

**Forane**<sup>®</sup>  
REFRIGERANTS

**A NEW - 100% HFC - EASIER RETROFIT FOR EXISTING R-22 INSTALLATIONS**

**FORANE<sup>®</sup> 427A**

 **ARKEMA**



A global chemical player, Arkema consists of 3 coherent and related business segments: Vinyl Products, Industrial Chemicals, and Performance Products. Present in over 40 countries with 17,000 employees, Arkema achieved sales of 5.7 billion euros in 2006. With its 6 research centers in France, the United States and Japan, and internationally recognized brands, Arkema holds leadership positions in its principal markets.

→ **MORE THAN A SOLUTION, ARKEMA PROPOSES  
A NEW CONCEPT : FORANE® 427A**

- easier than a retrofit
- more efficient than a drop-in

→ 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. In Europe in particular, R-22 is due to be phased out by 2010. In these countries therefore, the industry is looking for a zero-ODP\* solution to replace R-22 in existing equipment.

→ 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 direct expansion installations in a large range of applications.

**Forane® 427A** can be used to retrofit low temperature refrigeration equipment as well as air-conditioning installations.

## RESULTS OF FIELD TESTS

**Forane® 427A** has been tested successfully on several commercial equipment:

- for the conversion of air-cooled centralized refrigeration units in a supermarket in Italy,
- for the conversion of a water-cooled water chiller installation in France,
- for the conversion of a twin-stage compression water-cooled liquid chiller in France.

### → Comparative data of the field tests:

	AIR-COOLED CENTRALIZED REFRIGERATION UNITS FOR SUPERMARKET COLD ROOMS AND DISPLAY CABINETS		WATER-COOLED WATER CHILLER	TWIN-STAGE COMPRESSION WATER-COOLED LIQUID CHILLER
<b>Nominal cooling power</b>	9 kW	6 kW	400 kW	50 kW
<b>Temperature set point</b>	0 to 8°C	-20°C to -23°C	6°C	-20°C
<b>Forane® 427A charge</b>	76 kg	36 kg	75 kg	20 kg
<b>Oil return</b>	OK with 14.7% residual MO*	OK with 5.2% residual MO*	OK with 11.4% residual MO*	OK with 2.1% residual AB** oil
<b>Power consumption vs. R-22</b>	Same power consumption as R-22			

\*MO: mineral oil

\*\*AB: alkylbenzene

Highly satisfactory operating conditions were reached immediately during the fields tests, and several months later, still fulfill the customers' requirements:

- discharge temperatures can be up to 10°C lower with **Forane® 427A** which improves equipment lifetime,
- required temperature levels are reached easily and remain stable,
- oil return is good despite a high level of residual mineral or alkylbenzene oil,
- energy consumption is equivalent or lower.

**Forane® 427A** complements Arkema's comprehensive **Forane®** product range to better serve its customers' needs.

It is testimony to Arkema's R&D efforts in the field of refrigerants.





## SAFETY

**Forane® 427A** is non-toxic and non-flammable. All required toxicity and flammability tests have been performed in-house, and show that the product complies with the requirements of the A1 classification (non-toxic, non-flammable).

## MATERIAL COMPATIBILITY

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

## LUBRICANTS

**Forane® 427A** is a 100% HFC blend. It is consequently compatible with PolyOleEster (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% residual AB or mineral oil) which makes for a simplified retrofit procedure.

## RETROFIT PROCEDURE

- 1 Recovery of the whole R-22 charge\*
- 2 Drainage of the original oil from the system  
→ 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  
→ In most cases, no rinsing process is required. Only 1 oil drainage 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



PROPERTIES	UNITS	R-427A	R-22
Molecular weight	g/mol	90.4	86.5
Bubble point at 1.013 bar	°C	-42.7	-40.7
Temperature glide at 1.013 bar	K	7.1	-
Critical temperature	°C	86.8	96
Critical pressure	bar	44.0	49.8
Bubble pressure at 25°C	bar	11.2	10.4
Bubble pressure at 50°C	bar	20.8	19.7
Saturated liquid density at 25°C	kg/dm <sup>3</sup>	1.151	1.194
Density of saturated vapor at 1.013 bar	kg/m <sup>3</sup>	4.78	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*		2,000	1,700

\* GWP: Global Warming Potential



# Why choose ARKEMA as your n° 1 supplier of refrigerant?



CALVERT CITY ● PIERRE-BÉNITE ▲ GIVORS  
ZARAMILLO ●

CHANGSHU ●  
SINGAPORE ▲

● PRODUCTION AND PACKAGING PLANT  
▲ PACKAGING FACILITY

## FORANE® PRODUCTS AVAILABLE AROUND THE WORLD

Wherever you are in the world, ARKEMA can fulfill your refrigerant needs. We have facilities around the world designed to provide you with the fastest possible service.

### ➔ THE RIGHT EQUIPMENT TO MEET EVERY CUSTOMER REQUIREMENT

Railtanks, tanktrucks, a wide range of isotanks (last generation meeting the IMDG/DOT/SQLO/MITI/RID-ADR safety and transportation rules), DOT cylinders; refillable or disposable bottles.

### ➔ A SPECIALIZED AND DEDICATED LOGISTICS TEAM

To bring you the quickest and most suitable solutions on storage, packaging and transportation, we work in partnership with a selection of worldwide logistics companies able to respond to your requirements without delay.

## QUALITY AND CUSTOMER SERVICE

ARKEMA, through its Fluorochemicals business unit, is committed to providing high quality products and services to its customers, in particular with its Forane® product range. Our production plants in Europe have the ISO 9001 and ISO 14001 accreditations.

### ➔ CONTACTS

ARKEMA offers its customers all the necessary support:

**> a worldwide sales network with local agencies or sales offices and a central department, ARKEMA Fluorochemicals**

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### > technical service and R&D

Based in the Company's Pierre-Bénite Research Center (CRRR), this department is dedicated to providing all the necessary support to ARKEMA's customers through specific technical brochures or direct contact. ARKEMA CRRR - OFA Department  
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