

Top Tips

Completing Engine Management Diagnostics

Some of the most difficult vehicle issues to diagnose are engine management and drivability concerns. Over the past few decades, manufacturers have made significant strides in improving fuel economy and reducing emissions in vehicles. These recent improvements have added more sensors and actuators to engines. Emerging technologies in engine management and emissions controls require formal training and the latest diagnostic equipment.

Establishing a specific and thorough diagnostic process can ensure the repair will be correct the first time. Choosing Duralast® replacement sensors and actuators provides quality engine management operation.

Read on to learn how to improve the diagnostic process for locating faulty engine management sensors and actuators. Proper interpretation techniques and use of diagnostic tools will also be covered to understand crucial data, such as fuel trims from the ECM.

1

Identify engine management sensor faults.

Drivability symptoms may vary depending on the types of sensors equipped on an engine. One example of this is a manifold absolute pressure (MAP) sensor. If a MAP sensor skews and does not read pressures lower than atmosphere, the vehicle will barely run and may stall, without being able to restart. The related symptoms to the concern are what should drive the diagnostic process. This condition may come with a lean-running vehicle and may also still run correctly at higher RPMs.

An electronic coolant temperature (ECT) sensor that reads too cold will cause the vehicle to run rich, or in extreme conditions, may prevent the vehicle from starting. Despite the same customer complaint and presence of black smoke, the diagnostic process for each is vastly different. Identifying the related symptoms of the suspected faulty sensor is always a quick way to start diagnosing a difficult engine management issue.



2

Understand fuel trim readings.

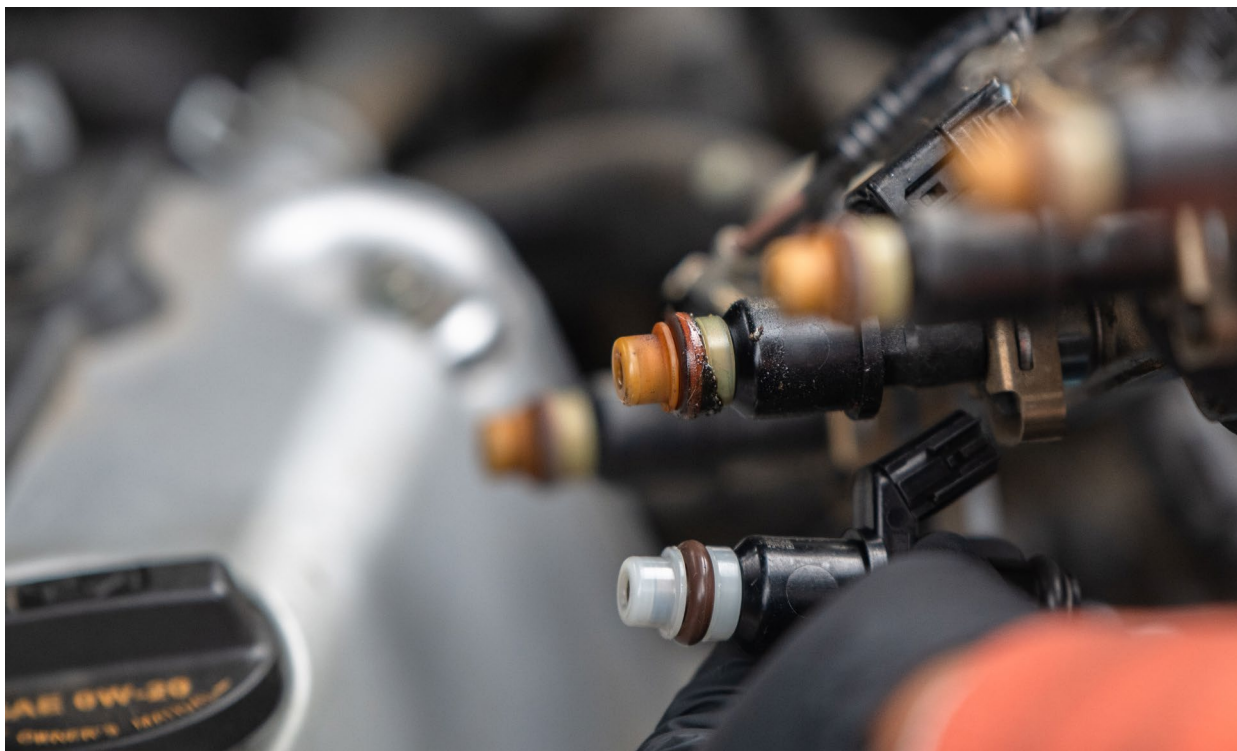
The oxygen (O2) sensors or air/fuel (A/F) ratio sensors help an engine optimize fuel economy. When diagnosing an issue related to fuel, examining fuel trims and O2 sensor data is a good starting point. Fuel trims are a good representation of the state of the fuel system. Seeing positive fuel trims represents a lean condition, and negative fuel trims represent a rich condition. It can be subjective, but if your fuel trims are between +/- 7% and +/-10%, you can start looking for a fuel control issue.

If the fuel trims are reading out of specification, the next step is to verify that the O2 or A/F sensors are operating properly. You may need to verify which sensor type the vehicle application has equipped. An O2 sensor will cycle voltage, reading lean at the lower voltage, and rich when at the higher voltage. An A/F sensor, on the other hand, will show a linear voltage on a scan tool and not cycle at all. Your diagnostic approach will differ depending on which sensor the vehicle possesses.

3

Interpret the fuel sensor and input data.

Engine sensor data is constantly being interpreted by the electronic control module (ECM). The ECM uses sensor data to determine engine management functions such as fuel injector pulse width and ignition timing. The ECM uses sensors mentioned already, such as the MAP and ECT, for its calculations. Mass air flow (MAF), throttle position (TPS), intake air temperature (IAT), crankshaft position (CKP), and camshaft position (CMP) sensors are also used for fuel calculations in the ECM. Knock sensors are used to determine if the ignition timing is off and needs adjusting. When engine management sensors fail, choose Duralast replacement sensors for OE quality or better performance.



4

Verify the actuator and output functions.

The ECM must balance all the operations of the engine's actuators. Fuel injectors are a high-priority output function that the ECM is always monitoring and adjusting. If a fuel injector is suspected of being faulty, the ECM may completely shut off the cylinder. This may require additional diagnostic testing, such as verifying injector operation using a scan tool or manually testing the circuit.



In some cases, you may need to use a scan tool to operate motors and other outputs alike. Some examples include a throttle actuator motor (TAC) and an exhaust gas recirculation valve (EGR). Each of these items can be commanded to move and see if the vehicle reacts. These tests must be performed "Key On, Engine Off" (KOEO) in order to be effective.

5

Select the correct testing and diagnostics tools.

Without the proper test equipment, diagnostics can be nearly impossible. For engine management faults, there are a few must-have tools. To enhance your diagnostic process, a comprehensive scan tool containing functions such as data streams, bi-directional controls, code reading and clearing, and other OBD II functions is needed. Select a scan tool with a user-friendly interface that supports a wide range of vehicle makes and models.



A high-quality multimeter can help you with most of your basic circuit testing, while an incandescent test light can assist with testing actuator circuits. Due to the continuing technological advancements in the industry, an oscilloscope is also becoming a required tool. An oscilloscope has the ability to visualize a sensor or actuator on a computer screen, which gives a clear picture of suspected issue(s) in the system. With a quality scan tool, multimeter, and oscilloscope, you can make your diagnostic process a success.

For more information on engine control and sensors, visit autozonepro.com/engine/management.

[Learn More >](#)