

Honeywell HFO1234yf



CUSTOMER INSIGHT:
HISPACOLD

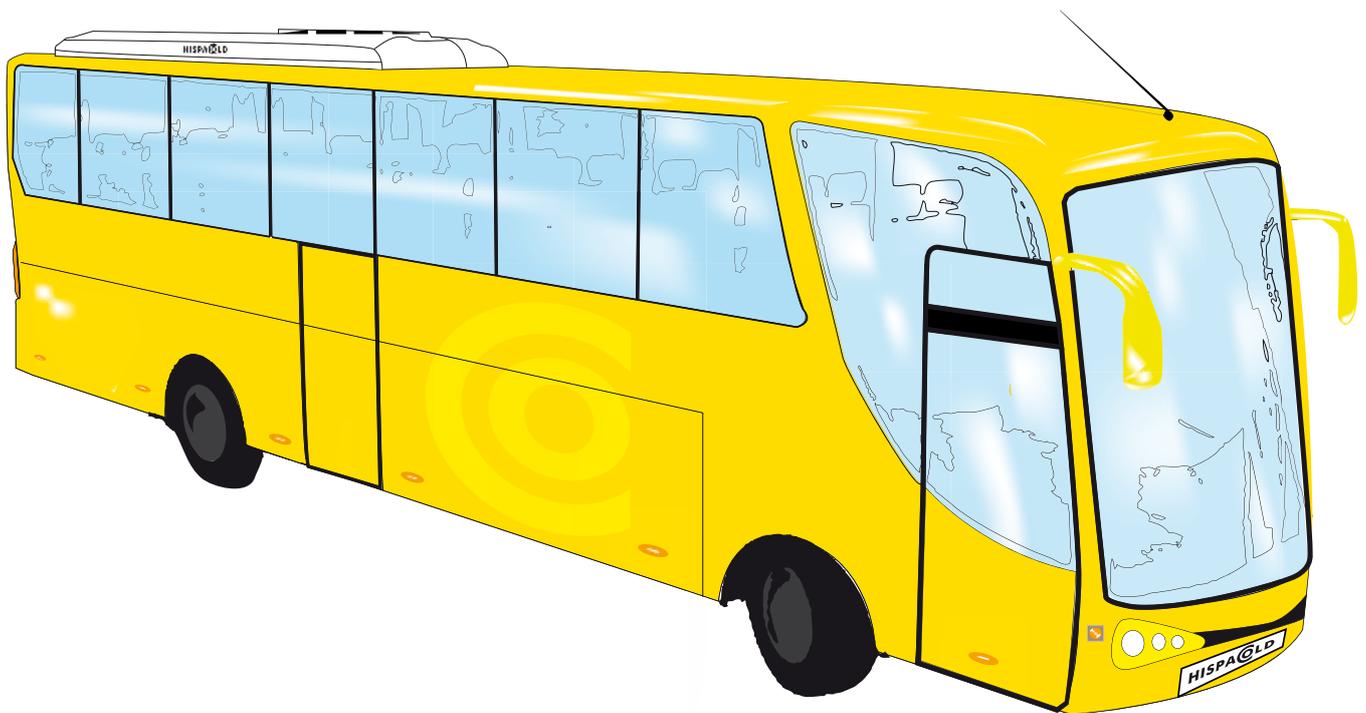
Spirit of Innovation Drives Eco-Friendly Refrigerant Application

Honeywell

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“We conducted thorough studies and extensive testing proving HFO-1234yf is a technically viable environmental alternative to R134a in our climate systems for buses and coaches. Our results are supported by CDTI (Centre for the Industrial Technological Development, from the Spanish Ministry of Science and Innovation).”

Jacobo Gutiérrez García – Market Manager, R&D Engineer (Hispacold)



Summary: Meeting the Automotive MAC Agenda

The EU's Mobile Air Conditioning (MAC) Directive, effective from January 2011, prohibits the use by automotive manufacturers of refrigerants with a global warming potential (GWP) higher than 150 in new vehicles.

Honeywell has developed a globally-compliant replacement for R134a refrigerant – HFO1234yf: a technology that provides a compelling proposition to the automotive sector as a result of its energy efficiency, environmental

benefits, safety, performance, ease of adoption and overall effectiveness. The newly-developed HFO1234yf refrigerants platform is based on hydro-fluoro-olefins (HFO) and is a near drop-in replacement for R134a, but with a GWP of just 4 – a figure 97% lower than the new regulation requires for Automotive and 99.7% lower than R134a. Moreover, HFO1234yf has an atmospheric lifetime of only 11 days, compared to 13 years for R134a and more than 500 years for CO₂. And, unlike

HFCs and CFCs, which take decades to decompose, HFO1234yf does not persist in the atmosphere.

These impressive features attracted the attention of Hispacold, a leading manufacturer of climate systems for buses and coaches, which was seeking an alternative to R134a and decided to conduct an extensive research exercise to compare the new Honeywell refrigerant and other alternative refrigerants, like CO₂, with 134a-based system.

The outcome proved the fuel efficiency, energy and emissions benefits of HFO1234yf.

- HFO1234yf is essentially a drop-in replacement refrigerant for current A/C systems
- HFO1234yf offers close to 20% reduction in gas charge compared with R134a
- HFO1234yf delivers direct emissions reduction of 99.77%, equating to 14,000 tonnes of CO₂e for a fleet of 2,000 buses (typical fleet size of a medium-to-large city).

Background: Supporting Hispacold's Innovation Strategy

Hispacold had been working to develop a climate system solution for buses and coaches far ahead of the potential transposition of the MAC Directive to road transport in order to affirm its strong position in their sector. Although competition is intense, Hispacold is the only company responsible for end-to-end climate

control unit production, giving the company unrivalled whole-system knowledge and know-how.

