Don't Sweat the Summer

Diagnosing Nissan HVAC Issues

As Summer arrives, we must be prepared for increased demand for air conditioning repairs. We'll focus on getting the necessary information from Nissan's TechInfo website, using the CONSULT III plus and addressing compressor issues.

Potentially complicated air conditioning problems should not be a reason to be apprehensive about offering HVAC repairs. A quick search online will support two important statements: 2015 was the hottest year on record; and, consumers highly rate the importance of working air conditioning for their cars. We can all expect that more customers will need help figuring out why their AC doesn't work this summer. Here we'll discuss logical diagnostic tips, and how to use the Nissan TechInfo website to find all needed information.

Getting Prepared for Anything HVAC

If your shop is expanding AC repairs to the Nissan brand, look at any vehicle's service manual section called "HA – Heating and Air Conditioning" and you'll find the "Preparation" portion outlines all the recommended service tools, including their Nissan Tech-Mate part numbers. Pricing and availability for these recommended service tools are excellent.

Take a moment to remember it is our responsibility as professional technicians to take proper precautions in handling refrigerant. Do not evacuate to the atmosphere, and use approved service tools for capture/recharging. Refrigerant R134a still contributes to environmental degradation. Also, be mindful that most fluorescent leak detection dyes will damage painted surfaces.

Where to Start?

A customer may ask for you to recharge their AC because they know it doesn't blow cold air. Don't skip asking them for more information. Does the AC start cold and get warm later, or vice-versa? If so, you might need to spend more time investigating the symptom than a simple recharge. Does it blow cold some days and not others? Does the heater work? By asking these few additional questions, you could give yourself a valuable lead as to where to check first.

As with fuel injection or ignition timing, having a general understanding of what the AC system is designed to do will help you tremendously when trying to figure out where to start or what went wrong. We'll address the components that create cold air through heat exchange, but be well aware that there may be no point in looking for refrigerant leakage if the blend is stuck too hot.

It is a universal law that heat energy only ever moves in one direction: from higher to lower temperature. The larger the difference between two temperatures, the faster the heat moves from the hotter into the colder. Both air conditioning and radiator cooling systems are engineered around the movement of heat energy. Both use a medium to hold the heat (refrigerant / radiator fluid), a method to flow the medium (compressor / water pump), or a way to dissipate heat stored in the medium (condenser / radiator).

The Medium

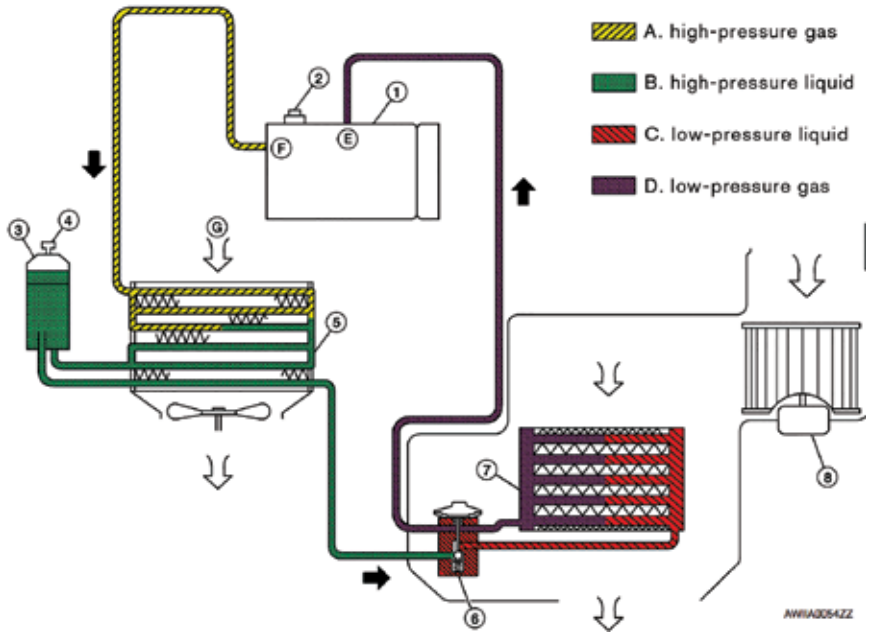
The lifeblood of the air conditioning is the refrigerant that facilitates the transfer of heat from one part of the AC into another. R134a is the most common refrigerant used in vehicles at this time, but new, more environmentally friendly refrigerant chemicals are beginning to appear. R134a will change from liquid to gas around -19°F, but this vaporization point will shift one degree higher for every increased pound of pressure per square inch. This 1:1 temperature to pressure relationship, and the ability to absorb heat, makes R134a excellent at moving heat from one location to another within air conditioning systems.

