

Forane®
REFRIGERANTS

A COMPLETE RANGE OF REFRIGERANTS



ARKEMA



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The main characteristics of FORANE® refrigerants are given in the following table. Further information is available in our product brochures or upon request.

PHYSICAL PROPERTIES	FORANE 409A	FORANE 134a	FORANE 408A	FORANE 404A	FORANE 507	FORANE 22	FORANE 407C	FORANE 410A	FORANE FX 100
Refrigerant type	HCFC-22 HCFC-124 HCFC-142b	HFC-134a	HCFC-22 HFC-143a HFC-125	HFC-125 HFC-134a HFC-143a	HFC-125 HFC-143a	HCFC-22	HFC-32 HFC-125 HFC-134a	HFC-32 HFC-125	HFC-32 HFC-125 HFC-143a HFC-134a
Molecular weight (g/mol)	97.4	102.0	87	97.6	98.8	86.5	86.2	72.6	90.44
Bubble temperature at 1.013 bar (°C)	- 34.5	- 26.1	- 44.4	- 46.4	- 47.1	- 40.7	- 43.4	- 52.2	- 42.7
Temperature glide at 1.013 bar (K)	7.1	0	0.7	0.9	0	0	7.2	0.1	7.1
Bubble pressure at 25°C (bar)	7.99	6.65	11.60	12.49	12.86	10.43	11.65	16.40	11.16
Critical temperature (°C)	106.8	101	83.7	72	71	96	86.2	72.2	86.8
Critical pressure (bar)	46	40.7	43.4	37.2	37.2	49.8	46.2	49.5	44.0
Latent heat of vaporisation at 1.013 bar (kJ/kg)	220.0	215.9	227.1	200.1	196.0	233.7	249.9	271.5	237.3
Liquid density at 25°C (kg/dm³)	1.216	1.206	1.062	1.04	1.04	1.194	1.139	1.061	1.151
Density of saturated vapour at 1.013 bar (kg/m³)	4.97	5.28	4.77	5.41	5.51	4.70	4.56	4.12	4.78
ODP	0.05	0	0.026	0	0	0.055	0	0	0

A global chemical player, Arkema consists of 3 coherent and balanced business segments: Vinyl Products, Industrial Chemicals, and Performance Products. Present in over 40 countries with 18,600 employees, Arkema achieves sales of 5.2 billion euros. With its 6 research centers in France, the United States and Japan, and internationally recognized brands, Arkema holds leadership positions in its principal markets.



→ THE FORANE® SOLUTIONS

The FORANE® range is based on long term solutions dedicated to new installations (HFCs) and, a series of blends especially made for the conversion of existing installations in order to postpone their end of life when the original refrigerant is no longer available.

This range of products is used and known worldwide in every application and is based on FORANE® standard refrigerants. Responsible use of these products is helping to reduce the impact of the refrigerant and air-conditioning industries on the stratospheric ozone layer (through the use of low or zero ODP products) and on greenhouse gas emissions (through improved energy efficiency).

EXISTING SYSTEMS

→ FORANE® 22:

The air-conditioning solution before its regulation, HCFC-22 remains a useful solution to eliminate CFCs in some applications, and for the maintenance of existing systems.

→ FORANE® FX 10: (R-408A)

To retrofit existing installations previously running with R-502:
+ easy and cost effective retrofit,
+ improved performance of the system after conversion.

→ FORANE® FX 56: (R-409A)

To retrofit most existing installations previously running with CFC-12*:
+ easy and cost effective retrofit.

→ FORANE® FX 100:

A simple retrofit of R-22 existing installations:
+ zero ODP R-22 replacement,
+ tolerates higher amount of old lubricants in PolyolEster,
+ exhibiting best performance in A/C applications.

* FORANE® FX 56 is not intended to retrofit mobile air conditioning systems using R-12.

NEW SYSTEMS

→ FORANE® 134a:

To replace R-12 in new installations both for refrigeration and air conditioning applications:
+ excellent thermodynamic properties.

→ FORANE® 404A: FORANE® 507:

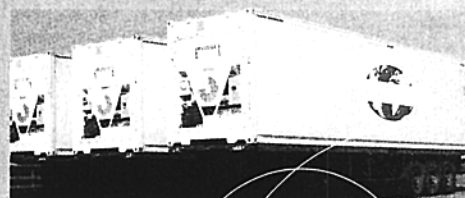
Near azeotropic (R-404A) and azeotropic (R-507) blends dedicated to new systems with evaporation temperature from -45°C to +10°C:
+ R-502 substitutes for new installations.

→ FORANE® 407C:

To replace R-22 in new stationary air conditioning systems (mainly small and medium size systems):
+ properties and performance similar to that of R-22,
+ widely used by most OEMs,
+ retrofit possible.

→ FORANE® 410A:

To replace R-22 in new air conditioning and heat pump systems (domestic and residential) and in some refrigeration applications:
+ enhanced cooling capacity,
+ necessary redesign of systems due to high pressure level,
+ good efficiency in heating mode.



Basic uses and recommendations are described in this brochure and further details on every product are included in our *More About* leaflets available to our customers upon request. In the case of installations conversions (retrofit...), the equipment manufacturer recommendations should be followed as a priority.



