Advanced Instruments Inc.

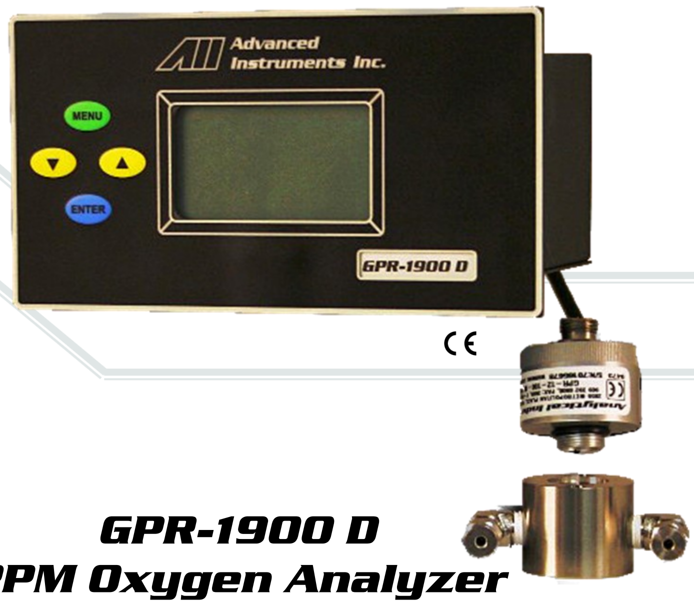
Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	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 user configurable alarms: magnetic coil relays rated 3A at 100 VAC, field programmable alarm time delays, alarm bypass for CAL and system fail alarm
Calibration:	Max interval—3 months. Use certified span gas with O2 content (balance N2) approximating 80% of full scale for fast 20-30 minute recovery to online use. Alternatively, air calibrate with clean source of compressed or ambient (20.9% O2) air on 0-25% range and allow 60 minutes on zero gas to recover to 10 ppm. For optimum accuracy,
Compensation:	Barometric pressure and temperature
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration, alarm and system functions
Display:	Graphical LCD 5" x 2.75"; resolution .01 PPM; displays real time ambient temperature and pressure
Enclosure:	Painted aluminum 6" x 4" x 4" panel mount
Flow:	Not flow sensitive, 1-2 SCFH recommended
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig to deliver 1-2 SCFH flow;
Power:	Universal; specify 100/120/220/240 VAC or 12-28 VDC
Range ID:	4-20mA non-isolated or 1-5V; option: relay contacts (eliminates alarms)
Recovery Time:	60 seconds in air to < 100 PPM in < 15 mins on N2 purge
Response Time:	90% of final FS reading < 10 seconds
Sample System:	None
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-100-4 for non-acid (CO2) gas streams; XLT-12-100-4 for gases containing > 0.5% CO2
Sensor Life:	24 months in < 1000 PPM O2 at 25ºC and 1 atm
Signal Output:	4-20mA non-isolated or 1-5V
Temp. Range:	5ºC to 45ºC (GPR sensor), -10ºC to 45ºC (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

Sample conditioning accessories - contact factory

* Specification subject to change without notice.



GPR-1900 D
PPM Oxygen Analyzer

Panel Mount Configuration for OEM Applications

Advanced Sensor Technology

- Unmatched Expected Life & Warranty
- Unmatched Recovery from Air to 10 PPM
- Extended Operating Range -20ºC (-4ºF)
- Excellent Compatibility with 0-100% CO_2
- Sensitivity < 0.5% FS Range
- Fast Response, No Maintenance

100-240 VAC or 12-28 VDC Power

2 Field Selectable Alarm Setpoints

Power and System Failure Alarms

4 Ranges Standard

Auto Ranging or Single Fixed

4-20 mA or 1-5V Signal Output

Range ID 4-20 mA, 1-5V or Relay Contacts

Stainless Steel Wetted Parts

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

Advanced Instruments Inc.

GPR-1900D
ppm Oxygen Analyzer

Owner's Manual

2855 Metropolitan Place, Pomona, California 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, e-mail: info@aii1.com

Table of Contents

1 Introduction

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

This analyzer is designed to measure the oxygen concentration in inert gases, gaseous hydrocarbons, hydrogen, a variety of gas mixtures and acid gases containing from 0-100% CO_2 (for CO_2 background, the XLT series sensor must be used) present.

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 retains 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 Certification

Date:	**Customer:**	**Order No.:**	**Pass**
Model:	GPR-1900D ppm Oxygen Analyzer	**S/N** ______________________	_________
Sensor:	( ) GPR-12-100-M ppm Oxygen Sensor		
	( ) XLT-12-100-M ppm Oxygen Sensor	**S/N** ______________________	_________
Accessories:	Owner's Manual		
	CABL-1008 Power Cord		_________
Configuration:	Ranges: 0-100 ppm, 0-1000 ppm, 0-1%, 0-25%		
	A-1161-3 PCB Assembly Micro / Display – **Software V.** ______		
	A-1162-3 PCB Assembly Power Supply / Interconnection		_________
	Power: ( ) 100/120/220/250 VAC		
	( ) 9-28 VDC non-loop		_________
	Enclosure: ( ) Panel mount 7W x 4"H x 4"D (panel cutout 6"W x 3"H)		
(GPR-1900DR)	( ) Panel mounted with rear cover for 19" rack 19x7x12"		
(GPR-1900DW)	( ) Door mounted for NEMA4 wall mount 12x12x8"		_________
	SS sensor flow housing and 1/8" compression type fittings for inlet and vent		_________
			_________
Test	System start-up diagnostics satisfactory		_________
	Auto/manual range		_________
	Alarm relays activate/deactivate with changes in O_2 concentration		_________
	Alarm bypass		_________
	Analog outputs: 4-20mA signal output		_________
	4-20mA range ID reflects range changes		_________
	Recovery from air to < 10 ppm in < 60 minutes		_________
	Baseline drift on zero gas < ± 2% FS over 24 hour period		_________
	Noise level < ± 1.0% FS		_________
	Span adjustment within 10-50% FS		_________
	Peak to peak over/under shoot < 0.5% FS		_________
	Overall inspection for physical defects		_________
Options			_________
Notes	1 of 1 due		_________

3 Safety Guidelines

General

This section summarizes the essential precautions applicable to the GPR-1900D ppm Oxygen Analyzer. Additional precautions specific to individual analyzer 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.

Pressure and Flow

Inlet Pressure: GPR-1900D Oxygen Analyzers is designed for flowing samples, equipped with 1/8" compression tube fitting connections on the side of the sensor flow housing (unless otherwise indicated, either fitting can serve as inlet or vent) and are intended to operate at positive pressure regulated to between 5-30 psig.

Outlet Pressure: The sample gas vent pressure should be atmospheric.

Installation

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, outdoor use requires mounting in a secondary enclosure with the appropriate NEMA rating. Mount as recommended by the manufacturer.

Power: Supply power to the analyzer only as rated by the specification or markings on the analyzer enclosure. The wiring that connects 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 wiring to remove it from an outlet or from the analyzer. The analyzer consumes approximately 30 watts of power.

Operating Temperature: The maximum operating temperature is 45º C on an intermittent basis.

Heat: Situate and store the analyzer away from sources of heat.

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.

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 located on the analyzer.

Maintenance

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.

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.

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 10 and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

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.

Nonuse Periods: If the analyzer is equipped with a range switch advance the switch to the OFF position and disconnect the power when the analyzer is left unused for a long period of time.

4 Features & Specifications

Specifications are subject to change without notice. See last page for current specifications, this section left blank intentionally.

5 Operations

Principle of Operation

The GPR-1900D ppm Oxygen Analyzer incorporates several advanced galvanic fuel cell type sensors for parts-per-million ppm oxygen analysis. This model is configured for panel mounting and requires a 6"W x 3"H cutout with 4 holes for the studs located on the back side of the analyzer's front panel.

Optional mounting configurations include a 19" rack or wall mount enclosure with or without a sample system. Contact the factory for additional information on options.

Advanced Galvanic Sensor Technology

The sensors function on the same principle and are specific for oxygen. They measure the partial pressure of oxygen from low ppm to 100% levels in inert gases, gaseous hydrocarbons, helium, hydrogen, mixed gases, acid gas streams and ambient air. Gas streams with acid gases like CO2 in the background in concentrations greater than 0.5% require the use of an XLT Series oxygen sensor to maintain accuracy and reasonable sensor life.

Oxygen, the fuel for this electrochemical transducer, diffusing into the sensor 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 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 design and chemistry add significant advantages to an extremely versatile oxygen sensing technology. The expected life of our new generation of percentage range sensors now range to five and ten years with faster response times and greater stability. Another significant development involves expanding the operating temperature range for percentage range sensors from -30°C to 50°C.

The GPR-1900D employs the GPR-12-100-M or XLT-12-100-M ppm oxygen sensor and a stainless steel sensor flow housing to provide a very cost effective versatile ppm trace oxygen analyzer with four (4) standard ranges: 0-100 ppm, 0-1000 ppm, 0-1% for analysis and 0-25% for air calibration (analysis is possible on this range provided the user can accept a drastic reduction in expected sensor life). Under constant conditions the GPR-1900D is capable of analyzing 1 ppm or less.

Electronics

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

Sample oxygen is analyzed very accurately. Response time of 90% of full scale is less than 10 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 low range.

Additional features of the micro-processor based electronics include manual or auto ranging, isolated 4-20mA signal for signal output and range ID. Whenever the analyzer is calibrated, a unique algorithm predicts and displays a message indicating a 'weak sensor' suggesting the sensor be replaced in the near future.

Users interested in adding their own sample handling or conditioning system are encouraged to consult the factory to ensure all applicable conditions are addressed to ensure proper operation of the analyzer. Advanced Instruments 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

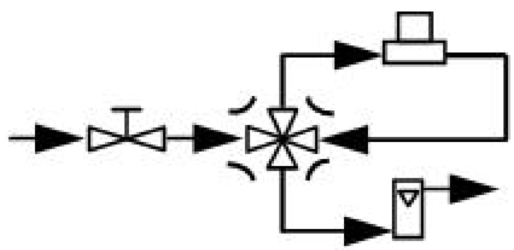
Sample System

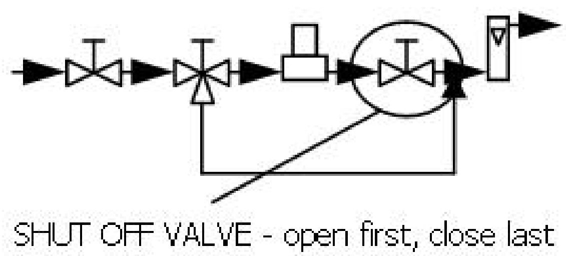
The GPR-1900 is designed to be integrated into a larger analyzer system and provide users with maximum flexibility, and, therefore is not equipped with a sample system. The sample must be properly presented to the sensor to ensure an accurate measurement. Users interested in adding their own sample conditioning system should consult the factory. Advanced Instruments 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.

