F-Gas European Regulation n° 517/2014

GeneralGas

KRYON Gas Refrigeranti

Chart showing actual products and new Low GWP Substitutes (HFO based)

(with GWP value, regulatory compliance, time limit for use, type of system and application)

Regulatory Compliance (F-GAS 517/2014) and time limits for use

APPLICATION	SYSTEM	ACTUAL / FUTURE	PRODUCT NAME	GWP (IPCC rev.4)	ASHRAE Classification	ASHRAE Flammability class	SERVICE 2015 > 19	SERVICE 2020 and beyond	NEW SYSTEMS 2015 > 19	NEW SYSTEMS 2020 > 21	NEW SYSTEMS 2022 > 24	NEW SYSTEMS 2025 and beyond	NEW SYSTEMS / RETROFIT	CAPACITY	EFFICI-ENCY	COMPRES-SOR	REMARKS
CHILLERS AND HEAT PUMPS	Medium/High pressure chillers	Baseline	Kryon® 134a	1.430	R134a	A1	✔	✔	✔	✔	✔	✔	—	—	—	Screw, Centrifugal	—
		New products	Solstice® N13	604	R450A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	14% lower	3% lower	Screw, Centrifugal	Better at higher ambient temperature
			Opteon® XP10	631	R513	A1	✔	✔	✔	✔	✔	✔	New	4% higher	2% lower	Screw, Centrifugal	OK for flooded evaporators
			Solstice® ze	6	R1234ze	A2L	✔	✔	✔	✔	✔	✔	New	20% lower	5% higher	Screw, Centrifugal	Better at higher ambient temperature
		Baseline	Kryon® 410A	2.088	R410A	A1	✔	✔	✔	✔	✔	✔	—	—	—	Rotary, Scroll	—
		New product	Solstice® L41y	698	R452B	A2L	✔	✔	✔	✔	✔	✔	New	7-10% lower	1-5% higher	Reciprocating, rotary, scroll	Works well at higher ambient temperature, lower pressure fluid
	Low pressure chillers	Baseline	R123	77	R123	A1	✘	✘	✘	✘	✘	✘	—	—	—	Centrifugal	—
		New product	Solstice® zd	5	R1233zd	A1	✔	✔	✔	✔	✔	✔	New	40-45% higher	equivalent	Centrifugal	Higher capacity range
	High temperature heat pumps	Baseline	Boilers, fossil fuels (LPG/methane), electrical heaters														
		New product	Solstice® zd	5	R1233zd	A1	✔	✔	✔	✔	✔	✔	New	—	—	Screw	
COMMERCIAL AND INDUSTRIAL REFRIGERATION — MT	DX (direct expansion) Multipack refrigeration systems with capacity <40KW	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	✘	(✔)	✘	✘	✘	—	—	—	Reciprocating, scroll, screw	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		New products	Performax® LT	1.824	R407F	A1	✔	✔	✔	✔	✔	✔	Retrofit	6% higher	12-14% higher	Reciprocating, scroll, screw	Discharge temperature ok (95-100°C)
			Solstice® N40	1.387	R448A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	4% higher	12-14% higher	Reciprocating, scroll, screw	No need to change TXV, discharge temperature ± 90°C
			Opteon® XP40	1.397	R449A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	3% higher	12-14% higher	Reciprocating, scroll, screw	No need to change TXV, discharge temperature ± 90°C
			Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✔	✔	Retrofit	4% lower	1% higher	Reciprocating, scroll	No need to change TXV, discharge temperature ± 80°C
	DX (direct expansion) Multipack refrigeration systems with capacity >40KW	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	✘	(✔)	✘	✘	✘	—	—	—	Reciprocating, scroll, screw	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		New products	Performax® LT	1.824	R407F	A1	✔	✔	✔	✔	✘	✘	Retrofit	6% higher	12-14% higher	Reciprocating, scroll, screw	Discharge temperature ok (95-100°C)
			Solstice® N40	1.387	R448A	A1	✔	✔	✔	✔	✘	✘	New / Retrofit	4% higher	12-14% higher	Reciprocating, scroll, screw	No need to change TXV, discharge temperature ± 90°C
