

OBDII and Emissions Testing



Are you up to speed on OBD II? You should be because starting in 2002, a number of states have announced plans to change their emissions testing programs over to OBD II.

Instead of doing a tailpipe emissions check on a dynamometer, an OBD II check is a simple plug-in test that takes only seconds. What's more, OBD II will detect emissions problems that might not cause a vehicle to fail a tailpipe test - which means emissions test failures under the OBD II test programs are expected to be significantly higher.

The second-generation self-diagnostic emissions software has been required on all new vehicles sold in this country since model year 1996, including all imports. OBD II is a powerful diagnostic tool that can give you insight into what's actually happening within the engine control system.

Unlike earlier OBD systems that set a DTC when a sensor circuit shorts, opens or reads out of range, OBD II is primarily emissions-driven and will set codes anytime a vehicle's emissions exceed the federal limit by 1.5 times. It also will set codes if there is a gross sensor failure, but some types of sensor problems won't always trigger a code. Consequently, the Check Engine light on an OBD II-equipped vehicle may come on when there is no apparent driveability problem, or it may not come on even though a vehicle is experiencing a noticeable driveability problem.

The determining factor as to whether or not the Check Engine light comes on is usually the problem's effect on emissions. In many instances, emissions can be held in check, despite a faulty sensor, by adjusting fuel trim. So as long as emissions can be kept below the limit, the OBD II system may have no reason to turn on the light.

CHECK ENGINE LIGHT

The "Malfunction Indicator Lamp" (MIL), which may be labeled "Check Engine" or "Service Engine Soon" or a symbol of an engine with the word "Check" in the middle, is supposed to alert the driver when a problem occurs.

Depending on how the system is configured and the nature of the problem, the lamp may come on and go off, remain on continuously or flash - all of which can be very confusing to the motorist because he has no way of knowing what the light means. Is it a serious problem or not? If the engine seems to be running okay, the motorist may simply ignore the light. With OBD II, the Check Engine light will come on only for emissions-related failures. A separate warning light must be used for other non-emissions problems such as low oil pressure, charging system problems, etc.

If the light is on because of a misfire or a fuel delivery problem, and the problem does not recur after three drive cycles (under the same driving conditions), the Check Engine light may go out. Though you might think the vehicle has somehow healed itself, the intermittent problem may still be there waiting to trigger the light once again when conditions are right. Whether the light goes out or remains on, a code will be set and remain in the computer's memory to help you diagnose the fault.

With some exceptions, the OBD II warning lamp will also go out if a problem does not recur after 40 drive cycles. A drive cycle means starting a cold engine and driving it long enough to reach operating temperature. The diagnostic codes that are required by law on all OBD II systems are "generic" in the sense that all vehicle manufacturers use the same common code list and the same 16-pin diagnostic connector. Thus, a P0302 misfire code on a Nissan means the same thing on a Honda, Toyota or Mercedes-Benz. But each vehicle manufacturer also has the freedom to add their own "enhanced" codes to provide even more detailed information about various faults.

Enhanced codes also cover non-emission related failures that occur outside the engine control system. These include ABS codes, HVAC codes, air bag codes and other body and electrical codes.

The second character in an OBD II will be a zero if it's a generic code, or a "1" if it's a dealer enhanced code (specific to that particular vehicle application).

The third character in the code identifies the system where the fault occurred. Numbers 1 and 2 are for fuel or air metering problems, 3 is for ignition problems or engine misfire, 4 is for auxiliary emission controls, 5 relates to idle speed control problems, 6 is for computer or output circuit faults, and 7 and 8 relate to transmission problems.

Codes can be accessed and cleared using an OBDII scan tool such as AutoTap.

MISFIRE DETECTION

If an emissions problem is being caused by engine misfire, the OBD II light will flash as the misfire is occurring. But the light will not come on the first time a misfire problem is detected. It will come on only if the misfire continues during a second drive cycle and will set a P0300 series code.

A P0300 code would indicate a random misfire (probably due to a vacuum leak, open EGR valve, etc.). If the last digit is a number other than zero, it corresponds to the cylinder number that is misfiring. A P0302 code, for example, would tell you cylinder number two is misfiring. Causes here would be anything that might affect only a single cylinder such as a fouled spark plug, a bad coil in a coil-on-plug ignition system or distributorless ignition system with individual coils, a clogged or dead fuel injector, a leaky valve or head gasket.

The OBD II system detects a misfire on most vehicles by monitoring variations in the speed of the crankshaft through the crankshaft position sensor. A single misfire will cause a subtle change in the speed of the crank. OBD II tracks each and every misfire, counting them up and averaging them over time to determine if the rate of misfire is abnormal and high enough to cause the vehicle to exceed the federal emissions limit. If this happens on two consecutive trips, the Check Engine light will come on and flash to alert the driver when the misfire problem is occurring.

Misfire detection is a continuous monitor, meaning it is active any time the engine is running. So too is the fuel system monitor that detects problems in fuel delivery and the air/fuel mixture, and something called the "comprehensive monitor" that looks for gross faults in the sensors and engine control systems. These monitors are always ready and do not require any special operating conditions.

Other OBD II monitors are only active during certain times. These are the "non-continuous" monitors and include the catalytic converter efficiency monitor, the evaporative system monitor that detects fuel vapor leaks in the fuel system, the EGR system monitors, the secondary air system monitor (if the vehicle has such a system), and the oxygen sensor monitors. On some 2000 and newer vehicles, OBD II also has a thermostat monitor to keep an eye on the operation of this key component. The thermostat monitor will be required on all vehicles by 2002. On some 2002 model-year vehicles, there also is a new PCV system monitor, which will be required on all vehicles by 2004.

