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Calibration Procedure for O2 Controller

WARNINGS

1. **This instrument is a tool of measurement and control. It should not be used as a safety device. Oxygen concentrations above ambient air should be considered an extreme fire hazard. Please contact safety organization with any questions regarding safety and operational parameters.**

2. **The calibration of the Sensor must be checked frequently as erroneous readings can result from normal Sensor aging as the electrolyte is consumed. The recalibration frequency depends upon exposure conditions and total exposure to O2 (higher exposure to O2 means more frequent calibration is needed). More information and recalibration frequency recommendations can be found in the section "When to Calibrate or Recalibrate".**

3. **Gas pressures into the back of the Oxygen Controller must not exceed 15 PSI.**

4. **The output flow of the O2 Controller must be regulated using the flow meters on the front of the Controller, not to exceed a total of 40 SCFH. If the gas flow exceeds 40 SCFH, there is a potential that the Sensor and Controller will not detect the rapid change, thus causing the gas level to exceed your set point value. There is also the potential of pressurizing the chamber.**

5. **Never obstruct gas flow in or out of the Chamber Relief Valves as this could result in a dangerous pressurization of the glove box.**

6. **Never attempt to service the O2 Controller. Call COY LABORATORY PRODUCTS, INC. for assistance.**

7. **Never put an open flame or create a spark in a Chamber, especially under hyperoxic conditions.**

8. **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.**

9. **If the Sensor becomes wet you will need to remove it from the Chamber and let it dry out in room atmosphere for at least 24 hours before use.**

10. **Do Not mount or hold the O2 sensor with the sensing membrane pointing upward. To function properly it needs to be in a sloped position with the measurement tip pointed downward or with the measuring membrane facing straight down.**

Scope

This manual will instruct the user how to calibrate the Coy O2 Controller and Sensor using the Coy O2 Sensor Calibrator. The calibration set-up and procedure are detailed in the sections below.

O2 Sensor Life Expectancy

The Coy O2 Sensor has a life expectancy of 2 – 5 years. The less O2 a sensor is exposed to the longer the life expectancy.

When To Calibrate

It is recommended that the Coy O2 Controller and Sensor be calibrated every 1 to 3 months or as needed by user.

The accuracy of the O2 Sensor can start to deteriorate faster towards the end of its life and require more frequent calibration.

Accuracy

The Coy O2 Sensor has an accuracy of ±1.0% of the calibration range. Example: if the sensor is calibrated at 0% and 10% the accuracy of the sensor would be ±0.1% between 0% and 10% O2. Note the accuracy of the gas used during calibration can affect the results of the calibration process and should be factored into the accuracy needed. This assumes all other parameters (primarily temperature and pressure) remain the same.

Calibration Process

The O2 Controller can be calibrated using a 2 point calibration (Zero and Span (high calibration point)) or a single point calibration (Span (high calibration point)). If you are operating at a single set point we recommend using the **Single Point Calibration** using a pre-mixed tank of that O2 level with .999% accuracy. If doing multiple levels of O2 within the next 1-3 calibration time the **2 Point Calibration** process is recommended.

2 Point Calibration – is a process that recalibrates both the zero and span points in the O2 Controller. This process will give the O2 Controller a consistent accuracy between the two calibration points.

Single point Calibration – is a process that recalibrates a single point of the controller. This process will allow the controller to be accurate at the calibration point but have an unknown accuracy if the set-point is ever adjusted. Example: if the controller is calibrated at 10%, the controller will perform normal at 10% but if the set-point was ever adjust to a different value, 8 or 12 for example, the controller would have an unknown accuracy and require recalibration at that set-point. It should also be noted that the sensor accuracy can vary based on the quality of the gas used to set the calibration.

Calibration Points

Zero – should always be calibrated before the span unless performing a single point calibration. Also it is recommended that Zero is calibrated with 99.999% pure N2 but a less accurate gas may be used. If a lesser gas is used for the calibration process then the accuracy of the gas used needs to be calculated into the accuracy of the sensor.

