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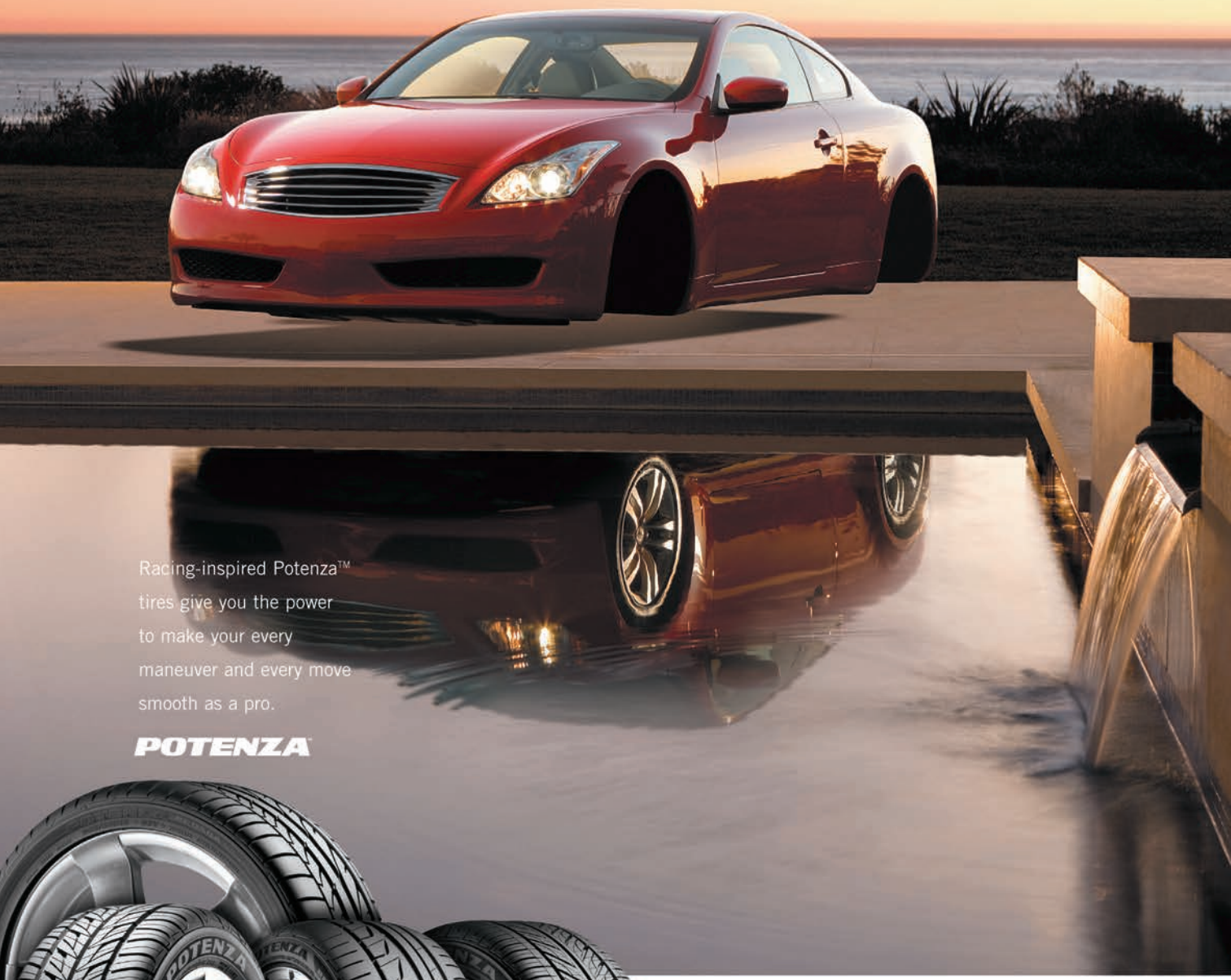

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No Codes? No Problem!

We've all gotten used to starting a driveability diagnosis with the help of a DTC or two. Don't panic when no codes are present. Instead, apply a logical procedure.

Customer concern: "Sometimes it sounds like marbles."

Getting your direction without a trouble code to kick off diagnostics can be intimidating. Modern vehicles have the ability to detect most faults that would cause a customer concern. In some ways, this can spoil us; we become reliant on the stored codes to give us that much-needed nudge. In most cases, however, sticking to a sound diagnostic strategy and logical problem-solving path will lead to success in short order. Having the proper tools, information, and training are keys to pinning down all root causes of a customer's concerns, especially when we don't have trouble codes to start with.

Recently, our shop had a good customer bring in her 2004 Nissan Maxima Her complaint was,

"Two days ago the throttle had no response when taking off from a stop. It's since become better, but now I hear abnormal noises when I accelerate."

When pressed for more information, it was determined that the noise sounded like "marbles."

Armed with this information, we plugged in the Consult 2, and performed a self-diagnosis, which showed there were no DTCs stored (Figure 2). We then went into Data Monitor mode, left it on Auto Trigger to allow Real Time Diagnostics, then selected the data items that we wanted to view. With this type of complaint, we like to look at A/F Alpha, Calculated Load, and various other items, as shown in Figure 3.

We then took the vehicle for a drive to duplicate the customer's concern. We didn't feel any issues with throttle response, and the noise from the engine compartment was fairly minor – even barely noticeable – but it was abnormal.

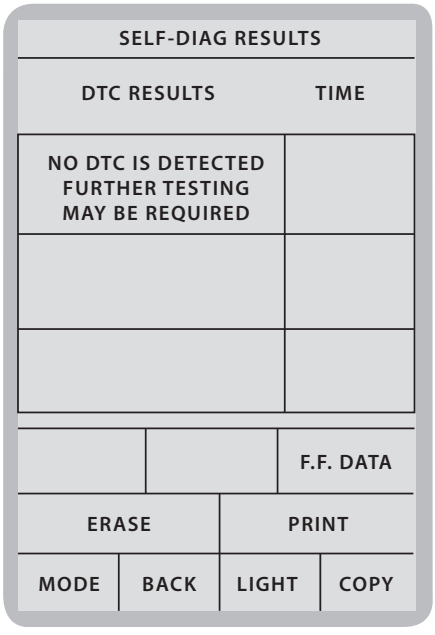


Figure 2: No codes means we need a different starting point.

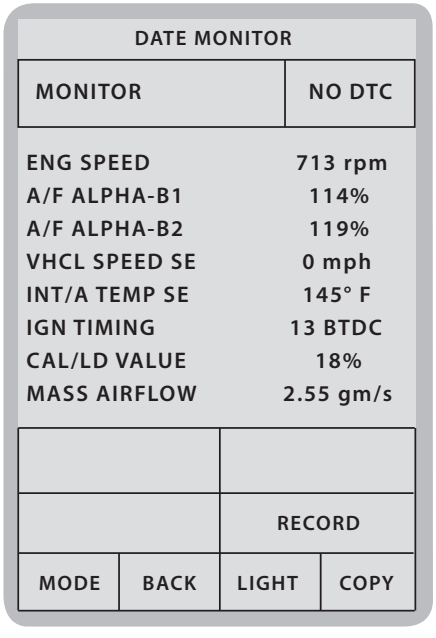
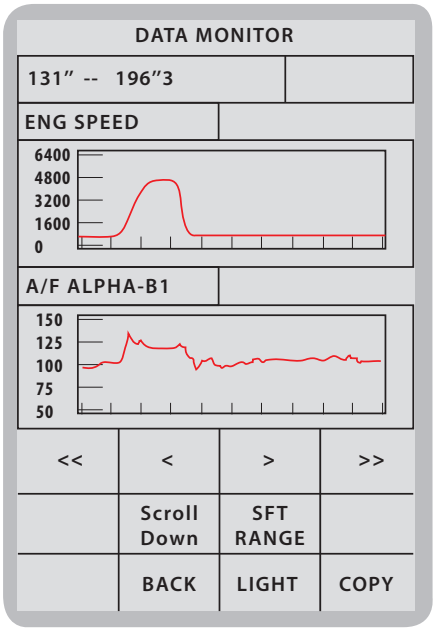


Figure 3: Real Time Diagnostics settings.



