ProOx Model P360
MANUAL

BioSpherix

BioSpherix

Technical Support

BioSpherix, Ltd.
P.O. Box 279
25 Union Street, Parish, NY 13131
Ph: 315.387.3414 Fax: 315.387.3415
Toll Free (US/CAN) 800.441.3414
Email: support@biospherix.com www.biospherix.com

BioSpherix, Ltd.
P.O. Box 279
25 Union Street, Parish, NY 13131
Tel: 315-387-3414 Fax: 315-387-3415

!ATTENTION!

Please follow your manual instructions on routine calibration of your gas sensor(s). Please also follow your manual guidelines on routine replacement of your gas sensor(s) when they no longer hold calibration. The frequency of calibration and replacement of the gas sensors depends on the exposure levels that the sensors have been immersed in and the type of sensor(s) you are using.

For replacement sensors or further information please contact the BioSpherix, Ltd. Service Department.

NOTE

BioSpherix, Ltd. strongly encourages all our customers to perform a test run on their system prior to beginning any actual experiments. Doing so will enable the user to understand how the system performs and estimate the amount of gas usage the unit will be using.

BioSpherix, Ltd.
-Service Department
TEL: 1-315-387-3414
Toll Free: 1-800-441-3414
Email: support@biospherix.com

v 0.1 d100213

BioSpherix, Ltd.
P.O. Box 279
25 Union Street, Parish, NY 13131
Tel: 315-387-3414 Fax: 315-387-3415

!ATTENTION!

Whenever using a mechanical device with a chamber containing live animals, there is an inherit risk. It it important that you utilize the safety features contained within this system in order to minimize any problems that can occur with a mechanical failure.

WARNING

The ProOx Model P360 is equipped with an additional safety feature for your animals. This feature is tied to the alarm so that when your oxygen levels rise above or below your specified alarm setpoint the audible alarm will sound and the control valve will close until the condition is cleared. This feature is only engaged when your alarm is set and activated. Failing to activate the alarm switch on the controller can compromise your experiments.

In order to properly activate your alarm:

1. Ensure that the alarm settings are set in the program mode of the controller. For instructions on how to set the alarm on the controller please refer to the following sections located in this manual: *Configuration, Program Functions Menu* and *Setting the Alarm Setpoint.*
2. Flip the **ALARM** switch down to the ON position (towards the word **ALARM**) on the front panel of the controller.

BioSpherix, Ltd. strongly encourages all of our customers to perform a test run on their system prior to beginning any actual experiments. Doing so will help the user to understand how the system performs. It is your responsibility to protect your animals by utilizing proper safety features and instructions described within this user manual. These features will help to reduce issues that can occur due to mechanical failures. If you have any questions, please contact BioSpherix, Ltd. Technical Support.

BioSpherix, Ltd.
-Service Department
TEL: 1-315-387-3414
Toll Free: 1-800-441-3414
Email:support@biospherix.com

v0.1 d012020

ProOx Model 360 Manual

version 2.8 January 2020

This manual is intended to help our customers efficiently setup and operate the equipment. We encourage not only all installers, but also all users to read this manual thoroughly. Keep it handy and refer to it often. Save it for future reference. If you have any problems or questions, please do not hesitate to call. We are here to help.

The ProOx model 360 is a versatile and compact gas oxygen controller for people who do oxygen sensitive work. Though designed to work with BioSpherix chambers, the ProOx model 360 works in incubators, glove boxes, animal cages, refrigerators, plant growth chambers, and many other semi-sealable chambers. Practically any medium to large enclosure can be fitted.

The unit works from outside of the host chamber by remotely sensing and displacing air oxygen inside the chamber with another gas. Nitrogen, or an oxygen-poor gas is used to lower the oxygen level within the host chamber. Oxygen, or an oxygen-enriched gas is used to raise the oxygen level within the host chamber.

Nominal range is 0.1-99.9% oxygen, depending on chamber size. Advanced feedback algorithms handle practically any oxygen gas dynamic. Infusion rates are adjustable up to 200 SCFH, sufficient for most lab chambers. Installation is easy. Operation is simple. The unit moves easily from one host chamber to another.

Please read and follow the safety and operations instructions on the following pages. Be careful. Any pressurized gas can be dangerous. Know what you are doing and do it safely.

BioSpherix, Ltd.
P.O. Box 279
25 Union Street, Parish, New York 13131
Tel: 315-387-3414 Fax: 315-387-3415
TOLL FREE US/CAN 800-441-3414
www.biospherix.com

! Anyone who has not thoroughly read and understood this manual must never attempt to operate the equipment. !

Table of Contents

Safety

System Safety Concerns and Safety Guidelines must be strictly adhered to.

Power Source
Unit should be connected to a power supply, only of the type described in the operating instructions or as marked on unit. Power Supply Cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them. Power Cord of unit should be unplugged from the electrical outlet when left unused for long periods of time.

CAUTION

ELECTRIC SHOCK Unit should never be used where it can fall or be pushed into water. When modifying host chamber, be careful not to drill or cut into electrical wires hidden behind chamber wall. Never drill or cut blindly.

WARNING

DO NOT remove cover of the ProOx model 360 due to presence of uninsulated “dangerous voltage” within product’s enclosure.

NOTE

Secure all pressurized gas connections with hose clamps. Never exceed pressure limits. Bleed all lines before disconnecting. Wear safety glasses at all times.

WARNING

Unit should be situated so that its location or position does not interfere with proper ventilation. Neither ProOx model 360 nor host chamber should be in poorly ventilated areas.

Falling Objects and Liquid Splash
Care should be taken so that objects do not fall on equipment and liquids do not spill, splash, or drip onto or into unit enclosure or power cord.

CAUTION

Unit should be situated away from heat sources such as radiators, heat registers, stoves, or other appliances or processes that produce heat.

Low Oxygen Atmospheres

Never enter a chamber which has a low oxygen atmosphere because of severe danger of suffocation. Host chamber should be in a well ventilated room. Control gas (nitrogen or other low oxygen gas) continuously leaks out of chamber and should never be allowed to build up in room or outside of the chamber.

High Oxygen Atmospheres

Never enter a chamber which has a high oxygen atmosphere due to danger of oxygen toxicity. Never smoke or allow any source of fire in or around a chamber with high oxygen atmosphere. Oxygen radically promotes combustion and can be explosive. Host chamber should always be in a well ventilated room. Oxygen continuously leaks out of chamber and should never be allowed to build up in room or outside of chamber.

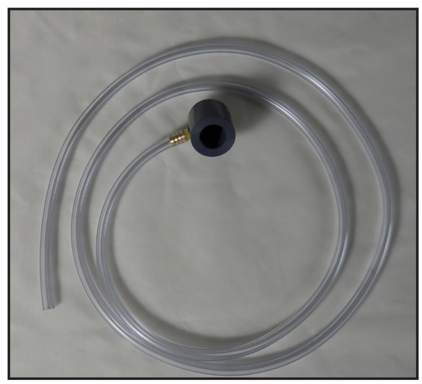
Cleaning

Do not immerse unit in water. Do not wipe unit with wet cloth or sponge or paper. Clean only with a dry cloth.

BioSpherix Supplied Parts

ProOx Model 360 unit

Oxygen Gas Sensor

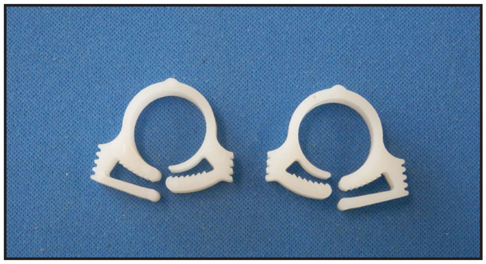


Calibration Chamber with Tubing

Infusion Tubing

Oxygen Gas Sensor Cable

(1) Gas Fitting



(2) Large Clamps

12VDC Regulated Power Supply

User Supplied Parts

This section will list the parts that the user will need to supply in order to operate the equipment.

1. Qty. (1) regulator for each compressed gas source. Make sure each regulator is either a one or a two stage regulator. Either way the unit requires two gauges (2500 PSIG input, 0-60 PSIG gauged output recommended). It is best to have two gauges in order to monitor the amount of gas in the compressed source and also monitor the amount passing through the output.
2. Qty. (1) compressed gas source of nitrogen. (If using for low oxygen levels.)
3. Qty. (1) compressed gas source of oxygen. (If using for high oxygen levels.)
4. Tubing to connect the regulators to the controller. It is recommended to use USA standard food grade, nylon reinforced tubing. It can be either poly, silicon, or a mixture of the two.

Front Panel Components

1. **Controller -** This controller acts as the "brain" of the unit, controlling a variety of variables. Some of these variables include: Telling the unit when to infuse gas into the chamber, what specific gas to infuse into the chamber, and how much gas is needed to be infused to reach the specific setpoint.

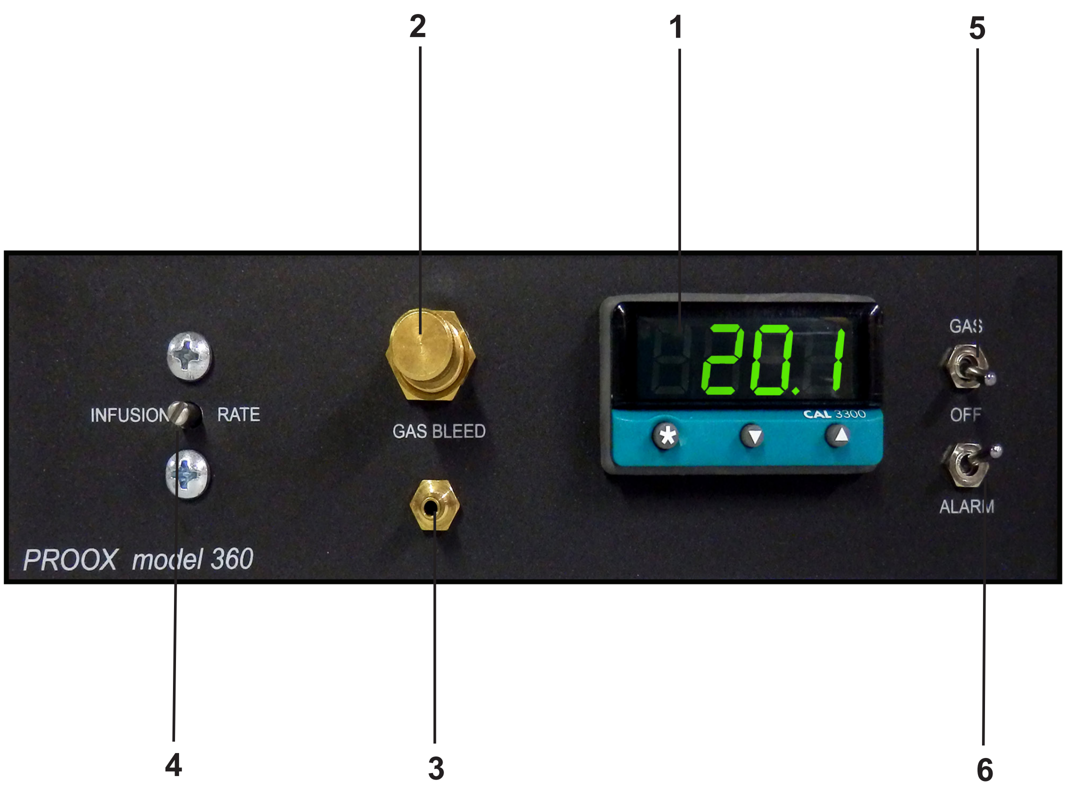
2. **Bleed Valve -** Used to check the compressed gas supplies. *(See the "Calibration of Gas Oxygen Sensor" and "Single Setpoint Control" sections for information on how to check the compressed gas supply.)* When the knob is turned in a counterclockwise direction it will open the bleed valve. This is used to check that the gas supply is properly connected, and also used during calibration procedures. The bleed valve works in correspondence with the bleed barb.

3. **Bleed Barb -** Used to check the compressed gas supplies. *(See the "Calibration of Gas Oxygen Sensor" and "Single Setpoint Control" sections for information on how to check the compressed gas supply.)* This barb is only used during calibration procedures. *Please refer to the "Calibration" section of this manual for more information.*

4. **Infusion Rate -** This needle valve provides the ability to adjust the flow rate. Adjusting the valve clockwise decreases the flow, and adjusting it counterclockwise will increase the flow. More power is needed for a larger chamber, and less power is needed for a smaller chamber.

5. **Gas Switch -** Turns gas on and off.

6. **Alarm Switch -** When oxygen levels rise above or below your specified alarm setpoint and the alarm switch is flipped down (towards the word **ALARM**) an audible alarm will sound and the control valve will close until the condition clears. For instructions on how to set the alarm on the controller please refer to the following sections located in this manual: *Configuration, Program Functions Menu* and *Setting the Alarm Setpoint.*



Back Panel Components

1. **12VDC -** Power receptacle for the supplied 12VDC regulated power supply.
2. **GAS SUPPLY 40 P.S.I.G MAX. Barb -** This is where the tubing extending from the compressed gas sources attaches to the unit. This barb is designed for 1/4" ID tubing.
3. **GAS OUT TO CHAMBER Barb -** This is where the infusion tubing connects to the chamber.
4. **SENSOR Receptacle -** This is where the sensor cable attaches to the controller.

Setup of Gas Supply

This section will describe how to setup the gas supply.

Gas must be supplied through a 1/4" ID hose to the back panel of the ProOx model 360. If the tubing coming from the compressed gas source (tank) is not 1/4" ID, then use the supplied gas fitting to adapt the tubing to 1/4" ID. The pressure must be regulated to 0-40 PSIG. PSIG stands for Pounds per Square Inch Gauge as opposed to PSIA which stands for Pounds per Square Inch Absolute.

NOTE

Never allow the pressure coming out of the compressed source to exceed 40 PSIG or damage will occur to the ProOx model 360 unit.

