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CO₂ Controller Instruction Manual

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WARRANTY

This product is warranted against defects in material and workmanship during the first 12 months after original date of shipment.

The factory will, at its option, repair or replace defective material within this period at no charge for parts and labor.

All returns or exchanges must first be authorized by COY LABORATORY PRODUCTS, INC.

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COY LABORATORY PRODUCTS, INC.

14500 COY DRIVE

GRASS LAKE, MI 49240

The responsibility of COY LABORATORY PRODUCTS, INC. is limited to the purchase price of this product, and COY LABORATORY PRODUCTS, INC. will not be responsible for any consequential damages.

This warranty does not cover damage in shipment or damage as a result of improper use or maintenance of this product. This warranty does not cover damages caused by excessive line transients on the AC supply line.

WARNINGS

- 1. Gas pressures into the back of the Carbon Dioxide (CO₂) Controller must not exceed 10 PSI.**
- 2. The gas flow out of the CO₂ controller must be regulated using the flow meters on the front of the controller, not to exceed a total of 15 SCFH for CO₂ and 60 SCFH for the background gas. If the gas flow exceeds these limits, there is a danger the sensor will not detect the rapid change thus causing the gas level to exceed your set point value. Smaller chambers will need a lower flow rate.**
- 3. Never obstruct gas flow in or out of the chamber Relief Valves.**
- 4. Never attempt to service the CO₂ controller. Call COY LABORATORY PRODUCTS, INC. for assistance.**
- 5. Use in well ventilated room. High concentrations of CO₂ can be hazardous to your health. Leaks in a chamber/glove box can allow CO₂ to enter the ambient atmosphere. To avoid risks, perform general maintenance provided in the manual.**
- 6. The sensor cell membrane is delicate. Do not scratch, puncture, or permit sharp objects to touch the cell face. Sensor failure due to mishandling voids the sensor warranty.**

General Description

The CARBOCAP® Carbon Dioxide Sensor

The CARBOCAP® is a new silicon based Non-Dispersive Infra-Red (NDIR) sensor for the measurement of gaseous carbon dioxide. Its working principle is Single-Beam Dual-Wavelength NDIR, the same method that is commonly used in expensive high performance NDIR analyzers. However, in the CARBOCAP® Sensor the traditional rotating filter wheel is replaced with a tiny electrically controlled Fabry-Perot Interferometer (FPI) made of silicon. A true Dual-Wavelength measurement can be provided in a very simple and practically solid state structure.

The operating principle

An infrared source at the end of the measurement chamber emits light into the gas chamber, where any carbon dioxide gas present absorbs part of the light at its characteristic wavelength. The FPI interference filter is electrically tuned so that its pass band coincides with the absorption wavelength of carbon dioxide. The detector measures the strength of the signal that gets through.

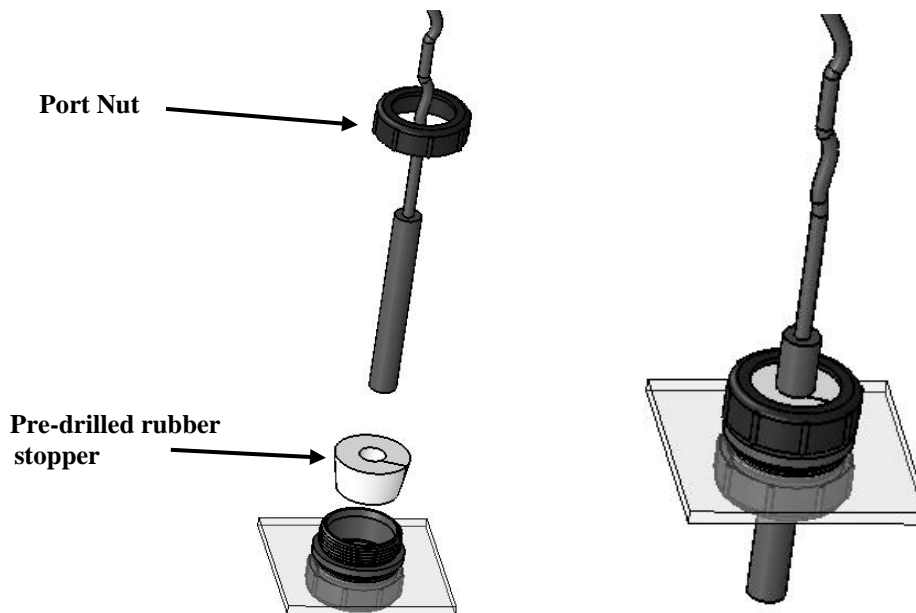
After this the pass band of the FPI is shifted to a wavelength where no absorption occurs. This provides the reference signal. The ratio of these two signals, one at the absorption wavelength and the other at the reference wavelength, indicates the degree of light absorption in the gas and thus the gas concentration. The reference signal compensates for the possible effects of sensor aging and contamination making the sensor very stable with time.

