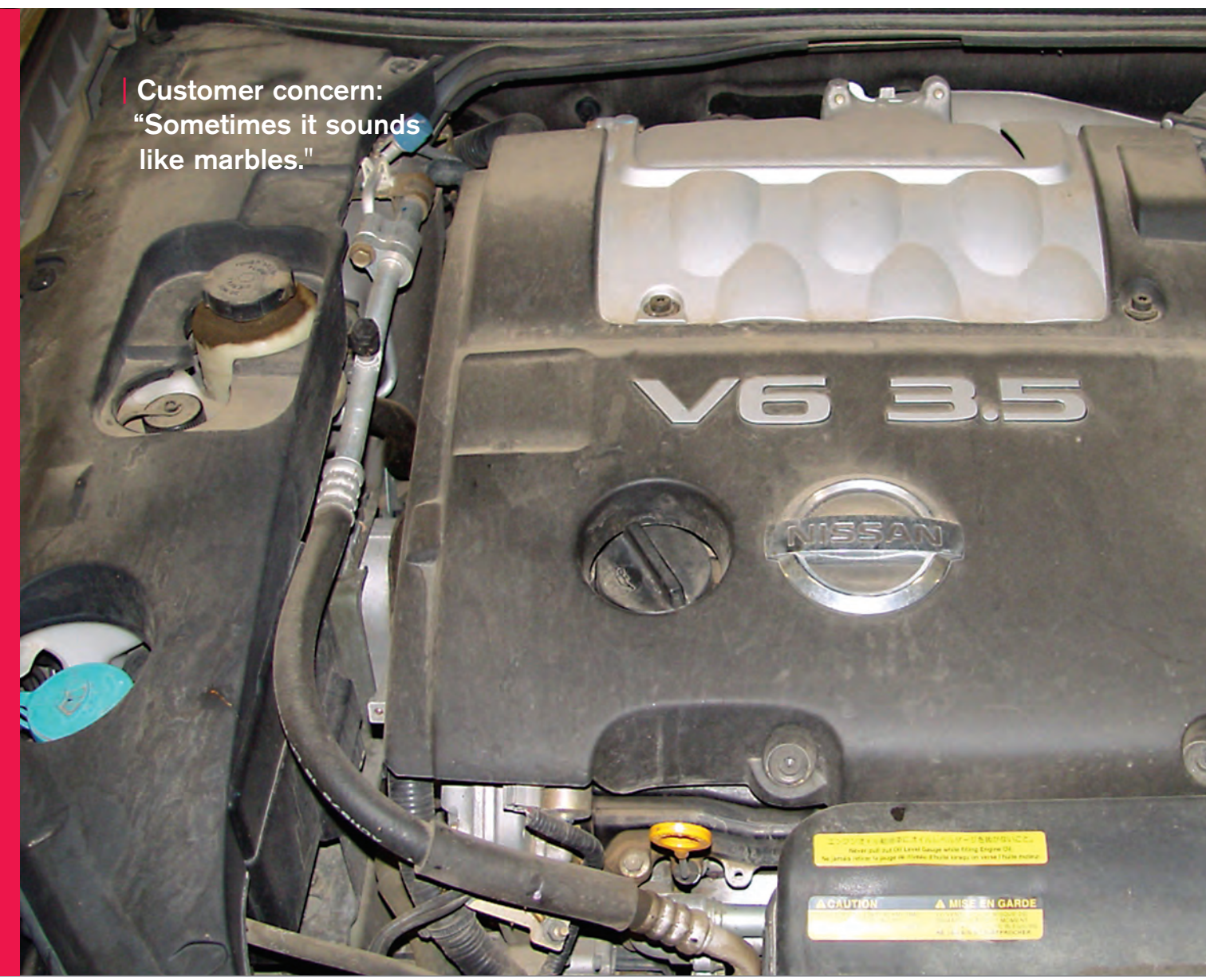
No Codes? No Problem!

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.

