# GAS PRESSURE SENSOR

## Description D0341


**Figure 1.** The Gas Pressure Sensor

**Short description**
The Gas Pressure Sensor can be used to monitor pressure changes in the range from 0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mmHg).
**A pressure above 404 kPa (4 atm or 3040 mm Hg) may damage the sensor permanently.**

Included with your Gas Pressure Sensor are accessories to allow you to connect it to a reaction container, such as an Erlenmeyer flask.
The following accessories are included:

- two tapered valve connectors inserted into a No. 5 stopper;
- one tapered valve connector inserted into a No. 1 stopper;
- one two-way valve;
- two Luer-lock connectors (white) connected to either end of a piece of plastic tubing;
- one 20-ml syringe;
- two transpiration tubing clamps (white).

The white stem on the end of the Gas Pressure Sensor Box has a small threaded end called a *luer lock*. With a gentle half turn, you may attach the plastic tubing to this stem using one of the Luer connectors already mounted on both ends of the tubing. The Luer connector at the other end of the plastic tubing can then be connected to one of the stems on the rubber stoppers that are supplied. The stopper can then be inserted into a flask or test tube to provide an airtight container to investigate a confined gas.

You can also attach the 20-ml plastic syringe included with the gas pressure sensor directly to this stem.

The Gas Pressure Sensor is delivered with a BT-plug and can be connected to the following interfaces:

- UIA/UIB through Measuring console (via 0520 adapter)
- CoachLab and CoachLab II
- SMI (via 0520 adapter)
- Texas Instruments CBL™ data-logger.
- Vernier LabPro ™ data-logger.

There is an adapter (art. 0520) to connect sensors with BT-plugs to 4-mm inputs.

**How the Gas Pressure Sensor Works**

The active sensor in this unit is the SenSym SDX30A4 pressure transducer. It has a membrane, which flexes as pressure changes. This sensor is arranged to measure absolute pressure. One side of the membrane is a vacuum, while the other side is open to the atmosphere. The sensor produces an output voltage, which varies in a linear way with absolute pressure. It includes special circuitry to minimize errors caused by changes in temperature. We provide an amplifier circuit that conditions the signal from the pressure transducer. With this circuit, the output voltage from the Gas Pressure Sensor will be linear with respect to pressure, with 0.00 volts corresponding to 0 kPa (0 atm) and 4.6 volts corresponding to the sensor's maximum pressure, 210 kPa (2.1 atm).

**Calibration**

As the signal of the Gas Pressure Sensor is linear with the absolute pressure a two-point calibration suffices. In some cases, the sensor can even be used without calibration e.g. when measuring relative pressure.

For the **first calibration point** perform the following operation:

- Open the 3-way valve on the sensor to the atmosphere, so it equilibrates to atmospheric pressure. When the voltage reading displayed on the computer, calculator, or CBL screen stabilizes, enter the atmospheric pressure, as recorded with a barometer.

For the **second calibration poin**t, do *one* of the following:

- Use the syringe provided with the Gas Pressure Sensor to produce a pressure very near zero. Before connecting the syringe, push its plunger all the way in to the 0-ml mark. Connect the syringe directly to the Gas Pressure Sensor stem. To produce near-zero pressure, pull the plunger out to the 20-ml position. If your syringe and valve have a tight seal, the pressure will be ~ 0 kPa (0 atm or 0 mm Hg).
- Apply pressure with a pump, measuring it at the same time with a pressure gauge.
- Before connecting the syringe, move the plunger on the syringe so that the syringe volume is set at 10 ml. Connect the syringe to the stem of the Gas Pressure Sensor. Move the syringe plunger so that the voltage reading displayed on the computer or calculator is 3.0 volts. Enter a value of 39.4 kPa as the value (or 1.376 atm, or 1045.9 mm Hg) for this calibration point.