This information is provided by Vaisala and more can be found at www.vaisala.com.

CO₂ Controller Setup Procedure

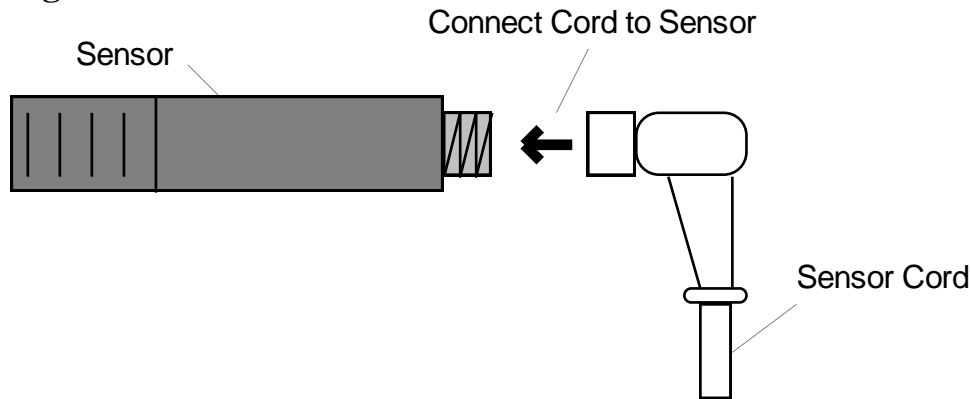
1. Locate the CO₂ sensor port on the chamber/glove box (generally centered in the back of the COY aluminum or on the top of the polymer style glove boxes, and behind the airlock on the flexible vinyl chamber. However custom built glove boxes and certain accessories, such as a UV Light, may change the location of the sensor ports.
2. Slide the CO₂ Sensor down through the port nut.
3. Using the pre-drilled large hole rubber stopper, insert the Co₂ sensor up until 1 inch of the sensor is sticking out of the top.
4. Push the rubber stopper back into the port as far as possible and screw the nut down tightly. The Co₂ sensor should be about 2-3 inches into the chamber.

Installing the CO₂ sensor option Fig #1:



5. Find a suitable location for the controller (i.e. top of the airlock, or external shelf).
6. Insert the sensor cord screw plug into the back of the CO₂ sensor (see figure 2). **Do not force the plug into the sensor.** The plug is “keyed” use light pressure to start and then allow the threads to pull the plug onto the sensor.

Figure #2 CO2 Sensor Connection



7. Measure and cut a length of tubing to reach from the controller gas outlet (see figure 5) to the chamber inlet. For attachment to existing COY Hypoxic Glove Box use the black Plastic "T" Fitting (supplied) to connect to the same Background Gas Inlet (nitrogen) as the Oxygen Controller (See Figure 3). The Gas Inlet on the Aluminum and Polymer Glove Boxes are located in the lower right corner. On the Vinyl chambers, the Gas Inlet is located behind the airlock next to the sensor.

