Service Tips

SPECIAL TOOLS

Special sockets are available for O_2 sensor removal and installation. These heavy-duty deep sockets have a slot cut in the side to prevent the possibility of damaging the sensor harness and connector assembly.

ANTI-SEIZE COMPOUND

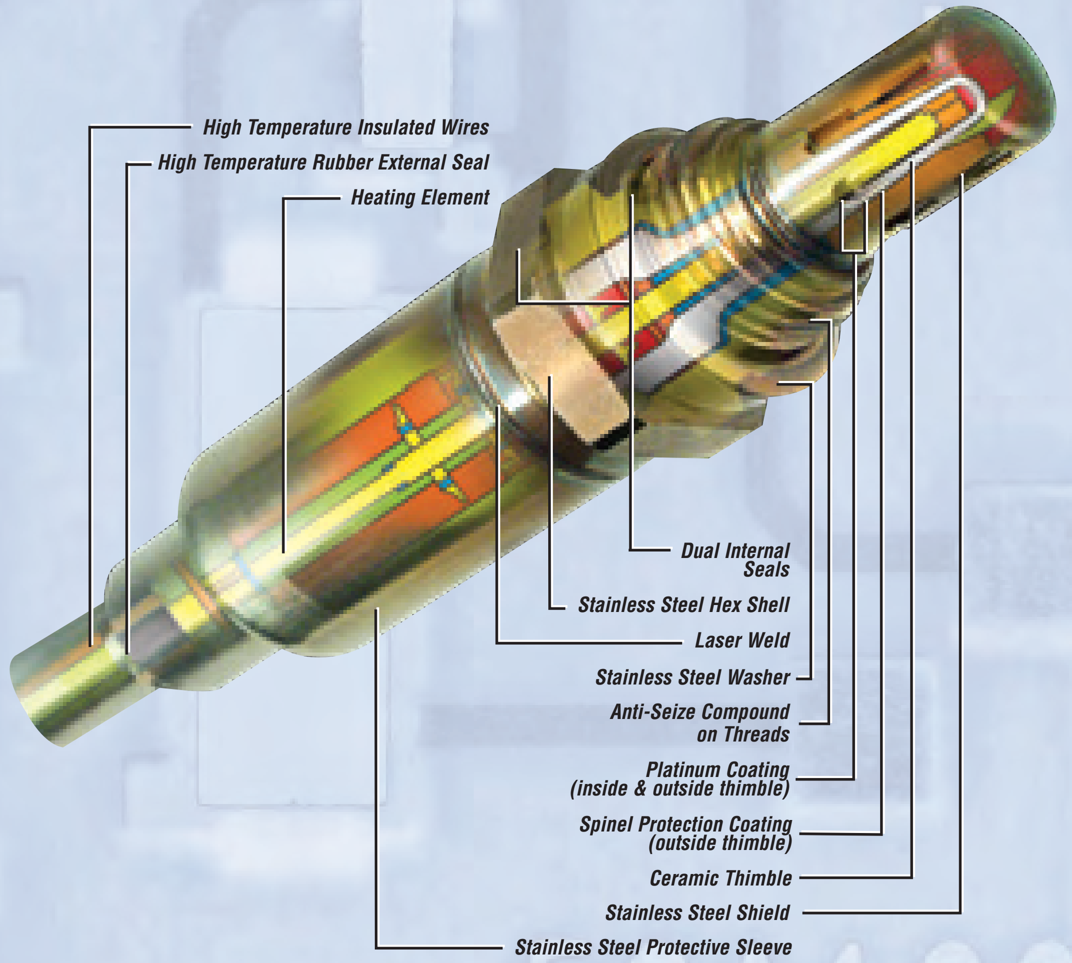
All new sensors have a coating of anti-seize compound on the threads to prevent the sensor from becoming seized to the exhaust manifold. If you are reinstalling a sensor make sure the threads are coated with anti-seize compound.

QUICK REMOVAL TIP

O_2 sensors can be very difficult to break free from the manifold on a cold engine. Run the engine for a few minutes to heat up the exhaust manifolds and you will find it takes less effort to unscrew the sensor.