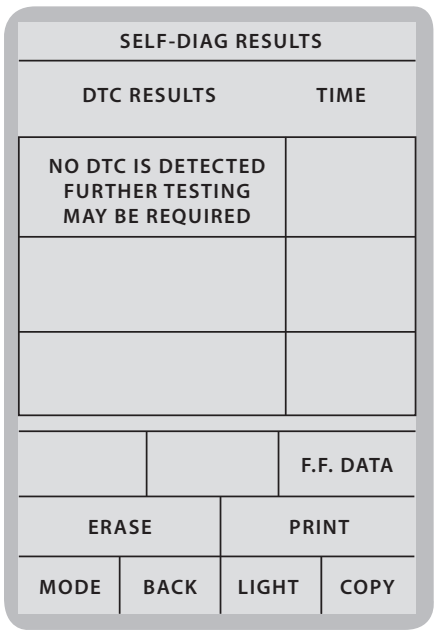


Figure 2: No codes means we need a different starting point.

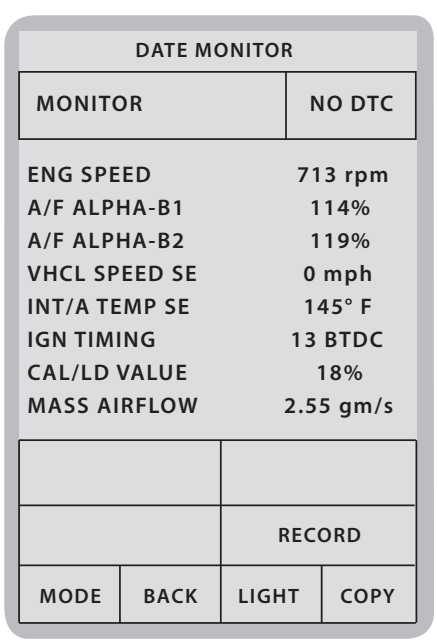
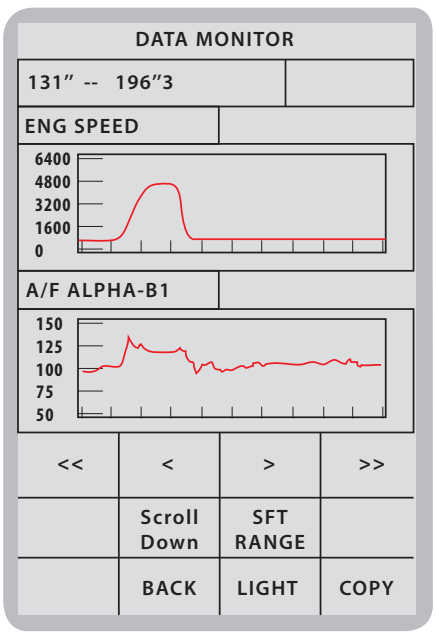


Figure 3: Real Time Diagnostics settings.



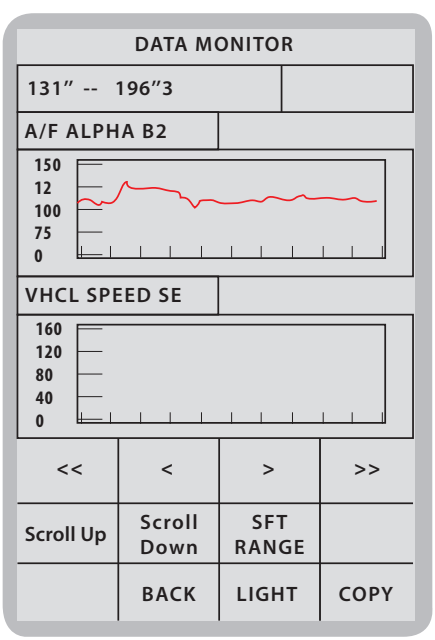


Figure 4: A/F Alpha rises rapidly with increased air flow.

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).