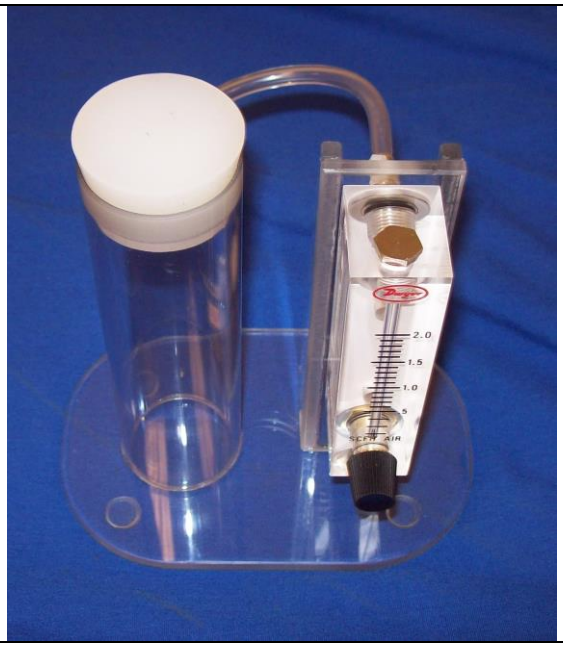
NOTE: On gas quality and size of the high quality tank. The chamber operation is recommended using the least expensive gas available to you as the accuracy of the chamber operation is determined by the controller and this calibration procedure. However as noted above a higher quality gas should be used for the zero or span calibration gas if using a fixed gas (see below explanation). Since the gas consumed in this calibration process is minimal we recommend buying the smallest tank available with the quality recommended.

Span – is the higher point or range of the calibration. The span can be calibrated using one of two different procedures.

Option 1 - (ambient air) – is a cost efficient procedure that should only be used during a two point calibration. After calibrating zero and ambient the controller will have an accuracy of ± 0.2% (1.0% of span, span = 0-20.9%).

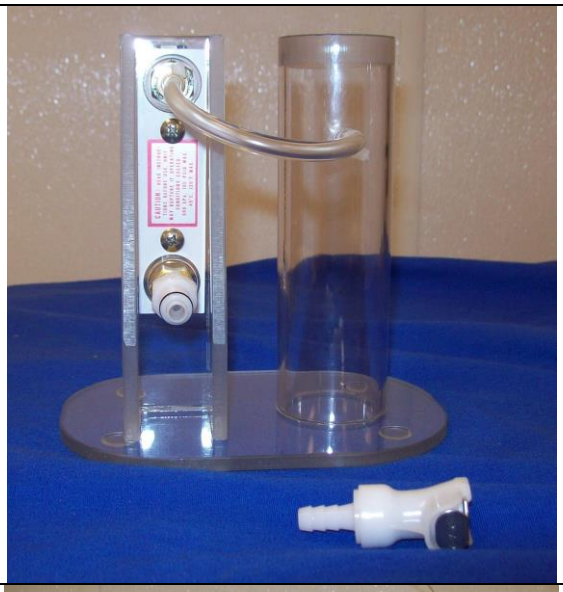
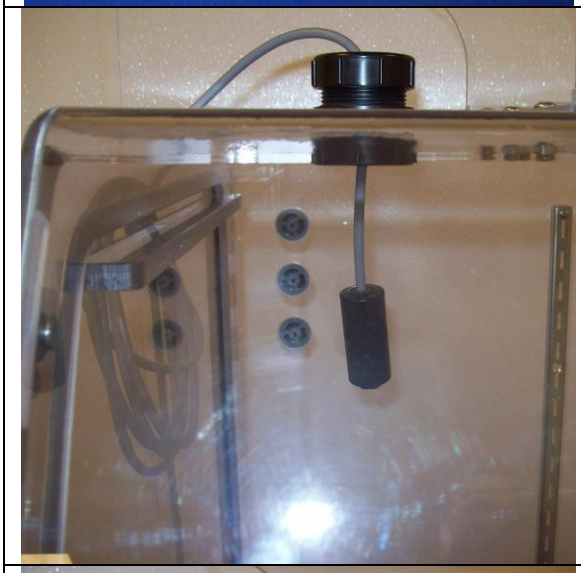
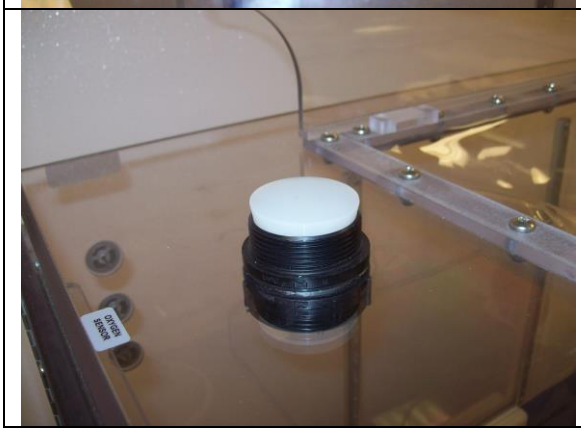
Option 2 - (calibrated gas mix with specified O2 %) – *the recommended procedure for calibrating the span.* This procedure can be used for both 2 point and single point calibration. The O2 % of the gas mix used for this procedure should be based on the desired function of the Glove Box/Cabinet. For 2 point calibration the calibrated gas mix should have an O2 % near the highest potential set-point desired for the Glove Box/Cabinet. For single point calibrations the gas mix must be equal to the desired set-point of the Glove Box/Cabinet.