The name of the Gas Pressure sensor in the sensor library of Coach 5 program is **Pressure sensor (0341&bt) (CMA)(0..210 kPa).**

**Suggestion for experiments**

- Measurements of pressure changes in gas law experiments such as Boyle's law and Gay-Lussac's law.
- Measurements of vapor pressure of liquids.
- Monitoring the production of $O_2$ during photosynthesis of an aquatic plant in a closed system.
- Determining transpiration rate for a plant under different conditions.
- Determining transpiration rate in germinating pea or bean seeds.
- Monitoring the pressure of a confined air pocket as water moves in and out of a semi-permeable membrane by osmosis.
- Studying the effect of temperature and concentration on the rate of decomposition of $H_2O_2$.

**Boyle's Law (Pressure *vs.* Volume)**

Boyle's law can be easily demonstrated using the Gas Pressure Sensor. One easy way to do this is to use the plastic syringe included with the sensor. Before connecting the syringe to the sensor, move its syringe to the 10-ml volume mark. Connect the plastic syringe to the white stem on the end of the Gas Pressure Sensor box, with a *gentle* 1/2 turn.

The pressure inside the syringe is now equal to atmospheric pressure at the volume you selected. You are now set to collect pressure-volume data. Take data as you change the volume. The syringe is marked in volume units (ml).You can both increase and decrease the volume.

Sample data collected with this sensor and the syringe are shown here:

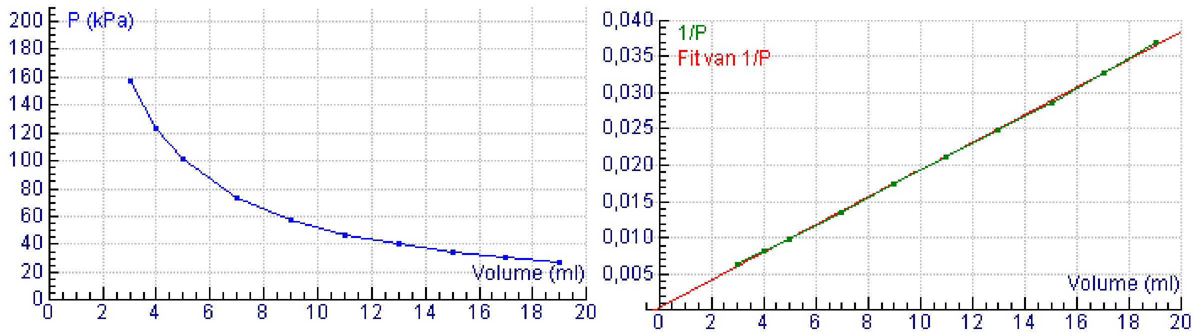
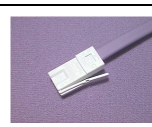



**Figure 2.** Experiment of Boyle, a measurement results and determination of the volume of the sensor.

Using Boyle's law the own volume of the sensor (Vs) can be determined.
Boyle's law for syringe (V) and own sensor volume (Vs) is:
$p*(V+Vs)=c$ so $(V+Vs)/c = 1/p$
On the Volume-axis: $1/p = 0$ so also $V+Vs = 0$ and $Vs = -V$.
By this method one obtains: $Vs = 0.2\ cm^3$.

## Technical data

| | |
|---|---|
| Output voltage | 0 - 4.6 V |
| Pressure range | 0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mm Hg) |
| Resolution using 10-bits 5V A/D converter<br>Resolution using 12-bits 5V A/D converter | 0.2 kPa (0.002 atm or 1.6 mm Hg)<br>0.05 kPa (0.0005 atm or 0.40 mm Hg) |
| Max. pressure | 404 kPa (4 atm or 3040 mm Hg) without permanent damage |
| Combined linearity and hysteresis | Typical ±0.2 % full scale |
| Response time | 100 microseconds |
| Connection |  BT (British Telecom) plug |

**CENTRE FOR MICROCOMPUTER APPLICATIONS**
**Kruislaan 404, 1098 SM Amsterdam, The Netherlands**
Fax: +31 20 5255866, e-mail: cma@science.uva.nl, http://www.cma.science.uva.nl/english