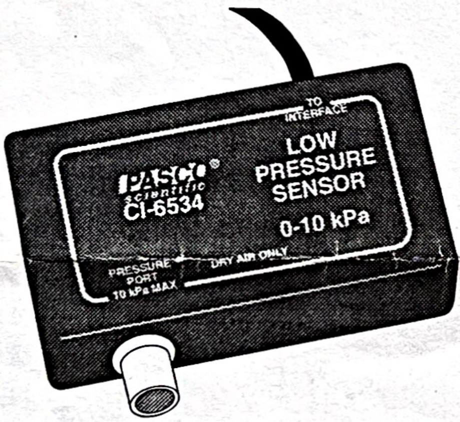
012-05914B
9/98
$1.00

**Instruction Sheet
for the PASCO Model
CI-6534 and CI-6535**

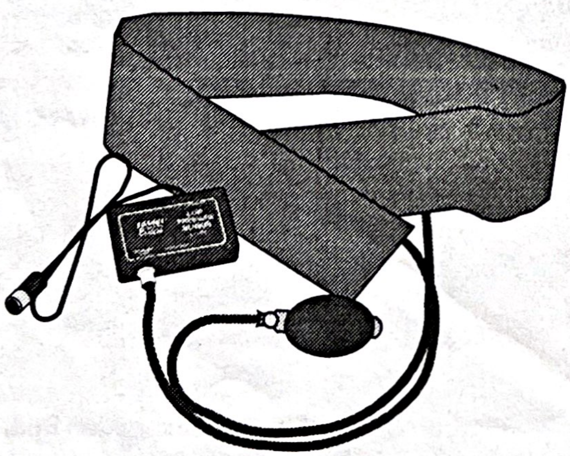
CI-6534 Low Pressure Sensor (0 - 10 kPa)
CI-6535 Respiration Rate Sensor

Introduction

The PASCO Model CI-6534 is a low pressure sensor that is designed to be used with a PASCO computer interface. This low pressure sensor is ideally suited for use with the PASCO Respiration Belt or the PASCO Heat Engine Apparatus.



The CI-6535 Respiration Rate Sensor consists of the Low Pressure Sensor and the PASCO Respiration Belt (003-05936).



Low Pressure Sensor

The low pressure sensor consists of the electronics box with a cable that has a DIN plug for connecting to a PASCO computer interface. The pressure sensor uses a MPX10GP (10 kiloPascal) transducer. This type of transducer has two ports. The reference port of the transducer is inside the electronics box. It is always open to the atmosphere and not available to the user. The other port is labeled PRESSURE PORT 10 kPa MAX on the outside of the electronics box. It has a "quick-release" style connector for attaching accessories such as the PASCO Respiration Belt. The pressure sensor gives a reading of "zero" when there is no pressure difference between the internal reference port and the external PRESSURE PORT.

The transducer is durable, but it is designed to be used with non corrosive gases such as air, helium, nitrogen, etc. Do not let the transducer get wet. The maximum short-term pressure that the sensor can tolerate without permanent damage is about 100 kPa (14 psi). Please be careful to not apply high pressure to the sensor.

The electronics box contains a precision operational amplifier (op amp) that can drive a heavy capacitive load, such as a six meter extender cable (CI-6515). There is a resistor in parallel with the transducer to compensate the sensor for temperature induced variations. The sensor has a negative temperature coefficient (resistance decreases as temperature increases) and the resistor has a positive temperature coefficient.

The sensor comes with a length of plastic (polyurethane) tubing and several "quick-release" style connectors. Extra parts are available as follows:

This instruction sheet written by: Dave Griffith

Item	Part Number
polyu[illegible] tubing (0.125")	640-023
quick-re[illegible] connector	640-021

Ra[illegible]ge and [illegible]lution

T[illegible] range of the CI-6534 Low Pressure Sensor is be- tween 0 and 10 kiloPascals. The resolution of the se[illegible] is 0.005 kiloPascals (kPa) when used with a PASCO co[illegible]ter interface. The output voltage from the sensor is +1.00 Volts when the pressure is 1 kiloPascal (kPa), and the output voltage is linear. Therefore, the output voltage should be +10.00 Volts at the top of the range (10 kPa)

Additional Equipm[illegible] Needed

- Comp[illegible]ter [illegible]erface such as one of the *Science Workshop* [illegible]erfaces

Recommen[illegible]ment

- Respiration Belt (part [illegible]-05936, included in the CI-6535 Res[illegible]ration Rate S[illegible]r)
- Heat En[illegible] Laws [illegible]ratus [illegible]

Respirati[illegible]

The PASC[illegible]ration [illegible] with the [illegible] Se[illegible] Rate Sensor package.