This diagram is a brief reminder of the AC flow. The compressor pushes high-pressure gas (A) into the

condenser, where it cools and becomes high-pressure liquid (B). The high-pressure liquid is metered into the low-pressure region inside the evaporator by the expansion valve. The drop in pressure also drops the refrigerant boiling point down to about 32°F (C). Drawing in heat from the cabin airflow passing over the evaporator fins, the low-pressure refrigerant liquid vaporizes and becomes low-pressure gas again (D).

With too little or too much refrigerant, the system pressures will be too low or high, and this prevents the system from operating correctly. For every Nissan vehicle, the service manual includes details about specific operating pressures, including altitude and ambient humidity considerations for AC cooling performance. This can be found under the "HAC – AC Control" section.

More often than not, an air conditioning system stops performing up to specification when the refrigerant leaks out. Be systematic in your approach to finding the source of a refrigerant leak. Check the high-flow Schrader valves of the high/low pressure service connections. Visually inspect every under-hood component for evidence of leak detection dye or residual refrigerant oil that may indicate a slow leak. A small amount of residual near the compressor pressure relief valve is normal. For suspected evaporator leaks, use a refrigerant "sniffer" (Nissan SST J-41995) in the evaporator plenum drain hose. In some models, you can remove the glove box and cabin filter to visually inspect the evaporator for leak detection dye. It is sometimes necessary to have a customer return to the shop later for a follow-up investigation if no leaks are found on the service appointment.



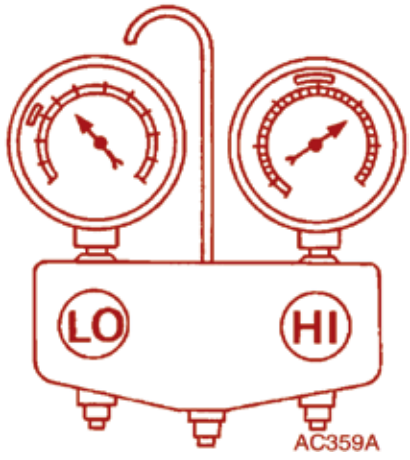
This 2004 Frontier lost its refrigerant recharge over the course of a week. Thankfully, this leaking high pressure hose was easy to identify.

What if the system was not discharged, but still malfunctioning? A fundamental understanding of the transition between the high-pressure and low-pressure sides of air conditioning will help logically identify potential problems.

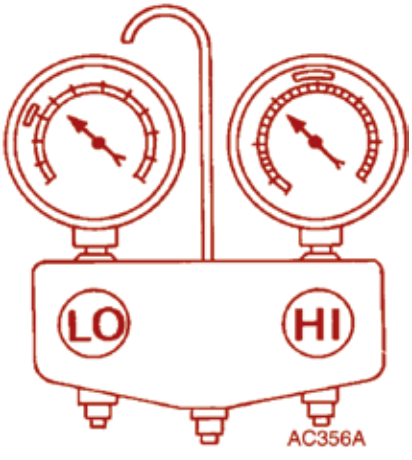
Moving the Medium: Compressor Operation

For the following, we are considering the 2010 Altima. According to the service manual, for 86°F ambient temperature, normal high-side pressure range is 177-217 psi and low-side pressure

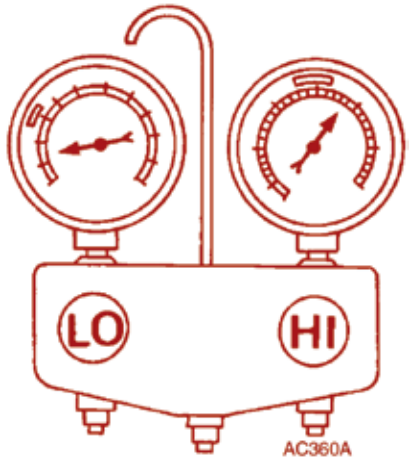
range is 35-43 psi. These figures are found in the "HAC – AC Control" section of the service manual. On each pressure gauge diagram,



High- and low-sides too high.