The amount of gas used is determined by how the chamber is used, not the ProOx model 360. The ProOx model 360 uses the least amount of gas possible, which is only what the chamber needs. The amount of gas used is dependent on: (1) The size and leakiness of the chamber (2) The amount of times and how long the chamber door(s) are opened and (3) The oxygen level being controlled. (The further from 21%, the more gas it takes.)

Use a one or a two stage, 2500 PSIG input, 0-60 PSIG output regulator at the source of the compressed gas. It is best to have two gauges: one gauge to monitor the amount of gas in the compressed source, and another gauge to monitor the amount passing through the output.

If the regulator is not near the ProOx model 360, then there should be a shutoff valve placed on the hose between the ProOx model 360 and the compressed gas source. When taking off the gas supply tube always make sure to shut off the compressed gas at the source first, bleed the pressure out of the line, and then take off the hose from the back of the ProOx model 360.

WARNING

Do not open any of the regulators at this time. Wait until the "Calibration" and "Single Setpoint Control" sections.

NOTE

BioSpherix, Ltd. strongly encourages all customers to perform a test run on the system prior to beginning any actual experiments. Doing so will enable the user to understand how the system performs and estimate the amount of gas consumption.

NOTE

BioSpherix, Ltd. strongly encourages all customers to perform a test run on the system prior to beginning any actual experiments. Doing so will enable the user to understand how the system performs and estimate the amount of gas consumption.

Connecting the Regulators to the Compressed Gas Supplies:

Controlling for Low Oxygen

1. Completely close the regulator and the compressed nitrogen gas source.
2. Screw the regulator onto the compressed nitrogen gas source.
3. Attach the supply tubing to the regulator on the compressed nitrogen gas source.
4. Connect the other end of the supply tubing to the hose barb labeled **GAS SUPPLY 40 P.S.I.G. MAX.** on the back panel of the controller.
5. Use a clamp (provided) to secure the tubing onto the hose barb.

Controlling for High Oxygen

1. Completely close the regulator and the compressed oxygen gas source.
2. Screw the regulator onto the compressed oxygen gas source.
3. Attach the supply tubing to the regulator on the compressed oxygen gas source.
4. Connect the other end of the supply tubing to the hose barb labeled **IN** on the back panel of the controller.
5. Use a clamp (provided) to secure the tubing onto the hose barb.

ProOx Model 360 Installation

This next section contains instructions on the hardware installation of the ProOx model 360 unit.

1. Set the ProOx model 360 unit on a level, secure surface; either on the chamber or within ten feet of the chamber.
2. The compressed gas supply should already be connected to the hose barb labeled **GAS SUPPLY 40 P.S.I.G. MAX.** on the back panel of the unit. *Please refer to the "Setup of Gas Supply" section for instructions on how to connect the gas supply.*

> **WARNING**
>
> *Do not turn the gas on yet; wait until the "Calibration," and "Single Setpoint Control" sections.*

3. Attach the adapter plate to the chamber. For instructions on how to connect the adapter plate, please refer to the corresponding section of this manual. (If this unit is not connecting to an adapter plate, skip this step.)
4. Attach the 1/4" ID infusion tube to the **GAS OUT TO CHAMBER** barb on the back panel of the controller.
5. Connect the other end of the 1/4" ID infusion tubing to the chamber.
6. Plug the jack end of the sensor cable into the port labeled **SENSOR** on the back panel of the unit. Push the sensor cable into the port until a "click" is heard, and then turn the ring clockwise until tight. **Do not overtighten**.
7. Plug the other end of the sensor cable into the sensor itself by lining up the key on the terminal with the key on the connector of the sensor cable. Push in and twist the ring on.
8. Connect the 12VDC regulated power supply by attaching the jack end into the port labeled **12VDC** on the back panel of the unit.
9. Attach the other end of the 12VDC regulated power supply to a power strip, battery backup, etc. The display on the front panel of the controller will light up once the unit is powered.

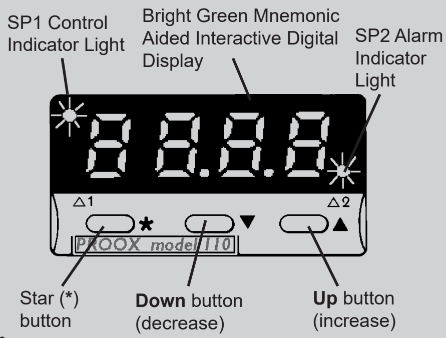
Operation

This section will give an overview of some of the different modes and functions within the ProOx model P360.

Front Panel Display

All operations are executed by three push button controls on the front panel. Interactive display and user friendly mnemonics will help to guide through all operations in both (1) program mode and (2) work mode.

Essential control and alarm operations can be monitored with configured flashing indicator lights.

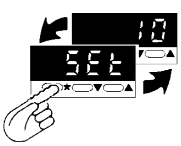


Work Mode

The controller will start in work mode when initially plugged in. Work mode is the normal day-to-day operating mode. Whether controlling or not, (parked) oxygen concentration at the sensor is continuously displayed, unless pre-empted by other operations.

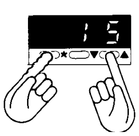
Operations in work mode are limited to: (1) view setpoint, (2) change setpoint, (3) reset alarm/ error message, (4) enter program mode.

View Setpoint



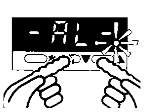
In work mode, press and hold the * button. Setpoint is shown in alternating display.

Change Setpoint



Press and hold the * button. Press the **up** button to increase setpoint. Press the **down** button to decrease setpoint. If change requires control output, **SP1** indicator will flash.

Reset Alarm/Error Messages



Once you have physically cleared the alarm condition inside the chamber, clear the alarm or error condition on the controller. To do this, momentarily press both **up** button and **down** button at the same time.

Program Mode

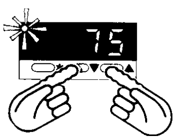
All configuration, calibration, and tuning operations take place in program mode.
Entry into the program menu is always at the same point, the **tunE** function on Level 1 (**LEVL 1**). In order to enter the program mode, push the **up** and **down** buttons at the same time for **3 seconds** until the **tunE** function appears. Once **tunE** is displayed, the controller is in program mode. Navigate through the program menu, select the appropriate options, and then exit back to work mode.

During programming, control with existing settings is maintained. New settings are written to memory only upon exiting program mode. Settings are retained in non-volatile memory for years even if the unit is unpowered.

Security locks can configure certain options unadjustable. However, all functions and locked options may be viewed even when locked.

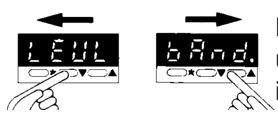
Exit program mode from any place in the menu. Exiting program mode returns the controller back to work mode with new settings.

Enter/Exit Program Mode



Simultaneously hold both **up** and **down** buttons for 3 seconds. Program mode is entered from normal operating mode at **tunE** function on **LEVL 1**. Exit program mode at any point in the menu, returning to normal operating mode. With exit, any new instructions get entered into the memory.

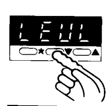
Single Level Navigation



Press the **up** or **down** button once to move to the next function. Hold the **up** or **down** buttons to automatically index through the functions. Always index **down** to get to **LEVL** function.

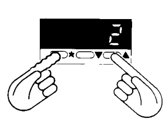
Change Levels

Multi-level menu of functions requires navigating from level to level.

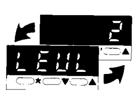


Index **down** button to **LEVL** function.

Release the **down** button to display current level.

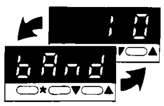


Press and hold the * button while using the **up** button or **down** button to select a new level.



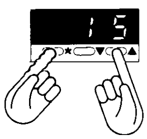
Release the * button to display new level.

View Function/Option



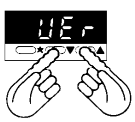
On release of **up** or **down** button at function, the display will alternate with the option selected.

Change Option



Index to required function. Press and hold the * button (current option displayed). Press **up** and/or **down** buttons to display new setting. Release the * button. **IMPORTANT:** Check new selection (alternating with function) before moving to another function or exiting program mode.

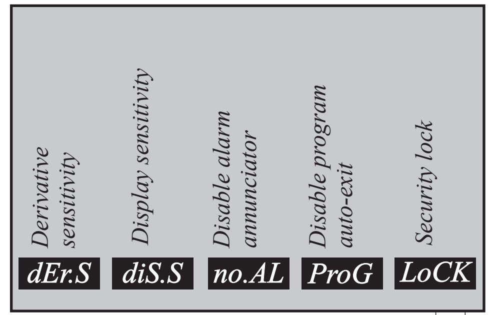
Entry to Hidden Level 4

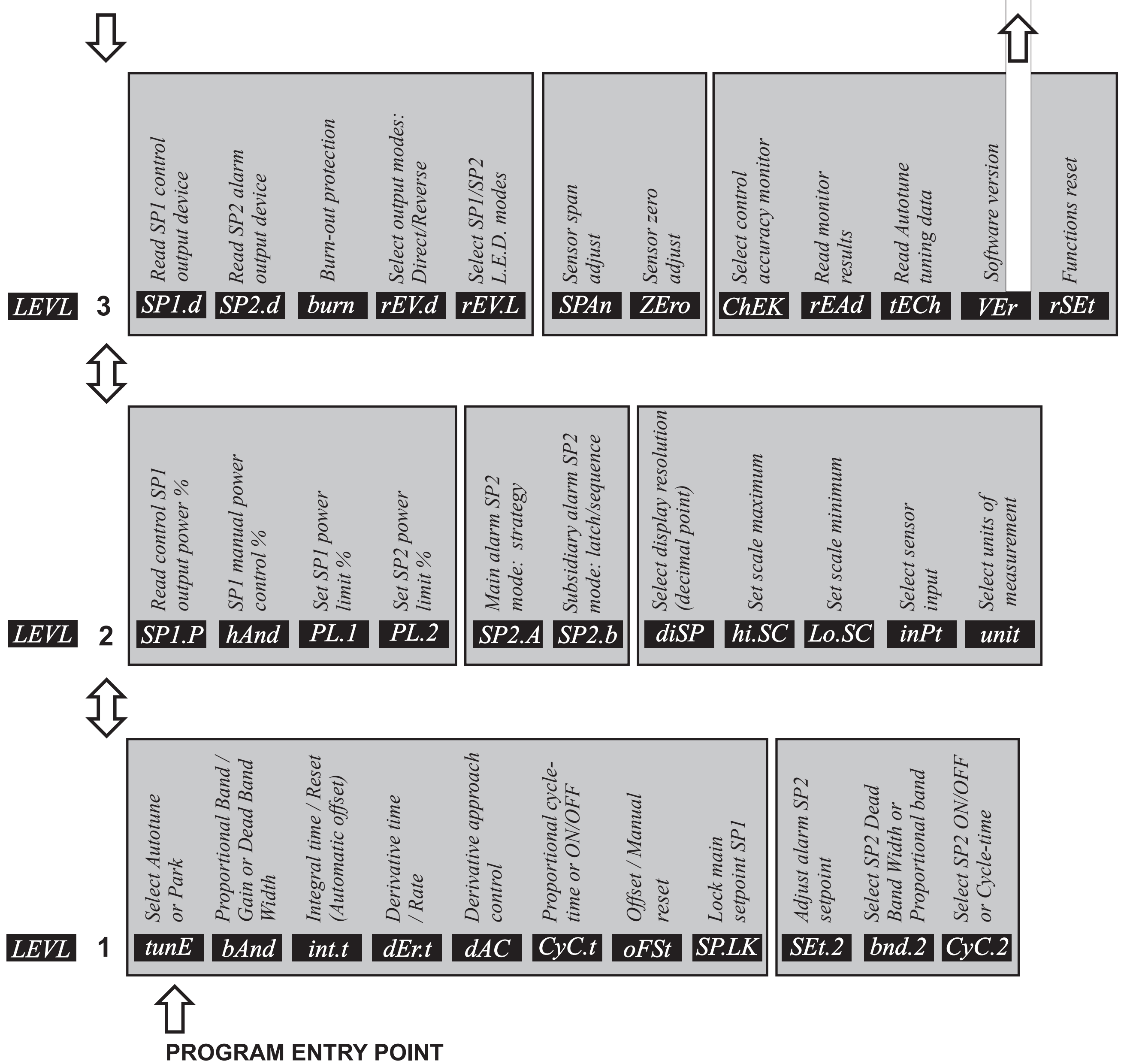


At **VEr** function on **LEVL 3**, press and hold both the **up** button and the **down** button simultaneously for **10 seconds** to enter **LEVL 4**. **VEr** is a read only function. This level should not be navigated to unless the controller has accidentally been reset. This should only ever be done by BioSpherix, Ltd. or with BioSpherix, Ltd. Technical Support.

Program Functions Menu

The Program Functions Menu is arranged on 4 levels. Entry into the menu is at the bottom of Level 1, and you are able to exit this menu from any point. Level 4 is hidden for security reasons; please contact the BioSpherix, Ltd. Service Department with any questions. Menu items are loosely grouped together according to similar functions. Some functions are defaults, some functions are read only, others are only active depending on other function settings, and some of these functions are used only in rare instances. Chances are, you will only have to become familiar with a few of the important ones.





Level 1: Tuning and Alarm Menu

LEVL 1	Function
tunE	Select Autotune or Park
bAnd	Proportional Band / Gain or Dead Band Width
int.t	Integral time / Reset (Automatic offset)
dEr.t	Derivative time / Rate
dAC	Derivative approach control
CyC.t	Proportional cycle-time or ON/OFF
oFSt	Offset / Manual reset
SP.LK	Lock main setpoint SP1
SEt.2	Adjust alarm SP2 setpoint
bnd.2	Select SP2 Dead Band Width or Proportional band
CyC.2	Select SP2 ON/OFF or Cycle-time

⇧

PROGRAM MODE ENTRY POINT

All controls and functions are located in program mode. To enter program mode on the controller, push the **up** and **down** buttons at the same time for 3 seconds until the **tunE** function appears. Once **tunE** is displayed, the controller is in program mode. Within the program mode there are multiple levels, and within each level, there are multiple functions within that level.