The bel[illegible] the following features:

- hoo[illegible]-and-pile strips sewn onto o[illegible]posite ends of the belt
- attached squeeze bulb for inflatin[illegible] the rubber blad- der inside the belt
- quick-release connector that can [illegible]ached to the pressure port on the Low Pressu[illegible] Sensor.

Operation: Using the Res[illegible]on Belt

To measure respiration rate (b[illegible] per min[illegible]), place the respiration belt around yo[illegible]st or upp[illegible] abdomen, connect one tube from the be[illegible] the low pre[illegible]ure sensor, inflate the respiration belt with [illegible] squeeze bulb, and monitor the respiration rate with the computer interface.

Placing the Respiration Belt

Arrange the belt around your body so the part of the belt that has the tubes on it is on the right side of your body with the tubes hanging down from the bottom edge of the belt.

Place the part of the belt that has the tubes against your chest first. When this part is against your chest, the strips of 'pile' should face away from your chest. Then place the left side of the [illegible]lt over the first part so the hook-and-pile strips match each other. The belt should be <u>snug</u> aro[illegible] the chest, but not so tight that breath- ing is restricted.

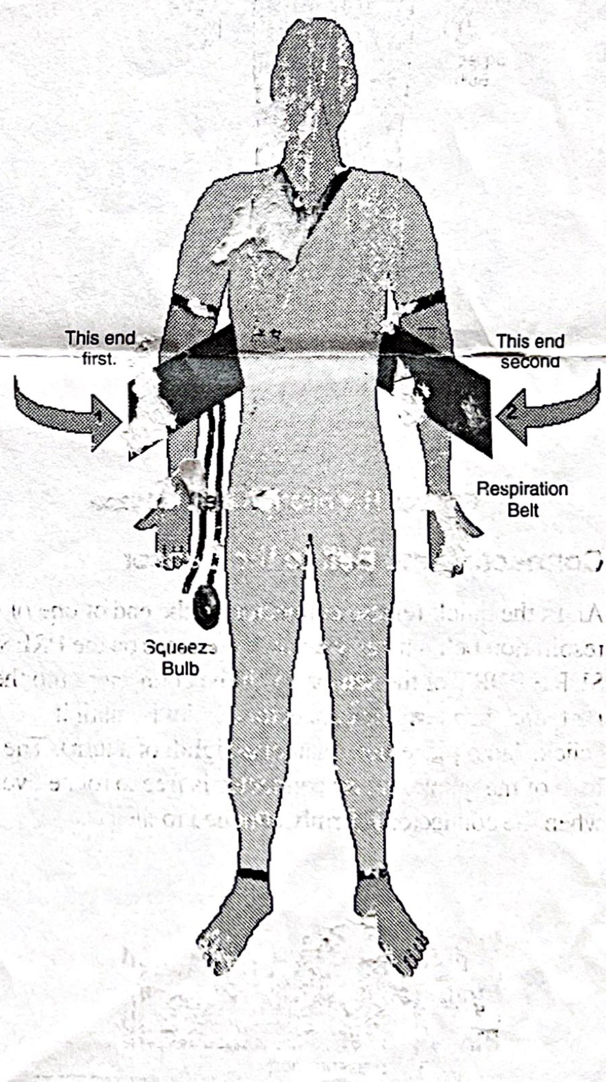


Figure: Connecting the Respiration Belt, Right Side First

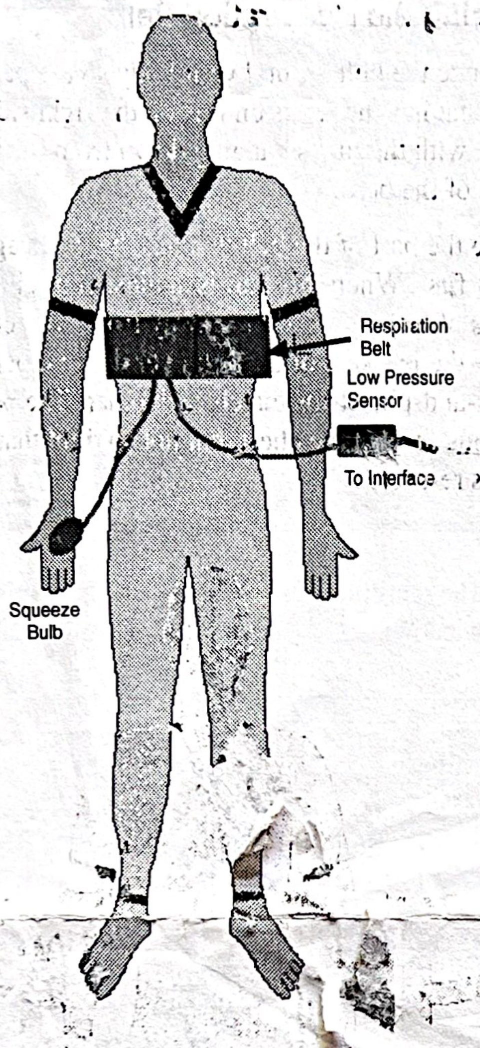
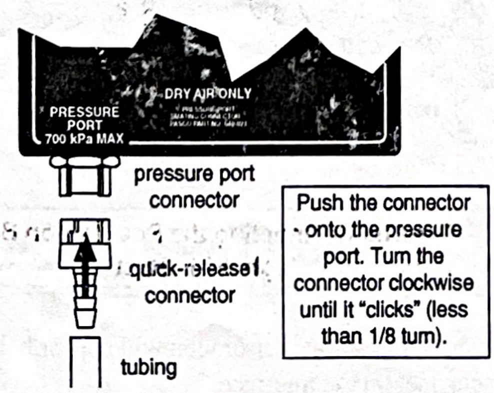


Figure: Respiration Belt In Place

Connecting the Belt to the Sensor

Align the quick-release connector on the end of one of the respiration belt's tubes with the connector on the PRESSURE PORT of the sensor. Push the connector onto the port, and then turn the connector clockwise until it "clicks" into place (less than one-eighth of a turn). The barb of the quick-release connector is free to rotate even when the connector is firmly attached to the port.



Inflating the Respiration Belt

Turn the knurled knob that is on the squeeze bulb fully clockwise to close the release valve. Squeeze the bulb several times to inflate the rubber bla... ...ou may have to squeeze the bulb more than twent... ...s in order to inflate the bladder. When the bladde... ...flated, the belt will be more snug against your chest.