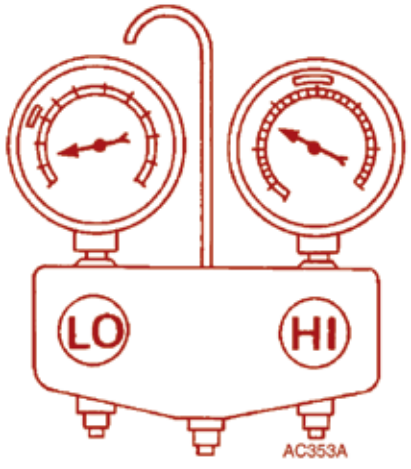
High-side too low, low-side too high.



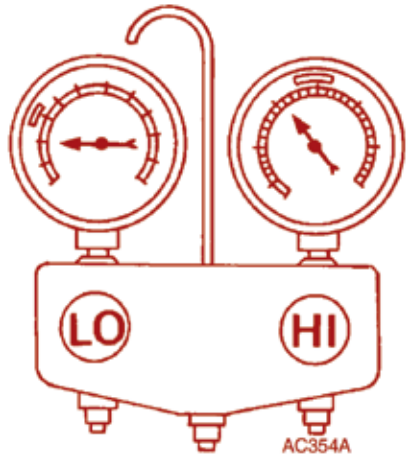
High-side too high, low-side too low.

this operating range is indicated on the dial face.

- **High- and low-sides too high**
  - *Possible cause:* overcharged system.
  - *If also:* the low-pressure line is NOT cold; *Possible cause:* restriction in condenser or poor heat exchange (because the condenser fan is inoperative).
  - *If also:* high-side pressure drops immediately when compressor stops its cycle; *Possible cause:* air trapped within the system.



High- and low-sides too low.



Low-side goes to vacuum

  - *If also:* evaporator is frosting over; *Possible cause:* expansion valve is stuck (partially) open at all times.
- **High-side too high, low-side too low**
  - *Possible cause:* expansion valve stuck closed.
  - *If also:* condenser is hot, but receiver/drier is NOT hot; *Possible cause:* condenser restriction or receiver/drier restriction.
- **High-side too low, low-side too high**
  - *If also:* high- and low-side pressures are equal; *Possible cause:* compressor is not operating
  - *If also:* high- and low-side pressures equalize soon after compressor stops cycling; *Possible cause:* compressor internals are defective
- **High- and low-sides too low**
  - *Possible cause:* system is partially discharged due to leak.
  - *If also:* pipe temperature near expansion valve is very low, or high-side pipe is cold to touch elsewhere; *Possible cause:* restriction at expansion valve or high-side pipe.
  - *If also:* temperature is different on inlet versus outlet sides of receiver/drier; *Possible cause:* deteriorated or saturated desiccant inside receiver/drier.

- **Low-side goes to vacuum**
  - *If also:* the system keeps cooling even after compressor stops cycling; *Possible cause:* water contaminating the refrigerant charge, icing the expansion valve, for example.
  - *Possible cause:* expansion valve stuck closed.

Control the Flow: Compressor Command Considerations

If air conditioning performance is spotty or intermittent, a customer's car may have a control malfunction. For most Nissan vehicles, when the AC or defroster switch is depressed on the instrument panel board, the front air control unit will output a COMPRESSOR ON signal to the BCM. Then, the BCM will transmit the COMPRESSOR ON signal to the ECM via CAN communications. The ECM determines whether the COMPRESSOR ON conditions are good. If the ECM judges the conditions acceptable, the ECM will command the IPDM E/R (Intelligent Power Distribution Module Engine Room – under-hood fuse and relay box) via CAN to turn on the AC compressor relay and provide power to the compressor.

Be sure to look up your vehicle's specific implementation of the command circuit components. For example, the 2014 370Z uses data from the combination meter to determine necessary data for its compressor cut-off consideration. Let's walk through how to evaluate each of these circuit components next.

