Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-10, 0-100, 0-1000 PPM, 0-1%, 0-25% (CAL) FS Auto-ranging or manual lock on a single range
Application:	Oxygen analysis in inert, helium, hydrogen, mixed and acid (CO_2) gas streams
Approvals:	CE
Area Classification:	General purpose
Alarms:	Two 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:	1 month interval using certified span gas or ambient air
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:	1-2 SCFH recommended
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig to deliver 1-2 SCFH flow; vent - atmospheric
Power:	Universal; specify 100/120/220/240 VAC or 12-28 VDC
Range ID:	4-20 mA or relay contacts
Recovery Time:	60 seconds in air to < 10 PPM in < 1 hr on N2 purge
Response Time:	90% of final FS reading < 10 seconds
Sample System:	Sample Flow-through sensor housing
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-333-M for non-acid (CO2) gas streams; XLT-12-333-M for gases containing > 0.5% CO2
Sensor Life:	24 months in < 1000 PPM O2 at 25ºC and 1 atm
Signal Output:	4-20mA
Temp. Range:	-10ºC to 45ºC (GPR), -20ºC to 45ºC (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

2-part SS sensor housing, Sample conditioning accessories - contact factory

* Specification subject to change without notice.

IND-190
PPM Oxygen Analyzer

Shown with optional 2-part SS sensor housing
Panel Mount Configuration for OEM Applications

Advanced Sensor Technology

- **Unmatched Expected Life & Warranty**
- **Unmatched Recovery from Air to 10 PPM**
- **Extended Operating Range to –10ºC**
- **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 Set-points

Power /System Failure Alarms

5 Ranges Standard

4-20 mA

Optional Range ID 4-20 mA or Relay Contacts

Stainless Steel Wetted Parts

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 3/1205

GPR-IN190
PPM Oxygen Analyzer

Shown with optional sensor housing

Owner's Manual

Revised August 2013

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-IN190 PPM Oxygen Analyzer	**S/N** _____	
Sensor:	( ) GPR-12-333-M PPM Oxygen Sensor		
	( ) XLT-12-333-M PPM Oxygen Sensor	**S/N** _____	
Accessories:	Owner's Manual		
	CABL-1008 Power Cord		
Configuration:	Ranges: 0-10 PPM, 0-100 PPM, 0-1000 PPM, 0-1%, 0-25%		
	A-1161-1 PCB Assembly Micro / Display – **Software V.** _____		
	A-1162 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-1900R)	( ) Panel mounted with rear cover for 19" rack 19x7x12"		
(GPR-1900W)	( ) Door mounted for NEMA4 wall mount 12x12x8"		
	SS sensor 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			

3 Safety Guidelines

This section summarizes the basic precautions applicable to all analyzers. 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 Instructions: Follow all warnings on the analyzer, accessories (if any) and in this Owner's Manual. Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the analyzer.
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 this Owner's Manual. 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 detailed by section 9, 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: Disconnect the power when the analyzer is left unused for a long period of time.

Installation

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

Contaminant Gases: A gas scrubber and flow indicator with integral metering valve are required upstream of the 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 sensor warranty if not identified at time of order placement. Consult factory for recommendations concerning the proper selection and installation of scrubber/filter 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 the basis of oxygen concentration (< 10,000 PPM), temperature (77°F/25°C) and pressure (1 atmosphere) in "normal" applications. As a rule of thumb sensor life is inversely proportional to changes in the parameters. Deviations of the gas concentration and or temperature outside of the specifications will affect the life of the sensor. Avoid exposure to oxygen levels above 1% (10,000 PPM) for hours at a time.

Failure to do so may result in damage to the sensor(s) as follows:

- GPR Series PPM sensors – reduced sensor life and loss of low end sensitivity when exposed continuously to 20.9% oxygen; sensor will last approximately 6-8 months and may develop a low end offset > 1-2 PPM
- XLT Series PPM sensors - reduced sensor life and loss of low end sensitivity (XLT sensor exposed continuously to the 20.9% O2 content of air will last approximately 7 days).

Accuracy & Calibration

Refer to section 5 Operation. The 0-25% Range is provided only for the purpose of air calibration which is recommended only if span gas is not available. Bringing the analyzer back online after calibration with the 20.9% oxygen content of air, takes longer than calibrating the analyzer with a span gas, for example, 80 PPM oxygen.

Materials

Assemble the necessary zero, sample 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 measurements.

Operating 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. The maximum recommended operating temperature is 45º C. On an intermittent basis, unless the user is willing to accept a reduction in expected sensor life – refer to analyzer specification, the analyzer may be operated at 50 degree ºC. At temperatures above 25ºC, the user can expect a reduction in sensor life of ~ 2.5% per degree increase in temperature. As an example, if the analyzer is continuously operated at 35ºC, the expected sensor life will be reduced by ~25%.

Pressure and 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 in a confined space in a control room or an open area such as a landfill or bio-pond).

Sample systems and flowing gas samples are generally required for applications involving oxygen measurements in a gas mixture. For sub PPM measurements, the use of stainless steel tubing and fittings is critical to maintaining the integrity of the gas stream to be sampled. Further, the inlet sample pressure must always be higher than the pressure at the outlet vent, which is normally at atmospheric pressure.

To analyze a gas stream, the gas must flow or be drawn through the sensor housing. The internal sample system of the analyzer may include sample/bypass valves, shut off valve, a flow control (please check the QC sheet to ensure the included sample system), a flow indicator and a stainless steel sensor housing with an o-ring seal to prevent the leakage of air into the sensor housing.

Inlet Pressure
Sample inlet should be set 5-30 PSIG; this pressure allows easy control of the sample flow with a flowmeter or by using a metering valve and a flow indicator.

Outlet Pressure
Ideally, the sample must be vented to ambient pressure or in a vent with pressure no greater than the 1-2 PSIG. If the sample is vented to a line where pressure may change, a back pressure regulated set at no greater 1-2 PSIG must be installed on the downstream of the sensor to ensure a constant pressure on the sensor.

Flow Rate
Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH may generate a backpressure on the sensor and cause erroneous oxygen readings.

Caution
Do not place your finger over the vent (it pressurizes the sensor) to check the sample flow 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).

Moisture & Particulates
Installation of a suitable coalescing and or particulate filter is required to remove liquid condensates, and/or particulates from the sample gas to prevent clogging of the sampling system. Moisture and/or particulates do not necessarily damage the sensor itself but collection of moisture/particulate on the sensing surface can block or inhibit the diffusion of sample gas into the sensor thus resulting in a reduction of sensor signal output – and the appearance of a sensor failure. Consult factory for recommendations concerning the proper selection of coalescing/particulate filters.

Moisture and/or particulates collected at the sensor may be removed by either blowing on the sensing surface or gently wiping the sensing surface with damp cloth.