Deflating the Respiration Belt

Turn the knurled knob on the squeeze belt counterclockwise to open the release valve. Use your hands to push the air out of the bladder. You can also deflate the respiration belt by disconnecting the tube from the pressure port on the sensor. Turn the quick-release connector counterclockwise to disconnect it from the pressure port.

Lift up on the top flap of the respiratio... belt to disengage the hook-and-pile strips from each ot... when you want to remove the belt.

Operation: Low Pre...sure Sens...

The Low Pressure Ser... is designed for experiments such as those that stu... rate of a ...mical reaction by monitoring the increa... decreas... ...ssure, the relations... ...rature ... ...re to volume in a c... ...spirati... of a person before a... afte...

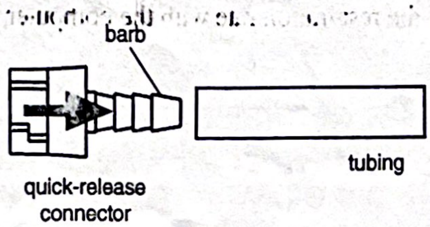
Connecting the Sensor to the Interface

Connect the DIN plug from the electronics box to Analog Channel A, B, or C on the computer interface box.

The sensor is dr... ...en with a constant current and it is temperature compe... ...ted. Therefore, changes in room temperature or cha... ...s in the computer's power supply will not interfere w... the data.

Using the Quick-Release Connectors

To attach a quic... ...ease connector to a piece of plastic tubing, cut the tu... ...o the desired length. Put the "barb" end of on... of the q... ...elease connectors into one end of the piece ...f tubing. ... the other end of the tubing to the acces...ry being ... in the experiment.



> NOTE: You can lubricate the end of the barb to make it easier to put into the short piece of tubing. Put a very small amount of silicon oil or saliva onto the barb and then wipe the barb with a cloth so there is only a thin layer of lubricant on the barb.

Align the quick-release connector with the connector on the PRESSURE PORT of the sensor. Push the connector onto the port, and then turn the connector clockwise until it "clicks" into place (less than one-eighth of a turn). The barb of the quick-release connector is free to rotate even when the connector is firmly attached to the port.

