GPR-1600
PPM OXYGEN ANALYZER

OWNERS MANUAL

Revised October 2013

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1. Introduction

Your new GPR-1600 PPM oxygen analyzer is a precision piece of equipment designed to give you years of use in a variety of industrial oxygen applications.

This analyzer is designed to measure oxygen concentration in inert gases, gaseous hydrocarbons, hydrogen, and a variety of gas mixtures. In order to derive maximum performance from your new oxygen analyzer, please read and follow the guidelines provided in this Owner's Manual.

The serial number of this analyzer may be found on the inside the analyzer. You should note the serial number in the space provided and retain this Owner's Manual as a permanent record of your purchase, for future reference and for warranty considerations.

Serial Number: _____

Every effort has been made to select the most reliable state of the art materials and components designed for superior performance and minimal cost of ownership. This analyzer was tested thoroughly by the manufacturer for best performance. However, modern electronic devices do require service from time to time. The warranty included herein plus a staff of trained professional technicians to quickly service your analyzer is your assurance that we stand behind every analyzer sold.

Advanced Instruments Inc. appreciates your business and pledge to make effort to maintain the highest possible quality standards with respect to product design, manufacturing and service.

2. Quality Control Certificate

Quality Control & Calibration Certification

Customer:			**Date:**		
Order No.:					
Model No.:		GPR-1600 PPM Oxygen Analyzer	**S/N:**		
Configuration:		A-1146-10 PCB Assembly, Main/Display	**Batch:**		
	( )	A-1147 PCB Assy, Interconnect, 4-20mA, 0-1V, 1-5 V	**Batch:**		
	( )	A-1174 PCB Assy, Interconnect, ( ) 1-5 V + Contacts **OR** ( ) 4-20mA + Contacts			
		Ranges: 0-10 PPM, 0-100, 0-1000 PPM, 0-1%, 0-25% (CAL only)	**Software Ver:**		
		Enclosure: Panel mount 10.75"W x 7.5"H x 12"D SS sensor housing, flow control & bypass valves, 1/8" tube connections			
	( )	Temperature Controlled Sample System: ( ) 110 VAC **OR** ( ) 220 VAC			
	( )	"Oxygen Service" see P-1507 Rev 1, label analyzer, provide certificate			
	( )	Automated Sample/Span/Zero Inlet Valves			
	( )	A-2829 Bezel, 19" Rack			
Sensor:	( )	GPR-12-333 PPM Oxygen Sensor			
	( )	XLT-12-333 PPM Oxygen Sensor	**S/N:**		
Accessories:		Owner's Manual			
		A-3491 Power Cord, Filtered			
		HRWR-1021 Wrench, 5/16" Combination			

		Expected Value	**Observed Value**	**Pass**
Test & Verify:	Default zero	.00 ± .05 low range		
	Default span in air @ 600 µA	19.0% to 23.0%		
	Span calibration upper limit in air @ 940 uA	20.5% to 21.3%		
	Span calibration lower limit in air @ 550 uA	20.5% to 21.3%		
	Reading after air (20.9%) calibration	20.5% to 21.3%		
	Reading after 30 sec exposure to air and zero gas purge is < 10 PPM after	< 60 minutes	min	
	Reading on continued zero gas purge is < 1 PPM after	< 12 hours	hrs	
	Reading after exposure to _____ PPM Oxygen span gas	±2% of _____ PPM		
	Baseline drift (<10° F) on zero gas over 24 hour period (±2% FS)	± .2 PPM of reading		
	Noise level (+1% FS)	± .1 PPM of reading		
	Reading after 24 hours in static (no flow to sensor) condition	< 500 PPM		
	Analog signal output 4-20 mA full scale			
	Analog Range ID output 4-20 mA full scale or relay contacts (above)			

		Alarm 1	**Alarm 2**	
	SETPOINT - Set alarm thresholds			
	MODE - Verify activation mode HIGH / LOW relative to setpoint			
	ENABLED - Verify alarms do not activate and OFF replaces SETPOINT			
	DELAY - Verify setpoint must be exceeded before activation			
	SILENCE/BYPASS - Verify main menu option de-activates alarm			
	Overall inspection for physical defects			
Options:				
Other:				NA

3. Safety

This section summarizes the essential generic precautions applicable to all analyzers. Additional precautions specific to individual analyzers are contained in the following sections of this manual. To operate the analyzer safely and obtain maximum performance follow the basic guidelines outlined in this Owner's Manual.

Caution: This symbol is used throughout the Owner's Manual to CAUTION and alert the user to recommended safety and/or operating guidelines.

Danger: This symbol is used throughout the Owner's Manual to identify sources of immediate DANGER such as the presence of hazardous voltages.

Read Instructions: Before operating the analyzer read the instructions.
Retain Instructions: The safety precautions and operating instructions found in the Owner's Manual should be retained for future reference.
Heed Warnings: Follow all warnings on the analyzer, accessories (if any) and in this Owner's Manual.
Follow Instructions: Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the analyzer.
Inlet Pressure: Recommended 5-30 PSIG, 100 PSIG maximum.
Outlet Pressure: The sample gas vent pressure should be atmospheric.
Oxygen Sensor: DO NOT open the sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in the Owner's Manual appendix. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

Mounting: The analyzer is approved for indoor use only. It may be used outdoors with optional enclosures. Mount as recommended by the manufacturer.

Power: Supply power to the analyzer only as rated by the specification in Section 4 and/or markings on the analyzer enclosure. The wiring/cords that connect the analyzer to the power source should be installed in accordance with recognized electrical standards and so they are not pinched, particularly near the power source and the point where they attach to the analyzer. Never yank a power cord to remove it from an outlet or from the analyzer.

ENSURE THAT POWER LINE INCULDES "SURGE PROTECTER" AND RFI/EMI FILTER TO PREVENT INTERFERENCE FROM EXCESSIVE LINE VOLTAGE VARIATIONS

Operating Temperature: The maximum recommended operating temperature is 45 ºC. However, an operating temperature of less than 35 oC is ideal to obtain maximum life of the oxygen sensor**.**
Heat: Situate and store the analyzer away from a direct source of heat.

Handling: Do not use force when using the switches and knobs. Before moving your analyzer, be sure to disconnect the wiring/power cord and any cables connected to the output terminals of the analyzer.

Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service. Only trained personnel with authorization of their supervisor should conduct maintenance.

Troubleshooting: Consult the guidelines in Section 8 for advice on the common operating errors before concluding that your analyzer is faulty. Do not attempt to service the analyzer beyond those means described in this Owner's Manual. Do not attempt to make repairs by yourself as this will void the warranty as per Section 9 and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

Liquid and Object Entry: The analyzer should not be immersed in any liquid. Care should be taken so that liquids are not spilled into and objects do not fall into the inside of the analyzer.

Oxygen Sensor: DO NOT open the sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in the Owner's Manual appendix. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

Nonuse Periods: Isolate the oxygen sensor from exposure to high oxygen as described in this manual. Disconnect the power when the analyzer is left unused.

Cleaning: The analyzer should be cleaned only as recommended by the manufacturer. Wipe off dust and dirt from the outside of the unit with a soft damp cloth then dry immediately. Do not use solvents or chemicals.

Handling: Do not use force when using the switches and knobs. Before moving your analyzer, be sure to disconnect the wiring/power cord and any cables connected to the output terminals of the analyzer.
Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service. Only trained personnel with authorization of their supervisor should conduct maintenance.
Troubleshooting: Consult the guidelines in Section 8 for advice on the common operating errors before concluding that your analyzer is faulty. Do not attempt to service the analyzer beyond those means described in this Owner's Manual. Do not attempt to make repairs by yourself as this will void the warranty as per Section 9 and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

4. Specifications

Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-10, 0-100, 0-1000 PPM, 0-1%, 0-25% (CAL) FS Auto-ranging or manual lock on a single range
Application:	Oxygen analysis in inert, helium, hydrogen, mixed and acid (CO_2) gas streams
Approvals:	CE
Area Classification:	General purpose
Alarms:	Two adjustable form C relay contacts non-latching; "weak sensor" indicator; power failure; system failure
Calibration:	3 month interval using certified span gas (preferred for fastest online time) or air with O2 value approximating 80% of full scale range balance N2
Compensation:	Barometric pressure and temperature
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration, alarm and system functions
Data Acquisition:	Selectable data point intervals
Display:	Graphical LCD 5" x 2.75"; resolution .01 PPM; displays real time ambient temperature and pressure
Enclosure:	Painted aluminum 7.5" x 10.8" x 12.25" panel mount
Flow:	Not flow sensitive; recommended flow rate 2 SCFH
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig to deliver 2 SCFH flow; vent - atmospheric
Power:	Universal; specify 100 or 200 VAC for heater system
Range ID:	Voltage, 4-20 mA or relay contacts
Recovery Time:	60 sec in air to < 10 PPM in < 1 hour on N_2 purge
Response Time:	90% of final FS reading < 10 seconds
Sample System:	Stainless steel wetted parts consisting of flow control and sample/bypass valves, flow indicator
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-333 for non-acid (CO2) gas streams XLT-12-333 for gas mixture with > 0.5% CO_2
Sensor Life:	24 months in < 1000 PPM O2 at 25ºC and 1 atm
Signal Output:	4-20mA isolated or 0-1V
Temp. Range:	5ºC to 45ºC (GPR sensor), -20°C to 45°C (XLT)
Warranty:	12 months analyzer; 12 months sensor

Optional Equipment

19" rack, wall mounting, auto zero/cal, remote communication-contact factory

* Specification subject to change without notice.