However, for optimal performance after exposing the sensor to air or elevated oxygen levels in terms of:

1) bringing the analyzer back online, and,
2) maximizing the service life of the sensor by isolating the sensor

Advanced Instruments recommends the user employ one of the following 'bypass sample system' designs illustrated below. Preference is given to the illustration on the left because it is the surest and simplest approach.



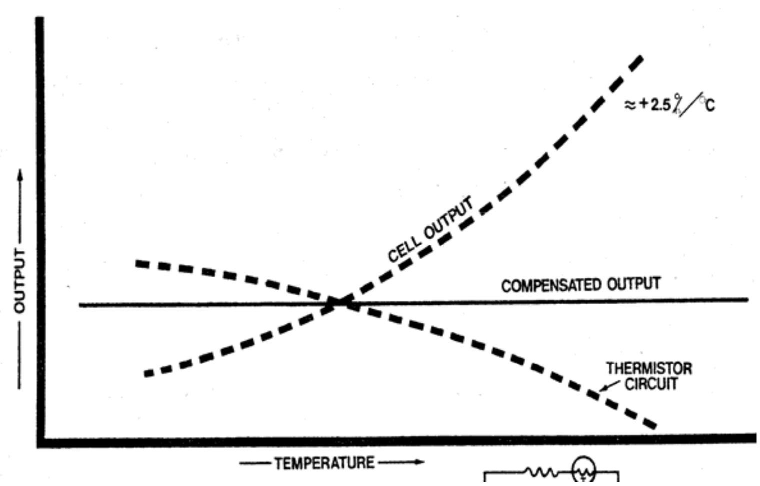


The 'bypass sample system' is optimal, however, it is not required. For example, deleting the 3-way valve from the illustration on the right enables the user to isolate the sensor but lengthens the time required to bring the analyzer online. The bypass feature diverts the flow of sample gas containing high concentrations of oxygen around the sensor – which when the valves are operated properly remains in an atmosphere containing a low concentration of oxygen, less than 100-200 ppm. The source of the atmosphere with the low concentration of oxygen can be either be a zero gas or sample gas is not important - only the oxygen concentration is important. Without the bypass feature, the sensor still can be isolated but not as easily and the best the user can do when connecting a new gas line is start the flow of sample gas (to purge the air trapped inside the line) several minutes before connecting to the analyzer.

Calibration & Accuracy Overview

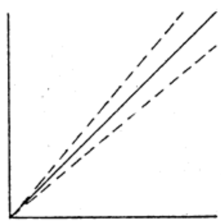
Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas. In the absence of oxygen the sensor exhibits an absolute zero, e.g. the sensor does not generate a current output in the absence of oxygen. Given these 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'. Readouts in percent are permissible only when the total pressure of the sample gas being analyzed remains constant. The pressure of the sample gas and that of the calibration gas(es) must be the same (reality < 1-2 psi).

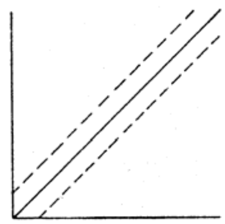


Temperature: The rate oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation is relatively constant 2.5% per ºC. A temperature compensation circuit employing a thermistor offsets this effect with an accuracy of ±5% or better and generates an output function that is independent of temperature. There is no error if the calibration and sampling are performed at the same temperature or if the measurement is made immediately after calibration. Lastly, small temperature variations of 10-15º produce < 1% error.

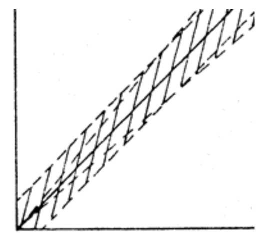
Accuracy: In light of the above parameters, the overall accuracy of an analyzer is affected by two types of errors: 1) those producing 'percent of reading errors', illustrated by Graph A below, such as ±5% temperature compensation circuit, tolerances of range resistors and the 'play' in the potentiometer used to make span adjustments and 2) those producing 'percent of full scale errors', illustrated by Graph B, such as ±1-2% linearity errors in readout devices, 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 < 0.5% 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, play in the multi-turn span pot or the temperature compensation circuit, during a span adjustment at 20.9% (air) of full scale range would be multiplied by a factor of 4.78 (100/20.9) if used for measurements of 95-100% oxygen concentrations. Conversely, an error during a span adjustment at 100% of full scale range is reduced proportionately for measurements of lower oxygen concentrations.

Zero Calibration: <u>In theory</u>, the electrochemical galvanic fuel cell type oxygen has an absolute zero meaning it produces no signal output when exposed to an oxygen free sample gas. <u>In reality</u>, expect the analyzer to generate an oxygen reading when sampling oxygen free sample gas due to contamination or quality of the zero gas; minor leakage in the sample line connections; residual oxygen dissolved in the sensor's electrolyte; and, tolerances of the electronic components. The Zero Offset capability of the analyzer is limited to 50% of lowest most sensitive range available with the analyzer.
Recommendation 1: Zero calibration, see Determining True Zero Offset below, is <u>recommended only</u> for online analyzers performing continuous analysis below 5% of the lowest most sensitive range available with a ppm analyzer, e.g. analysis below 0.5 ppm on the 10 ppm range, or below 0.1% (1000 ppm) with a percent analyzer. **Note 1:** Once the zero offset adjustment is made, zero calibration is not required again until the sample system connections are modified, or, when installing a new oxygen sensor. As a result, zero calibration is not practical and therefore not recommended for higher ranges or portable analyzers.

<u>Determining True Zero Offset:</u> Allow the analyzer approximately 24 hours to stabilize with flowing zero gas as evidenced by a stable reading or horizontal trend on an external recording device. **Note 2:** 24 hours is required to assure the sensor has consumed the oxygen that has dissolved into the electrolyte inside the sensor while exposed to air or percentage levels of oxygen. For optimum accuracy, utilize as much of the actual sample system as possible.

Span Calibration: Involves adjusting the analyzer electronics to the sensor's signal output at a given oxygen standard. Regardless of the oxygen concentration of the oxygen standard used, a typical span calibration takes approximately 10 minutes.

Note 3: The amount time required to get the analyzer back on line for normal use is influenced by a.) the level of oxygen analysis anticipated during normal operation (also determines the initial analyzer selection), and, b.) whether the sensor is new or has been in service for at least two weeks.

<u>General guidelines</u> for analyzers to come online following span calibration and exposure to a zero/purge/sample gas with an oxygen content below the stated thresholds:

- measurements above 1000 ppm or 0.1% require less than 3 minutes
- measurements above 100 ppm (parts-per-million analyzer) require less than 10 minutes
- measurements below 10 ppm (part-per-million analyzer) require 20 minutes if the sensor has been in service at ppm levels for at least two weeks, and, 60 minutes if the sensor is new assuming the zero/purge/sample gas has an oxygen concentration below 1 ppm

Recommendation 2: For 'optimum calibration accuracy' calibrate with a span gas approximating 80% of the full scale range one or two ranges higher than the full scale range of interest (normal use) to achieve the effect illustrated on Graph A and Example 1. Always calibrate at the same temperature and pressure of the sample gas stream.

Note 4: Calibrating with a span gas approximating 10% of the full scale range near the expected oxygen concentration of the sample gas is acceptable but less accurate than 'optimum calibration accuracy' method recommended – the method usually depends on the gas available. Calibrating at the same 10% of the full scale range for measurements at the higher end of the range results in magnification of errors as discussed in Graph A and Example 1 and is not recommended. Of course the user can always elect at his discretion to accept an accuracy error of $\pm$2-3% of full scale range if no other span gas is available.

Air Calibration: Based on the inherent linearity of the electrochemical galvanic fuel cell type oxygen sensor enables the user to calibrate the analyzer with ambient air (20.9% oxygen) and operate the analyzer within the stated accuracy spec on the lowest most sensitive range available with the analyzer – there is no need to recalibrate the analyzer with span gas containing a lower oxygen concentration. Except for Oxygen Purity Analyzers intended to measure elevated oxygen levels ranging from 50-100% oxygen, calibrating either a ppm or percent analyzer with ambient air on the CAL or 0-25% range meets the 80% criteria discussed in Recommedation 2.

Recommendation 3: Air calibrate the analyzer (with the exception of Oxygen Purity Analyzers intended to measure elevated oxygen levels ranging from 50-100% oxygen) when operating a percent analyzer, installing and replacing a ppm oxygen sensor, to verify the oxygen content of a certified span gas or when a certified span gas is not available to calibrate a ppm analyzer (immediately following air calibration reintroduce a gas with a low oxygen concentration to expedite the return to ppm level measurements as per Note 3).

Installation Considerations

Gas Sample Stream: Ensure the gas stream composition of the application is consistent with the specifications and review the application conditions before initiating the installation. Consult the factory if necessary to ensure the sample is suitable for analysis.

Note: In natural gas applications such as extraction and transmission, a low voltage current is applied to the pipeline itself to inhibit corrosion. As a result, electronic devices can be affected unless adequately grounded.

Contaminant Gases: A gas scrubber and flow indicator with integral metering valve are required upstream of the analyzer to remove interfering gases such as oxides of sulfur and nitrogen or hydrogen sulfide that can produce false readings, reduce the expected life of the sensor and void the sensor's warranty if not identified at time of order placement. Installation of a suitable scrubber is required to remove the contaminant from the sample gas to prevent erroneous analysis readings and damage to the sensor or optional components. Consult the factory for recommendations concerning the proper selection and installation of components.

Expected Sensor Life: With reference to the publish specification located as the last page of this manual, the expected life of all oxygen sensors is predicated on oxygen concentration (< 1000 ppm or air), temperature (77°F/25°C) and pressure (1 atmosphere) in "normal" applications. Deviations are outside the specifications and will affect the life of the sensor. As a rule of thumb sensor life is inversely proportional to changes in the parameters.

Optimum Accuracy: Determine if Zero Calibration is recommended for your application. If it is Zero Calibration should precede Span Calibration and both should be repeated after the analyzer has been allowed to stabilize, typically 24-36 hours after installation. For Span Calibration use a certified span gas with an oxygen content (balance nitrogen) approximating 80% of the next higher full scale range above the intended measuring range is recommended for optimum accuracy, see Calibration and Accuracy.

Assuming the initial zero is performed according to the procedure described herein, the analyzer should not require Zero Calibration again until the either the sensor is replaced or a change is made to the sample system or gas lines, and, it should not require Span Calibration again for up to 3 months under "normal" application conditions as described in the published specifications. One of the unique features of analyzers based on the electrochemical galvanic fuel cell type oxygen sensor is the fact that it can be field calibrated at the user's discretion to whatever standard of certified span gas the user elects to use.