To navigate through Level 1 functions, push the **up** or **down** button. In order to navigate to Level 2 (*LEVL 2)* from Level 1 (*LEVL 1*), push the **up** or **down** button until the controller displays **LEVL**. Once the controller displays LEVL hold the ***** button and push the **up** button. To make a change to a function or a level, hold down the ***** button while pressing the **up** or **down** button.

The following section will provide a description of each function on the ProOx model 360 controller.

tunE

Should always be *off*. This is the setting that the controller goes to when entering into program mode. A common error is to accidentally change tune setting to *park* or *at.sp*. If this happens, change the setting back to **off**.

bAnd

Proportional control band. This is the area around the setpoint where the proportional control actually operates. +/- both sides of the setpoint. This allows the system finer control. Proportional band allows the power to be more than just on or off.

int.t

Integral time. Most protocols have *int.t* set to *off*. This setting is often used if the load on the chamber is fluctuating to keep setpoint at a steady state. A very leaky chamber is an example of when *int.t* would typically be used.

Level 1: Tuning and Alarm Menu (cont.)

LEVL 1	Description
tunE	Select Autotune or Park
bAnd	Proportional Band / Gain or Dead Band Width
int.t	Integral time / Reset (Automatic offset)
dEr.t	Derivative time / Rate
dAC	Derivative approach control
CyC.t	Proportional cycle-time or ON/OFF
oFSt	Offset / Manual reset
SP.LK	Lock main setpoint SP1
SEt.2	Adjust alarm SP2 setpoint
bnd.2	Select SP2 Dead Band Width or Proportional band
CyC.2	Select SP2 ON/OFF or Cycle-time

dEr.t

Derivative time. This setting checks the approach to setpoint and makes adjustments if approaching or deviating from setpoint too fast.

dAC

Derivative approach control. This is a factory setting and should only be adjusted if advised to do so by BioSpherix, Ltd. Technical Support.

CyC.t

Proportional cycle time. This is the length of a control cycle in seconds when proportional control is on. A low number will increase responsiveness, but will increase wear on the system.

oFSt

Manual offset. Moves the proportional band above or below the setpoint at a fixed distance so that steady state will be at the desired setpoint.

SP.LK

Setpoint lock. This setting is defaulted to *off*. Set to **on** to prevent changing of the setpoint.

SEt.2

Alarm setpoint. This value depends on what alarm mode strategy is chosen in the *Level 2* setting *SP2.A*. If **FS.hi** or **FS.Lo** is chosen, enter the actual setpoint value desire for alarm. For example, to have the alarm activate at above a setpoint of *10.0*, enter **10.0** into **SEt.2** with **FS.hi** selected for **SP2.A**. If **dV.hi** or **dV.Lo** is chosen, then enter in the amount of deviation from setpoint before the alarm activates. For example, to have the alarm activate if the O2 reading goes above *15.0* and the control setpoint is *10.0*, then enter **5.0** into **SEt.2** with **dV.hi** selected for **SP2.A**.

bnd.2

Proportional band around *SEt.2*. This controls how quickly the alarm activates when the alarm condition is met. For quickest activation, enter the value of **0.1**.

CyC.2

Sets the cycle time of the *SEt.2*. This is set to *on.off* as the alarm is either on or off. This setting should not be changed.

Level 2: Tuning and Alarm Menu

LEVL 2	Description
SP1.P	Read control SP1 output power %
hAnd	SP1 manual power control %
PL.1	Set SP1 power limit %
PL.2	Set SP2 power limit %
SP2.A	Main alarm SP2 mode: strategy
SP2.b	Subsidiary alarm SP2 mode: latch/sequence
diSP	Select display resolution (decimal point)
hi.SC	Set scale maximum
Lo.SC	Set scale minimum
inPt	Select sensor input
unit	Select units of measurement

In order to navigate to *LEVL 2* from *LEVL 1,* push the **up** or **down** button until the controller displays **LEVL**. Once the controller displays **LEVL** hold the ***** button and push the **up** button. To navigate back to *LEVL 1,* hold the ***** button and push the **down** button.

SP1.P

This function is read only.

hAnd

Factory set for *off*. This setting should not change.

PL.1

Sets power limit of *Setpoint 1*. Factory set for *100*. Do not change.

PL.2

Sets power limit of *Setpoint 2*. Factory set for *100.* Do not change.

SP2.A

Alarm mode strategy. This is the operating mode for the alarm. There are five choices: *FS.hi*, *FS.Lo*, *dV.hi*, *dV.Lo*, and *band*. To ensure that the alarm activates over a specific setpoint, select **FS.hi** (set in **SEt.2**). To ensure that the alarm activates below a specific setpoint, select **FS.Lo**.
Select **dV.hi** to ensure that the alarm will activate at a certain deviation above the work mode setpoint. (Select the deviation amount in **SEt.2**.) Select **dV.Lo** to ensure that the alarm will activate at a certain deviation below the work mode setpoint. (Select the deviation amount in **SEt.2**.) Select **band** to ensure that the alarm will activate above or below a deviation amount from the work mode setpoint.

SP2.b

This is a factory setting for *none.* Do not change.

diSP

Display resolution. Selects the unit's display resolution. This is set at the factory. Do not change.

Level 2: Tuning and Alarm Menu (cont.)

	Read control SP1 output power %	SP1 manual power control %	Set SP1 power limit %	Set SP2 power limit %	Main alarm SP2 mode: strategy.	Subsidiary alarm SP2 mode: latch/sequence	Select display resolution (decimal point)	Set scale maximum	Set scale minimum	Select sensor input	Select units of measurement
LEVL 2	SP1.P	hAnd	PL.1	PL.2	SP2.A	SP2.b	diSP	hi.SC	Lo.SC	inPt	unit

hi.SC

High Scale reading of the system; sets the sensor's maximum reading. This is set at the factory and should not change.

Lo.SC

Low Scale reading of the system; sets the sensor minimum reading. This is set at the factory and should not change.

inPt

Selects the input of the sensor. This is set for *Lin1* at the factory and should not change.

unit

Selects the unit the system displays as. This is set at the factory and should not change.

Level 3: Calibration and Control Menu

	SP1.d	SP2.d	burn	rEV.d	rEV.L	SPAn	ZEro	ChEK	rEAd	tECh	VEr	rSEt
LEVL 3	Read SP1 control output device	Read SP2 alarm output device	Burn-out protection	Select output modes: Direct/Reverse	Select SP1/SP2 L.E.D. modes	Sensor span adjust	Sensor zero adjust	Select control accuracy monitor	Read monitor results	Read Autotune tuning data	Software version	Functions reset

In order to navigate to *LEVL 3* from *LEVL 2,* push the **up** or **down** button until the controller displays **LEVL**. Once the controller displays **LEVL** hold the * button and push the **up** button. To navigate back to *LEVL 2* or *LEVL 1,* hold the * button and push the **down** button.

SP1.d

This is a factory setting for *SSd*. Do not change.

SP2.d

This is a factory setting for *rLY.* Do not change.

burn

Sensor burnout. This affects the behavior of the output when the sensor is disconnected. It works in conjunction with the system output setting. Normally the preferred behavior is close to the output if the sensor is not present. Thus, if the output setting of *rEV.d* is *1d*, set burn for **dn.SC**. If output setting of *rEV.d* is *1r*, set burn for **uP.SC**. It is important to test this setting and verify that the system behaves as expected in case the sensor is ever disconnected.

rEV.d

System output settings. *1* is the valve output and *2* is the alarm output. For *1*, the valve output value can be either *r* for reverse or *d* for direct. For example, if controlling O2 down the setting would be *1d2r*, but to control O2 up the value would be *1r2r*. For *2*, the value should always be kept as *r*.

rEV.L

This setting configures the indicator lights. *1* is the gas infusion LED and *2* is the alarm LED.

SPAn

Calibration coefficient for Span calibration. Initially the value is set at the factory. This setting will change over the course of a sensor's lifespan with subsequent calibrations. It is highly recommended to keep track of this value when calibrating.

ZEro

Calibration coefficient for the Zero calibration. Initially the value is set at the factory. This setting will change over the course of a sensor's lifespan with subsequent calibrations. It is highly recommended to keep track of this value when calibrating.

Level 3: Calibration and Control Menu (cont.)

LEVL 3

SP1.d	Read SP1 control output device
SP2.d	Read SP2 alarm output device
burn	Burn-out protection
rEV.d	Select output modes: Direct/Reverse
rEV.L	Select SP1/SP2 L.E.D. modes
SPAn	Sensor span adjust
ZEro	Sensor zero adjust
ChEK	Select control accuracy monitor
rEAd	Read monitor results
tECh	Read Autotune tuning data
VEr	Software version
rSEt	Functions reset

ChEK

This is a factory setting for *OFF*. Do not change.

rEAd

This is a factory setting for *VAr°*. Do not change.

tECh

This is a factory setting for *Ct A*. Do not change.

VEr

VEr is a read only function. Level 4 is accessed here, but should not be navigated to unless the controller has accidentally been reset. This should only ever be done by BioSpherix, Ltd. or with BioSpherix, Ltd. Technical Support.

rSEt

Reset setting. This resets all the settings to base factory settings and should not be done without the assistance of BioSpherix, Ltd. Technical Support.

Configuration

Extensive configuration options in alarming, security, and display functions all can be set later, if necessary. Only one main configuration setting is required to start: high or low oxygen. This setting is already pre-set at the factory. Should this setting need to be changed, this section will provide instructions on how to make the necessary adjustments on the controller.

Secondary Configurations

Alarm configuration options include deviation, band, and fullscale. Output can be *reverse* or *direct* acting. Alarm intensity is configurable by timed pulse proportioning.
Security options against operational errors include setpoint lock, setpoint range limits, and limited menu access to prevent unauthorized changes. Burnout contingencies and output overload limits protect against machine malfunctions.
Display resolution and sensitivity, alarm annunciator priority, and flashing indicator lights are adjustable too.
All of these settings are secondary to the main job of oxygen control. They are explained elsewhere.

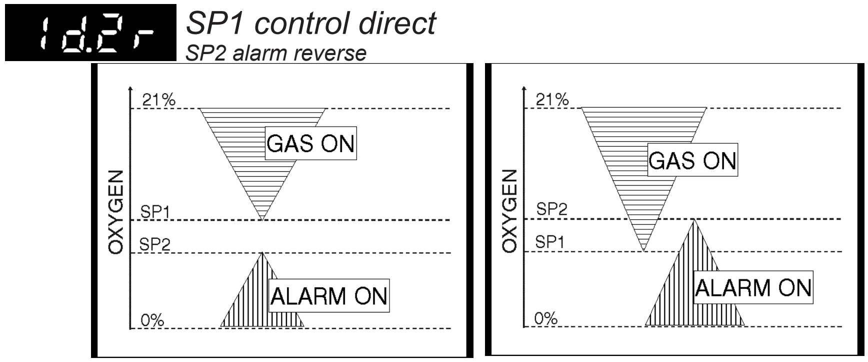
High/Low Oxygen

Enter program mode. Navigate to **rEV.d** function on Level 3.
Control output is either *direct* or *reverse*. Direct means oxygen decreases as output decreases on approach to setpoint. Reverse means oxygen increases as output decreases on approach to setpoint.
To control high oxygen levels, set **SP1** (setpoint 1) output mode to **reverse**. To control low oxygen, set **SP1** output mode to **direct**. Mnemonic: **1r** or **1d**.
Alarm *SP2* output also sets but is not active until alarm is configured. Set **2r** or **2d** later if necessary.

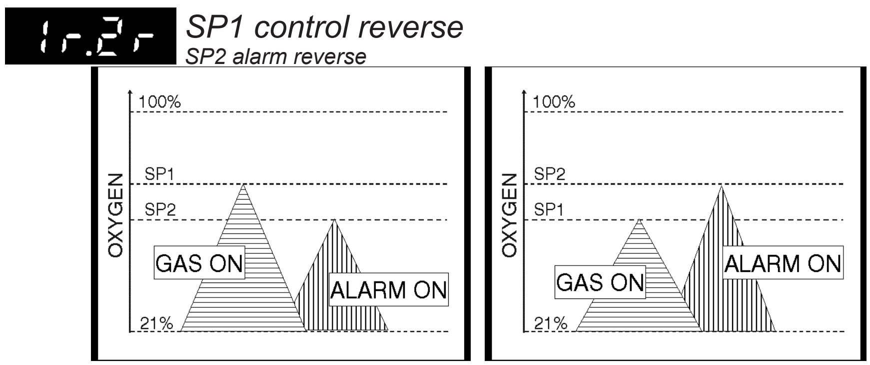
The illustrations on the following page are visual representations of different output modes on the controller.

Visual Representation of Output Modes on the Controller

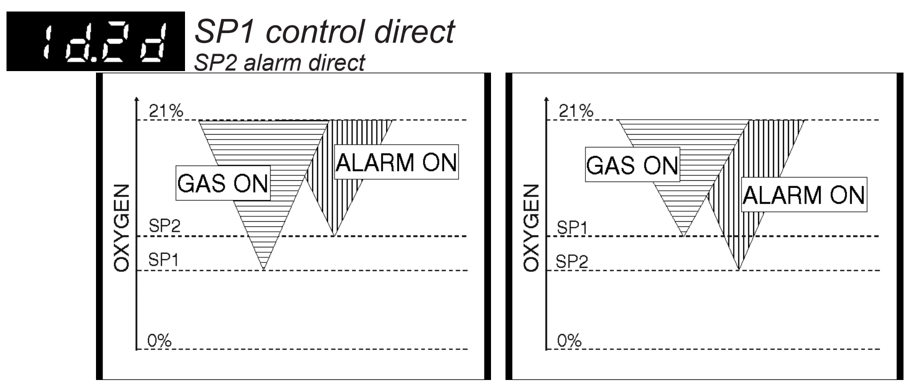
SP1 control direct
SP2 alarm reverse



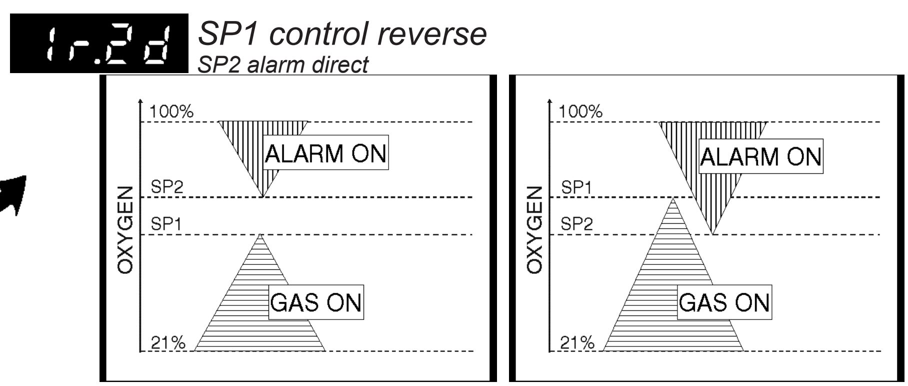
SP1 control reverse
SP2 alarm reverse



SP1 control direct
SP2 alarm direct



SP1 control reverse
SP2 alarm direct



The controller has two output modes which are located in the *rEV.d* function in Level 3. Direct output (1d) is used for low oxygen control, generally under ambient air (21%). Reverse output (1r) is used for high oxygen control, generally above ambient air (21%). The output mode programmed is predetermined at the factory based on customer specifications.

