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Our commitments:

- + The safety of our employees
- + The quality of our products
- + Being responsible stewards for the protection of the environment, the communities in which we operate and our customers



Honeywell Fluorine Products

Europe B.V.

Laaderhoogtweg 18
1101 EA Amsterdam
The Netherlands

Honeywell Belgium N.V.

Haasrode Research Park
Grauwmeer 1
B-3001 Heverlee
Belgium
Tel: +32 16-391 278
Fax: +32 16-391 277
www.1234facts.com

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Honeywell HFO 1234yf



HONEYWELL'S LOW GLOBAL WARMING
POTENTIAL REFRIGERANT IS THE COOL CHOICE

Cool for all concerned

The Honeywell logo, consisting of the word "Honeywell" in a bold, red, sans-serif font.

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HFO-1234yf — A Green Solution to a Global Challenge

Introduction

Starting in 2011, automakers must meet the EU's MAC Directive, which prohibits the use of refrigerants with a global warming potential (GWP) higher than 150 in new vehicle types.

This Directive created a need for a globally-compliant replacement for R134a refrigerant, and it was a challenge that Honeywell worked to solve for several years. Honeywell is offering a drop-in or near drop-in solution called HFO-1234yf. Its GWP of 4 is 97% lower than the new EU regulation requires and 99.7% lower than R134a.

Mobile air conditioning systems using Honeywell HFO-1234yf are also more energy efficient than those using CO₂, particularly at higher ambient temperatures; vehicles equipped with HFO-1234yf will use less fuel and emit fewer greenhouse gases than the CO₂ alternative, which further increases the environmental benefit and reduces the carbon footprint.

HFO-1234yf is safe and easily integrated into current systems. As a near drop-in replacement, or even a drop-in replacement in certain cases, it requires virtually no alterations to current equipment. So it's easy to adopt and enables automakers to meet new regulations.

Cool for the Environment

HFO-1234yf has an atmospheric lifetime of only 11 days – compared to 13 years for R-134a and more than 500 years for carbon dioxide. Unlike HFCs and CFCs, which take decades to decompose, HFO-1234yf does not persist in the atmosphere. Quite simply, vehicles using highly energy-efficient HFO-1234yf refrigerant will use less fuel and produce fewer emissions than many of the existing alternatives.

Verified as Safe

HFO-1234yf has been verified as safe to use in automobiles through extensive third-party testing, including tests performed by the Society of Automotive Engineers and crash testing conducted by automakers. Today, HFO-1234yf is the refrigerant of choice in automotive air-conditioning.

Highly Compatible and Easy to Implement

Because the pressure and performance of HFO-1234yf is so similar to 134a it can be used as a replacement for HFC-134a with little or no reengineering of automotive systems. This enables automakers to comply with the new EU regulations quickly and cost-effectively.

HFO-1234yf Physical Properties

Component:	Chemical name:	Molecular formula:
HFO-1234yf	2,3,3,3-Tetrafluoro-prop-1-ene	CF ₃ CF=CH ₂
Molecular weight	(g/gmol)	114
Boiling point at 101.3 kPa	(°C)	-29.55
Freezing point at 101.3 kPa	(°C)	-150
Vapour density at boiling point	(kg/m ³)	5.98
Liquid density	(kg/m ³)	1092
Liquid heat capacity at 25°C	(kJ/kg·°K)	1.411
Vapour heat capacity at 25°C	(kJ/kg·°K)	1.066
Heat of vaporization at boiling point	(kJ/kg)	180.1
Vapour Pressure at 25°C	(kPa)	683
Liquid thermal conductivity at 25°C	(W/m·°K)	0.067
Vapour thermal conductivity at 25°C	(W/m·°K)	0.016
Liquid viscosity at 25°C	(μPa·sec)	155.4
Vapour viscosity at 25°C	(μPa·sec)	12.3
Solubility of HFO-1234yf in water	(wt. %)	0.020
Solubility of water in HFO-1234yf	(wt. %)	0.025
Ozone Depletion Potential (ODP-R11=1)		0

Pressure/Temperature Table

Temperature	Pressure
(°C)	(kPa)
-40	63.
-35	79
-30	99
-25	123
-20	151
-15	184
-10	222
-5	266
0	316
5	373
10	438
15	510
20	592
25	683
30	784
35	895
40	1018
45	1154
50	1302
55	1464
60	1642
65	1834
70	2044

Compatibility with Plastics and Elastomers

The table below provides a summary of materials compatibility data derived from tests performed by Honeywell and other global organizations. Since there are many different grades and formulations of these materials, we recommend that compatibility testing be performed on the specific grade of materials under consideration when designing new systems. This data should be used only as a guide to the compatibility of materials with HFO-1234yf. The rankings in the table should be used with caution since they constitute judgments based on limited samplings. Customers are advised to consult with the manufacturer or conduct further independent testing.

