

# TECHNICAL REPORT

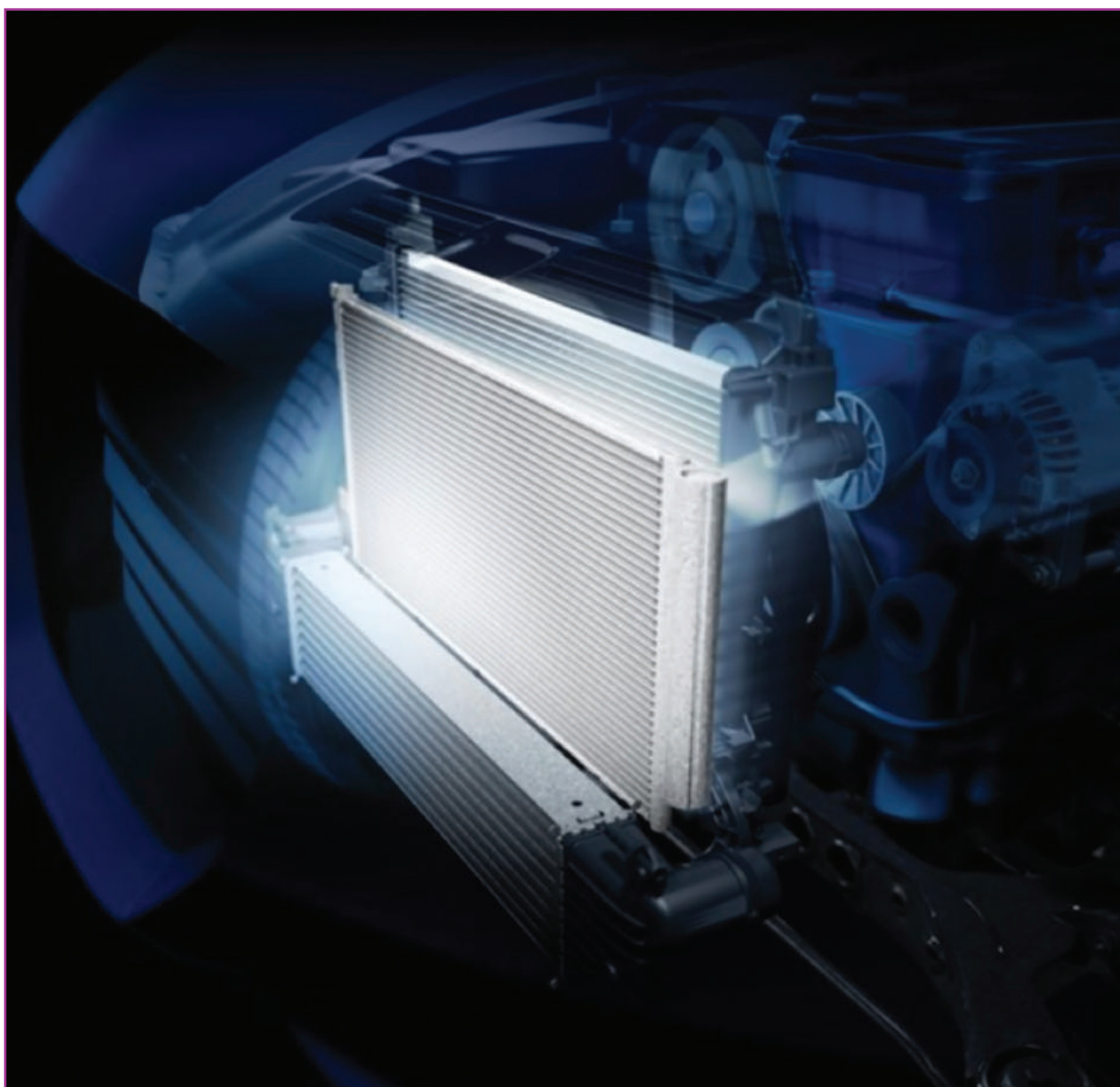


HVAC – CHANGING  
TIMES FOR  
AUTOMOTIVE AIR  
CONDITIONING...