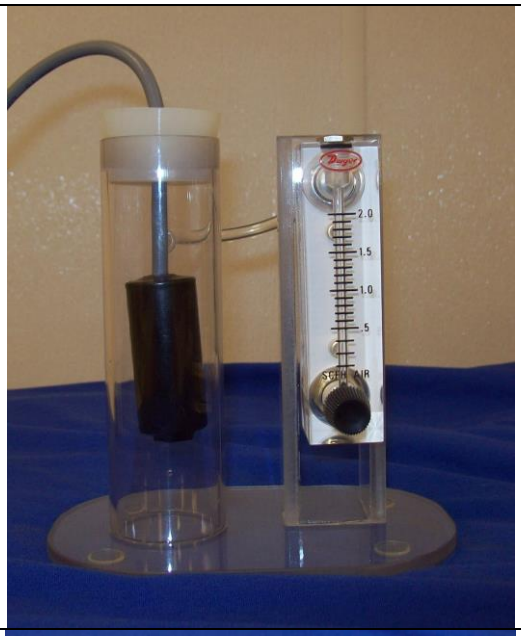
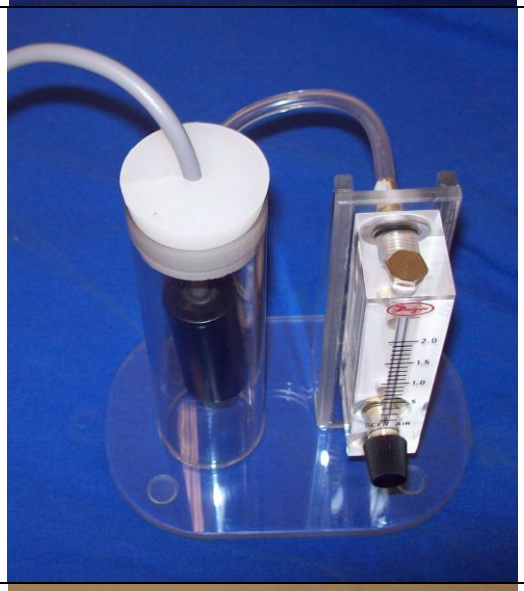
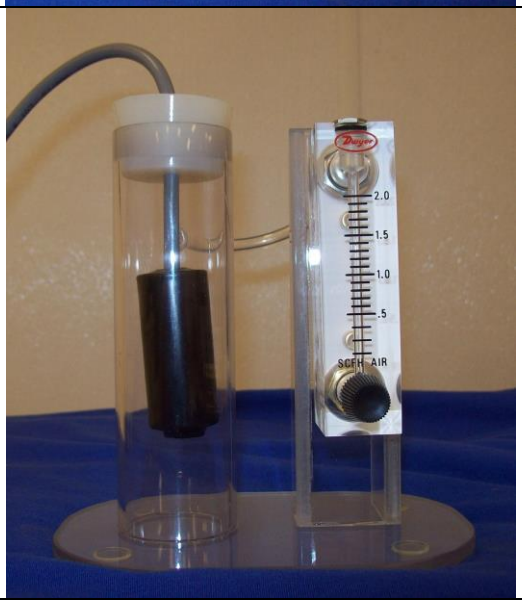
Calibration Set-Up



