Gas Pressure Sensor
(Order Code GPS-BTA)

The Vernier Gas Pressure Sensor is used to monitor pressure changes in gas-law experiments in chemistry and physics, such as Boyle's law (pressure *vs.* volume) and Gay-Lussac's law (pressure *vs.* absolute temperature). Vapor pressure of various liquids and solutions can be monitored using this sensor. Biology teachers can use the Gas Pressure Sensor to monitor the production or consumption of oxygen or carbon dioxide gases in an enclosed atmosphere. The following is a partial list of activities and experiments that can be performed using this sensor.

- Investigate the relationship between pressure and volume, Boyle's law.
- Measure vapor pressure of liquids.
- Study the effect of temperature on gas pressure, Gay-Lussac's law.
- Monitor the production of O_2 during photosynthesis of an aquatic plant in a closed system.
- Determine the rate of transpiration for a plant under different conditions.
- Determine the rate of respiration in germinating pea or bean seeds.
- Monitor the pressure of a confined air pocket as water moves in and out of a semi-permeable membrane by osmosis.
- Study the effect of temperature and concentration on the rate of decomposition of H_2O_2.
- Study human respiratory patterns using the Vernier Respiration Monitor Belt.

Gas Pressure Sensor Accessories

Included with your Gas Pressure Sensor are accessories to allow you to connect it to a reaction container, such as an Erlenmeyer flask. Check to be sure that each of these items is 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 connected to either end of a piece of plastic tubing
- one 20 mL syringe
- two transpiration tubing clamps

Potential uses of the accessories included with your Gas Pressure Sensor:

- 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, as shown in Figure 1.
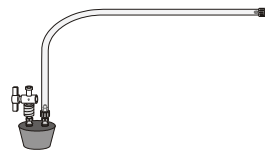
Figure 1

- The stopper can then be inserted into a flask or test tube to provide an airtight container to investigate a confined gas, as shown in Figure 2. **Note:** The second valve on the rubber stopper is shown in a closed position.
- You can also attach the 20 mL plastic syringe included with the Gas Pressure Sensor directly to this stem, as shown here in Figure 3.
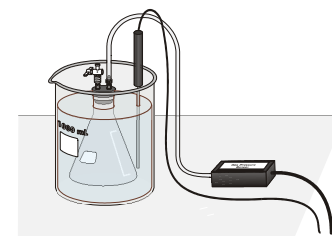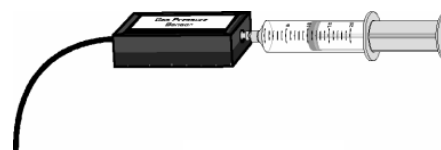
Figure 2

Figure 3

Collecting Data with the Gas Pressure Sensor

This sensor can be used with the following interfaces to collect data.

- Vernier LabQuest® 2 or original LabQuest® as a standalone device or with a computer
- Vernier LabQuest® Mini with a computer
- Vernier LabPro® with a computer or TI graphing calculator
- Vernier Go!®Link
- Vernier EasyLink®
- Vernier SensorDAQ®
- CBL 2™
- TI-Nspire™ Lab Cradle

Here is the general procedure to follow when using the Gas Pressure Sensor:
1. Connect the Gas Pressure Sensor to the interface.
2. Start the data-collection software.[1]
3. The software will identify the Gas Pressure Sensor and load a default data-collection setup. You are now ready to collect data.

Data-Collection Software

- **Logger *Pro* 3** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link.
- **Logger *Pro* 2** This computer program is used with ULI or Serial Box Interface.
- **Logger Lite** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link.
- **LabQuest App** This program is used when LabQuest 2 or LabQuest is used as a standalone device.
- **EasyData App** This calculator application for the TI-83 Plus and TI-84 Plus can be used with CBL 2, LabPro, and Vernier EasyLink. We recommend version 2.0 or newer, which can be downloaded from the Vernier web site,

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[1] If you are using Logger *Pro* 2 with either a ULI or SBI, the sensor will not auto-ID. Open an experiment file for the Gas Pressure Sensor in the Probes & Sensors folder

www.vernier.com/easy/easydata.html, and then transferred to the calculator. See the Vernier web site, www.vernier.com/calc/software/index.html for more information on the App and Program Transfer Guidebook.

- **DataMate program** Use DataMate with LabPro or CBL 2 and TI-73, TI-83, TI-84, TI-86, TI-89, and Voyage 200 calculators. See the LabPro and CBL 2 Guidebooks for instructions on transferring DataMate to the calculator.
- **DataQuest™ Software for TI-Nspire** This calculator application for the TI-Nspire can be used with the EasyLink or TI-Nspire Lab Cradle.
- **LabVIEW** National Instruments LabVIEW™ software is a graphical programming language sold by National Instruments. It is used with SensorDAQ and can be used with a number of other Vernier interfaces. See www.vernier.com/labview for more information.