Mounting
The standard analyzer is approved for indoor use only. Outdoor use requires optional enclosures, consult factory. Mount analyzer as recommended in this manual.

The analyzer is configured for panel mounting and requires a 7.5x10.8" (T configuration) cutout with 4 holes for the analyzer's front panel. Optional configurations include a panel mount (TO configuration) with 7.75x7.75" cutout; 19" bezel for rack mounting either the T or TO; 12x12x8" wall mount enclosure (GPR-1600W) and 18.2x16x10" panel mount configuration (GPR-1600W-306).

Gas Connections
Inlet and outlet vent gas lines for PPM analysis require 1/8" or ¼" stainless steel compression fittings and SS tubing; hard plastic tubing with a low gas permeability factor may be used for measurements above 100 PPM oxygen.

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. Ensure that the analyzer enclosure is properly grounded and meets the requirements of recommended local electrical standards.

Never yank wiring to remove it from a terminal connection.

AC or DC powered analyzers consume a maximum of 7 watts.

4 Features & Specifications

Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-10, 0-100, 0-1000 PPM, 0-1%, 0-25% (CAL) FS Auto-ranging or manual lock on a single range
Application:	Oxygen analysis in inert, helium, hydrogen, mixed and acid (CO_2) gas streams
Approvals:	CE
Area Classification:	General purpose
Alarms:	Two 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:	3 month interval using certified span gas (preferred for fastest online time) or air with O2 value approximating 80% of full scale range balance N2
Compensation:	Barometric pressure and temperature
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration, alarm and system functions
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; vent - atmospheric
Power:	Universal; specify 100/120/220/240 VAC or 12-28 VDC
Range ID:	4-20 mA or relay contacts
Recovery Time:	60 seconds in air to < 10 PPM in < 1 hr on N2 purge
Response Time:	90% of final FS reading < 10 seconds
Sample System:	None
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-333-4 for non-acid (CO2) gas streams; XLT-12-333-4 for gases containing > 0.5% CO2
Sensor Life:	24 months in < 1000 PPM O2 at 25ºC and 1 atm
Signal Output:	4-20mA isolated or 0-1V
Temp. Range:	-10ºC to 45ºC (GPR), -20ºC 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-IN190
PPM Oxygen Analyzer
Shown with optional sensor housing
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 0-1V Signal Output
Range ID 4-20 mA or Relay Contacts
Stainless Steel Wetted Parts

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

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5 Operations

Principle of Operation

The GPR-IN190 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. All configurations are tested and calibrated by the manufacturer prior to shipment.

The GPR-IN190 series analyzers and sensors conform to CE standards and are manufactured under a Quality Assurance System, certified by an independent agency, in accordance with ISO 9001:2008 standards.

Advance Galvanic Sensor Technology

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

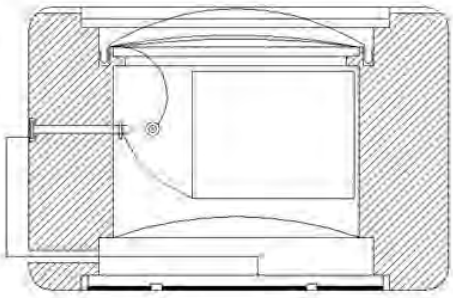
Proprietary advancements in the design and chemistry add significant advantages to an extremely versatile oxygen sensing technology. Sensors for low PPM analysis recover from air to PPM levels in minutes, exhibit longer life, offer extended operating range of -10°C to 50°C, have excellent compatibility with CO_2 and acid gases (XLT series sensors) and reliable quality thus giving the user a significant advantage over other competitors. Other advancements include extending the expected life of our new generation of percentage range sensors to five to ten years with faster response times and greater stability. Another significant development involves the first galvanic oxygen sensor capable of measuring oxygen purity continuously and expanded operating temperature range from -40°C to 50°C. Consult factory for selection of sensors for your specific applications.

Design Objectives

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

ppm Oxygen Sensors

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



GPR/XLT 12 Series ppm Oxygen Sensor

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.

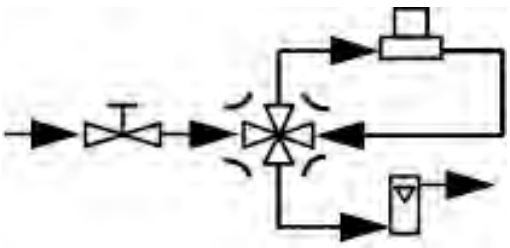
Users interested in adding their own sample handling or conditioning system are encouraged to consult the factory to ensure all applicable conditions are addressed to ensure proper operation of the analyzer. Advanced Instruments Inc. offers a full line of sample handling, conditioning and expertise to meet your application requirements. Contact us at 909-392-6900 or e-mail us at info@aii1.com

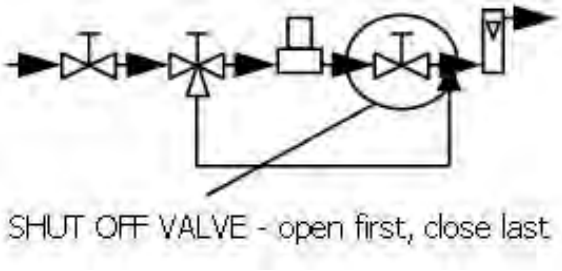
Sample System

The GPR-IN190 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.

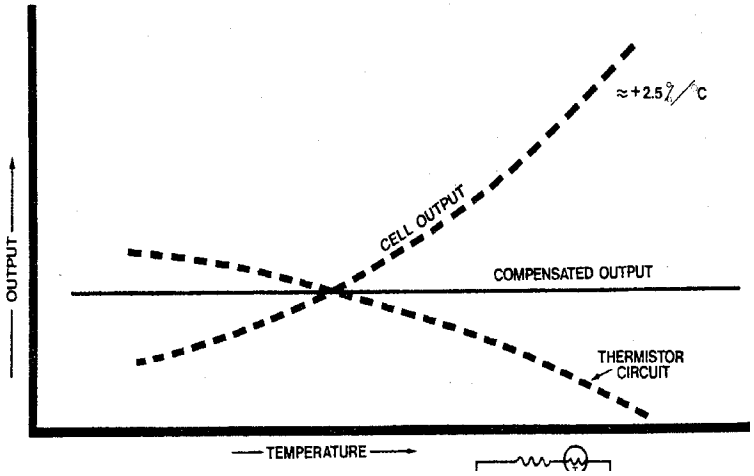




The 'bypass sample system' is optimal, however, it is not required. For example, deleting the 3-way valve from the illustration on the right enables the user to isolate the sensor but lengthens the time required to bring the analyzer online. The bypass feature diverts the flow of sample gas containing 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 the linearity and absolute zero properties, single point calibration is possible.



