



NISSENS' TECHNICAL ARTICLES MARCH 2022

This series of technical articles have been written based on the technical insights from the AC system professionals with many years in the system service field, Nissens' quality engineers, and Nissens' technical trainers involved in the best AC service practice sharing.



CLIMATE COMFORT SYSTEM IN NEW ENERGY VEHICLES

Step-by-Step Diagnostics

The hybrid and electric cars differ from conventional cars and require special handling and safety procedures to maintain and repair. For many, their thermal system relies on a heat pump solution, which is also an advanced system compared to a standard A/C loop.

Here's what you need to know when working on the climate control systems of hybrid and electric vehicles in your garage.

4 pages article
9 min reading time

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LEARN THE HEAT PUMP SYSTEM

Unlike a conventional vehicle's A/C, the heat pump-based system is capable of both heating and cooling. It also manages the temperature of the vehicle's electric motor, battery pack, and power electronics. The system functions as the vehicle's thermal management system and helps the car conserve battery life and extend its total range.

The heat pump is a very energy-efficient thermal solution. It ensures optimal heating and cooling performance and is not as intensive on the vehicle's battery since fewer PTC heaters are needed to reach the same comfort level.

The heat pump in NEVs differs from a conventional A/C loop and has more and different parts. Many of the parts that would be mechanical in conventional engines are fully electric in NEVs. For example, a high-voltage, fully electric A/C compressor is applied to keep the system fully functional, even when the vehicle is not running. Furthermore, several electronic valves govern flows inside the loop in various directions. Other parts include more heat exchangers such as the cabin heat condenser or the so-called chiller, a water-cooler heat exchanger. These additional components add a level of complexity to the system maintenance.

SERVICING NEV'S HEAT PUMP

Several service procedures for NEVs are similar to conventional vehicles but remember that hybrid and electric A/C systems operate as thermal management systems. It means it has to be fully functional in all seasons, not only for comfort but also for the proper function of other systems. Many new energy vehicles will not start if the A/C system is malfunctioning because of the risk of damage to the battery and the electric drive components. So, regular system maintenance becomes even more crucial than before.

Furthermore, it's important to remember that many parts in the NEV A/C system are high-voltage and require special safety procedures. Consult the manufacturer's safety guidelines and learn more about safe handling via dedicated instructions.

COMMON PROBLEMS

Just as you can have failures in conventional climate comfort systems, failures can also occur in NEVs' heat pumps. The most common failures you're likely to encounter include leakages, improper compressor lubrication, inner loop contamination, and compressor burnout. Lower system performance or a total system failure are consequences of not fixing these problems quickly.

There are hybrid vehicle models where the engine cooling system works along with the A/C loop. Both systems' potential failures may impact the overall heating or cooling performance and, thus, battery performance. Good maintenance of these systems is now essential to the car's longevity.

Comfortable cabin temperature is another aspect. Poor climate control is often the first symptom of a problem with the system.

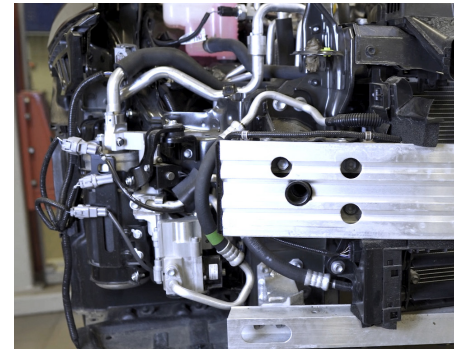
INITIAL INSPECTION

Start any NEV's heat pump system inspection like any other conventional A/C system. First, check to ensure the system is working according to set parameters. You should look at the manufacturer's guide on the number of heating/cooling functions and engage and test them one by one. Keep in mind outside temperature can affect how the refrigerant flows through the system. As a result, the valves that steer flows in the loop will open or close relative to ambient temperature if the system is functioning correctly. If it isn't, there's a risk that components could break down.