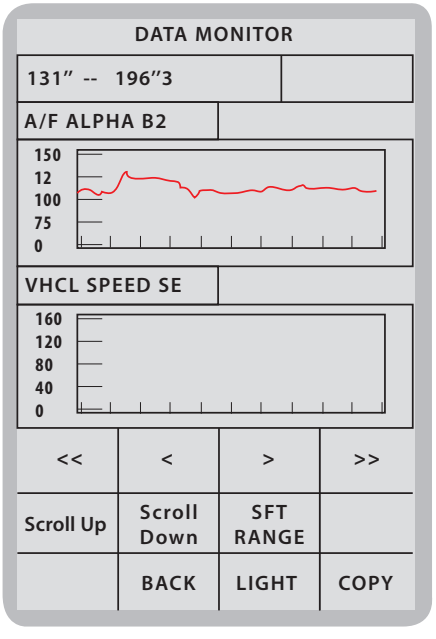


Figure 4: A/F Alpha rises rapidly with increased air flow.

In the course of the drive, the Consult 2 never displayed a DTC, but we did note some issues with the A/F Alpha that gave us a hint of what the problem could be (Figure 4).

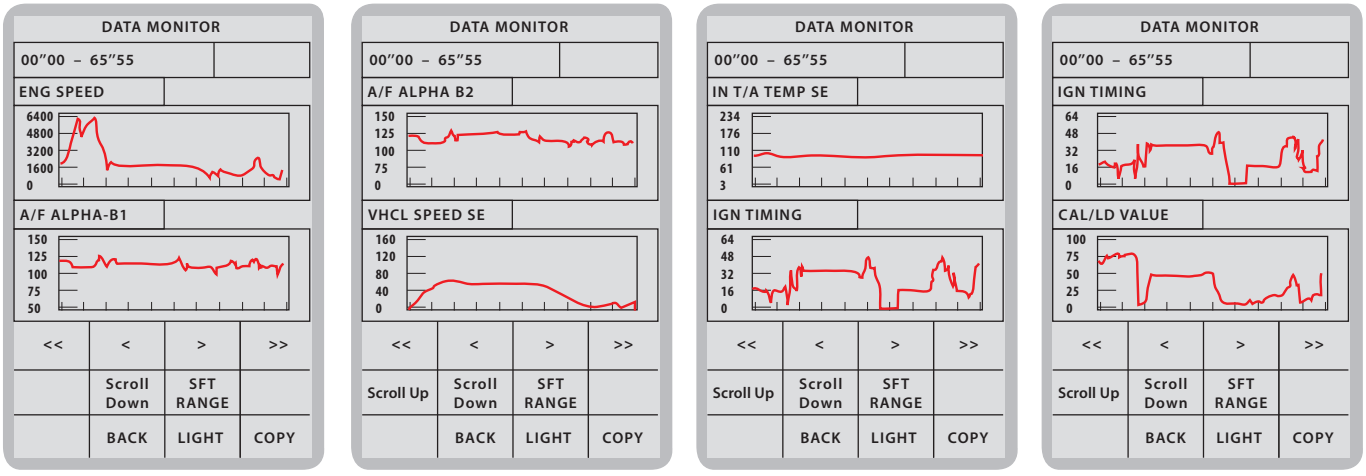


Figure 5: Reviewing the data after a test drive.

As can be seen from the data, in Figure 4, the A/F Alpha was showing somewhat lower fuel corrections at idle, but rose rapidly in concert with increased airflow. With that data, we suspected there could be an issue with the MAF sensor reading incorrectly. So we did snapshots of a couple of wide-open throttle accelerations to see what the MAF is capable of reading, and how close to reality it is.

Back in the shop, we took a closer look at the data (Figure 5). The key pieces of data are the Calculated Load (CAL/ID), A/F Alpha-1, A/F Alpha-2, rpm and Throttle Position.

What we found in the data, as we noted during the test drive, is that the A/F Alpha would rise directly when the MAF rate (as indicated by Calculated Load) would increase. We also noted that the highest load reading we could achieve at Wide-Open Throttle was in the high 70% range. Normally, we expect the A/F Alpha not to trend with the Mass Air Flow rate, and to stay at 100% A/F Alpha ± 10%. Further, we expected this vehicle to be able to achieve at least 90% Calculated Load. Clearly, was not occurring.

What exactly is A/F Alpha?

Nissan service information (http://www.nissan-techinfo.com) describes it as "the mean value of the air-fuel ratio feedback correction factor per cycle."

In other words, it's the average overall correction to the base fuel schedule. A 100% A/F Alpha indicates that the overall correction to the base fuel schedule is 0% (100% of the Base Fuel Schedule is being used). A reading of 90% means that the correction is -10% (90% of the Base Fuel Schedule is being used).

In short, A/F Alpha is a total fuel trim correction factor. To relate it to Short Term Fuel Trim and Long Term Fuel Trim, it's the total fuel correction for the bank displayed, meaning both Long Term and Short Term are included in the reading.

How about calculated load?

Nissan service information says it "indicates the value of the current air flow divided by peak air flow," which means that Calculated Load for this vehicle is the currently-measured airflow (via the MAF sensor), divided by the theoretical maximum airflow at unrestricted throttle, under the current ambient conditions. As you can see, Calculated Load on this vehicle is an excellent way to see either how well the engine is breathing, or how well the MAF sensor is reading.

Since the A/F Alpha indicated a correction for a lean condition, and the Calculated Load indicated significantly less measured airflow than the theoretical maximum at Wide-Open Throttle, the MAF sensor is the most likely reason for the data seen on the Consult 2.

But would a faulty MAF cause the customer's concerns? Yes. It can cause both of the reported symptoms. If the MAF sensor readings are significantly skewed

before the ECU has been able to learn the A/F Alpha correction, the vehicle runs too lean to stay running, which causes a loss of throttle response. Alternatively, if the vehicle lost battery voltage for any reason, the long-term learned values for A/F Alpha would be reset, which could also cause a loss of throttle response. The engine noise was due to pinging caused by over-advanced timing. As Nissan Service information shows, Base Fuel Schedule and rpm are the main parameters for scheduling the timing advance. If the MAF sensor under-reports the air flow, the base fuel schedule is less than nominal, which increases timing advance. The noise was resolved and throttle response felt great after replacing the MAF sensor and clearing the Self Learning Control (Figure 6).

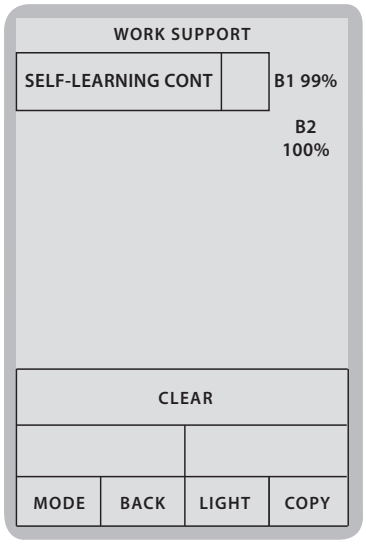
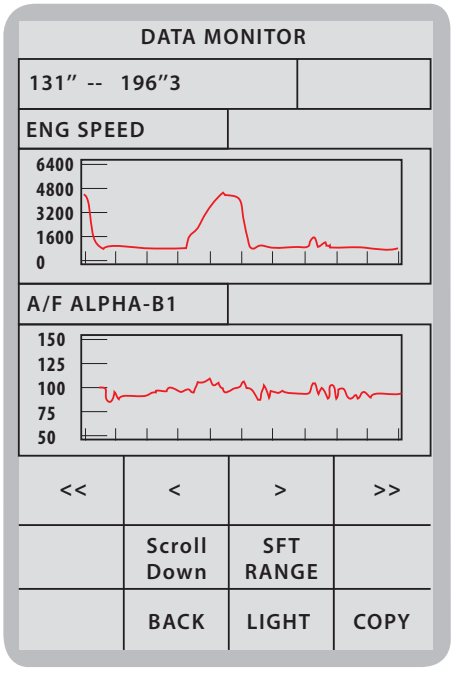


Figure 6: Clearing the Self-Learning Control.