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

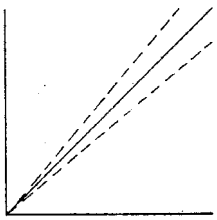
Temperature: The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier. The fact that all diffusion processes are temperature sensitive, the sensor's electrical output also varies with temperature. This variation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

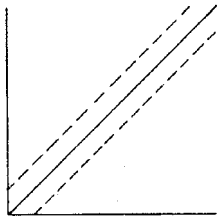
Accuracy: In light of the above parameters, the overall accuracy of an analyzer is affected by two factors:

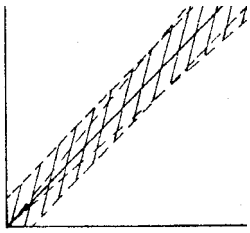
1) 'Percent of reading errors', illustrated by Graph A below, such as ±5% inherited error in the temperature compensation circuit due to the tolerances of the resistors and thermistor.

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

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


A. PERCENT OF READING ERRORS


B. PERCENT OF FULL SCALE ERRORS


C. OVERALL ACCURACY

Example 1: As illustrated by Graph A any error during a span adjustment, e.g., at 20.9% (air) of full scale range would be multiplied by a factor of 4.78 (100/20.9) when used for measurements of 95-100% oxygen concentrations.

Conversely, an error during span adjustment at 100% of full scale range will be reduced proportionately for measurements of lower oxygen concentrations. Refer to the Calibration section for additional details.

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.

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 Consult factory for recommendations concerning the proper selection and installation of scrubber components.

Expected Sensor Life: With reference to the publish specification the expected life of all oxygen sensors is predicated on oxygen concentration, temperature and pressure (see section 4 for more info). Deviations outside these specifications will affect the life of the sensor. As a rule of thumb, sensor life is inversely proportional to changes in the parameters.

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 is recommended only for online analyzers performing continuous analysis below 5% of the lowest most sensitive range available with analyzer, e.g. analysis below 0.5 PPM on the 10 PPM range.

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.

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.

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 range of interest or one range above the intended measuring range is recommended for optimum accuracy.

Recommendation: 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. However, a certified span gas may be used for calibration (see above).

Air calibrate the analyzer when installing and replacing a new oxygen sensor assures the user that analyzer and sensor are within the specifications; air calibration failure will alert the user to take immediate steps to correct the mode of failure (analyzer electronics or sensor/sensor housing).

Temperature: The sample must be sufficiently cooled (within the operating range of the analyzer) 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.

Mounting the Analyzer and Sensor

The GPR-IN190 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 stainless steel sensor 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:

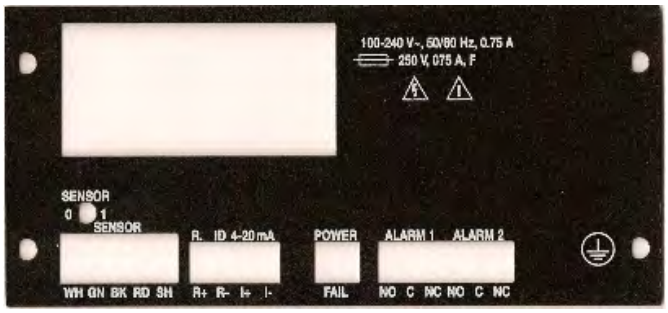
1. The GPR-IN190 front panel measures 7"W x 4"H x 4.5"D. This compact configuration is designed for panel mounting directly to any flat vertical surface, wall or bulkhead plate with the appropriate 6"W x 3"H cut out and four ¼" diameter holes for insertion of the mounting studs located on the back side 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.
3. Position the sensor housing along any flat surface. The bracket attached to the sensor housing is fabricated with two 6/32 mounting holes. The oxygen sensor is not position sensitive but it is recommended to orient the sensor housing with the upper section identified by the interconnection cable facing the ceiling.
4. If not already connected, connect the four wires of the sensor housing cable, following the color coding noted at the terminal block, at the rear of the analyzer.
5. Mount the sensor housing as suggested above.
6. Do not install the sensor at this time, see below.

Gas Connections

The GPR-IN190 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.

Electrical Connections

The appropriate AC or DC power requirement must be specified at the time of placing order.



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 7 watts.

Terminal blocks are provided for power failure, alarm relays and signal output connections. A sensor bypass switch is provided at the rear of the analyzer 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, supplying power to 4-20 mA terminal will permanently damage the 4-20 mA IC.

Procedure:

1. As illustrated above the sensor, power and alarm relays and signal output connections are mounted on the PCB with the screw type terminal protruding out for making external connectionsr.
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. Connecting Relays as " 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.

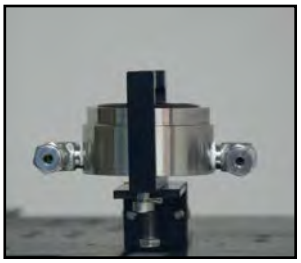
Installing the Oxygen Sensor

The GPR-IN190 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. The sensor has not been installed at the factory (in standard configuration there are no valves to isolate the sensor) and it will be necessary to install the sensor in the field.
2. As described above the following steps should already be completed:
   a) Secure the sensor housing bracket with two 6/32 mounting screws, in the preferred position the upper section with the interconnection cable should be facing the ceiling;
   b) connect the gas lines;
   c) electrical connections.



1. **Caution:** Do not change the factory settings until instructed to do in this manual.
2. Purge the oxygen trapped in the newly connected gas lines for 3-5 minutes.
3. Flow zero gas or sample gas with a low ppm oxygen concentration to the analyzer at the predetermined flow rate of 2 SCFH.
4. Using the 5/16 wrench supplied loosen but do not remove the clamp bolt located under the sensor housing, see photo.
5. Rotate the upper section of the sensor housing 90º to disengage from the clamp.
6. Remove the upper section by pulling it straight up and place it on a smooth surface.
7. Select the AUTO RANGING option from the SAMPLE menu with gas flowing to the analyzer.
8. Remove the oxygen sensor from the bag and remove the red shorting device (including the gold ribbon) from the PCB located at the rear of the sensor.
9. Minimize the time the sensor is exposed to ambient air.
10. Immediately place the sensor in the bottom section of the sensor housing with the PCB facing up.
11. Immediately place the upper section of the sensor housing over the sensor, gently push the upper section downward and rotate 90º to engage the clamp.
12. Finger tighten the clamp bolt and then tighten it one full turn with the 5/16 wrench to securely lock the two sections of the sensor housing.
13. The analyzer will OVER RANGE for a short period of time as indicated by the graphical LCD display.
14. Wait until the display shows a meaningful oxygen reading and begins to approach the expected oxygen content of the sample gas.

