certain applications, both now and in the future.**

In order to meet these requirements, producers have thought ahead and developed new HFO molecules that achieve a global warming potential of less than 1. In general, lower GWP comes with flammability.

A compromise therefore had to be found between flammability and GWP in order to meet professionals' needs as effectively as possible and provide solutions that are both environmentally acceptable and efficient.

***The new A2L (mildly flammable) fluids can be used in many applications and various different processes similar to HFCs and HCFCs but at the same time need to comply with current legislation and flammability precautions (in accordance with building code standards and requirements).***

### A2L classification: safety and flammability

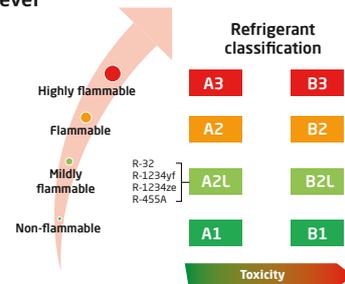
The safety classification of refrigerants is determined by the international standard ISO 817 and adopted by American standard ASHRAE 34 according to their toxicity and flammability.

#### The letter indicates the level of toxicity:

**A** = Refrigerant with lower toxicity  
**B** = Refrigerant with higher toxicity

#### The number indicates the flammability level:

**1** = Non-flammable  
**2L** = Mildly flammable  
**2** = Flammable  
**3** = Highly Flammable



#### Main parameters that characterise the degree of flammability of a refrigerant fluid:

- the lower flammability limit (LFL) and upper flammability limit (UFL)
- burning velocity (BV)
- minimum ignition energy (MIE)
- heat of combustion (HOC)



## Applicable standards for equipment safety



Refrigeration and air conditioning equipment is designed according to the product safety standards (eg EN 60335-2-24 standard for domestic refrigeration). If the A2L classification is not yet included in this standard, the reference to be taken into account is the group safety standard. The reference in use today is European standard EN378: 2016. This does not apply to systems designed before the date on which it came into force. It does, however, apply to extensions or alterations carried out on systems after its publication, or in the event of systems being transferred and then used on a different site. It is also permitted to use a risk assessment in the EU by working with organisations certified for this purpose.

Applications	Product safety norm	Norm EN 378	Refrigerants	GWP*	LFL kg/m <sup>3</sup> **	LFL %**	ELV***	PED
Commercial / Industrial Refrigeration	EN 60335-2-89	x	R-455A (Solstice® L40X)	146	0.431	11.8	0.414	Group 1
			R-454A (Opteon™ XL40)	239	0.278	8	0.461	Group 1
			R-454C (Opteon™ XL20)	146	0.293	7.7	0.371	Group 1
			R-1234ze (Solstice® ze)	< 1	0.303 <sup>(2)</sup>	6.5 <sup>(2)</sup>	0.28	Group 2
Domestic refrigeration	EN 60335-2-24	x	R-1234yf (Solstice® yf)	< 1	0.289	6.2	0.47	Group 1
Chillers	EN 60335-2-40	x	R-1234ze (Solstice® ze)	< 1	0.303 <sup>(2)</sup>	6.5 <sup>(2)</sup>	0.28	Group 2
Air Conditioning	EN 60335-2-40	x	R-32	677	0.307	12.7	0.3	Group 1
			R-452B (Solstice® L41y / Opteon™ XL55)	675	0.31	11.9	0.467	Group 1
			R-454B (Opteon™ XL41)	466	0.278	11.7	0.435	Group 1
			R-1234yf (Solstice® yf)	< 1	0.289	6.2	0.47	Group 1
			R-1234ze (Solstice® ze)	< 1	0.303 <sup>(2)</sup>	6.5 <sup>(2)</sup>	0.28	Group 2
Heat Pumps	EN 60335-2-40	x	R-452B (Solstice® L41y / Opteon™ XL55)	675	0.31	11.9	0.467	Group 1
			R-454B (Opteon™ XL41)	466	0.278	11.7	0.435	Group 1
			R-455A (Solstice® L40X)	146	0.431	11.8	0.414	Group 1
Car Air Conditioning	ISO 13043[1]		R-1234yf (Solstice® yf)	< 1	0.289	6.2	0.47	Group 1

\*IPPC5 - \*\*LFL = Lower flammability limit - \*\*\* ELV = Exposure Limit Value (ATEL/ODL)

(1) ISO 13043 only covers refrigerants R-134a, R-744 and R-1234yf, all others are outside of its scope. ISO 5149 1 and ISO 5149 2, specifically exclude mobile air conditioning (MAC).