Zero Calibration: In theory, the oxygen sensor produces no signal output when exposed to an oxygen free sample gas. In reality, expect the analyzer to generate an oxygen reading when sampling oxygen free sample gas due to contamination or quality of the zero gas; minor leakage in the sample line connections; residual oxygen dissolved in the sensor's electrolyte; and, tolerances of the electronic components.

Zero calibration, see Determining True Zero Offset below, is recommended only for online analyzers performing continuous analysis below 5% of the lowest most sensitive range available with a ppm analyzer, e.g. analysis below 0.5 ppm on the 10 ppm range, or below 0.1% (1000 ppm) with a percent analyzer. **Note:** Once the zero offset adjustment is made, zero calibration is not required again until the sample system connections are modified, or, when installing a new oxygen sensor. As a result, zero calibration is not practical and therefore not recommended for higher ranges or portable analyzers.

Determining True Zero Offset: Allow the analyzer approximately 24 hours to stabilize with flowing zero gas as evidenced by a stable reading or horizontal trend on an external recording device. **Note:** 24 hours is required to assure the sensor has consumed the oxygen that has dissolved into the electrolyte inside the sensor while exposed to air or percentage levels of oxygen. For optimum accuracy, utilize as much of the actual sample system as possible.

Span Calibration: Involves adjusting the analyzer electronics to the sensor's signal output at a given oxygen standard, e.g. a certified span gas with an oxygen content (balance nitrogen) approximating 80% of the next higher full scale range above the intended measuring range is recommended for optimum accuracy, see Calibration and Accuracy.

Recommendation: Based on the inherent linearity of the galvanic oxygen sensor enables the user to calibrate the analyzer with ambient air (20.9% oxygen) and operate the analyzer within the stated accuracy spec on the lowest most sensitive range available with the analyzer – there is no need to recalibrate the analyzer with span gas containing a lower oxygen concentration. Calibrating either a ppm or percent analyzer with ambient air (with the exception of Oxygen Purity Analyzers intended to measure elevated oxygen levels ranging from 50-100% oxygen) on the CAL or 0-25% range meets the 80% criteria discussed above.

Air calibrate the analyzer (with the exception of Oxygen Purity Analyzers intended to measure elevated oxygen levels ranging from 50-100% oxygen) when operating a percent analyzer, installing and replacing a ppm oxygen sensor, to verify the oxygen content of a certified span gas or when a certified span gas is not available to calibrate a ppm analyzer (immediately following air calibration reintroduce a gas with a low oxygen concentration to expedite the return to ppm level measurements).

Materials: Assemble the necessary zero, purge and span gases and optional components such as valves, coalescing or particulate filters, and, pumps as dictated by the application; stainless steel tubing is essential for maintaining the integrity of the gas stream for ppm and percentage range (above or below ambient air) analysis; hardware for mounting.

Temperature: The sample must be sufficiently cooled before it enters the analyzer and any optional components. A coiled 10 foot length of ¼" stainless steel tubing is sufficient for cooling sample gases as high as 1,800ºF to ambient.

Pressure & Flow: All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The sensors are equally capable of analyzing the oxygen content of a flowing sample gas stream or monitoring the oxygen concentration in ambient air (such as a confined space such in a control room or an open area such as a landfill or bio-pond).

Sample systems and/or flowing gas samples are generally required for applications involving oxygen measurements at levels other than ambient air and when the pressure exceeds ambient. In these situations, the use of stainless steel tubing and fittings is critical to maintaining the integrity of the gas stream to be sampled and the inlet pressure must always be higher than the pressure at the outlet vent which is normally at atmospheric pressure. The sensor is exposed to sample gas that must flow or be drawn through metal tubing via 1/8" compression inlet and vent fittings, a stainless steel sensor housing with an o-ring seal to prevent the leakage of air and stainless steel tubing.

Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH generate backpressure and erroneous oxygen readings because the diameter of the integral tubing cannot evacuate the sample gas at the higher flow rate. The direction the sample gas flows is not important, thus either tube fitting can serve as the inlet or vent – just not simultaneously.

A flow indicator with an integral metering valve upstream of the sensor is recommended as a means of controlling the flow rate of the sample gas. A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

Caution: Do not place your finger over the vent (it pressurizes the sensor) to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor (voiding the sensor warranty). To avoid generating a vacuum on the sensor (as described above) during operation, always select and install the vent fitting first and remove the vent fitting last.

Application Pressure - Positive: A flow indicator with integral metering valve positioned upstream of the sensor is recommended for controlling the sample flow rate between 1-5 SCFH. To reduce the possibility of leakage for low ppm measurements, position a metering needle valve upstream of the sensor to control the flow rate and position a flow indicator downstream of the sensor. If necessary, a pressure regulator (with a metallic diaphragm is recommended for optimum accuracy, the use of diaphragms of more permeable materials may result in erroneous readings) upstream of the flow control valve should be used to regulate the inlet pressure between 5-30 psig.

Application Pressure - Atmospheric or Slightly Negative: For accurate ppm range oxygen measurements, an optional external sampling pump should be positioned downstream of the sensor to draw the sample from the process, by the sensor and out to atmosphere. A flow meter is generally not necessary to obtain the recommended flow rate with most sampling pumps.

Caution: If the analyzer is equipped with an optional flow indicator with integral metering valve or a metering flow control valve upstream of the sensor - open the metering valve completely to avoid drawing a vacuum on the sensor and placing an undue burden on the pump. If pump loading is a consideration, a second throttle valve on the pump's inlet side may be necessary to provide a bypass path so the sample flow rate is within the above parameters.

Recommendations to avoid erroneous oxygen readings and damaging the sensor:

- Do not place your finger over the vent (it pressurizes the sensor) to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor (voiding the sensor warranty).
- Assure there are no restrictions in the sample or vent lines
- Avoid drawing a vacuum that exceeds 14” of water column pressure – unless done gradually
- Avoid excessive flow rates above 5 SCFH which generate backpressure on the sensor.
- Avoid sudden releases of backpressure that can severely damage the sensor.
- Avoid the collection of liquids or particulates on the sensor, <u>they block the diffusion of oxygen into the sensor</u>.
- If the analyzer is equipped with an optional integral sampling pump (positioned downstream of the sensor) and a flow control metering valve (positioned upstream of the sensor), completely open the flow control metering valve to avoid drawing a vacuum on the sensor and placing an undue burden on the pump.

Moisture & Particulates: Installation of a suitable coalescing or particulate filter is required to remove condensation, moisture and/or particulates from the sample gas to prevent erroneous analysis readings and damage to the sensor or optional components. Moisture and/or particulates do not necessarily damage the sensor, however, collection on the sensing surface can block or inhibit the diffusion of sample gas into the sensor resulting in a reduction of sensor signal output – and the appearance of a sensor failure when in fact the problem is easily remedied by blowing on the front of the sensor. Consult the factory for recommendations concerning the proper selection and installation of components.

Gas Connections: Inlet and outlet vent gas lines for ppm analysis require 1/8” or ¼” stainless steel compression fittings; hard plastic tubing with a low permeability factor can be used percentage range measurements.

Power Connection: Locate the appropriate source of to meet the analyzer or analyzer requirements, ensure that is properly grounded and meets the area classification.

Mounting the Analyzer & Sensor

The GPR-1900D consists of a six (6) foot insulated cable which connects the sensor to the rear of the electronics module, a long life maintenance free oxygen sensor and a sensor flow housing equipped with 1/8” diameter stainless steel compression fittings.

The compact design also lends itself to optional mounting configuration such as a standard 19” rack or wall mount enclosures, both of which can be equipped with optional sample system components. Contact the factory for additional information.

Procedure:

1. The GPR-1900D front panel measures 7”W x 4”H x 4.5”D. This compact configuration is designed for panel mounting directly to any flat vertical surface, wall or bulkhead plate with the appropriate 6”W x 3”H cut out and four ¼” diameter holes for insertion of the mounting studs located on the back side of the front panel.
2. When mounting the analyzer position it approximately 5 feet off the floor for viewing purposes and allow sufficient room for access to the terminal connections at the rear of the enclosure. **Note:** The proximity of the analyzer to the sample point and use of optional sample conditioning components have an impact on sample lag time.
3. Position the sensor flow housing along any flat surface. The base of sensor flow housing is fabricated with two 6/32 mounting holes. The oxygen sensor is not position sensitive but it is recommended to orient the sensor flow housing with the female threaded opening facing the ceiling.
4. Next screw the sensor into sensor flow housing, snug the sensor’s sealing o-ring but do not over tighten or crush it.
5. Register the female plug molded to the cable with the mating male connector attached to the rear of the sensor.
6. Remove the shorting device, normally a formed spring type wire, from the sensor, push the registered mating connectors together and turn the knurled lock ring on the molded plug until finger tight on the sensor’s connector.
7. Connect the four wires of the cable, following the color coding above the terminal block, at the rear of the analyzer.
8. Attach the flow housing to the mounting position determine above.

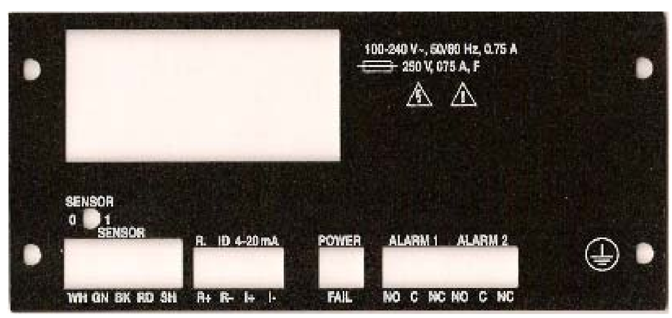
Gas Connections

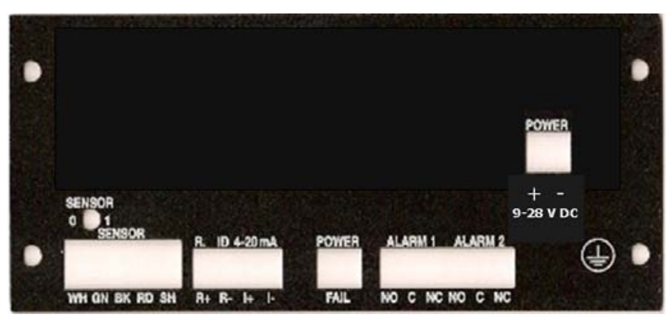
The GPR-1900D with its standard flow through configuration is designed for positive pressure samples and requires connections for incoming sample and outgoing vent lines. The user is responsible for calibration gases and the required components, see below. Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH generate backpressure and erroneous oxygen readings because the diameter of the integral tubing cannot evacuate the sample gas at the higher flow rate. A flow indicator with an integral metering valve upstream of the sensor is recommended as a means of controlling the flow rate of the sample gas. A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

Caution: Do not place your finger over the fitting designated as the vent (it pressurizes the sensor) or to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor (voiding the sensor warranty).