GPR-1600
PPM Oxygen Analyzer

Advanced Full Featured Process PPM O2 Analyzer

Advanced Sensor Technology

- Unmatched Performance in PPM O2 Analysis
- Unmatched Expected Life & Warranty
- Unmatched Recovery to 10 PPM
- Sensitivity < 0.5% FS Range
- Excellent Compatibility with 0-100 CO2

Bypass Sample System

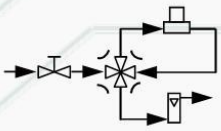
2 Field Selectable Alarm Setpoints

Auto Ranging or Single Fixed

Options: Temperature Control

Auto-Zero and Auto-Cal

Remote Communication



Integral stainless steel bypass sample system significantly increases user productivity. The bypass valve isolates the sensor from high oxygen levels when changing sample lines.

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

INTERTEK ISO 9001:2008

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 3/12

5. Operation

Principle of Operation

GPR-1600 Oxygen series analyzers incorporate a variety of PPM range advanced galvanic fuel cell type sensors. Standard analyzer is configured for panel mounting and requires a 7.5x10.8" (T configuration) cutout with 4 holes for the analyzer's front panel. Optional configurations include a panel mount (TO configuration) 7.75x7.75" with cutout; 19" bezel for rack mounting either T or TO; 12x12x8" wall mount enclosure (GPR-1600W); 18.2x16x10" panel mount configuration (GPR-1600W-306) using wall mount enclosure. Contact the factory for additional information on options. All configurations are tested and calibrated by the manufacturer prior to shipment.

GPR-1600 series analyzers and sensors conform to CE standards and are manufactured under a Quality Assurance System, certified by an independent agency, in accordance with ISO 9001:2015 standards.

Advance Galvanic Sensor Technology

All galvanic sensors function on the same principle and are specific to oxygen. They measure the partial pressure of oxygen ranging from low PPM to 100% levels in inert gases, gaseous hydrocarbons, helium, hydrogen, mixed gases and acid gas streams. **Oxygen, the fuel for this electrochemical transducer, diffuses into the sensor and reacts chemically at the sensing electrode to produce an electrical current output proportional to the oxygen concentration in the gas phase.** The sensor's signal output is linear over all measuring ranges and remains virtually constant over its useful life. The sensor requires no maintenance and is easily and safely replaced at the end of its useful life.

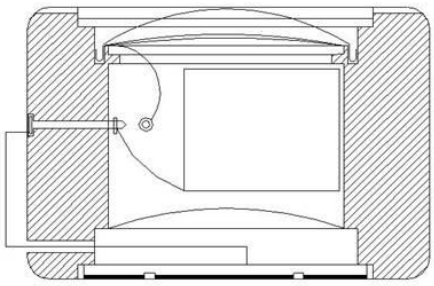
Proprietary advancements in the design and chemistry add significant advantages to an extremely versatile oxygen sensing technology. Sensors for low PPM analysis recover from air to PPM levels in minutes, exhibit longer life, offer extended operating range of -20°C to 50°C, have excellent compatibility with CO_2 and acid gases (XLT series sensors) and reliable quality thus giving the user a significant advantage over other competitors. Other advancements include extending the expected life of our new generation of percentage range sensors to five to ten years with faster response times and greater stability. Another significant development involves the first galvanic oxygen sensor capable of measuring oxygen purity continuously and expanded operating temperature range from -40°C to 50°C. Consult factory for selection of sensors for your specific applications.

Design Objectives

- Improve quality and reliability through a proprietary controlled manufacturing process . . .
- Comply with domestic and international quality standards
- Compact disposable dimensions
- No sensor maintenance
- Improve performance over replacement sensors - sensitivity, stability, response, recovery
- Longer operating and shelf life - translate into longer warranty period
- Low cost of ownership

ppm Oxygen Sensors

- Shorten manufacturing cycle from 4-6 weeks to 3-4 days
- Recovery to 10 ppm from oxygen shock or air . . .
  in less than 1 hour on nitrogen purge
- Higher signal output to achieve . . .
  50 ppb sensitivity
  Enhanced stability, less temperature dependent
- Superior compatibility with 0.5 to 100% CO_2 gas streams
  ppm O_2 contamination in natural gas
  ppm O_2 contamination in beverage grade pure CO_2
- Operating life of 24 months in ppm O_2 concentrations
- Extended operating range –20ºF to 50º F
- Develop special sensor for high ppm/low % applications



GPR/XLT 12 Series ppm Oxygen Sensor

Analyzer Electronics

The signal generated by the sensor is processed by state of the art low powered micro-processor based digital circuitry. The first stage amplifies and converts the electrical current into voltage signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for the sensor's signal output variations caused by ambient temperature variations. The result is a very stable sensor signal.

Sensor's response time of 90% of a "step change" is less than 10-30 seconds (actual experience may vary due to the integrity of sample line connections, dead volume and flow rate selected) on all ranges under ambient monitoring conditions. Sensitivity is typically 0.5% of full scale of the lowest range of analysis.

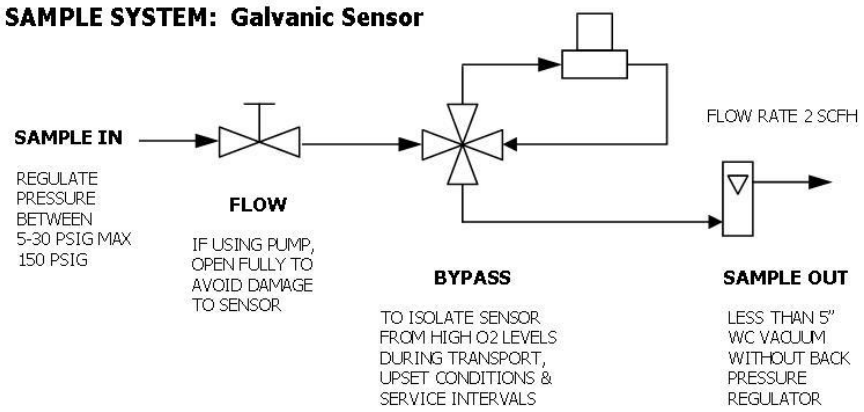
Additional features of micro-processor based electronics include manual or auto ranging, auto-zero and auto-cal, isolated 4-20mA signal for signal output, optional 4-20 mA as range ID, separate relay contacts rated 30 VDC max @ 1A or 110/220 VAC @ 5A are provided for the alarm feature. Optional range ID contacts are rated at 30 VDC @1A.

Whenever analyzer is span calibrated, a unique algorithm predicts and displays a message indicating a 'weak sensor' (if sensor output has fallen below a certain level), suggesting sensor be replaced in the near future.

Sample System

For accurate measurements, sample gas must be properly presented to the sensor. In standard form, GPR-1600 is equipped with a sample system that complements performance capabilities of the advanced oxygen sensor.

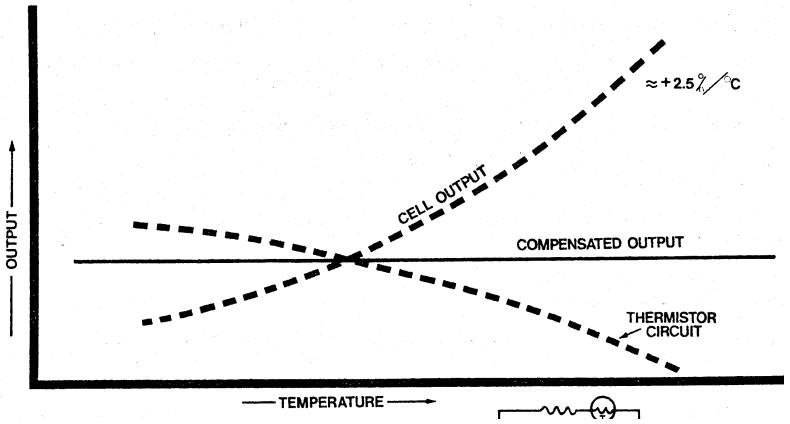
Integral sample system of analyzer is shown schematically below (please check the QC sheet in this manual to ensure analyzer is equipped with the sample system ordered).



Analytical Industries, Inc. offers a full line of sample handling, conditioning and expertise to meet your application requirements. Contact us at 909-392-6900 or e-mail us at info@aii1.com for your specific requirements.

6. Accuracy Overview

Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas. In the absence of oxygen the sensor exhibits an absolute zero, e.g. the sensor does not generate a current output in the absence of oxygen. Given the linearity and absolute zero properties, single point calibration is possible.



Pressure: Because sensors are sensitive to the partial pressure of oxygen in the sample gas, their output is a function of the number of molecules of oxygen 'per unit volume'. For best accuracy, the pressure of the sample gas and that of the calibration gas must be the same (in reality within 2-5 psi) so that when the SAMPLE/SPAN gases are switched, the gas flow rate would not drastically change.

