

Lambda sensors

Construction

A ceramic element of zirconium oxide (ZrO_2) is placed in a specific packing in a metal piece made of premium, highly temperature resistant steel. The ceramics sensor element is enclosed by a protective tube to prevent the sensor element from wetness and coarse particles. The sensor element consists of several layers of ceramic with thin platinum contacts in between.

Functionality

To ensure the functionality of the sensor, the ceramic element is heated to nearly $800^{\circ}C$. The heater is integrated into the sensor element and is controlled by a pulse duration modulation.

Due to the high temperature the ceramic becomes conductive to ions and because of different oxygen concentrations (partial pressure) an ion exchange takes place between the exhaust gas and an oxygen-containing reference gas.

There are diverse ways to produce this reference gas. The easiest one is to take the reference oxygen out of the air. An air chamber in the sensor sources the oxygen through the strands of the connecting cable. Therefore it is essential to keep the plug connector free from pollution, e.g. contact spray.

Another much better method is to produce the reference oxygen in the sensor. For this a special element (pumping cell) in the ceramic provides the reference gas with a fed, so called pumping current. The

actual measuring of the different oxygen concentrations happens in the Nernst cell; named after the innovator Prof. Walther Nernst (1864 – 1941). Due to the ion exchange (similar to the potential difference and the resulting current flow in a battery) develops a potential difference in the Nernst cell, which enables a current flow (the oxygen ions).

The higher it is, the higher is the potential difference. On this basis the different oxygen concentration can be determined. In case of lambda sensors with pumping cells/flow not the Nernst voltage is measured, but the pumping flow. Meanwhile it is tried to keep the Nernst voltage on an adjusted value and to vary the pumping flow. Therefore a special test circuit is needed, e.g. like the Bosch Lambdatronic LT4 offers.

A percental measuring of the oxygen content is not possible with a lambda sensor. A Lambda sensor does not know the amount of the test gas (exhaust gas) and can not be used as temperature sensor. Although the resistance of the Nernst cell is temperature-dependent, it is tried to keep the temperature constant with the adjusted heater.

Measuring range

There are so called jump sensors (Bosch LSH, LSM and LSF), but also the broad-band sensors Bosch LSU. The measuring range of the Bosch snap sensors is within lambda 0,93 to 1,15 and for the Bosch broad-band sensors within lambda 0,6 to ∞ .