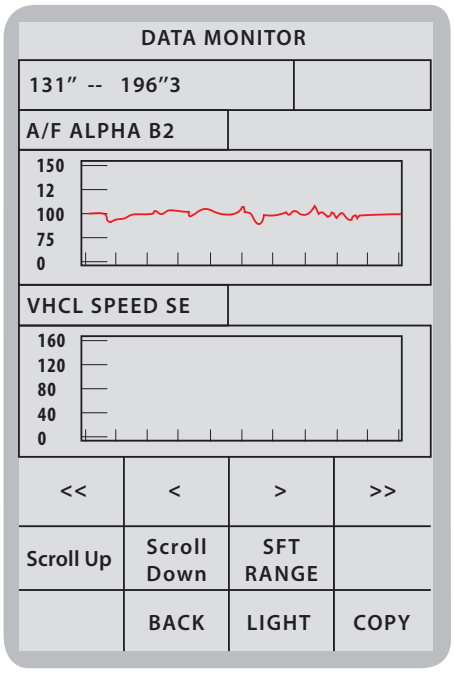
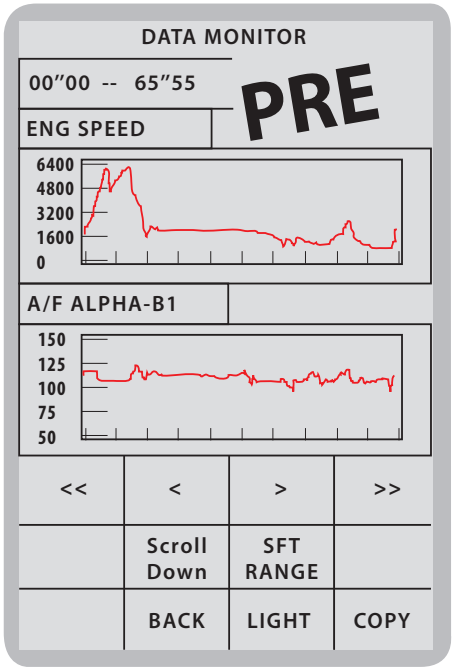


Figure 7: A/F Alpha no longer reflects pin.



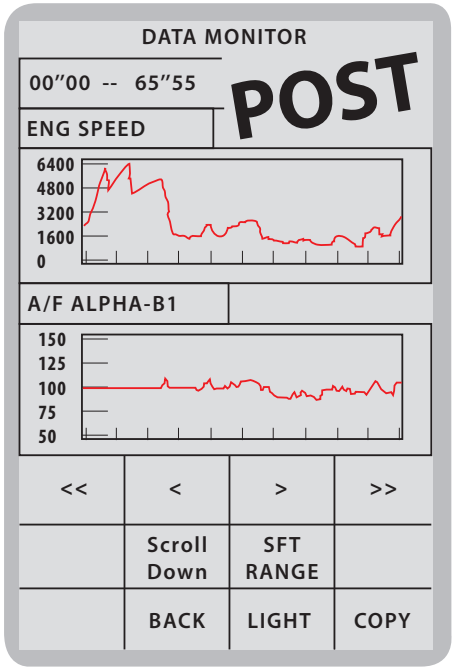


Figure 8: Before and after replacement of the MAF.

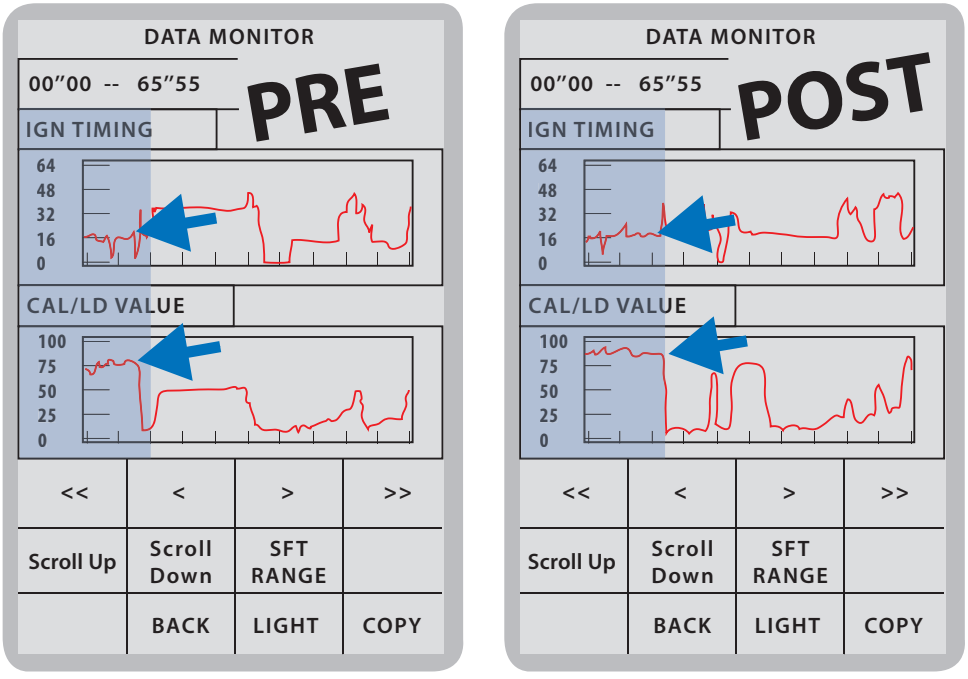


Figure 9: Calculated load is now much closer to 100% during WOT.

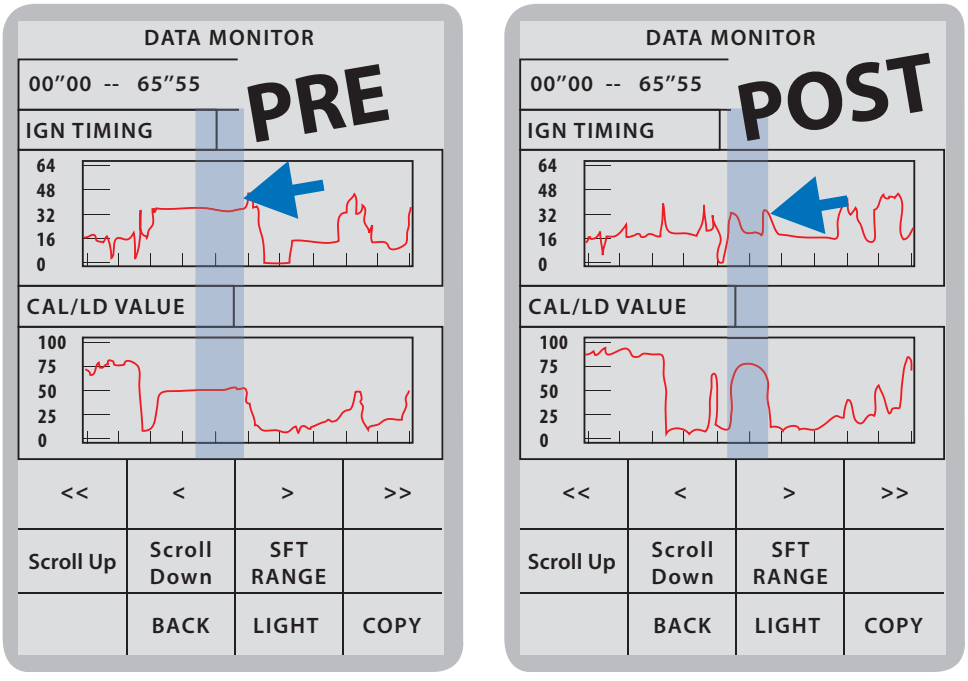


Figure 10: Ignition timing was substantially advaned with the old MAF.