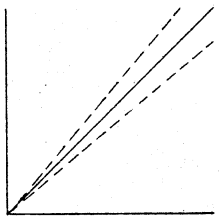
Temperature: The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier. The fact that all diffusion processes are temperature sensitive, the sensor's electrical output also varies with temperature. This variation is relatively constant (2.5% per ºC change in temperature). A temperature compensation circuit employing a thermistor offsets this effect with an accuracy of $\pm$5% or better (over the operating temperature range of the analyzer) and generates an output signal that is virtually independent of small ambient temperature variation. To minimize error in oxygen measurement, the calibration of the analyzer should be carried out as close as possible to the temperature during sampling. A small temperature variation of ~10º F will produce < 2% error.

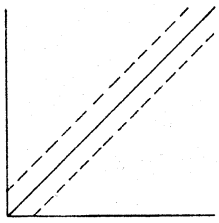
Accuracy: In light of the above parameters, the overall accuracy of an analyzer is affected by two factors:

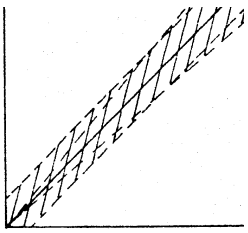
1) 'Percent of reading errors', illustrated by Graph A below, such as $\pm$5% inherited error in the temperature compensation circuit due to the tolerances of the resistors and thermistor.

2) 'Percent of full scale errors', illustrated by Graph B, such as $\pm$1-2% linearity errors generally associated with tolerances in the electronic components, which are really minimal due to today's technology and the fact that other errors are 'spanned out' during calibration.

Graph C illustrates these 'worse case' specifications that are typically used to develop an analyzer's overall accuracy statement of < 1% of full scale at constant temperature or < 5% over the operating temperature range. QC testing is typically < 1% prior to shipment.


A. PERCENT OF READING ERRORS


B. PERCENT OF FULL SCALE ERRORS

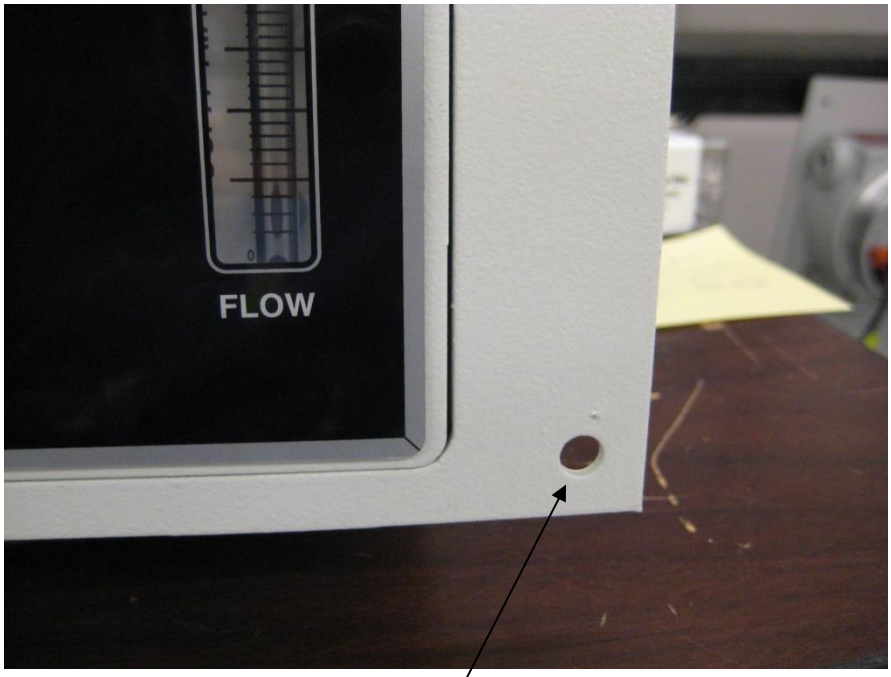

C. OVERALL ACCURACY

Example 1: As illustrated by Graph A any error during a span adjustment, e.g., at 20.9% (air) of full scale range would be multiplied by a factor of 4.78 (100/20.9) when used for measurements of 95-100% oxygen concentrations. Conversely, an error during span adjustment at 100% of full scale range will be reduced proportionately for measurements of lower oxygen concentrations. Refer to the Calibration section for additional details.

Mounting the Analyzer

Standard GPR-1600 is designed to be panel mounted and requires a cutout that accommodates the enclosure and 4 mounting bolts. The design also lends itself to 19" rack mounting with an optional bezel or wall mount enclosures as illustrated below.

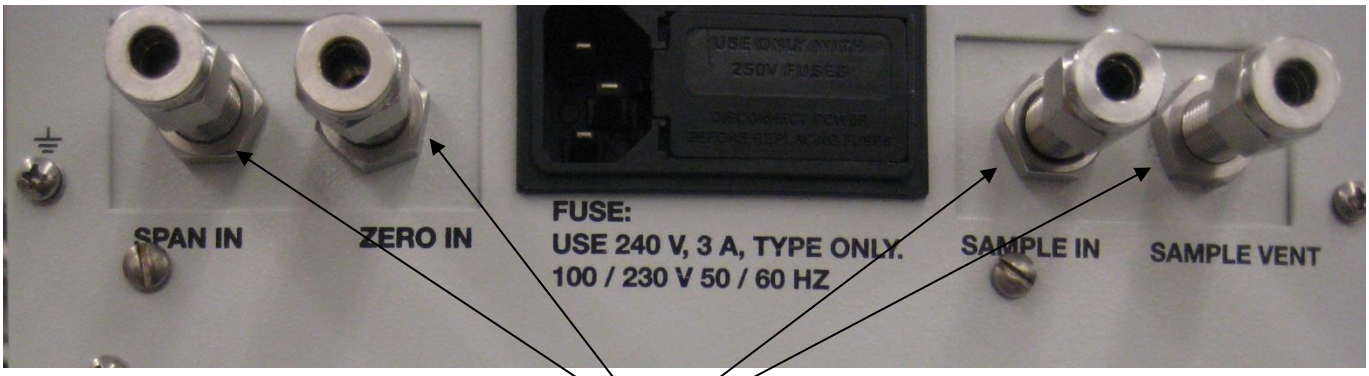
1. Standard GPR-1600 is designed for panel mounting directly to any flat vertical surface, wall or bulkhead plate with appropriate cut out and four ¼" diameter holes for insertion of the mounting studs through the front mounting bezel.
2. When mounting the analyzer, position it approximately 5 feet above the floor for better viewing purposes and easy access to various functions of the analyzer. Leave sufficient room for access to the terminal connections at the rear of the enclosure.
3. **Note:** Proximity of analyzer to the sample point and use of optional sample conditioning components, such as a sample cooling coil, a coalescing filter and or a particulate filter may have an impact on sample lag time and hence the analyzer response time.



Four mounting holes on four corners to secure analyzer on a flat vertical surface

Gas Connections

GPR-1600 with its standard flow through configuration is designed for positive sample pressure and requires ¼" compression type connections for incoming sample, span and zero gas and outgoing vent lines.



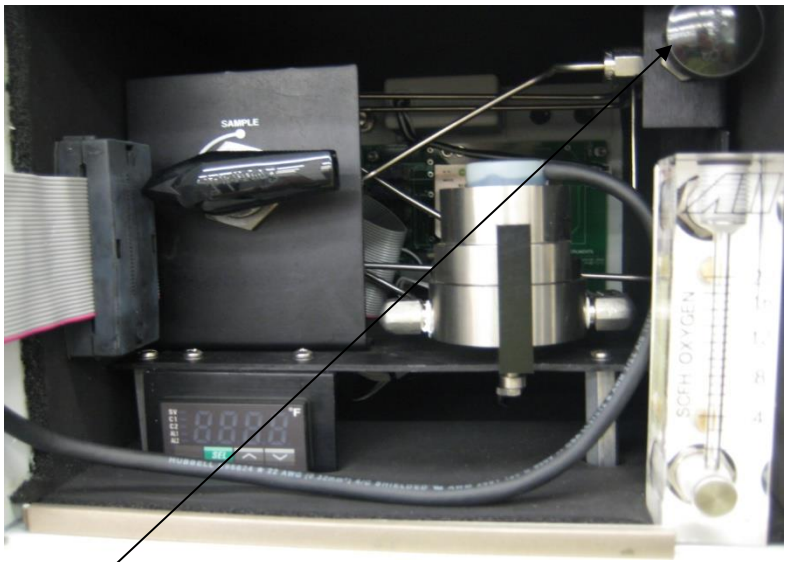
Rear of analyzer showing the SAMPLE, SPAN, ZERO AND VENT ports **(Span and Zero ports are optional)**

The user is responsible for providing calibration gases and other optional components (if not purchased with the analyzer).

Caution: The sample, span and zero gas pressure must be set between 5-30 PSIG and must be within 5 PSIG of each gas. Failure to do so will cause a sudden spike in the gas flow when switching from sample to span/zero gas and back which may cause an upward/downward spike on the analyzer signal output.