Figure #3A: CO2 Controller Connections to COY Polymer or Aluminum Hypoxic Glove Box (Rear View)

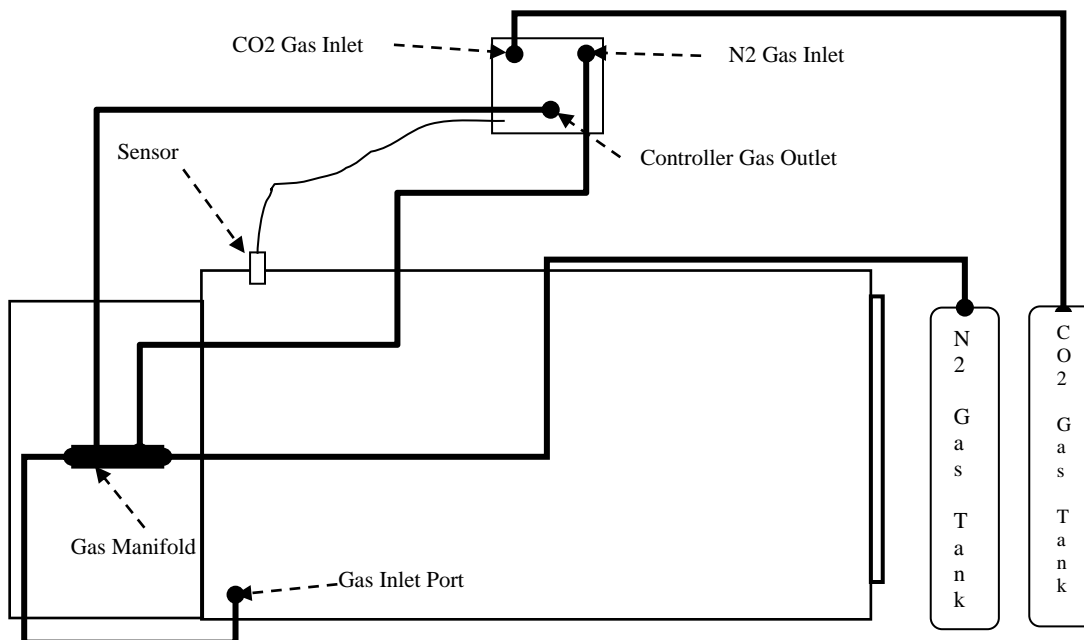


Figure #3B: CO2 Controller Connections to COY Vinyl Glove Box

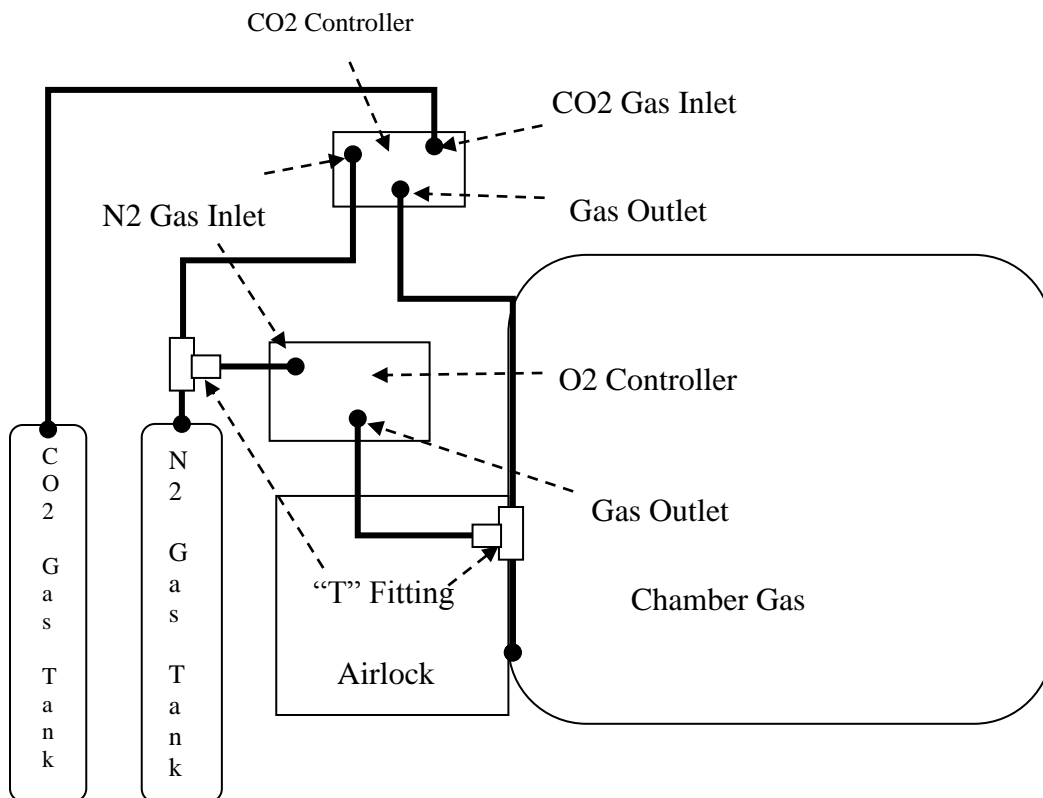
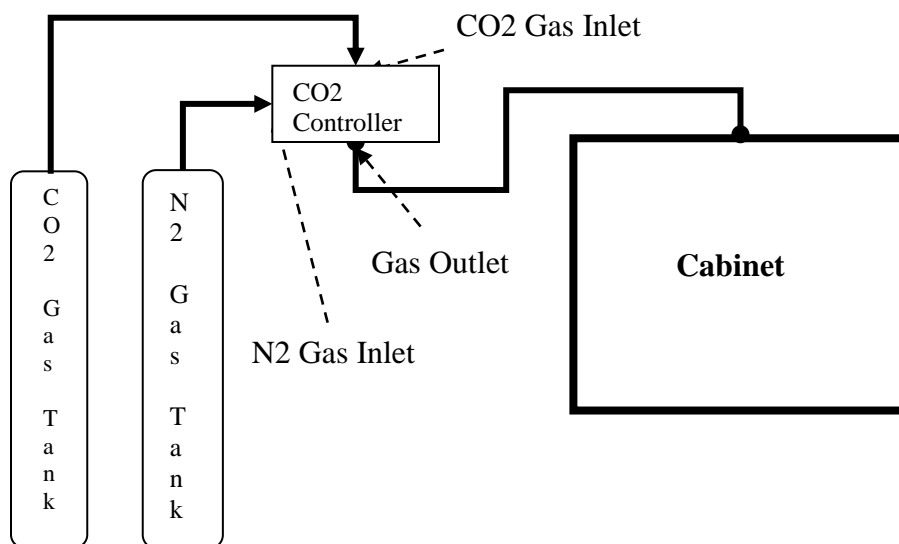


Figure #3C: CO2 Controller Connections to Coy InVitro Cabinets