(2) Non-flammable < 30°C.



# Charges of A2L fluids allowed

in refrigeration and air conditioning applications



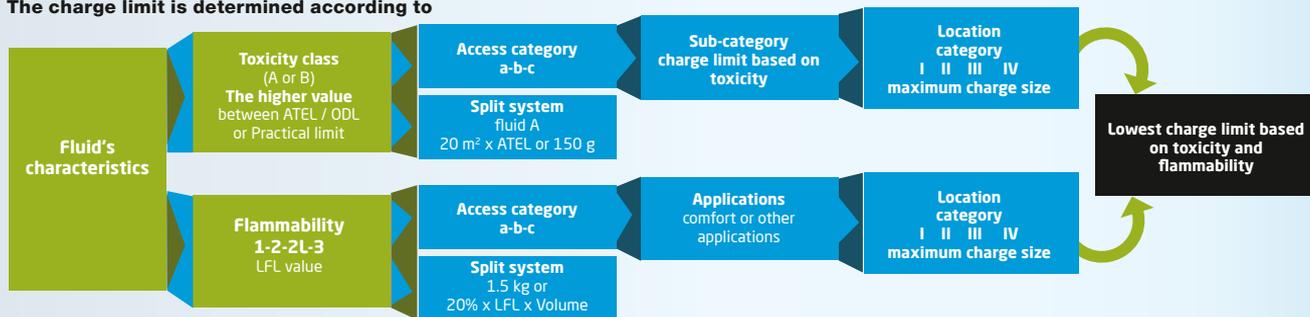
## Calculation method

As per EN378-1 - Annexe C - Requirements for maximum refrigerant charge limits

### Drawer calculation method:

Several levels of calculation are possible - The higher the value for the two risks (toxicity/flammability) should be selected - Then the lower of the two values will determine the maximum charge

The charge limit is determined according to



Fluid charges allowed in refrigeration and air-conditioning equipment are governed by International and European standards, as well as local regulations.

The EN 378 standard can be used to calculate an installation's maximum charge, taking three criteria into consideration: the characteristics of the refrigerant selected, access category and equipment location.



# Charges of A2L fluids allowed

in refrigeration and air conditioning applications



## Examples of how charges are calculated depending on the application according to the EN378 standard

Split system in a 150 m<sup>3</sup> building open to the general public (categories a and I)

Fluid	Limit affected	Charge in kg
R-290 (A3)	Flammability	0.15
R-455A (A2L)	Flammability	2.59
R-1234ze (A2L)	Flammability	1.81
R-448A (A1)	Toxicity	7.76

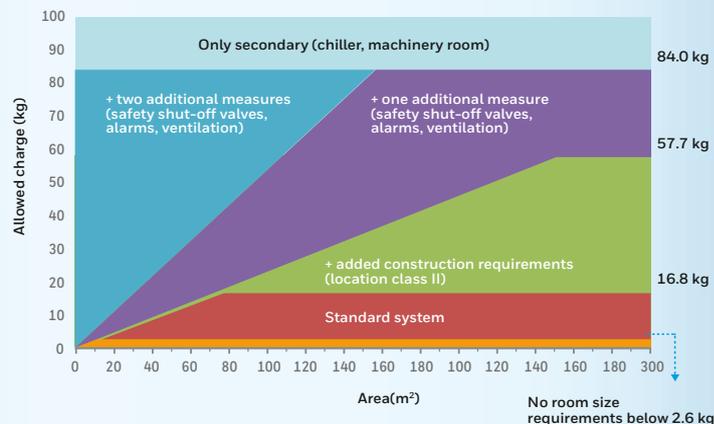
For a comfort installation installed on a wall, located in a 50 m<sup>3</sup> space for 20 m<sup>2</sup>, used for beds (categories a and I)