In the initial inspection, include the service steps you know as standard for the conventional A/C system. Besides the system performance check, these include:

- 01 LOOP VISUAL CONTROL
- 02 CONTROL OF THE LOOP COMPONENTS' TEMPERATURE
- 03 SYSTEM STATIC AND WORKING PRESSURES CHECK
- 04 LOOP TIGHTNESS CONTROL
- 05 OBD AND ELECTRICAL SYSTEM TEST

NEW ENERGY VEHICLES CLIMATE COMFORT SYSTEM



The heat pump system is much more advanced than a regular A/C loop. Make sure you learn its layout, the key components placement, and functions before the service.



The system performance check belongs to the troubleshooting fundamentals. Take time to thoroughly inspect the output of each of the heating and cooling modes.



There still is refrigerant parameters that can tell you a lot about the system condition. The loop components' temperature and the pressure diagnostics never grow out of fashion.



DIVE DEEPER INTO NEV HEAT PUMP SYSTEM REPAIR

Often, there are no specific procedures to follow from the manufacturer related to the heat pump system maintenance or service. We've put together some general best practices to get you started.

There are several things that Nissens found crucial to investigate, namely because of the complexity of the system's design. These may apply universally to NEV vehicles and heat pump systems.

A BE PREPARED

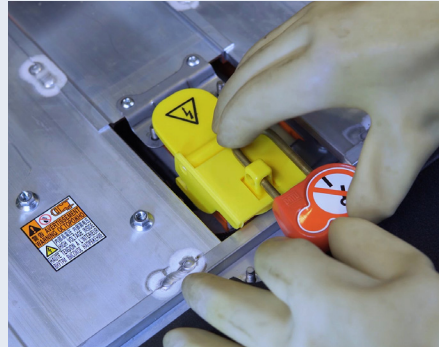
The vehicle's OE documentation is the key for a regular workshop in the aftermarket to service these cars. We recommend learning the specific system, you're working on and obtaining as much information before you begin your work.

System layout info, technical notes, bulletins, and service procedure information will ease the process and enable you to perform any diagnostic work correctly.

B SPECIAL PROCEDURES

Remember, safety is the key when working with high-voltage systems. However, you should only power the system down if you're about to open the HV system by replacing the A/C compressor, for example. You don't need to power down for a diagnostics test for temperature or pressure.

Follow dedicated procedures and use protective equipment and tools. Only certified technicians can carry out service work, and you should familiarize yourself with the safety protocols before you begin. Take the time to learn the layout of the electrical system circuit in the car you will be servicing.



Thoroughly study and obey the safety procedures for the vehicle. This will help you avoid electrocution, personal injuries, and severe system damage.

Disabling the high voltage system differs across make and model, so ensure to retrieve and study the required manufacturer documentation before performing the disconnection operation.

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. Keep in mind that a heat pump design loop may have several valves to control the inside flows, and often, it is of significant bigger refrigerant volume.

C WHAT TOOLS DO I NEED?

Depending on the heat pump system, you can use various new tools. To determine this, take a closer look at the refrigerant. You won't need new tools if the heat pump uses R1234yf. If you're already a certified technician, you have the tools in your workshop to replace or service the components.

Digital thermometer, wireless clamps, or gauges: Since you'll have to determine a lot of exact parameters, we recommend you get an exact thermometer or gauges, and having them wireless will ease the process

High voltage tools and protective gear: use only approved equipment and insulated tools certified for 1000 volts. Keep in mind you need to be trained and authorized to work on HV installations. Never work alone on high voltage systems.

If the system is charged with R744 (CO2), invest in approved tools for use with the refrigerant. The recovery and filling station,

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connector, hoses, and pressure gauges must be R744 (CO2)-dedicated. Their function is the same as for R1234yf, but the higher work pressure of R744 (CO2) could be as much as ten times greater; hence, the tools must be able to withstand high pressure. In addition, the system lubricant has to be specific for



High-pressure R744/CO2-driven heat pumps will be seen more and more in battery-driven vehicles. Servicing these systems requires, among others, a dedicated service station and tools of much more robust design.

R744 (CO2), and it could be POE or PAG. Look at the specifications on the compressor to double-check that you're working with the correct oil.