(in vivo units only if operating at elevated CO₂ levels)

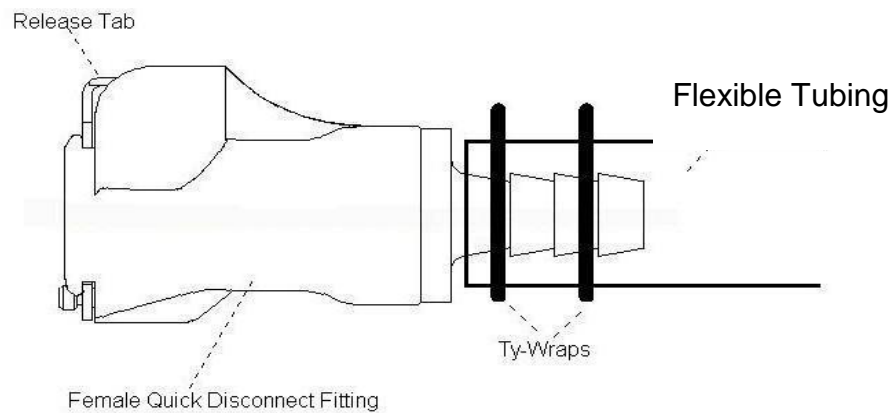


To Attach Tubing use Figure 4

8. Place a female fitting on each end of tubing.
9. Place 2 ty-wraps around the hose barb on the female fittings and pull them as tight as possible. Cut off excess ty-wrap.