Flow Control Valve: A flow control valve is mounted upstream of the sensor and provides means of controlling the flow rate of the sample, span and zero gases. Sample flow rate of 1-5 SCFH cause no appreciable change in the oxygen reading. However, for optimum performance, a flow rate of 1-2 SCFH is recommended.

Caution: Do not place your finger over the fitting designated as the vent (it pressurizes the sensor) to test the gas flow. Blocking of the gas vent will pressurize the sensor and by suddenly removing finger, a slight vacuum will be pulled on the sensor which may damage the sensor.



Flow Control Valve

4-Way Sample/Bypass Valve

The analyzer is equipped with a 4-way Sample/Bypass valve; the Bypass valves allows the purging of gas lines before the gas flows to the sensor. During non-used period, the Bypass valve isolates the sensor and prevents air diffusion into the sample line. All gas connections are ¼" compression fittings type connections.

Electrical Connections

The analyzer operates with a universal 100-240 VAC input. Supply power to analyzer as rated and marked on the analyzer panel. Incoming power is supplied through a universal power entry module. A standard computer type power cord is required t0 supply power.

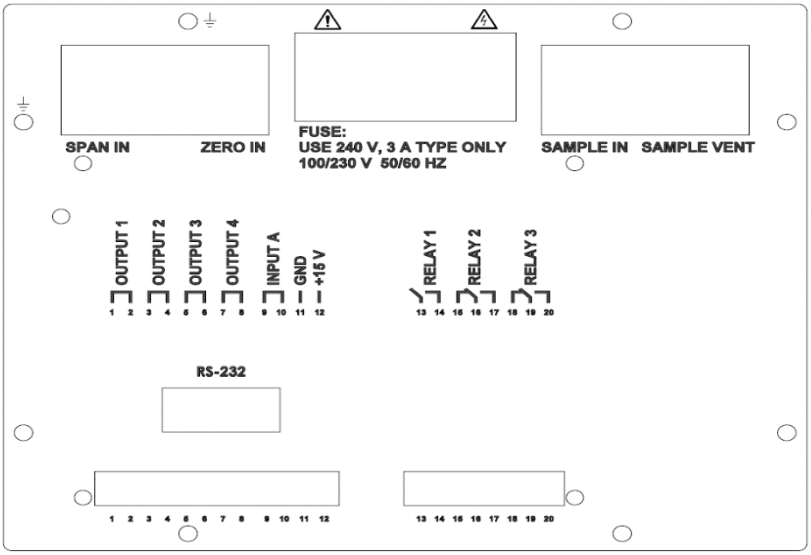
To make electrical connections with terminal block marked,

- Strip the ends of wires to no more than 3/16 inch.
- Use a small bladed screwdriver to loosen the appropriate terminal levers as illustrated above and insert the stripped end of the wire in the slot and release the lever. The wire will firmly be held by the lever of the terminal block
- Repeat above step for making all required connections. NOTE: In the standard analyzer configuration, the sensor is internally connected to the PCB, therefore, no external SEN+ and SEN- connection are required
- Provide power by inserting the power cable provide in to the Power Entry Module.
- To connect to an active relay or "fail safe", connect the live cable to the common terminal C and the secondary cable to the normally open NO terminal.
- To break the connection upon relay activation, connect the secondary cable to the normally closed NC terminal.

Danger: While connecting the cables to the relay terminals, ensure there is no voltage on the cables to prevent electric shock and possible damage to the analyzer.

Caution: Assure the stripped wire ends of the cable are fully inserted into the terminal slots and do not touch each other or the back panel of the analyzer enclosure.

Caution: Integral 4-20mA converters are internally powered and do not require external power. DO NOT supply any voltage to any of the terminals of the 4-20 mA signal output or the 4-20 mA range ID. If a power is supplied, the 4-20 mA chip can be permanently damaged.



Oxygen Threshold Alarms

Analyzer is provided with two user configurable oxygen alarms. The alarms Alarm 1 (Relay 2) and Alarm 2 (Relay 3) represent two oxygen threshold type alarms that can be configured in the field as either HI-HI or HI-LOW alarms from the analyzer's menu driven LCD display as follows:

- Establish independent set points for oxygen concentration
- Select each alarm either Hi or LOW
- Select either On or Off (enabled or disabled); this feature is useful during maintenance or an upset condition when Alarms may trigger un-necessary alarm.
- Both alarms can be temporarily defeated using a user entered 'timeout' period (normally minutes)

The alarm set point represents an oxygen value. When oxygen reading exceeds (high alarm) or falls below (low alarm) the alarm set point, the relay is activated and the LCD displays the alarm condition. When activated the alarms trigger SPDT Form C non-latching resistive relays rated @ 5A, 30VDC or 240VAC.

To prevent chattering of the relays, a 2% hysteresis is added to the alarm set point. This means that the alarm will remain active until the oxygen reading has fallen 2% below the alarm set point (high alarm) or risen 2% above the alarm set point (low alarm) after the alarm was activated.

Alarm Bypass and Alarm Timeout

Aside from being totally defeated in the Alarm Bypass mode, the Alarm Timeout feature is useful while replacing the oxygen sensor or during calibration when the oxygen reading might well rise above the alarm set point and trigger a false alarm.

Note: When making connections the user must decide whether to configure/connect Alarm as "Failsafe Mode" (Normally Open – NO – where the alarm relay de-energizes and closes in an alarm condition) or "Non-Failsafe Mode" (Normally Closed – NC – where alarm relay energizes and opens in an alarm condition).

Note: Selection of the optional Range ID contacts configuration utilizes the alarms relays contacts thereby eliminating the alarms feature.

Power Failure Alarm (Relay 1)

A dry contact rated at 30VDC @ 1A is provided as a power failure alarm that activates when power is supplied to the analyzer. The contact is normally closed but opens when the power to the analyzer is switched off or interrupted and cannot be disabled.

Range ID (Output 1)

1-5 VDC is provided as range ID. The voltage output changes 1 V with each range, for example, 4V, 3V, 2V and 1 V; 1V representing the most sensitive analysis range.

4-20 mA is also provided as range ID, with each range change, the range ID will change 4 mA.

4-20mA Signal Output (Output 2)

The analyzer provides a 4-20mA full scale fully isolated ground.

The 4-20mA current output is obtained by connecting the current measuring device between the positive and negative terminals labeled OUTPUT 4-20mA.

Caution: Integral 4-20mA converters are internally powered and do not require external power. DO NOT supply any voltage to any of the terminals for 4-20mA signal output and range ID.

0-5 (Output 3) and 0-1 (Output 4) VDC Output

In addition to 4-20 mA full scale signal, 0-1 V and 0-5 VDC full scale signal output is also provided.

Low Flow Alarm Option

An optional low flow alarm is available. The contact of the low flow alarm closes when gas flow falls below a preset value, for example, below 1 SCFH. The alarm contact is rated at 30VDC @ 1A. Consult factory for this option.

RS-232 or RS-484 Communication Port

Optional RS-232 or RS-485 communication ports are available

Temperature Controlled Heater System

Standard GPR-1600 Series analyzer is generally not equipped with a heater system. However, in anticipation of very low PPM (less than 0.2 PPM) oxygen analysis, the user may elect to add heater system. If analyzer is equipped with an optional temperature controlled heater system, open front door of analyzer to access heater control. This unit is a PID controller which operates between 0-99°F. At factory, controller is programmed to maintain temperature of interior of analyzer at 85°F.

Caution: Do not change this setting. A higher temperature setting may drastically reduce sensor life and possibly cause damage to the electronic circuitry of both controller and analyzer.

Warning: Keep front door securely fastened and closed when temperature controller is ON.

When power is applied to temperature controller, the controller tunes itself to eliminate and/or minimize the over/under shoot of temperature from the set point. It is recommended that at initial start-up, when replacing the oxygen sensor or when trouble shooting, turn off power to the heater (by setting temperature set point at 60°F to prevent overheating of analyzer). When operating analyzer under normal conditions, set temperature controller at 85°F.

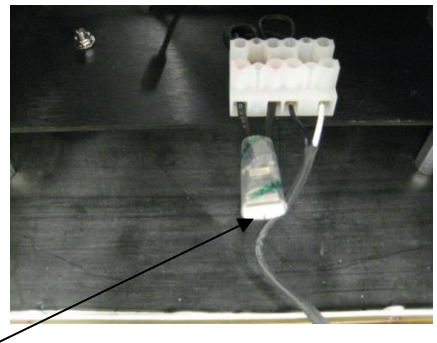
Changing the display value from °F to °C:

1. Push the UP ARROW and ENTER buttons down for 5 seconds to access the SECURE MENU
2. Press INDEX to advance to the F-C MENU
3. Select °C or °F by pressing the UP ARROW key
4. Press the ENTER key when F-C starts flashing on the display
5. Press INDEX to exit the SECURE MENU

Heater Runaway Protection

Part of the optional temperature controlled heater system is a heater runaway protection circuit that protects the electronics in the event temperature controller should fail and thereby allowing heater to runaway thus damaging the components inside of analyzer.

Heater runaway protection is provided by a J2 type device positioned between temperature controller and heater. This device cuts-off power to heater if temperature inside analyzer exceeds 70°C. Should the J2 device cut power to the heater, correct problem and reset the runaway protector device (J2 will conduct under normal conditions) by exposing it to 0°C for a few minutes (a refrigerator freezer will do). NOTE, should the J2 fail to reset itself, replace it.