HEATING-  
VENTILATION-  
AIR-CONDITIONING –

## PART I

THE GOOD, THE NOT-SO-GOOD, AND OTHER FACTS ABOUT REFRIGERANT TECHNOLOGIES  
FOR AUTOMOTIVE APPLICATIONS.



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Before we wade into some of the new - age technologies being developed for automotive Air Conditioning (A/C) applications, it is important to look back on where this all began :

## **BRIEF HISTORY :-**

A company in New York was supplying & installing A/C systems for customers that operated limousines & luxury cars way back in 1933. Packard became the first automaker to offer air conditioning as an option for its cars in 1939 – these were clumsy, cumbersome systems that had the blower and evaporator units mounted in the rear, which took up to half of the available boot space. Reliability and prohibitive costs proved the downfall of these early AC units.

With the advent of WWII, it would be 1953 before Chrysler developed an A/C option on its regular production, Imperial model.

In 1954, Nash was the first American automaker to have a front-end, fully integrated, HVAC system – available in its Ambassador model line-up. This layout became the preferred system, and is fundamentally similar to the modern sophisticated systems used in today's vehicles.

A/C became widely available in automobiles in the later part of the 20th century – by 1969, 54% of the US vehicle fleet were equipped with air conditioning.



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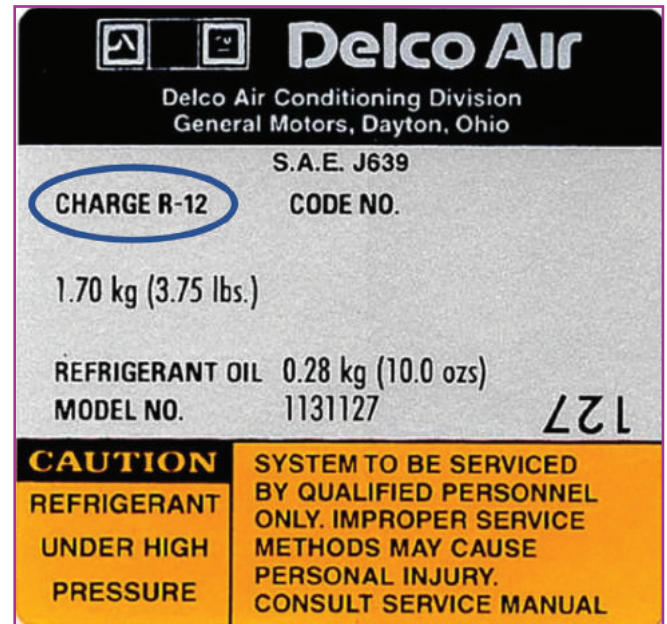


## REFRIGERANT DEVELOPMENT :-

Many different types of fluids can be used to act as refrigerants – Those favoured in the earlier years were those that displayed better thermodynamic properties, were non-corrosive and safe (non-toxic and non-flammable).

**CFCs** or **ChloroFluoroCarbons**, became the refrigerants of choice - The trade name “Freon” was developed by DuPont & identified as **R12**.

The 1970s & 1980s sparked ongoing debate about the environmental impact of refrigerants used in A/C systems.



In the 1990's, law changes put a ban on CFC – based fluids as these were seen to have an adverse affect on the ozone layer. For the most part, vehicle-makers had already developed, and were using alternative refrigerants. The chosen fluid was **R134A** – a type of **Hydro Fluoro Carbon (HFC)** which has a zero rating for ozone depletion.



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In addition to its ozone friendly properties, an R134A refrigerant system could be easily and cost effectively, retro-fitted to an existing R12 HVAC unit, as the refrigerants and oils are compatible :-

Enter the age of global warming awareness – we now observe that while R134A has zero impact on ozone depletion, it (along with other HFCs) does have a substantial, detrimental impact on greenhouse gas emission levels.

