System overview

CarboSen
HydroSen

LAMTEC

Sensors and systems for combustion engineering

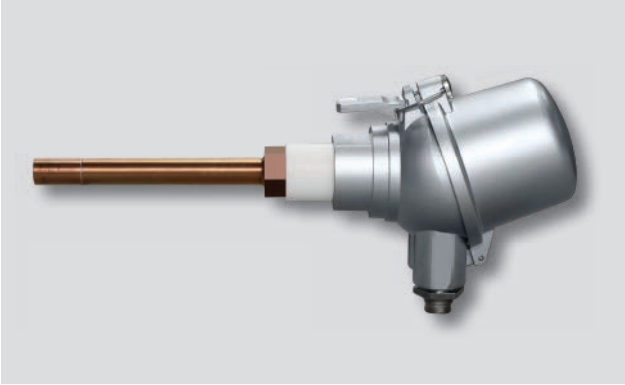
www.lamtec.de

CarboSen – the sensor for measuring combustible gases.

For the detection of oxidising CO/H_2 gas components in gases, as well as the optimisation and monitoring of combustion processes.

CarboSen is a sensor system for detecting combustible gases like CO, H_2, or HC. In sum, these gases are also called "CO equivalent" (CO_e). The sensor system consists of the sensor and sensor electronics. The unit of sensor element, sensor housing, and sensor signal cable form the sensor, which is used to record the measuring variable. The sensor electronics permit a temperature-compensated operation and flexible actuation of the sensor, as well as the recording and output of relevant sensor variables. In the ST design, the electronics are integrated into the sensor head.

CarboSen has a high resolution and is suited for the detection of small CO_e concentrations for the range between 0 ppm and 3,000 ppm (best resolution up to 1,000 ppm).

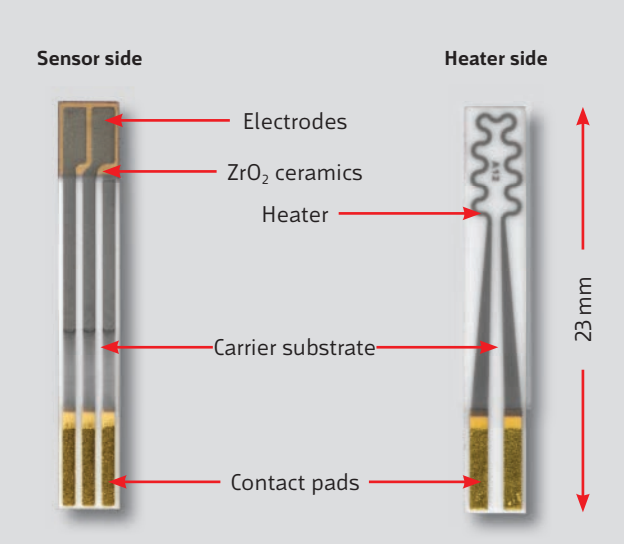


CarboSen is a solids electrolyte sensor. The technology used is generally known through the lambda probe and wide-spread. In contrast with the lambda probe, which measures oxygen according the Nernst principle, CarboSen works according to the non-Nernst principle. Through the variation of geometry, the material of the electrodes, and electrical circuitry, sensors can also detect other gases such as CO, H_2, or HC according to the non-Nernst principle.

For the operation of the sensor, it is necessary to heat it up to its working temperature. This takes place through a heating structure attached to the back of the sensor element. The platinum heater coil resistor has a defined temperature dependency. This permits the adjustment of the working temperature of the sensor. This temperature lies at about 600 °C, is set automatically by the electronics, and kept constant during operation.

The sensor temperature can be varied for special applications. For this purpose, easy parametrisation is possible. Upon customer wish, this can be performed at LAMTEC or by means of a programming unit on site. The sensor characteristic adapts to changes in the working temperature. An increase in temperature of the sensor results in a reduction of sensitivity, i.e., the sensor becomes more insensitive to CO_e, and the characteristic curve becomes flatter. In addition the sensor dynamics become larger, that is, the response and recovery behaviour is accelerated.

CarboSen detects the concentration of the sum of all combustible (oxidisable) gas components, like CO, H_2, etc., called CO_e, in situ. In case of a known fuel with a constant composition, the CO concentration can be determined with a limited precision of ± 25 % of the measured value.



CarboSen sensor element.

Advantages:

- Drift-free zero position
- High resolution
- Fast response behaviour
- Mechanically, chemically, and thermally robust
- Compact, evaluation electronics in the head (ST)
- Compact, evaluation electronics separate (HT)
- Small dimension
- Wide range of applications

XC164 sensor electronics.