The A/F Alpha on both banks looked fairly consistent between idle and higher airflows (Figure 7). Figure 8 shows how A/F Alpha has settled down during wide-open throttle – pre-repair compared to post-repair during similar hard accelerations.

As can be seen in Figure 9, the Calculated Load has changed drastically. At WOT, the timing is not greatly affected, but, as shown in Figure 10, during steady acceleration and cruise conditions, the timing is advanced significantly more with an under-reporting MAF, which caused the "marbles" sound.

The lessons to be learned from the Maxima are several: First, listen to your customer's concerns, and ask enough questions to develop a theory of what might be going on with the vehicle. Then, armed with the right tools, the right information, and a good understanding of how the system works, monitor the items corresponding to your theory, using a sound problem-solving approach. Finally, analyze the results, modify your theory if needed, then repeat the process until the problem is solved. Chances are, you'll make quick work of getting to the solution that will keep the vehicle running like new, and send your customer on her way smiling.

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Testing the Battery, Starting and Charging Systems is Not Just for No-Starts Anymore

Why test? Because you'll not only head off electrical breakdowns, you'll also prevent subtle electronic glitches that can defy normal troubleshooting.

The new way versus the old.

Today's Nissans and Infinitis are loaded with electronics. Ten years ago, you might still have had a Nissan wander into your shop with a single computer. Today, it's not uncommon to find these vehicles with 30 different control units all connected and talking to each other. If you ask yourself, "What requirement is common to every single one of these control units?" you'll have the answer to why the starting and charging system is so important today. All electronic modules must have good, clean power to work properly. If the battery, starting and charging systems aren't working properly, digital chaos will ensue. Starting and charging system testing is not just for cars towed in "no start/no crank" anymore; it's a starting point for any electrical or electronic diagnosis.

Here's a quick case study to demonstrate how charging system problems can cause some very odd symptoms. The High Capacity Actively Controlled Suspension (HICAS) light was illuminated on a 1994 J30t with HICAS 4-wheel steering, and it seemed to have no power assist. The Consult II was able to connect to the PCM, TCM, and SRS control units, but the HICAS control unit was not available. The problem? Shorted alternator diodes and a battery with a dead cell. Temporarily disconnecting the alternator and battery, then running the car with a booster pack connected restored communication with the HICAS control unit as well as normal power steering operation.

It may seem strange that a 10.45V battery and an AC-producing alternator were adequate for communication with three control units, yet not the HICAS unit, but that was the case. A few minutes spent checking the basics before launching into diagnosis likely saved hours of diagnostic time.

At minimum, a starting and charging system inspection should include a test of the battery condition, an alternator test, and a starter test. This is an important part of what's known as "base-lining" a car. Key-off parasitic-draw testing and voltage drop testing may also be needed, depending on why the test is being done and upon the results of the alternator and starter testing.

This may seem like a lot of extra work to do before starting a seemingly unrelated electronic diagnosis. The good news is that the new generation of conductance testers, such as the hand-held Midtronics EXP-1000, or the Midtronics GR-8 diagnostic station, are able to perform just such tests in less than five minutes, which makes checking the basics on every car a lot more attractive.

The old way: Testing the battery with a carbon-pile tester.

Testing the battery with an old-fashioned carbon-pile load tester can be accurate, but only if the test is done properly.

Before testing:

- Always be sure to check the electrolyte levels. If a plate is exposed, the battery may explode during load testing, assaulting you with flying plastic, acid spray, and a boom that may cause hearing loss.
- Test the state of charge. Unless the battery has rested for about six hours before the voltage measurement is taken, using a hydrometer or refractometer is a far more accurate way to test SOC (State of Charge) than open circuit voltage. After the proper rest, the open circuit voltage should be 12.45V (75% SOC), or higher, before load testing.
- If the battery is discharged, charge it properly. Charging voltage should not exceed 14.7V. Plan on a battery that is discharged to 11.89V or lower taking 10 to 16 hours (or more) to fully charge. A battery that is 12.24V will take about 5 hours to charge enough to test. The all-to-common practice of a 90-minute fast charge on "HI" will damage a battery with less than a 70% charge (12.40V), and if open circuit voltage is used as an indicator of SOC, the battery may undeservedly fail a subsequent load test.

Evaluate a battery load test as follows:

The voltage measured after 15 seconds with a load equal to ½ the battery's CCA rating applied should be greater than or equal to 9.6V with an electrolyte temperature of 70 deg. F.

However, if the electrolyte temperature is not 70 deg. F, you must compensate with the following formula:

Add 0.1V for every 10 deg. over 70 deg. F, or subtract 0.1V for every 10 deg. under 70 deg. F.

The temperature compensation is often left out of load testing, even when the battery is tested after sitting out overnight or right after a test drive on a hot day. However, it's necessary to include temperature compensation if accurate results are your goal.

Another pitfall when load testing: Recharging a battery just prior to a load test may temporarily mask a bad battery. A second load test may be a good idea if the battery required charging before the test.

The new way: Using the Midtronics System Test

The Midtronics EXP-1000 analyzes the starting /charging system in less than five minutes.

As you can see, testing a battery properly with a load tester can be very time-consuming, especially if the battery needs to be charged before testing.

Testing the battery with a conductance tester has numerous advantages:

- The battery can be tested in discharged condition.
- A recent charge will not "fool" the tester into falsely reporting it as good.
- There is no danger of explosion during testing.
- The temperature correction is made automatically, so there's no need for a chart or manual calculation.
- Test results are as accurate as load testing, when load testing is done properly, and more accurate than improper load testing.
- Tester algorithms are able to quickly find shorted cells.
- Electrolyte level should still be checked, but the battery won't explode if this step is forgotten.

The Midtronics System Test performs a quick menu-guided series of checks. The entire procedure takes less than five minutes, and can be done with a small hand-held tester, so there's no need to roll a cumbersome cart across the shop.

Many Midtronics testers are able to print a diagnostic report at the end of the system test. In fact, Nissan and Infiniti dealerships are required to submit a printout from the Midtronics GR-8 testing station for warranty claims on batteries, starters, and alternators as proof that proper testing was performed. Independent repair shop patrons will likely also appreciate documentation of problems with a manufacturer-approved testing system.

Hook it up

The Midtronics testers are easy to hook up. A system test can be performed with just the positive and negative probes clamped on the battery terminals. However, for more accurate testing, it's also a good idea to connect the amp clamp.

Connecting the EXP-1000 is simple

The amp probe clamps on the negative cable

With Midtronics testers, connecting the amp clamp is easy. It is simply placed around the negative battery cable (Figure 5). In contrast, conventional VAT testing requires the amp clamp be placed on the B+ cable at the back of the alternator, which can require a bit of contortion on some cars.

Test the battery

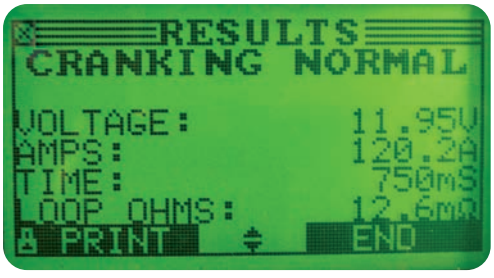
The Midtronics System Test begins with a battery check. The Midtronics tester uses conductance to determine the battery's state of health and predict how long it might continue to function adequately. A small AC ripple is applied to the battery, which generates an AC response. The relative ratio of AC current variation to AC voltage variation is measured, and an algorithm is applied to the measurement to produce a Good/Bad/Marginal response, as well a CCA rating equivalent.

Understanding load testing is certainly more intuitive, but luckily we don't need to fully understand how conductance testing works for it to work well for us. Just follow the on-screen prompts, and rest assured the results will be as accurate as a properly performed load test, just a whole lot faster.