Procedure:
1. **Caution:** Do not change the factory setting until instructed.
2. Designate the female quick disconnect fittings, right side of the analyzer, as inlet and vent respectively.
3. Regulate the pressure and flow as described in Pressure & Flow above.
4. Install one mating male vent fitting into the female quick disconnect fitting designated as the VENT – connection of 1/8" dia. metal vent line (requires an 1/8" male NPT to tube adapter) is optional.
5. Connect the second mating male fitting to 1/8" dia. metal sample line using a 1/8" male NPT to tube adapter.
6. Connect the third mating male fitting to 1/8" dia. metal span gas line using a 1/8" male NPT to tube adapter.
7. Install either the sample or span mating male fitting into the female quick disconnect fitting designated as SAMPLE.
8. Set the flow rate to 2 SCFH (open the flow control valve completely if using an external sampling pump positioned downstream of the sensor).
9. Allow gas to flow through the analyzer for 3-5 minutes and proceed to Calibration or Sampling.

Electrical Connections





The appropriate AC or DC power requirement must specified be specified at order placement.

Incoming power for the 100-250V AC powered analyzers is supplied through a universal power entry module. A standard computer type power cord (P/N A-1008) is required for the universal power entry module. DC power cable must be supplied by the user. A well grounded insulated power cable is recommended to avoid noise resulting from unwanted interference. Power consumption is approximately 30 watts.

Filtered terminal blocks are provided for power failure, set point alarm relays and signal output connections. The PCB also includes a transformer to power the relays, a sensor bypass switch for troubleshooting the electronics

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 or **the 4-20mA converters will be damaged**.

Caution: To assure proper grounding, connect the 4-20mA signal output to the external device (PLC, DCS, etc.) before attempting any zero or span adjustments.

Procedure:
1. As illustrated above the sensor, power and alarm relays and signal output connections are hard wired to screw type terminal blocks located at the rear of the analyzer.
2. Use a small bladed screwdriver to loosen the appropriate terminal screws as illustrated above.
3. Strip the wires of the cable no more than 3/16 inch.

4. 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.
5. To break the connection upon relay activation, connect the secondary cable to the normally closed NC terminal.
6. Insert the stripped end of the cables into the appropriate terminal slots assuring no bare wire remains exposed that could come in contact with the back panel of the analyzer enclosure.
7. Tighten the terminal screws to secure the wires of the cable.

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.

Alarm Relays
Alarm 1 and Alarm 2 represent two threshold type alarms that can be configured in the field from the analyzer’s menu driven LCD display as follows:

- Establish independent set points
- Either Hi or Lo
- Either On or Off (enabled or disabled)
- Both temporarily defeated using a user entered ‘timeout’ period (normally minutes)

The alarm set point represents a value. When the 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 relays @ 5A, 30VDC or 240VAC resistive. 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. Aside from being totally defeated in the Alarm Bypass mode, the 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 1 and Alarm 2 in 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).

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

4-20mA Signal Output and Range ID
The analyzer provides a 4-20mA full scale fully isolated ground signals for external recording devices. The integral IC on the main PCB provides 4-20mA fully isolated signals for output and range ID. The 4-20mA current output is obtained by connecting the current measuring device between the positive and negative terminals labeled OUTPUT 4-20mA. To check the signal output of the 4-20mA E/I integrated circuit connect an ammeter as the measuring device and confirm the output is within $\pm$0.1mA of 4mA. A finer adjustment of the zero offset of the 4-20mA converter can be provided by a potentiometer mounted on the main PCB Assembly. Consult factory for instructions

For range ID the output of 4mA, 8mA, 12mA, 16mA, 20mA correspond to the most sensitive to least sensitive analysis range.

Caution: The integral 4-20mA converters are internally powered and do not require external power. DO NOT supply any voltage to any of the two terminals of the 4-20mA converter.

Installing the Oxygen Sensor

The GPR-1900D Oxygen Analyzer is equipped with an external oxygen sensor. They have been tested and calibrated by the manufacturer prior to shipment and are fully operational from the shipping containers. The sensor has not been installed at the factory and it will be necessary to install the sensor in the field. **Caution:** Review procedure before proceeding, mainly 2 and 9.

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 manner similar to that of a common battery in accordance with local regulations.

Procedure:

1. As described above the following steps should already be completed:
   a) Locate and secure the sensor flow housing with two 6/32 mounting screws, in the preferred position the threaded female should be facing the ceiling;
   b) connect the gas lines;
   c) electrical connections.
2. Open the barrier bag containing the new sensor **and do not expose to air any longer than necessary to calibrate.**
3. The sensor is equipped with a wire spring type shorting device, remove the shorting wire from the pins of the male receptacle attached to the new sensor.
4. Line up the registration point of the female plug molded to the cable and male receptacle on the oxygen sensor.
5. Push the female plug (including the knurled lock ring) into the male receptacle attached to the oxygen sensor.
6. Screw and finger tighten the knurled lock ring of the cable plug into to the male connector attached to the sensor.
7. Place the analyzer in the auto ranging mode, see below.
8. With the sensor exposed to ambient air wait for 5-10 minutes until the reading stabilizes.
9. Perform and air calibration as described below **and purge with zero or low oxygen content gas to bring on line.**
10. Screw the new sensor, finger tight plus ¼ turn, into the threaded hole in the flow housing and ensure the o-ring seal is engaged but not 'crushed'.
11. Begin sampling.

Span Gas Preparation

A percent analyzer such as the GPR-1900D may be reliable calibrated with the known 20.9% oxygen content of ambient air and operated confidently at the lowest levels of the most sensitive analysis range. However, the GPR-1900D may be calibrated with span gas at the user's discretion. **Caution:** Do not contaminate the span gas cylinder when connecting the regulator. Bleed the air filled regulator (faster and more reliable than simply flowing the span gas) before attempting the initial calibration of the instrument.

Required components:

- Certified span gas cylinder with an oxygen concentration, balance nitrogen, approximating 80% of the full scale range above the intended measuring range.
- Regulator to reduce pressure to between 5 and 30 psig.
- Flow meter to set the flow between 1-5 SCFH,
- Suitable fittings and 1/8" dia. 4-6 ft. in length of metal tubing to connect the regulator to the flow meter inlet
- Suitable fitting and 1/8" dia. 4-6 ft. in length of metal tubing to connect from the flow meter vent to tube fitting designated SAMPLE IN on the GPR-1900D.

Procedure:

1. With the span gas cylinder valve closed, install the regulator on the cylinder.
2. Open the regulator's exit valve and partially open the pressure regulator's control knob.
3. Open slightly the cylinder valve.
4. Loosen the nut connecting the regulator to the cylinder and bleed the pressure regulator.
5. Retighten the nut connecting the regulator to the cylinder
6. Adjust the regulator exit valve and slowly bleed the pressure regulator.
7. Open the cylinder valve completely.
8. Set the pressure between 5-30 psig using the pressure regulator's control knob.
9. **Caution:** Do not exceed the recommended flow rate. Excessive flow rate could cause the backpressure on the sensor and may result in erroneous readings and permanent damage to the sensor.

Establishing Power to the Electronics:

Once the power to the electronics is established, the digital display responds instantaneously. When power is applied, the analyzer performs several diagnostic system status checks termed “START-UP TEST” as illustrated below:

START-UP TEST

ELECTRONICS – PASS
TEMP SENSOR – PASS
BAROMETRIC SENSOR – PASS

REV. 1.61

Note: The analyzer display defaults to the sampling mode when 30 seconds elapses without user interface.
Note: At installation expect the range to default to 25% range, thereafter, 100 ppm range but only if properly isolated.

3.3 **PPM**

AUTO SAMPLING
100 PPM RANGE
24.5 C
LO1 2 PPM **10 PPM HI2**

Menu Navigation

The four (4) pushbuttons located on the front of the analyzer operate the micro-processor:

1. blue ENTER (select)
2. yellow UP ARROW
3. yellow DOWN ARROW
4. green MENU (escape)

Main Menu

Access the MAIN MENU by pressing the MENU key:

MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS

Range Selection

The GPR-1900D analyzer is equipped with four (4) standard measuring ranges (see specification) and provides users with a choice of sampling modes. By accessing the MAIN MENU, users may select either the AUTO SAMPLING (ranging) or MANUAL SAMPLING (to lock on a single range) mode.

Note: For calibration purposes, use of the AUTO SAMPLE mode is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE for calibration as dictated by the accuracy of the analysis required – for optimal accuracy, a span gas with an 800 ppm oxygen concentration with the balance nitrogen would dictate the use of the 0-1000 ppm full scale range for calibration for analysis below 100 ppm, whereas, 80 ppm span gas is acceptable but not "optimal", see Calibration & Accuracy.

Auto Sampling:
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight AUTO SAMPLE.
3. Press the ENTER key to select the highlighted menu option.
4. The display returns to the sampling mode:

MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS

3.3 PPM
AUTO SAMPLING
100 PPM RANGE
24.5 C
LO1 2 PPM 10 PPM HI2

The display will shift to the next higher range when the oxygen reading (actually the sensor's signal output) exceeds 99.9% of the upper limit of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the upper limit of the next lower range.

For example, if the analyzer is reading 1% on the 0-10% range and an upset occurs, the display will shift to the 0-25% range when the oxygen reading exceeds 9.9%. Conversely, once the upset condition is corrected, the display will shift back to the 0-10% range when the oxygen reading drops to 8.5%.

Manual Sampling:
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight MANUAL SAMPLE.
3. Press the ENTER key to select the highlighted menu option.
4. The following display appears:

MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS

>>>

MANUAL RANGE

25%
1%
1000 ppm
100 ppm

5. Advance the reverse shade cursor using the ARROW keys to highlight the desired MANUAL RANGE.
6. Press the ENTER key to select the highlighted menu option.
7. The following displays appears with the range selected and oxygen concentration of the sample gas:

MANUAL RANGE	>>>	3.3 PPM
25% 1% 1000 ppm 100 ppm		AUTO SAMPLING 100 PPM RANGE 24.5 C LO1 2 PPM 10 PPM HI2

8. The display will not shift automatically. Instead, when the oxygen reading (actually the sensor's signal output) exceeds 110% of the upper limit of the current range an OVER RANGE warning will be displayed.
9. Once the OVER RANGE warning appears the user must advance the analyzer to the next higher range via the menu and keypad Press MENU, select MANUAL SAMPLING, press ENTER, select the appropriate MANUAL RANGE and press ENTER again.

Alarms

The CONFIG ALARMS features a system that can be configured in the field. Two field adjustable alarm relays with dry contacts operate independently of one another which means the alarms can be set-up as:

- HI and LO
- LO and LO, LO,
- HI and HI,HI

Additional feature includes delaying the activation of the local audible alarm and relay contacts for up 99 minutes to enable users to distinguish between transient occurrences and true upset conditions which is particularly useful on remote applications without affecting the 4-20mA signal output. The local audible alarm can be silenced or disabled as well without affecting the 4-20mA signal output.