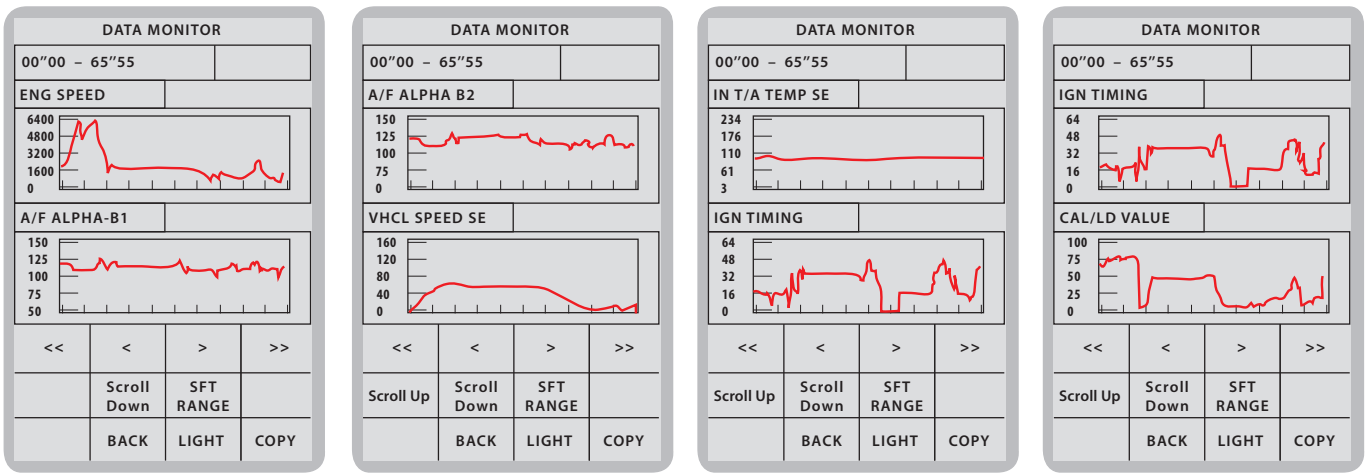


Figure 5: Reviewing the data after a test drive.

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).

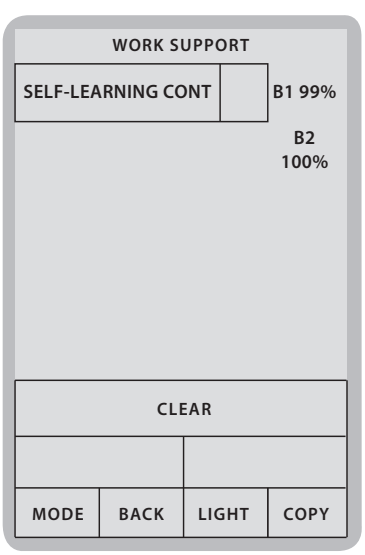


Figure 6: Clearing the Self-Learning Control.

