Technical Bulletin

February 2021 TSB-VSA-EMS-022021-03

TIPS & TRICKS

Oxygen Sensors diagnostic & failures

Applications

All engine models

Why replace a defective Oxygen Sensor?

Oxygen sensors are one of the sensors that contribute to controlling the air/fuel mixture, so if this sensor is defective, it should be replaced in order to fulfill the following conditions:

- **Improvement** of engine performance
- Fuel consumption **reduction** of about 15%
- **Reduced** pollutants emissions
- **Reduced** risk of damaging the catalytic converter

Oxygen Sensor symptoms

Oxygen Sensor **failure** can be detected through one or several symptoms:

- **Lower** than usual engine performance
- **Abnormal increase** of exhaust emissions and fuel consumption
- Engine Indicator lamp illuminated (**MIL**)
- Stored fault code in ECM (**DTC**)

Oxygen Sensor failure causes

Oxygen sensor failure can occur due to several reasons

- Internal & external short circuits
- No ground/voltage supply
- Use of leaded fuel/additives
- Overheating
- Deposits/contaminations
- Mechanical damage

Step 1: Oxygen Sensor diagnostic. Visual inspection

The first diagnostic step is to conduct a visual inspection on the sensor body and verify there is no damage in the sensor housing.

The 5 **main** points to check visually are:

- Coolant leakage **(see fig.1)**
- Engine oil leakage **(see fig.2)**
- Air/fuel mixture is too high **(see fig.3)**
- Excess of lead in exhaust gases **(see fig.4)**
- Contamination from the silicon **(see fig.5)**

Fig. 1

Fig. 2

Fig. 3

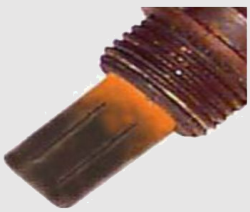


Fig. 4

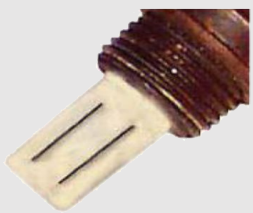


Fig. 5

Source:
https://dannysengineportal.com/o2-oxygen-sensors-function-failure-symptoms-testing-procedures/

Step 2: Oxygen Sensor diagnostic. Heater Sensor

When the sensor heater **does not work properly** it will affect the output values.

When the Oxygen Sensor **heater** has an **open** circuit this results in:

- Heating process will not be **fast**
- ECM will illuminate **check engine** lamp

How to check the heater circuit for opening circuit fault?

- Identify the **two pins** for the Oxygen Sensor heater
- Use **multimeter** probes on **continuity mode** and measure the **internal resistance** of the heater, it should give a **small value** (values are in car manufacture manual)

It is important to check the **signals from ECU** are correct and that there is **no cut** in wires

Switching Sensors: The heater should get a fixed voltage (reference in car manufacturer)

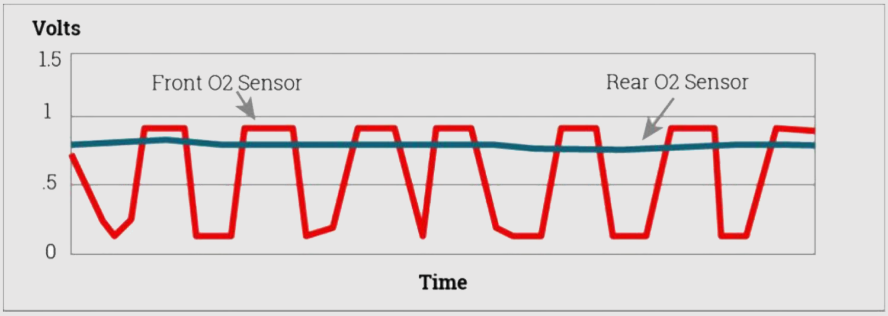
Wideband Sensors: The heater should get a pulsed voltage (reference in car manufacturer)

Step 3: Oxygen Switching sensor diagnostic. Output signal

Back probe the Switching Oxygen Sensor connector to the oscilloscope **without disconnecting** the connector from the ECU harness.

- Engine revs at **2000 RPM**
- The oscilloscope reading should **fluctuate** from **0.1V to 0.9V** before the catalytic converter
    - **Thimble Sensor** signal fluctuates every **1 second**
    - **Planar Sensor** signal fluctuates **3 or 4 times per second**

- The sensor placed **after** the catalytic converter has a signal output of **0.45V** which indicates that the catalytic converter is working **properly**



Step 4: Oxygen Wideband Sensor diagnostic. Output signal

Wideband Sensors are based on **current variation**, so take into consideration the following points:

- The voltage should be **steady** and **variation** happens in current
- If voltage **fluctuation** occurs, this means the engine is running either in **rich** or **lean** mixture conditions

Oxygen Switching/Wideband output signal analysis

For sensors pre-catalytic converter, the reading should **vary** from **0.1V to 0.9V** in **normal** conditions.

In the case of a **rich** or **lean** mixture, the voltage will be fixed at **0.9V** or **0.1V** respectively

In a **rich** mixture condition:

- **Output voltage**: **steady** at **0.9V** (not good)
- **Simulation** is needed by **increasing** the amount of air input to engine
- Ensure the output voltage **drops** to **0.1V** after simulation
- If change happens in the reading, it means there is **no fault** in the sensor and the **issue** is from **another part** but if there is **no change** in the reading, this means there is a problem with the sensor

In a **lean** mixture condition:

- **Output voltage**: **steady** at **0.1V** (not good)
- **Simulation** is needed by **increasing** the fuel input or **decreasing** the input air from throttle body
- Ensure the output voltage **rises** to **0.9V** after simulation
- If change happens in the reading, it means there is **no fault** in the sensor and the **issue** is from **another area** but if there is **no change** in the reading, this means there is a problem with the sensor