MOTOR AGE®

Achieving Diagnostic Success

Textbook knowledge is only half the challenge; success depends on effective real-world execution.

Experienced automotive diagnosticians have navigated many trials and tribulations that have contributed to their success. Although the journey takes hard work and dedication, it becomes easier as they learn to develop and implement a strategy. Diagnostic success doesn't happen by accident — true success comes from accuracy and efficiency.

The diagnostic game plan

Just as the coach of a successful sports team has a plan for each play, the beauty of successful diagnostics lies in a well-planned approach. This involves understanding your opponent.

Understanding how components function leads to a better understanding of how to test them and what test results to anticipate. Regardless of the vehicle you may be challenged with, they all basically have the same components and similar functions. These include sensors that indicate:

- Speed
- Position
- Temperature
- Air mass
- Pressure
- Vibration
- Oxygen concentration

Learning how those components deliver that data is key in determining how to test them and what to look for. This easy-to-grab data should be leveraged (right from the driver's seat).

In essence, the easy tests should lead to more precise testing. Each successful step forward should be justified by the previous and eventually lead to visible inspection. This approach is used to determine the area in which to invest further and spend more time getting hands-on experience.

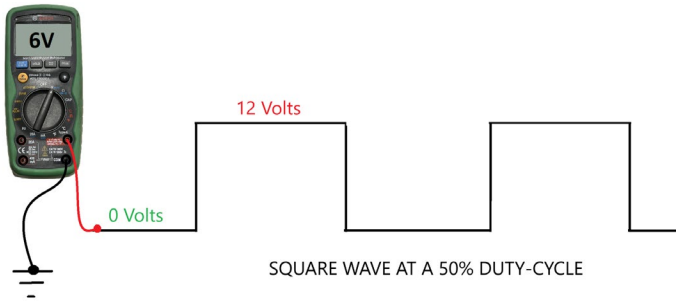
A misfiring Dodge Durango

A technician was faced with a 2019 Dodge Durango with a 3.6 L engine and the DTC P0300 complaint, as well as misfires being flagged for Bank 1 cylinders. Per the technician, the PCM only registered misfires above 3000 rpm (a clue to the nature of the fault and the conditions under which it presents).

The engine data was evaluated with a scan tool during the fault, and the fuel trim (corrective factor) showed no signs of a fueling issue as the cause of the fault (derived directly from the driver's seat without opening the hood). This led to evaluating the ignition system and eliminating it as a root cause of the misfiring symptom as well. With the evidence supporting both a properly operating fuel delivery system and ignition system, the engine itself was a suspect.

The justified subsequent steps

A relative compression test was performed instead of removing all the spark plugs, as is typically done in a traditional compression test. The test was conducted with a scope and amp probe and showed a variation in the cylinders' ability to load the starter motor. This could have been caused by a loss of compression or a variation in intake valve duration, which can be determined in minutes without disassembly. This justified further investigation.



A second perspective was added, now including the pressure changes in the induction system, measured with a pressure transducer. With a variation shown in the relative compression waveform, the pressure waveform from the induction system helped indicate why the compression variations were present.

The rhythmic variation in the induction system pulses suggested a possible cam timing fault; however, timing shifts didn't occur (not displayed here but proven with a two-trace lab scope).

Researching both the cylinder configuration and the firing order of this particular engine revealed the most likely cause of the symptom and characteristics exhibited in the data captured. More importantly, justification for engine disassembly was warranted.

Justified visible inspection

Analysis of the scope captures justified removal of the valve covers for visible inspection of the cam lobes. The evidence was clear and supported what was seen in the easily collected data.

The intake cam lobes on only one bank of the engine were significantly worn. This prevented the Bank 1 cylinders from breathing correctly, especially under heavy loads/the misfiring conditions. Revisiting the data to make the correlation is beneficial to ongoing success.

- The fuel trim revealed little change as the issue causing the symptom was not related to the ignition or fueling systems.
- The relative compression waveform showed a variation in starter load. This is because the intake valves are responsible for trapping the air in the cylinder (for the compression stroke). One half of the engine's cylinders trapped more air than the other half.
- This is also the reason the variations were visible in the induction system pressure waveform. The alternating pattern of high and low intake pressure pulse peaks was caused by the configuration of the engine, the cylinder position, and firing order. Had the engine been configured differently, the pattern would have presented differently.

The leap of faith

Diagnostic success is not solely based on talent. Any technician with the desire to master the functionality of the few basic components that make up virtually every vehicle out there can learn to be the best.

Choosing to be the best means investing in tools that will deliver a return on investment. However, simply owning the tools isn't enough. You must leverage the tools to see that return.

Doing so means practicing on known-good vehicles, where there is little chance of an unanticipated test result generating a misdiagnosis. Proving your capability of implementing the tools/techniques properly (on known-good vehicles) should lead to supplementing them on suspect vehicles. But don't go "all-in" on the new tools/tests immediately. First, simply add them as an additional "arrow in the target," so to speak.

Over time, as the results from newer tools/techniques continually align with more traditional testing results, you will feel comfortable setting aside the more time-consuming techniques. This will allow you to rely solely on the efficient tools and testing techniques described above.

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