TORQUE SPECIFICATIONS

A new sensor should only be tightened to a torque of 30 foot-pounds. If the sensor is over tightened it may cause the sensor to seize to the exhaust manifold. The next O_2 replacement will require replacing or repairing the exhaust manifold.



More detailed counter person training is available on our website at: www.smp-training.com
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Universal Sensor Replacement Tips

The following replacement procedures should be followed when installing universal sensors.

1. Disconnect the negative battery cable to prevent the possibility of a short circuit.

2. Remove the old sensor (see Service Tips) from the exhaust system and place it next to the new universal sensor.

3. With the two sensors laid out next to each other cut the old wire lead(s) at the splice point. This will maintain the original harness length. See figure 1.

   Strip 3/8" of insulation from the old wire(s) and twist the exposed wire strands together.

   Note: On multiple wire sensors you must match the wire colors between the old and the new sensor. If the wire colors do not match consult the vehicle wiring diagram to identify the each wire. The color code for a new four wire universal sensor is:

   Black or Purple Lead = Sensor Signal
   Grey or Tan Lead = Sensor Ground
   White or Brown Lead = Sensor Heater

4. Insert and crimp the stripped wires into the terminals. After the wires are secure heat the terminal with a hot air or heat gun to seal the connector from moisture contamination. See figure 2.

5. Install the new sensor using the correct socket and torque it to 30 foot-pounds. Reconnect the original connector making sure it is clean and tight.

6. Reconnect the negative battery cable. Make certain the sensor harness is not touching any hot engine parts or rubbing against the vehicle chassis.

Figure 1

Figure 2

STANDARD Engine Performance Specialists
Long Island City, NY 11101

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OXYGEN SENSORS

A Counterperson's Guide

STANDARD Engine Performance Specialists

Why Oxygen Sensors?

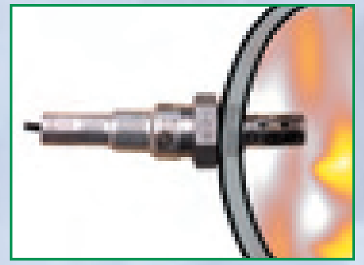
In the early 1970s the EPA enacted air pollution regulations aimed at improving our air quality. To comply with these regulations and the demands of the motoring public, automakers in North America, Europe and Japan developed engine control systems that reduce exhaust gas emissions, improve fuel economy and provide good engine performance. In 1973 the initial Zirconia oxygen sensor was developed, making the development of the closed loop engine control system possible. The closed loop engine control system is used by every automaker today.

Closed Loop Engine Control

The closed loop system consists of an engine control computer, fuel delivery system, oxygen sensor and a catalytic converter. Oxygen sensors are placed in the exhaust stream to determine the amount of oxygen in the exhaust gases. The voltage signal generated by the O_2 sensor is sent to the Engine Control Module (ECM). Based on these input signals the ECM controls the amount of fuel entering the engine, keeping the engine in the optimum operating range.

Oxygen Sensor Operation

Sensors are placed in the exhaust system where a constant flow of exhaust gas flows across the outer electrode. The sensor's inner electrode is open to outside air. When the sensor is heated to over 600°F the ceramic thimble begins to conduct oxygen ions between the electrodes. The flow of oxygen ions from the inner to the outer electrode creates an electrical voltage.

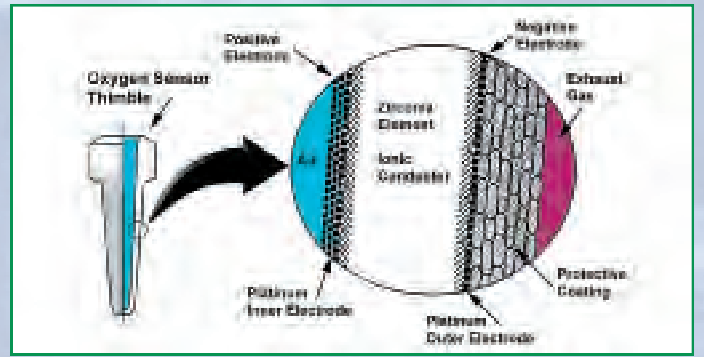


Oxygen Sensor Design

Oxygen sensors have a center ceramic element made up of Zirconium Oxide, Alumina and Yttrium Oxide. The operation of the sensor is based upon the fact that the ceramic material is porous and permits diffusion of the oxygen that is present in the air. The inner and outer surfaces of the element are coated with platinum. The inner electrode is exposed to the outside air and forms the positive terminal. The outer electrode, which is exposed to the exhaust stream, makes up the negative terminal. A Spinel coating is applied to the outer platinum electrode to prevent solid particles present in the exhaust gas from eroding the platinum layer.

