# Recovery of the New Refrigerant R-1234yf

## 2,3,3,3-Tetrafluoropropene, or HFO-1234yf, is a hydrofluoroolefin replacement for R-134a as a refrigerant in automobile air conditioners.

HFO-1234yf is the first in a new class of refrigerants acquiring a global warming potential (GWP) rating 1/335th that of R-134a and an atmospheric lifetime of about 400 times shorter. It was developed to meet the European directive 2006/40/EC that went into effect in 2011 requiring that all new car platforms for sale in Europe use a refrigerant in its AC system with a global warming potential (GWP) below 150.

HFO-1234yf, which has a 100-year GWP of 4, could be used as a "near drop-in replacement" for R-134a, the current product used in automobile AC systems, which has a 100-year GWP of 1430. This means that automakers would not have to make significant modifications in assembly lines or in vehicle system designs to accommodate the product. HFO-1234yf has the lowest switching cost for automakers among the currently proposed alternatives, although the initial cost of the product is much higher than that of R-134a. Initially, the refrigerant is expected to be about ten times more expensive than R134a. **The higher retail cost of the product should be an incentive in the recovered product market for auto recyclers.** The product will be handled in repair shops in much the same way as R-134a, although it would require different equipment to perform the service. One of the reasons for that is the mild flammability of HFO-1234yf. Another issue affecting the compatibility between HFO-1234yf and R-134a-based systems is the choice of lubricating oil. A new piece of recovery equipment will be required to capture the refrigerant.

The rule governing the existing products will also apply to the R-1234yf refrigerant. Venting Prohibition Section 608 prohibits intentionally releasing (also called venting) ozone depleting substance (ODS) refrigerants and most alternatives including all HFCs, HFOs, and their blends, while maintaining, servicing, repairing, or disposing of MVAC equipment. CO2 refrigerants are exempt from the venting prohibition. R-134a is an HFC and R-1234yf is an HFO.

Shortly after confirmation from automakers that R-1234yf would be adopted as a replacement of R-134a automotive air-conditioning refrigerant, Honeywell and DuPont announced that they will jointly build a manufacturing facility in Changshu, Jiangsu Province, China to produce HFO-1234yf, which is now in operation. In addition, Honeywell is building a new plant in Geismar, Louisiana, USA to produce the new refrigerant as well. Although others claim to be able to make and sell HFO-1234yf, Honeywell and DuPont hold most or all of the patents registered for HFO-1234yf.

Although the product is classified as slightly flammable by ASHRAE, several years of testing by SAE proved that the product could not be ignited under conditions normally experienced by a vehicle. In addition, several independent authorities evaluated the safety of the product in vehicles and some of them concluded that it was as safe to use as R-134a.

In December 2012, tests by Mercedes-Benz showed that the substance ignited when researchers sprayed it and A/C compressor oil onto a car's hot engine. Stefan Geyer, a senior Daimler engineer who ran the tests, stated "We were frozen in shock, I am not going to deny it. We needed a day to comprehend what we had just seen." Combustion occurred in more than two thirds of simulated head-on collisions. The engineers also noticed etching on the windshield caused by the corrosive gases. BMW, and VW-Audi agreed with Mercedes and left the SAE R-1234yf CRP Team, stating that the performed tests are not sufficient to fully judge the safety of

their vehicles. The German Automakers have been leaning towards carbon dioxide refrigerant that is safer for both passengers and the environment.

Following Mercedes claims that the new refrigerant was unsafe, Germany's Kraftfahrt-Bundesamt (Federal Motor Transport Authority) ran a series of tests. The Authority concluded that while the substance was potentially more hazardous than previously used R-134a, it did not comprise a serious danger. However, the German Automakers disagree with their findings, and test procedures. Following other independent and in house testing, General Motors still plans to transition all new models to the new refrigerant by 2018. Chrysler announced that they would continue the transition to R-1234yf as well. Reference: SAE International Publishes a Final Report on R-1234yf Posted on July 25, 2013 by https://macsworldwide.wordpress.com/author/macsworldwide/

The Cooperative Research Project (CRP1234-4) team has confirmed that R-1234yf is safe to use in automotive direct-expansion air conditioning systems. As previously reported the estimated overall risk of vehicle fire exposure attributed to use of R-1234yf is conservatively estimated at $3 \times 10^{12}$ events per vehicle operating hour. This is nearly six orders of magnitude less than the current risk of vehicle fires due to all causes (approximately $1 \times 10^{6}$ per vehicle operating hour) and also well below other risks accepted by the general public. All OEMs in the new CRP have indicated agreement with these conclusions. The members are European, North American and Asian OEMs: Chrysler/Fiat, Ford, General Motors, Honda, Hyundai, Jaguar Land Rover, Mazda, PSA, Renault and Toyota. To access the report, visit: http://www.sae.org/standardsdev/tsb/cooperative/crp_1234-4_report.pdf

## RobinAir 1234YF Recover, Recycle, Recharge Machine

The AC1234-6 is the only product available today that fully meets SAE's requirement for recovering, recycling and recharging vehicle A/C systems that use the new R-1234yf refrigerant. The AC1234-6 is a fully automatic ACS machine that comes with an integrated refrigerant identifier that samples the refrigerant in the vehicle's A/C system prior to recovery, is a highly accurate and reliable machine, and can service both standard and hybrid vehicle A/C systems. http://www.robinair.com/products/1234yf-recover-recycle-recharge-machine

Grainger has the new recovery pump listed for $7427 (Item # 44ZY98) while the National Tool Warehouse has the same item for sale via Amazon at $5920 and Century Tool & Equipment has a machine that meets the specifications by using an adapted fitting listed for $3950. http://www.centurytool.net/FA1234_CPS_1234YF_R_134a_Refrigerant_Recovery_p/cpsfa1234.htm

Although the EPA requirements DO NOT require recovery only technician to be MACS certified like technicians that recharge systems, the MACS Mobile A/C Training Class "Refrigerant Recovery and Recycling Certification (Section 609)" classes are updated to cover R-1234yf. The acquisition of the new piece of equipment will need to be reported to EPA, just as the R134a equipment was when it was first placed in to service at the facility. The EPA Refrigerant Recovery or Recycling Device Acquisition Form can be found at https://www.epa.gov/sites/production/files/2016-03/documents/recoveryform.pdf. If you are unsure or have not reported the original acquisition of equipment that same form may be used to do so.

*About the author: Sue Schauls is an independent environmental consultant with automotive expertise. She is the Iowa Automotive Recyclers Executive Director and the I-CARE Program Manager. Contact Sue via www.SueSchauls.com*