Subaru Emissions System Service

All Subaru vehicles manufactured since 1996 are equipped with a second generation on-board diagnostic system (OBD II), as required by government regulations. The emissions warranty for many of these vehicles has ended, and some are finding their way to independent repair shops for emissions system repairs.

While the implementation of the OBD II standards was intended to bring a level of standardization to emissions diagnostics and repairs, vehicle manufacturers and individual vehicles will continue to have unique design characteristics and repair techniques. This article offers a collection of repair tips and tricks collected from the field, focused on late model Subaru emissions system diagnosis, service and repair.

EGR Flow Malfunctions

OBD II diagnostic trouble code (DTC) P0400 indicates an exhaust gas recirculation flow malfunction. It's important to keep in mind that this is a functional check of the EGR system. A P0400 DTC usually does not indicate an electrical fault, but rather a failure of one of the components in the EGR system.

The OBD II system tests EGR operation only under specific conditions. A test failure must occur on two consecutive 'trips' before the OBD II system will trigger the dashboard CHECK ENGINE light to alert the driver of an emissions system problem.

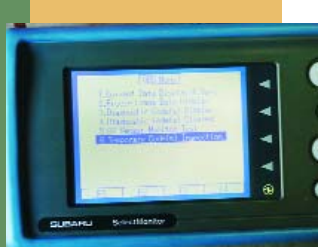
Several factors may contribute to a DTC P0400, so a systematic approach is needed to quickly determine what might, or might not, be at fault.

- Begin with a visual inspection of the EGR system. It's important to point out that not all Subaru engines are equipped with an EGR system. Only those that are will be capable of triggering a P0400.
- Check all vacuum control hoses running between the EGR solenoid valve, back pressure transducer and EGR valve. All hoses must be properly installed. Look for any kinking or loose hoses that would impede the flow of vacuum through the system.
- Metal pipes dip below the throttle cables. Condensation may form in this area, causing corrosion on the inside of the metal pipes. If this corrosion is allowed to get bad enough, it may block the flow of vacuum through the pipes and trigger a DTC P0400. Remove the vacuum hoses from the pipes, then blow through the pipes with compressed air to make certain they are fully open.

- A metal pipe also connects the backpressure transducer to the EGR valve. The rubber hose at the backpressure transducer end of the pipe may become deteriorated and begin to leak due to engine heat. A weak vacuum signal will keep the EGR valve from fully opening when commanded, which may also cause a DTC P0400.
- Check the components themselves. Carbon from the EGR valve may back up into the backpressure transducer port, affecting its flow. Engine exhaust heat may also damage the diaphragm inside the backpressure transducer, keeping it from operating properly. As exhaust backpressure increases, pressure on the transducer diaphragm increases and more vacuum is allowed to flow to the EGR valve. The transducer can be checked with a pressure pump, but there are no specifications for exactly when and how much it should open for a specific pressure.
- The last item to check is the EGR valve. An EGR valve with heavy carbon deposits will not be able to flow the required amount of exhaust gas during the the P0400 functional test. If the flow is low, a DTC P0400 will be stored in the pending code memory. Remove the EGR valve and clean it as necessary.

Remember, P0400 is a two trip DTC. The EGR system must fail the test twice on two consecutive trips. So it may be difficult to determine whether you've successfully repaired the problem. It may be difficult for most customers to understand why you need to keep their cars for an extended period of time to verify your repairs. There is an easier way, however:

- After repair are completed, clear all DTCs from the control unit's memory.
- Locate the green diagnostic connectors under the driver's side dash and plug them together.
- Plug in your OBD II-compatible scanner and take the vehicle for a test drive.
- The EGR system functional test only occurs under specific condition. Simply stated, the vehicle must be running at a steady speed of approximately 55 mph for a specified period of time. Consult the appropriate service manual for a detailed explanation.
- If the vehicle successfully completes the EGR system functional test, no 'temporary' or 'pending' codes will be stored in the control unit and displayed on the scanner screen.
- Disconnect the green diagnostic connectors and return the vehicle to the customer.



Cylinder Misfire Codes

If you encounter cylinder misfire codes on Subaru vehicles equipped with an OBD II system, check the past service history to see if the vehicle's fuel filter was changed recently.