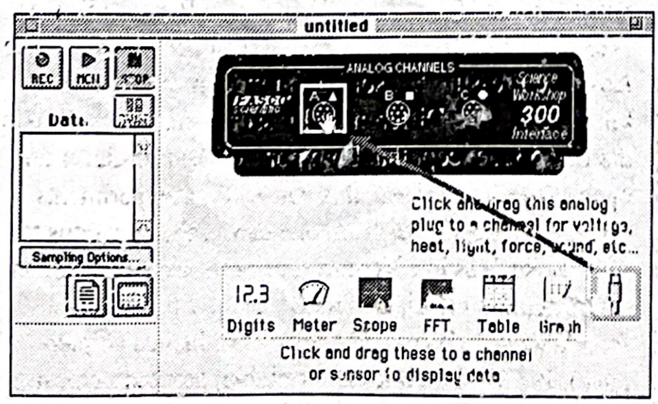
Calibrating the Sensor

The sensor is designed to produce one volt at a pressure difference of 1 kiloPascal (i.e., a difference of 1 kPa between the internal reference port and the external pressure port). **Therefore, the sensor does not need to be calibrated.** Instead, the output voltage can be converted directly into pressure. For example, an output voltage of 2 volts equals a pressure difference of 2 kPa.

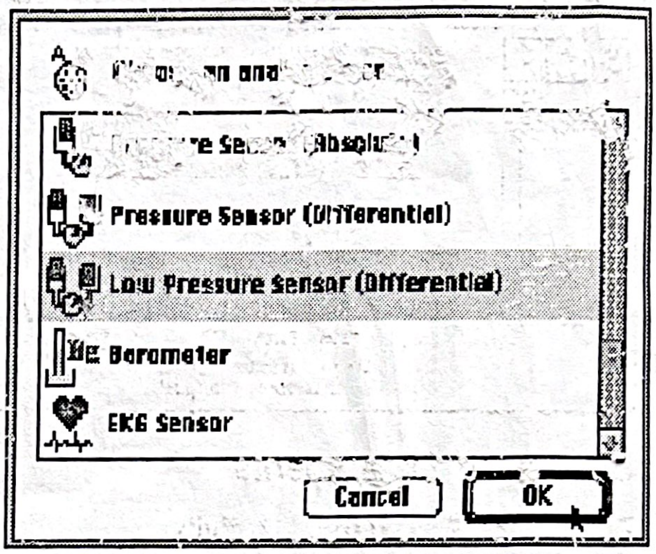
Using the Low Pressure Sensor with the *Science Workshop* Program

① Connect the DIN plug of the sensor to Analog Channel A on the interface.

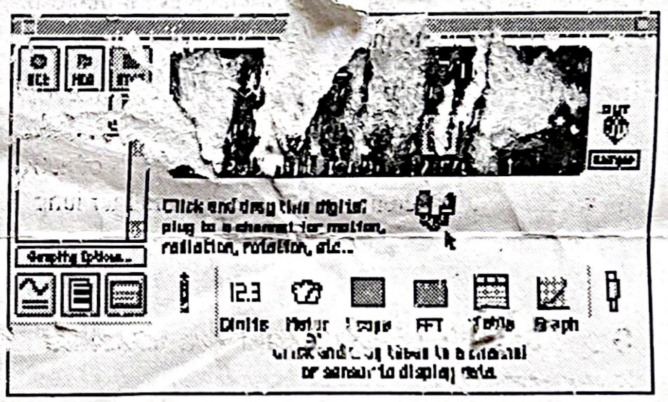
② Start the *Science Workshop* program. In the Experiment Setup window, click-and-drag the analog sensor plug icon () to one of the analog channels (see below).



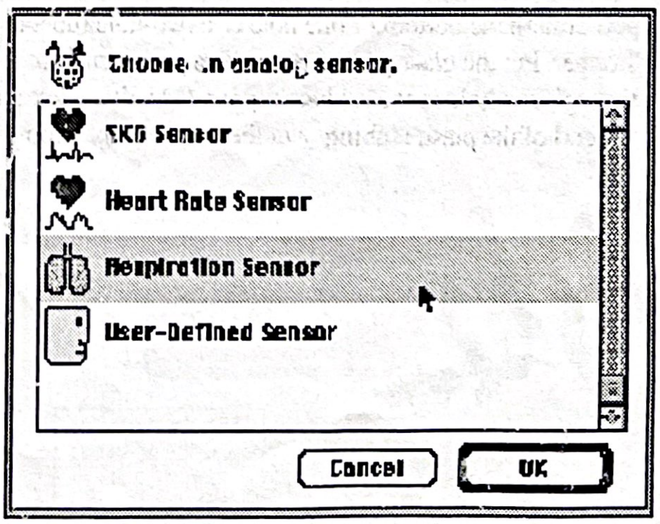
③ Select "Low Pressure Sensor" from the list of analog sensors. Click OK.