Span Gas Preparation

A percent analyzer such as the GPR-IN190 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-IN190 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

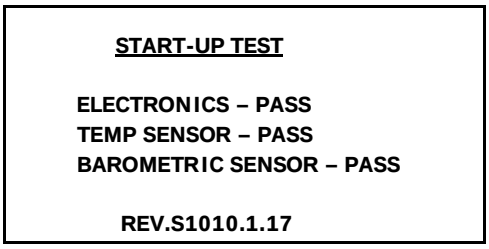
- Suitable fitting and 1/8" dia. 4-6 ft. in length of metal tubing to connect from the flow meter vent to tube fitting designated SAMPLE IN.

Procedure:

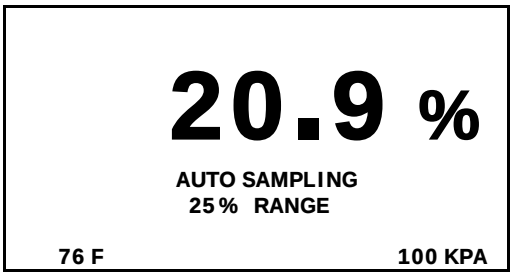
1. With the span gas cylinder valve closed, install the regulator on the cylinder.
2. Open the regulator's exit valve and partially open the pressure regulator's control knob.
3. Open slightly the cylinder valve.
4. Loosen the nut connecting the regulator to the cylinder and bleed the pressure regulator.
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 Analyzer

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:



After self diagnostic tests, the analyzer turns itself into the sampling mode. And displays oxygen contents the sensor is exposed to, the analysis range, the ambient temperature and pressure and the software rev level.

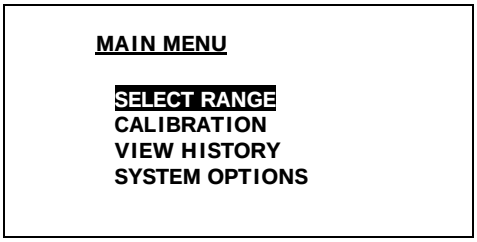


Menu Navigation

The four (4) pushbuttons located on the front of the transmitter control the micro-processor functions:
Blue ENTER (select)
Yellow UP ARROW
Yellow DOWN ARROW
Green MENU (escape)

Main Menu

To access the MAIN MENU, press the MENU (ESC) key and the following screen will appear.



This screen show various option available. You can use the UP and DOWN arrow key to move the cursor and highlight the desired function. After moving the cursor to the desired function, you can press ENTER to get to that function.

Range Selection

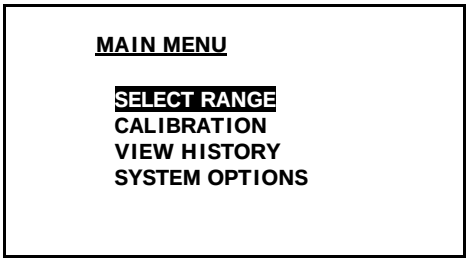
The GPR-1500-AIS transmitter is equipped with five (5) standard measuring ranges (see specification) and provides users with a choice of sampling modes. By accessing the MAIN MENU, users may select either the AUTO SAMPLING (ranging) or MANUAL SAMPLING (to lock on a single range) mode.

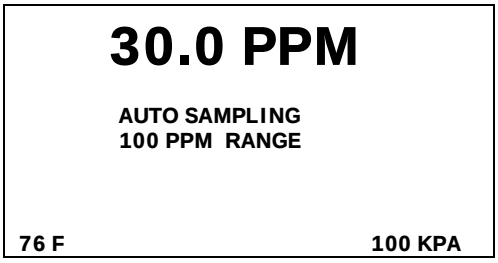
Note: For calibration purposes, use of the AUTO SAMPLE mode and ambient air (20.9% oxygen on the 0-25% range which meets the 80% of FS recommendation described below) is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE for calibration as dictated by the accuracy of the analysis required – for example, a span gas with an 80 PPP oxygen concentration in nitrogen would dictate the use of the 0-100 PPM full scale range for calibration and a 0-100 PP measuring range.

Auto/ Manual Sampling

Access the MAIN MENU by pressing the MENU key.
Advance the reverse shade cursor using the ARROW keys to highlight SELECT RANGE and press ENTER
The display will show *AUTO and the actual range of analysis. Press the ENTER to select MANUAL RANGE and advance the cursor to the desired RANGE and press ENTER.
The following display appears:

The display returns to the sampling mode:



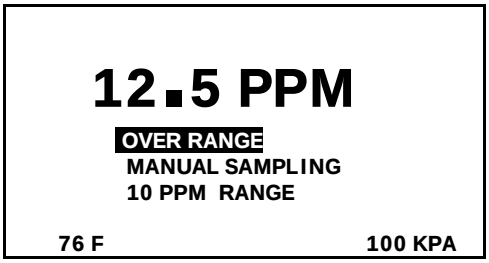


The display will shift to the next higher range when the oxygen reading exceeds 99.9% of the upper limit of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the upper limit of the next lower range.

For example, if the transmitter is reading 5 PPM on the 0-10 PPM range and an upset occurs, the display will shift to the 0-100 PPM range when the oxygen reading exceeds 9.99 PPM. Conversely, once the upset condition is corrected, the display will shift back to the 0-10 PPM range when the oxygen reading drops to 8.5 PPM.

Pressing SELECT RANGE and then pressing ENTER will toggle between AUTO and MANUAL sampling

When MANUAL range is selected and If the oxygen value goes above the selected range, display will not shift to the next higher range. Instead, when the oxygen reading exceeds 110% of the upper limit of the current range, an OVER RANGE warning will be displayed.



Once the OVER RANGE warning appears the user must advance the transmitter to the next higher range.
NOTE: With oxygen reading above 110% of the selected range, the mA signal output will increase but will freeze at a maximum value of 24 mA. After the oxygen reading falls below the full scale range, the mA signal will become normal.

Analyzer Calibration

The electrochemical oxygen sensors generate an electrical current that is **linear** or proportional to the oxygen concentration in a sample gas. In the absence of oxygen the sensor exhibits an **absolute zero**, i.e., the sensor does

not generate a current output in the absence of oxygen. Given the properties of linearity and an absolute zero, a single point calibration is possible.

The analyzer is equipped with “Zero Calibration” feature. However, as described below, zero calibration is recommended only when the application (or user) demands optimum accuracy of below 5% of the most sensitive or lowest range available on the analyzer. For example, if the user requires analysis of a sample gas below 0.05%, zero calibration may be required.

Span calibration, it is necessary to adjust the analyzer sensitivity for accurate measurements of oxygen by using a standardized (certified) oxygen or by using ambient air (20.9%).