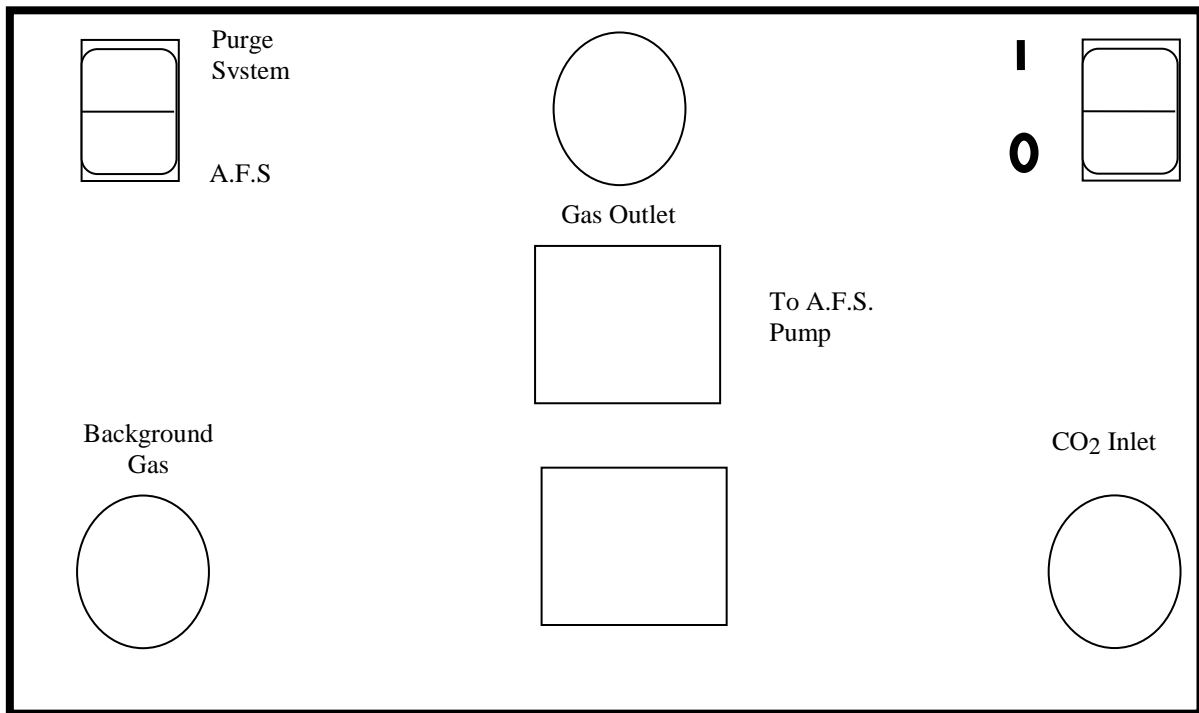
WHEN CUTTING TUBING, THE ENDS SHOULD BE AS SQUARE AS POSSIBLE

Figure # 4 Tubing connection to Quick Disconnect Fitting and “T” Fitting



10. Attach this tubing from the controller Outlet (see figure 3) to the chamber Inlet or “T” Fitting if connecting in a COY Hypoxic system. When fitting is seated correctly, you will hear a “click”.
11. Position your Carbon Dioxide and background gas tanks so the remaining tubing when cut in half will reach the controller.
12. Take the end of each tubing and place a female fitting into that end.
13. Place 2 ty-wraps around the hose barb and pull them tight as possible. Cut off excess ty-wrap.

Figure #5 Rear Panel of Carbon Dioxide Controller



14. Attach one tube to the hose barb on the CO₂ regulator.
15. Place 2 ty-wraps around the hose barb and pull them as tight as possible. Cut off excess ty-wrap.
16. Attach the other end to the “CO₂ Inlet” (see figure 3) on the back of the controller. When fitting is seated correctly, you will hear a “click”.
17. Attach the other tubing to the hose barb on the background gas regulator.
18. Place 2 ty-wraps around the hose barb and pull them tight as possible. Cut off excess ty-wrap.
19. Attach the other end to the “Background Inlet” (see figure 3) on the back of the controller. When fitting is seated correctly, you will hear a “click”.
20. The CO₂ controller is now ready to use. Be sure the safety relief valves on the Glove Box work properly before leaving the equipment to operate unattended. The relief valves are working properly when the chamber is pressurized and the user can hear air escaping into the atmosphere. They should also allow no air back into the chamber. Use compressed air to check the reverse flow of the relief valve.