The **American Environmental Protection Agency (EPA)** measures the potency of these compounds, based on how much they will contribute to global warming while remaining in the atmosphere over the course of a century. These are categorised as:-

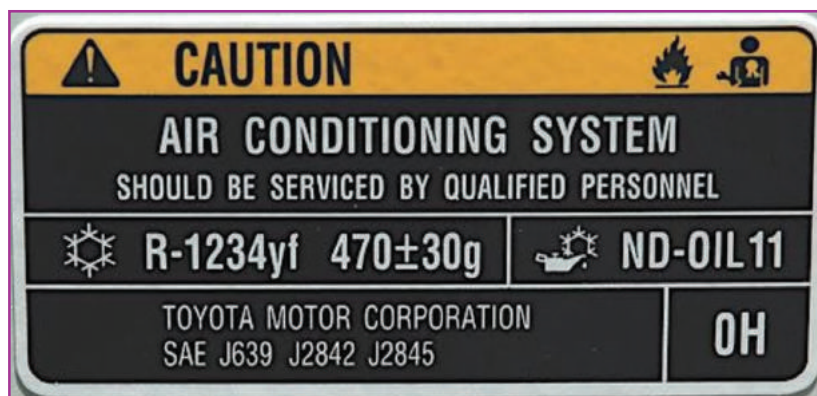
- **Global Warming Potential (GWP)**
- **Ozone Depletion Potential (ODP)**

These categories are then measured and given a number – the lower the number, the more environmentally-friendly the refrigerant is.

European Directive 2006/40/EC which went into effect in 2011 requires that all new vehicles sold in Europe have a refrigerant that has a **GWP** below **150** – R134A refrigerant has a GWP of 1430 – this effectively meant a replacement refrigerant needed to be developed.



Enter **HFO1234yf** or, as it is more commonly known, **R1234yf**. This refrigerant has a **GWP** of just **4**, which of course, makes it entirely suitable for new generation HVAC systems. Developed by DuPont in a joint venture with Honeywell, they hold most, if not all of the world patents for this refrigerant – It is worth noting that the after-market claims to be able to manufacture and sell HFO1234yf - which may present some issues in the future, insofar as possible system failures and reduced performance etc, should these non-patented products be used.



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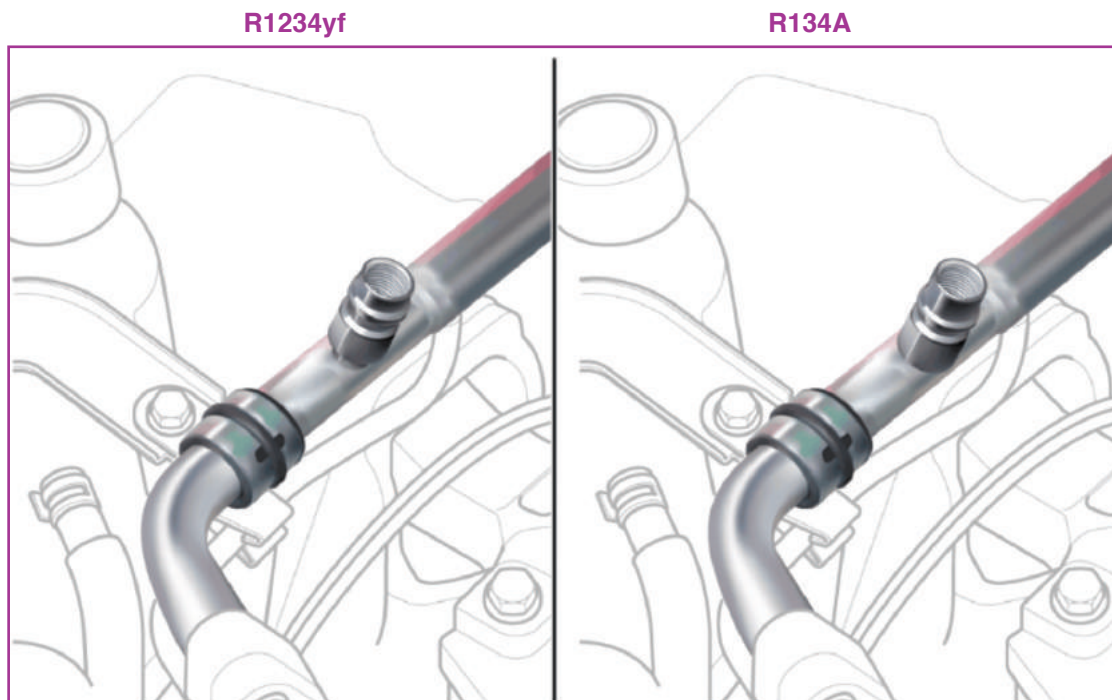


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Aside from that, there are some important points to note and understand when working with this HVAC system :-

- While R1234yf & R134A **charge ports** look almost identical, there are subtle differences between them that prevent incorrect connection (& subsequent cross-contamination).