Oxygen Sensor Operation

The sensor element, or thimble, is held in a threaded mounting shell and a protective shield is placed over the tip. A seal prevents the exhaust gasses from blowing past the threaded shell to the outside air. A vented sleeve is attached to the top of the thimble, which holds the electrical terminals and allows outside air to enter the inner section of the thimble.

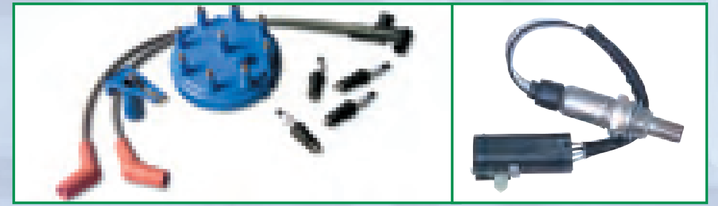


Why Oxygen Sensors Fail

Most O_2 sensors slowly degrade in performance over time. Sensors can become "lazy" responding very slowly to changes in the exhaust gas or they may send false signals to the ECM. The normal life cycle of an O_2 sensor is dependent on the condition of the engine. If the engine is well maintained and in good operating order you can expect the O_2 sensor to deliver good performance for 30,000 to 50,000 miles. On vehicles equipped with heated O_2 sensors, good performance can last for 60,000 to 100,000 miles. O_2 sensors will fail quickly if the engine is in poor operating condition. Sensors can be killed by the following conditions:

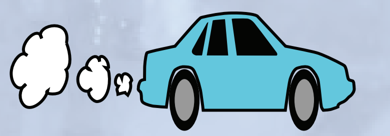
- **Engines producing excessive carbon or soot.**
- **Coolant entering the exhaust stream.**
- **Excessive engine temperatures.**
- **Excessive engine vibrations.**
- **Blocking the air supply to the inner core.**
- **Other contaminants in the system such as silicone-based products.**

When a vehicle is in need of a "tune-up" the O_2 sensor should be tested for proper operation. Replacing worn out or degraded O_2 sensors is an important step when it comes to maintaining vehicle performance.



Failed Oxygen Sensor Symptoms

If any of the following symptoms are present the oxygen sensor(s) should be tested for proper operation and replaced if performance has degraded.

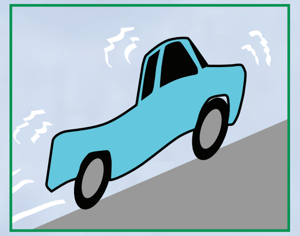


FAILING EMISSION TEST

Failing a state emissions test could be caused by a worn out or a failed O_2 sensor. A recent survey showed 70% of the cars failing emission testing resulted from poor performing or failed oxygen sensors.

POOR FUEL ECONOMY

Deteriorating fuel mileage can be a direct result of lazy or failed O_2 sensors. The ECM must adjust the air fuel mixture and ignition timing every few milliseconds in order to maintain optimum performance. Without the input from the O_2 sensor the ECM loses this ability.

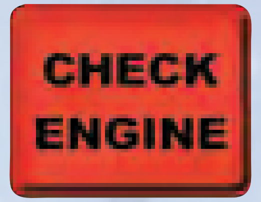


ROUGH ENGINE IDLE AND POOR PERFORMANCE

A rough idling engine can be a symptom of a failed or lazy O_2 sensor. Late model vehicles do not have any external adjustments to compensate for a rough idling engine. The system relies on sensor inputs to maintain a smooth idle speed. Driveability symptoms such as surging or hesitation can be a direct result of a worn out O_2 sensor. The ECM's inability to precisely control ignition timing and air fuel ratios can lead to these symptoms.