Note: A separate feature, BYPASS ALARMS described below, enables the user to disable the local audible alarm and relay contacts during calibration or servicing. The alarms are enabled when the alarm condition is corrected.

Set Alarm Values:

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CONFIG ALARMS.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appears:

MAIN MENU	>>>	MAIN MENU
AUTO SAMPLE MANUAL SAMPLE CALIBRATION CONFIG ALARMS BYPASS ALARMS		SET ALARM 1 SET ALARM 2 SET ALARM DELAY ALARM 1 HI/LO ALARM 2 HI/LO ALARMS AUDIBLE/SILENT

5. Advance the reverse shade cursor using the ARROW keys to highlight the SET ALARM 1 option.
6. Press the ENTER key to select the highlighted menu option.
7. The following displays appears with PERCENT as the default alarm value :

```
MAIN MENU

SET ALARM 1
SET ALARM 2
SET ALARM DELAY
ALARM 1 HI/LO
ALARM 2 HI/LO
ALARMS AUDIBLE/SILENT
```

>>>

```
GAS CONCENTRATION

PERCENT
PPM
```

8. Advance the reverse shade cursor using the ARROW keys to highlight the desired option.
9. Press the ENTER key to select the highlighted menu option.
10. **Note:** The PERCENT alarm value is entered with one decimal, the PPM alarm value is entered as an integer.

```
GAS CONCENTRATION

PERCENT
PPM
```

>>>

```
01.0

SET ALARM  1  VALUE

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

```
GAS CONCENTRATION

PERCENT
PPM
```

>>>

```
002

SET ALARM  1  VALUE

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

11. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the alarm value.
12. Press the ARROW keys to enter the alarm value.
13. Repeat steps 11 and 12 until the complete span value has been entered.
14. **Note:** If an alarm is set as a PERCENT value and subsequently changed to a PPM value, the PERCENT value is not retained and is reset to 00.0. This holds if the alarm was first set as PPM value and then changed to a PERCENT value.
15. **Save the alarm value by pressing the ENTER key or abort by pressing the MENU key.**
16. The system returns to the SAMPLING mode and displays:

```
3.3 PPM

AUTO SAMPLING
100 PPM  RANGE
24.5 C
LO1  2 PPM          10 PPM   HI2
```

Repeat the steps above to set the ALARM 2 value:

MAIN MENU	>>>	MAIN MENU
AUTO SAMPLE MANUAL SAMPLE CALIBRATION **CONFIG ALARMS** BYPASS ALARMS		SET ALARM 1 **SET ALARM 2** SET ALARM DELAY ALARM 1 HI/LO ALARM 2 HI/LO ALARMS AUDIBLE/SILENT

Set Alarm Delay:
Once the values for ALARM 1 and ALARM 2 have been entered, the user may elect to delay the activation of the local alarms and relay contacts for up to 99 minutes. This feature allows users to distinguish between transient occurrences and true upset conditions. This feature can be particularly useful on remote applications without affecting the 4-20mA signal output.

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CONFIG ALARMS.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

MAIN MENU	>>>	MAIN MENU
AUTO SAMPLE MANUAL SAMPLE CALIBRATION **CONFIG ALARMS** BYPASS ALARMS		SET ALARM 1 SET ALARM 2 **SET ALARM DELAY** ALARM 1 HI/LO ALARM 2 HI/LO ALARMS AUDIBLE/SILENT

5. Advance the reverse shade cursor using the ARROW keys to highlight the SET ALARM DELAY.
6. Press the ENTER key to select the highlighted menu option.
7. The following displays appear with last alarm delay value :

MAIN MENU	>>>	99
SET ALARM 1 SET ALARM 2 **SET ALARM DELAY** ALARM 1 HI/LO ALARM 2 HI/LO ALARMS AUDIBLE/SILENT		DELAY IN MINUTES PRESS UP OR DOWN TO CHANGE VALUE ENTER TO SAVE MENU TO RETURN

8. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the alarm value.
9. Press the ARROW keys to enter the alarm value.
10. Repeat steps 17 and 18 until the complete span value has been entered.
11. **Save the alarm value by pressing the ENTER key or abort by pressing the MENU key.**
12. The system returns the SAMPLING mode and displays:

3.3 PPM
AUTO SAMPLING
100 PPM RANGE
24.5 C
LO1 2 PPM 10 PPM HI2

Set HI/LO Alarms:

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CONFIG ALARMS.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appears:

```
MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS
```

\>>>

```
MAIN MENU

SET ALARM 1
SET ALARM 2
SET ALARM DELAY
ALARM 1 HI/LO
ALARM 2 HI/LO
ALARMS AUDIBLE/SILENT
```

5. Advance the reverse shade cursor using the ARROW keys to highlight the ALARM 1 option, which appears as either ALARM 1 HI or ALARM 1 LO.
6. Press the ENTER key to toggle and change the displayed setting. After 3 seconds, the system returns to SAMPLING mode.

```
3.3 PPM

AUTO SAMPLING
100 PPM  RANGE
24.5 C
LO1  2 PPM            10 PPM   HI2
```

7. Repeat steps 1 through 6 for the ALARM 2 HI/LO setting.

Set Local Alarms:

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CONFIG ALARMS.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appears:

```
MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS
```

\>>>

```
MAIN MENU

SET ALARM 1
SET ALARM 2
SET ALARM DELAY
ALARM 1 HI/LO
ALARM 2 HI/LO
ALARMS AUDIBLE/SILENT
```

5. Advance the reverse shade cursor using the ARROW keys to highlight the ALARMS AUDIBLE/SILENT option, which appear as either ALARMS AUDIBLE or ALARMS SILENT.
6. Press the ENTER key to toggle and change the displayed setting. After 3 seconds, the system returns to SAMPLING mode.

```
3.3 PPM

AUTO SAMPLING
100 PPM  RANGE
24.5 C
LO1  2 PPM            10 PPM   HI2
```

Bypass Alarms:
This feature, separate from CONFIG ALARMS above, enables the user to disable the local audible alarm and relay contacts during calibration or servicing. The alarms are enabled when the alarm condition is corrected.

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight BYPASS ALARMS.
3. The following displays appears:

MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS

4. Press the ENTER key to bypass and disable both the local audible alarm and relay contacts. After 3 seconds, the system returns to SAMPLING mode.

Note: The appropriate alarm setting will alternately reverse shades indicating the alarm condition exists but the BYPASS ALARMS feature has disabled the local audible alarm and relay contact. The alarms are enabled when the alarm condition is corrected.

3.3 PPM

AUTO SAMPLING
100 PPM RANGE
24.5 C
LO1 2 PPM 10 PPM HI2

Installation & Start-up is now complete . . . proceed to Calibration

Zero Calibration

In theory, the oxygen sensor produces no signal output when exposed to an oxygen free sample gas. In reality, expect the analyzer to generate an oxygen reading when sampling oxygen free sample gas due to:
- Contamination or quality of the zero gas
- Minor leakage in the sample line connections
- Residual oxygen dissolved in the sensor's electrolyte
- Tolerances of the electronic components

Recommendation: Zero calibration is recommended only for online analyzers intended for continuous precise measurements below 5 ppm on the 0-100 ppm range and then only when the sample system connections are modified and when installing a new oxygen sensor. It is not practical on higher ranges or portable analyzers for the following reasons:

1. Determining the true zero offset requires the user allow the analyzer approximately 24 hours to stabilize with flowing zero gas as evidenced by a stable reading with no downward trend on an external recording device. **Note:** Approximately 24-36 hours is required to assure the sensor has consumed the oxygen that has dissolved into the electrolyte inside the sensor while exposed to air or percentage levels of oxygen. For optimum accuracy, utilize as much of the actual sample system as possible.
2. Thus it is not practical to find the true zero offset particularly in the case of applications requiring higher level oxygen measurements because of the low offset value, normally 50% of the most sensitive analysis range, is not material to the accuracy of higher level measurements. Nor is it practical to zero a portable analyzer every time it is moved from one sample point to another.
3. **Caution:** Prematurely zeroing the analyzer can cause a negative reading in both the ZERO and SAMPLE modes.
4. Satisfying users that the zero offset is reasonably acceptable for their application can be accomplished much quicker. Unless the zero gas is contaminated or there is a significant leak in the sample connections, the analyzer should read less than 1000 ppm oxygen within 2-3 minutes after being placed on zero gas thereby indicating it is operating normally.

Procedure:
Zero calibration should precede the span calibration and once performed should not have to be repeated with subsequent span calibrations. Normally, zero calibrations are performed when a new sensor is installed or changes are made in the sample system connections.

Refer to Span Calibration below for the detailed procedure. Differences include the displays illustrated below, substituting a suitable zero gas for the span gas and the time required to determine the true zero offset of specific oxygen sensor, analyzer and sample system combination.

The maximum zero calibration adjustment permitted is 50% of the lowest full scale range available. Accordingly, the analyzer's ZERO has not been adjusted prior to shipment because the factory conditions are different from the application condition at the user's installation.

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

MAIN MENU		CALIBRATION
AUTO SAMPLE		SPAN CALIBRATE
MANUAL SAMPLE	>>>	ZERO CALIBRATE
CALIBRATION		DEFAULT SPAN
CONFIG ALARMS		DEFAULT ZERO
BYPASS ALARMS		OUTPUT SPAN
		OUTPUT ZERO

5. Advance the reverse shade cursor using the ARROW keys to highlight ZERO CALIBRATE.
6. Press the ENTER key to select the highlighted menu option.
7. The following displays appear:

0.000 PPM ZERO CALIBRTION ENTER TO CALIBRATE MENU TO ABORT

8. Press the ENTER key to calibrate or MENU key to abort and return to SAMPLING mode.
9. Allow approximately 60 seconds for the calibration process while the processor determines whether the signal output or reading has stabilized within 50% of the full scale low range.
10. Both the Zero Calibrate and Span Calibrate functions result in the following displays:

PASSED CALIBRATION	OR	FAILED CALIBRATION

Default Zero:
The software will eliminate any previous zero calibration adjustment and display the actual the signal output of the sensor at any specific oxygen concentration. For example, assuming a zero gas is introduced, the display will reflect an oxygen reading representing basically the zero calibration adjustment as described above. This feature allows the user to test the sensor's signal output without removing it from the sensor housing.

Procedure:
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

MAIN MENU AUTO SAMPLE MANUAL SAMPLE CALIBRATION CONFIG ALARMS BYPASS ALARMS	>>>	CALIBRATION SPAN CALIBRATE ZERO CALIBRATE DEFAULT SPAN DEFAULT ZERO OUTPUT SPAN OUTPUT ZERO

5. Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT ZERO.
6. Press the ENTER key to select the highlighted menu option.
7. The following display appears and after 3 seconds the system returns to the SAMPLING mode:

FACTORY DEFAULTS SET	3.3 PPM AUTO SAMPLING 100 PPM RANGE 24.5 C LO1 2 PPM 10 PPM HI2

Output Zero:
In rare instances the 4-20mA signal output may not agree to the reading displayed by the LCD. This feature enables the user to adjust the 4mA signal output when the LCD displays 00.00. Compute the adjustment value as described in Appendix B or consult the factory.

