MOTOR AGE

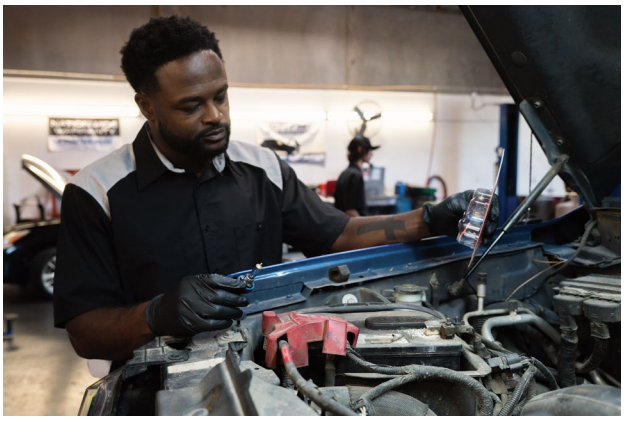
Top Tips for Diagnosing Engine Control Systems

Drivability or engine run issues are often complex and some of the most frustrating problems customers experience. An engine relies on various systems working together to run properly. If there is an issue with the ignition, fuel injection, input sensors, air distribution system, or mechanical components, the engine will not run correctly, and a fault must be diagnosed. Extra precautions and care should also be taken around gasoline direct injection (GDI) systems to ensure shop safety.

Read on to learn techniques for diagnosing vehicle issues related to fuel delivery and injection, ignition, as well as intake and exhaust systems. Advanced topics such as GDI systems, variable valve timing (VVT), and proper oscilloscope usage are also covered to help reduce diagnostic time and increase confidence when servicing systems equipped with the latest engine control technology.

1 Properly diagnose faulty ignition systems

When a vehicle is running rough or lacks power, checking the ignition system is usually a good first step. Most modern vehicles use coil-on-plug ignition systems. In many cases, ignition coils are accessible but may be covered by the intake manifold in some engine configurations. Before checking individual ignition components, the battery and charging system's operation should be verified to ensure sufficient voltage is supplied to the system.



If a vehicle has a misfire in one cylinder and the ignition coil is accessible, a visual inspection of the ignition coil, boot, and spark plug is a quick way to check the integrity of system components. If the coil is inaccessible or passes a visual inspection, analyzing scan tool data or using an oscilloscope to capture a waveform can help determine whether the ignition system is causing the misfire. In some cases, a faulty driver inside the powertrain control module (PCM) can also cause an ignition system-related misfire.

2 Verify fuel delivery and injection system operation

Issues with a vehicle's fuel delivery or injection systems can cause problems that may be hard to pinpoint at first. In most cases, if there is a lack of fuel, a vehicle will develop a misfire or may not start at all. Key indicators that can help identify a fuel delivery issue include a lean reading from the oxygen sensors or verifying fuel pressure data using a scan tool. If a fuel injector is suspected of causing a misfire, there are a few methods to diagnose it efficiently.

An injector balance test can be performed with a scan tool by deactivating and activating each injector to check for pressure drops within the system. Other tools, like a noid light, can be plugged into a fuel injector harness to verify circuit integrity and proper PCM function. A fuel injector can also be checked with an oscilloscope if the problem remains undetermined or intermittent. An oscilloscope pattern can show useful information, such as the pulse width of the fuel injector's spray, and the voltage spike that occurs when the injector's magnetic field collapses.

3 Service GDI systems safely

GDI systems have increasingly become standard equipment on new vehicles. Vehicles equipped with GDI are proven to have significantly better fuel economy and advanced control over the fuel injection system. Due to their high operating fuel pressures of over 1,000 psi, extra procedures and precautions must be followed when servicing these systems.

When a mechanical component of the system needs to be serviced, the system must be properly depressurized, usually through a scan tool-guided procedure. GDI systems also contain two fuel pumps: a low-pressure electric pump inside the fuel tank and a mechanical high-pressure pump typically driven by an engine camshaft. In many cases, GDI fuel injectors are not easily accessible and may require removal of the intake manifold to access them or their electrical connectors. GDI systems require an extra level of patience and attention to detail to maintain a safe and effective shop environment.

4 Efficiently inspect and repair VVT components

VVT systems are used in vehicles to improve efficiency and assist with exhaust gas recirculation, in place of an independent valve. VVT issues can cause a check engine light, run problems, or acceleration issues. The VVT system is oil-controlled and can be affected by low-quality or low oil levels in the engine. System operation can also be affected by timing issues such as stretched timing chains, worn chain guides, or VVT actuator problems.

A quick way to verify that the VVT actuators are working is by using the scan tool to activate them. If they do not actuate properly, then the actuator itself must be verified before further diagnosis. Verifying VVT operation with a scan tool can reduce diagnostic time and confirm whether an actuator needs to be replaced.

5 Utilize oscilloscopes effectively

As diagnostics become more complex, oscilloscopes will continue to become increasingly useful for technicians. Oscilloscopes can be used to capture sensor or actuator data, verify timing and compression, and perform other vehicle tests that can be visually analyzed. To observe multiple sensors and actuators at once, a minimum of a four-channel scope is recommended. In some cases, a one or two-channel scope may also be sufficient.

When using a scope, ensure sensor or actuator connectors are properly back-probed using thin enough pins. It is also important to verify that all scope leads and computer wires are connected properly, and any potential grounds are secured. Technicians should also consider the settings configured within the oscilloscope's software. Parameters such as time base and voltage or amperage scales must be adjusted depending on what is being tested. Mastering oscilloscope setup and usage is essential for accurate vehicle diagnostics on complex automotive systems.

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