			Opteon® XP40	1.397	R449A	A1	✔	✔	✔	✔	✘	✘	New / Retrofit	3% higher	12-14% higher	Reciprocating, scroll, screw	No need to change TXV, discharge temperature ± 90°C
			Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✘	✘	Retrofit	4% lower	1% higher	Reciprocating, scroll	No need to change TXV, discharge temperature ± 80°C
COMMERCIAL AND INDUSTRIAL REFRIGERATION — LT	DX (direct expansion) Multipack refrigeration systems with capacity <40KW	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	✘	(✔)	✘	✘	✘	—	—	—	Reciprocating, scroll, screw	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		New products	Performax® LT	1.824	R407F	A1	✔	✔	✔	✔	✔	✔	Retrofit	10% lower	1% higher	Reciprocating, scroll, screw	Compressor discharge temp ± 140-145°C. Liquid injection required, compressor head ventilation required.
			Solstice® N40	1.387	R448A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	equivalent	20% higher	Reciprocating, scroll, screw	No need to change TXV, compressor dischargetemp 125-128°C. Compressor head ventilation required.
			Opteon® XP40	1.397	R449A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	equivalent	18% higher	Reciprocating, scroll, screw	No need to change TXV, compressor dischargetemp 125-128°C. Compressor head ventilation required.
			Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✔	✔	Retrofit	10% lower	1% higher	Reciprocating, scroll	No systems modifications required, no need to change TXV.
	DX (direct expansion) Multipack refrigeration systems with capacity >40KW	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	✘	(✔)	✘	✘	✘	—	—	—	Reciprocating, scroll, screw	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		New products	Performax® LT	1.824	R407F	A1	✔	✔	✔	✔	✘	✘	Retrofit	10% lower	1% higher	Reciprocating, scroll, screw	Compressor discharge temp ± 140-145°C. Liquid injection required, compressor head ventilation required.
			Solstice® N40	1.387	R448A	A1	✔	✔	✔	✔	✘	✘	New / Retrofit	equivalent	20% higher	Reciprocating, scroll, screw	No need to change TXV, compressor dischargetemp 125-128°C. Compressor head ventilation required.
			Opteon® XP40	1.397	R449A	A1	✔	✔	✔	✔	✘	✘	New / Retrofit	equivalent	18% higher	Reciprocating, scroll, screw	No need to change TXV, compressor dischargetemp 125-128°C. Compressor head ventilation required.
			Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✘	✘	New / Retrofit	10% lower	1% higher	Reciprocating, scroll	No systems modifications required, no need to change TXV.
	Transcritical CO_2	New technology	CO_2	1	R744	A1	✔	✔	✔	✔	✔	✔	New				
	DX (direct expansion) MT - Medium Temperature CO_2 cascade systems	Baseline	Kryon® 134A	1.430	R134a	A1	✔	✔	✔	✔	✔	✔	—	—	—	Reciprocating, screw	—
		New products	Solstice® N13	604	R450A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	14% lower	3% lower	Reciprocating, screw	Better at higher ambient temperature
			Opteon® XP10	631	R513A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	4% higher	2% lower	Reciprocating, screw	OK for flooded evaporators
			Solstice® ze	6	R1234ze	A2L	✔	✔	✔	✔	✔	✔	New	20% lower	5% higher	Reciprocating, screw	Installation outdoor / atex
MT	Plug-in's (eg. refrigerated cabinets)	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	✘	(✔)	✘	✘	✘	—	—	—	Reciprocating, rotary, scroll	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		Retrofit R404A	Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✘	✘	Retrofit	10% lower	1% higher	Reciprocating, Scroll	No systems modifications required.