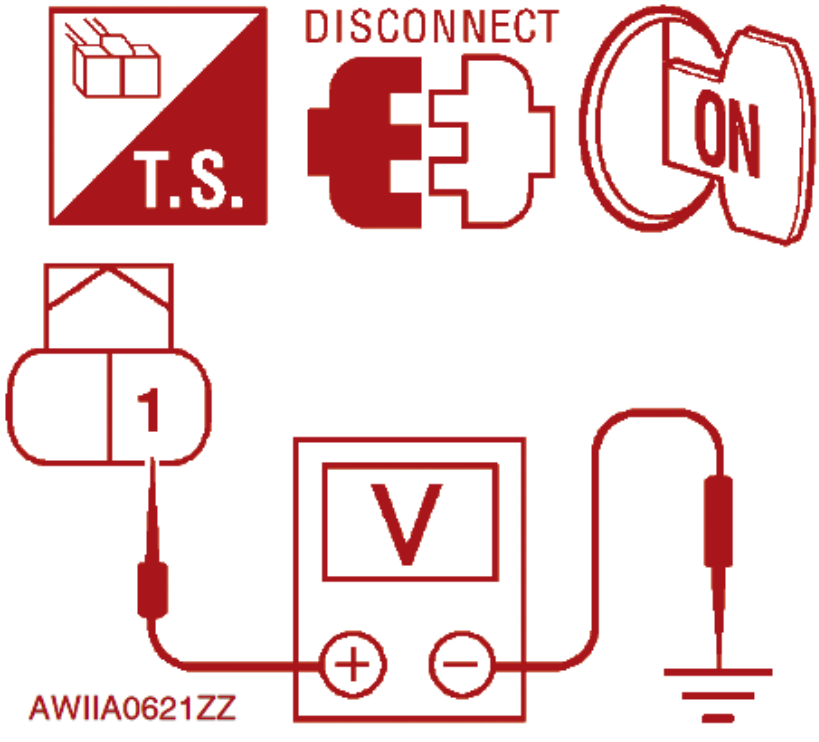
Diagnosing Compressor Circuit Failure

Before breaking out tools and going hands-on, check for appropriate technical service bulletins. All TSBs are available on Nissan-techinfo.com up-to-the-minute, and may point you in the right direction immediately. Specific information below pertains to a 2010 Altima, and can be referenced in the service manual "HAC" section.

On non-hybrid vehicles, the compressor is still belt-driven, so be sure to check whether the belt is in good health, in proper tension, and not misaligned to the compressor pulley.

Does the Magnet Clutch Not Engage?

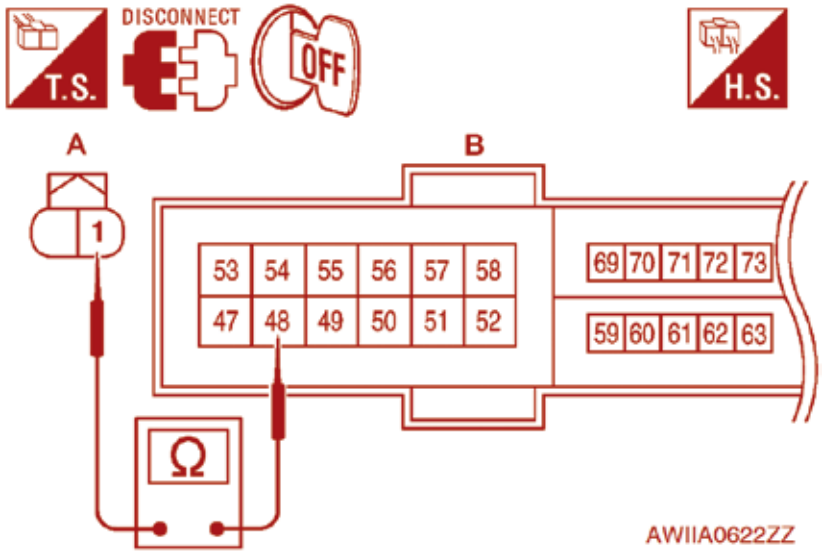
- Check the electrical circuit at the compressor connector first for power and ground. At this point, you can provide a 12v power source directly to the magnet clutch