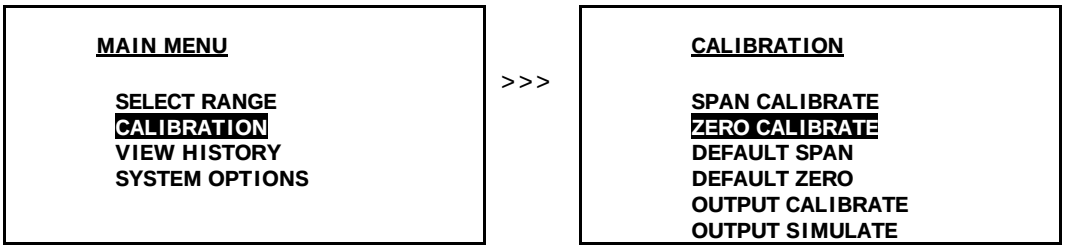
Zero Calibration

Ideally, with no oxygen, the sensor should have zero signal but in reality, the analyzer may display oxygen reading with a sample gas containing no oxygen (zero gas). Under such circumstance, it may be necessary to perform a Zero calibration to remove any offset with oxygen free sample gas. The maximum zero offset correction is limited to a maximum of 10% of the lowest (most sensitive) range for positive zero offset and 10% of the lowest range for negative zero offset.

Zero calibration could be carried out before or after the span calibration. Normally, zero calibrations are performed when a new sensor is installed or changes are made in the sample system connections. Allow the ZERO gas to flow through the analyzer and wait until the signal has dropped to a low value and is stable.

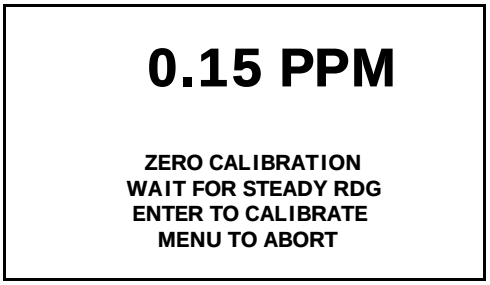
Access the MAIN MENU by pressing the MENU key.
Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
Press the ENTER key to select the highlighted menu option.

The following displays appear:



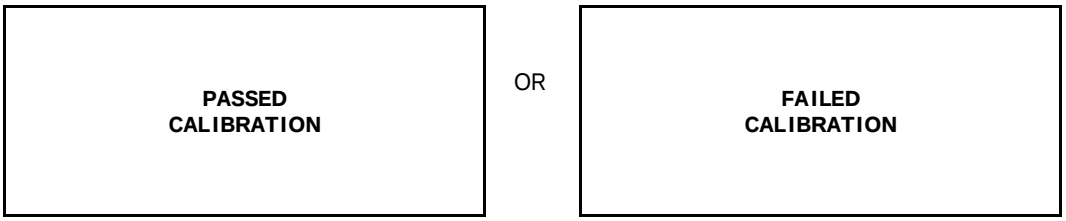
Advance the reverse shade cursor using the ARROW keys to highlight ZERO CALIBRATE.
Press the ENTER key to select the highlighted menu option.

The following displays appear:



Wait until the analyzer reading stabilizes (depending on the history of the sensor, it may take a few minutes to several hours) and then press the ENTER key to calibrate (or MENU key to abort).
If the offset is less than 10% of the lowest range, by pressing ENTER will pass the calibration and the analyzer will return to the Sample mode. On the other hand, if the offset is above 10%, pressing ENTER will fail calibration and the analyzer will return to Sample mode without completing the Zero calibration.

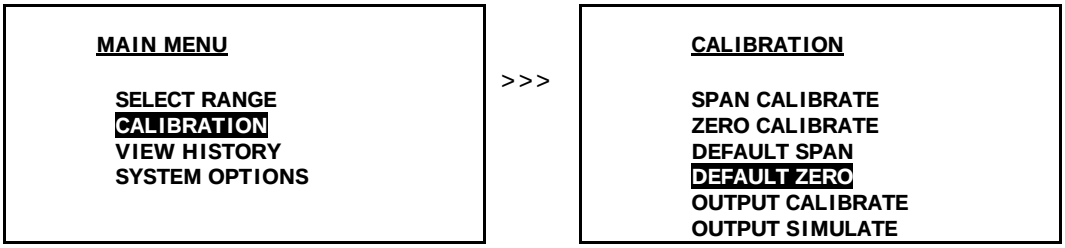
Both the Zero Calibrate and Span Calibrate functions result in the following displays:



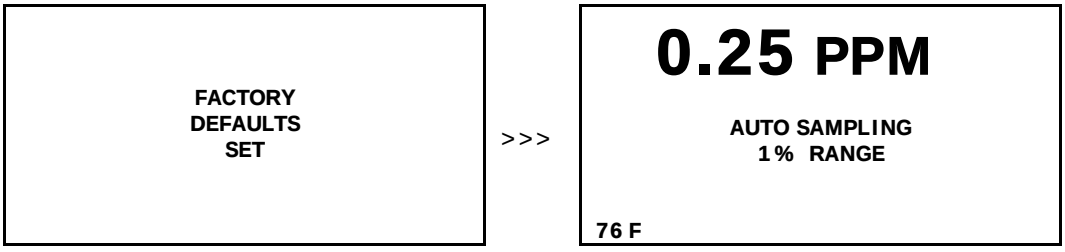
Default Zero

This feature will eliminate any previous zero calibration adjustment and display the actual signal output of the sensor at a specified oxygen concentration. This feature allows the user to ensure that the accumulative zero offset never exceeds 10% of the lowest range limit. To perform Default Zero,
Access the MAIN MENU by pressing the MENU key.

Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
Press the ENTER key to select the highlighted menu option.
The following displays appear:



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

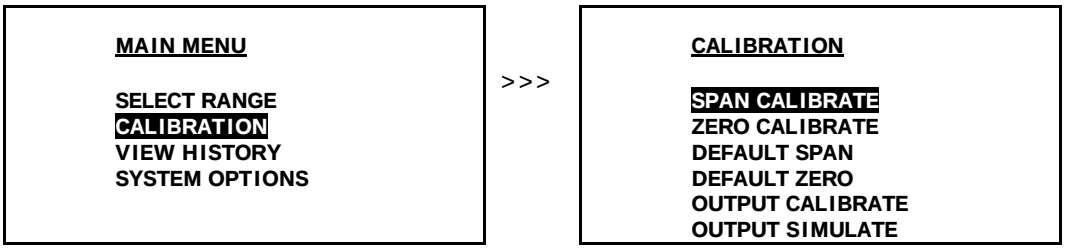


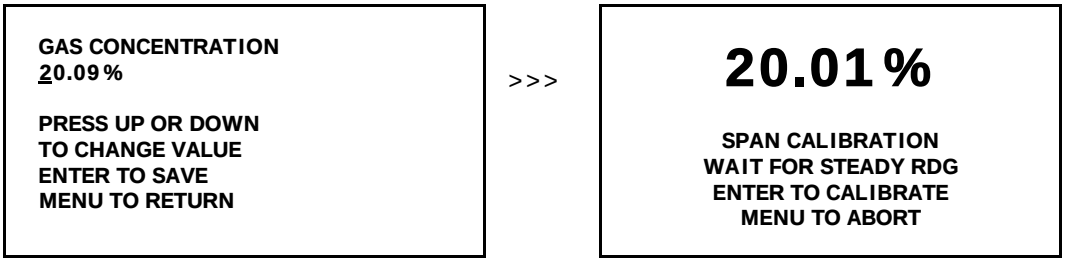
Analyzer Calibration-Span Calibration
Air Calibration