To access J2, remove the back cover of analyzer. J2 is mounted on a white terminal block as shown in the figure above.

Establishing Power to the Electronics

Power to the analyzers is supplied by an integral universal 100-240VAC power supply. The appropriate AC line voltage is supplied by using a standard power cord connected to the universal power entry module. **Ensure that EMI/RFI filter on the power cord remains intact and close to the power entry module.**

ENSURE THAT POWER LINE INCULDES "SURGE PROTECTER" AND RFI/EMI FILTER TO PREVENT INTERFERENCE FROM EXCESSIVE LINE VOLTAGE VARIATIONS

Check power rating of the analyzer printed at the back of the analyzer and make sure that a proper AC voltage supply is available. Incorrect AC power may cause safety hazard and damage to the analyzer.

Once the power cord is inserted into to the power entry module at the rear of the enclosure, as illustrated above, connect the plug end of the power cord to an appropriate AC outlet. When power is supplied to the analyzer, the analyzer performs self-diagnostic checks and the 5" x 2.75" graphical back-lit LCD displays the following message

he main screen contains information pertinent to the analyzer. This information consist of

- Temperature and pressure at the upper left corner.
- The current MODE of the analyzer is indicated at the middle center of the LCD. A user customizable name appears across the top center line of the LCD.
- Date and time at the upper right corner.
- Left hand side of the LCD shows if Alarm 1 & 2 are currently active (Example shows Alarm 1 active and Alarm 2 inactive) and the speaker symbol is if the audible alarm is active or not.
- At the center of the LCD displays the current reading of the sensor and below that displays the range the analyzer.
- Right hand side of the LCD displays:
    - SC: Signal Conditioning option selected.
    - Out Hold: Holds output until user has finished servicing analyzer.
    - Def Rnge: Default Range enabled.
- Bottom right hand side of LCD displays if the analyzer is locked with a passcode.

What if Power to the Analyzer is interrupted?

In the event power to the analyzer is interrupted, all pneumatic valves will close. When power is restored, the analyzer will return to operation in the STANDBY mode. The analyzer requires user intervention to bring analyzer back to the same conditions that existed prior to power interruption.

Menu Navigation

Sample Screen:

- Press **Menu/Esc** to show Main Menu (if the menu is locked, a passcode prompt will appear)
- Press **Enter** to show graph screen
- Press **Up** to bypass an active alarm or accept a span or zero calibration in progress
- Press **Down** to abort a span or zero calibration in progress
- Hold **Menu/Esc** and **Enter** for ½ second to restart analyzer
- Hold **Menu/Esc** for ½ second to clear non-critical error messages

Main Menu:

- Press **Up/Down** to move selection pointer
- Press **Enter** to select a menu item
- Press **Menu/Esc** to return to previous menu

Graph Screen:

- Press **Enter** to cycle graph (O2, Temperature, Pressure)
- Press **Menu/Esc** to return to sample screen or Data Logging menu
- Press **Up/Down** to go to Next/Previous graph page (page number is displayed in upper-right corner, page 1 is most recent data)
- Hold **Up/Down** for ½ second to zoom graph to next higher/lower range

Numeric/Alpha-numeric entry:

- Press or hold **Up/Down** to increase/decrease digit value
- Press **Enter** to edit next digit to the right or accept entry (right-most digit)
- Press **Menu/Esc** to edit the next digit to the left or abort entry (left-most digit)

There are several sub-menus within each main menu. The details of selecting certain features within a menu or sub-menu are given below

Normal Operation of Analyzer

After sensor installation, analyzer is ready to sample the gas. However, it is recommended that analyzer be calibrated before use.

As pointed earlier, sensor has an absolute zero. Therefore, a signal point calibration (calibration with a certified span gas) is sufficient to analyze samples. If analyzer is to be used below 0.5 PPM, option for zero calibration is provided. User is responsible for providing certified span gas and zero gas.

Auto Ranging Mode

In AUTO RANGING mode, output signal will shift to higher range when oxygen reading exceeds 99.9% of the current range. Output will shift to the next lower range when oxygen reading drops to 85% of the next lower range.

For example, if analyzer is reading 0.10 PPM on 0-10 PPM range and an upset occurs, output will shift to 0-100 PPM range when oxygen reading exceeds 9.99 PPM. Conversely, once the upset condition is corrected, output will shift back to 0-10 PPM range when oxygen reading drops to 8.5 PPM.

Note: In AUTO RANGING Mode, analog signal output (voltage and mA) will always correspond to the percent of full scale range displayed. For example, at 50.0 PPB on 0-100 PPB range, analog signal will be 0.5 V and 12 mA. Similarly, at 0.50 PPM on 0-1 PPM range, analog signal will be 0.5 V and 12 mA.

Manual Ranging Mode

In MANUAL RANGING, output will not shift automatically. Instead, when oxygen reading exceeds 125% of the upper limit of the current range, output will freeze at 125% value of the selected range but analyzer display will shift to the next higher range and show actual oxygen concentration.

To select MANUAL RANGING, select SAMPLE and press ENTER, then select MANUAL RANGING and then advance cursor to the appropriate range and press ENTER again.

Note: In MANUAL RANGING, signal output will max out at about 125% of the selected range (even though oxygen reading on the LCD will shift to the next higher range).
In MANUAL RANGING, following information will appear on the LCD display.

Installing a new Oxygen Sensor

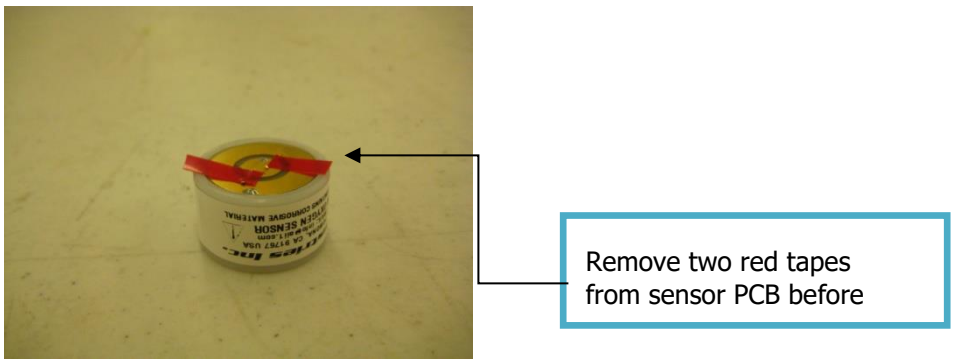
Analyzer is equipped with an internal oxygen sensor that has been tested and calibrated by the manufacturer prior to shipment and is fully operational from the shipping containers. The sensor has been installed at factory. However, it may be necessary to install a new sensor in the field. **Caution:** Complete "ESTABLISHING POWER TO ANALYZER" section before proceeding to install sensor.

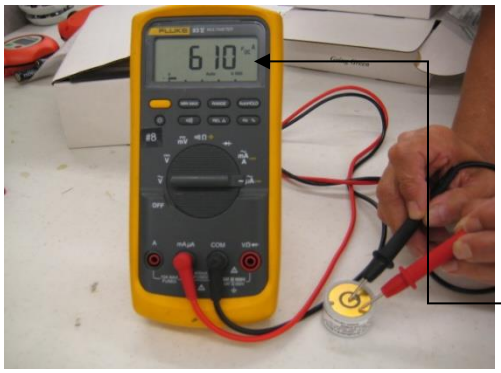
Caution: DO NOT open/dissect sensor - sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to Material Safety Data Sheet contained in Owner's Manual appendix. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in manner similar to that of a common battery in accordance with local regulations.

To install a new sensor, follow steps below

CAUTION: Do not remove sensor from its original package until the analyzer is ready to accept sensor installation.

1. Make sure that a low PPM gas is flowing through the analyzer.
2. Set sample flow rate between 1-2 SCFH
3. Loosen the nut at the bottom of sensor housing with 5/16" ranch provided.
4. Twist upper section of the sensor housing 90 degree and then pull it away.
5. Remove old sensor (if previously installed).
6. Remove new sensor from the package (use a pair of scissors to cut the bag, do not use hands to tear the bag)
7. Remove two red ribbons from the two ring gold contact plate at the back of sensor.



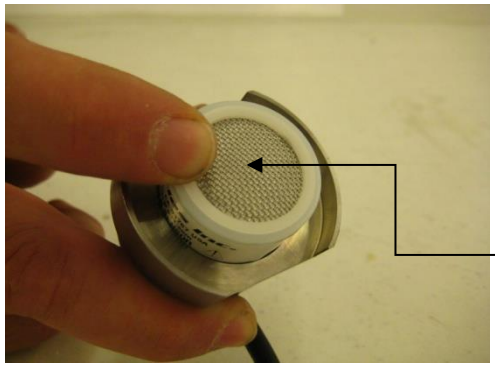


You may check Sensor output in air, it must be within ~500 - 950 uA

Quick Air Calibration when installing a new sensor

It is not necessary but a quick air calibration could be useful to ensure that sensor has acceptable signal output.. To perform air calibration, see instructions in the Calibration Section.

