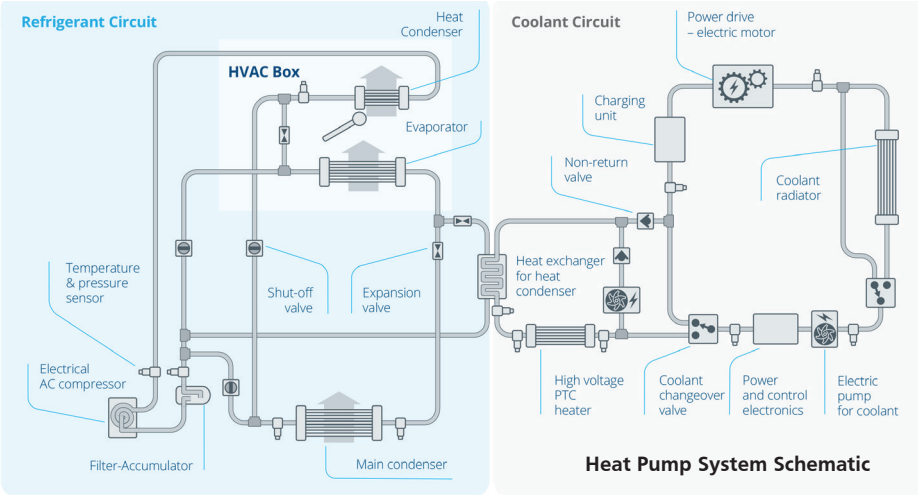
EV and Hybrid heat pump system fundamentals

Unlike a conventional vehicle's A/C, the heat pump based system is capable of both heating and cooling. Nissens explains the key components of these new systems that are becoming more common, as more hybrid and electric vehicles are entering the independent garage aftermarket.



Heat Pump System Schematic

Key Components

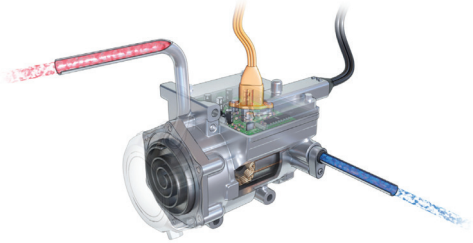
Electrical AC Compressor

Applies a scroll solution driven by a high-voltage electric DC motor. Same functions as the regular AC compressor.

For safety reasons, it requires a special type of low-hygroscopic Polyol Ester (POE) lubricant to secure the optimal electrical isolation between the HV motor and the vehicle's ground. Never use PAG oils in high-voltage AC compressors, and always check the manufacturer's specifications before adding oil to a Heat-Pump system.

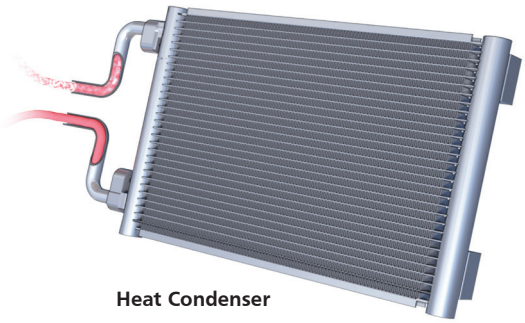
The compressor should be diagnosed with a current that controls its functionality as an electrical device. Advanced troubleshooting using an oscilloscope may be recommended, along with OBD and input signals inspection.

The system's purity is crucial for the scroll-based compressors to function properly.


Electrical AC Compressor

Heat Condenser

Exchanges heat between the refrigerant inside and the ambient air blown through it. Warms up the air before it gets into the cabin, and the heat transfer process inside enables the refrigerant to condensate – to change state from gaseous to liquid.


Heat Condenser

If the condenser is a parallel flow design, it should never be flushed and must be replaced if the AC compressor burns out or seizes. The condenser's narrow tubes cannot cleanse effectively from particles/clogs.

Valves

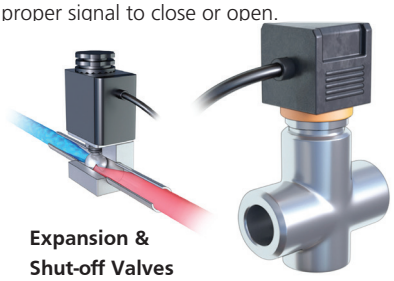
Several electric valves manage the operation of the heat pump and make the system perform various functions and in multiple modes.

Expansion valve - Electric signal-driven expansion valve is designed with a special v-shaped cut gate that enables a step-less flow control from 0 to 100%.

Shut-off valve - the shut-off valves govern the refrigerant flow according to the heat pump requested function and mode, including flow reversing and activation of double function for the given heat exchanger.

System evacuation and charging procedures may require a special OBD command to release the flow's directing valves. Otherwise, evacuation or charge procedures might not be possible.

Solenoid valves can be checked by using the OBD scan tool, by measuring the valve with a thermometer on each side to control if the valve is fully open/closed. Using a multimeter, the current measurement of the valves can help determine if the valve receives a proper signal to close or open.


Expansion & Shut-off Valves

Refrigerant

Heat pumps utilize the physical properties of specially designed refrigerants. The heat pump system operates by varying the medium's pressure and provoking the refrigerant to change its physical state, thus enabling its capability to transfer heat. Commonly used refrigerant types for nowadays automotive heat pump systems are R134a , R1234yf and R744 (CO_2)

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