FORANE®
REFRIGERANTS
BY ARKEMA

FORANE® 427A /

The low-GWP retrofit solution for R-22 installations

FORANE® 427A

The most efficient solution for the retrofit of HCFC-22 installations

- No equipment change necessary
- Similar performance to HCFC-22
- Works well with residual mineral oil or AB
- Broad range of low, medium, and high temperature applications
- Low GWP (1828)

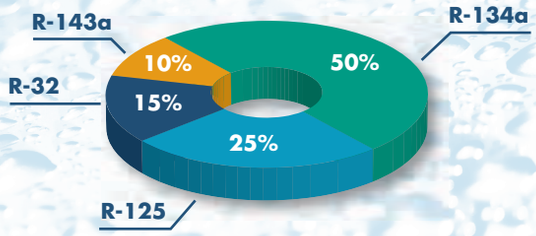
HCFC-22 has been used for decades mostly in air conditioning applications due to its excellent thermodynamic properties; however, like all HCFCs (hydrochlorofluorocarbons), R-22 is subject to the regulations of the Montreal Protocol and its subsequent amendments.
Developed countries are already reducing their consumption of HCFCs to meet their phase-out obligations under the Montreal Protocol, which call for a 90% reduction from baseline by 2015. Even the use of recycled R-22 will be totally banned in Europe after January 1, 2015.
For Article 5 countries (developing countries), the cap on HCFCs consumption will start from 2013.
In this context, the need for retrofit solutions is growing worldwide and the most cost efficient solution to keep your R-22 installations running is Forane® 427A.

A non-toxic, non-flammable and zero-ODP refrigerant, **Forane® 427A** requires just one drainage of the system's oil followed by its replacement by a POE lubricant.
Optimum performance similar to R-22 can be achieved without the need for a long and costly rinse of the circuit thanks to high tolerance to the residual original oil (mineral or alkylbenzene). No modification of the installation is required.

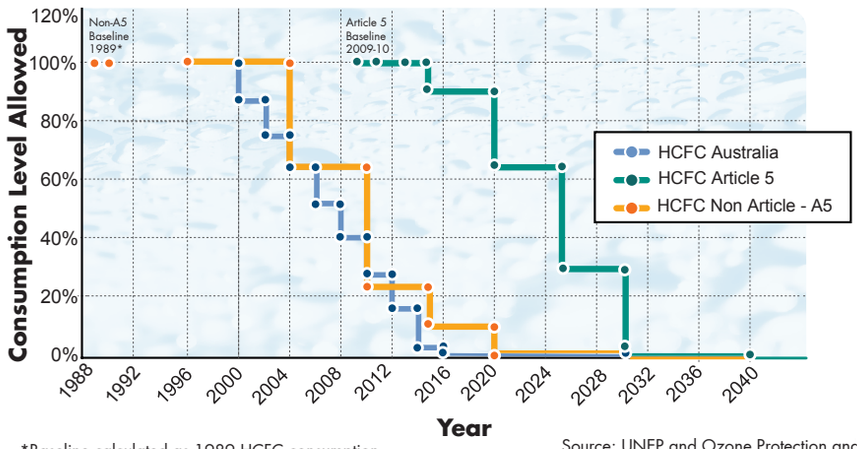
Forane® 427A is a simplified retrofit solution for existing R-22 installations in a large range of applications.

Forane® 427A can be used to retrofit low and medium temperature refrigeration equipments as well as air conditioning installations.

Composition of Forane® 427A
A 100% HFC blend



HCFCs Consumption Reduction Schedule



*Baseline calculated as 1989 HCFC consumption + 2, 8 per cent of 1989 CFC consumption

Source: UNEP and Ozone Protection and Synthetic Greenhouse Gas Management Act 1989

SAFETY

Forane® 427A refrigerant is non-toxic and non-flammable with an A1 ASHRAE safety classification.

MATERIAL COMPATIBILITY

Forane® 427A is a 100% HFC blend. It is consequently compatible with elastomers or with plastics normally compatible with R-410A, R-407C and R-404A.