1. Insert sensor into the upper section of the sensor housing with contact plate facing toward the two gold pins of the sensor housing. Hold sensor and the sensor housing in your hand while keeping sensor pushed against the two gold pins.



Hold sensor pressed against the contact pins inside the

2. Advance cursor on the MAIN MENU to SAMPLE and press ENTER to accept selection. Check oxygen reading; it should reach close to 20.9% (+7% -4%) indicating that the sensor has proper signal output. At this time perform a quick air calibration (**detailed instruction for span calibration follows**).
3. After air calibration, insert sensor into the bottom section of the sensor housing with metal screen of sensor facing down. Place upper section of the sensor housing, push it gently downward and twist it 90 degree until it fits on the lower section of the sensor housing. Tighten the nut (3/4 turn after figure tight) holding two sections of sensor housing.

Zero Calibration

Theoretically, with zero gas, analyzer should display 0.00 PPM. However, even with pure gas (no oxygen), analyzer will display a signal anywhere from 0.1-0.9 PPM. This oxygen value is called as the "Zero Offset" This offset is contributed by

1. Minor leakage in the sample line connections.
2. Residual oxygen dissolved in sensor's electrolyte
3. Tolerances in electronics components

In order to achieve accurate results in the low PPM levels, analyzer must be "Zero calibrated" before accurate measurements could be made.

Zero Calibration Procedure

GPR-1600 analyzer has no integral oxygen scrubber to produce zero gas from sample gas. An external source of zero gas is required to perform zero calibration. To perform Zero calibration, follow the steps below.

In order to perform a ZERO calibration,

- From the MAIN MENU screen, select Calibration.
- From CALIBRATION menu, select Zero Calibrate.
- On the bottom left of the LCD Zero Cal will appear with Up = Accept, Down = Abort. A timer of 30 minutes will appear underneath the valve mode selected. After the 30-minute timer is up then the analyzer will attempt to perform the zero calibration. The user may Accept or Abort the calibration at any time. Ensure reading is stable before prematurely Accepting the zero calibration.

After ZERO calibration, analyzer will automatically return to the previous valve mode selected.
CAUTION: If zero calibration is performed pre-maturely (analyzer still trending down), analyzer may show a negative reading in the SAMPLE mode.

Span Calibration

Oxygen sensors produce a certain amount of current per unit of oxygen concentration. However, due to the tolerances involved in various components of the sensor, sensor's current signal may vary from one sensor to another. This variation, however, is within approximately +/- 30-50% of the nominal sensor signal. In order to achieve accurate results, sensor must be calibrated by using a certified span gas.

Span Calibration Procedure

Analyzer may be calibrated by using a certified span gas with oxygen content 5-8 PPM balance nitrogen.

To enter a span gas value:

- Go to the Calibration Menu.
- Select Span Gas: 08.00 PPM
- Using the Up/Down and Enter keys select the span gas value listed on the gas tank.
- Once the span gas value has been selected, select Span Background Gas: Nitrogen.
- Select span background gas and press Enter.

To initiate a span calibration

- Select Span Calibrate on the Calibration Menu.
- The valves will actuate to Span Bypass for 30 seconds to ensure the line is purged down before continuing to Span Calibration.
- On the bottom left of the LCD Span Cal will appear with Up = Accept, Down = Abort. A timer of 30 minutes will appear underneath the valve mode selected. After the 30-minute timer is up then the analyzer will attempt to perform the span calibration. The user may Accept or Abort the calibration at any time. Ensure reading is stable before prematurely Accepting the span calibration.

Sampling the Gas

After successful SPAN and ZERO calibration, place the analyzer in SAMPLE mode. You may select MANUAL RANGING or AUTO RANGING option.
Analyzer will continue to analyze the sample gas unless otherwise instructed by the user.

Analyzer Transportation

For moveable cart applications - Before transporting the analyzer from one place to another, make sure the second installation site is ready to install the analyzer. Follow the steps below

1. Place analyzer in Bypass mode.
2. Disconnect analyzer power
3. Disconnect sample, span gas lines and instrument air from analyzer.
4. Transport analyzer to new site as soon as possible
5. Establish sample connections at the new installation site. **CAUTION:** Purge sample and span gas lines before connecting to analyzer ports, failure to do so will increase the trending down time.
6. Establish power to analyzer
7. Select BYPASS mode, set sample flow between 1-2 SCFH and purge for 5 minutes
8. Select Sample mode and let sample purge for 5 minutes
9. The analyzer will begin trending down
10. It is not necessary to re-calibrate the analyzer

Optional Internal Sampling Pump

When operating the sample pump **ENSURE** the flow valve is completely open. This prevents drawing a vacuum across the sensor. Extended vacuum draw across the sensor with damage the sensor.

The optional internal sampling pump can operated with two actions:

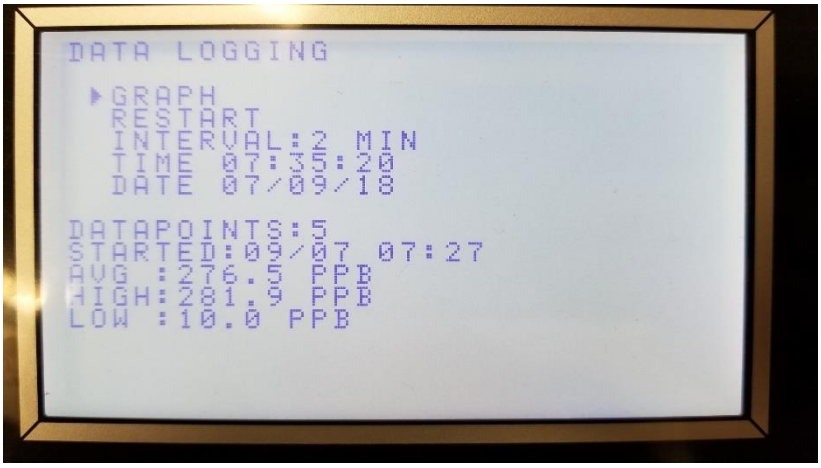
1. Press and Hold for 3 seconds the enter button on the overlay while on the sampling screen.

   Or

2. Selecting the PUMP option on the main menu.

Data Logging

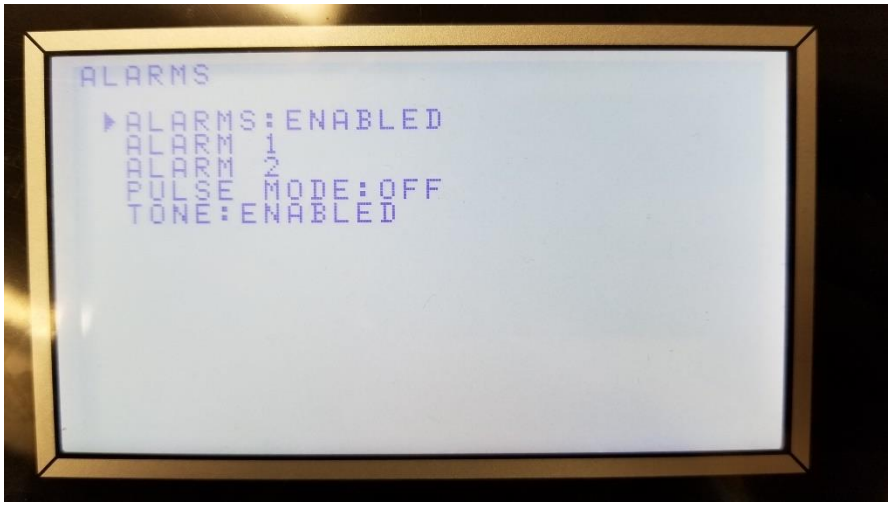
In the Data Logging Menu the user can select the following options.



- **Graph Screen:**
  - Press **Enter** to cycle graph (O2, Temperature, Pressure)
  - Press **Menu/Esc** to return to sample screen or Data Logging menu
  - Press **Up/Down** to go to Next/Previous graph page (page number is displayed in upper-right corner, page 1 is most recent data)
  - Hold **Up/Down** for ½ second to zoom graph to next higher/lower range
- **Restart**: Clears any information on the graphs and starts from zero.
- **Interval**: Sets the logging interval in minutes.
- **Time**: The user can change to time to match the location the analyzer is located.
- **Date**: The user can change the date to match the location the analyzer is located.
- **Datapoints**: How many datapoints have been taken since the data logging has begun.
- **Started**: The date and time data logging began.
- **Avg:** Average O2 reading of the sensor.
- **High**: Highest O2 reading since beginning of data logging.
- **Low:** Lowest O2 reading since beginning of data logging.

Alarms

In the Alarms Menu the user has the following options.



- Alarms: Enable or Disable both alarms.
- Alarm 1:
    - Enable or Disable Function
    - Setpoint: Set the value that the user wishes for the alarm to trigger.
    - Mode: Low or High. If set Low the alarm will trigger when the reading travels below the setpoint. If set High the alarm will trigger when the reading travels above the setpoint.
    - Delay: Sets a timer delay for the alarm. When the O2 reading reaches the setpoint, the alarm will trigger once the delay timer has expired. Setting delay to 00 will trigger the alarms immediately when the O2 reading reaches the setpoint.
    - Latching: If YES, active alarm must be manually bypassed.
    - Failsafe: If YES, alarm relay is energized while inactive, de-energized while active.
- Alarm 2: Same as Alarm 1.
- Pulse Mode: Disables Alarm 2. Relay 1 energizes for 3 seconds on activate, relay 2 energizes for 3 seconds on de-activate.
- Tone: Enables/Disables the beeper when alarms are triggered.