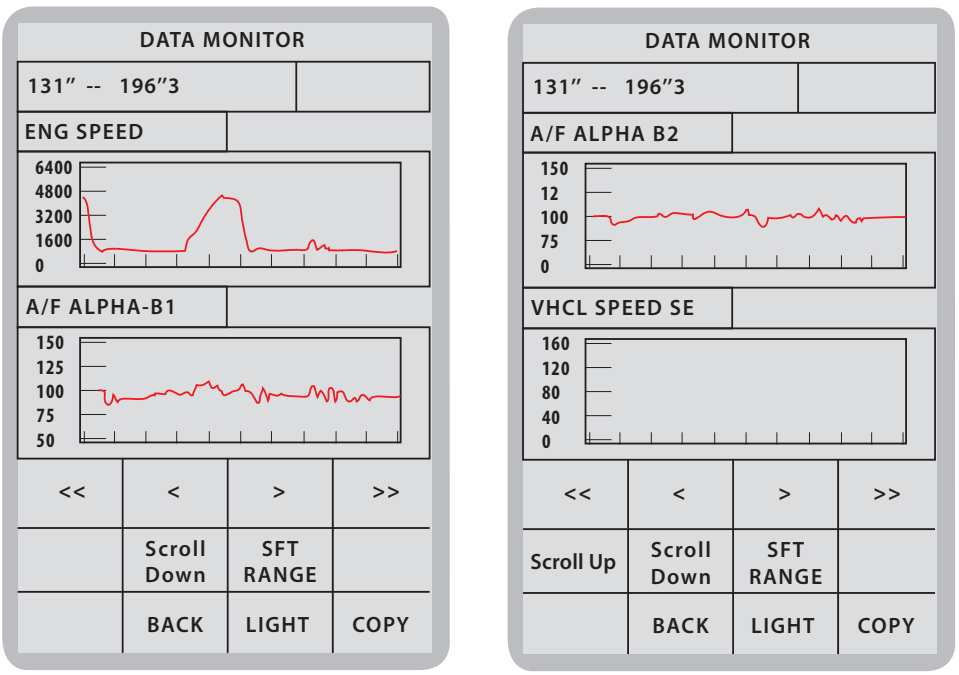


Figure 7: A/F Alpha no longer reflects pin.

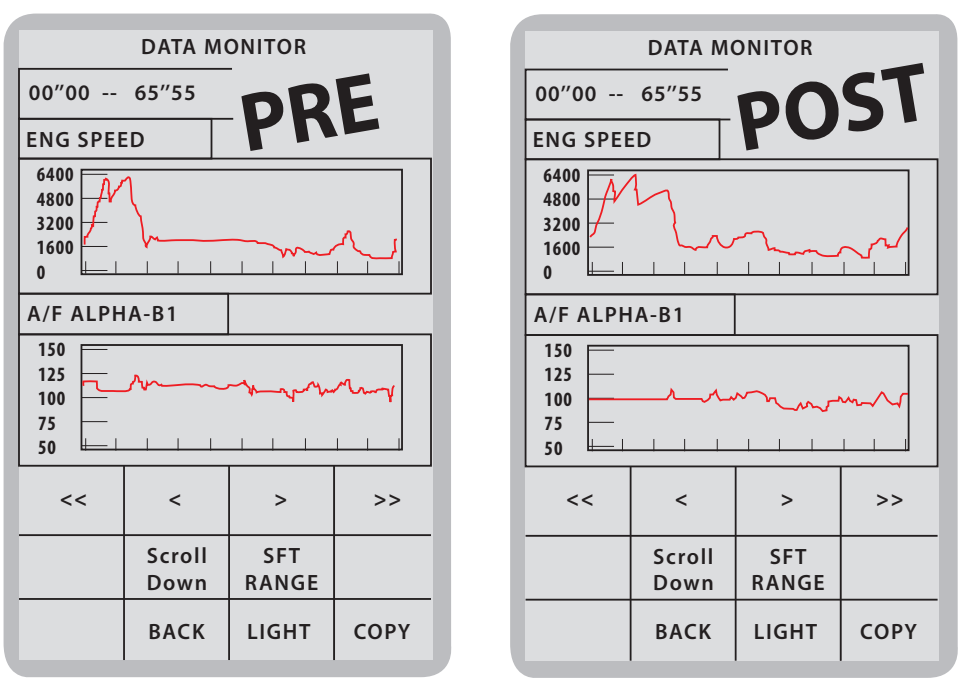


Figure 8: Before and after replacement of the MAF.