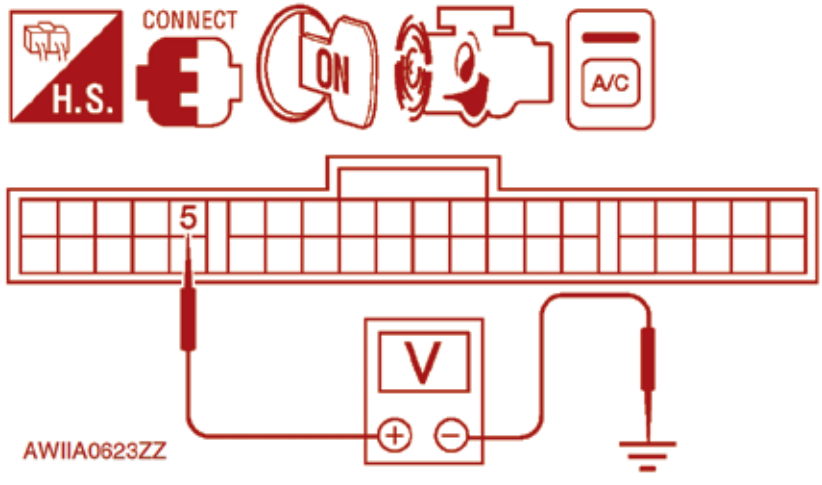
Each quick reference test diagram uses symbols to expedite diagnosis. The multimeter icon will show where to put the probe leads, and what to check for (voltage, amperage, resistance). The first icon along the top tells you how to orient yourself with the connector needed for testing: whether to look at it Terminal Side (TS), or from the Harness Side (HS) for back-probing. The second icon confirms you must disconnect the connector for testing. This third icon means Key on, Engine off. There is a separate icon for engine running, and all icons are found in the service manual "GI – General Information" section.

and confirm compressor operation.

- Check circuit continuity between AC relay in IPDM and AC compressor. Be aware that in some models, individual relays are not sold separately, and are intrinsic to the IPDM assembly.
- Check fuse in IPDM (exact location and amperage rating specified in service manual).
- Check for COMPRESSOR ON signal leaving the front air control connector when AC button is cycled.
- Check for continuity between front air control and BCM harness connections.



Testing the AC Compressor relay. Meter set to resistance. Check for continuity from AC compressor connector terminal 1 (TS) to terminal 48 of the IPDM harness connector viewed from harness side (HS).



Testing whether the compressor ON signal is leaving the front air control unit. Check the manual because the expected test results may not be obvious: Compressor ON signal = 0v; compressor OFF signal = 9-12v.

If everything checks out OK up to this point, there may be a CAN communications error. The CONSULT III plus can perform Local Area Network (LAN) testing. Perform an all-systems check, then click the CAN support monitor tab. Check for communications between BCM to ECM, and between ECM to IPDM.

It may seem heavy-handed to do all the testing outlined above, but it would be a real bummer to mistakenly replace a compressor assembly when the problem is control-related. The purpose of the above testing is to ensure that the compressor ON signal is capable of reaching the compressor magnet clutch, and once there, the clutch can cycle on.

Does the Magnet Clutch Circuit Test Good, but Still Not Engage?

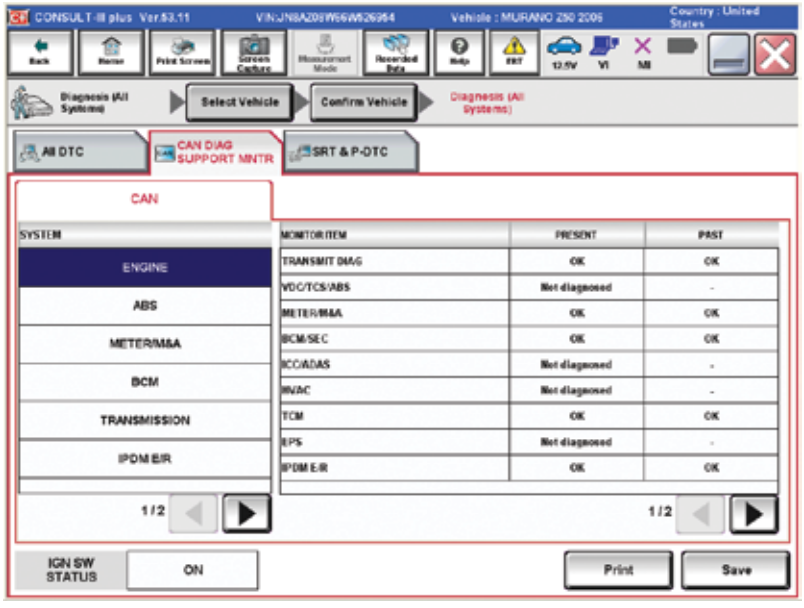
The ECM may have judged the operating circumstances such that the compressor cannot be turned on, and therefore it does not send the signal at all. We should check for the activation of safety or self-protection components:

- Check the refrigerant pressure sensor. For the 2010 Altima, compressor OFF signal will be transmitted if data from pressure sensor is less

than 17.4 psi, or greater than 398 psi. Note: this sensor test procedure is found in the service manual's "EC – Engine Control" section.

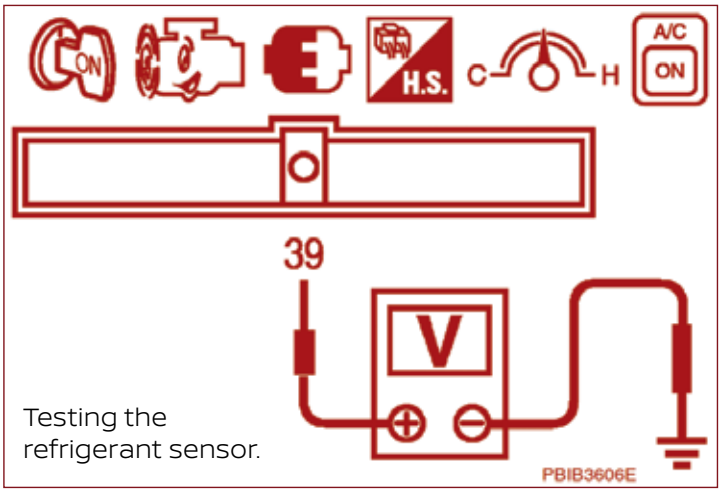
- Check the ambient cabin temperature sensor (for systems with automatic AC). Compressor OFF signal is sent when ambient temperature sensor data is < 23°F.

The ECM will also deny compressor ON signal if the vehicle is driven wide-open-throttle, if the engine coolant temperature is excessively high, while the engine is cranking, at excessively high or low engine speeds, or based on power steering demands while at low speeds.



CAN support monitor screen shows whether a control module is not responding, or has not responded recently.

At the end of the line, if a magnet clutch is determined to be faulty, Nissan offers complete rebuilt compressor assemblies at reasonable pricing. On most applications, individual clutch or coil components are not available separately.



Testing the refrigerant sensor.

Hybrid Vehicle Air Conditioning

It is worth mentioning that Nissan hybrid vehicles have different implementations for air conditioning. First, the engine is not always running, and therefore a belt-driven compressor would not operate unless the engine was started back up. Second, using the HV battery pack to power the compressor reduces engine load and increases fuel efficiency.

Electric AC compressors are three-phase motors and the refrigerant is suspended in non-conductive oil, different than standard vehicles' PAG oil. The two oils are not compatible, and using standard PAG or even normal fluorescent leak detection dyes can contaminate entire hybrid AC systems. Be sure to consult the specifics of the service manual before working on hybrid AC systems, and reference the previous Nissan TechNews article on hybrid compressors (August 2011, *High Voltage Air Conditioning*) at NissanTechNews.com for more details.

Finishing the Job with Confidence

Customers and technicians sometimes fear air conditioning repairs for the same reason: they may not succeed the first time. Properly educated, customers can be prepared for an initial recharge and then a follow-up leak check for repairs. Nissan Genuine Parts are priced competitively, and are perfect fit replacements to finish the job confidently. With support from Nissan's TechInfo website, nissan-techinfo.com, and their quality parts, you can tackle any AC problem – no sweat!