Note: Adjust the 20mA signal output with the OUTPUT SPAN option described below. The true adjustment value must be determined empirically by trial and error. Adjust the initial adjustment value for additional percent errors.

Procedure:
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

MAIN MENU	>>>	CALIBRATION
AUTO SAMPLE		SPAN CALIBRATE
MANUAL SAMPLE		ZERO CALIBRATE
CALIBRATION		DEFAULT SPAN
CONFIG ALARMS		DEFAULT ZERO
BYPASS ALARMS		OUTPUT SPAN
		OUTPUT ZERO

5. Advance the reverse shade cursor using the ARROW keys to highlight OUTPUT ZERO.
6. Press the ENTER key to select the highlighted menu option.
7. The following display appears

```
100.0

OUTPUT  ZERO  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

8. Compute the adjustment value as described in Appendix B. **Note:** The true adjustment value must be determined empirically by trial and error. Adjust the initial adjustment value for additional percent errors.

```
090.0

OUTPUT  ZERO  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

9. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the OUTPUT ZERO OFFSET value.
10. Press the ARROW keys to enter the OUTPUT ZERO OFFSET value.
11. Repeat steps 9 and 10 until the complete OUTPUT ZERO OFFSET value has been entered.
12. **Save the adjustment value by pressing the ENTER key or abort by pressing the MENU key.**
13. The system returns to the SAMPLING mode.

Span Calibration

Maximum drift from calibration temperature is approximately 0.11% of reading per °C. The analyzer has been calibrated at the factory. However, in order to obtain reliable data, the analyzer must be calibrated at the initial start-up and periodically thereafter. The maximum calibration interval recommended is approximately 3 months, or as determined by the user's application.

Calibration involves adjusting the analyzer electronics to the sensor's signal output at a given oxygen standard, e.g. a certified span gas with an oxygen content (balance nitrogen) approximating 80% of the next higher full scale range above the intended measuring range is recommended for optimum accuracy, see Calibration and Accuracy.

Recommendation – based on the inherent linearity of the galvanic oxygen sensor air calibrate the analyzer as described below when installing and replacing the oxygen sensor (exception UHP and MS versions of the Pico Ion Sensor); or, to verify the oxygen content of a certified span gas; or, when a certified span gas is not available (immediately following air calibration reintroduce a gas with a low oxygen concentration to expedite the return to ppm level measurements).

Caution: Prematurely initiating the SPAN CALIBRATION key before the galvanic fuel cell sensor based analyzer reading has stabilized can result in erroneous readings.

For example, to assure an accurate air calibration when installing a new ppm oxygen sensor from its packaged oxygen free atmosphere allow the oxygen sensor 2-3 minutes to reach equilibrium with the oxygen content of the ambient air surrounding it before pressing the SPAN CALIBRATE key. A ppm oxygen sensor that has not been allowed to reach equilibrium will generate a lower current output than a ppm oxygen sensor that has reached equilibrium. Pressing the SPAN CALIBRATE key before the ppm oxygen sensor has reached equilibrium forces the micro-processor to prematurely read the (erroneous low) current output of the ppm oxygen sensor and introduce larger (erroneous) than required electronic gain adjustment and display (also erroneous) CALIBRATION SUCCESSFUL message to the user. The error will become evident when a zero gas with a low oxygen concentration is introduced into the ppm analyzer to purge it down below 10 ppm. The analyzer reading may stop and appear to stabilize as high as 1800 ppm – giving the user the (erroneous) impression there is a problem with the ppm oxygen sensor when in fact the problem lies with the user's failure to follow the recommended calibration procedure.

Required components: Refer to Installing Span Gas section above.

1. Certified span gas cylinder with an oxygen concentration, balance nitrogen, approximating 80% of the full scale range above the intended measuring range.
2. Regulator to reduce pressure to between 5 and 30 psig.
3. Flow meter to set the flow between 1-5 SCFH,
4. Suitable fittings and a 4-6 ft. in length of 1/8" dia. metal tubing to connect the regulator to the flow meter inlet
5. Suitable fitting and a 4-6 ft. in length of 1/8" dia. metal tubing to connect to the flow meter vent
6. 1/8" male NPT to tube adapter fitting to connect the 1/8" dia. metal tubing from the flow meter vent to the mating male fitting supplied with the GPR-1900D.

Procedure:

The user must ascertain that the oxygen reading (actually the sensor's signal output) has reached a stable value within the limits entered below before entering the span adjustment. Failure to do so will result in an error.

This procedure assumes a span gas under positive pressure and is recommended for a analyzer without an optional sampling pump, which if installed downstream of the sensor should be placed in the OFF position and disconnected so the vent is not restricted during calibration. To assure an accurate calibration, the temperature and pressure of the span gas must closely approximate the sample conditions.

For calibration purposes, use of the AUTO SAMPLE mode is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE for calibration as dictated by the accuracy of the analysis required – for example, a span gas with an 80 ppm oxygen concentration with the balance nitrogen would dictate the use of the 0-100 ppm full scale range for calibration and a 0-10 ppm measuring range. Select as described above.

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight AUTO SAMPLE.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

```
MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS
```

```
        3.3 PPM

   AUTO SAMPLING
   100 PPM  RANGE
24.5 C
LO1  2 PPM        10 PPM   HI2
```

5. Return to the MAIN MENU by pressing the MENU key.
6. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
7. Press the ENTER key to select the highlighted menu option.
8. Repeat to select SPAN CALIBRATE
9. The following displays appear:

```
MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS
```

>>>

```
CALIBRATION

SPAN CALIBRATE
ZERO CALIBRATE
DEFAULT SPAN
DEFAULT ZERO
OUTPUT SPAN
OUTPUT ZERO
```

10. Assure there are no restrictions in vent line.
11. Regulate the pressure and control the flow rate as described above at 5-30 psig and a 2 SCFH flow rate.
12. Allow the span gas to flow for 1-2 minutes to purge the air trapped in the span gas line.
13. Disconnect the sample gas line and install the purged span gas line.
14. **Caution: Allow the span gas to flow and wait until the reading is stable before proceeding with calibration**. The wait time will vary depending on the amount oxygen introduced to the sensor when the gas lines were switched.
15. Press the ENTER key to select the SPAN CALIBRATE option.
16. **Note:** A span gas concentration above 1000 ppm dictates the selection of the PERCENT option.
17. Advance the reverse shade cursor using the ARROW keys to highlight the desired GAS CONCENTRATION.
18. Press the ENTER key to select the highlighted menu option.

```
GAS CONCENTRATION

PERCENT
PPM
```

19. The following displays appear:

```
000.00  PPM

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

>>>

```
080.00  PPM

SPAN
CALIBRATION
ENTER TO CALIBRATE
MENU TO ABORT
```

20. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the alarm value.
21. Press the ARROW keys to enter the alarm value.

22. Repeat steps 20 and 21 until the complete SPAN value has been entered.
23. **Save the adjustment value by pressing the ENTER key or abort by pressing the MENU key.**
24. Allow approximately 60 seconds for the calibration process while the processor determines whether the signal output or reading has stabilized within 60% of the full scale low range. Both the Zero Calibrate and Span Calibrate functions result in the following displays:

PASSED CALIBRATION	OR	**FAILED CALIBRATION**

25. If the calibration is successful, the analyzer returns to the SAMPLING mode after 30 seconds.
26. If the calibration is unsuccessful, return to the SAMPLING mode with span gas flowing through the analyzer, make sure the reading stabilizes and repeat the calibration before concluding the equipment is defective.
27. Before disconnecting the span gas line and connecting the sample gas line, restart if necessary the flow of sample gas and allow it to flow for 1-2 minutes to purge the air inside the line.
28. For ppm sensors disconnect the span gas line and replace it with a purged, see above, zero or low oxygen content gas line to purge the sensor down to the desired analysis range as quickly as possible.
29. Wait until the reading is stable and proceed to sampling.

Default Span

The software will set the SPAN adjustment based on the average oxygen reading (actually the sensor's signal output) at any specific oxygen concentration. For example, when a span gas is introduced, the micro-processor will display an oxygen reading within ±50% of the span gas value. This feature allows the user to test the sensor's signal output without removing it from the sensor housing.

Procedure:

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appears:

MAIN MENU **AUTO SAMPLE** **MANUAL SAMPLE** **CALIBRATION** **CONFIG ALARMS** **BYPASS ALARMS**	>>>	**CALIBRATION** **SPAN CALIBRATE** **ZERO CALIBRATE** **DEFAULT SPAN** **DEFAULT ZERO** **OUTPUT SPAN** **OUTPUT ZERO**

5. Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT SPAN.
6. Press the ENTER key to select the highlighted menu option.
7. The following displays appear and after 3 seconds the system returns to the SAMPLING mode:

FACTORY DEFAULTS SET	**3.3** PPM **AUTO SAMPLING** **100 PPM RANGE** **24.5 C** **LO1 2 PPM 10 PPM HI2**

Output Span:
In rare instances the 4-20mA signal output may not agree to the reading displayed by the LCD. This feature enables the user to adjust the 20mA signal output should the LCD display not agree.

Note: Adjust the 4mA signal output with the OUTPUT ZERO option described above.

Procedure:
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

```
MAIN MENU

AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION
CONFIG ALARMS
BYPASS ALARMS
```

\>>>

```
CALIBRATION

SPAN CALIBRATE
ZERO CALIBRATE
DEFAULT SPAN
DEFAULT ZERO
OUTPUT SPAN
OUTPUT ZERO
```

5. Advance the reverse shade cursor using the ARROW keys to highlight OUTPUT SPAN.
6. Press the ENTER key to select the highlighted menu option.
7. The following display appears

