Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions, e.g. constant temperature, flow rate and ambient pressure: ±5% with temperature fluctuation of ±10°F
Analysis:	Ranges: 0-5%, 0-10%, 0-25% and 0-100% FS Auto-ranging or fixed single range
Application:	Continuous analysis of high purity oxygen concentrations up to 100% oxygen in inert and mixed gases
Approvals:	CE
Area Classification:	General purpose
Alarms:	Two adjustable form C relay contacts non-latching; "weak sensor" indicator; power failure; system failure
Calibration:	1-3 month interval using certified span gas of 95-100% O2 balance N2 for high purity analysis; otherwise use O2 content approximately 80% of full scale range
Compensation:	Barometric pressure and temperature; temperature controlled sample system and sensor for stability
Connections:	Compression tube fittings 1/8" inlet, 1/4" vent
Controls:	Water resistant keypad; menu driven range selection, calibration, alarm and system functions
Data Acquisition:	Selectable data point intervals
Display:	Graphical LCD 5" x 2.75"; resolution .01%; displays real time ambient temperature and pressure
Enclosure:	Painted aluminum 7.5" x 10.8" x 12.25" panel mount
Flow:	Not flow sensitive; recommended flow rate 2 SCFH
Linearity:	±2% over all ranges
Pressure:	Inlet - regulate to 5-30 psig to deliver 2 SCFH flow; vent - atmospheric
Power:	Universal; specify 100 or 200 VAC for heater system
Range ID:	Voltage, 4-20 mA or relay contacts
Response Time:	90% of final FS reading < 10 seconds
Sample System:	Stainless steel wetted parts, flow control, flow indicator, special integral sample
Sensitivity:	< 0.1% oxygen
Sensor Model:	GPR-11-120-OP
Sensor Life:	24 months in 100% oxygen at 25ºC and 1 atm
Signal Output:	4-20mA isolated or 0-1V
Temp. Range:	5ºC to 45ºC
Warranty:	12 months analyzer; 12 months sensor

Optional Equipment

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

* Specification subject to change without notice.

GPR-3100B
Oxygen Purity Analyzer

Innovative Sensor & Analyzer (see back page)

Advanced Sensor Technology

- Unmatched ROI and Performance in O2 Analysis
- 24 Month Life Continuous Exposure @ 100% O2
- Sensitivity < 0.1% Oxygen

Temperature Control Sample System

4 Analysis Ranges

4½ Digit Display with 0.01% Resolution

Insensitive to minor Vibration

2 Field Selectable Alarm Set-points

Auto Ranging or Single Fixed

Options: Auto-Zero and Auto-Cal

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 3/12

Owner's Manual

GPR-3100B
Oxygen Purity Analyzer

Advanced Sensor Technology
24 Month Operating Life in 100% Oxygen

June 26, 2013

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, e-mail: info@aii2.com, www.aii2.com

Table of Contents

2. Quality Control Certificate

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 purity of oxygen gas containing innert gases such as nitrogen, helium or argon and/or other reactive gases such as hydrogen and gaseous hydrocarbon gases as minor contaminants.

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

3. Safety

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

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

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

Read Instructions: Before operating the analyzer read the instructions.

Retain Instructions: The safety precautions and operating instructions found in the Owner's Manual should be retained for future reference.

Heed Warnings: Follow all warnings on the analyzer, accessories (if any) and in this Owner's Manual.

Follow Instructions: Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the analyzer.

Inlet Pressure: Recommended 5-30 psi**,** 100 psi maximum.

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

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

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

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

Operating Temperature: The maximum operating temperature is 45º C.

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.

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.

Troubleshooting: Consult the guidelines in Section 8 for advice on the common operating errors before concluding that your analyzer is faulty.

Do not attempt to service the analyzer beyond those means described in this Owner's Manual. Do not attempt to make repairs by yourself as this will void the warranty as per Section 9 and may result in

electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

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: Isolate ppb and ppm oxygen sensors as described in this manual and disconnect the power when the analyzer is left unused for a long period of time.

4. Specifications

Advanced Instruments Inc.

Technical Specifications *

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Analysis:	Ranges: 0-5%, 0-10%, 0-25% and 0-100% FS Auto-ranging or fixed single range
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5. Operation

Principle of Operation

The GPR-3100 oxygen analyzer incorporates an advanced galvanic fuel cell type sensor capable of measuring 100% oxygen on a continuous basis It is the only electrochemical sensor based analyzer capable of this measurement.

