

TECHNICAL FILE

EU F-Gas Regulation and Standard EN378: Refrigeration System Changes Starting January 2022

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PREAMBLE ON THE REGULATORY CONTEXT

Changes for refrigeration

With the 2014 implementation of the EU F-Gas Regulation and its upcoming revision, the commercial refrigeration market is changing. These changes will affect the environmental impact of the industry in terms of products, training of installers and work habits. In this context it is important to be aware of the regulatory implications and to ask the appropriate questions in order to choose a refrigeration solution that is sustainable and will not be at risk of being limited in the future. Among the solutions offered by PROFROID, systems using (CO₂) as a refrigerant, offer the best balance of total life cycle cost, cooling performance, energy recovery, environmental impact and regulatory compliance.

As a pioneer in sustainable refrigeration systems, PROFROID can support its customers and consultants, whether it is for the identification of a technical solution adapted to the need, training of the installation teams, commissioning and system troubleshooting.

The global warming potential of refrigerants, called GWP

It has long been recognized that synthetic refrigerants used in refrigeration, such as hydrofluorocarbon (HFC) gases R134a, R404A, R449A, can have significant environmental impacts. As far as their direct greenhouse gas emissions are considered, these impacts are measured and classified by its global warming potential, called GWP.

The global warming potential of a greenhouse gas is calculated in relation to that of CO_2 over a period of 100 years, as established in Annexes I and II of Regulation (EU) No 517/2014 of 16 April 2014, called the EU F-Gas Regulation. The higher the GWP, the more likely the refrigerant will have an impact on global warming and the greenhouse effect. It is therefore essential to limit it.

Thus, natural refrigerants such as CO_2 (R744), ammonia NH3 (R717) or propane (R290), and synthetic HFO refrigerants with low GWP classified A2L, constitute alternatives with good thermodynamic properties and reduced ecological impact, as shown below.

	Non flammable				N nor	loder 1-flan	ately nmat	/ ole		Flammable				Highly flammable							
Low toxicity	A1				A2L*				A2					A3							
High toxicity	B1				B2L B2				B3												
	1		_	1																	
Fluids	R507A	R404A	R452A	R407A	R410A	R407F	R407C	R134A	R449A	R448A	R32	R513A	R450A	R454C	R455A	R152a	1234ze	1234YF	R 290 (propane)	R744 (C0 ₂)	R717 (NH ₃)
GWP	3985	3922	2141	2107	2088	1825	1744	1430	1397	1273	675	631	600	148	145	124	6	4	3	1	0
Security class	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A2L*	A1	A1	A2L*	A2L*	A2	A2L*	A2L*	A2	A1	B2

GWP, toxicity and flammability of refrigerants

The Montreal Protocol, the Kigali Amendment and the EU F-Gas Regulation

In addition to the Montreal Protocol (1987) for the protection of the ozone layer which has already worked for the prohibition of chlorofluorocarbons (CFCs) and the phase-out of hydrochlorofluorocarbons (HCFC), Regulation (EU) No 517/2014, called the EU F-Gas Regulation, supplemented by decree No 2015-1790 of 28 December 2015, defines a roadmap for substantially reducing the use of fluorinated greenhouse gases by 2030 for the whole European Union.

This EU F-Gas Regulation addresses in particular HFC-type gases with a high GWP, with a reduction of import quotas by 79% by 2030 and a probationary period for maintenance and upkeeping existing facilities.

Chronology of quotas for placing HFCs on the market, expressed in CO_2 equivalents of HFCs compared to 2015:



PROVISIONS OF THE EU F-GAS REGULATION IN 2022

The new provisions of the EU F-Gas Regulation in January 2022



After a GWP limit set in 2020 at 2,500 for stationary refrigeration systems, thereby prohibiting the use of HFC R404A, a second GWP limit of 150 will take effect in January 2022 for commercial refrigeration systems with capacity greater than or equal to 40kW as indicated below.

Extract from Annex III of the F-GAS for application in 2022

13.Multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 150 or more, except in the primary refrigerant circuit of cascade systems where fluorinated greenhouse gases with a GWP of less than 1 500 may be used

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The only exception allows CO_2 / R134a cascading systems with an indirect high temperature circuit, which can be used with a GWP limited to 1,500 for the primary circuit of this medium temperature circuit containing HFC (R134a still authorized in this case), as well as water loop circuits of the type "chiller" using refrigerants with a maximum GWP of 2,500 (R134a or R1234ze as examples).