Each output mode (rEV.d) has a fail safe mechanism known as "Burn-out protection" (burn), in the case that there is an "input fail" which generally occurs when the controller loses connection with the sensor. In the case of an "input fail," "Burn-out protection" (burn) will shut off gas infusion to the chamber until the error is corrected.

For example, nitrogen will be infused when the controller is in *Direct* (1d) mode to maintain low oxygen levels. Oxygen will be infused when the controller is in *Reverse* (1r) mode to maintain high oxygen levels.

However, if output mode (rEV.d) is manually changed from the original setting declared by the factory, then it is highly recommended to change the "Burn-out protection" (burn) to activate the corresponding fail safe mechanism. Otherwise, in the case of an "input fail," the valve will open fully, eventually flooding the chamber with gas.

The following chart displays the recommended settings for each output mode:

OUTPUT MODE (**rEV.d**)	BURN-OUT PROTECTION (**burn**)
Direct (**1d.2r**)	Downscale (**dn.SC**) Used for low oxygen control
Reverse (**1r.2r**)	Upscale (**uP.SC**) Used for high oxygen control

The fail safe mechanism, "Burn-out protection," (burn) is only linked to the case of "input fail" and otherwise has no effect.

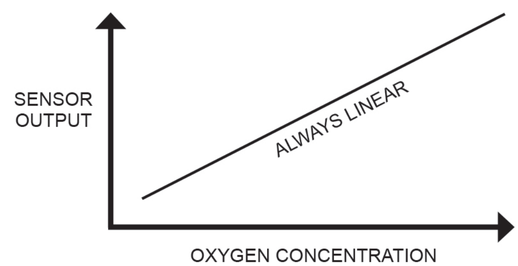
Sensor Calibration

Calibration of the sensors is mandatory for the continual operation of the ProOx model 360 unit. Calibration should be performed:

- Upon System Startup
- Before and after every production run or experiment
- On a periodic basis, at least once a week

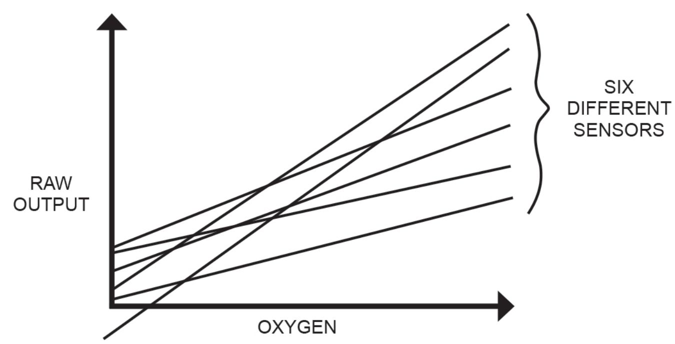
Calibration Overview Tutorial

If a sensor is not calibrated, it will not be accurate. Since the sensor provides the feedback for control, if the sensor is not accurate then control will not be accurate either.

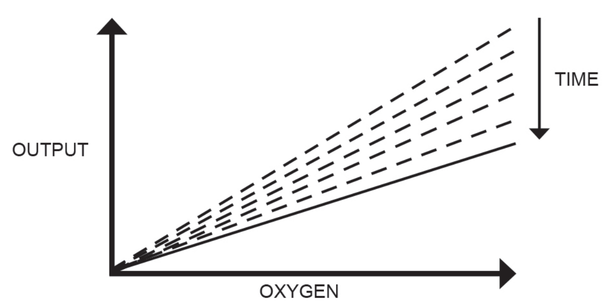


Sensors generate an electrical signal (output) which is linear and directly proportional with the gas concentration.

Sensors are not identical. Although always linear and directly proportional, raw output can be quite different for each sensor.

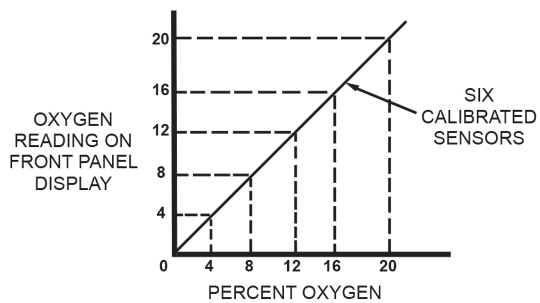


Sensor output changes over time (drift), generally but not always in a slow, downward direction. Sensors remain linear but gradually lose power. Some sensors drift more than others.

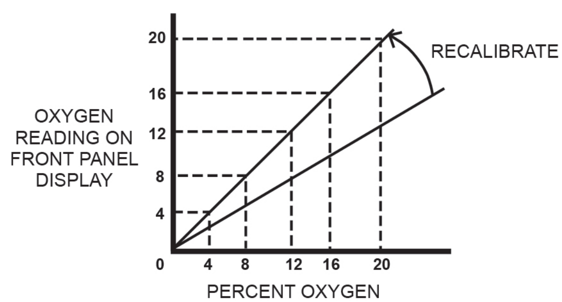


Calibration electronically corrects for the difference among sensors. Regardless of each sensor's raw output, it makes all of them read the same. It makes them read what they should read. It makes them accurate.

Calibration also compensates for drift. Drift can be monitored with periodic calibration checks. If sensors drift away from accuracy, they will not read what they should read. Simply re-calibrate.



Check calibration as frequently as necessary to have confidence in accuracy. Weekly checks are usually sufficient. Check before and after each experiment.



Calibration Standards

Sensors are calibrated to a known standard, either pure gas or a mixture with known gas concentrations. Since sensors are linear, calibrating at two known points makes all other points accurate as well. Ambient air (21%) is always one point. It is a handy standard. Immerse the sensor in ambient air by externalizing it from the chamber.

Control gas, either nitrogen (0%) or oxygen (100%) is the other point. Immerse sensor in the control gas by using the calibration chamber and bleed valve. *Please refer to the "Calibration Chamber" section for further information.* Of course, other standards can be used as well. Or calibrate to third party oxygen analyzers. Just be confident in the standard.

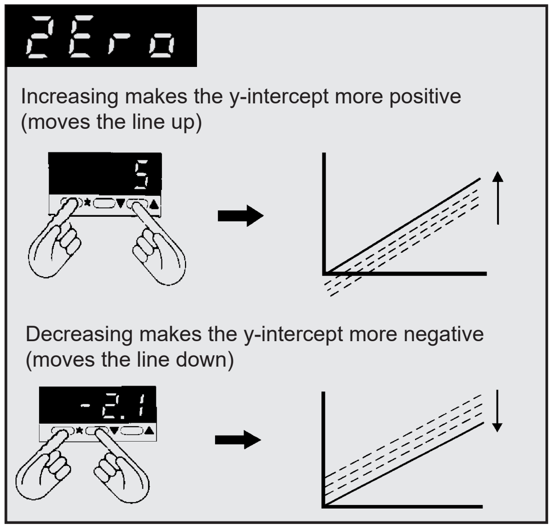
Calibration Checks

Once sensors are calibrated at ZERO and SPAN, the SPAN calibration must be checked periodically in order to detect and correct for drift. Usually the ZERO point will not change over the life of the sensor, but the SPAN will. Drift is usually minimal for 90% of a sensor's active life. Re-calibration may not be required for a long time, but the only way to know is to check.

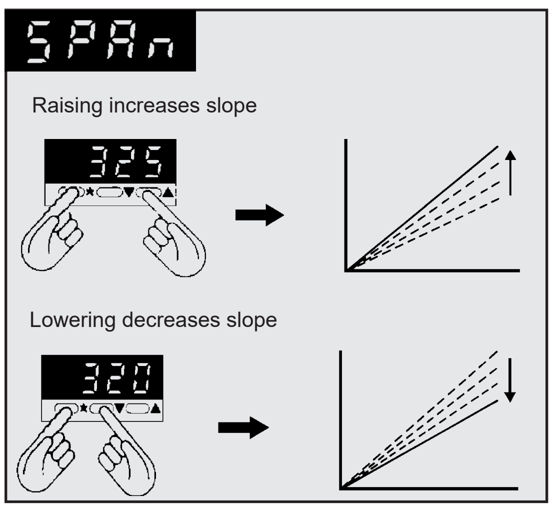
Check calibration as frequently as necessary to have confidence in accuracy.

Calibration Menu Functions

SPAn and **ZEro** functions on **LEVL 3** of the menu calibrate the sensor. Both of these functions adjust the sensor output lines without disrupting linearity; however, each function works differently. The **ZEro** function affects only the Y-intercept of the line, not the slope. It moves the line up and down without changing the slope. Always do the **ZEro** function first.



The **SPAn** function adjusts the slope of the line, but does not affect the Y-intercept (set by **ZEro** function). Always do **SPAn** after **ZEro**.



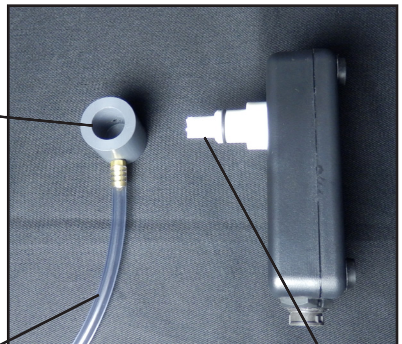
REMEMBER: Never adjust the **ZEro** function without adjusting the **SPAn** function afterwards. **ZEro** affects **SPAn** setting, but **SPAn** does not affect **ZEro** setting.

Calibration Chamber

This section will describe how to connect the calibration chamber to the ProOx model 360 controller in order to prepare it for calibration procedures.

Overview

The calibration chamber is a tool for immersing the sensor in calibration gases. It connects to the gas source via 1/8" ID tubing. It holds up the tip of the sensor in the gas stream. In the following sections, this chamber will be used for calibration purposes.

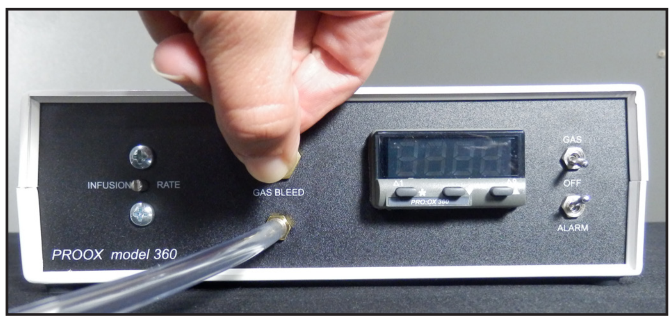


In order to connect the calibration chamber to the ProOx model 360 unit, please follow these steps:

1. Connect the calibration chamber tubing to the **GAS BLEED** hose barb on the front panel of the ProOx model 360.

2. Then, insert the sensor tip into the calibration chamber. The sensor hole is sized for a snug fit and allows the sensor to be in the gas stream within the calibration chamber; as seen below.

3. With the calibration chamber connected, open the **GAS BLEED** valve knob on the front panel of the ProOx model 360 unit until gas is heard expelling slightly through the calibration chamber.



Temperature Affect

Temperature can affect calibration. If the sensor will be used in a temperature controlled chamber, (e.g. refrigerator or incubator) always bring the sensor to operating temperature first before calibrating. It takes at least 15 minutes for the sensor to thoroughly equilibrate to the temperature of its surroundings.

Temperature affect places a time limit on the calibration procedure. A change in temperature will not affect the sensor reading for almost 5-6 minutes. It takes that long for the temperature inside the sensor to change. Fortunately, the sensor responds to oxygen much faster; within a minute or two.

Eliminate temperature interference by promptly calibrating the sensor after externalization from the chamber; before it has time to change temperature. Be ready. Have the calibration chamber in position. Calibration is easily accomplished before the temperature starts to throw off the sensor; 1-2 minutes to stabilize in high oxygen standard followed by a quick adjustment of the **ZEro** function, then 1-2 minutes to stabilize in high oxygen standard followed by a quick adjustment of the **SPAn** setting, and it is back into the chamber.

Calibration of Gas Oxygen Sensor

This section will describe how to calibrate the gas oxygen sensor using the ProOx model 360 controller. The following procedure will demonstrate how to calibrate the sensor in correspondence to its controlling setpoint. Depending on whether the ProOx model 360 controller is controlling for low or high oxygen levels, directly affects the calibration procedure that must be used in order to effectively calibrate the sensor. ***For more information regarding setpoint control, please refer to the "Single Setpoint Control" section of this manual.***

> **NOTE**
>
> In order to properly regulate the pressure on the controller, please reference the green customer setup sheet that was provided with this manual. This sheet also contains the factory configuration settings for the controller.

Zero Calibration for the Oxygen Sensor (if controlling with a low level of oxygen)

1. Connect the 1/4" ID tubing coming from the compressed nitrogen source to the **GAS SUPPLY 40 P.S.I.G. MAX.** barb on the back panel of the ProOx model 360. If the tubing coming from the compressed nitrogen source is not 1/4" ID, then use an adapter to adjust.