The microprocessor-control sensor electronics assume the following tasks in the system:

- Heating of the sensor and regulation to a constant temperature
- Recording of the sensor voltages in mV
- Conversion of the measured sensor voltages and output to the analogue output (0/4 ... 20 mA)
- Monitoring of both sensor voltages
- Output of all relevant measured values to the LAMTEC SYSTEM BUS (LSB)

The voltage supply of the electronics is implemented with 13 V to 30 V direct voltage, ideally with 24 V / 2 A.

At the analogue output, U_{COe} is output in the factory default setting (4 mA ... 20 mA-100 mV ... 900 mV), calculated from the mean of both sensor voltages. Internally, both sensor voltages are compared with each other and tested for the following fault criteria (standard parametrisation):

- Difference greater than 25 mV or
- Difference greater than 25 % of the current measured value.

The failsafe SiCarboSen sensor electronics.

The microprocessor-control sensor electronics assume the following tasks in the system:

- Heating of the sensor and regulation to a constant temperature
- Recording of the sensor voltages in mV
- Conversion of the measured sensor voltages and output to the analogue output (0/4 ... 20 mA)
- Monitoring of both sensor voltages
- Check of the analogue output
- Output of all relevant measured values to the LAMTEC SYSTEM BUS (LSB)

The voltage supply of the electronics is implemented with 13 V to 30 V direct voltage, ideally with 24 V / 2 A.

At the analogue output, U_{COe} is output in the factory default setting (4 mA ... 20 mA-100 mV ... 900 mV), calculated from the mean of both sensor voltages. Internally, both sensor voltages are compared with each other and tested for the following fault criteria (standard parametrisation):

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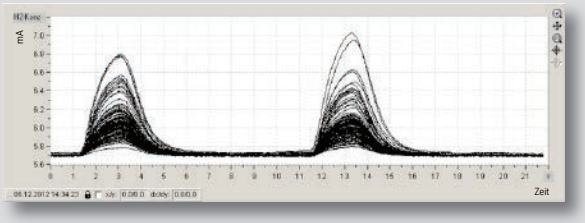
HydroSen – The leak detection sensor.

HydroSen is based on the miniaturised CarboSen sensor system. Through specialised aerospace know-how in connection with state-of-the-art production techniques, a sensor system was created that is especially suited from measuring ranges under 1,000 ppm H_2. A solids electrolyte sensor according to the non-Nernst principle is used. This sensor makes it possible to measure concentrations from 1 ppm H_2 already and can thus be used advantageously for industrial leakage detection.

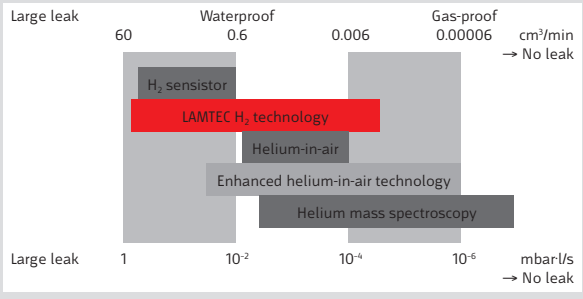
This is implemented as follows in today's practice

For many automobile manufacturers, helium has been recognised and established as a test gas, for example, when testing fuel systems. On the one hand, this lies in the relevance to safety, the limited test pressure with gas, and the bad reproducibility in air tests. Helium sources that can be used naturally, however, are rare. This means that helium is very expensive to procure and the demand is very high. Newly developed gas sensors for various gases offer similar alternatives. Hydrogen receives special consideration in this context as it is also known as a test gas in the automobile industry, for example, for leakage detection in areas to be repaired.

Whoever uses helium as a test gas knows how costly it is. In addition to the acquisition costs for helium, expensive equipment is also required. Time is also a factor.



Sensor signal curve along the travelling track of a test specimen with 2 leaks.



Leakage technology vs. product requirement.