Material	Rating
HNBR	S
Polyester	Su
Nylon	S
Epoxy	S
Polyimide	S
Neoprene	S
HNBR	S
EPDM	S
Silicone	S
Butyl Rubber (IIR)	Su
Polyvinylidene Fluoride and copolymer of Vinylidene Fluoride and Hexafluoropropylene	U

S: Suitable, Su: Suitable with some exceptions, U: Unsuitable

Other Refrigeration and Air-Conditioning Applications

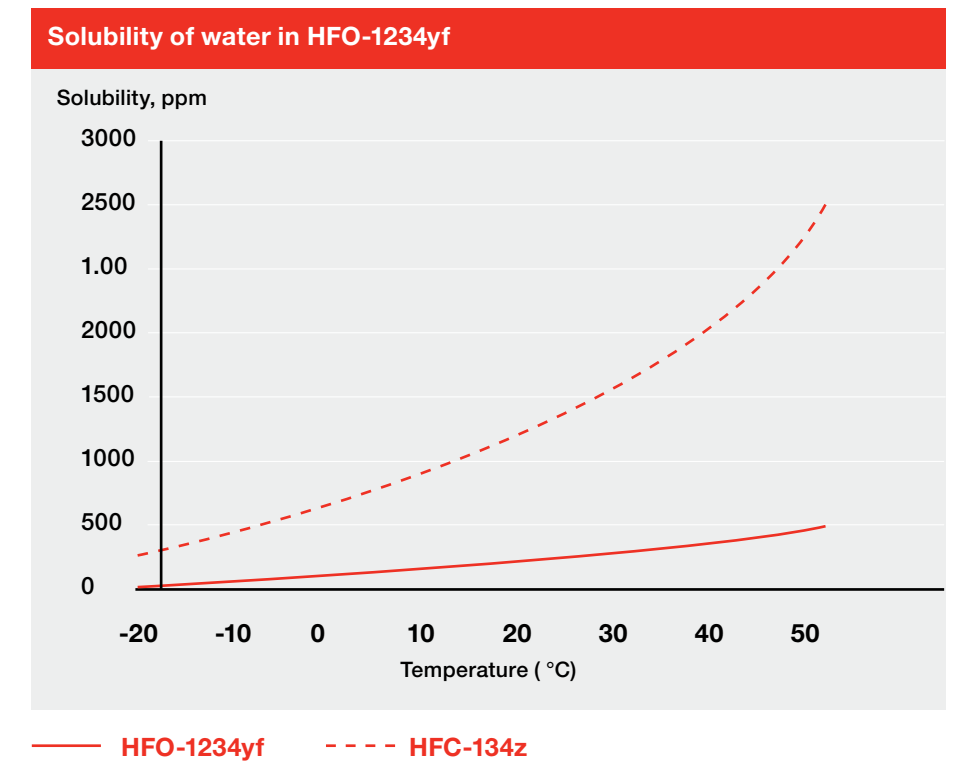
HFO-1234yf has been developed for a number of applications beyond automotive air conditioning. These include supermarket cases, walk-in coolers, residential refrigerators and chillers. Generally, there are few compressor design changes necessary to optimize the performance of HFO-1234yf in these applications, so once again it brings considerable benefit with easy implementation.

Easy Serviceability

The parts and components used in HFO-1234yf systems are identical or similar to those used in HFC-134a systems – both use flexible hoses to connect components. These parts are mass-produced in high volumes worldwide and widely available at reasonable prices. This makes systems repair and assembly easy and inexpensive.

Solubility of Water in HFO-1234yf

The solubility of water in HFO-1234yf is shown in the graph below. It is lower than that of HFC-134a.



Lubricants

HFO-1234yf performs well when used with polyalkylene glycol (PAG) and with polyol ester lubricants. Most automotive original equipment manufacturers have chosen specific PAG lubricants for their systems. For non-automotive applications, most compressor manufacturers recommend specific polyol ester lubricants. Users should check with the equipment manufacturer for the recommended lubricants for their system.

Toxicity

HFO-1234yf has undergone extensive toxicity testing, and has been found to be safe for use in its intended applications. It is also registered in the EU under REACH in the +1000 MT tonnage band. Consult the Material Safety Data Sheet (MSDS) before using HFO-1234yf.