2. Open the regulator at the compressed nitrogen source to 5-40 PSIG. **Never exceed 40 PSIG or damage will occur to the unit.** *Please refer to the "Tuning" section under the "Power" heading section of this manual for further information.*

3. Flip the toggle switch labeled **GAS** to the OFF position (away from the word **GAS**). This will make it so the gas only goes to the calibration chamber.

4. Flip the toggle switch labeled **ALARM** to the OFF position (away from the word **ALARM**). This will make it so the controller does not generate a false alarm while calibrating.

5. To ensure that the nitrogen is connected properly, open the bleed valve on the front panel of the controller, labeled **GAS BLEED**. If gas is heard expelling from the bleed barb, then it is connected correctly. Once it has been confirmed that the gas is connected properly, close the bleed valve.

6. If using an incubator: route the calibration chamber and tubing into the incubator, which is at operating temperature.

7. Connect the calibration chamber to the **GAS BLEED** hose barb on the front panel using the 1/8" ID calibration tubing.

8. Slightly open the bleed valve knob on the front panel until gas is heard expelling slightly from the calibration chamber; this will establish an oxygen level of 0% through the calibration chamber.

9. Insert the oxygen sensor tip into the calibration chamber and let the sensor stabilize in 0% oxygen (for a minute or two).

10. In work mode, watch the sensor's response to immersion in oxygen in order to tell when it stabilizes. Make note of whether the oxygen reading is below or above **0.0** and by how much.

11. Enter the program mode by holding down the **up** and **down** buttons for three seconds.

12. Push the **down** button to navigate to the **LEVL** function.

13. Hold down the ***** button and push the **up** button until Level **3** is reached.

14. Once in Level **3**, push the **up** button to navigate to the **ZEro** function. Raise the setting if the reading was low by holding down the ***** button and pushing the **up** button. Decrease the setting if the reading was high by holding down the ***** button and pushing the **down** button. The number in the **ZEro** function stands for the same amount in the work mode. For example, if the number in the **ZEro** function is changed by **0.2,** then the number in the work mode will change by **0.2**. The number that is in the program mode is not what the number in the work mode is.

15. Exit the program mode to see the new reading by holding the **up** and **down** buttons for three seconds. Repeat until the reading is what it should be, **0.0**.

16. Close the bleed valve knob and then remove the sensor from the calibration chamber.

17. Turn off the nitrogen at the compressed gas source.

18. Open the **GAS BLEED** valve knob and allow the gas to escape out of the bleed barb.

19. Disconnect the 1/4” ID tubing from the **GAS SUPPLY 40 P.S.I.G. MAX.** barb on the back panel of the controller.

Span Calibration for the Oxygen Sensor (if controlling with a low level of oxygen)

Now, the necessary adjustments for the "Span offset adjustment" can be made in order to achieve the proper span reading.

1. Externalize the sensor from the chamber and let it stabilize in room air (for a minute or two). While waiting for the sensor to stabilize, remove the calibration tubing from the **BLEED** outlet.
2. In work mode, watch the sensor's response to immersion in 21% oxygen (percentage of oxygen in ambient air). Make note of whether the oxygen reading is below or above **21.0** and by how much.
3. Enter the program mode by holding down the **up** and **down** buttons for three seconds.
4. Push the **down** button to navigate to the **LEVL** function.
5. Hold down the ***** button and push the **up** button until Level **3** is reached.
6. Push the **up** button to navigate to the **SPAn** function and raise the setting if the reading in the work mode was low by holding down the ***** button and pushing the **up** button. Decrease the setting if the reading was high by holding down the ***** button and pushing the **down** button.
7. Exit the program mode to see the new reading by holding the **up** and **down** buttons for three seconds. Repeat until the reading is what it should be, **21.0**. The number in the **SPAn** function is not an exact correspondence with the number in the work mode, it is a coarse adjustment.
8. The sensor is calibrated when it reads **0%** oxygen after stabilization in nitrogen, and **21%** oxygen after stabilization in room air.
9. Place the sensor back into the oxygen sensor port.

Zero Calibration for the Oxygen Sensor (if controlling with a high level of oxygen)

> **NOTE**
>
> In order to properly regulate the pressure on the controller, please reference the green customer setup sheet that was provided with this manual. This sheet also contains the factory configuration settings for the controller.

1. Externalize the sensor from the chamber and let it stabilize in room air (for a minute or two).
2. In work mode, watch sensor response to 21% oxygen (percentage of oxygen in ambient air). Make note of whether the oxygen reading is below or above **21.0** and by how much.
3. Enter the program mode by holding the **up** and **down** buttons for three seconds.
4. Push the **down** button to navigate to the **LEVL** function.
5. Hold down the ***** button and push the **up** button until Level **3** is reached.
6. Once in Level **3**, push the **up** button to navigate to the **ZEro** function. Raise the setting if the reading was low by holding down the ***** button and pushing the **up** button. Decrease the setting if the reading was high by holding down the ***** button and pushing the **down** button.
7. Exit the program mode to see the new reading by holding the **up** and **down** buttons for three seconds. Repeat until the reading is what it should be, **21.0**. The number in the **ZEro** function stands for the same amount in the work mode. For example, if the number in the **ZEro** function is changed by **0.2,** then the number in the work mode will change by **0.2**. The number that is in the program mode is not what the number in the work mode is.
8. Place the sensor back into the oxygen sensor port.

Span Calibration for the Oxygen Sensor (if controlling with a high level of oxygen)

Now, the necessary adjustments for the "Span offset adjustment" can be made in order to achieve the proper span reading.

1. Connect the 1/4" ID tubing coming from the compressed oxygen gas source to the **GAS SUPPLY 40 P.S.I.G. MAX.** barb on the back panel of the ProOx model 360. If the tubing coming from the compressed oxygen source is not 1/4" ID, then use an adapter to adjust.
2. Open the regulator to 5-40 PSIG. **Never exceed 40 PSIG or damage will occur to the unit.** *Please refer to the "Tuning" section under the "Power" heading section of this manual for further information.*
3. Flip the toggle switch labeled **GAS** to the OFF position (away from the word **GAS**). This will make it so the gas only goes to the calibration chamber.
4. Flip the toggle switch labeled **ALARM** to the OFF position (away from the word **ALARM**). This will make it so the controller does not generate a false alarm while calibrating.
5. To ensure that the oxygen is connected properly, open the bleed valve on the front panel of the controller, labeled **GAS BLEED**. If gas is heard expelling from the bleed barb, then it is connected correctly. Once it has been confirmed that the gas is connected properly, close the bleed valve.
6. Connect the calibration chamber to the **GAS BLEED** hose barb on the front panel using the 1/8" ID calibration tubing.
7. Slightly open the bleed valve knob on the front panel until gas is heard expelling slightly from the calibration chamber; this will establish an oxygen level of 100% through the calibration chamber.
8. Insert the sensor tip into the calibration chamber and let the sensor stabilize in 100% oxygen (for a minute or two).
9. In work mode, watch the sensor's response to immersion in oxygen in order to tell when it stabilizes. Make note of whether the oxygen reading is below or above **100.0** and by how much.
10. Enter the program mode by holding down the **up** and **down** buttons for three seconds.
11. Push the **down** button to navigate to the **LEVL** function.
12. Hold down the * button and push the **up** button until Level **3** is reached.
13. Once in Level **3**, push the **up** button to navigate to the **SPAn** function and raise the setting if the reading in the work mode was low by holding down the * button and pushing the **up** button. Decrease the setting if the reading was high by holding down the * button and pushing the **down** button.
14. Exit the program mode to see the new reading by holding the **up** and **down** buttons for three seconds. Repeat until the reading is what it should be, **100.0**. The number in the **SPAn** function is not an exact correspondence with the number in the work mode, it is a coarse adjustment.
15. The sensor is calibrated when it reads **21%** oxygen after stabilization in room air, and **100%** oxygen after stabilization in oxygen.
16. Close the bleed valve knob and then remove the sensor from the calibration chamber.
17. Turn off the oxygen at the compressed gas source.

18. Open the **GAS BLEED** valve knob and allow the gas to escape out of the bleed barb.

19. Disconnect the 1/4” ID tubing from the **GAS SUPPLY 40 P.S.I.G. MAX.** barb on the back panel of the controller.

20. Remove the calibration tubing from the **GAS BLEED** outlet barb

Single Setpoint Control

Once the calibration of the oxygen sensor is finished, the device is now operable. This section will describe how to use single setpoint control with the ProOx model 360 controller. Single setpoint control is a way to control the level of gas in the chamber.

> **NOTE**
>
> In order to properly regulate the pressure on the controller, please reference the green customer setup sheet that was provided with this manual. This sheet also contains the factory configuration settings for the controller.

Single setpoint control using a low level of oxygen (approximately 21.0% oxygen and lower)

1. Connect the 1/4” ID tubing coming from the compressed nitrogen gas supply to the **GAS SUPPLY 40 P.S.I.G. MAX.** barb on the back panel of the ProOx model 360. If the tubing coming from the compressed nitrogen source is not 1/4” ID, then use an adapter to adjust.

2. Ensure that the infusion tubes are connected to the ProOx model 360. *Please refer to the “ProOx Model 360 Installation” section for instructions on how to attach the infusion tubes.*

3. Open the regulator at the compressed nitrogen source to 1-40 PSIG. **Never exceed 40 PSIG or damage will occur to the unit**. The pressure must be regulated to 1-40 PSIG. *Please refer to the “Tuning” section under the “Power” heading section of this manual for further information.*

4. To ensure that the nitrogen is connected properly, open the bleed valve on the front panel of the controller, labeled **GAS BLEED**. If gas is heard expelling from the bleed barb, then it is connected correctly. Once it has been confirmed that the gas is connected properly, close the bleed valve.

5. To set a setpoint, push and hold the ***** button. While holding the ***** button use the **up** and **down** buttons to adjust the setpoint to read the desired setpoint. Once the number has been adjusted to the desired reading, release the ***** button and the controller will begin to go towards the new setpoint.

6. Flip the toggle switch labeled **GAS** to the ON position (towards the word **GAS**). This will allow the gas to enter the chamber.

Single setpoint control using a high level of oxygen (approximately 21.1% oxygen and higher)

1. Connect the 1/4” ID tubing coming from the compressed oxygen gas supply to the **GAS SUPPLY 40 P.S.I.G. MAX.** barb on the back panel of the ProOx model 360. If the tubing coming from the compressed oxygen source is not 1/4” ID, then use an adapter to adjust.

2. Ensure that the infusion tubes are connected to the ProOx model 360. *Please refer to the “ProOx Model 360 Installation” section for instructions on how to attach the infusion tubes.*

3. Open the regulator at the compressed oxygen source to 1-40 PSIG. **Never exceed 40 PSIG or damage will occur to the unit**. The pressure must be regulated to 1-40 PSIG. *Please refer to the “Tuning” section under the “Power” heading section of this manual for further information.*

4. To ensure that the oxygen is connected properly, open the bleed valve on the front panel of the controller labeled **GAS BLEED**. If gas is heard expelling from the bleed barb, then it is connected correctly. Once it has been confirmed that the gas is connected properly, close the bleed valve.

5. To set a setpoint, push and hold the ***** button. While holding the ***** button use the **up** and **down** buttons to adjust the setpoint to read the desired setpoint. Once the number has been adjusted to the desired reading, release the ***** button and the controller will begin to go towards the new setpoint.

6. Flip the toggle switch labeled **GAS** to the ON position (towards the word **GAS**). This will allow the gas to enter the chamber.

Setting the Alarm Setpoint

This section will explain how to set the alarm setpoint on the controller. Remember, in order for the alarm function to be active, the alarm switch on the front of the controller must be on.

1. Push the **up** and **down** buttons at the same time for 3 seconds. This will enter program mode from normal operating mode at tune function on Level 1 in the menu.
2. Now, go to **LEVL 2** by holding down the * button and pushing the **up** button.
3. In **LEVL 2** navigate to **SP2.A** by pushing the **up** button.
4. Change this number to either **DV.hi** (Deviation High) or **DV.Lo** (Deviation Low) by holding the * button and push the **up** or **down** button. This will determine whether the alarm activated below or above the **SEt.2** (alarm setpoint).
5. In **LEVL1** navigate to **SEt.2** by pushing the **up** button.
6. Adjust this number by holding the * button and using the **up** or **down** buttons. Change this number to the desired alarm setpoint.
7. In **LEVL 1** navigate to **bnd.2** by pushing the **up** button. This number will determine the range of the alarm setpoint. **The bnd.2 number is a coarse adjustment, the number that this is changed to will not be the exact size of the bandwidth.**
8. To set the alarm to activate as quickly as possible, set the band to **0.1**. Increase the number to increase the range. Remember, it is a coarse adjustment.
9. Remember, in order for the alarm to have the ability to come on, the **ALARM** switch on the front panel of the controller must be flipped to the ON position (towards the word **ALARM**). Also, please refer to following sections in the manual for more information regarding the alarm: *Configuration* section and *Program Functions Menu* section.

Whenever using a mechanical device with a chamber containing live animals, there is an inherit risk. It it important that you utilize the safety features contained within this system in order to minimize any problems that can occur with a mechanical failure.

WARNING

The ProOx Model P360 is equipped with an additional safety feature for your animals. This feature is tied to the alarm so that when your oxygen levels rise above or below your specified alarm setpoint the audible alarm will sound and the control valve will close until the condition is cleared. This feature is only engaged when your alarm is set and activated. Failing to activate the alarm switch on the controller can compromise your experiments.

BioSpherix, Ltd. strongly encourages all of our customers to perform a test run on their system prior to beginning any actual experiments. Doing so will help the user to understand how the system performs. It is your responsibility to protect your animals by utilizing proper safety features and instructions described within this user manual. These features will help to reduce issues that can occur due to mechanical failures. If you have any questions, please contact BioSpherix, Ltd. Technical Support.

Tuning

Tuning matches the control parameters of the ProOx model 360 to the gas dynamics of the host chamber in order to achieve effective control.