```
100.0

OUTPUT  SPAN  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

8. Compute the adjustment value as described in Appendix B or consult the factory. The true adjustment value must be determined empirically by trial and error. Adjust the initial adjustment value for additional percent errors.

```
099.0

OUTPUT  SPAN  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

9. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the OUTPUT SPAN OFFSET value.
10. Press the ARROW keys to enter the OUTPUT SPAN OFFSET value.
11. Repeat steps 9 and 10 until the complete OUTPUT SPAN OFFSET value has been entered.
12. **Save the adjustment value by pressing the ENTER key or abort by pressing the MENU key.**
13. The system returns to the SAMPLING mode.

Sampling

GPR-1900D Oxygen Analyzer requires positive pressure to flow the sample gas by the sensor to measure the oxygen concentration in a sample gas, refer to Sample System and Pressure & Flow sections at the beginning of Section 5 Operation. To assure optimal performance: connect gas lines with metal tubing, quality compression type fittings to minimize leaks, follow pressure and flow recommendations and avoid exposing the sensor to air and high oxygen concentrations for prolonged periods of time (this does not include the 5 minutes it should take to air calibrate the analyzer once a week).

Note: Prematurely initiating the ZERO CALIBRATION procedure can cause the analyzer to display a negative reading in both the ZERO and SAMPLE modes. Prematurely initiating the SPAN CALIBRATION procedure can cause erroneously high offsets and inaccurate readings.

Procedure:
Following calibration the analyzer returns to the SAMPLE mode after 30 seconds.

1. Select the desired sampling mode - auto or if manual, the range that provides maximum resolution – as described above.
2. Use metal tubing to transport the sample gas to the analyzer.
3. The main consideration is to eliminate air leaks which can affect oxygen measurements above or below the 20.9% oxygen concentration in ambient air - ensure the sample gas tubing connections fit tightly into the 1/8" male NPT to tube adapter, and, the NPT end is taped and securely tightened into the mating male quick disconnect fittings which mate with the female fittings on the analyzer
4. Assure there are no restrictions in the sample line.
5. For sample gases under positive pressure the user must provide a means of controlling the inlet pressure between 5-30 psig and the flow of the sample gas between 1-5 SCFH, a flow rate of 2 SCHF is recommended
6. For sample gases under atmospheric or slightly negative pressure an optional sampling pump is recommended to draw the sample into the analyzer. Generally, no pressure regulation or flow control device is involved.
7. **Caution:** If the analyzer is equipped with an optional sampling pump and is intended for use in both positive and atmospheric/slightly negative pressure applications where a flow meter valve is involved – ensure the valve is completely open when operating the sampling pump. Refer to the Pressure & Flow section above.
8. Assure the sample is adequately vented for optimum response and recovery – and safety.
9. Allow the oxygen reading to stabilize for approximately 10 minutes at each sample point.

To avoid erroneous oxygen readings and damaging the sensor:

- Do not place your finger over the vent (it pressurizes the sensor) to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor (voiding the sensor warranty).
- Assure there are no restrictions in the sample or vent lines
- Avoid drawing a vacuum that exceeds 14" of water column pressure – unless done gradually
- Avoid excessive flow rates above 5 SCFH which generate backpressure on the sensor.
- Avoid sudden releases of backpressure that can severely damage the sensor.
- Avoid the collection of particulates, liquids or condensation collect on the sensor that could block the diffusion of oxygen into the sensor.
- If the analyzer is equipped with an optional integral sampling pump (positioned downstream of the sensor) and a flow control metering valve (positioned upstream of the sensor), completely open the flow control metering valve to avoid drawing a vacuum on the sensor and placing an undue burden on the pump.

Standby

The analyzer has no special storage requirements.

- The sensor should remain connected during storage periods.
- Store the analyzer with the power OFF.
- If storing for an extended period of time protect the analyzer, cable and sensor from dust, heat and moisture.

6 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 requirements of this analyzer. **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-1900D analyzer. As a general guideline, expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.

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.

Procedure:
1. Unscrew the knurled lock ring connecting the cable to the sensor.
2. Disconnect and remove the female plug (including the knurled lock ring) molded to the cable from the male receptacle attached to the old oxygen sensor.
3. Unscrew the old oxygen sensor from the threaded hole in the sensor flow housing.
4. Open the barrier bag containing the new sensor.
5. The new oxygen sensor is equipped with a wire spring type shorting device, remove the shorting wire from the pins of the male receptacle attached to the new oxygen sensor.
6. Line up the registration point of the female plug molded to the cable and male receptacle on the oxygen sensor.
7. Push the female plug (including the knurled lock ring) into the male receptacle attached to the oxygen sensor.
8. Screw and finger tighten the knurled lock ring of the cable plug into to the male connector attached to the sensor.
9. Place the analyzer in the auto ranging mode, as described above.
10. With the sensor exposed to ambient air wait for 5-10 minutes until the reading stabilizes.
11. Perform and air calibration as described above.
12. Screw the new sensor, finger tight plus ¼ turn, into the threaded hole in the flow housing and ensure the o-ring seal is engaged but not 'crushed'.
13. Begin sampling.

7 Spare Parts

Recommended spare parts for the GPR-1900D Oxygen Analyzer include:

Item No.	Description
GPR-12-100-M	ppm Oxygen Sensor
XLT-12-100-M	ppm Oxygen Sensor (CO_2 background gas)

Other spare parts:

CONN-1014	Connector 4 Conductor Shielded Cable with Plug
A-2568	Housing Flow 1/8 SS Tube Fittings
MTR-1011	Meter Digital Panel LCD Backlight
A-1161-A4	PCB Assembly Main / Display
A-1162-AC	PCB Assembly AC Power Supply / Interconnection
A-1162-DC	PCB Assembly AC Power Supply / Interconnection

8 Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery or	At installation, defective sensor	Replace sensor if recovery unacceptable or O_2 reading fails to reach 10% of lowest range
	Air leak in sample system connection(s)	Leak test the entire sample system: Vary the flow rate, if the O_2 reading changes inversely with the change in flow rate indicates an air leak - correct source of leak
	Abnormality in zero gas	Qualify zero gas (using portable transmitter)
	Damaged in service - prolonged exposure to air, electrolyte leak	Replace sensor
	Sensor nearing end of life	Replace sensor
High O_2 reading after installing or replacing sensor	Transmitter calibrated before sensor stabilized caused by:	Allow O_2 reading to stabilize before making the span/calibration adjustment
	1) Prolonged exposure to ambient air, worse if sensor was **unshorted**	Continue purge with zero gas
	2) Air leak in sample system connection(s)	Leak test the entire sample system (above)
	3) Abnormality in zero gas	Qualify zero gas (using portable transmitter)
High O_2 reading Sampling	Flow rate exceeds limits	Correct pressure and flow rate
	Pressurized sensor	Remove restriction on vent line
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO_2 or acid gases are present
Response time slow	Air leak, dead legs, distance of sample line, low flow rate, volume of optional filters and scrubbers	Leak test (above), reduce dead volume or increase flow rate
O_2 reading doesn't agree to expected O_2 values	Pressure and temperature of the sample is different than span gas	Calibrate the transmitter (calibrate at pressure and temperature of sample)
	Abnormality in gas	Qualify the gas (use a portable transmitter)

Symptom	Possible Cause	Recommended Action
Erratic O_2 reading or No O_2 reading	Change in sample pressure	Sensors without PCB use mV setting. Calibrate the transmitter (calibrate at pressure and temperature of sample)
	Dirty electrical contacts in upper section of sensor housing	Clean contacts with alcohol (minimize exposure time of MS sensor to ambient air to extent possible)
	Corroded solder joints on sensor PCB from corrosive sample or electrolyte leakage from sensor	Replace sensor and 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 alcohol, flow sample or zero gas for 2-3 hours to flush sample system and sensor housing Sensor: Replace if leaking and return it to the factory for warranty determination
	Liquid covering sensing area	Wipe with alcohol and lint free towel or flow sample or zero gas for 2-3 hours to flush
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO_2 or acid gases are present. Consult factory.
	Presence of interference gases	Replace sensor and install scrubber
	Unauthorized maintenance	Consult factory.
	Sensor nearing end of life	Replace sensor
Erratic O_2 reading or Negative O_2 reading or No O_2 reading accompanied by electrolyte leakage	Pressurizing the sensor by flowing gas to the sensor with the vent restricted or SHUT OFF valve closed and suddenly removing the restriction draws a vacuum on the sensor	Zero the transmitter. If not successful replace the sensor
	or partially opening the valves upstream of the transmitter when using a pump downstream of the transmitter to draw sample from a process at atmospheric pressure or a slight vacuum. Placing a vacuum on the sensor in excess 4” of water column is strongly discouraged.	Avoid drawing a vacuum on the sensor, a pressurized sensor may not leak but still produce negative readings.
	A premature adjustment of the ZERO OFFSET potentiometer is a common problem	From MAIN MENU select DEFAULT ZERO

Purpose: **SPAN CALIBRATION** of digital (reference to analog) ppm O_2 analyzer already in-service.
TROUBLESHOOT ppm O_2 analyzer to confirm response and stability under controlled conditions.

Preliminary Test

1.) Confirm metal sample system components - no plastic.
2.) Leak Test: Vary analyzer flow rate up/down and observe reading.

Reading stable?

No:
1.) Tighten and 'Snoop' connections
2.) STOP if reading is not stable and contact factory.

Yes

Set-up

1.) Place analyzer SAMPLE/BYPASS valve(s) in BYPASS mode, see (a) below.
2.) Select AUTO-RANGING mode or MANUALLY select range for span gas
3.) Perform DEFAULT ZERO or MANUALLY eliminate previous zero adjustments
4.) Perform DEFAULT SPAN
Note: Zeroing the analyzer is only recommended for continuous analysis < 1 ppm which normally excludes portable analyzers - constantly changing gas lines.

Connect Gas Line

1.) Connect the span gas line or if equipped with a 3-way SAMPLE/SPAN valve place it in the SPAN mode.
2.) Allow the span gas to flow for 5-10 minutes to purge the air (20.9% O_2) from inside the span gas line - during connection or leaks during standby.

If analyzer is not equipped with BYPASS SAMPLE SYSTEM, see (a) below:
1.) Purge the span gas line before connecting to the analyzer.
2.) Connect the gas lines as quickly as possible - some air will be introduced.
3.) Allow extra time for the reading to stabilize - the sensor was exposed to air.
4.) When off-line, maintain gas flow thru analyzer or cap connections (inlet first) to avoid damaging the sensor by exposing it to air (20.9% O_2).

Calibration Procedure

1.) Place analyzer SAMPLE/BYPASS valve(s) in SAMPLE mode, see (a) below.
2.) Allow the reading to stabilize, normally 2-10 minutes unless exposed to air.
3.) Once stable - initiate CALIBRATION routine (or unlock and adjust SPAN knob) from MAIN MENU, select SPAN CALIBRATE, enter SPAN VALUE, press ENTER.

Calibration successful?

No:
1.) Confirm span gas with portable analyzer calibrated with ambient air.
2.) Repeat at least twice.
3.) Replace sensor and repeat once.
4.) If unsuccessful with new sensor, STOP and contact factory.

Yes

Troubleshooting

Note: SPAN CALIBRATION is complete and for TROUBLESHOOTING purposes demonstrates the sensor/analyzer responds normally - under controlled conditions.

For TROUBLESHOOTING purposes only: Connect one of the analyzer's signal outputs to an external recording device and continue the flow of span gas for 1-2 hours.

Reading stable?

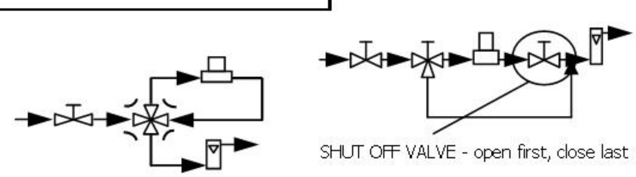
No:
1.) Replace sensor and repeat once.
2.) If unsuccessful with new sensor, STOP and contact factory.

Yes

Sampling

1.) Place analyzer SAMPLE/BYPASS valve(s) in BYPASS mode, see (a) below.
2.) Connect Gas Line - as above for sample gas.
3.) Place analyzer SAMPLE/BYPASS valve(s) in SAMPLE mode, see (a) below.

(a) Analyzer equipped (or supplied by user) with either type of BYPASS SAMPLE SYSTEM:



Purpose: AIR CALIBRATION of digital (reference to analog) ppm O_2 analyzer (only use for 0-25% range):

a.) when installing a new sensor,

b.) when span gas (instrument air piped to sensor - address as SPAN CALIBRATION) is not available or

c.) when it is advantageous from a troubleshooting standpoint to employ a portable analyzer that has been calibrated with ambient air as a "referee" to confirm other analyzers or span gas values.

Note 1: The drawback to air calibration is the time required for a ppm sensor exposed to air (1-2 minutes for calibration purposes) to recover to the 0-10 ppm range and the added requirement for low ppm O_2 concentration gas (sample, zero, purge or span) to purge the sensor of the oxygen that dissolves into the sensor's electrolyte when exposed to air (20.9% or 209,000 ppm O_2)

Note 2: Expected recovery time to 10 ppm on 1-2 ppm purge gas is < 1 hr at installation and < 20 minutes for an analyzer that has been in-service > 2 weeks. For higher ppm analysis, expected recovery time to 80-100 ppm on 1-2 ppm purge gas is < 10 minutes.

Preliminary

1.) Confirm metal sample system components - no plastic.

Set-up

1.) Select AUTO-RANGING mode or MANUALLY select 0-25% range for air calibration
2.) Perform DEFAULT ZERO or MANUALLY eliminate previous zero adjustments
Note: Zeroing the analyzer is only recommended for continuous analysis < 1 ppm which normally excludes portable analyzers - due to the constant changing of gas lines.
3.) Perform DEFAULT SPAN
4.) Install only: Place analyzer SAMPLE/BYPASS valve(s) in SAMPLE mode, see (a) pg. 1
5.) Install only: Connect the gas line or if equipped with a 3-way SAMPLE/SPAN valve place it in the SAMPLE mode.
6.) Start the low ppm O_2 gas (sample, zero, purge or span) flowing at 2 SCFH to purge the line of air and after air calibration to purge the sensor and expedite recovery to ppm levels.

Accessing Sensor

To access the sensor for replacement or air calibration:
1.) Locate the SS sensor housing inside the analyzer.
2.) Using a 5/16" wrench, loosen the bolt in the center of the bottom section.
3.) Rotate the upper section of the sensor housing 90°
4.) Pull-up gently to separate the sensor housing (DO NOT lose or dry off the o-ring).

Calibration Procedure

In-service air calibration only, liquid in upper section ?

Yes

1.) Short sensor across PCB foils temporarily
2.) Clean contact pins (damp rag)
3.) Perform continuity test - center pin to black wire, outer pin to red wire

Pass continuity test?

Yes

No

STOP, contact factory

No

1.1) Replacement: a.) Remove 'old sensor' and dispose of - local regs for batteries.
b.) Remove 'new sensor' from N_2 purged shipping package
c.) Remove red shorting tabs from the PCB foils
1.2) In-service air calibration - if necessary, remove shorting device after continuity test.
2.) Insert PCB end of sensor into upper section making contact with pins and hold it steady.
3.) Allow the reading to stabilize, normally 2-10 minutes unless exposed to air previously.
4.) Once stable - initiate CALIBRATION routine (or unlock and adjust SPAN knob) from MAIN MENU, select SPAN CALIBRATE, enter SPAN VALUE, press ENTER.

Calibration successful?

No

1.) Repeat with current sensor.
2.) Replace sensor and repeat.
3.) If unsuccessful with new sensor, STOP and contact factory.

Yes

1.) Place the sensor in the bottom section and reassemble the sensor housing.
2.) The low ppm O_2 gas (above) should already be flowing at 2 SCFH to purge the to purge the sensor and expedite recovery to 10 ppm range - continue for 60-90 minutes.

Expected recovery time?

No

1.) Perform LEAK TEST, see pg. 1
2.) If successful, continue purge 1 hr.
3.) If unsuccessful after additional purge, replace sensor and repeat.
4.) If unsuccessful with new sensor, STOP and contact factory.

Yes

1.) Place analyzer SAMPLE/BYPASS valve(s) in BYPASS mode, see (a) pg.1
2.) Connect Gas Line - see pg. 1 - for sample gas as necessary
3.) Place analyzer SAMPLE/BYPASS valve(s) in SAMPLE mode, see (a) pg. 1

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9 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 monitor, analyzers 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. Advanced Instruments Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your Advanced Instruments Inc. monitor, 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 Advanced Instruments 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
Advanced Instruments Inc. will not pay for: loss of time; inconvenience; loss of use of your Advanced Instruments Inc. analyzer or property damage caused by your Advanced Instruments 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 Advanced Instruments Inc. at 909-392-6900 (or e-mail info@aii1.com) between 7:30 AM and 5:00 PM 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 you analyzer, postage prepaid to:

Advanced Instruments 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 your Advanced Instruments Inc. analyzer, we will ship it to you at no cost for parts and labor.

10 MSDS Material Safety Data Sheet

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	Aqueous solutions: KOH = Colorless, odorless or Acetic Acid = Colorless, vinegar-like odor

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 Special Protection	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

Appendix B

Correlating Readings - LCD Display and 4-20mA Output

In rare instances the 4-20mA signal output may not agree to the reading displayed by the LCD. The Output Zero and Output Span features enable the user to adjust the 4mA signal output to correlate with the reading displayed by the LCD.

For optimum accuracy make two separate adjustments as follows:
1. OUTPUT ZERO feature: To adjust the 4mA signal output and requires zero gas.
2. OUTPUT SPAN feature: To adjust the 20mA signal output and requires span gas near full range.

In the field or in the absence of the preferred gases, use the OUTPUT SPAN feature and adjust the 20mA signal output using the span gas available.

Procedure – regardless of type of adjustment:
1. The microprocessor defaults to 100% to start.
2. The "actual" 4-20mA signal output will be adjusted to the "theoretical" value of the LCD display.
3. Adjustment general rule:
   a) If the actual 4-20mA value < the theoretical LCD value, the adjustment value will be > 100%.
   b) If the actual 4-20mA value > the theoretical LCD value, the adjustment value will be < 100%.
4. Convert the "actual" reading of the LCD display to the "theoretical" 4-20mA as follows:
   a) Divide the "actual" (ppm or percent) LCD reading by the value of the span gas available.
   b) Multiply 16mA (20mA – 4mA) times the "result of a."
   c) Add 4mA plus the "result of b." to obtain the "theoretical" 4-20mA signal output value.
5. Adjustment value: Divide the theoretical by the actual 4-20mA values and multiply by 100.
6. Enter the adjustment value via OUTPUT ZERO or OUTPUT SPAN routines described below.

Example: Analyzer reading is 60 ppm oxygen (100 ppm range) on 84 ppm span gas, 4-20mA signal output at PLC is 24mA

Solution: a) Use OUTPUT SPAN feature to make the adjustment.
b) Adjustment will be < 100% (default value of OUTPUT SPAN feature).
c) 13.6mA is the "theoretical" 4-20mA converted from the "actual" reading of the LCD.
60 ppm divided by 84 ppm = 0.71 or 71%
16mA multiplied by 0.71 = 11.36mA
4mA plus 11.36mA = 15.36mA "theoretical" 4-20mA signal output value
d) 15.36mA divided by 24mA the "actual" 4-20mA value = 64.0 adjustment value
e) Enter 64.0 via OUTPUT SPAN procedure below.

Output Zero
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:

MAIN MENU		CALIBRATION
AUTO SAMPLE MANUAL SAMPLE CALIBRATION	>>>	SPAN CALIBRATE ZERO CALIBRATE DEFAULT SPAN DEFAULT ZERO OUTPUT SPAN OUTPUT ZERO

5. Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT ZERO.
6. Press the ENTER key to select the highlighted menu option.
7. The following display appears:

```
100.0

OUTPUT  ZERO  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

8. Enter the calculated adjustment value. **Note:** Once the initial adjustment is made and checked at the PLC it may be necessary to fine tune the initial adjustment by repeating. Any additional percent error must be added or subtracted from the initial adjustment value.

```
000.0

OUTPUT  ZERO  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

9. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the adjustment OUTPUT ZERO OFFSET value.
10. Press the ARROW keys to enter each the numerical value of each digit of the adjustment OUTPUT ZERO OFFSET value.
11. Repeat until the complete OUTPUT ZERO OFFSET value has been entered.
12. **Save the adjustment value by pressing the ENTER key or abort by pressing the MENU key.**
13. The system returns to the SAMPLING mode.

Output Span

14. Access the MAIN MENU by pressing the MENU key.
15. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
16. Press the ENTER key to select the highlighted menu option.
17. The following displays appear:

```
MAIN MENU                 >>>     CALIBRATION

AUTO SAMPLE                       SPAN CALIBRATE
MANUAL SAMPLE                     ZERO CALIBRATE
CALIBRATION                       DEFAULT SPAN
                                  DEFAULT ZERO
                                  OUTPUT SPAN
                                  OUTPUT ZERO
```

18. Advance the reverse shade cursor using the ARROW keys to highlight OUTPUT SPAN.
19. Press the ENTER key to select the highlighted menu option.
20. The following display appears:

```
100.0

OUTPUT  SPAN  OFFSET

PRESS UP OR DOWN
TO CHANGE VALUE
ENTER TO SAVE
MENU TO RETURN
```

21. Enter the calculated adjustment value, refer to example described above. **Note:** Once the initial adjustment is made and checked at the PLC it may be necessary to fine tune the initial adjustment by repeating. Any additional percent error must be added or subtracted from the initial adjustment value

064.0
OUTPUT SPAN OFFSET
PRESS UP OR DOWN TO CHANGE VALUE ENTER TO SAVE MENU TO RETURN

.

22. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the adjustment OUTPUT SPAN OFFSET value.
23. Press the ARROW keys to enter the numerical value of each digit of the OUTPUT SPAN OFFSET value.
24. Repeat until the complete OUTPUT SPAN OFFSET value has been entered.
25. **Save the adjustment value by pressing the ENTER key or abort by pressing the MENU key.**
26. The system returns to the SAMPLING mode.