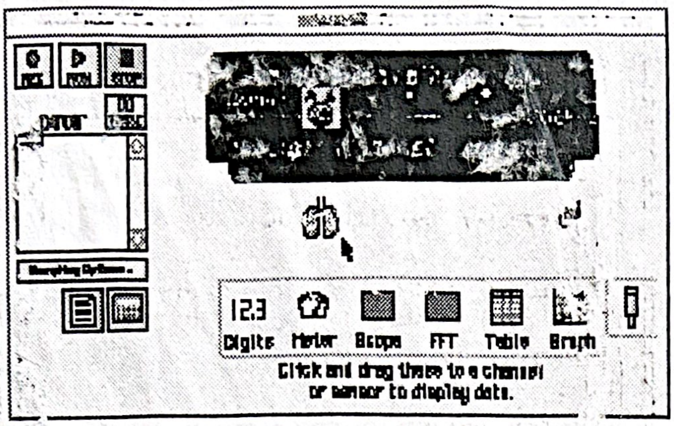
• The sensor icon will appear in the Experiment Setup window.



> NOTE: If you are using the Low Pressure Sensor with the Respiration Rate belt, select "Respiration Sensor" from the list of sensors.



• The Respiration Sensor icon will appear below the channel on the interface.



Suggested Experiments

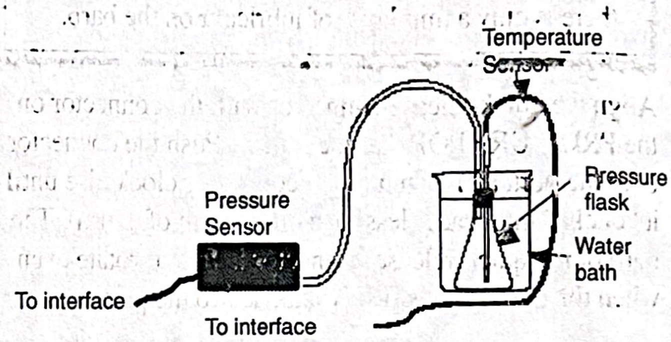
Respiration Rate versus Activity

Monitor respiration rate before and after exercise. Measure the respiration rate while resting. Then exercise vigorously. Measure the respiration rate immediately after exercise, and the measure how long it takes for the respiration rate to [illegible] ("normal") rate.

Resp[illegible] of time) depends on [illegible] health, and level of activity. Higher altitudes and levels of activity would tend to increase respiration rate. Larger lung capacity and generally good health would tend to decrease respiration rate.

Gay-Lussac's Law (pressure vs absolute temperature)

Gay-Lussac's Law states that if the volume remains constant, the pressure of a container of gas is directly proportional to its absolute temperature. Set up a sealed container of air by attaching the longer piece of plastic tubing to a stopper in a 125 mL Erlenmeyer flask. Put a drop of glycerin on the bottom of one hole of a two-hole rubber stopper. Put the glass part of an eyedropper tip end up through one hole in the rubber stopper. CAREFULLY put the end of the plastic tubing over the tip of the eyedropper. Connect the other end of the tube to the PRESSURE PORT. Put a drop of [illegible]cerin on the top of the other hole. Insert a temperature sensor through the hole. Place the stopper in the top of the flask.



Place the flask in water baths of different temperatures. Record data on how the pressure changes with the temperature changes.

Pressure in Liquids

Put the end of the longer piece of tubing under water. The pressure reading should increase by 0.0978 kPa (0.02896 in of mercury) per centimeter of depth below the surface. You can also use a "J" shaped tube to study how pressure relates to the difference in heights of the liquid in the two parts of the tube.

Studying Chemical Reactions by Monitoring Pressure

Many chemical reactions produce gases that can cause an increase in pressure in a sealed container. The pressure change can be used to monitor the rate of the reaction.

Other

PASCO scientific also produces an Absolute Pressure Sensor (Model CI-6532), a Differential Pressure Sensor (Model CI-6533) and a Barometer (Model CI-6531). The Absolute Pressure Sensor has a range from 0 to 700 kiloPascals. The Differential Pressure Sensor is similar to the CI-6532, except that both ports of the transducer are open to the atmosphere. It is designed for experiments where pressure differs from one part of the apparatus to another, such as in a Venturi tube or for a demonstration of Bernoulli's principle. The Barometer has a range from 800 to 1100 milliBar (24 to 32 inches of mercury). It is designed to be a reliable, accurate pressure sensor for weather studies. It is temperature compensated and has a voltage regulator, so changes in temperature or changes in the computer's power supply will not interfere with the data.