System Menu

Security

- Lock Now: Will go to sample screen and require a user passcode to enter menus. (Default passcode: 2855).
- Set Passcode: Will allow the user to set a passcode.
- Auto Lock: Locks the menu if no keys are pressure for the set time. Setting to 0 disables Auto Lock.

Analog Output

- Output Hold:
    - Display: Analog output follows the displayed O2.
    - Freeze: Analog output stops updating and holds the last output reading.
    - Zero: Analog outputs 0V or 4mA.
    - Full-scale: Analog outputs 1V, 5V, or 20mA.
- Calibrate 0-1V: Allows the user to calibrate the 0-1V output.
- Calibrate 0-5V: Allows the user to calibrate the 0-5V output.
- Calibrate 4-20mA: Allows the user to calibrate the 4-20mA output.
- Test: Using Up/Down keys allows the user to test the analog outputs in increments of 20%.

Signal Conditioning

- None: No signal conditioning applied to the O2 signal.
- Average: Rolling average over the number of samples (N) provided by the user. A new sample is taken every second.
- Fast:
    - A: Attenuation. Change of reading divided by the attenuation equals final change in reading.
    - T: Threshold. Set % of full scale of the signal that would be attenuated. The threshold compares the current sample reading to the previous sample. i.e. T =2% of 500ppb range, 2% is 10ppb. Any reading change of less than 10ppb will divide the change of reading by the attenuation factor. So, if A = 100 and change of reading is 5ppb then the reading will only change by 0.05%.

Auto Bypass

When the O2 reading travels to 20% of the 3rd range the analyzer will automatically switch to bypass valves to ensure the sensor does not get exposed to high amounts of oxygen. Exposure to high amounts of oxygen will damage the sensor and auto bypass will help protect the sensor.

Show Negative

The analyzer provides the user with the option to choose whether they wish to display negative readings. This feature is useful if the user prematurely zeroes the analyzer either inadvertently or knowingly during a quick start situation.

Unit ID

User customizable identification of the analyzer. The name given to the analyzer displays on the top center of the sample screen.

Temperature

User selectable temperature units, to display the temperature in either Fahrenheit or Celsius.

Pressure

User selectable pressure units, to display the pressure in either PSI or KPA.

Date Format

User selectable data format:

- YY/MM/DD
- DD/MM/YY
- MM/DD/YY

Info

The information screen displays the analyzer characteristics such as model number, serial number, firmware version, and more.

Standby and Storage

Short term shutdown

This procedure is for momentarily shutting down and moving the analyzer from one site to another or for a temporary shutdown.

1. After short term shutdown, to restart,
    1.1. Establish power to analyzer
    1.2. Set sample flow rate to 1-2 SCFH
    1.3. Allow sample line to purge for 5 minutes
    1.4. Move crossover valve to Sample and begin sampling

If the **analyzer is not to be used** for analyzing a sample gas, it is recommended that you keep the analyzer running and have pure nitrogen (at least 99.999) flow through analyzer (to preserve gas, a flow rate as low as 0.1 SCFH should be sufficient). This will always keep analyzer in "ready state" for analyzing sample gases.

Long term Shutdown

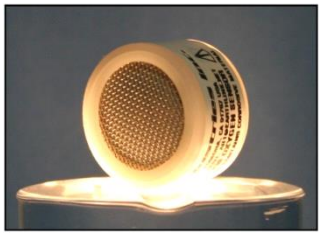
If analyzer is to be stored for a long period of time (greater than 30 days), it is recommended to remove sensor from analyzer and store analyzer in a clean environment. This is to prevent the likelihood of electrolyte leaking out of sensor and damaging the sensor housing. WHEN STARTING ANALYZER AGAIN, YOU MUST INSTALL A NEW SENSOR

7. Maintenance

There are no moving parts in the analyzer given the modular nature of the electronics and sensor. Cleaning the electrical contacts when replacing the sensor is the extent of the maintenance required.

Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service. Only trained personnel with the authorization of their supervisor should conduct maintenance.

Sensor Replacement



Periodically, the oxygen sensor will require replacement. The operating life is determined by a number of factors that are influenced by the user and therefore difficult to predict. The sections dealing with Specification and Installation Considerations define the normal operating conditions and expected life of the standard sensor utilized by the GPR-1600 analyzer. As a general guideline, expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.

The signal output of a PPM sensor (GPR-12-333 OR XLT-12-333) in air ranges from 500 uA to 950 uA. You may check the sensor output of a sensor by using an ammeter (set ammeter in the micro-amp mode and connect the com of the meter to the inner gold contact and the mA/uA of the meter to the outer gold contact at the back of the sensor). If the output of the sensor in air is not within the expected range, do not install the sensor. Install a new sensor and send the defective sensor to factory for warranty evaluation.

Caution: DO NOT open the oxygen sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in the Owner's Manual appendix. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

8. Spare Parts

Recommended spare parts for the GPR-1600 Oxygen Analyzer include:

Item No.	Description
GPR-12-333	PPM Oxygen Sensor
XLT-12-333	PPM Oxygen Sensor for Sample containing CO2

Other spare parts:

CTRL-1004	Controller Temperature PID
HTR-1006	Heater 220VAC
A-1004-1-36	Housing Sensor Stainless Steel
A-1016-SS	Housing Sensor Bottom Assembly Stainless Steel
B-2762-A-3-16	Housing Sensor Upper Assembly Stainless Steel
MTR-1008	Meter Digital Panel LCD Backlight
ORNG-1007	O-ring 3/32 x 1-3/8 x 1-9/16 Viton
A-1146-10-rG	PCB Assembly Main / Display
A-1147-10-rG3	PCB Assembly Power Supply
A-1147-10-AV	PCB Assembly Power Supply with AV option
SNSR-1002	RTD Temperature Sensor
SNSR-1006	Thermal Runaway Protector J-2 Sensor
TOOL-1001	Wrench Combination 5/16”

9. Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery	At installation, sensor was exposed to air for too long.	Replace sensor while minimizing sensor exposure to air
	Defective sensor	If recovery unacceptable or O_2 reading fails to reach 50% of lowest range after 48-72 hours of installation of sensor, check gas connections and gas integrity before replacing sensor again
	excessive, dead volume in sample line	
	contaminated sample gas due to leakage in sample line connections	Leak test the entire sample system:
	Abnormal zero gas	Vary the flow rate (1-5 SCFH); O_2 reading that changes inversely to the changes in flow rate indicates a leakage in the sample system bringing gas to the analyzer
	Sensor damaged in service due to prolonged exposure to air or electrolyte leakage	Correct source of leak
	Sensor nearing end of life	Qualify zero gas (by using a second analyzer). If problem persist,
		Replace sensor
90 % Response time slow	Increased dead legs or distance of sample line	Reduce dead volume by reducing sample tube length
	low flow rate	Increase flow rate
O2 reading doesn't agree with expected O2 values	Pressure and temperature of the sample is varying	Calibrate the analyzer at the sample temperature, pressure and flow.
		Main a constant sample flow.
	Abnormality in sample gas	
		Qualify sample gas (using a second analyzer)
Continued	Corroded solder joints on sensor PCB from corrosive sample or electrolyte leakage from sensor	Replace sensor and if corroded contact, return sensor to the factory for warranty determination
	Corroded spring loaded contact in upper section of sensor housing from liquid in sample or electrolyte leakage from sensor	Upper section of sensor housing: Clean contacts with water, flow sample or zero gas for 2-3 hours to flush sample system and sensor housing
	Liquid covering sensing area of sensor	Sensor: Replace if leaking and return it to the factory for warranty determination
	Presence of interference gases	
	Unauthorized maintenance done	Replace sensor, follow procedure in section 5 Operation

	Sensor nearing end of life	Consult factory
		Replace sensor, obtain authorized service
		Replace sensor
Erratic, negative or no O2 reading possibly accompanied by electrolyte leakage	Pressurizing the sensor by flowing gas to the sensor with the vent restricted and suddenly removing the restriction draws a vacuum on the sensor, causing electrolyte leakage	Replace sensor re-calibrate the analyzer.
		Remove any restriction on sample vent line.
		Vent sample to atmospheric pressure.
	Senor exposed to high O2 at time of installation or during normal use	Watch O2 signal for 24-48 hours, if the spikes persist, replace sensor
O2 signal shows periodic spikes	Zero offset beyond acceptable limit	Check source of zero gas, watch O2 on a recording device, if trends down slowly, wait until zero offset is less than 50% of the lowest range, re-attempt zero calibration
Cannot perform Zero calibration	Contaminated sample/zero gas or exhausted O2 scrubber	Check integrity of sample/zero gas, if O2 in sample gas is in the low PPB level but analyzer still shows high zero offset, replace exhausted O2 scrubber (integral to analyzer or external)
Cannot perform zero calibration even after replacing sensor		
O2 reading drifts slowly upward	Sensor exposed to high O2 for an extended period of time or Sensor is nearing end of its useful life	Replace sensor
span requires large gain adjustment	Low sensor output signal possibly due to moisture condensation on sensor from liquid in sample gas or electrolyte leakage from sensor	Ensure there is no condensable moisture in the sample gas. Flow sample or zero gas for 2-3 hours to flush moisture from sample system and sensor housing
	Liquid covering sensing area of sensor	Sensor: Replace if leaking and return it to the factory for warranty determination
	Presence of interference gases, e.g., CO_2 ,Cl_2, HCl	Consult factory
O2 reading swings too much with minor variation in ambient temperature	Sensor exposed to high O2 for an extended period of time, sensor is damaged	Replace sensor
	Software bug	