			Solstice® N40	1.387	R448A	A1	✔	✔	✔	✔	✘	✘	New / Retrofit	4% lower	12-14% higher	Reciprocating, Scroll, Screw	Suction piping insulation required.
		New technology	Kryon® 290	3	R290 (propano)	A3	✔	✔	✔	✔	✔	✔	New	10% lower	12% higher	Reciprocating, rotary, scroll	Highly flammable (A3 classification). Charge limited to 150 grams.
		New Products	Solstice® L40X	146	R455A	A2L	✔	✔	✔	✔	✔	✔	New	4% lower	3-6% higher	Reciprocating, rotary, scroll	New systems
LT	Plug-in's (eg. refrigerated cabinets)	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	✘	(✔)	✘	✘	✘	—	—	—	Reciprocating, rotary, scroll	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		Retrofit R404A	Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✘	✘	Retrofit	10% lower	1% higher	Reciprocating, Scroll	No systems modifications required.
		New technology	Kryon® 290	3	R290 (propano)	A3	✔	✔	✔	✔	✔	✔	New	10% lower	12% higher	Reciprocating, rotary, scroll	Highly flammable (A3 classification). Charge limited to 150 grams.
		New Products	Solstice® L40X	146	R455A	A2L	✔	✔	✔	✔	✔	✔	New	4% lower	3-6% higher	Reciprocating, rotary, scroll	New systems
REFRIGERATED TRANSPORTS	DX (direct expansion)	Baseline	Kryon® 404A Kryon® 507	3.922 3.985	R404A R507	A1	(✔)	(✔)	(✔)	(✔)	(✔)	(✔)	—	—	—	Reciprocating	Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
		New products	Opteon® XP44	2.141	R452A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	10% lower	1% higher	Reciprocating	Discharge temperature same as R404A
			Solstice® N40	1.387	R448A	A1	✔	✔	✔	✔	✔	✔	New / Retrofit	Equivalent	1-4% higher	Reciprocating	Higher discharge temperature in LT appl's
MOBILE AIR CONDITIONING		Baseline	Kryon® 134A	1.430	R134A	A1	✔	✔	✘ since 1/1/2017	✘	✘	✘					Already banned on new car models; banned on all new vehicles from 1/1/17
		New product	Solstice® YF	4	R1234yf	A2L	✔	✔	✔	✔	✔	✔	New	Equivalent	Equivalent	—	Mildly flammable (class A2L)
RESIDENTIAL AIR CONDITIONING	Air Conditioning and Heat Pumps systems with refrigerant charge < 3 kg (monosplit, dual & trial	Baseline	Kryon® 410A	2.088	R410A	A1	✔	✔	✔	✔	✔	✘				Reciprocating, rotary	
		New products	Solstice® L41y	698	R452B	A2L	✔	✔	✔	✔	✔	✔	New	7-10% lower	1-3% higher	Reciprocating, rotary, scroll, screw	Works well at higher ambient temperature, lower pressure fluid
			Kryon® 32	675	R32	A2L	✔	✔	✔	✔	✔	✔	New	2% higher	3% lower	Reciprocating, rotary	Mildly flammable (class A2L)
		Baseline	Kryon® 407C	1.744	R407C	A1	✔	✔	✔	✔	✔	✘				Reciprocating, rotary, screw	
			R22	1.810	R22	A1	✘	✘	✘	✘	✘	✘				Reciprocating, rotary, screw	HCFC (use banned in EU)
		New product	Solstice® L20	295	R444B	A2L	✔	✔	✔	✔	✔	✔	New	vs R22: 95% vs R407C: equivalent	vs R22: 95% vs R407C: 3% higher	Reciprocating, rotary, screw	Works well at higher ambient temperature
	Air Conditioning and Heat Pumps systems with refrigerant charge > 3 kg (multisplit)	Baseline	Kryon® 410A	2.088	R410A	A1	✔	✔	✔	✔	✔	✔				Reciprocating, rotary	
		New products	Solstice® L41	698	R452B	A2L	✔	✔	✔	✔	✔	✔	New	7-10% lower	1-3% higher	Reciprocating, rotary, scroll, screw	Works well at higher ambient temperature, lower pressure fluid
			Kryon® 32	675	R32	A2L	✔	✔	✔	✔	✔	✔	New	2% higher	3% lower	Reciprocating, rotary	Mildly flammable (class A2L)
