

Oxygen sensors are a product that have been around for over 20 years not, yet most motorists don't even know they have one or more of these devices on their vehicle - let alone what it does.

The only time motorists become aware of the oxygen sensor is if they get a Check Engine light and there's a code that indicates an O2 sensor problem or their vehicle fails an emissions test because of a sluggish or dead O2 sensor. If their engine isn't running well or is using too much fuel, somebody might tell them they might need a new O2 sensor. But in most cases, they won't have a clue as to how to diagnose or test this mysterious little device that is often blamed for all kinds of driveability and emission ills. That puts the sales knowledge on the parts professional.

FUNCTION

So what exactly does the O2 sensor do? It monitors the fuel mixture so the engine computer can adjust the air/fuel ratio to maintain the lowest possible emissions and best fuel economy. The O2 sensor does this by reacting to unburned oxygen in the exhaust. The sensor generates a small voltage signal (usually less than 1 volt) that increases when the air/fuel mixture goes rich, and drops when the air/fuel mixture goes lean. It acts like a rich/lean switch that signals the computer every time the fuel mixture changes, which is constantly.

The way the computer maintains a balanced fuel mixture is by doing the opposite of what the O2 sensor reads. If the O2 sensor reads rich (too much fuel), the computer shortens the on-time of each injector pulse to reduce the amount of fuel being squirted into the engine. This makes the mixture go lean. As soon as the O2 sensor detects this and gives a lean reading (not enough fuel), the computer reacts and increases the on-time of each injector pulse to add more fuel. This back-and-forth balancing act creates an average mixture that is pretty close to ideal. This is the "fuel feedback control loop" that allows today's vehicles to maintain extremely low emission levels, and the O2 sensor is the key sensor in this loop.

The computer uses other sensor inputs, too, like those from the coolant sensor, throttle position sensor, manifold absolute pressure sensor, airflow sensor, etc. to further refine the air/fuel ratio as needed to suit changing operating conditions. But the O2 sensor provides the main input that determines what happens to the fuel mixture. So if the O2 sensor isn't reading right, it screws up everything. Typically, a bad O2 sensor will read low (lean), which causes the engine to run too rich, pollute too much and use too much gas. A low reading can be caused by several things: old age, contamination, a bad wiring connection, or an ignition or compression problem in the engine.

AGING O2 SENSORS

As an O2 sensor ages, it doesn't react as quickly as it once did. The increased lag time makes the sensor sluggish and prevents the engine from keeping the air/fuel mixture in close balance. If the engine burns oil or develops an internal coolant leak, the sensor element may become contaminated causing the sensor to fail. Back when leaded gasoline was still available, a single tankful of leaded fuel would kill most O2 sensors in a few hundred miles. That's why the government finally eliminated leaded fuel.

Because the sensor reacts to oxygen in the exhaust and not fuel, any engine problem that allows unburned air to pass through the cylinders will also trick an O2 sensor into reading lean. A misfiring spark plug or a leaky exhaust valve - even a leak in the exhaust manifold gasket - may allow enough air into the exhaust to screw up the sensor readings. It won't damage the sensor, but it will create a rich running condition that hurts emissions and fuel economy.

HOT, HOT, HOT

Something else you need to know about O2 sensors is that they have to be hot (617 to 662 degrees F) to produce a voltage signal. It may take a few minutes for the exhaust to heat up the sensor, so most O2 sensors in newer vehicles have a built-in electrical heater circuit to get the sensor up to temperature as quickly as possible. These are usually three-wire and four-wire O2 sensors. The single and two-wire O2 sensors are unheated. If the heater circuit fails, it won't affect the operation of the O2 sensor once the exhaust gets hot but it will delay the computer from going into closed loop, which may cause a vehicle to fail an emissions test.

DIAGNOSIS AND REPLACEMENT

O2 sensors can be diagnosed a variety of ways, most of which require special equipment. A scan tool or code reader is required to pull O2 codes from most newer vehicles, though manual "flash codes" are available on older vehicles. If an O2 sensor problem is suspected, the sensor's response and voltage output can be monitored with a scan tool, a voltmeter or digital oscilloscope. If the tests confirm the O2 sensor is dead or sluggish, replacement is the only repair option. There is no way to "clean" or "rejuvenate" a bad O2 sensor.

Replacement sensors must be the same basic type as the original (heated or unheated) and have the same performance characteristics and heater wattage requirements. Installing the wrong O2 sensor could affect engine performance and possibly damage the heater control circuit in the engine computer. So make sure you follow the O2 sensor supplier's replacement listings.

Don't go by appearance alone. Some replacement O2 sensors have an OEM-type wiring connection and require no modifications to install. Others (typically the "universal type O2 sensors") require splicing the sensor wires into the original connector harness.

REPLACEMENT INTERVALS

To maintain peak engine performance, there's no need to wait until the sensor fails to replace it. Some experts now recommend replacing O2 sensors at specific mileage intervals for preventive maintenance. The recommended interval for unheated one or two wire O2 sensors on 1976 through early 1990s applications is every 30,000 to 50,000 miles. Heated three- and four-wire O2 sensors on mid-1980s through mid-1990s applications can be changed every 60,000 miles. And on 1996 and newer OBD2 vehicles, the recommended replacement interval is 100,000 miles.

HOW MANY?

Four cylinder and straight six cylinder engines typically have only one O2 sensor in the exhaust manifold. With V6 and V8 engines, there is one O2 sensor for each cylinder bank, or a total of two (one in each exhaust manifold).

On 1996 and newer vehicles with OBD2 (On Board Diagnostics II), there is also one or more additional O2 sensors mounted after the catalytic converter to monitor the efficiency of the converter. If a vehicle has dual exhausts, there will be one downstream O2 sensor for each side. So a V8 vehicle with dual exhausts will usually have a total of four O2 sensors.

NEED MORE INFO?

Check out our article, "[What the Home Mechanic Needs to know about O2 sensors](http://www.autotap.com/)" in the [OBDII library](http://www.autotap.com/) at <http://www.autotap.com/>.

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