Gas Supply Setup

Gas Pressure Regulators decrease the pressure exiting from the gas supply (primary pressure) to a pressure suitable for the Airlock and CO₂ controller (secondary pressure). If the tanks are within approximately 10 feet (3 meter) of the airlock, the secondary pressure must **not exceed 15 psi** (4.2Kg/sq.cm). If you extend the gas lines, you may need to set the regulators higher than 15 psi (1.4 Kg/sq. cm) to produce the same flow of gas. The Background Gas Regulator as supplied will fit a standard Nitrogen tank: however, if a CO₂/N₂ mix is used, then the supplied adapter will be needed.

!!!Caution: Turn the “T” screw on the regulator counter-clockwise until it almost falls out. This initializes the regulator to zero and avoids damage to the regulator.

Once the Gas Regulators are installed and all tubing is connected properly, slowly open the supply tanks. The primary pressure gauge will now display the amount of gas remaining in the tank. Turn the pressure gauge valve to regulate the gas flow to the airlock/controller (secondary pressure gauge) to read 15 psi.

Disconnecting the gas lines and leaving the fittings open will not damage the controller. This is also true when changing gas sources. There is no need to plug open fittings of the controller. The controller will still work properly as if the gas lines were connected (i.e. indicator lights showing gas flow will still come on). However, the user can see that no gas is entering the chamber (through the controller) because the respective flow meter will read zero. This is not a cause for concern about the controller, but may be confusing to the user.

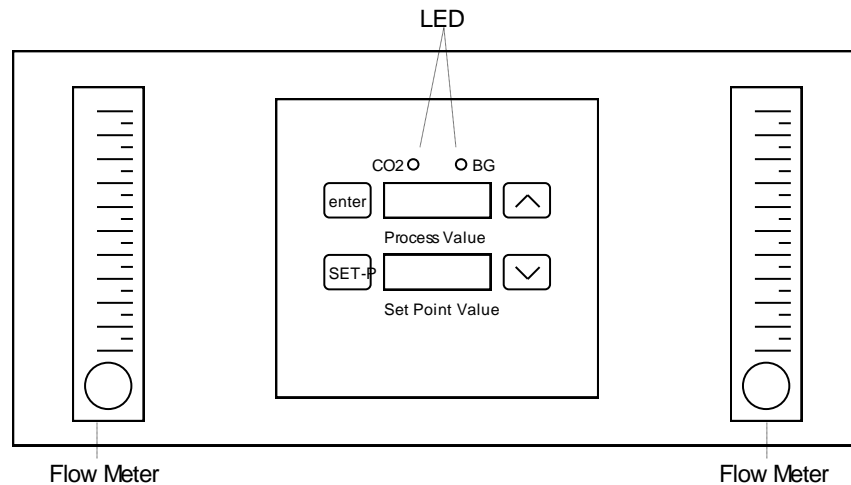
If the chamber equipment also includes a purge airlock, a “T” fitting and tubing may be placed in the background gas supply line at a convenient place between the tank regulator and the connection at the CO₂ controller. With this plumbing arrangement, both the controller and the airlock can be operated independently. If desired, a shut off valve may be placed so as to isolate the airlock (or the controller); but this is not a requirement. Alternatively the controller and Airlock may each have their own gas tank supply, in which case the “T” Fitting would not be used.

System Function

The Carbon Dioxide Controller is intended to maintain a CO₂ level in a chamber/glove box. It accomplishes this by sensing the current concentration, and then opening the appropriate solenoid valve to allow gas to flow and purge the system to the desired level. The set point (see figure 5) is used to set the CO₂ level desired in the chamber. The controller has been programmed to maintain a level of CO₂ within +/- 0.1% of the set point, this is the **Control Tolerance**.