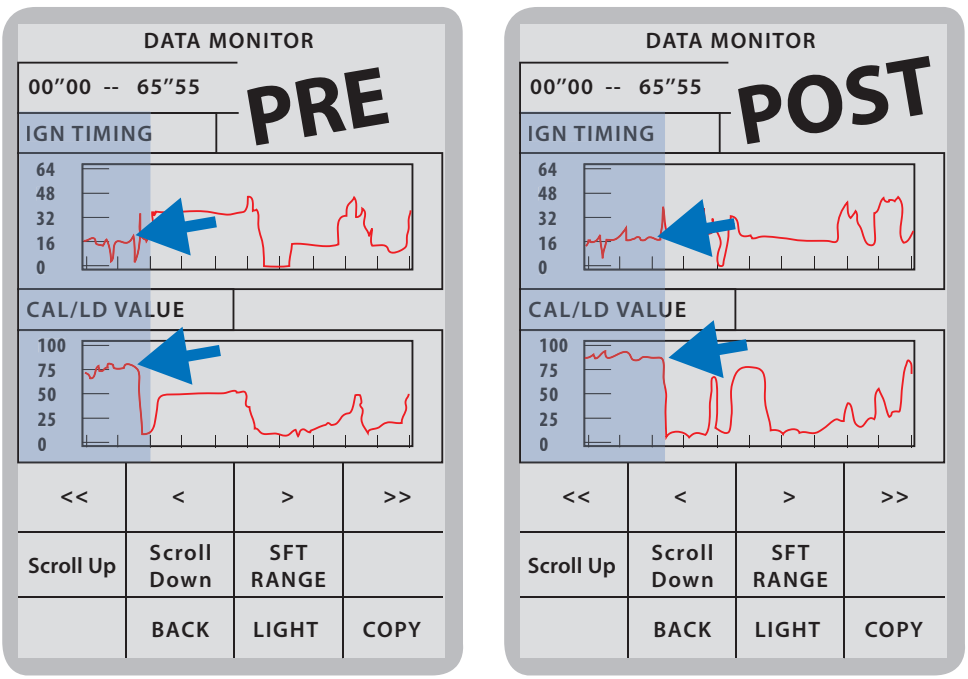


Figure 9: Calculated load is now much closer to 100% during WOT.

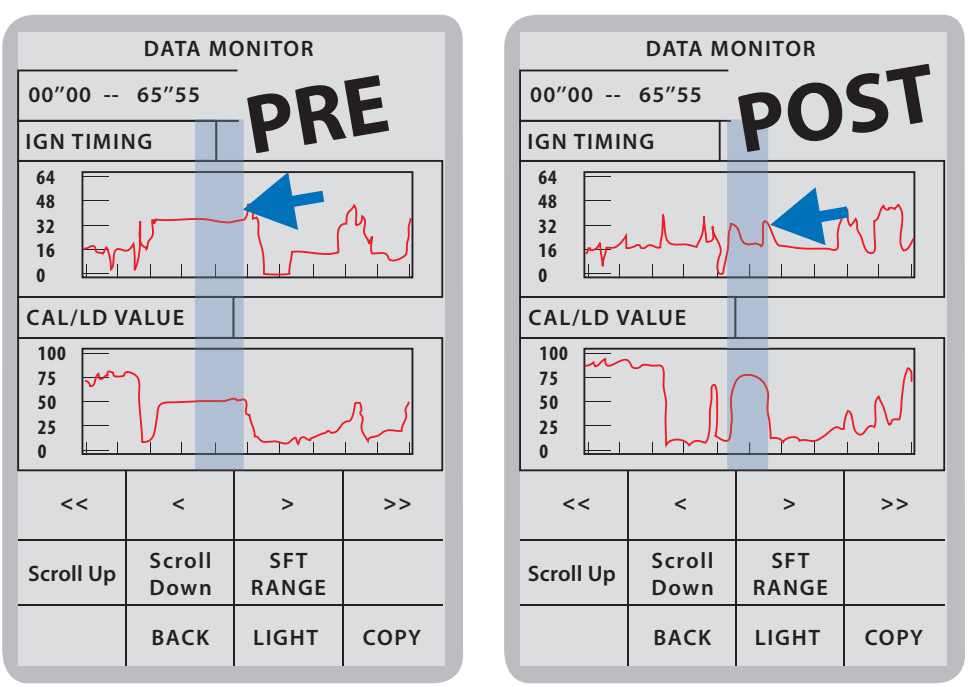


Figure 10: Ignition timing was substantially advaned with the old MAF.

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.