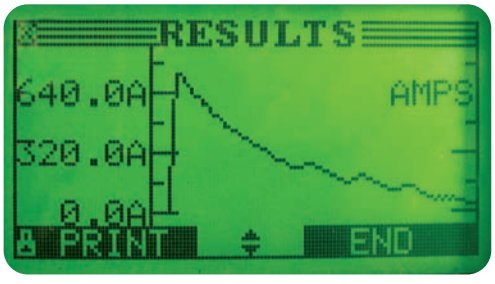
Test the starting system

After the battery test is complete, the Midtronics unit prompts you to start the car while it monitors cranking voltage (Figure 7) and amperage (Figure 8). The tester's sample rate is quite high – similar to an oscilloscope's – so it's able to measure, record, and graph spikes in both voltage and amperage in the short period of cranking before the engine starts up. This means the ignition or fuel systems don't need to be disabled to test cranking voltage and starter draw, which saves time compared to standard starter testing with an amp clamp and voltmeter.

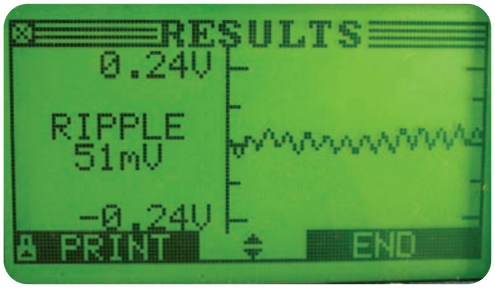
Conductance testing yields quick results



Starting system test: cranking voltage



Starting system test: cranking amperage



Charging system test: ripple voltage

Once the engine starts, the tester reports any starting system problems. If the battery is discharged or bad, the tester will remind you of this instead of displaying the starter test results, so the starting system test will need to be performed again after the battery has been recharged or replaced. The starting system test takes only a few seconds, but provides very accurate results.

Test the charging system

In the charging system test, the tester takes measurements during four phases:

- 2,000 rpm with accessories off for five seconds
- idle with accessories off for five seconds
- idle with high beams, blower, and rear defroster on for five seconds
- 2,000 rpm with high beams, blower, and defroster on for five seconds

This 20-second test yields a wealth of information. The Midtronics tester determines the health of the diodes, checks for an open or shorted stator phase, and verifies adequate alternator output.

Although it's no longer the officially recommended Nissan tool, a carbon pile tester (Figure 10) can still be useful to test alternator output beyond what accessory load will pull. So even though the Midtronics tester will nearly always be the best choice, don't roll the VAT-40 out to the curb yet. It may still come in handy in a few cases.

A carbon pile can be used to add accessory load.

The results of the five-minute test

- You know whether the vehicle's power supply system is working.
- You know whether the electronic components have adequate power when the starter load is pulling the system voltage down.
- You know whether running volt age is too high or contaminated with AC ripples.

In short, you know whether an inadequate power supply might be the cause of your troubles, or whether you should continue with the normal diagnostic procedure. If the reason for the test was a check of the basics, you're done.

However, starting and charging system inspection can also be used for the more traditional reason – finding problems that might prevent the vehicle from starting. Now that the System Test is complete, you know if the battery has the necessary capacity to start the car reliably. You know if the alternator is able to power the car and recharge the battery. You know whether or not the starter is getting the power it needs to crank the engine.

There are a few more things that need to be tested if the customer concern is a no-start condition.

Test for key off drain

Key-off drain should be checked to ensure the battery is not going to discharge while the vehicle isn't in use. The best tool for this job is an ammeter capable of accurately measuring current in milliamps. Simply hook the leads in series with the negative cable by disconnecting the negative cable from the battery post, then attaching one meter lead to the negative battery cable and the other to the negative battery post (Figure 11).

The level of acceptable drain varies depending on the battery's capacity and the length of time the car's likely to be sitting unused, but as a general rule, key-off drain should be less than 80 mA, and is usually much lower.

When testing for key-off drain, it's important to remember that control units normally stay active for a while, or even become active at certain times. A draw of 400 mA, or even 800 mA, may be normal, so long as it doesn't last too long. One method of differentiating battery-draining draws from normal momentary draws is to use the MIN/MAX feature built in to many DVOMs. The average draw can be found by recording the key-off drain over a period of time then deciding if it's acceptable.

Measuring key-off drain

Voltage drop testing in one simple step

Test for voltage drops

If the System Test finds a problem with the starter or alternator circuit, voltage drop testing may be necessary. In a nutshell, voltage drop testing is measuring how much voltage a given segment of a circuit is consuming. In starting and charging system testing, the focus is usually on the battery cables and the alternator B+ cable.

By using conductance technology, Midtronics testers provide a new and timesaving way to perform voltage drop testing without even operating the load. The tester comes with two sets of leads, the standard leads used for battery testing, and an additional set for DMM and scope testing. By connecting both sets, one at the component and the other at the battery, both sides of the circuit can be tested at the same time.

For testing the starter circuit:

1. Select STARTER CIRCUIT.
2. Select the circuit rating (150A is the default, but the tester can test circuits with ratings up to 1000A).
3. Connect battery probes to the starter: B+ to the starter's battery stud, B- to the starter housing.
4. Connect the DMM probes to the battery: positive probe to positive terminal, negative probe to negative terminal.
5. Wait for the test to complete and read the results.

There's no need to crank the engine, disable the ignition, or test one side of the circuit at a time. The results are displayed in voltage drop for both sides individually. There's no need to memorize the maximum allowable voltage drop for a given circuit; the tester will alert the user to any problems.

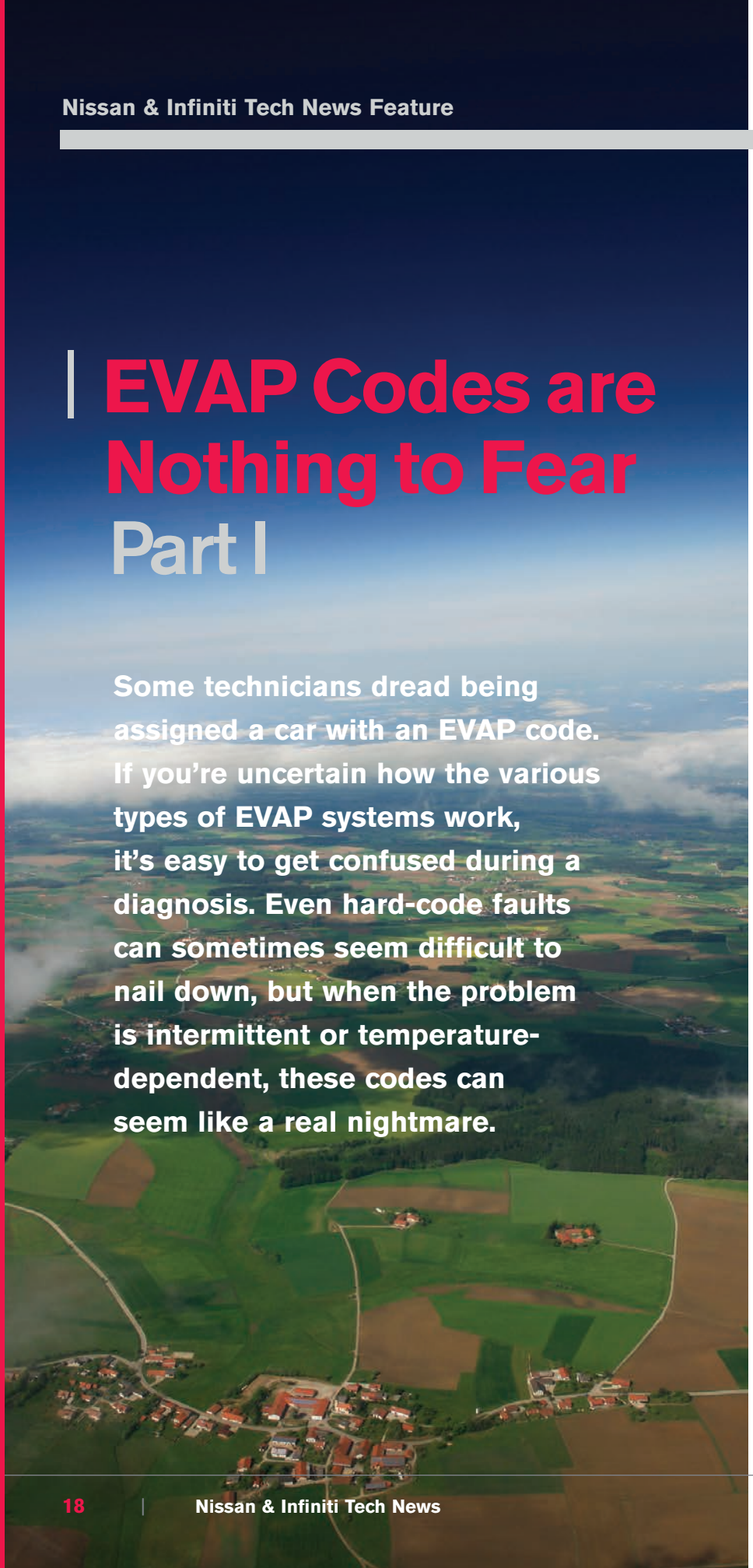
In addition to the starter circuit test, the Midtronics tester also has preset tests for the voltage drop on the alternator circuit and the battery body ground strap. Beyond that, any circuit can be voltage-drop tested by selecting OTHER, then manually entering the amperage rating.