Overview

Different oxygen control jobs in different chambers require specific control parameters. Tuning means setting those control parameters that result in acceptable control. Which parameters to set and how to set them depends on the job. Is oscillation acceptable? If so, how much? Is overshoot permissible? Undershoot? How much? For how long? Is the load fixed or a variable? Does setpoint change? Must recovery be fast?

Capability exists to handle practically any oxygen control job. However, the more complex and demanding the job, the more involved tuning becomes. Tune only what is necessary to accomplish the job. Any additional control parameters probably will not help, and might hurt. Excessive tuning can reduce control stability. Most oxygen control jobs are simple, thus tuning is easy. Only a few parameters need to be set. Advanced control capabilities are available, but use them only if needed.

Just watch the control process and see how each control parameter affects it. This is the only definitive way. Usually it is the easiest too. Tuning takes time. Tuning takes gas. It means sitting and watching the control process, sometimes over and over. There is no shortcut. Trial and error is the only way to tell if a tune set works.

Refer to the green customer setup sheet that was supplied with the ProOx model 360 controller. This sheet contains all the pretuning information that was done at the factory. Do not lose this sheet. Should the sheet become lost, call the number at the front of this manual to receive a new copy. Always change only one control parameter at a time. See how that setting works first before changing another. Record each tune set. When satisfied with the control, copy it and set it aside for safekeeping. A tune does not have to be perfect to work. However, do not stop short either. Once tuning is done and done right, it may never need further attention.

Power

First, adjust power. Power is the only control parameter not set in program mode. Once power is set, other control parameters may be tuned. Power is a function of infusion rate. The more gas infused per unit, the higher the power. Infusion rate is adjustable up to 350 SCFH (Standard Cubic Feet an Hour). Infusion rate is a function of the gas supply delivery pressure. The higher the pressure, the faster the infusion rate. Gas supply delivery pressure is set at the pressure regulator on the gas source. Infusion rate is dependent on the pressure of the gas coming from the compressed gas source. **Never exceed 40 PSIG.**

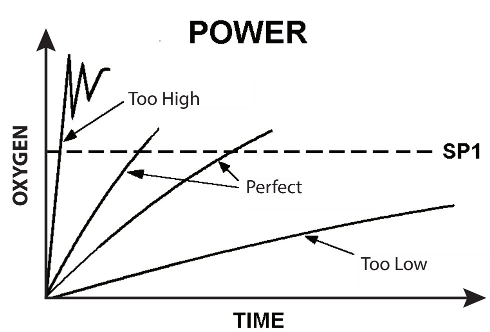
The ProOx model 360 power must roughly match the dynamic gas load of the chamber. Too little power and it takes a long time to reach the setpoint. Too much power and the control is unstable. The bigger the chamber, the more power (gas) it takes. For example, a small incubator might take 2-5 SCFH, but a tissue culture incubator might take 10-30 SCFH. The leakier the chamber, the more power (gas) it takes. For example, an incubator with a tight seal might take 10 SCFH, but one with a loose seal might take 20 SCFH.

There are methods to calculate power, but it is faster and easier to adjust the power empirically. Watch the control process and adjust the infusion rate so the ProOx model 360 is able to deliberately push oxygen from ambient to past the setpoint under normal load conditions. Most jobs can be tuned over a relatively wide power range. However, once the other control parameters are tuned, any change in the power/load balance may require re-tuning those parameters.

STEPS:

1. Set the gas supply delivery pressure. Range 0-40 PSIG.

2. Watch the number in work mode approach the setpoint. If it is too fast and unstable, turn down the pressure to lower the infusion rate. If it is too slow, turn up the pressure to increase the infusion rate. **Never exceed 40 PSIG.**



Proportional Control

Proportional control eliminates oscillation. It controls steady-state by the straight line attenuation as oxygen approaches the setpoint. When power (gas infused per unit time) *exactly matches* load (gas leaking out per unit time), oxygen stabilizes. Unlike ON/OFF control where power is either 100% or 0%, proportional control can adjust power anywhere between 100% and 0%. Power is adjusted by *timing* gas pulses. “Proportional” means gas pulses get proportionately smaller as the distance between the oxygen level and setpoint (SP1) gets smaller.

Pulses are timed by setting a cycle time and are varied by percentage of the cycle time. Maximum pulses are 100% of the cycle time. Minimum pulses are 0% of the cycle time. Proportioned pulses are in between. Timed pulse proportioning occurs only over a narrow band of oxygen levels centered around the setpoint. Control gas is infused full blast (100% output) with no timing until it reaches this band, and then it cycles. The deeper it goes into the proportional band, the shorter the pulses. Band size determines how quick pulses shorten and power thus weakens.

Somewhere between 100% and 0% of the cycle time there is a pulse time that holds the steady-state. However, if proportional band is too small, it may not be easy to find. Small changes in oxygen will cause huge changes in output, similar to ON/OFF control. Oxygen will oscillate and never reach steady-state. On the other hand, if proportional band is too wide, proportioning inhibits approach to the setpoint. Power starts decreasing way too soon. Proportional band should be big enough so there is no gross overshoot every time proportioning kicks in, but not so big that there is needless pulsing long before oxygen gets even close to the setpoint.

Cycle time should be as long as possible to minimize wear and tear of the equipment, but not so long that it becomes unresponsive. If no other control parameters are set, proportional band centers around setpoint (SP1). All additional parameters accentuate proportional control. Without proportional control (proportional band and cycle time), no other parameters are active. Some affect the position of the band, but not the size. Some affect the size, but not the position. None affect the cycle time.

Manual Offset

Proportional band is basically a “blind” control parameter. When set alone, it positions itself arbitrarily; centered around the setpoint. Chances are steady-state will not be at the setpoint. If proportional control steady-state is not at the setpoint, the offset must be eliminated to move steady-state to the setpoint.

Manual offset moves the proportional band by a fixed distance so that steady-state is at the setpoint. If steady-state is +0.3% oxygen above the setpoint, then an offset of -0.3 will move the proportional band down so the pulse is perfectly proportioned to match the load at the setpoint. Manual offset works well when controlling against a fixed load. Once set, it makes proportional control nearly perfect with no overshoot.

STEPS:

1. Watch the control process in work mode until steady-state is reached. Note the variance from the setpoint.
2. Enter program mode, navigate to **oFSt** function on Level **1** and set the number that offsets variance.

> **NOTE**
>
> The **int.t** function on Level **1** must be set to **off** to manually adjust the offset, otherwise the **oFSt** function is not active but read-only.

Integral Control Automatic Offset Reset

Proportional control jobs with fluctuating loads require automatic offset to keep steady-state at the setpoint. The integral control parameter automatically and continuously monitors divergences between the setpoint and steady-state and acts to correct offset by repositioning the proportional band. It changes the area between the setpoint line and the oxygen level line, then shifts the proportional band in the proper direction to minimize area. As the load changes, steady-state follows the setpoint, if the integral is tuned properly.

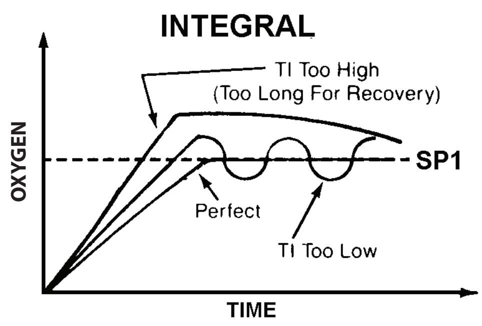
Integral control overshoots on initial start up and after significant interruptions. Far away from the setpoint it senses a big offset, so it shoots the proportional band as far as possible in the corrective direction. Only after passing the setpoint does integral pick up the need to bring the proportional band back near the setpoint. The integral control parameter is time. Integral resets offset as frequently as specified. If integral time is too short, it recalculates too many times before oxygen moves much and moves proportional band too far too fast. The result is oscillation. Eventually oscillation will dampen to steady-state, if load has not changed yet. If integral time is too long, control will be slow to respond. The steady-state and setpoint take a long time to merge.

STEPS:

1. Watch the oxygen control process in work mode under normal load change. Note the offset at one load. While load changes, note the time until the new offset stabilizes at steady-state. To change load, open the chamber door and ventilate.

2. Enter program mode, navigate to **int.t** function on Level 1, and set integral time to **30-70%** of noted time. Range is 0.1-60 minutes.

3. Exit program mode to work mode. Watch as normal load changes occur and note the time until offsets disappear.



4. Repeats steps 2-3 until control is acceptable.

Derivative Control

The most demanding control job is the one that has to be fast and tight under fluctuating loads. With power and proportional band tuned aggressively (high power, narrow band), conditions are ripe for overshoot. Add integral action and overshoot is virtually guaranteed at startup and after large disturbances. Derivative control suppresses overshoot. It also speeds response to disturbances, large or small.

Derivative algorithms measure rate and direction of the change of oxygen in relation to the setpoint. Then temporarily, but quickly, shifts proportional band in the opposite direction by a distance proportional to the rate of change. The faster the change, the further it shifts. Shift is just long enough to “extract” an output determination. The effect is to quickly weaken power on approach to the setpoint, and quickly boost the power if oxygen suddenly pulls away from the setpoint. Properly tuned, derivative should not disturb proportional or integral action at steady-state.

On fast approach to the setpoint without derivative, when oxygen first hits the proportional band, the initial pulse might be 97% of the cycle time. That is not very weak. The next pulse might be significantly less, but by that time it is too late. Oxygen changed too fast; overshoot already occurred. When integral action finally kicks in, it is way too late. With derivative, fast oxygen change immediately pulls up the proportional band. Then the first pulse might be 1% of the cycle time. This quickly slows the approach to the setpoint. Slower rate of change calculation might only “extract” a pulse of 12% of the cycle time. Slower still, maybe 19%.

As rate of change of oxygen decreases, derivative action decreases. At steady-state there is no derivative action. Ideally, at that point oxygen is near the setpoint and integral action takes over. Derivative also speeds response to disturbances. Without it, as oxygen quickly diverges away from the setpoint, the first pulse from proportional control band might be only 22% of the cycle time, the second pulse 53%, the third 87% and by the time output goes to 100%, oxygen is far away. With derivative, the fast change in oxygen away from setpoint would immediately pull proportional band back toward the setpoint and result in 100% output before oxygen gets too far.

Derivative control is the hardest to tune. The proper setting is very sensitive to gas dynamics and other control parameters. If it is not required, keep it off as it will tend to reduce control stability.

Derivative parameter is time. It sets the rate of corrective action. Rule-of-thumb: Set 3-8 times faster than integral. If it is too short, it inhibits reaching the setpoint and slows response to upsets. If it is too long, it oscillates and over corrects. It is only active in the proportional band.

STEPS:

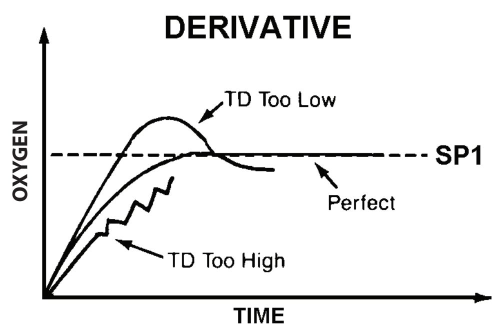
1. With power, proportional, and integral parameters set, watch the control process in the work mode. Note any overshoot. Next, open the chamber briefly to induce a large upset in control. Note the speed of response.

2. Enter program mode, navigate to **dEr.t** function on Level 1 and set derivative time. Range **0.1-0.4** of integral time.

3. Exit program mode and air out the chamber. Watch the control process and note overshoot on approach and response to disturbance.

4. Re-enter program mode and navigate to **dEr.t** function again. If there is too much overshoot on approach and too slow of a response to upset, decrease derivative time. If approach to setpoint is inhibited and response under corrects, increase derivative time.

5. Repeat steps 3-4 until overshoot on approach and response to upset is acceptable.



Derivative Approach Control

Derivative action (1) suppresses overshoot and (2) speeds response to upsets. However, it may not always be possible to do both with one setting. Depending on the power/load balance, sometimes derivative tuned for quick response will not suppress overshoot enough. Derivative approach control parameter **dAC** solves this problem. It tunes overshoot parameters by controlling when derivative action starts on approach to setpoint. Normally derivative action is only in proportional band. **dAC** is a multiplier of the proportional band.

The smaller the **dAC** setting, the closer to setpoint derivative action begins. Too small and oxygen overshoots. Too large and approach is slowed and stepped.

STEPS:

1. With power, proportional, and integral parameters tuned; and derivative time tuned for fast response to upsets, watch the control process in work mode. Note the approach to setpoint.

2. Enter program mode and navigate to **dAC** function on Level 1. If overshoot suppression is needed, increase multiple of proportional band. Range is 0.5-5.0. If approach is stepped and slow, decrease multiple.

3. Repeat steps 1-2 until control is acceptable.

Maintenance

This section will describe how to calibrate, re-calibrate and replace the sensor.

Check Calibration and Re-calibration
The sensor's calibration will need to be checked at least once every two weeks. In order to check the calibration, the sensor must be disconnected from the chamber. The calibration chamber and 1/8" ID tubing will be needed in order to check the calibration.Follow the steps of the "*Calibration of Gas Oxygen Senso*r" section to check the calibration and to re-calibrate (if necessary). If it is not accurate then it will need to be re-calibrated. To re-calibrate the sensor, follow the full set of procedures as was used for the original calibration. The oxygen sensor has a slow, natural decay, and over time this will cause the sensor to drift, requiring the sensor to be re-calibrated to compensate.

New Sensor
In the event that the sensor quits functioning, call the number on the side of the sensor to purchase a new one. To replace the sensor, follow steps 6-7 of "*ProOx Model 360 Installation*."

WARNING

Safety goggles and neoprene gloves are recommended when handling oxygen sensors. The sensors are sealed, and under normal circumstances, the contents of the sensors do not present a health hazard. In case of a leak, respiratory protection and full protective clothing should be worn. The spill should be neutralized with soda ash or lime. Carefully place the material into a clean, dry container and cover, and then flush the spill area with water.