The O2 reading freezes even though O2 in sample is changing.		Press the RESET button on A-1146 PCB to restart analyzer. Watch start-up screen and check self-diagnostic passes all tests. If any of the tests fail, replace A-1146 PCB.
LED display does not agree with 4-20mA signal output	Minor variations in tolerances of electronic components	Use AII Configuration software to correct disagreement. If problem persist, Contact the factory.
No 4-20mA output	Defective component or PCB	Contact the factory.
No graphic on LCD but has the analog signal output	Electrostatic discharge could cause graphic to disappear	Reset electronic by pressing RESET button on A-1146 or turn the power the analyzer OFF and then ON again.

10. Warranty

The design and manufacture of GPR Series oxygen analyzers, monitors and oxygen sensors are performed under a certified Quality Assurance System that conforms to established standards and incorporates state of the art materials and components for superior performance and minimal cost of ownership. Prior to shipment every analyzer is thoroughly tested by the manufacturer and documented in the form of a Quality Control Certification that is included in the Owner's Manual accompanying every analyzer. When operated and maintained in accordance with the Owner's Manual, the units will provide many years of reliable service.

Coverage

Under normal operating conditions, the analyzer and sensor are warranted to be free of defects in materials and workmanship for the period specified in accordance with the most recent published specifications, said period begins with the date of shipment by the manufacturer. The manufacturer information and serial number of this analyzer are located on the rear of the analyzer. Analytical Industries Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your analyzer and/or oxygen sensor is determined to be defective with respect to material and/or workmanship, we will repair it or, at our option, replace it at no charge to you. If we choose to repair your purchase, we may use new or reconditioned replacement parts. If we choose to replace your Analytical Industries Inc. analyzer, we may replace it with a new or reconditioned one of the same or upgraded design. This warranty applies to all monitors, analyzers and sensors purchased worldwide. It is the only one we will give and it sets forth all our responsibilities. There are no other express warranties. This warranty is limited to the first customer who submits a claim for a given serial number and/or the above warranty period. Under no circumstances will the warranty extend to more than one customer or beyond the warranty period.

Limitations

Analytical Industries Inc. will not pay for: loss of time; inconvenience; loss of use of your Analytical Industries Inc. analyzer or property damage caused by your Analytical Industries Inc. analyzer or its failure to work; any special, incidental or consequential damages; or any damage resulting from alterations, misuse or abuse; lack of proper maintenance; unauthorized repair or modification of the analyzer; affixing of any attachment not provided with the analyzer or other failure to follow the Owner's Manual. Some states and provinces do not allow

limitations on how an implied warranty lasts or the exclusion of incidental or consequential damages, these exclusions may not apply.

Exclusions

This warranty does not cover installation; defects resulting from accidents; damage while in transit to our service location; damage resulting from alterations, misuse or abuse; lack of proper maintenance; unauthorized repair or modification of the analyzer; affixing of any label or attachment not provided with the analyzer; fire, flood, or acts of God; or other failure to follow the Owner's Manual.

Service

Call Analytical Industries Inc. at 909-392-6900 (or e-mail info@aii1.com) between 8:00am and 5:30pm Pacific Time Monday thru Thursday or before 12:00 pm on Friday. Trained technicians will assist you in diagnosing the problem and arrange to supply you with the required parts. You may obtain warranty service by returning your analyzer, postage prepaid to:

Analytical Industries, Inc

2855 Metropolitan Place, Pomona, Ca 91767 USA

Be sure to pack the analyzer securely. Include your name, address, telephone number, and a description of the operating problem. After repairing or, at our option, replacing the analyzer, we will ship it to you at no cost for parts and labor.

11. Material Safety Data Sheet – MSDS

Product Identification

Product Name	Oxygen Sensor Series - PSR, GPR, AII, XLT
Synonyms	Electrochemical Sensor, Galvanic Fuel Cell
Manufacturer	Analytical Industries Inc., 2855 Metropolitan Place, Pomona, CA 91767 USA
Emergency Phone Number	909-392-6900
Preparation / Revision Date	January 1, 1995
Notes	Oxygen sensors are sealed, contain protective coverings and in normal conditions do not present a health hazard. Information applies to electrolyte unless otherwise noted.

Specific Generic Ingredients

Carcinogens at levels > 0.1%	None
Others at levels > 1.0%	Potassium Hydroxide or Acetic Acid, Lead
CAS Number	Potassium Hydroxide = KOH 1310-58-3 or Acetic Acid = 64-19-7, Lead = Pb 7439-92-1
Chemical (Synonym) and Family	Potassium Hydroxide (KOH) – Base or Acetic Acid (CH_3CO_2H) – Acid, Lead (Pb) – Metal

General Requirements

Use	Potassium Hydroxide or Acetic Acid - electrolyte, Lead - anode
Handling	Rubber or latex gloves, safety glasses
Storage	Indefinitely

Physical Properties

Boiling Point Range	KOH = 100 to 115° C or Acetic Acid = 100 to 117° C
Melting Point Range	KOH -10 to 0° C or Acetic Acid – NA, Lead 327° C
Freezing Point	KOH = -40 to -10° C or Acetic Acid = -40 to -10° C
Molecular Weight	KOH = 56 or Acetic Acid – NA, Lead = 207
Specific Gravity	KOH = 1.09 @ 20° C, Acetic Acid = 1.05 @ 20° C
Vapor Pressure	KOH = NA or Acetic Acid = 11.4 @ 20° C
Vapor Density	KOH – NA or Acetic Acid = 2.07
pH	KOH > 14 or Acetic Acid = 2-3
Solubility in H_2O	Complete
% Volatiles by Volume	None
Evaporation Rate	Similar to water
Appearance and Odor	KOH = Colorless, odorless aqueous solution or Acetic Acid = Colorless, vinegar-like odor aqueous solution

Fire and Explosion Data

Flash and Fire Points	Not applicable
Flammable Limits	Not flammable
Extinguishing Method	Not applicable
Special Fire Fighting Procedures	Not applicable
Unusual Fire and Explosion Hazards	Not applicable

Reactivity Data

Stability	Stable
Conditions Contributing to Instability	None
Incompatibility	KOH = Avoid contact with strong acids or Acetic Acid = Avoid contact with strong bases
Hazardous Decomposition Products	KOH = None or Acetic Acid = Emits toxic fumes when heated
Conditions to Avoid	KOH = None or Acetic Acid = Heat

Spill or Leak

Steps if material is released	Sensor is packaged in a sealed plastic bag, check the sensor inside for electrolyte leakage. If the sensor leaks inside the plastic bag or inside an analyzer sensor housing do not remove it without rubber or latex gloves and safety glasses and a source of water. Flush or wipe all surfaces repeatedly with water or wet paper towel (fresh each time).
Disposal	In accordance with federal, state and local regulations.

Health Hazard Information

Primary Route(s) of Entry	Ingestion, eye and skin contact
Exposure Limits	Potassium Hydroxide - ACGIH TLV 2 mg/cubic meter or Acetic Acid - ACGIH TLV / OSHA PEL 10 PPM (TWA), Lead - OSHA PEL .05 mg/cubic meter
Ingestion	Electrolyte could be harmful or fatal if swallowed. KOH = Oral LD50 (RAT) = 2433 mg/kg or Acetic Acid = Oral LD50 (RAT) = 6620 mg/kg
Eye	Electrolyte is corrosive and eye contact could result in permanent loss of vision.
Skin	Electrolyte is corrosive and skin contact could result in a chemical burn.
Inhalation	Liquid inhalation is unlikely.
Symptoms	Eye contact - burning sensation. Skin contact - soapy slick feeling.
Medical Conditions Aggravated	None
Carcinogenic Reference Data	KOH and Acetic Acid = NTP Annual Report on Carcinogens - not listed; LARC Monographs - not listed; OSHA - not listed
Other	Lead is listed as a chemical known to the State of California to cause birth defects or other reproductive harm.

Special Protection Information

Ventilation Requirements	None
Eye	Safety glasses
Hand	Rubber or latex gloves
Respirator Type	Not applicable
Other Protective Equipment	None

Special Precautions

Precautions	Do not remove the sensor's protective Teflon and PCB coverings. Do not probe the sensor with sharp objects. Wash hands thoroughly after handling. Avoid contact with eyes, skin and clothing. Empty sensor body may contain hazardous residue.
Transportation	Not applicable