LUBRICANTS

Forane® 427A is a 100% HFC blend.
It is consequently compatible with Polyolester (POE) lubricants. However one specificity of **Forane® 427A is its ability to tolerate a high residual amount of original oil in the POE lubricant** (good oil return up to 10-15% of residual AB or mineral oil) which makes for a simplified retrofit procedure. In some cases, it has been noticed that Forane® 427A has been used without changing the original oil if the system has an oil separator and reliable oil return.

RETROFIT PROCEDURE

1. Recovery of the whole R-22 charge*
2. Drainage of the original oil from the system (when necessary - see text on lubricants)
   ➜ An analysis of the original oil is recommended to ensure that the R-22 installation is in a good state of repair.
3. POE lubricant charge (when necessary - see text on lubricants)
   ➜ In most cases, no rinsing process is required. Only 1 oil drainage is required.
4. Change of the filter drier.
5. Vacuum pumping of the installation and recharge with **Forane® 427A.** Arkema recommends to first fill the installation with a Forane® 427A charge equal to 95% wt of the nominal R-22 charge, and to top up to 100% if necessary.

* Arkema does not recommend to mix Forane® 427A with R-22

Physical properties of FORANE® 427A

Data Refprop Version 9.0 - NIST Standard Reference Database 23

Properties	Units	R-427A	R-22
Molecular weight	g/mol	90.4	86.5
Bubble point at 1.013 bar	°C	-43.0	-40.8
Temperature glide at 1.013 bar	K	6.8	-
Critical temperature	°C	85.3	96.1
Critical pressure	bar	43.3	49.3
Bubble pressure at 25°C	bar	11.4	10.4
Bubble pressure at 50°C	bar	21.3	19.4
Saturated liquid density at 25°C	kg/dm³	1.129	1.191
Density of saturated vapor at 1.013 bar	kg/m³	4.85	4.70
Liquid thermal conductivity at 25°C	W/(m.K)	0.081	0.083
Vapor thermal conductivity at 25°C and 1.013 bar	W/(m.K)	0.014	0.012
Surface tension at 25°C	mN/m	6.9	8.1
Liquid viscosity at 25°C	mPa.s	0.15	0.17
Vapor viscosity at 25°C and 1.013 bar	mPa.s	0.013	0.013
Liquid specific heat	kJ/(kg.K)	1.58	1.26
Vapor specific heat at 25°C and 1.013 bar	kJ/(kg.k)	0.842	0.662
ODP		0	0.055
GWP*		1828	1500

Saturation pressure (bar absolute)

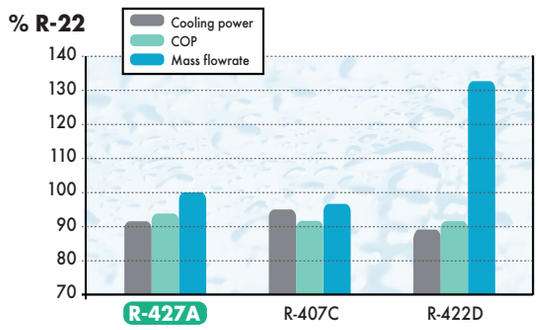
Temp (°C)	Liquid Pressure (bar abs.)	Vapor Pressure (bar abs.)
-50	**0.7**	**0.5**
-45	**0.9**	**0.6**
-40	**1.2**	**0.8**
-35	**1.5**	**1.1**
-30	**1.8**	**1.4**
-25	**2.2**	**1.7**
-20	**2.7**	**2.1**
-15	**3.3**	**2.6**
-10	**3.9**	**3.1**
-5	**4.6**	**3.8**
0	**5.5**	**4.5**
5	**6.4**	**5.3**
10	**7.5**	**6.3**
15	**8.6**	**7.4**
20	**10.0**	**8.6**
25	**11.4**	**9.9**
30	**13.0**	**11.4**
35	**14.8**	**13.1**
40	**16.8**	**15.0**
45	**18.9**	**17.0**
50	**21.3**	**19.3**