This procedure requires only a source of clean ambient air and removal of the sensor from its flow housing.
Access the interior of the analyzer by removing the 4 clamps securing the door of the analyzer.

Caution: Do not remove the gaskets from the enclosure. Failure to do so will void the NEMA rating.
Remove the sensor from the screw-in sensor housing or push the air through the analyzer SAMPLE IN thus exposing the sensor to ambient air or alternatively, flow a certified span gas through the analyzer.
Advance the cursor on the MAIN MENU to CALIBRATE and press ENTER.
Advance the cursor to SPAN CALIBRATION and press ENTER

The following displays appear:



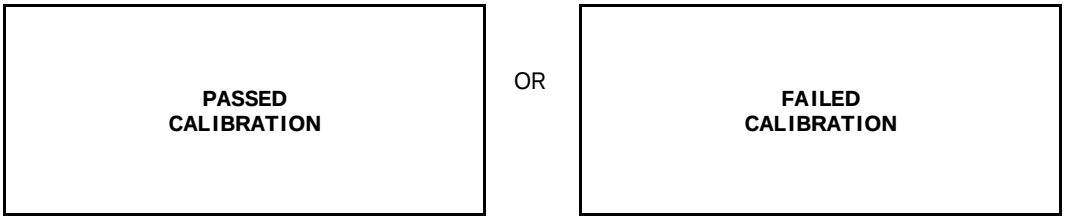


By using the UP or DOWN arrow keys, enter the appropriate digit where the cursor is blinking
Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the gas value.
Repeat until the complete span value has been entered.
In the example above, a span value of 20.09% has been entered.
After the span value has been entered, the analyzer will display the actual oxygen reading and prompt to press the ENTER key to accept SPAN CALIBRATION or MENU to escape.

Caution: Allow the analyzer reading to stabilized before accepting calibration.

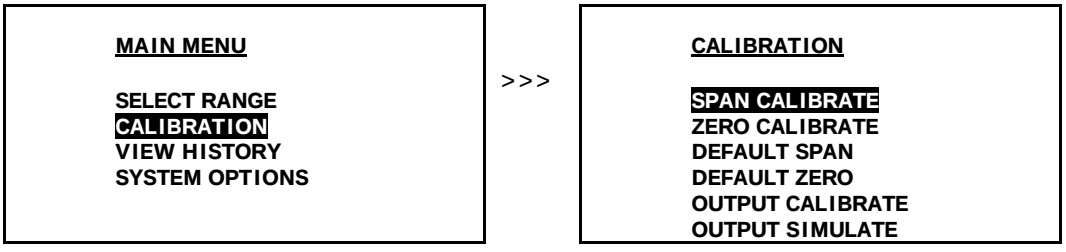
After successful calibration, the analyzer will display a message “Passed Calibration” and return to the Sample mode.

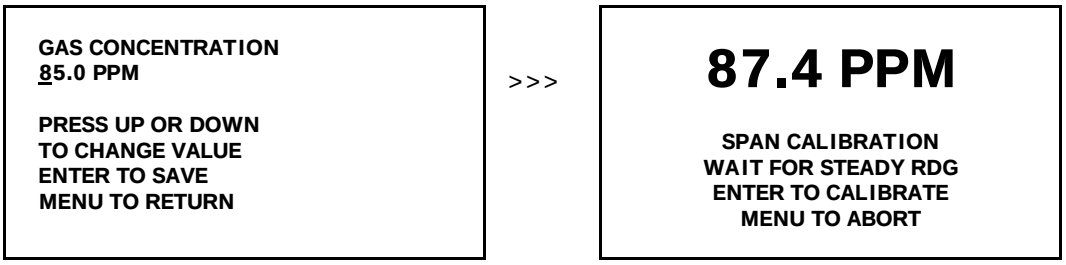
NOTE: The analyzer is allowed to accept calibration when O2 reading is within the acceptable value. If the O2 reading is outside of this limit, by pressing ENTER to accept calibration will result in “Failed Calibration” and return to the Sample mode without completing Span calibration. After pressing ENTER either of the following two messages will be displayed and the analyzer will return to SAMPLE mode.



Span Gas Calibration

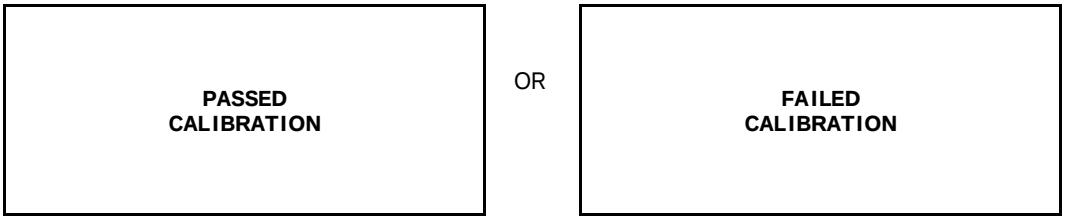
This procedure assumes a span gas under positive pressure. Connect the span gas to the analyzer Sample input port and set the span gas flow 1-2 SCFH
NOTE: To assure an accurate calibration, the temperature and pressure of the span gas must closely approximate the sample conditions.
For calibration purposes, use of the AUTO SAMPLE mode is recommended.
Access the MAIN MENU by pressing the MENU key.
Advance the reverse shade cursor using the ARROW keys to highlight AUTO SAMPLE.
Press the ENTER key to select the highlighted menu option.
The following displays appear:





By using the UP or DOWN arrow keys, enter the appropriate digit where the cursor is blinking
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 gas value.
Repeat until the complete span value has been entered.
In the example above, a span value of 85.0 PPM has been entered.
After the span value has been entered, the analyzer will display the actual oxygen reading and prompt to press the ENTER key to accept SPAN CALIBRATION or MENU to escape.
Caution: Allow the analyzer reading to stabilized before accepting calibration.
After successful calibration, the analyzer will display a message "Passed Calibration" and return to the Sample mode.