		Baseline	Kryon® 407C	1.774	R407C	A1	✔	✔	✔	✔	✔	✔				Reciprocating, rotary, screw	
			R22	1.810	R22	A1	✘	✘	✘	✘	✘	✘				Reciprocating, rotary, screw	
		New product	Solstice® L20	295	R444B	A2L	✔	✔	✔	✔	✔	✔	New	vs R22: 95% vs R407C: equivalent	vs R22: 95% vs R407C: 1-3% higher	Reciprocating, rotary, screw	Works well at higher ambient temperature
ORC (ORGANIC RANKINE CYCLE)		Baseline	Kryon® 134a	1.300	R134a	A1	✔	✔	✔	✔	✔	✔					
		New product	Solstice® ze	<1	R1234ze	A2L	✔	✔	✔	✔	✔	✔	New	20-25% lower	1-5% higher	—	Depending temperature of use Contact technical dpt.
		Baseline	R245fa	858	R245fa	B1	✔	✔	✔	✔	✔	✔					
		New product	Solstice® zd	1	R1234zd	A1	✔	✔	✔	✔	✔	✔	New	see remarks	see remarks	see remarks	Depending temperature of use Contact technical dpt.
"DROP-IN" RETROFIT BLENDS FOR SYSTEMS CHARGED WITH CFCs AND HCFCs	Drop-in R22 Commercial & Industrial Refrigeration MT and LT	Baseline	Kryon® 422D Chemours Freon® MO99	2.473 2.059	R422D R438A	A1	✔	(✔)					Retrofit				Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
	Drop.in R22 Chillers & Refrigerated Transports	Baseline	Kryon® 434A	3.065	R434A	A1	✔	✘ charge >40 ton CO_2 eq.					Retrofit				Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
	Retrofit R22 systems with flooded evaporator																
	Drop-in R12 / R401a / R409A Mobile Air Conditioning	Baseline	Chemours Freon® MO49 Plus	1.639	R437A	A1	✔	✔					Retrofit				
	Drop-in R22 Residential air Conditioning	Baseline	Chemours Freon® MO59	2.127	R417A	A1	✔	✔					Retrofit				
	Drop-in R502/R402A/R403A/R408A Commercial & Industrial LT Refrigeration Refrigerated Transports	Baseline	Chemours Freon® MO79	2.847	R422A	A1	✔	✘ charge >40 ton CO_2 eq.					Retrofit				Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
	Drop-in R-13B1 Industrial Refrigeration LLT	Baseline	Chemours Freon® MO89	3.521	N/D	A1	✔	✔					Retrofit				Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing
	Retrofit R-13 e R503 systems Industrial Refrigeration LLT (-40°C to -100 °C)	Baseline	Chemours Freon® 95	12.292	R508B	A1	✔	✔					Retrofit				Shortages forecastable due to quota mechanism (F-Gas), prices likely increasing

Important remarks:

1) following the introduction of european F-Gas regulation n° 517/2014 the leading refrigerants producers are constantly developing new low GWP solutions; for this reason, some of the latest products, already released and announced at the R&D stage, but not yet commercially available, are not listed or mentioned in this chart. It is thus likely that the range of available options, for a given application, changes in a short/middle term.

2) for some applications (specifically those in MT and LT commercial refrigeration) the market segmentation, for a given system lay out, has such a complexity level to be impossible to represent it thoroughly on a simple chart.

Therefore, the scope of this chart is to provide an overview, as accurate as possible, of the diverse technical solutions available on the date of its publication; for more details and insights we recommend our customers to sign up to the e-learning platform General Gas Academy (**www.generalgasacademy.it**), where an updated and interactive application (F-Gas guide) is provided, to guide you through the different options available for a given application and system lay-out.