Wrap up

In the past, battery, starting and charging system diagnosis was most often performed because a car either wouldn't start, or died while driving. On today's Nissan and Infiniti cars, these systems' critical responsibilities go far beyond providing power for the starter and ignition system. Digital communication's role will only increase with every new model year. Quickly verifying a good power supply will be key to avoiding unnecessary diagnostic difficulties. So, whether you're diagnosing a warning light or a power window, start with the basics -- verify a good power supply. You'll be glad you did!

EVAP Codes are Nothing to Fear Part I

Some technicians dread being assigned a car with an EVAP code. If you're uncertain how the various types of EVAP systems work, it's easy to get confused during a diagnosis. Even hard-code faults can sometimes seem difficult to nail down, but when the problem is intermittent or temperature-dependent, these codes can seem like a real nightmare.



This is Part One of a two-part series on how to diagnose evaporative emissions systems. It starts with an overview of the Nissan/Infiniti evaporative emissions system logic, then discusses leak testing and best repair practices. Part Two will focus on specific EVAP system faults.

After reading this series, you'll be on your way to becoming a fearless conqueror of EVAP maladies, rather than a finger-crossing gas cap tightener who hopes that the car will be assigned to someone else when it comes back. If you are already an EVAP pro, you may still be able to pick up a useful tip or two, so read on.

What is EVAP?

The evaporative emission control system (EVAP) is designed to reduce the amount of fuel vapor that escapes from the fuel tank while the car is in use or parked.

The fuel tank must be vented. Without a vent, the tank would over-pressurize due to thermal expansion, and draw into a vacuum and collapse as the engine used fuel.

Before EVAP systems were introduced in 1971, the tank was vented directly to the atmosphere, which avoided the pressure and vacuum issues, but allowed fuel vapors to escape into the atmosphere where they can combine with oxides of nitrogen and create ground-level ozone. This compound can damage lungs and aggravate respiratory conditions.

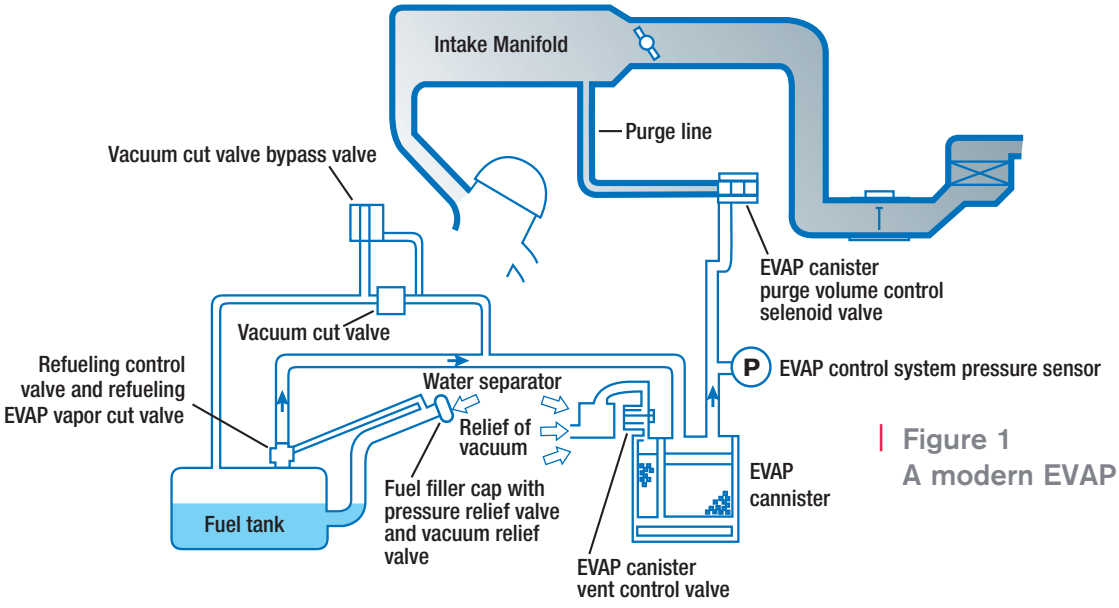


Figure 1
A modern EVAP System

What's been done?

Evaporative emissions account for a large percentage of the total HC vehicles emit. Therefore, reducing evaporative emissions has been of some concern for Nissan/Infiniti for decades. The company has made many improvements to its EVAP systems over the years. What was once a very simple system has grown in efficacy and complexity. In the 1970s, Nissan (no Infiniti division yet) used a basic system with a charcoal canister to store vapors from the fuel tank and carburetor (remember them?) float bowl. When the engine is running, fuel vapors are purged from the canister and burned by the engine. There is no facility for monitoring whether or not the EVAP system is working, and no feedback control of the purge flow.

In the early 1990s, Nissan/Infiniti added an EVAP and EGR control solenoid valve to prevent EVAP purge and EGR flow under certain conditions. The self-diagnostic system was not able to detect any EVAP system faults. In the mid-1990s, Nissan/Infiniti added purge control to more accurately manage the burning of stored vapors. This was accomplished by adding an EVAP canister purge control solenoid valve to regulate the flow of fuel vapor into to intake while the throttle is open. The only detectable fault is an open or short in the canister purge control solenoid valve circuit.

Around the turn of the century, Nissan/Infiniti gave its EVAP systems a complete makeover. Many major changes were made over the space of just a few years, and a number of new components were added to the systems.

Use Figure 1 and the component descriptions that follow to familiarize yourself with the type of EVAP system you'll most likely encounter in the service bay. Today's EVAP systems resemble one another more than they differ. Sorting out any peculiarities is easy when you have a good grasp of the basics, so having an idea of how this example system should work – even before you crack a book or open a hood – will save you a lot of time.

Components

Figure 2
The purge valve is a duty-cycle controlled by the PCM

Nissan/Infiniti usually calls the purge valve the "EVAP Canister Purge Volume Control Solenoid Valve," which is an extremely accurate name, but quite a mouthful. The purge valve regulates the flow of fuel vapors from the canister into the intake manifold. It also provides vacuum for OBD II leak testing. The valve is duty-cycle controlled by the

Figure 3
The fuel tank pressure sensor works like a MAP sensor.

PCM, so it does more than just allow or block flow; it regulates the flow based on feedback from the oxygen sensor. You'll almost always find the purge valve mounted close to the intake manifold.