Comfort and commercial air conditioning



NEW SYSTEMS

Comfort air conditioning applications include a wide range of systems from small room air conditioners to larger split or multi-split commercial systems dedicated to shops, restaurants, hotels or private houses for example. HCFC-22 has been the refrigerant of choice in the entire world for these applications for several decades. Following the implementation of the European regulation on HCFCs (EC regulation N° 2037/2000 adopted on June 29, 2000) the use of HCFCs as refrigerants in new installations is prohibited since January 1st 2004.

Consequently, alternate refrigerants are now being used for new systems in accordance with local regulations:

- FORANE® 407C, a blend of HFC-134a, 125 and 32 developed to closely match R-22 properties and performance;
- FORANE® 410A, a high pressure refrigerant blend of HFC-32 and 125 with improved cooling capacity and requiring system redesign.

These two refrigerants have gained acceptance especially in Europe, Japan and the United States as reliable refrigerants for comfort and commercial air conditioning systems.

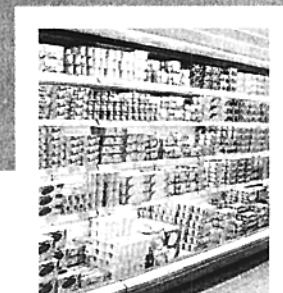
Product advantages

FORANE® 407C and 410A are standardized products that meet the essential safety criteria of non toxicity and non flammability defined by ASHRAE standard 34. Being based on HFCs, they have no Ozone Depletion Potential.

PROPERTIES	R-22	R-407C	R-410A
Boiling point at 1.013 bar (°C)	- 40.7	- 43.4	- 52.2
Bubble pressure at 25°C (bar a)	10.44	11.65	16.40
Liquid density at 25°C (kg/dm³)	1.194	1.139	1.061
Critical temperature (°C)	96	86.2	72.2
Critical pressure (bar a)	49.8	46.2	49.5
Latent heat of vaporisation at 1.013 bar a (kJ/kg)	233.7	249.9	271.5



Domestic and commercial refrigeration



NEW SYSTEMS

Commercial refrigeration includes a broad variety of systems currently used in supermarkets and retail food stores such as central refrigeration systems connected to display cases or self contained units which design is often close to that of domestic refrigerators and freezers.

A range of long term zero ODP refrigerants including FORANE® 134a, 404A and 507 is available for commercial and domestic refrigeration applications.

For domestic systems, FORANE® 134a is the main option today in the world.

For commercial applications, FORANE® 134a is mainly used in positive temperature self-contained units and glass door cabinets as FORANE® 404A is the main choice for medium and low temperatures.

FORANE® 404A and 507 are the preferred options for centralised direct and indirect systems because of their performance in low temperature applications. Equipment is now available from all manufacturers to run with FORANE® 404A and 507 with an improved energy efficiency and a reduced environmental impact.

Product advantages

FORANE® 134a, 404A and 507 are standard refrigerants for commercial and domestic refrigeration applications and meet all the essential safety criteria of non toxicity and non flammability defined by ASHRAE standard 34.

PROPERTIES	HFC-134a	R-404A	R-507
Boiling point at 1.013 bar (°C)	- 26.1	- 46.4	- 47.1
Bubble pressure at 25°C (bar a)	6.65	12.49	12.86
Liquid density at 25°C (kg/dm³)	1.206	1.044	1.042
Critical temperature (°C)	101	72	71
Critical pressure (bar a)	40.7	37.2	37.2
Latent heat of vaporisation at 1.013 bar a (kJ/kg)	215.9	200.1	196.0

EXISTING SYSTEMS

Based on the cooling need (low medium and high temperatures) there were two options in the past: R-502 and R-12. These refrigerants have now been replaced by retrofit refrigerants such as FORANE® FX 10 (R-408A) for R-502 existing systems and FORANE® FX 56 (R-409A) for R-12 existing systems.



Transport refrigeration



NEW SYSTEMS

Difficult and sometimes extreme conditions encountered in all transport refrigeration require reliable operation of equipment over a wide range of temperatures. Equipment design and refrigerant selection are key factors to fulfil these needs along with the worldwide availability of refrigerants.

Thanks to its complete range of refrigerants, Arkema offers you the solution you need for your application:

- long term HFCs for your new equipment;
- worldwide adopted retrofit blends for your existing systems.

Refrigerated vehicles use mainly engine driven systems. FORANE® 134a or FORANE® 404A are the main refrigerants of choice depending on the cooling needs.

The choice for refrigerated containers or trucks are similar since the cooling needs are not very different.

For Marine applications e.g. reefer boats R-22 has always been widely used.

Today FORANE® 404A, 507 and 410A are the main options chosen upon technology of the system.

Product advantages

FORANE® 134a and 404A are the main standard refrigerants for transport refrigeration applications. They are available worldwide and meet all the essential safety criteria of non toxicity and non flammability defined by ASHRAE standard 34.

PROPERTIES	HFC-134a	R-404A	R-507
Boiling point at 1.013 bar (°C)	- 26.1	- 46.4	- 47.1
Bubble pressure at 25°C (bar a)	6.65	12.49	12.86
Liquid density at 25°C (kg/dm³)	1.206	1.044	1.042
Critical temperature (°C)	101	72	71
Critical pressure (bar a)	40.7	37.2	37.2
Latent heat of vaporisation at 1.013 bar a (kJ/kg)	215.9	200.1	196.0