Prohibited and recommended systems in January 2022

The table below summarizes the GWP limits by system type and cooling capacity; and prohibited and recommended systems as of January 2022.

System type and cooling capacity	Direct expansion (DX) < 40kW	Direct expansion (DX) ≥ 40kW	Cascade systems CO ₂ / HFC	Indirect expansion with water loop		
GWP limit authorized by EU F-Gas Regulation	GWP < 2500 (since 2020)	GWP < 150 (since 2022)	GWP < 1500 on primary circuit (since 2022)	GWP < 2500 (since 2020)		
Prohibited refrigeration systems for commercial use in 2022	Condensing units using R404A	Systems using HFC A1 or A2L with GWP > 150	Cascade systems using HFC R449A for the primary circuit	Systems using HFC R449A not prohibited		
Recommended refrigeration systems in 2022	CO₂ condensing units Condensing units with HFC 134a or HFO	CO₂ compressor racks HFO water loops	Cascade systems CO ₂ / HFC 134a or HFO	CO2 water loops HFO water loops		

European standard EN 378 and its requirements for HFOs

Like the EU F-Gas Regulation in 2014, the European standard EN 378 relating to refrigeration systems and heat pumps was revised in 2017 and provides rules and recommendations concerning the design, installation, operation and maintenance of these systems. It emphasizes the flammability classes of refrigerants with the addition of a 2L classification to define mildly flammable refrigerants such as low GWP HFOs.

EN 378 indicates that in the case of a direct expansion HFO refrigeration system located in a store, restaurant or cold room and considered as buildings open to the public, a load limit ranging from 56 kg to approximately 84kg should be calculated depending on the type of refrigerant and the volume of the room in which the refrigeration system is installed. The calculation rules (QLMV, QLAV) are described in section EN 378-1 C.3, in addition to the safety measures to be implemented. Thus, only condensing units with a low charge of HFO refrigerant, equivalent to our Quietis and Quietor ranges are authorized for use in this case.

The standard also indicates that if the system is located outdoors and has indirect expansion with a water loop, then safety measures apply according to \$4.2 of EN 378-3, with no charge limit for HFOs. On the other hand, if the system is located in a building that is restricted to less than one person per 10 m² of surface, such as a cold room without preparation or a cold store, then there is no charge limit for HFOs.

Limitations imposed by the European standard EN 378 concerning HFOs

Refrigerant location	Capacity and GWP limitation by the F-GAS	Charge limit per application according to EN378 (flammability)
	Capacity < 40 kW	Small stores <400m², restaurants, cold rooms –>HFCs allowed –>HFOs with charge limit of 56 84kg depending on the refrigerants
Direct expansion	Capacity ≥ 40 kW GWP < 150	Discount stores, supermarkets, hypermarkets > 400m ² ->HFC prohibited in systems for commercial use ->HFOs with charge limit of 56 84kg depending on the refrigerants
Indirect expansion / water loop	All capacities GWP < 2,500	Supermarkets, warehouses ->No charge limitation for HFCs or HFOs

Direct expansion <40kW: Starting in January 2022, the installation of transcritical condensing units using CO₂ such as the QuietCO₂OL ranges up to 9.1kW MT and QuietCO₂OL MC Multi-Compressors up to 49.5kW MT with a GWP of 1, is recommended. It is also always possible to commission HFC R448A / R449A / R134a or HFO A2L condensing units such as Quietis up to 18kW MT and Quietor up to 46kW. **Direct expansion** \ge 40kW: for higher power applications, the installation of transcritical CO₂ plants whether in a machine room or outdoors, of the MiniCO₂OL type up to 380kW, MaxiCO₂OL up to 550kW or PowerCO₂OL up to 1.5MW, is recommended. On the other hand, a water loop system running on HFO R1234ze with a refrigerant tank located outside is an alternative.

CO₂ / HFC cascade system: As an exception to the EU F-Gas Regulation indicated in Annex III, indirect cascade systems using CO₂ for low temperature and HFC R134a for the primary circuit of the medium temperature circuit can still be installed. See our CombiCO₂OL or FlexiCO₂OL range.