Advantages:

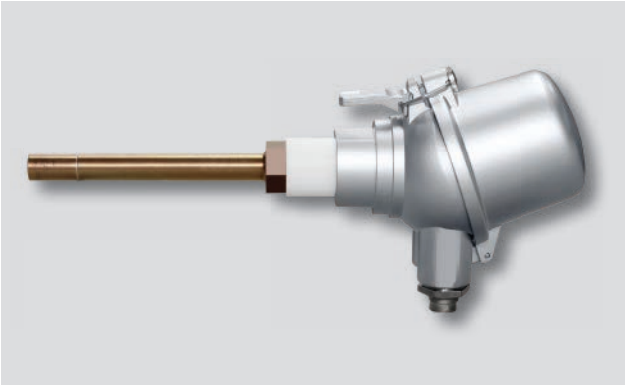
- Hydrogen evaporates more quickly than helium and leaks are more unproblematic.
- Compact sensor, easier to install.
- No special hoses required.
- Forming gas 5 acts like air during calibration (5 % H_2 in 95 % N_2).
- H_2 sensor has stable zero values (underground measurement is possible).
- H_2 sensor recovers quickly, no problems with large concentrations.
- H_2 sensor has a long service life.
- No hydrogen shortages are expected.
- The measuring equipment is more affordable.
- Low operating costs (observe the boundary conditions).
- Operation of H_2 sensor system possible without vacuum.

Testing with helium is lengthy since the sensor system reacts very sluggishly.

On the basis of H_2 (5 % H_2, 95 % N_2), LAMTEC has developed a sensor that makes it possible to perform leakage tests affordably and at short intervals. The sensors can be used in three different designs:

- Handheld device: for leakage testing in mobile objects.
- Industrial leakage detection – the sensor and reader are permanently attached to each other.
- Industrial leakage detection – the reader is permanently and the sensor if flexible attached to robots, for example.

Basic model.

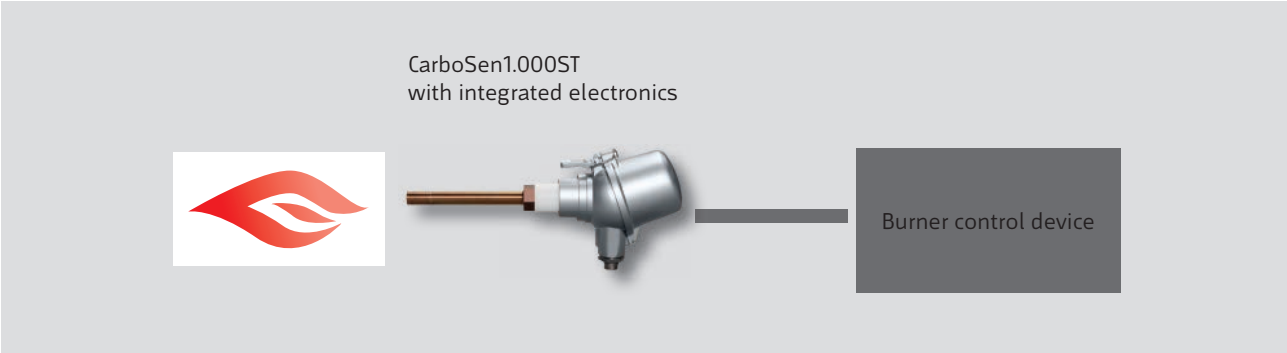


CarboSen1.000ST with electronics in housing.

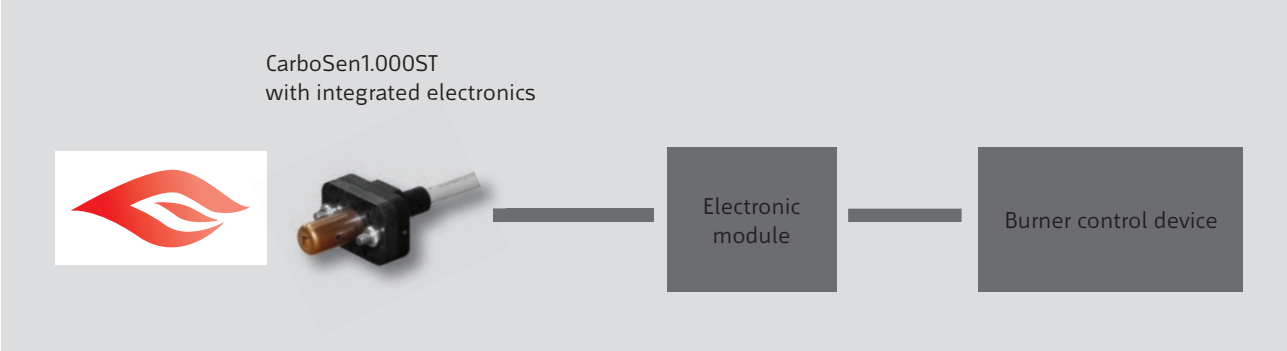
CarboSen1.000G in rod housing.

CarboSen1.000 in clip-on housing.

CarboSen1.000K.



Functional overview of CarboSenST with integrated sensor electronics and burner control device.



Functional overview of CarboSen with external electronics and burner control device.

Notes.

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Publication no. DLT5817-15-aEN-011