The fuel tank pressure sensor is a pressure/vacuum transducer. It's similar to a MAP sensor, but can respond to much smaller changes in pressure. The sensor has three wires. Two are for 5V reference and ground; the third is the signal output. Its output is a voltage that will change as the pressure changes. The pressure sensor can be located on the fuel tank, but most often it is found in the purge line between canister and the purge valve.

The EVAP canister is typically a plastic box with three ports. The canister is packed with very fine charcoal powder. Its exposed surface area is substantial enough to absorb a fair amount of hydrocarbons before it becomes saturated. When fuel vapors are forced from the tank by thermal expansion, they're routed through the canister where the charcoal absorbs the hydrocarbons. Only fresh air is allowed to escape into the atmosphere. Once the engine is running, air is routed through the canister and into the intake manifold, which strips the HCs from the charcoal and carries them into the engine where they're burned as fuel.

The canister vent valve is an ON/OFF solenoid valve controlled by the PCM. It goes by a lot of names and abbreviations. Nissan/Infiniti usually calls it a "Canister Vent Control Valve" in the manuals, but your scan tool may call it by another name. Regardless, the vent valve always functions the same way. When active, the valve closes to seal the canister vent, thereby shutting the EVAP system off from the atmosphere. The only time the PCM closes the canister vent is during OBD II EVAP system self-testing; the rest of the time there's no voltage applied, which allows air to flow though the canister. You'll almost always find this valve bolted directly to the canister.

The water separator is a plastic tank with baffles inside, designed to keep water (from puddles, etc.) out of the canister. If the charcoal in the canister is waterlogged, it cannot absorb HCs. A badly saturated canister can also become

Figure 4
The canister stores and separates fuel vapors.

Figure 5
The canister vent valve is activated on during self-test.

Figure 6
The water separator is the canister's fresh air intake.

clogged. The water separator has no moving or wearing parts, so it's not a high failure item. However, sometimes bugs build nests inside the water separator, which can cause symptoms similar to a stuck-closed canister vent or a clogged canister.

The vacuum cut valve is not electronic. It's a mechanical check valve that only allows flow in one direction. Its purpose is to prevent vacuum in the purge line from reaching the fuel tank. It is always located in the line between the fuel tank and the canister.

Figure 7
The vacuum cut valve is a mechanical check valve.

The vacuum cut valve bypass valve is an ON/OFF solenoid valve controlled by the PCM. It's mounted in parallel with the vacuum cut valve. Its purpose is to bypass the vacuum cut valve during EVAP self testing, which makes perfect sense when you think about it – if the vacuum cut valve's job is to block vacuum to the tank, how else could a vacuum be applied to the tank during testing? The bypass valve can be easily identified because the vacuum cut valve is always right next to it.

Figure 8
The bypass valve bypasses the check valve during self-test.

Other players

- **Fuel cap:** Laugh if you must, but this is a critical component! Did you know there are calibrat ed pressure and vacuum reliefs built into the fuel cap? Choosing the proper cap is very important. Just because it fits, doesn't mean it's right. Buying from Nissan or Infiniti by VIN is the best way to avoid headaches.

- **Fuel Tank Temperature Sensor:** This is a thermistor, just like a coolant temperature sensor. Not all Nissan and Infiniti cars have fuel tank temperature sensors. Its primary purpose is as an input for Engine Off Natural Vacuum (EONV) testing, where the PCM uses the naturally-occurring pressure changes in a closed chamber – in this case the fuel tank – to determine whether the system is well sealed.

- **Fuel Level Sensor:** On some vehicles, the fuel tank level sensor provides additional input to the PCM for EVAP testing.

The efficacy and reliability of Nissan/Infiniti's EVAP systems have greatly improved over time. In spite of this, EVAP system repairs are on the rise, but only because 10-year-old cars with 10-year-old rubber components are capable of detecting tiny leaks, whereas a 13-year-old car (pre-OBD II) wouldn't know if you left the gas cap off entirely. If the measure of an EVAP system's efficacy is its ability to reduce evaporative emissions, then Nissan/Infiniti's current systems are better than ever, which is a good thing for everyone who breathes air, as well as techs who know how to fix them.

So, you found an EVAP code. What's next?

The first step, no matter what code you find, should be to copy or print the freeze frame data (Figure 9), then note any information you find in it that might help your diagnosis.

Figure 9
Capture the freeze frame data.

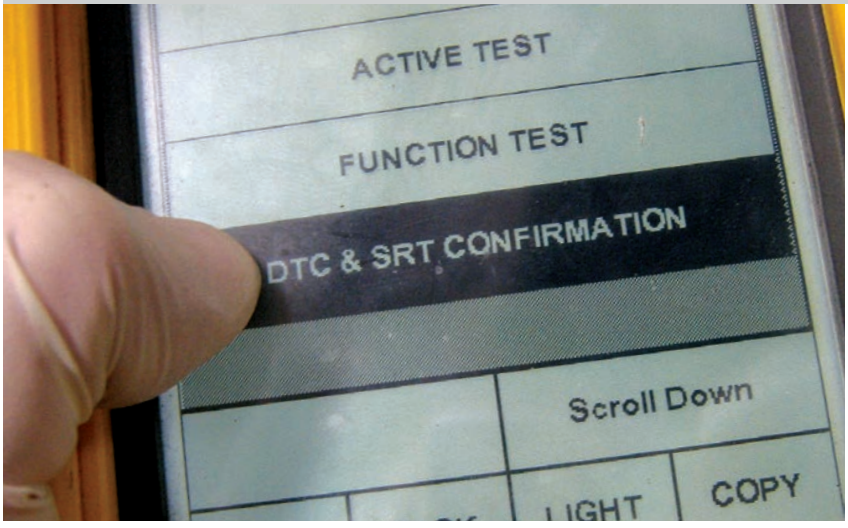


Figure 10
The Consult's Confirmation Procedure can save you time.

You might also want to collect the Mode 6 data for the EVAP monitor before clearing the codes. This data can be used after the repairs are complete to determine how much improvement the repair caused, rather than just a pass/fail on the monitor status.

If you have a Consult II, clear the code then use the DTC confirmation procedure (Figure 10) to verify the problem is still present. If you don't have a Consult II, you are probably better off just jumping into diagnosis. It will likely take at least 20 minutes to get the EVAP monitor to run; your time will likely be better spent following the diagnostic procedures for the stored code.

Finally, before you spend a bunch of time, do yourself a favor: Check for TSBs. Some EVAP problems are well known and documented. A relevant TSB for your code may lead you straight to the cause of the trouble. Some EVAP problems might be nearly impossible to fix without engineering help.

Even if you don't have a Nissan/Infiniti Techinfo subscription, you can read through the TSB descriptions for free (Figure 11). Just visit the Nissan/Infiniti Service Information website (http://www.nissan-techinfo.com), or the Infiniti Service Information website (http://www.infiniti-techinfo.com).

If you find a relevant TSB, paying for a one-day subscription may save you hours of diagnostic work. Unlike many aftermarket information services that are updated on a quarterly basis, Nissan/Infiniti Techinfo always has the latest and most accurate information available.

Testing for EVAP leaks

You may have noticed that Nissan/Infiniti recommends using a hand-held pump, low-pressure gauge, and an ultrasonic leak detector for EVAP leak detection. However, since most independent shops do not own an ultrasonic leak detector, this article will focus on using smoke machines, which are becoming common.

It is extremely important to use a smoke machine that regulates pressure to 0.5 psi (14 inches of water). If pressure exceeds 0.6 psi (Figure 12), it may damage EVAP system components and produce invalid findings. Many types of smoke machines exceed this pressure, and are not suited for EVAP testing. In addition, some types of smoke machines use a glow plug than can ignite fuel vapor if any is allowed to flow back from a pressurized EVAP system into the smoke machine.