Sensor Disposal
Oxygen sensors should be disposed of in accordance with all applicable federal, state, and local environmental regulations, with regards to lead or lead acetate.

Adapter Plate for the Large A-Chamber Manual

version 0.6 April 2016

This manual will describe the components of the adapter plate for a BioSpherix, Ltd. Large A-Chamber.

BioSpherix, Ltd.
P.O. Box 279
25 Union Street, Parish, New York 13131
Tel: 315-387-3414 Fax: 315-387-3415
TOLL FREE US/CAN 800-441-3414
www.biospherix.com

! Anyone who has not thoroughly read and understood this manual must never attempt to operate the equipment. !

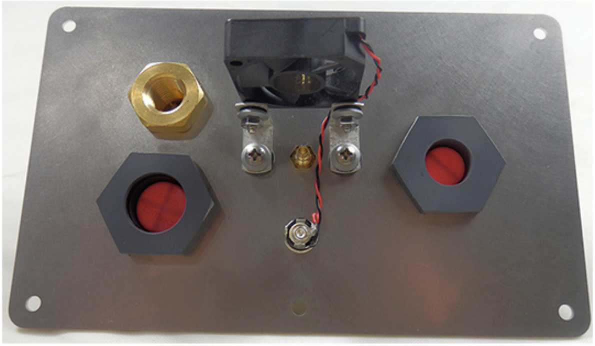
Adapter Plate

Table of Contents

BioSpherix Supplied Parts

The following pictures represent the adapter plate that connects to the A-Chamber.

Adapter Plate (Front)



Adapter Plate (Back)

12VDC Regulated Power Supply

Adapter Plate

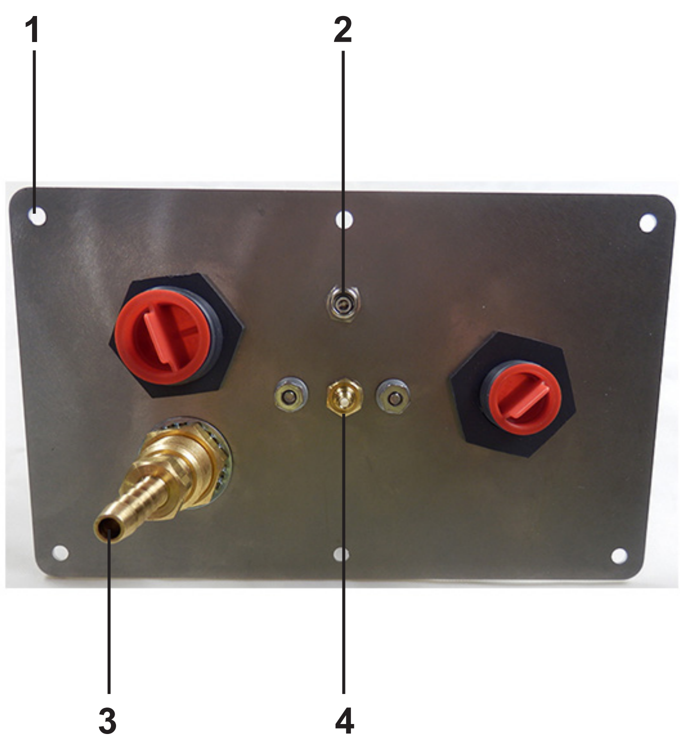
This section will provide a brief description of the components found on the adapter plate.

1. **Mounting Holes -** These holes are used for mounting the adapter plate to the chamber. Most adapter plates will already come mounted to the chamber. If assistance is needed in mounting an adapter plate that is not already attached to the chamber, please contact BioSpherix, Ltd. Technical Support.

2. **Power Supply -** Receptacle for the supplied 12VDC regulated power supply. Plug the 12VDC regulated power supply into a wall outlet and plug the jack end into the power port on the adapter plate. This will supply power to the fan, which homogenizes the gases inside of the chamber. The fan should automatically come on when plugged in.

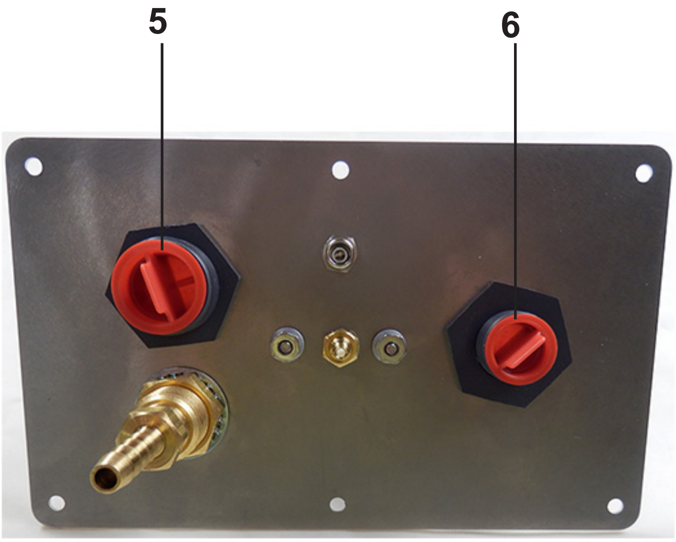
3. **Oxygen Infusion Tube Barb -** This hose barb is for infusing gas into the chamber. Attach the infusion tube to the 1/4” ID hose barb on the adapter plate.

4. **Carbon Dioxide Infusion Tube Barb -** This hose barb is for infusing gas into the chamber. Attach the infusion tube to the 1/8” ID hose barb on the adapter plate.



5. **Carbon Dioxide Sensor Port -** This port is for mounting the carbon dioxide sensor. Remove the plug that is inside of the port. Attach the carbon dioxide sensor cable to the particular controller that is being used and then attach it to the carbon dioxide sensor itself. Make sure to line up the key on the receptacle of the cable with the key on the receptacle on the sensor. Now route the sensor to the adapter plate and insert the sensor tip into the carbon dioxide sensor port (the larger one) on the adapter plate. Make sure the sensor tip is snug when it is inserted. *(Refer to the corresponding manual for the controller that is being used for more information on the carbon dioxide sensor.)*

6. **Oxygen Sensor Port -** This port is for mounting the oxygen sensor. Remove the plug that is inside of the port. Attach the oxygen sensor cable to the controller and then attach it to the oxygen sensor itself. Make sure to line up the key on the receptacle of the cable with the key on the receptacle on the sensor. Now route the sensor to the adapter plate and insert the sensor tip into the oxygen sensor port (the smaller one) on the adapter plate. Make sure the sensor tip is snug when it is inserted. *(Refer to the corresponding manual for the controller that is being used for more information on the oxygen sensor.)*



Maintenance

This section will describe how to properly clean the adapter plate.

Cleaning
The adapter plate and fan may need to be cleaned periodically. Make sure the power source is not plugged in when cleaning.

- Use soap and water on the adapter plate to clean. Allow the adapter plate to dry prior to plugging the power source back in.
- For routine cleaning of the fan, use compressed air to blow off any dust or surface contamination.
- Periodically spray or soak the fan in alcohol. The fan is designed to be submerged in liquid; this will not harm the fan. Allow the fan to dry prior to plugging the power source back in.

Adapting a Generic Chamber Manual

version 0.7 January 2018

This manual will describe how to install and adapt a generic chamber. Read this manual thoroughly before installing and adapting the generic chamber.

BioSpherix, Ltd.
P.O. Box 279
25 Union Street, Parish, New York 13131
Tel: 315-387-3414 Fax: 315-387-3415
TOLL FREE US/CAN 800-441-3414
www.biospherix.com

! Anyone who has not thoroughly read and understood this manual must never attempt to operate the equipment. !

Table of Contents

Safety

System Safety Concerns and Safety Guidelines must be strictly adhered to.

Power Cord Protection
Power Supply Cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them. Power Cord of unit should be unplugged from the electrical outlet when left unused for long periods of time.

CAUTION

ELECTRIC SHOCK If modifying host chamber, be careful not to drill or cut into electrical wires hidden behind chamber wall. Never drill or cut blindly.

WARNING

DRILLING PRECAUTIONS Keep a firm grasp on the drill at all times. Drill slowly and cautiously. Be aware of sharp drill bit.

CAUTION

MAKING CUTOUT FOR ADAPTER PLATE The cutout for the adapter plate should only be made by an experienced fabricator.

WARNING

Unit should be situated so that its location or position does not interfere with proper ventilation. Host chamber should never be in a poorly ventilated area.

High Concentration of Gas
Never adapt a host chamber when gas is evident inside of the chamber.

CAUTION

Host Chamber should be situated from heat sources such as radiators, heat registers, stoves, or other appliances or processes that produce heat.

Low Oxygen Atmospheres

Never enter a chamber which has a low oxygen atmosphere because of severe danger of suffocation. Host chamber should be in a well ventilated room. Control gas (nitrogen or other low oxygen gas) continuously leaks out of chamber and should never be allowed to build up in room or outside of the chamber.

High Oxygen Atmospheres

Never enter a chamber which has a high oxygen atmosphere due to danger of oxygen toxicity. Never smoke or allow any source of fire in or around a chamber with high oxygen atmosphere. Oxygen radically promotes combustion and can be explosive. Host chamber should always be in a well ventilated room. Oxygen continuously leaks out of chamber and should never be allowed to build up in room or outside of chamber.

Installation

Overview

The chamber must be in a well ventilated room. Control gas will continually leak out of the chamber and should never be allowed to build up outside of the chamber.

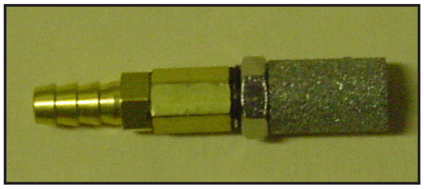
The chamber must be semi-sealed. If the chamber is sealed too tight then it may develop positive pressure, which sensors cannot tolerate. Positive pressure occurs when there is no small opening for the gases inside of the chamber to vent out, or for the outside air to vent in. The chamber cannot be too leaky or it will not be possible to hold an inner atmosphere inside of the chamber. It is important to have leaks when performing an experiment that deals with both low levels of oxygen and high levels of oxygen.

Experiments Dealing with a Low Level of Oxygen
Nitrogen (or an oxygen-poor gas) will be infused into the chamber, causing the level of oxygen inside the chamber to decrease. Through the leaks, the outside air (approximately 20.8% oxygen) will be raising the level of oxygen. This is important because without the outside air coming inside the chamber, the oxygen level will drop to 0% and stay there.

Experiments Dealing with a High Level of Oxygen
Oxygen (or an oxygen-rich gas) will be infused into the chamber, causing the level of oxygen inside the chamber to increase. Through the leaks, the outside air (approximately 20.8% oxygen) will be decreasing the level of oxygen. This is important because without the outside air coming inside the chamber, the oxygen level will raise to 100% and stay there.

Plan the best access point(s) into the chamber for the sensor and the infusion tube. Any passageway will work as long as the sensor can monitor the inside of the chamber and gas can be infused into the chamber.

A muffler will be provided with the ProOx model 110 and ProOx model 360 controllers. This muffler attaches to the end of the infusion tube.



Muffler

There are three ways to install the sensor and infusion tubing:

1. Install the sensor inside of the chamber and then route the cables through an access port.

2. Install the sensor onto the chamber by drilling a hole inside of the chamber in order to accommodate a BioSpherix, Ltd. port.

3. Mounting a BioSpherix, Ltd. adapter plate to the chamber.

(*Refer to the corresponding manual for the controller that is being used for detailed instructions on how to adapt the chamber to the controller.*)

Adapting a Chamber for a ProOx Model 110

This section will explain how to adapt the generic chamber for a ProOx model 110 controller.

There are three ways to adapt the generic chamber for a ProOx model 110 controller:

I. Install the sensor inside of the chamber and then route the cables through an access port.

II. Install the sensor onto the chamber by drilling a hole inside of the chamber in order to accommodate a BioSpherix, Ltd. port.

III. Mounting a BioSpherix, Ltd. adapter plate to the chamber.

I. Installing the Sensor Inside of the Chamber:

> **NOTE**
>
> If the sensor is placed inside of the chamber, it must be placed in such a way so that it can be pulled out of the chamber for calibration purposes. In order to calibrate the chamber the sensor must be outside of the chamber and in ambient air.

1. Drill an opening into the chamber, approximately 9/16" for so that both the sensor cable and the 1/8" ID infusion tube are able to fit through.
2. Route the sensor cable and the infusion tube through the opening.
3. Attach the muffler to the infusion tube inside the chamber
4. Attach the sensor to the sensor cable inside of the chamber by lining up the key on the terminal with the key on the connector of the sensor cable. Push in and twist the ring on.
5. From inside of the chamber, route the smaller end of the sensor cable to the outside of the chamber and connect it to the port labeled **SENSOR** on the back panel of the ProOx model 110. Push the sensor cable into the port until a "click" is heard, and then turn the ring clockwise until tight. **Do not overtighten**.

Using this method to install the sensor will create a small leak. This leak will enable gas inside of the chamber to vent out and outside air to vent in. More leaks may be required, depending on the size of the chamber.

II. Install the Sensor Onto the Chamber

Important: If using a bulkhead that is not supplied by BioSpherix, Ltd. then use the specific measurements associated with the size of the bulkhead in order to drill an opening to properly fit the bulkhead.

1. Drill a hole into the chamber, approximately 3/4” for the bulkhead to snugly fit into the opening.
2. Drill a separate hole into the chamber, approximately 5/16” for the 1/8” ID infusion tube, so that the gas can be infused into the chamber.
3. Place the bulkhead into the 3/4” hole and tighten it down with a nut.
4. Mount the sensor into the bulkhead. This will allow the sensor to be mounted outside of the chamber, but still monitor the inner atmosphere.
5. Slide the infusion tube through the 5/16” hole on the chamber. Once the infusion tube is routed into the chamber make sure there is not a complete seal. A small opening is required for the gas to leak slightly so as not to create positive pressure. The size of the hole will depend on how big the chamber is; the bigger the chamber, the bigger the opening; the smaller the chamber, the smaller the opening. The chamber may already be leaky enough without having to create an opening.
6. Attach the muffler to the infusion tube inside the chamber.