- **O rings** are integrated into the dust caps (which are typically tethered), to not only keep the filler ports clean of debris that may prevent the valve from seating correctly after servicing (creating a leak), but also in situations where the vehicle sits long enough at low ambient air temperatures to allow the refrigerant to condense back into a liquid – this can cause system pressure to drop to the point where the service port valve may become unseated.



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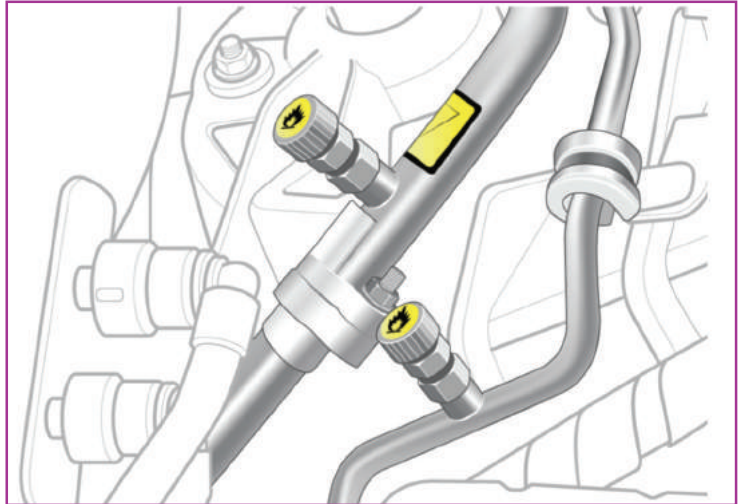
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- R1234yf is considered **flammable**, and while substantial testing has determined that the refrigerant will burn, there are a lot of other fluids under the bonnet that will ignite more easily.

All the same, some service caps and many spec labels include an icon to identify that it is still a flammable substance. New R1234yf service machines incorporate ventilation fans and ignition-proof solenoid switches in recognition of this.

Handling & storage requirements also recognise the flammability issue – warning labels on containers indicate that the refrigerant is “Highly Flammable” – this is because even though it is classified as “Mildly Flammable”, it is under pressure and accordingly, comes under the same classification for other compressed flammable gasses.



- An **In-line Heat Exchanger (IHX)** is often (but not always) used. This can be either built into the accumulator, or seen as a separate part. A tube-within-a-tube configuration that improves the overall efficiency of the system.



*An inline heat exchanger (IHX) has concentric inner and outer chambers. Liquid refrigerant from the condenser flows through the main inside chamber, and the outside chamber surrounds it with vapor from the evaporator.*

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## REFRIGERANT MANAGEMENT SYSTEMS (RMS) :-

The latest recovery/recycle/recharge (RRR) machines have fittings that will ONLY connect to vehicles that use R1234yf. SAE standard J2843 describes the major features of the recovery machine :-

- It will recover 95% of the refrigerant in the system.
- It will recharge the system to within 1/2 ounce of specification.
- After recovering 150 pounds of refrigerant, it will not run again until the onboard filter/drier is changed.
- It will have a built-in refrigerant identifier or a USB port to connect an identifier.
- It will not allow recovery of contaminated refrigerant.
- It will not recharge the system if it detects a leak.
- It has ventilation fans and non-sparking switches, motors, relays, etc.

Additionally, the recovery and recharge processes are highly automated and/or fully automatic. Equipment at OEM dealerships may have software that is brand specific and may not work on other makes of vehicle - however aftermarket machines are universal.



## THE PRICE OF GOING GREEN :-

R1234yf refrigerant is significantly more expensive than R134A – around 5 times the cost!!!

Furthermore, R1234yf RRR machines will only recover the refrigerant (& oil) if it is at least **98% pure**. Any shops that are looking to invest in this new technology will realistically need to have some sort of recovery-only machine for contaminated refrigerant.



*These articles have been written by Martyn Lane: I-CAR Instructor, Weld Test Administrator and Technical Specialist to the auto body industry*



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