Some auto manufactures that recommend smoke machines for EVAP diagnosis also recommend using nitrogen instead of pressure-regulated shop air. Nitrogen is an inert gas, so a combination of fuel vapor and nitrogen will not ignite.

However, using nitrogen does not eliminate the need for common sense, nor does it make it impossible for you to burn your customer's car and your shop to

Figure 11
Review Nissan/Infiniti TSB descriptions for free.

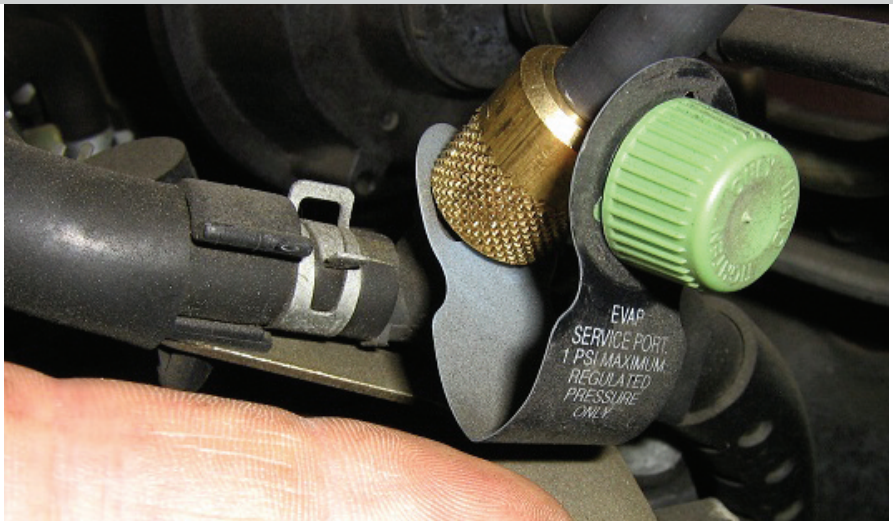


Figure 13
Remove the Schrader valve for smoke testing.

the ground. Whether using shop air or nitrogen in the smoke machine, vapors escaping from the EVAP system will mix with air and become combustible. Always post "Inflammable" signs in your work area when doing EVAP work, and keep potential sources of ignition away from fuel vapors.

Service port

Most modern Nissan and Infiniti cars have an EVAP service port (Figure 13). The port has a green cap, and can be found near the purge valve, somewhere near the intake manifold. The EVAP service port has a high-flow Schrader valve, similar to those found on A/C systems, but with one important difference: The EVAP service port valve core has reverse threads; it must be spun clockwise for removal, and counter-clockwise for installation. If you didn't read that last sentence, replacement service ports are available from your Nissan or Infiniti dealer.

In order to use the service port for testing, the valve core must be removed. Typically, smoke machines designed for EVAP testing come with an adaptor to connect to the port.

Figure 12
Use only a smoke machine designed for EVAP testing.

Leak check, then smoke

Before filling the system with smoke, it's a good idea to do a quick leak check as follows:

- Close the canister vent control valve using a scan tool.
- Apply 0.5 PSI using the smoke machine without smoke.
- Monitor the flow gauge. If there are no leaks, the ball should settle at the bottom of the gauge after the system fills. If the ball continues to float, the system has a leak.

Once the smoke machine is hooked up and pumping smoke into the service port, it will take a while to displace the air in the EVAP system. Many smoke machine manufacturers recommend removing the gas cap to allow trapped air to escape faster, then replacing the cap once smoke comes out of the filler neck. However, if you disturb the gas cap, and it wasn't fully tight or its gasket seals only intermittently, you'll have removed the cause of the problem without knowing it.

A better way to let the air escape is to open the canister vent. If the canister vent is still being held closed from the leak check, you'll need to open it with the scan tool. The canister vent close valve is normally open, so if you didn't close it during the leak check, it will already be open.

There are two advantages to this technique:

- It leaves the system as found, without disturbing the cap.

- Fuel vapors are vented through the canister, reducing the amount of explosive vapor that is pumped into your shop.

Once the system is full of smoke, you'll be able to see it escaping from the leak. Using a very bright light will make the smoke much easier to see. Just follow the purge line from the purge volume control solenoid valve to the canister, then from the canister to the by-pass valve and vacuum cut valve and on to the tank and filler neck.

Some leaks are affected by temperature changes. If you can't find a leak on your first try, it might be a good idea to let the car sit overnight and check it first thing in the morning. Your customer may not be happy about leaving the car overnight, but he or she will likely be more upset if the car must return several times to figure out what the problem is.

Repair it right

Very small EVAP leaks can cause very big headaches. Why add to someone's future frustration (maybe yours!) by using incorrect or sub-standard parts? It may occasionally seem like a good idea to replace a defective section of purge hose with some bulk fuel line and a couple of screw clamps to avoid waiting for parts to arrive from your Nissan or Infiniti dealer. But when the repair starts to leak later, it won't seem so wise. Here are a few tips to avoid comebacks and embarrassment:

- Lubricate EVAP O-rings with mineral oil, Nissan/Infiniti part number 999MP-AJ000. This is not just for lubrication on installa tion; it also improves the seal.
- Use Genuine Nissan/Infiniti EVAP hose with the proper constant-tension clamps to avoid future temperature-dependent leaks.
- Use Nissan/Infiniti fuel caps, ordered by VIN. Some fuel caps look the same, but are in fact different.
- Replace the canister vent valve O-ring any time the canister vent valve is removed.

Completing the monitors

After diagnosis and repair, you could deliver the car to the customer with the trouble codes cleared and the System Readiness Tests (SRT), or Monitors, incomplete, and it would probably be okay. But what if you made an error in diagnosis, or a hose disturbed during service is now leaking? The only way to check your repair work is to verify that the EVAP monitor completes successfully. There are two ways to cause the monitors to run.

One way is to drive the car in a way that meets certain criteria necessary for the monitor to run. This is known as a "drive cycle." Drive cycles vary from car to car, so to find the exact procedure, you'll need to check http://www.nissan-techinfo.com or http://www.infiniti-techinfo.com.

The typical drive cycle begins with a cold engine, idled until warm, then driven alternately between periods of steady 55-60 mph driving and idling. Many techs find that using a dynamometer to complete the drive cycle makes completing the SRTs easier, since traffic and road conditions make adhering to the drive cycle pattern difficult. However, even with a dynamometer, completing the drive cycle can be time-consuming.

Figure 14
The Consult makes running the SRT's easy.

An easier way to cause the EVAP monitor to run is to use the DTC confirmation procedure available on the Consult II/III (Figure 14). This allows a single SRT to run without completing a drive cycle. Availability and procedure vary from car to car, so consult service information for specifics. In general, 1999 and newer Nissan and Infiniti vehicles will have DTC confirmation procedures available to speed clearing EVAP monitors.

Use what you've learned

If you weren't very familiar with EVAP systems, you now have some new things to try the next time you're assigned a Nissan or Infiniti with an EVAP code. Better yet, play around with a known-good car the next time you have some free time. A few moments borrowed from your boss to improve your knowledge of how a car should work will surely be repaid with faster diagnosis the next time you encounter a car that isn't working as it should.

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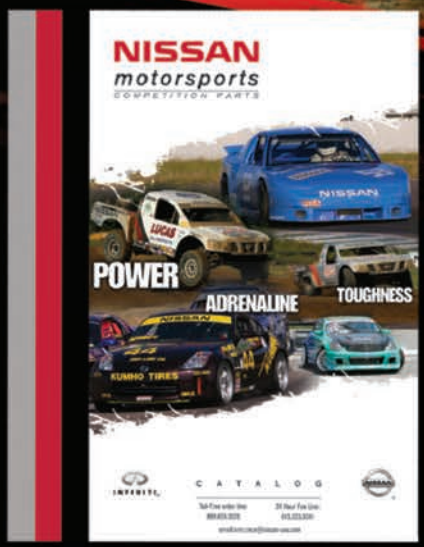

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