Flammability

According to ASHRAE Standard 34, HFO-1234yf is classified in safety group A2L. This means it is in the lower segment of the mildly flammable refrigerants. Its flammability characteristics are shown in the table below:

Flame Limits – ASTM E681-01 at 21C	Rating
LFL (Vol% in Air)	6.2
UFL (Vol% in Air)	12.3
Minimum Ignition Energy (mJ)	> 5000
Auto ignition temperature ©	405
Heat of Combustion (kJ/g)	9.5
Burning Velocity (cm/s)	1.5

HFO-1234yf has undergone extensive application-specific flammability tests and risk assessment by the SAE CRP1234. Based on these results, the sponsors of the SAE CRP1234 have concluded that it can be used as a global replacement refrigerant in mobile air conditioning.

Leak Detection

Leak detectors can be used to pinpoint leaks or to monitor an entire room on a continual basis. Leak detection is important for refrigerant conservation, equipment protection and performance, reduction of emissions, and protection of those coming into contact with the system. Customers should check with equipment manufacturers for appropriate detector equipment.

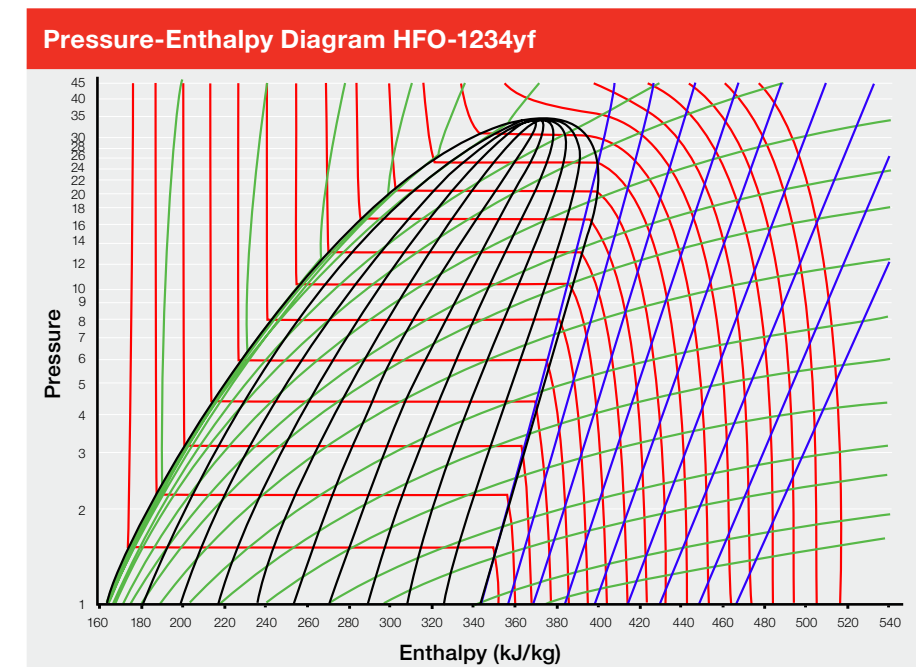
Storage & Handling – Bulk & Cylinder

HFO-1234yf cylinders must be clearly marked and stored in a cool, dry and properly ventilated area away from heat, flames, corrosive chemicals, fumes and explosives — and be otherwise protected from damage. Under no circumstances should an empty cylinder be refilled with anything other than virgin product. Once empty, the cylinder valve should be properly closed and the valve cap replaced. Empty cylinders should be returned to a Honeywell distributor.

Cylinders containing HFO-1234yf should be kept out of direct sunlight, especially in warm weather. Liquid HFO-1234yf expands significantly when heated, reducing the amount of vapour space left in the cylinder. Once the cylinder becomes liquid-full, any further rise in temperature can cause it to rupture or explode, potentially resulting in severe damage and injury. A cylinder should never be allowed to get warmer than about 50°C.

Vessels, containers, transfer lines, pumps and other equipment used with HFO-1234yf should not be exposed to high-temperature sources until they have been thoroughly cleaned and found free of vapours or liquid. Cylinders should never be exposed to welding, brazing or open flames. When possible, maintenance or cleaning of equipment should be performed without entering the vessel. If a tank or any confined space must be entered, then formal confined space entry procedures must be followed. These procedures require that a fully qualified work team be used and a confined space entry form be completed.

Honeywell's Low Global Warming Potential refrigerant is an innovative solution tackling the challenge of climate change while providing superior performance. The business has a wide variety of offerings for the refrigeration industry in general. For more information and to download product literature, please go to www.honeywellrefrigerants.com.



Reference State: h=200kJ/kg, s=1.00 kJ/kg -K sat. liq at 0°C