This sensor is equipped with circuitry that supports auto-ID. When used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, Go! Link, SensorDAQ, TI-Nspire Lab Cradle, EasyLink, or CBL 2, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor.

Specifications

Pressure range	0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mm Hg)
Maximum pressure that the sensor can tolerate without permanent damage	4 atm
Resolution	
13-bit (SensorDAQ)	0.032 kPa (0.00032 atm or 0.24 mm Hg)
12-bit (LabPro, LabQuest 2, LabQuest, LabQuest Mini, Go! Link, or TI-Nspire Lab Cradle)	0.06 kPa (0.0006 atm or 0.45 mm Hg)
10-bit (CBL 2)	0.26 kPa (0.003 atm or 2.0 mm Hg)
Sensing element	Honeywell SSCMRNN030PAAA5
Accuracy	typical ±0.25% FSS BFSL*
Response time	100 microseconds
Stored Calibration Values	
kPa slope	51.71
intercept	–25.86
atm slope	0.5103
intercept	0.247426
mm Hg slope	387.8
intercept	188.044

* Full Scale Span Best Fit Straight Line

How the Gas Pressure Sensor Works

The active sensor in this unit is the Honeywell SSCMRNN030PAAA5 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.

Pressure Units

Pressure can be measured in many different units. We quote values here in several of the units shown below. Some equivalent values for 1 atmosphere are

1 atmosphere	= 101.325 kPa
	= 760 mm Hg
	= 29.92 in. of Hg (at 0°C)
	= 14.70 psi
	= 1013 millibar

Optional Calibration Procedure

You do not have to perform a new calibration when using the Gas Pressure Sensor in the classroom. We have set the sensor to match our stored calibration before shipping it.

If you would like to perform your own calibrations, follow the steps described here. The standard calibration procedure we use with most of our sensors is a 2-point calibration. For detailed instructions, see www.vernier.com/til/2341

1. **First calibration point** Allow the sensor to equilibrate to atmospheric pressure. When the voltage reading stabilizes, enter the atmospheric pressure, as recorded with a barometer.
2. **Second calibration point** 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, and therefore the voltage reading, will be ~ 0 kPa (0 atm or 0 mm Hg).
   - Apply pressure with an external pump, measuring it at the same time with a pressure gauge. Input the gauge reading into the calibration dialog box in your data-collection program.

Suggested Experiments

We have a wide variety of experiments already written for use with the Gas Pressure Sensor in our chemistry, biology, and physical science lab books.. Here are some of the experiments you can perform with your Gas Pressure Sensor.

Boyle's Law (Pressure vs. Volume)
Experiment 6, Chemistry with Vernier
Experiment 30, Physical Science with Vernier

Gay-Lussac's Law (Pressure vs. Absolute Temperature)
Experiment 7, *Chemistry with Vernier*
Experiment 31, *Physical Science with Vernier*

Vapor Pressure Measurements
Experiment 10, *Chemistry with Vernier*

Rate of Plant Transpiration
Experiment 10, *Biology with Vernier*

Measuring Respiration of Insects
Experiment 23, *Biology with Vernier*

Control of Human Respiration
Experiment 26, *Biology with Vernier*
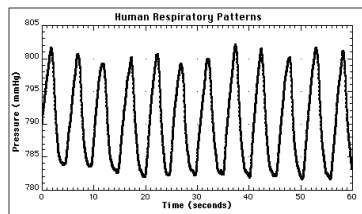
Pressure in Liquids: Depth Measurements

If you measure the pressure at the end of a long plastic tube forced underwater, you can indirectly measure depth. Connect the tubing to the stem of the Gas Pressure Sensor and then put the end of the tube under water. The pressure reading will increase 8.105 kPa (0.0800 atm or 60.79 mm Hg) for every meter below the surface of the water.

Note: If you measure depth in this way, the depth you are measuring is to the top of the air, which extends up the tube for a short distance.

Additional Pressure Sensor Accessories

In addition to the accessories that ship with the Gas Pressure Sensor, the following accessories are available for purchase.

Item	Order Code
Pressure Sensor Accessories Kit	PS-ACC
#1 1-Hole Rubber Stopper	PS-STOP1
#5 2-Hole Rubber Stopper	PS-STOP5
Luer Lock Connector	PS-LUER
Plastic 2-Way Valve	PS-2WAY
Plastic Tubing	PS-TUBING
Stopper Stem	PS-STEM
Syringe	PS-SYR
Plastic Tubing Clamps (pkg. of 100)	PTC

Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.
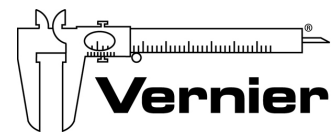
Measure. Analyze. Learn.™
Vernier Software & Technology