There is a short period of time when the vehicle is first started, after the filter has been changed, when the cylinders do not get the fuel charge they should. This may translate into a slight cylinder misfire.

If the fuel filter was changed recently, clear the codes and test drive the vehicle. Chances are good the codes will not return if the filter change was the cause of the problem.

Other Misfire Code Causes

The control unit constantly monitors the signal from the crankshaft and camshaft position sensors. Sudden changes in the signals from these sensors could indicate that the engine is either speeding up or slowing down in an uncontrolled manner. These sudden changes may be caused by cylinder misfires. Since one of the OBD II system's main jobs is to protect the catalytic converter, cylinder misfires are a high system priority.

Several things can contribute to intermittent or constant cylinder misfire DTCs. Not surprisingly, many of them are the same things that have been causing cylinder misfires for as long as there have been internal combustion engines:

- Carefully inspect the ignition coil(s). Look for signs of carbon tracking or physical damage to the coils. Anything that will impede the flow of current to the spark plugs may cause a cylinder misfire DTC.
- Check the ignition wires for damage or wear.
- Remove and inspect the spark plugs. Some Subaru models are equipped with long-life platinum spark plugs. These are not, however, unlimited life spark plugs. The vehicle owner may

have neglected to have the spark plugs changed at the recommended service interval.

- Prolonged use of low octane fuels may lead to the accumulation of carbon deposits in various areas of the engine. These deposits may cause cylinder misfires. Carbon deposits may be treated with carbon cleaning equipment and products, but some deposits may be difficult to reach. Carbon may accumulate in the exhaust ports. Extreme cases have been known to cause displacement of the valve guides. An incorrectly positioned valve guide would impede valve seating, possibly leading to a cylinder misfire DTC.

Incorrect Parts Substitution

During the 1999 model year, several changes were made to the 2.2 and 2.5 liter engines destined for the North American market. The 1999 and later engines are designated as Phase 2 engines, while those that preceded them are designated as Phase 1 engines. To further complicate matters, these engines were 'phased in.' So it's possible for a 1999 Legacy to have either a Phase 1 or Phase 2 engine, depending on whether it's equipped with a 2.2 (Phase 1) or 2.5 (Phase 2) engine. All 1999 Forester and Impreza models were equipped with Phase 2 engines, regardless of displacement.

Two of the components that were changed during the changeover to Phase 2 are the crankshaft and camshaft sprockets. The number of teeth on the reluctors on the back side of these pulleys differs between Phase 1 and 2. This change was made to shorten the time needed for cylinder discrimination and to improve the accuracy of misfire detection. An example of the waveforms produced by a 1995 2.2 liter Legacy engine is shown here.

Camshaft sprockets may be damaged in a front end collision, necessitating replacement. Installation of incorrect components *should* result in a no start condition. However, we have received at least one report from the field of a vehicle that had the wrong camshaft pulley installed by a body shop during accident repairs. The engine ran, but very poorly. The Check Engine light was on, and a PO341 DTC (camshaft position sensor range/performance problem) was stored in the control unit's memory.

Both camshaft sprockets have the same number of teeth for the engine timing belt. However, they have a different number of reluctor teeth for the camshaft position sensor to read. Installing the correct camshaft sprocket corrected the running problem and eliminated the DTC.

Code P0500

This diagnostic code may be repaired by verifying adequate ground connections. These grounds include, but may not be limited to, the following points:

- Negative battery cable clamp,
- Negative battery cable pigtail connection at the clamp,
- The ground on the radiator support,
- The ground on the frame rail behind the LF headlight,
- The main engine ground,
- The shock tower grounds.

Rough Idle On MPFI Vehicles

If you encounter a rough idle complaint on any sequential injection MPFI vehicle, one of your basic checks should be to ensure that the correct injector wire connector is on the correct injector. These will either be numbered or can be checked by comparing wire colors with the wiring diagrams. This may seem like an obvious check, but in your zeal to quickly diagnose a vehicle, the obvious can be overlooked. If two injector connectors have been inadvertently switched, the symptoms can be a slightly rough or irregular idle on a fully warmed up engine and a hesitation during initial acceleration from a stop.

