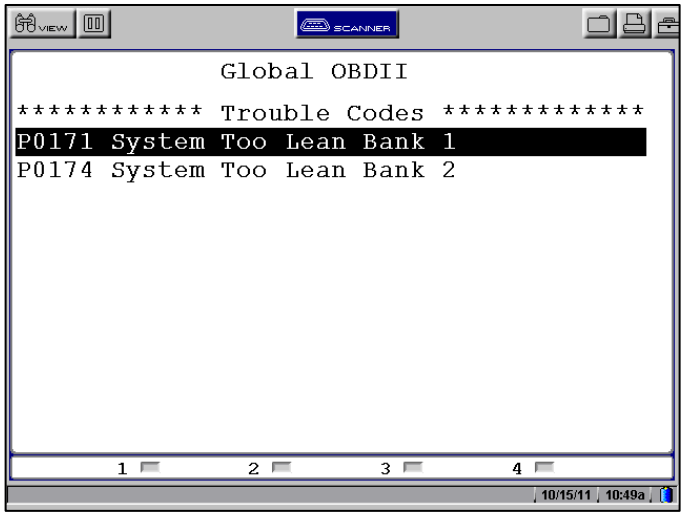
The Choking Maxima

A 2000 Nissan Maxima came in with a complaint of a 'slipping transmission', but it was obvious driving into the service bay that this customer's best guess was nowhere close. The idle was so rough that we almost made an equally rash assumption that the 3.0L V6 needed the all-too-common ignition coil replacement. However, a quick check of the stored codes revealed not P020X or P030X codes, but P0171 & P0174 codes for lean conditions on both banks.



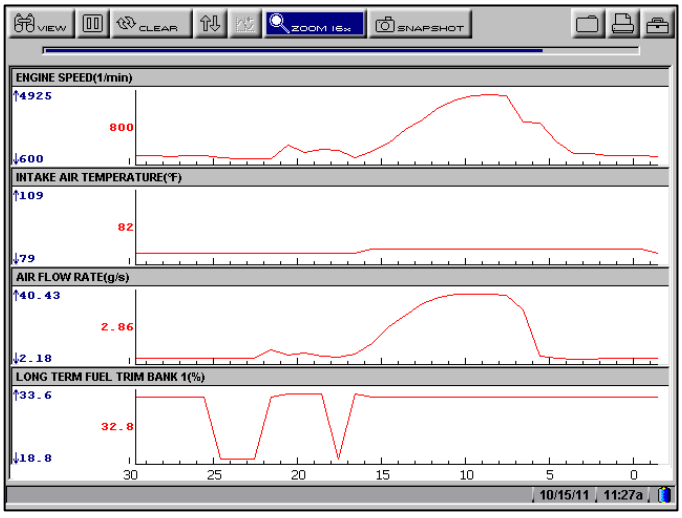
Best First Test?

These lean codes are common for all manufacturers, and they are not component-specific. Could these codes be set by a coil failure? Possibly, but Nissans reliably set actual coil codes and misfire codes for coil failures. Still, the list of possibilities is endless. At ATG, we try to choose the tests that return the most information with the least effort to not only fix the car correctly the first time, but to do it in a fraction of the time compared to the traditional flowchart diagnostic path.

The ATG approach asks what every one of the possible faults has in common, and for these codes the only possible answers are that the engine is breathing wrong or that it's fueling wrong. A simple Scan Tool test drive can zero in on which of those two areas need more focus. No fuel pressure check? No inspection for vacuum leaks? Until the Scan Tool says one of those tests is needed, they're just a waste of effort. It's time for a VE test.