Under normal use, only one gas line will be open at a time. The flow must be adjusted using the Flow Meters on the front of the controller (see figure 5). **The gas flow on the Flow Meters can only be adjusted when gas is flowing through that particular Valve.** To adjust the Flow Meters, simply turn the black knob on the front of the Flow Meter. Clockwise increases flow, counter clockwise decreases flow.

Figure # 6 Front Panel of CO₂ Controller



UNDER NO CIRCUMSTANCE SHOULD THE INLET PRESSURE EXCEED 15 PSI. GAS PRESSURES IN EXCESS OF 15 PSI MAY DAMAGE THE CO₂ CONTROLLER AND VOID THE WARRANTY.

To obtain uniform CO₂ concentration throughout the chamber, the small circulating fan must be on at **ALL** times. Please note the addition of a COY Fan Box (heated or unheated) eliminates the need for this fan.

During operation, the chamber will pressurize and the sleeves may begin to stand out (NOTE: A gloveless sleeve model this does not happen as the Arm Port Plugs should be installed to maintain proper glove box atmosphere).

The excess pressure will be removed by the COY Automatic pressure relief valves installed on the COY Glove Boxes. Be sure that these pressure relief valves are not blocked.

Operation/Calibration of CO₂ Controller

1. Plug the controller into an electrical outlet.
2. Turn the unit on using the rocker switch on the back (see figure #5).
3. Let the device warm up for a period of five minutes. During this warm up period make sure all gases are manually turned off at the gas regulator.
4. After going through a warm up period, the display will show two numbers. The top number (Process Value) is the measured CO₂ concentration and the bottom number (set point value) is the present CO₂ set point.
5. Using figure #6 adjust the set points:
 - A) Press the lower left key (SET-P). This enables the set point to be adjusted. If the SET-P button is not pushed the user could push the up and down buttons and nothing would change.
 - B) Press the arrow key (up or down) until the desired set point for the CO₂ level is displayed in red on the bottom numeric display.
 - C) Press the upper right key (Enter) to set the value in memory. **If you do not do this, the new value will NOT be set, and the previous value will be restored.** Notice that if the set point is outside the control tolerance (0.1 %) a LED will turn on indicating that a gas needs to enter the chamber in order to bring the content to the desired level.
GREEN = Background Gas
RED = CO₂
 - D) With the gas on and the controller indicating a gas needs to enter the chamber, adjust the flow meters to the proper settings according to the table at the end of the manual. Proper adjustment of the flow meters is necessary for the controller to work. If gas is flowing into the chamber too fast the sensor will not have enough time to react therefore causing “overshoot”. If the controller is having difficulty stabilizing turn the flow rates down.

Calibration:

The sensor has an expected life of greater than 2 years. During that time, there may be a drift in the CO₂ measurements. The sensor has a long term stability of less than $\pm 5\%$ Full Scale/2 years. It is best to periodically (once a year) calibrate the sensor. To do this, remove the sensor from the chamber, plug the opening in the sensor fitting to maintain chamber integrity and remove the sensor from its cord. The sensor can then be shipped to the factory. **Notice only the sensor needs to be returned to the factory not the entire controller.**

Controller Specifications

Range	0-19.9%
Accuracy	$\pm [0.02\% \text{ CO}_2 + 2\% \text{ of reading}]$
Nonlinearity	$\pm 0.5\%$ of full scale FS
Repeatability	$< \pm 1\%$ of FS
Temperature Dependence	-0.1% FS/degree Celsius
Pressure Dependence	+0.15 % of reading/hPa
Long-term stability	$< \pm 5\%$ FS/2 years
Response time	90% at 1 minute
Operating Temperature	
Range	-20 - +60 degrees C
Humidity Range	0-100% RH (non-condensing)

Flow Rates

Chamber Type	Flow Rate (SCFH)	
	Carbon Dioxide	Background Gas
<i>All Glove Boxes</i>	2 or less	10 or less
<i>Invitro Cabinet</i>		
Model 1	Less than 0.2	1 or less
Model 2	Less than 0.2	1.5 or less
Model 3	Less than 0.2	2.5 or less
Model 4	Less than 0.4	4 or less

For custom sized chambers please contact the factory