Fluid	Limit affected	Charge in kg
R-290 (A3)	Flammability	0.34
R-455A (A2L)	Flammability	12.9 or 84 with 2 security measures
R-32 (A2L)	Flammability	4.6 or 59.9 with 2 security measures
R-452B (A2L)	Flammability	4.66 or 60.5 with 2 security measures
R-410A (A1)	Toxicity	22 or without restriction if 2 security measures

If stricter local regulations exist, they take precedence over EN 378.

## Comparison of alternatives and charge size limitations

Under ISO 5149 and EN 378 standards, the maximum charge size of refrigerant is calculated based on the location of the system, the type of occupancy and the safety class of the refrigerant. When using Solstice® L40X (R-455A) in a public space, and taking into account the minimum dimensions of the room, higher refrigerant charges can be used, as shown in the graph below.





## Use of A2L refrigerants in refrigeration and air conditioning equipment



A2L refrigerants must only be used with **new purpose-built equipment** or **with** systems specially designed to operate with these products.

Under no circumstances should a system operating with a non-flammable fluid be retrofitted to run on a flammable fluid without carrying out studies or preliminary

reclassification and authorisation in order to ensure continued compliance with current regulations.

- ***The generic system safety standard EN378: 2016 and safety standards for devices such as EN60335-2-40, EN60335-2-89 provide recommendations to ensure, for example, that the refrigerant charge size in a specific area do not exceed the maximum permitted limits.***



**Conversion of existing equipment** designed for non-flammable refrigerants to flammable refrigerants may result in the loss of the CE marking.



**Proper training and qualification is essential**, if not mandatory, for the safe handling of refrigerants. The EN13313 standard on «Refrigeration systems and heat pumps – Competence of Personnel» provides useful guidance on the competence levels required for all types of refrigerants.



**Installers or users of refrigeration and air conditioning** systems must follow manufacturers' installation and operating instructions. They must also ensure compliance with local standards and legislation.



**An installer or user who modifies the equipment**, or assembles his own equipment, becomes a «manufacturer» and will therefore be responsible for the safety of this equipment.



## Use of A2L refrigerants



### PACKAGING OF A2L FLUIDS

- Recognisable by the red shoulder.
- Red label with the flame.
- Test pressure engraved on the packaging.
- Valve connection with left hand thread.



### RECOVERY BOTTLES

- The recovery of A2L fluids is mandatory from a regulatory requirement and must be carried out in packaging specific to flammable fluids labelled and identified in accordance with the regulations.



### SPECIFIC EQUIPMENT SUITABLE FOR LOW FLAMMABILITY FLUIDS A2L

- Recovery machine.
- Vacuum pump (backflow protection by means of an isolating solenoid valve in the event of a power failure - switch isolated or remote from the discharge zone).
- Leak detector and room controller.
- Manifold and standard hoses: pressure gauges and hoses suitable for the fluid pressure.



### TRANSPORT AND STORAGE (MSDS - SECTION)

- Safety and implementation: comply with the safety instructions for use, transport and storage of refrigerants.



## Safety precautions



• Consult the Safety Data Sheet. All appropriate risk safety measures must be taken. For any handling or exposure to the product, personal protection recommended by the safety data sheet must be worn.

• The usual precautions for use must be observed and it is absolutely forbidden to weld, solder, cut, grind, or look for a possible leak with an open flame on a circuit containing refrigerant. The use of electric arcs or any other source of power ignition is prohibited.

• As the vapour of the refrigerant is heavier than air, it is necessary to ventilate the work areas by creating air movement along the floor of premises and not to use this refrigerant in the basement or cellar without taking the necessary precautions.

• Do not use the ventilation ducts to exhaust vapours.

• When using a refrigerant, it is important to conduct and document a risk assessment, ensuring that all risks are understood and that precautions are in place to prevent such risks from occurring.

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