# Automobile Air Conditioning & Climate Control

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## Aim of the Project

Automotive air conditioning has become an integral part of driving comfort. When it's missing, we notice. The air conditioning system is designed to improve visibility, reduce the risks of potential accidents and to help maintain optimal humidity levels inside the vehicle. Our objective is to get a better understanding of what air conditioning is and how it operates.

## Background

The automotive air-conditioning system has been with us longer than you might think and dates back to 1933 when Packard, an American Luxury Automobile company, first invented it. By 1940 they were the first car company to offer factory-installed air conditioning. The early system lacked a thermostat, but by 1969, more than half of all new cars were sold with air conditioning built in.

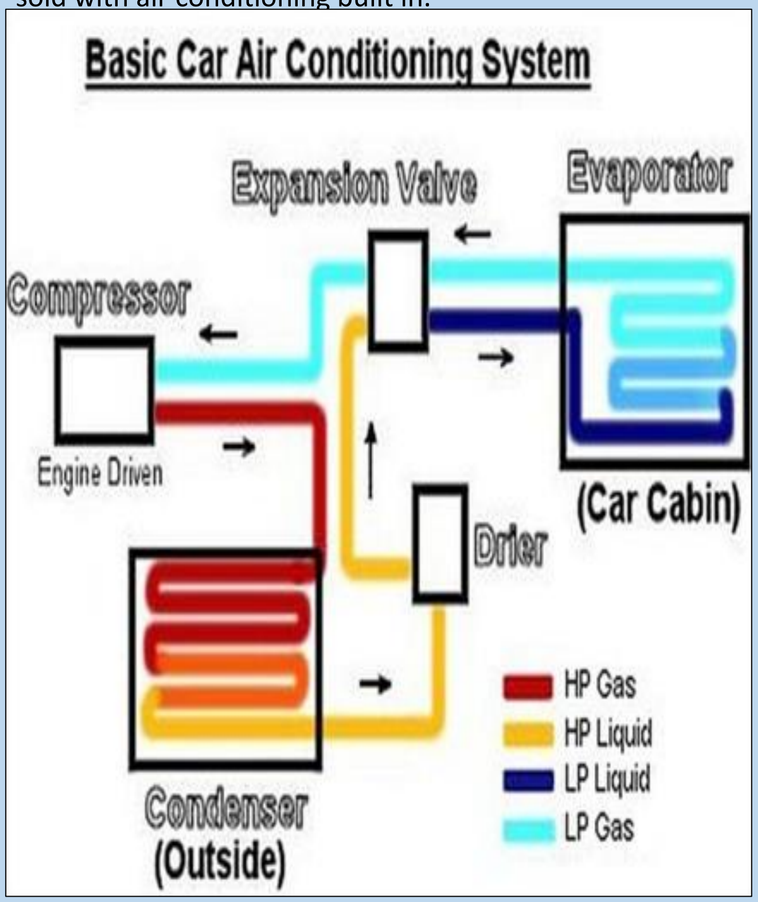


***Figure 1: Air condition systems components.***

## System Components & Operation

- **Compressor:** The process begins with the compressor, which is typically driven by the engine. The compressor pressurizes and circulates refrigerant (usually a chemical compound like R134a or R1234yf) through the air conditioning system.
- **Condenser:** The high-pressure, hot refrigerant gas then flows into the condenser, usually located in front of the vehicle's radiator. In the condenser, the refrigerant releases heat to the outside air and condenses into a high-pressure liquid.
- **Drier (Receiver-Drier or Accumulator):** Before entering the next stage, the refrigerant passes through the drier. The drier contains a desiccant material (such as silica gel or activated alumina) that absorbs moisture from the refrigerant. It also serves to filter out any contaminants present in the refrigerant stream
- **Expansion Valve:** The high-pressure liquid refrigerant then passes through the expansion valve, which regulates the flow of refrigerant into the evaporator. The expansion valve reduces the pressure and temperature of the refrigerant, allowing it to expand rapidly.
- **Evaporator:** As the low-pressure, expanded refrigerant enters the evaporator, it absorbs heat from the air inside the vehicle cabin. This heat absorption causes the refrigerant to evaporate into a gas state. The evaporator also removes moisture from the air, dehumidifying it.
- **Blower Fan:** The vehicle's blower fan blows air over the evaporator coils, where the cooled and dehumidified air is then circulated into the cabin through the vents.
- **Refrigerant Cycle:** After absorbing heat from the cabin air, the refrigerant returns to the compressor to restart the cycle. It is compressed again, releasing heat in the condenser, and the process repeats

## Types of Refrigerant

The two common types of automotive air conditioning refrigerants used:

**R134a:** This refrigerant has been widely used in automotive air conditioning systems for many years. It is a hydrofluorocarbon (HFC) refrigerant known for its effective cooling properties. However, due to its high global warming potential (GWP), there has been a push to transition to more environmentally friendly alternatives.

**R1234yf:** This refrigerant is gaining popularity as a replacement for R134a due to its lower GWP and better environmental profile. R1234yf is classified as a hydrofluoroolefin (HFO) refrigerant and is considered more environmentally friendly than R134a. Many newer vehicle models are equipped with air conditioning systems that use R1234yf refrigerant.

R1234yf gaining prominence as automotive manufacturers adopt more sustainable practices and comply with environmental regulations.

## Climate Control System

The climate control system allows you to accurately dictate the exact temperature of air entering the cabin. It uses a feedback loop to keep the cabin at a certain temperature, and if the loop detects the ambient temperature increasing, it will increase fan speed, allowing a faster cooling rate. Vehicles use Sunlight sensors to predetermine the amount of heat entering the car via solar radiation. Most cars these days will come with air conditioning as standard, with climate control being an optional extra or standard on more expensive models.

## Regulation

The EU F-Gas Regulation (Regulation (EU) No 517/2014) is a key piece of legislation enacted by the European Union to regulate the use of fluorinated greenhouse gases (F-gases). The regulation aims to reduce emissions of F-gases, which have high global warming potential (GWP), by controlling their production, import, export, use, recovery, and destruction. The regulation requires personnel involved in the installation, servicing, and maintenance of F-gas-containing equipment to undergo appropriate training and obtain certification to handle these substances safely and responsibly.

## Conclusion

Automobile air conditioning and climate control systems have revolutionized the driving experience, providing comfort and convenience to passengers regardless of external weather conditions. With advancements in technology, these systems continue to evolve, becoming more efficient, eco-friendly, and integrated with vehicle electronics. As automotive manufacturers strive to enhance comfort and sustainability, future innovations in air conditioning and climate control systems are expected to further improve the driving experience while minimizing environmental impact.

## References

https://eur-lex.europa.eu/EN/legal-content/summary/emissions-from-air-conditioning-systems-in-motor-vehicles.html#:~:text=It%20introduces%20EU-wide%20rules%20to%20cut%20emissions%20from,global%20warming%20potential%20%28GWP%29%20%2A%20higher%20than%20150.