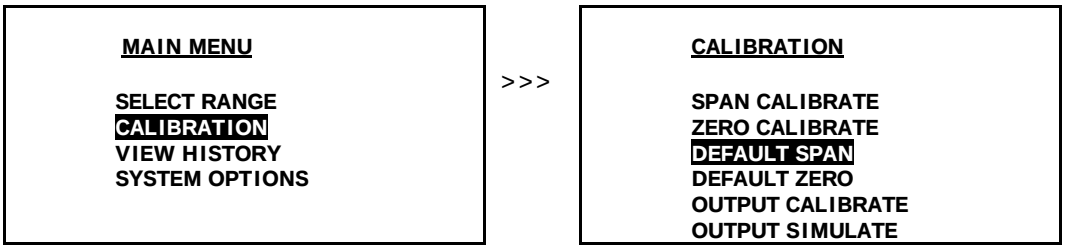
NOTE: The analyzer is allowed to accept calibration when O2 reading is within the acceptable value. If the O2 reading is outside of this limit, by pressing ENTER to accept calibration will result in "Failed Calibration" and return to the Sample mode without completing Span calibration. After pressing ENTER either of the following two messages will be displayed and the analyzer will return to SAMPLE mode.



Default Span

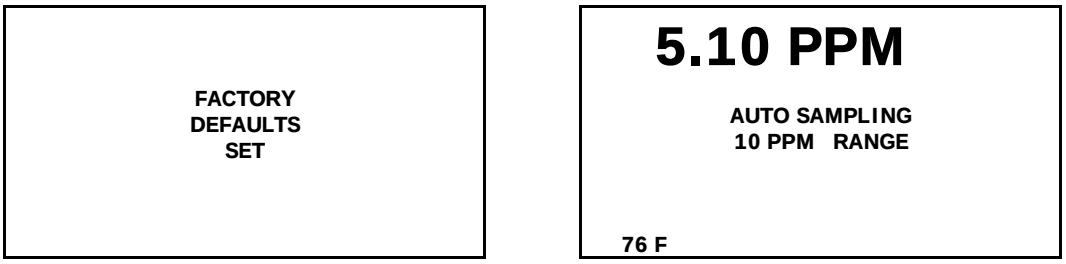
The software will set the SPAN adjustment based on the average output of the oxygen at a specific oxygen concentration and erase any previous span calibration data. For example, with factory default settings, when a span gas is introduced, the micro-processor will display oxygen reading within ± 30-50% of the span gas value, indicating that the sensor output is within the specified limits. This feature allows the user to check the sensor's signal output at a specified oxygen concentration without removing it from the sensor housing.

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



Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT SPAN.
Press the ENTER key to select the highlighted menu option.

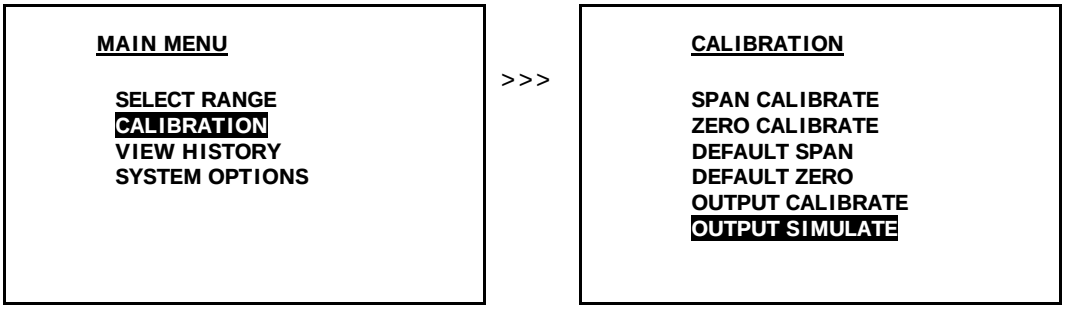
The following displays appear and after 3 seconds the system returns to the SAMPLING mode and display the current oxygen reading.

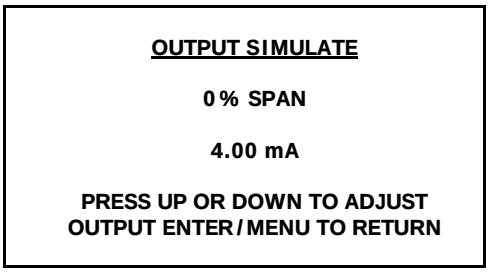


Analog Output Check-Output Simulate

This feature allows the user to simulate the electronics and the signal output. A know current is added to the analyzer electronics internally to generate equivalent analog signal output. This feature allows the user to check all interconnections from the analyzer to the signal output recording device before installation of sensor thus preventing the user to open the sensor bag before the analyzer installation is complete and satisfactory. To simulate signal output

Access the MAIN MENU by pressing the MENU key.
Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION and then select OUTPUT SIMULATE.
Press the ENTER key to select the highlighted menu option.
The following displays appear:



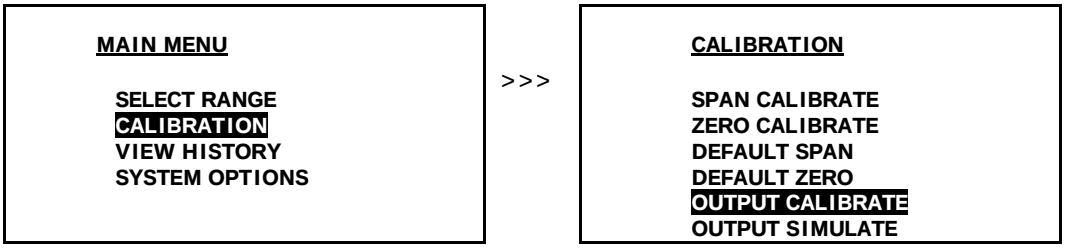


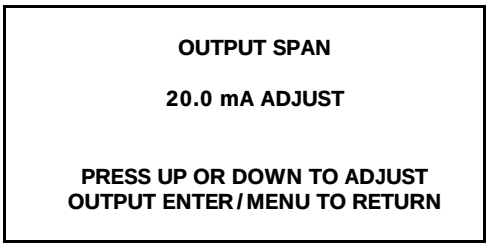
Pressing UP or DOWN key will increase or decrease the output by 5% of the full scale signal each time. Check the output on the external recording device or voltmeter/ammeter. The output on the external recording would be the % of the full scale signal selected, for example, 0% will represent 4.00 mA, 25% value will represent 8 mA and 50% span value will represent 12.0 mA of the 4-20 mA full scale. After SIMULATION is complete, press ENTER/MENU key to return to SAMPLE mode.
Note: To perform "Calibrate-Output Simulation", an external recording device must be connected between the negative terminal of the power source and negative terminal of the transmitter.