Legacy And Impreza Engines With No Injection Pulse #1 Cylinder

Built into the fuel injection control unit is logic that will shut off the #1 injector if the computer believes that it can no longer control the Idle Air Control Valve. Remember this design characteristic if you are trying to diagnose a "hard" code for the Idle Air Control Valve or a dead miss in the number one cylinder due to no injection at idle. A problem in the Idle Air Control Valve circuit may be responsible. (Component testing shows that it most likely is not the valve itself.)

Also, if the computer is deprived of its "back up power supply," some computers will generate a false code for the Idle Air Control Valve and kill the injector

for cylinder #1. The pin location of this power supply can be found in the Control Unit Module I/0 Signal pages of the appropriate Service Manual.

Impreza Air Suction Valve Noise

Some Subaru Impreza models are equipped with air suction valves (ASV). These valves may make some noise for brief periods of time during initial cold startup and driving. The noise sounds very much like lifter noise.

This condition is considered to be a normal operating condition and no repairs should be made. Also remember that this is an emission control device and can not be legally tampered with.

The noise reported usually shows up at ambient temperatures of approximately 40 degrees F or lower, with engine speeds of 2,000 RPM or higher. The noise may go away during this time if your foot is removed from the gas pedal and may return if the throttle is again applied. Once the engine has warmed up slightly, the noise goes away and will not return until the engine has had an extended cool down period (usually overnight).

If you have a customer complaining of a cold engine noise, it may very well be the ASVs that are causing the noise. Question the owner about when the noise occurs and how the vehicle is being operated before attempting any repairs.

1980-1989 Subaru Vehicles Pressure Testing of Fuel Tank During State Emission Test

The U.S. Environmental Protection Agency has issued evaporative technical guidance requirements for conducting a functional pressure test of the evaporative system on pre-1996 model year vehicles as part of state emission inspections. The evaporative pressure testing of the fuel tank system consists of identifying and clamping off the vapor hose line from the fuel tank as close to the evaporative canister as possible. The vehicle shall fail the test if the fuel vapor control system loses more than six inches of water pressure over a period of 120 seconds, starting from a stabilized pressure of 14 ± 1 inch of water.

Certain early model Subaru vehicles were built with a vapor hose connecting to the evaporative canister with a small spring inserted to maintain the hose integrity while under vacuum conditions. Under state I/M Program conditions of clamping this vapor hose, the spring prevents the clamp from creating a proper seal, which results in a false pressure test failure.

Subaru strongly recommends that state I/M programs exempt the models listed below from the functional evaporative pressure test.

Subaru Model	Affected Model Years with Spring Hose
2 Door (Hatchback)	All 1980-89
4-Door Sedan	All 1980-84
Hardtop	All 1980-84, except turbo models (1984)
Station Wagon	All 1980-84, except turbo models (1983/84)
MPV (BRAT)	All 1982-88, except turbo models (1983/84)

For pre-1996 Subaru vehicles, which are deemed testable, Subaru provides the following recommendation:

Warning! Improper clamping may damage the vapor hose. Clamping should only be performed using a non-cutting surface grip pliers or similar tool. Ensure that the fuel tank system is pressurized in an even and consistent manner with the applied pressure not exceeding 14.5 inches of water or fuel system damage may occur. Improper pressurizing may also damage the 2-way rollover valve.

Model Year 1998 Changes In P0440 Evap Operation

1998 model year vehicles with the Enhanced Evaporative Emissions Control System no longer electrically cycle their fuel tank Pressure Control Valves (PCV) to regulate fuel tank pressure on a regular basis. However, the valve is still cycled electrically while performing the OBD diagnostic function for Code P0440. What this means is that, while test driving a vehicle for this code, the Select Monitor will no longer indicate any PCV operation just after the beginning of driving and will no longer indicate periodic operation of the valve throughout the drive. It will still, however, show operation of the PCV valve when the computer begins to enter the diagnostic phase of driving for P0440 when the PCV valve is on and the vent valve comes on along with the canister purge to draw a low pressure on the tank. The PCV valve can still be operated in the compulsory valve operation mode.