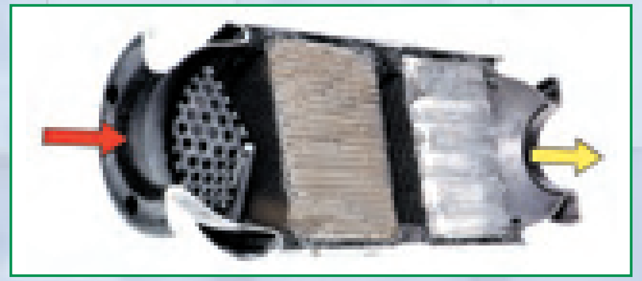
CHECK ENGINE LIGHT ON

Whenever the "Check Engine" light comes on, the O_2 sensor should be tested for proper operation. A poor performing O_2 sensor can set diagnostic trouble codes forcing the ECM to turn the light on.



FAILED CATALYTIC CONVERTER

A failed catalytic converter can be the result of a degraded O_2 sensor. The life of the converter is dependent upon receiving exhaust gasses burned from an optimum air fuel ratio of 14.7 to one. This optimum ratio, which is maintained by the O_2 sensor, provides an excess air factor of 1.0 to the converter. The surplus oxygen is used by the three-way catalytic converter to reduce HC, CO and NO_x.



The Oxygen Sensor Line

We provide comprehensive coverage to meet all of your customer needs. The O_2 sensor line includes coverage from their introduction to the present. We have complete OE style coverage for foreign and domestic applications. Universal sensors can be used when the application is not available or not in stock. With our oxygen sensor line you'll never miss a sale.

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UNHEATED & HEATED

Unheated sensors rely on the temperature of the exhaust gas to maintain an operating temperature above 600°F. If the temperature of the sensor falls below 600°F it will fail to generate a signal. The computer control system will then revert to open loop operation and stop controlling the air-fuel ratio and ignition timing. Single wire sensors use the shell, which is threaded into the exhaust manifold, to complete the ground path. Two wire sensors use one lead for the signal and the other lead is attached to a ground source.

Using heaters quickly brings O2 sensors up to operating temperature at vehicle start-up when the vehicle is cold. In addition, sensors can be placed away from the cylinder heads… allowing easier serviceability and longer service life. Four wire sensors use two wires to supply the internal heater with current, one wire is used to carry the signal and the other wire is used to complete the ground path. Three wire sensors use an internal ground path through the sensor shell.

ZIRCONIA - *Electrochemical Voltage Generator*

This is the most common type of oxygen sensor that uses a ceramic "thimble" element made from zirconium oxide. At over 600°F the zirconia sensor will produce between 0V and 1.1V depending on the difference of oxygen content between the atmospheric reference air and the exhaust.

TITANIA - *Variable Resistor*

Using a flat thick film ceramic element made from titanium oxide, this sensor requires a heating element and a reference voltage from the PCM. This type of sensor switches very quickly from low resistance, when rich; to high resistance, when lean.

PLANAR *(Fast Light Off) - Electrochemical Voltage Generator*

This sensor uses a multi-layer flat thick-film ceramic element from zirconium oxide and contains a high wattage heating element. This permits the vehicle to enter closed loop fuel control within 10 seconds of start-up. At over 600°F the planar sensor will produce between 0V and 1.1V as required.

WIDEBAND *(WRAF, LAF, A/F) - Electronic Voltage Generator*

Operating at over 1200°F, this 5-wire sensor reduces emissions by enabling closed loop fuel control over wider ranges of air/fuel mixtures using a dual element design and high amperage heater circuit. The PCM measures the amount of current required to keep element one at 450mv determining air-fuel ratio, for precise control of the fuel mixture during wide-open throttle and fuel-cut conditions.

AIR / FUEL *(Air/Fuel Ratio Sensor)*

Requiring special PCM controls similar to the wide-band sensor, this sensor is comparable to a thimble or planar design. It uses one sensing element with a Spinel coating and a powerful silicon nitride heater to maintain an operating temperature of 1200°F. The PCM applies a 3.3-volt bias across the sensing element and measures changes in current flow. This design does not constantly cycle from rich to lean and as a result it produces an accurate control of the air fuel ratio with lower emissions and improved fuel economy.