The spirit of innovation that has defined Hispacold for over 30 years was applied to its research into a new refrigerant that would meet both the future potential MAC Directive

targets and the company's broader commitment to sustainable development – a key driving force behind their innovation strategy. Hispacold's pursuit of being best-in-class in climate controls, blowers and compressors is extended now to include refrigerants in this strategy view.

Laboratory Test Implementation: Finding the Coolest Environmental Solution

In order to find a replacement for R134a – one that would meet the company's energy-efficiency and sustainability objectives as well as its future potential regulatory commitments - Hispacold conducted laboratory research involving a rooftop unit with condenser and evaporator (model 12S) to assess the relative performance of both Honeywell

HFO1234yf and CO₂ with the original 134a-based system.

Both fluids had previously undergone risk assessment (life, endurance, crash....) in automotive sector, which had proven them to be safe in terms of toxicity and flammability (ref. CRP150-1, EPA; performed for the

SAE (Society of Automotive Engineers) by Gradient Corporation).

However, following initial bench tests by Hispacold with the CO₂ system, it was discarded, because performance was confirmed not to be acceptable above 30°C and overall system cost was higher.

System Description: The Hispacold test involved its 12S roof top unit

- Compact system
- Condenser in the middle, evaporators at the sides
- Compressor: Ecoice (Hispacold) 660cc
- Refrigerant charge: 4.8kg for 134a versus 3.9 kg for HFO1234yf
- Compressor regime: 29.6Hz=1500rpm and 43.4Hz=2200rpm compressor
- No liquid receiver Same pipes, hoses and fittings as for 134a (compatible with HFO1234yf)
- Same equipment feed as for the R134a refrigerant system: no differences and no issues
- Refrigerant fed in gas phase, since it is pure and shows non-azeotropic composition
- Drier filter: same model, new one
- Oil: POE 68.



Test Description

The bench test of the complete roof-top unit compared the performance of Honeywell's new HFO1234yf refrigerant against R134a.

The test used R134a with the unit's existing expansion valves, repeated the test with HFO1234yf with the same set-up, and then tested HFO1234yf with a new expansion valve supplied by Honeywell Cooling Solutions.

Two compressor speeds were run - 1500 and 2000 rpm – with multi ambient temperature / evaporating temperature settings: 40°C/25°C; 35°C/23°C; 45°C/27°C; 42°C/23°C.

Laboratory Test Results: Proving the Eco-Value of Honeywell Technology

Capacity (kW) of HFO1234yf vs baseline R134a

Ambient temperature	Evaporation temperature	HFO1234yf
35°C	23°C	95%
40°C	25°C	95%
42°C	23°C	96%
45°C	27°C	95%

Discharge temperature (°C) of HFO1234yf vs baseline R134

Ambient temperature	Evaporation temperature	HFO1234yf
35°C	23°C	-9°C
40°C	25°C	-7°C
42°C	23°C	-10°C
45°C	27°C	-11°C

- With the new valves, HFO1234yf capacity practically matched R134a performance (not optimized system).
- HFO1234yf discharge temperature was up to 11°C lower, better for compressor durability.
- Charge was 20% lower for HFO1234yf versus R134a.
- No pressure drop observed along suction line from evaporator to compressor.

Carbon Footprint Reduction

The switch from R134a to HFO1234yf resulted in a reduction of close to 20% in refrigerant gas, along with lower direct emissions of almost 100% (99.77%) – the equivalent of 14,000 tones of CO₂e for a typical fleet of 2000 buses.

	GWP	Charge (kg)	CO ₂ e
134a	1430	4.8	6,864
HFO1234yf	4	3.9	16
Difference		0.9	6,848
%		81%	99.77%

Feedback: An Eco-Friendly Innovation for Hispacold

“We conducted thorough studies and extensive testing of Honeywell’s HFO-1234yf. These studies showed HFO1234yf is a technically viable environmental alternative to R134a in our climate systems for buses and coaches. It also is an essential drop-

in to R134a systems with similar efficiency to R134a. Our results are supported by CDTI (Centre for the Industrial Technological Development, from the Spanish Ministry of Science and Innovation). We look forward to extensively using this new refrigerant

in our products in the market, so we can reduce our carbon footprint.”

Jacobo Gutiérrez García
Market Manager,
R&D Engineer (Hispacold)

“We have evaluated CO₂-based systems. However performance is drastically reduced above 30°C ambient temperature, which significantly reduces market potential at

this moment. We have thus focused our efforts on HFO1234yf, which is a proven and supported technology selected by several automotive manufacturers to replace R134a.”

Juan Bernal Cantón
R&D Manager (Hispacold)

Sector Perspective: The Cool Technology that is Supporting a Sustainable Automotive Industry

As the automotive industry seeks solutions both for ever-tightening emissions standards and to meet the demands of consumers for more fuel efficient and eco-friendly technology, Honeywell’s new HFO1234yf refrigerant is proving its credentials as a drop-in replace-

ment for R134a. The new platform is a technology based on hydro-fluoro-olefins (HFO), with a GWP of just 4 – a figure 97% lower than the new MAC Directive requires for Automotive and 99.7% lower than R134a. Moreover, HFO1234yf has an atmospheric lifetime of only

11 days, compared to 13 years for R134a and more than 500 years for carbon dioxide (CO₂). And, unlike HFCs and CFCs, which take decades to decompose, HFO1234yf does not persist in the atmosphere.

For further information on Honeywell HFO1234yf visit www.1234facts.com
For further information on Hispacold product range visit www.hispacold.es

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August 2011
Printed in Germany
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