Volumetric Efficiency vs. Fuel Trim

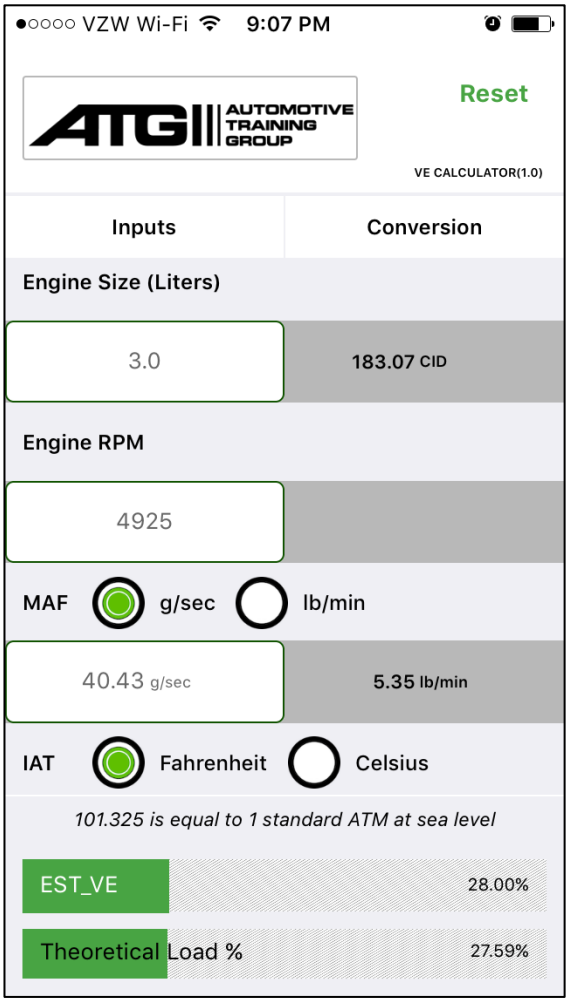
Can this engine breathe? Can it fuel? A simple Volumetric Efficiency (VE) test determines engine breathing as a percentage of engine displacement, and Fuel Trim determines how hard the closed loop engine management system is struggling to keep the mixture correct. Both of these topics are discussed in great depth in ATG manuals and seminars, but for this case let's just plug some test drive numbers into the free ATG VE app (use the online version at www.atgtraining.com or check your app store).



The test drive capture above shows the MAF sensor grams per second, engine speed, and intake air temperature (IAT) during full-throttle acceleration. Long Term Fuel Trim is added in order to make sense of the results (more on that later).

VE Calculation

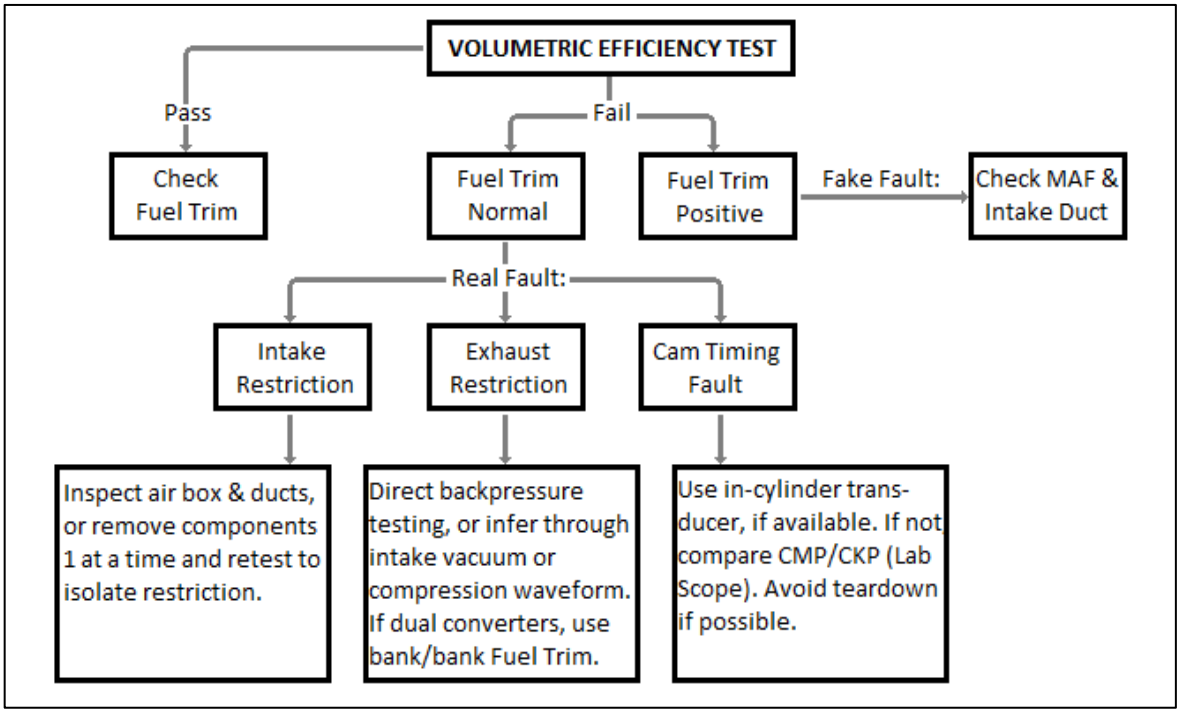
The IAT and peak RPM and MAF values were entered into the ATG VE calculator, and the result is 28%! So this 3.0L engine was only flowing 0.84 Liters. This engine should have a VE over 90%, so that clearly explains why it's running poorly.