NEVER STOP LEARNING

The hybrid and electric vehicles will soon come in for A/C repairs and routine maintenance. Your ability to troubleshoot and fix their climate control systems will be vital for your continued success in the automotive/ AC business.

We publish a great deal of learning material regarding the NEV climate systems and, among others, on how to flush the heat pump loops or replace the high-voltage AC compressor. We will continue with more NEV-related stories, and you can access them all, plus much more tech materials on our expert knowledge portal at www.nissens.com/experts



SPECIFIC COMPONENTS TO CHECK

Nissens recommends all inspections cover these specific components:

IHX

This device raises the temperature of the inlet of the compressor. You can use a thermometer to check the temperature difference between the inlet and the outlet to control the unit condition. Then you know it raises the temperature using the refrigerant coming from the high side of the A/C system.

SOLENOID VALVES

The valves can be checked by using the OBD scan tool. But this does not necessarily tell you if the valve is slightly open. To be on the safe side, measure the valve with a thermometer on each side. If the valve is fully closed, there will be a significant temperature difference. If not, the temperature should be the same on each side. If the tube on the outlet starts to feel cold, you know that the valve is slightly open because the refrigerant is starting to expand.



There are many solenoid valves in the heat pump systems. Inspect them in terms of input signals and currents that steer their operation. If necessary, flush or replace.

The current measurement of the valves using a multimeter can be helpful to determine if the valve receives a proper signal to close or open. OE data related to operational voltage data must be obtained to perform such a diagnosis.

TEMPERATURE SENSORS

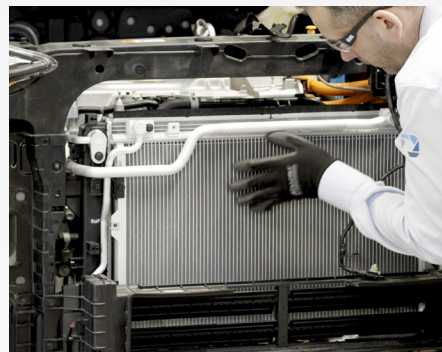
These are the same type as in a regular A/C system, but more of them control the advanced functionality of the flows in the heat pump design loop with more valves and reverse flows. You can use your scan tool to test them or simply use a heat source to set off the sensor to see if it reacts.

PRESSURE SENSORS

Without a scan tool, these may be difficult to check. Since there is only one low-side and high-side service port, you will not get an accurate reading at specific sensors.

CONDENSER

You must check this part regularly for dirt, deterioration, and any damage to the heat exchanging surface. Remember, if there is no heat transfer through the condenser, the refrigerant will not turn into a liquid, and therefore no cooling or heating will occur.



The main condenser's condition is one of the major points to control.

Besides error codes registered by the system control unit, the improper working parameters caused by the impaired condenser function can lead to severe damage to the AC compressor.

HEAT CONDENSER/ INTERNAL CONDENSER

This heat exchanger supports the condenser function in the heat pump system and either removes or absorbs heat. It's near the evaporator and, therefore, well protected by the dashboard. But make sure there is not something preventing the air from flowing through and that the air flaps controlling the airflow function properly.



The heat condenser is less exposed to dirt and deterioration as it sits well packed in the HVAC box. Make sure there are no airflow restrictions in the unit.

HIGH VOLTAGE ELECTRIC AC COMPRESSOR

In the heat pump systems of a battery-driven or hybrid car, it is a high voltage electrical compressor. As in any other AC system, it is the heart of the system, and its lifespan is crucial for the entire system operation. It is essential to mention these compressors are highly robust electrical motor-driven units based on scroll technology. The majority have specific lubricant requirements, which cannot be conductive.



The high-voltage electrical AC compressor requires special lubricant. When troubleshooting, besides visual, sound, and OBD inspection, it is worth including input signals and current diagnostics.

As for any other electrical device, the compressor's functionality depends on the current signal, which the technician should also diagnose. Advanced troubleshooting utilizing an oscilloscope may be recommended, along with OBD and input signals inspection. The inner purity of the loop is also of crucial importance for the scroll-design compressor's vitality.