Analog Output check-Output Calibrate

In certain cases, the full scale analog may not match with full scale display. This feature allows the user to adjust the electronics so that the full scale display matches with full scale analog signal output. To calibrate full scale signal output

Access the MAIN MENU by pressing the MENU key.
Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION and then select OUTPUT SIMULATE.
Press the ENTER key to select the highlighted menu option.
The following displays appear:





Pressing UP or DOWN key will increase or decrease the full scale output signal each time. Check the output on the external recording device or voltmeter/ammeter. Repeat this step until the out equals the full scale analog signal expected, for example 20 mA in the present case. After OUTPUT CALIBRATION is complete, press ENTER/MENU key to return to SAMPLE mode.

Sampling a Gas

GPR-1500 Oxygen Analyzer requires a positive pressure to flow the sample gas across the sensor to measure the oxygen concentration in a sample gas. If a positive sample pressure is not available, install a high quality external sample pump to push the sample through the analyzer; see the option of using a sample pump as described above.

Procedure

Following calibration, the analyzer will return to the SAMPLE mode and ready for sampling the gas.

Select the desired sampling mode - auto or manual – as described above.
Use a suitable tubing to transport the sample gas to the analyzer
The main consideration is to eliminate any air leaks which can affect oxygen measurements.
For sample gases under positive pressure, the user must provide a means of controlling the inlet pressure between 5-30 psig.
For sample gases under atmospheric or slightly negative pressure, an external pump is necessary to push the sample through the sensor housing. Generally, when using a low voltage DC pump, no pressure regulation is necessary but a flow control device is recommended; a flow meter upstream of analyzer is recommended to ensure that the sample flow is adequate and steady.
Assure the sample is adequately vented for optimum response and recovery – and safety.

Allow the oxygen reading to stabilize for approximately 2 minutes at each sample point.

View History

This feature allows the user to view
Maximum PPM O2
Minimum PPM O2
Average PPM O2
Maximum ambient temperature
Number of days the sensor has been in service (at the time of installation and first calibration, the user must enter YES to confirm "new sensor") and
Number of days since the last calibration was done.

System Options

This features allows the user to

1. Set security; password protected operation
2. Define ranges; choose a range between two ranges, for example, 200 PPM full scale instead of 1000 PPM full scale.
3. Display signal below 0.00; Negative signal, YES or NO.
4. Displays MODBUS COMM menu

Security

PASSCODE LOCK- Prevents un-authorized access to the analyzer menu options. Selecting PASSCODE LOCK will put the analyzer in Sample Mode and accessing the menus will require a valid passcode.
To enter pass code, from SYSTEN OPTIONS menu, select SECURITY, select PASSCODE LOCK and then enter four digit PASS CODE, numeral numbers only and press ENTER. Then select AUTO LOCK option and enter the number of minutes after which access to MENU options will be locked (access allowed only after entering the PASS CODE).
In the vent the PASS CODE is lost, enter the factory default PASS CODE 2855 to access the MENU and then renter the new PASS CODE.
Choosing the option to display negative number will allow the user to see the display below 0.00 but the output will not go below 3.80 mA.

Configure Alarms

The analyzer is equipped with two programmable alarm relays; ALARM 1 and ALARM 2. The two alarms set points are user adjustable and can be set either as LOW/HIGH, LOW/LOW or HIGH/HIGH.

Alarm Pulsing

Sets the duration of Alarm relay pulses. Setting the duration to 0 seconds disables pulse mode (PULSING=OFF). If the duration is greater than 0, the PULSE MODE is enabled and PULSE MODE will be dieplayed at the lower-right corner of the sample screen.

Alarm Delay

Alarm delay option allows the user to ignore the alarm should a sudden short spike in the oxygen reading occurs.

Alarm Bypass

The alarms bypass feature allows the user to bypass the alarm during trouble shooting/repair or test run. However, once the alarm bypass is selected, alarm will remain disabled even if the oxygen reading is over/under the alarm set point. The alarm will re-arm itself only after the fault condition has been reverted.
The alarms are automatically disabled during SPAN/ZERO calibration.
The relays are rated at 1A @ 230V.
CAUTION; When using these relays, do not exceed the recommended rating.

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.

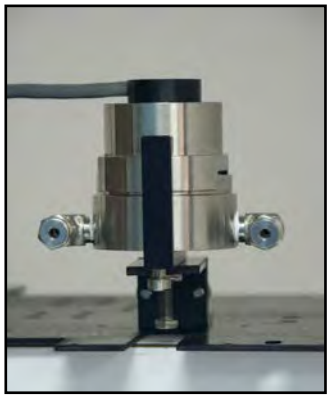
6 Maintenance

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-1900 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. Remove the four (4) screws securing the analyzer's front panel.
2. **Caution:** Do not discard the gaskets from the enclosure.
3. Using the 5/16 wrench supplied loosen but do not remove the clamp bolt located in the center of the housing with the elbows attached.
4. Rotate the upper section of the sensor housing 90º to disengage from the clamp.
5. Remove the upper section by pulling it straight up and place it on a smooth surface.
6. Remove the old oxygen sensor and dispose of it as you would a battery.
7. Remove the new oxygen sensor from the shipping bag.
8. Remove the red label and the gold ribbon from the PCB at the rear of the sensor.
9. **Caution:** Minimize the time the sensor is exposed to ambient air.
10. Place the new sensor in the bottom section of the sensor housing with the PCB facing up.
11. Place the upper section of the sensor housing over the sensor.
12. Span Calibrate the analyzer in 20.9% ambient air, once the reading stabilizes – see above.
13. Gently push the upper section downward and rotate 90º to engage the clamp.
14. Finger tighten the clamp bolt and one full turn with the 5/16 wrench to compressed the o-ring seal.

Connect zero gas or low oxygen content sample gas line to purge the sensor of oxygen.

7 Spare Parts

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

Item No.	Description
GPR-12-333-4	ppm Oxygen Sensor
XLT-12-333-4	ppm Oxygen Sensor (CO_2 background gas)

Other spare parts:

MTR-1011	Meter Digital Panel LCD Backlight
A-1161-A1	PCB Assembly Main / Display
A-1162-AC	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 analyzer)
	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	Analyzer 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 analyzer)
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 analyzer (calibrate at pressure and temperature of sample)
	Abnormality in gas	Qualify the gas (use a portable analyzer)
Erratic O_2 reading or No O_2 reading	Change in sample pressure	Sensors without PCB use mV setting. Calibrate the analyzer (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 or partially opening the valves upstream of the analyzer when using a pump downstream of the analyzer 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.	Zero the analyzer. If not successful replace the sensor 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

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