





TIPS & TRICKS

Oxygen Sensors: Types

Applications

All engine models

Oxygen Sensor types

SENSOR TYPE	Zirconia Binary Oxygen Sensor			Wideband Oxygen Sensor
				
Sensing material	Zirconium dioxide (ZrO ₂)			Zirconium dioxide (ZrO ₂)
Working principle	Electrochemical			Electrochemical
Output signal	Voltage (comparison between two atmospheres)			Current
Air reference	Yes		No	Sometimes
size	Standard		Mini	Standard
Heating element	No	Yes	Yes	Yes
Number of wires	1 or 2	3 or 4	1 or 4	5

Zirconia Binary Oxygen (Switching Sensor) types & signalling method

This type of sensor has an internal heater to get the sensor into working temperature operation rapidly.

- **Heated Switching sensors** : these Oxygen sensors **generate** their own voltage, about **450 mV** when the mixture is **stoichiometric**. For a **LEAN** air/fuel mixture, the sensor displays a low voltage of **0.1 V**, which indicates a **high** exhaust Oxygen concentration. For a **RICH** air/fuel mixture, residual Oxygen concentration is **low** and the sensor voltage rises up to **0.9 V**.

Two subfamilies can be found in Switching Sensors:

- Heated **Planar** Switching Sensor
- Heated **Shimble** Switching Sensor



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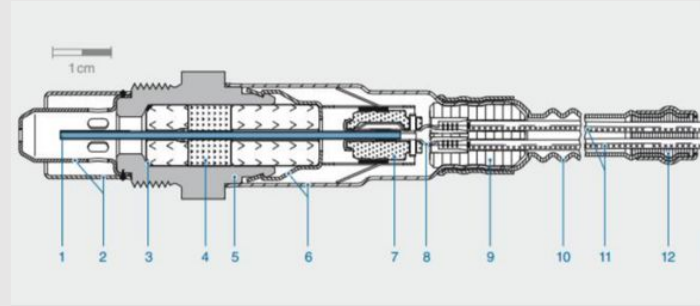


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Zirconia binary oxygen: Heated Planar construction

S	Name	S	Name
1	Planar measuring cell	7	Contact holder
2	Double protective tube	8	Contact slip
3	Sealing ring	9	PTFE grommet
4	Sealing packing	10	PTFE shaped sleeve
5	Sensor housing	11	Five connection cables
6	Protective sleeve	12	seal



Zirconia Binary Oxygen Sensors (Heated planar): how do they work?

- Planar sensors have a **flat and thin** ZrO₂ element
- They have a **smaller** heater and need **less electric power** than **Thimble** Sensors
- **High** response rate **5 to 7** times per second
- Signal voltage from **0.1V** to **0.9V**
 - **0.1V** when the mixture is **lean**
 - **0.45mV** when the mixture is **stoichiometric**
 - **0.9V** when the mixture is **rich**
- Reach normal operating temperature **fast** which results in
 - **Reduced** pollutant emissions
 - **Increased** fuel economy
 - **Reduced** light-off time



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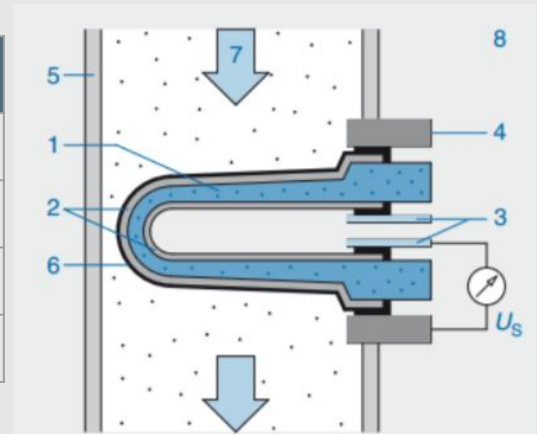
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Zirconia Binary Oxygen Sensors: Heated Thimble construction

S	Name
1	Sensor ceramic element
2	Electrodes
3	Contacts
4	Housing contact

S	Name
5	Exhaust pipe
6	Ceramic protective layers(porous)
7	Exhaust gas
8	Outside air

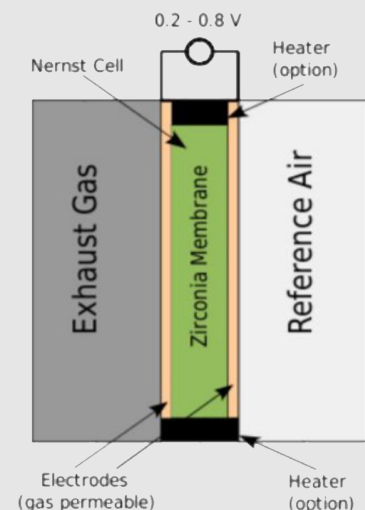


- Solid electrolyte consists of a **ceramic element** that is **impenetrable** to gas
- It is a mixed oxide comprising **Zirconium & Yttrium** formed in a tube closed at the end
- The surfaces on both sides have electrodes made from a **microporous thin-noble-metal layer**
- The ceramic body is inside the exhaust pipe and the platinum electrode acts as a **miniature catalytic converter** on its outside surface
- Exhaust gas which reaches this **electrode** will be **processed catalytically** and results in a **stoichiometric** balance

Zirconia Binary Oxygen Sensors (Heated Thimble): how do they work?

How does this system measure the Oxygen concentration?

- Based on a solid state electrochemical fuel cell called **NERNST** cell
- **2** electrodes provide an output voltage corresponding to the **quantity** of **Oxygen** in the exhaust compared to the atmosphere
- The **difference** in Oxygen content on each side of the sensor **generates** an electrical voltage between the **2 layers**



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Wideband Oxygen Sensors: how do they work?

- Based on a planar **zirconia** element and incorporate an **electrochemical gas pump**
- An electronic circuit that contains a **feedback** loop controls the gas pump current
- This gas pump current keeps the output of the electrochemical cell **constant**
- The pump current indicates the **Oxygen content** of the exhaust gas