III. Mounting a BioSpherix, Ltd. Adapter Plate to the Chamber

For instructions on how to mount a BioSpherix, Ltd. adapter plate to the chamber, please refer to the “Mounting an Adapter Plate to the Chamber” section.

Adapting a Chamber for a ProCO2 Model 120

This section will explain how to adapt the generic chamber for a ProCO2 model 120 controller.

There are three ways to adapt the generic chamber for a ProCO2 model 120 controller:

I. Install the sensor inside of the chamber and then route the cables through an access port.

II. Install the sensor onto the chamber by drilling a hole inside of the chamber in order to accommodate a BioSpherix, Ltd. port.

III. Mounting a BioSpherix, Ltd. adapter plate to the chamber.

I. Installing the Sensor Inside of the Chamber:

NOTE

If the sensor is placed inside of the chamber, it must be placed in such a way so that it can be pulled out of the chamber for calibration purposes. In order to calibrate the chamber the sensor must be outside of the chamber and in ambient air.

1. Drill an opening into the chamber, approximately 5/8" so that both the sensor cable and the 1/8" ID infusion tube are able to fit through.
2. Route the sensor cable and the infusion tube through the opening.
3. Attach the muffler to the infusion tube inside the chamber.
4. Attach the sensor to the sensor cable inside of the chamber by lining up the key on the terminal with the key on the connector of the sensor cable. Push in and twist the ring on.
5. From inside of the chamber, route the smaller end of the sensor cable to the outside of the chamber and connect it to the port labeled **SENSOR** on the back panel of the ProCO2 model 120. Pull the ring back on the sensor cable and line up the key on the terminal with the key on the connector of the sensor cable. Push in and release the ring, securing the sensor cable in place.

Using this method to install the sensor will create a small leak. This leak will enable gas inside of the chamber to vent out and outside air to vent in. More leaks may be required, depending on the size of the chamber.

II. Install the Sensor Onto the Chamber

Important: If using a bulkhead that is not supplied by BioSpherix, Ltd. then use the specific measurements associated with the size of the bulkhead in order to drill an opening to properly fit the bulkhead.

1. Drill a hole into the chamber, approximately 1 ¼ ” for the bulkhead to snugly fit into the opening.
2. Drill a separate hole into the chamber, approximately 5/16” for the infusion tube, so that the gas can be infused into the chamber.
3. Place the bulkhead into the 1 ¼” hole and tighten it down with a nut.
4. Mount the sensor into the bulkhead. This will allow the sensor to be mounted outside of the chamber, but still monitor the inner atmosphere.
5. Slide the infusion tube through the 5/16” hole on the chamber. Once the infusion tube is routed into the chamber make sure there is not a complete seal. A small opening is required for the gas to leak slightly so as not to create positive pressure. The size of the hole will depend on how big the chamber is; the bigger the chamber, the bigger the opening; the smaller the chamber, the smaller the opening. The chamber may already be leaky enough without having to create an opening.
6. Attach the muffler to the infusion tube inside the chamber.

III. Mounting a BioSpherix, Ltd. Adapter Plate to the Chamber

For instructions on how to mount a BioSpherix, Ltd. adapter plate to the chamber, please refer to the “Mounting an Adapter Plate to the Chamber” section.

Adapting a Chamber for a ProOx Model 360

This section will explain how to adapt the generic chamber for a ProOx model 360 controller.

There are three ways to adapt the generic chamber for a ProOx model 360 controller:

I. Install the sensor inside of the chamber and then route the cables through an access port.

II. Install the sensor onto the chamber by drilling a hole inside of the chamber in order to accommodate a BioSpherix, Ltd. port.

III. Mounting a BioSpherix, Ltd. adapter plate to the chamber.

I. Installing the Sensor Inside of the Chamber:

NOTE

If the sensor is placed inside of the chamber, it must be placed in such a way so that it can be pulled out of the chamber for calibration purposes. In order to calibrate the chamber the sensor must be outside of the chamber and in ambient air.

1. Attach the provided gas fitting to the 1/4" ID infusion tubing.
2. Attach the the 1/8" ID tubing to the other end of the gas fitting, so that the infusion tube is now 1/8" ID.
3. Drill an opening into the chamber, approximately 9/16" for the sensor cable and infusion tubing so that both the sensor cable and the 1/8" ID infusion tube are able to fit through.
4. Route the sensor cable and the infusion tube through the opening.
5. Attach the muffler to the infusion tube inside the chamber.
6. Attach the sensor to the sensor cable inside the chamber by lining up the key on the terminal with the key on the connector of the sensor cable. Push in and twist the ring on.
7. From inside of the chamber, route the smaller end of the sensor cable to the outside of the chamber and connect it to the port labeled **SENSOR** on the back panel of the ProOx model 360. Push the sensor cable into the port until a "click" is heard, and then turn the ring clockwise until tight. **Do not overtighten**.

Using this method to install the sensor will create a small leak. This leak will enable gas inside of the chamber to vent out and outside air to vent in. More leaks may be required, depending on the size of the chamber.

II. Install the Sensor Onto the Chamber

Important: If using a bulkhead that is not supplied by BioSpherix, Ltd. then use the specific measurements associated with the size of the bulkhead in order to drill an opening to properly fit the bulkhead.

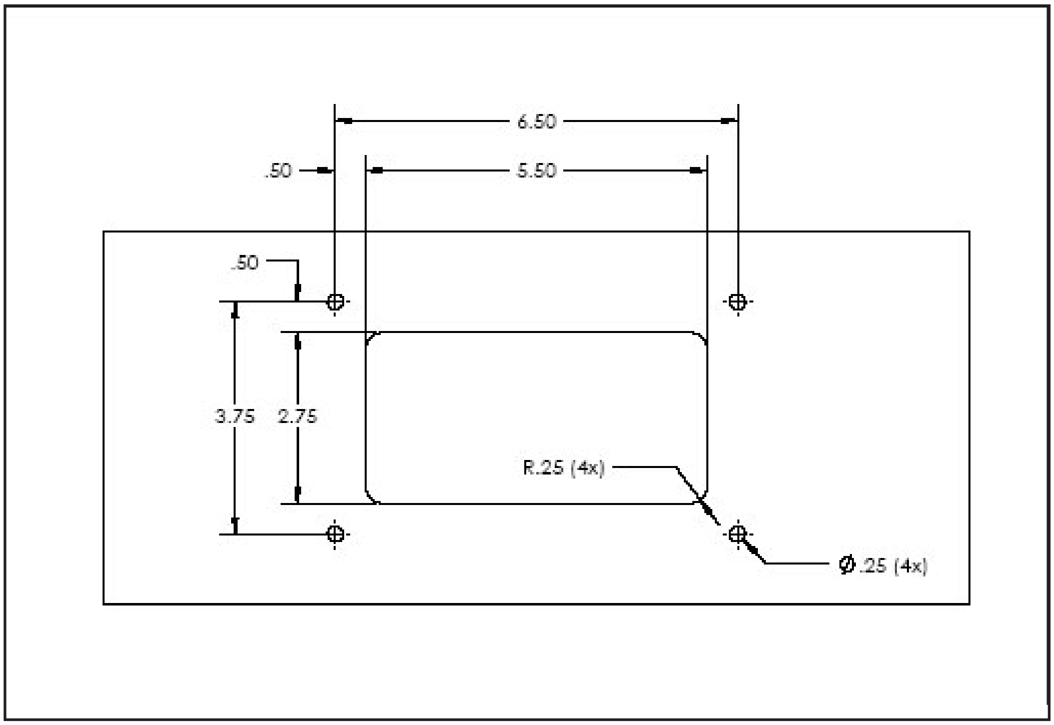
1. Attach the provided gas fitting to the 1/4" ID infusion tubing.
2. Attach the the 1/8" ID tubing to the other end of the gas fitting, so that the infusion tube is now 1/8" ID.
3. Drill a hole into the chamber, approximately 3/4" for the bulkhead to snugly fit into the opening.
4. Drill a separate hole into the chamber, approximately 5/16" for the 1/8" ID infusion tube, so that the gas can be infused into the chamber.
5. Place the bulkhead into the 3/4" hole and tighten it down with a nut.
6. Mount the sensor into the bulkhead. This will allow the sensor to be mounted outside of the chamber, but still monitor the inner atmosphere.
7. Slide the infusion tube through the 5/16" hole on the chamber. Once the infusion tube is routed into the chamber make sure there is not a complete seal. A small opening is required for the gas to leak slightly so as not to create positive pressure. The size of the hole will depend on how big the chamber is; the bigger the chamber, the bigger the opening; the smaller the chamber, the smaller the opening. The chamber may already be leaky enough without having to create an opening.
8. Attach the muffler to the infusion tube inside the chamber.

III. Mounting a BioSpherix, Ltd. Adapter Plate to the Chamber

For instructions on how to mount a BioSpherix, Ltd. adapter plate to the chamber, please refer to the "Mounting an Adapter Plate to the Chamber" section.

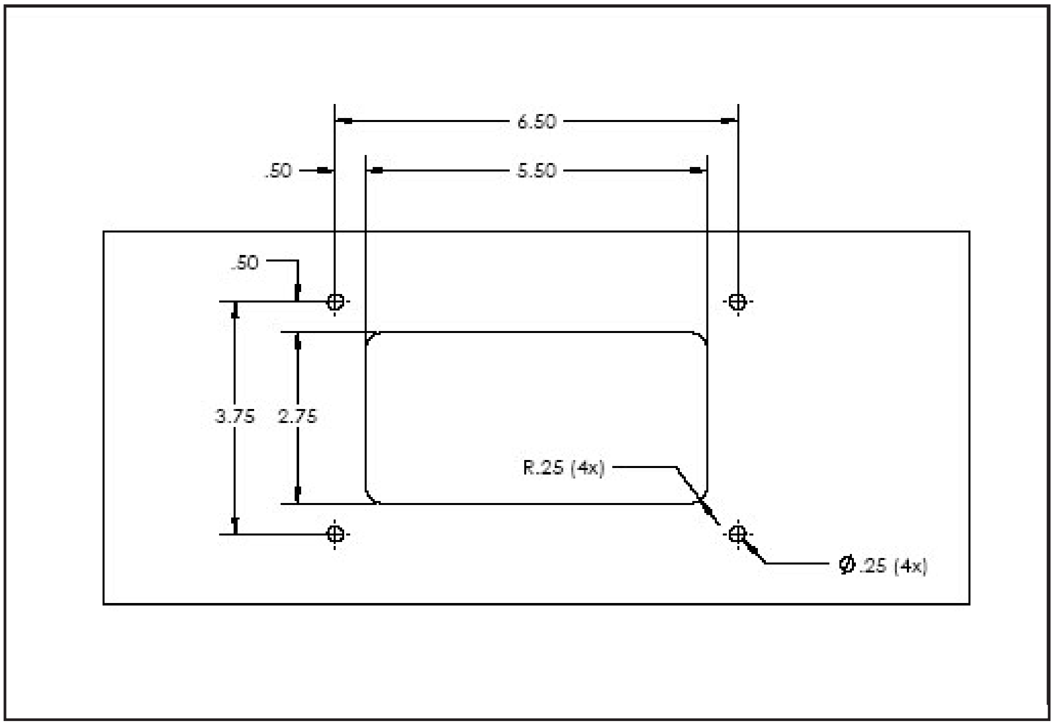
Mounting an Adapter Plate to the Chamber

Use the following illustration to determine the correct size of the holes and the cutout size needed in order to fit the BioSpherix, Ltd. adapter plate to the chamber. If the chamber is being adapted according to this illustration then the supplied muffler may not be needed.



Mounting a Pod to the Chamber for a ProOx Model C21

Use the following illustration to determine the correct size of the holes and the cutout size needed in order to fit the BioSpherix, Ltd. ProOx model C21 Monitor Pod to the chamber.



BIOSPHERIX, LTD.
ONE-YEAR WARRANTY

Except to the extent specifically stipulated, BioSpherix, Ltd. shall have no liability or obligation under warranty, express or implied, including the implied warranty of merchantability and any implied warranty of fitness for a particular purpose; statutory or otherwise except as stated.

BioSpherix, Ltd. (BioSpherix) warrants that all apparatus of its manufacture has been factory inspected and is free from defects in material and workmanship. And that when such apparatus receives normal use and service, BioSpherix will correct defects in material and workmanship that might occur within a twelve (12) month period from the date of delivery to customer. This warranty is limited to the repair, replacement or exchange of parts, subject to the exceptions listed below, which prove defective on examination by BioSpherix. Costs assumed by BioSpherix under this warranty cover only the cost of material and workmanship. This warranty does not cover consumables.

GENERAL CONDITIONS OF WARRANTY

This warranty shall be void if apparatus, in the judgment of BioSpherix, has been subject to misuse, negligence, chemical action, accident or operated contrary to those operating procedures recommended by BioSpherix, or if the serial number and/or trademarks have been altered, defaced or removed.

BioSpherix shall not be liable for any delay in performance under this warranty caused by any contingency beyond the control of BioSpherix, including War, government restriction or restraints, strikes, acts of God, or short or reduced supply of raw materials.

Costs borne by BioSpherix do not reflect the cost of labor involved; nor will BioSpherix assume the responsibility for payment of same except when expressly consented to in writing.

Determination of whether or not apparatus has been used properly or improperly (thereby voiding any warranty) is solely at the discretion of BioSpherix.

BioSpherix reserves the right to inspect any and all equipment or parts of said equipment claimed to be defective prior to authorizing warranty repairs.

All apparatus claimed to be defective and sent to BioSpherix for repairs must be returned freight prepaid.

BioSpherix disclaims all liability to its customers, dealers and all others concerned for special or consequential damages arising out of any circumstances or incident whatsoever, connected with the use, operation, manufacture, sale, handling, repair, maintenance, replacement or any other circumstance connected with the use of said apparatus.

BioSpherix, Ltd.
Parish, New York, USA