Indirect expansion with water loop: from 2020 and without change from 2022, systems using CO_2 , HFC (GWP <2500) or HFO R1234ze in "chiller" mode will still be authorized. It is strongly recommended to install the HFO chillers outdoors for safety reasons and in particular when it is an ERP.

PROFROID SOLUTIONS

PROFROID refrigeration solutions compliant with EU F-Gas Regulation

		0 10	30	70	150	300	600	1200	2000	kW BT/MT	
	QuietCO₂OL™										
CO₂ racks and condensing units	QuietCO₂OL [™] MC		l i								
	MiniCO ₂ OL [®]	<i></i>								l	
	MaxiCO ₂ OL®										8
	MiniCO2OL® & MaxiCO2OL® with ejectors COOLtecEvo										1
	PowerCO₂OL [®] with ejectors COOLtecEvo			1			//////				-1999
	CombiCO₂OL [®]				ð						
Hybrid CU2/HFC	FlexiCO20L®	<i></i>									
HFC Condensing units	Quietis®										
	Quietor®		////								
HF0 Chiller	Chiller										
CO₂ Chiller	PowerCO₂OL									THE	
	Soprano [®] CO₂ (centrifuge)										
	Soprano [®] CO ₂					Ň					
Gas coolers CO₂	Alto™ CO₂							-	ł		
	Tenor® CO₂ (centrifuge)										
	Tenor® CO₂							4	P		_
CO₂ Air Coolers	SOLO™ CO₂ single discharge			/////		•		00			
	DUO™ CO₂ dual discharge			1							
HFC Air Coolers	SOLO™ CO₂ single discharge			/////,	60	•					
	SOLO™ CO₂ dual discharge										

Réfrigerant:								
LT	MT							
/////.		CO ₂						
/////		CO ₂ /HFC						
/////		HFC/HFO						

PROFROID's support in this transition

Created 60 years ago with a production and technological excellence center in Aubagne, France, PROFROID has continuously developed and established itself as one of the leading European manufacturers of refrigeration units and heat exchangers for the large food distribution markets and logistics sites.

The company has adapted to address market expectations and environmental requirements by making strategic shifts such as the development of systems operating with natural refrigerant CO_2 in 2008 ranging from small surfaces to industrial applications, innovative technologies improving the energy efficiency ($CO_2OLtec EVO^{\circ}$), dissipated heat recovery and systems for improving operation in the hottest climates (modulating ejectors associated with a CO_2 pump).



Providing refrigeration solutions for all applications:



With its DNA based on recognized technological and technical expertise in natural refrigerants, customer support and its team of experts passionate about refrigeration, PROFROID offers many services to support its partners in this transition from HFCs to alternative solutions: Programme de formation en présentiel ou à distance sur les installations CO_2 ,

- Face-to-face or remote training program on CO₂ installations
- Complete training center in Germany with working systems (CO₂OL Academy)
- Regular online webinars with technology reminders and tips
- Free commissioning assistance for the first transcritical CO₂ installation
- Advice and clarifications provided by a centralized team of competent engineers
- Field support by experienced salespeople and field technicians

Training your teams is now the key to a successful transition to CO_2 . Our support and your willingness to seize these new opportunities will bring you many advantages in the long term: Différenciation par rapport aux acteurs qui ne voudront pas changer leurs habitudes,

- Differentiation from actors who will not want to change their habits
- Opening up to new segments such as supermarkets for which CO_2 is deeply rooted in habits
- Durability of 12 to 15 years of CO_2 compressors which do not require regular maintenance
- CO2 is, and will remain, a coolant that is inexpensive to purchase and not taxed, which is a real benefit for the user
- CO₂ is non-flammable, non-toxic and non-explosive. The risks associated with high pressure are well controlled by the proven design of the systems
- Compared to other refrigerants, CO₂ systems are relatively inexpensive to operate and maintain
- CO₂ offers very high heat recovery performance
- Up to 30% energy savings with modulating ejector systems (CO₂OLtec[®] EVO) compared to a traditional transcritical CO₂ system
- A very rapid return on investment less than 2.5 years has been observed on site, of course depending on the capacity and the type of climate

Become a player in the development and use of natural refrigerants too. Let us all contribute to safeguarding our natural resources daily.

If you would like to get in touch with one of our experts, contact us at https://www.profroid.com/en/contact-us/contact-form/ or phone +334 42 18 05 00.



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