This is the Coy O2 Sensor Calibrator.

A solid stopper is provided to seal sensor feed-thru in Glove Box/Cabinet during calibration.

	On the back of the Calibrator is one connection for gas inlet. Gas being used for calibration needs to be connected to this fitting. An extra fitting to connect gases is included. Pressure to Calibrator needs to be set between 5-15 psi.
	Remove sensor from Glove Box/Cabinet. *Note:* *Turn off all gases to O2 Controller before removing sensor. Once the sensor leaves the Glove Box/Cabinet it will start reading Ambient O2 levels while controlling gases to the Glove Box/Cabinet.*
	Insert solid stopper from sensor calibrator into senor feed-thru in Glove Box/Cabinet. This will minimize the disruption of the Glove Box/Cabinet environment during calibration.

	Insert sensor into calibrator as shown. Adjust sensor cord in stopper so the sensor is centered in calibrator tube.
	Make sure stopper is seated firmly in calibrator tube.
	Adjust flow meter to desired flow. It is recommended that flow rate is between 1.5 – 2.0 SCFH. *Notes:* *After calibration is complete disconnect gas from calibrator.* *When reinstalling sensor in Glove Box/Cabinet make sure sensor in at least 3" from any surface.*

Location

1. Outside of Glove Box/Cabinet.
2. In room with stable temperature and humidity. It is ideal that temperature and humidity are not fluctuating during calibration.

Equipment

1. Temperature Meter
2. Humidity Meter
3. Pot Adjuster (supplied with O2 Controller) or Small Screwdriver

O2 Calibration Procedure

Notes: Always calibrate Zero before calibrating the Span (maximum value) unless performing a single point calibration.

Use chart on last page to log calibration results.

Make sure all gases to O2 Controller are turned off.

Zero Calibration

1. Plug sensor into O2 Controller and turn on controller.
2. Connect Zero calibration gas to Calibrator, 5-15 psi.
    a. 99.999% N2 is recommended for Zero Calibration.
    b. A less accurate gas can be used, but may change the overall accuracy of the calibration and your sensor.
3. Adjust Flow Meter between 1.5 and 2.0 SCFH.
4. Allow gas to flow for 30 minutes or until sensor is stable.
    a. Sensor should be stable for at least five minutes before calibrating.
    b. If sensor reading is not stable after 40 minute, stop and recheck set-up.
5. Adjust "Zero" pot on front of O2 Controller until display reads "0.0".
6. Adjust flow meter to 0.0 SCFH flow.
7. Disconnect gas from Calibrator.
8. Perform Span Calibration procedure next.

Span Calibration (Option 1: using ambient air) *option 2 is the preferred procedure*

1. Remove Sensor from Calibrator.
2. Position Sensor in ambient air so that the Sensor is pointing downward and not in contact with anything.
3. Allow Sensor 60 minutes to stabilize.
    a. Sensor should be stable for at least five minutes before calibrating.
4. Monitor temperature and humidity.
    a. It is recommended that temperature does not vary more then 0.5ºC during sensor stabilization.
    b. It is recommended that humidity does not vary more than 2% RH during sensor stabilization.
5. Calculate the % of O2 in the air using the following formula:

    Note: Ambient O2 is approximately 20.9%.