The catalytic converter monitor keeps an eye on converter efficiency by comparing the outputs from the upstream and downstream oxygen sensors. If the converter is doing its job, there should be little unburned oxygen left in the exhaust as it exits the converter. This should cause the downstream O2 sensor to flatline at a relatively fixed voltage level near maximum output.

If the downstream O2 sensor reading is fluctuating from high to low like the front sensor, it means the converter is not functioning. The Check Engine light will come on if the difference in O2 sensor readings indicates hydrocarbon (HC) readings have increased to a level that is 1.5 times the federal limit. For 1996 and newer vehicles that meet federal Low Emission Vehicles (LEV) requirements, the limit allows only 0.225 grams per mile (gpm) of HC - which is almost nothing. Converter efficiency drops from 99 percent when it is new to around 96 percent after a few thousand miles. After that, any further drop in efficiency may be enough to turn on the Check Engine light. We're talking about a very sensitive diagnostic monitor.

The EVAP system monitor checks for fuel vapor leaks by performing either a pressure or vacuum test on the fuel system. For 1996 through 1999 vehicles, the federal standard allows leaks up to the equivalent of a hole .040 inches in diameter in a fuel vapor hose or filler cap. For 2000 and newer vehicles, the leakage rate has been reduced to the equivalent of a .020 in. diameter hole, which is almost invisible to the naked eye but can be detected by the OBD II system. Finding these kinds of leaks can be very challenging.

READINESS FLAGS

An essential part of the OBD II system are the "readiness flags" that indicate when a particular monitor is active and has taken a look at the system it is supposed to keep watch over. The misfire detection, fuel system and continuous system monitors are active and ready all the time, but the non-continuous monitors require a certain series of operating conditions before they will set - and you can't do a complete OBD II test unless all of the monitors are ready.

To set the converter monitor, for example, the vehicle may have to be driven a certain distance at a variety of different speeds. The requirements for the various monitors can vary considerably from one vehicle manufacturer to another, so there is no "universal" drive cycle that will guarantee all the monitors will be set and ready.

As a general rule, doing some stop-and-go driving around town at speeds up to about 30 mph followed by five to seven minutes of 55 mph plus highway speed driving will usually set most or all of the monitors (the converter and EVAP system readiness monitors are the hardest ones to set). So if you're checking the OBD II system and find a particular monitor is not ready, it may be necessary to test drive the vehicle to set all the monitors.

The Environmental Protection Agency (EPA) realized this shortcoming in current generation OBD II systems. So, when it created the rules for states that want to implement OBD II testing in place of tailpipe dyno testing, it allows up to two readiness flags to not be set prior to taking an OBD II test on 1996 to 2000 vehicles, and one readiness flag not to be set on 2001 and newer vehicles. You can use the AutoTap OBDII scantool to check that your readiness flags are set before having your vehicle emissions-tested. This can save you the aggravation of being sent off to drive around and come back later.

Some import vehicles have known readiness issues. Many 1996-'98 Mitsubishi vehicles will have monitors that read "not ready" because setting the monitors requires very specific drive cycles (which can be found in their service information). Even so, these vehicles can be scanned for codes and the MIL light without regard to readiness status. On 1996 Subaru, turning the key off will clear all the readiness flags. The same thing happens on 1996 Volvo 850 Turbos. This means the vehicle has to be driven to reset all the readiness flags. On 1997 Toyota Tercel and Paseo models, the readiness flag for the EVAP monitor will never set, and no dealer fix is yet available. Other vehicles that often have a "not ready" condition for the EVAP and catalytic converter monitors include 1996-'98 Volvos, 1996-'98 Saabs, and 1996-'97 Nissan 2.0L 200SX models.

OBD II TEST

An official OBD II emissions test consists of three parts:

1. An inspector checks to see if the MIL light comes on when the key is turned on. If the light does not come on, the vehicle fails the bulb check.
2. A scanner similar to AutoTap is plugged into the diagnostic link connector (DLC), and the system is checked for monitor readiness. If more than the allowed number of monitors are not ready, the vehicle is rejected and asked to come back later after it has been driven sufficiently to set the readiness flags. The scanner also checks the status of the MIL light (is it on or off?), and downloads any fault codes that may be present. If the MIL light is on and there are any OBD II codes present, the vehicle fails the test and must be repaired. The vehicle also fails if the DLC is missing, has been tampered with or fails to provide any data.

3. As a final system check, the scanner is used to command the MIL lamp on to verify it is taking commands from the onboard computer. If the OBD II light is on, or a vehicle has failed an OBD II emissions test, your first job is to verify the problem. That means plugging into the OBD II system, pulling out any stored codes and looking at any system data that might help you nail down what's causing the problem. Long-term fuel trim data can provide some useful insight into what's going on with the fuel mixture. If long-term fuel trim is at maximum, or you see a big difference in the numbers for the right and left banks of a V6 or V8 engine, it would tell you the engine control system is trying to compensate for a fuel mixture problem (possibly an air leak, dirty injectors, leaky EGR valve, etc.).

OBD II also provides "snap shot" or "freeze frame" data, which can help you identify and diagnose intermittent problems. When a fault occurs, OBD II logs a code and records all related sensor values at that moment for later analysis.

Once you've pinpointed the problem and hopefully replaced the faulty component, the final step is to verify that the repair solved the problem and that the OBD II light remains off. This will usually require a short test drive to reset all the readiness monitors and run the OBD II diagnostic checks.

OBD II TOOLS & EQUIPMENT

You can't work on OBD II systems without some type of OBD II-compliant scanner. The AutoTap OBDII Scan Tool is available in both PC/laptop versions and Palm PDA versions. The computing power and display of a PC or Palm gives AutoTap a much broader range of features than the older style hand-held scantools.

AutoTap – OBDII Automotive Diagnostic Tool

<http://www.autotap.com>