The Breathing Diagnostic Path

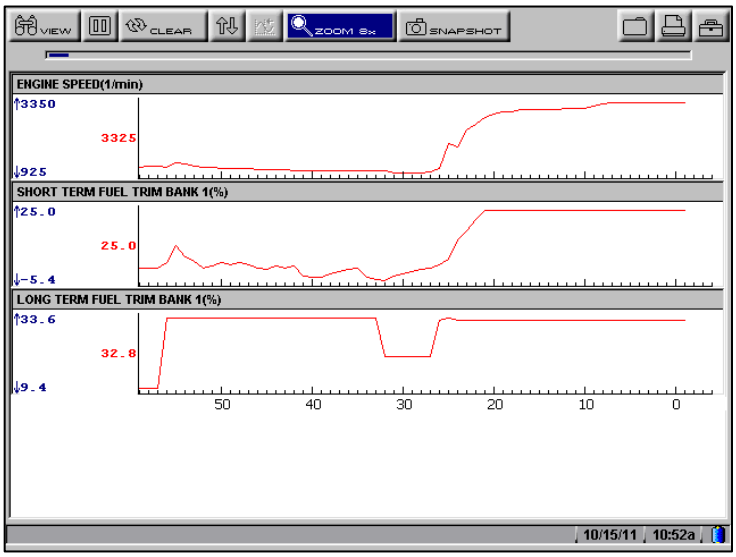
The chart below is our own universal breathing flowchart (for MAF engines) that we've used in many of our manuals and seminars. The path clearly shows that for a low VE results, the Fuel Trim values determine whether you're dealing with a real breathing fault or a 'fake' one.

- Real breathing faults include intake restrictions, exhaust restrictions, cam timing faults, and certain other intake or engine mechanical faults.
- Fake breathing faults include the MAF sensor and, well, that's it unless the duct is torn between the MAF and throttle plate. In other words, the MAF is reporting airflow that is far lower than actual airflow. Too little fuel is injected based on the low MAF value, so Fuel Trim is positive to compensate.



More About Fuel Trim and Real Breathing Faults

The ATG breathing diagnostic strategy in the chart on the previous page indicates that low VE should be compared to Fuel Trim to see if the breathing fault is real or fake. An engine that really is breathing poorly will have a low MAF signal and deliver appropriately low fuel quantities. The end result is a somewhat normal Fuel Trim. Low airflow plus low injection quantity yields a poorly running engine with near perfect mixture! This makes Fuel Trim the best indicator for determining what to do with a low VE result.



In the capture to the left, the Short Term and Long Term Fuel Trim added together at high RPM is 57.8%, so according to our chart, this is clearly a 'fake' breathing fault. Again, if the engine is really breathing at 28%, it will be fueling for 28% and Fuel Tr4im will not need to adjust. The fact that this PCM is adding so much fuel indicates that the MAF value is lower than actual engine breathing. If the intake duct isn't disconnected or torn, then it needs a MAF sensor. It just does. Sure, MAF circuits may fail, but it's extremely rare. While we don't like bolting parts on, when more than 99 out of 100 have good circuits and connections, spending a half-hour checking all circuits on the other 99 makes no sense.

Conclusion

The point of this case study isn't that it is difficult. The point is that it is a reliable diagnosis in 10 minutes, including a quick visual of the intake duct, and a check of the MAF for debris in the air path – no dead bugs here! Can you make money being that sure in 10 minutes? We think so. And this isn't just about MAF sensors – it's about asking the right questions up front to best categorize the fault, so that every testing decision is more focused than the one before. Remember, your time is your money.