    % O2 at constant temperature = 20.9 X [1 – (A x B / 100 / 760)]

    A = Saturated vapor pressure of water at certain temperature
    (See chart below to determine "A")
    B = Relative Humidity (RH)

T = Temperature ºC / P = Vapor Pressure of Water in mm Hg					
T	P	T	P	T	P
19.1	16.581	21.1	18.765	23.1	21.196
19.2	16.685	21.2	18.880	23.2	21.324
19.3	16.789	21.3	18.996	23.3	21.453
19.4	16.894	21.4	19.113	23.4	21.583
19.5	16.999	21.5	19.231	23.5	21.714
19.6	17.105	21.6	19.349	23.6	21.845
19.7	17.212	21.7	19.468	23.7	21.977
19.8	17.319	21.8	19.587	23.8	22.110
19.9	17.427	21.9	19.707	23.9	22.243
20.0	17.535	22.0	19.827	24.0	22.377
20.1	17.644	22.1	19.948	24.1	22.512
20.2	17.753	22.2	20.070	24.2	22.648
20.3	17.863	22.3	20.193	24.3	22.785
20.4	17.974	22.4	20.316	24.4	22.922
20.5	18.085	22.5	20.440	24.5	23.060
20.6	18.197	22.6	20.565	24.6	23.198
20.7	18.309	22.7	20.690	24.7	23.337
20.8	18.422	22.8	20.815	24.8	23.476
20.9	18.536	22.9	20.941	24.9	23.616
21.0	18.650	23.0	21.068	25.0	23.756

6. Adjust "%" (high calibration point) pot on front of O2 Controller until display reads calculation results value.

Span Calibration (Option 2: using a calibrated gas mix) *preferred method*

1. Make sure Zero calibration has been completed before proceeding unless performing a single point calibration.
2. Connect Calibrated Gas mix to Calibrator, 5-15 psi.
    a. A calibrated gas mix with an O2 % close to Glove Box/Cabinet operating O2 level is recommended for Span Calibration.
    b. The closer the Span calibration is to working O2 levels in the Glove Box/Cabinet the more accurate the sensor will read.
    c. The accuracy of the gas mixed used will affect the accuracy of the sensor
3. Adjust Flow Meter between 1.5 and 2.0 SCFH.
4. Allow gas to flow for 30 minutes or until sensor is stable.
    a. Sensor should be stable for at least five minutes before calibrating.
    b. If sensor reading is not stable after 40 minute, stop and recheck set-up.
5. Adjust "%" (high calibration point) pot on front of O2 Controller until display reads the calibrated gas mix O2 % value.
6. Adjust flow meter to 0.0 SCFH flow.
7. Disconnect gas from Calibrator.

Reinstall Sensor in Glove Box/Cabinet and turn gases to O2 Controller back ON.

O2 SENSOR CALIBRATION RECORDING SHEET

Sensor Identification # _____ Date_____

Time	Temperature (C)	Humidity (%RH)	Controller Reading (%O2)
Zero Calibration			
Span or % O2 Calibration			

Reference Gas and Purity: _____for Zero Calibration _____for Span Calibration
(Use only when span calibration gas is not room air)

Room Ambient Pressure (hPa) at start: _____

Room Ambient Pressure (hPa) at end: _____

Calculated % O2 in air _____used for span calibration
[saturation water vapor pressure used in calculation (from attached chart) = _____]
(Use only when ambient air is the span calibration gas)

% Oxygen concentration at constant temperature = 20.9 x [1 – (A x B/100/760)]

A= Saturated vapor pressure of water at certain temperature (mmHg)
B= Relative humidity (%R.H.)

Controller Identifier (Serial Number or other unique designation): _____

Completed by: _____