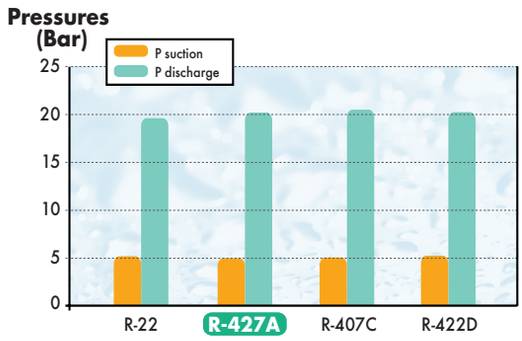
* GWP values for 100year time horizons according to the IPCC 1996 Second Assessment Report

FORANE® 427A: the closest retrofit for R-22 at any level of temperature, from air conditioning to medium and low temperature refrigeration

PERFORMANCE COMPARISON OF R-22 alternatives vs. R-22

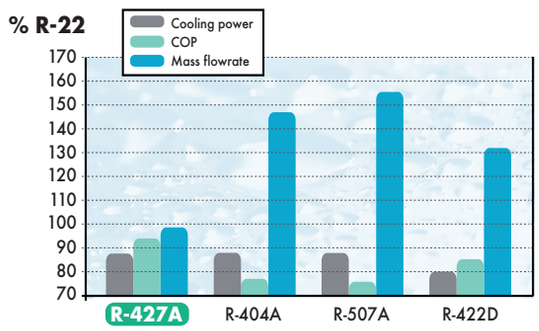
Air Conditioning (water chiller)

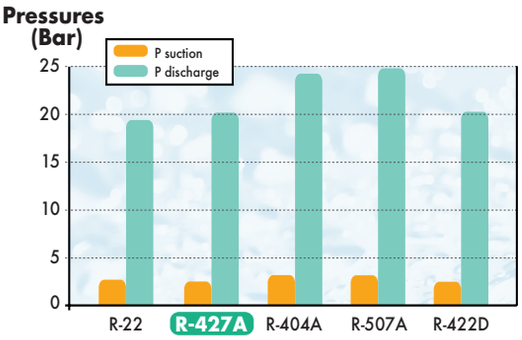




Operating conditions: evaporating temperature 2°C, ambient temperature 35°C, inlet temperature 12°C, outlet temperature 7°C

Low temperature refrigeration





Operating conditions: evaporating temperature -18°C, ambient temperature 35°C, inlet temperature -11°C, outlet temperature -15°C

Forane® 427A has proven to be a robust retrofit of R-22 since 2005 in various fields:

- ➜ Commercial and domestic air conditioning: chillers, rooftop units, split systems, heat pumps, etc.
- ➜ Commercial refrigeration and food-processing sector : supermarkets, warehouses, cold rooms, etc.
- ➜ Industrial refrigeration*.

Forane® 427A is the retrofit solution which offers the closest match to R-22 in term of performances as well as regarding the mass flow rates and operating pressures in both air conditioning and refrigeration. Due to its similar behavior in operation, Forane® 427A is the only retrofit that can be used in equipments designed for R-22 without requiring any changes on the installation (no need to change the expansion valves, liquid lines, condensing units or any other costly parts of your system).

*Field experience has shown that Forane® 427A provides good performance in some flooded evaporator systems. However, it is essential to check if the system allows the use of a non-azeotropic blend (design pressures, refrigerant distribution...). It is strongly recommended to contact our technical support team before retrofitting a flooded evaporator system.

FORANE® REFRIGERANTS: available worldwide

Main benefits of FORANE® 427A

- One fluid to cover the full range of temperature (AC, medium and low temperature refrigeration)
- Better efficiency on the full range of temperature than any other R-22 retrofit refrigerants, with nearly the same operating pressures to R-22
- Easy and fast retrofit procedure, most cost-effective solution to keep your R-22 installations running
  - No modification to the installation required when switching to Forane® 427A, only small adjustments of settings may be necessary to optimize system performance after the retrofit.
  - Highly tolerant to residual mineral or AB oil up to 15%. In some cases, some retrofits to Forane® 427A have been performed without changing the original oil.
- Discharge temperature up to 10°C lower (which improves equipment lifetime)
- One of the lowest GWP (1828) among R-22 retrofit solutions

Contacts

For any commercial or technical request (or for more information on product availability in your country), please contact us at the following address: **kylie.farrelley@arkema.com**

Additional information

Additional information (technical data, case studies, retrofit guidelines…) are available at: **www.forane427a.com**

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