Background

The production of pure oxygen has been confined to the production of medical grade oxygen (99.0%, typically specified at 99.5% or greater purity). However, the demand for oxygen is expanding rapidly due largely to recent developments in chemical processes requiring elevated concentrations of oxygen (85-95%) that boost yields and reduce emissions without significant cost increases and to a lesser extent the growth of transfilling oxygen (92%) cylinders for home care use. The oxygen supplied can be generated cryogenically or by pressure (PSA) or vacuum (VSA) swing adsorption methods.

Historically producers and users have relied on analyzers based on paramagnetic method for measuring oxygen purity. These sensor offer highly accurate results especially at the 0-100% oxygen. However, they are very sensitive to changes in the flow rate of sample gas, the presence of minute particulates and moisture, temperature variations and vibration. Consequently, paramagnetic analyzers are expensive and require frequent almost daily calibration.

Analyzers based on galvanic sensor concept have always generated an interest for oxygen purity measurements because they are specific to oxygen, versatile, low maintenance and inexpensive. However, short sensor life (3-4 months at best) and the gradual drop (drift) in the signal output of the micro-fuel cell with time has precluded their use.

Major Advancement in Galvanic Fuel Cell Sensor Technology

In competing with paramagnetic devices the focus was primarily on advancing the galvanic sensor technology but also included temperature controlling the sample gas and automatically compensating the signal output of the sensor for barometric pressure variations to assure a stable 'drift free' oxygen measurement.

An advanced galvanic sensor has been developed that provides two years of sensor life and is capable of operating properly on a continuous basis in 100% oxygen concentrations. This proprietary design addresses the challenges of:

Providing a sufficient amount of anode material to support the reduction of oxygen over several years.

Maintaining at all times a sufficient concentration of hydroxyl ions to support the reduction of oxygen at and near the sensing cathode.

Preventing the build-up of PbO at and near the sensing cathode (that eventually starts precipitating and covers the sensing cathode) that can cause the signal output of the sensor to drop (drift) with time.

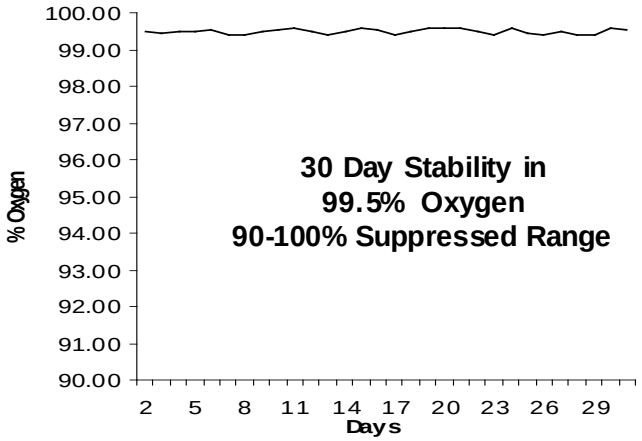
Through proprietary means the production rate of the reaction product is controlled without sacrificing either the fast less than 13 second response time or any of the features (described above) of the micro-fuel cell analyzer. The resulting on-line and portable analyzers are approximately half the cost of their paramagnetic counterparts.

The performance of the sensor was validated over 14 months of testing and exhibited excellent stability in 100% oxygen. The sample flow rate was set at 0.1 lpm (and insensitive to changes of up to 1.0 lpm) with the sample vented to the atmosphere via ¼" diameter tube to minimize the backpressure.

With the sensor and sample gas lines temperature controlled and the signal output of the sensor compensated for ambient pressure variations it was possible to measure oxygen in the suppressed range of 90-100% with less than ±1% of full scale (±0.1% oxygen) accuracy. The calibration was checked periodically and found to be within ±1% of full scale over the fourteen month test period suggesting the interval between calibrations could be extended to several months.

To demonstrate the stability of the new analyzer, 99.5% oxygen was introduced (typically the threshold for gas manufacturers) for 30 days and the output plotted as shown at the right. The resolution of the analyzer's 4-1/2 digit display is 0.01%.

The maximum variation in the signal output is ±0.1% oxygen over a 24 hour period and is primarily to the variation in ambient temperature.



Advanced Sensor Technology Overview:

The sensor 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.

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. Sensors for low ppm analysis recover from air to ppm levels in minutes, exhibit longer life and reliable quality.

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.

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.

Additional features of the micro-processor based electronics include manual or auto ranging, optional integral sample, span and zero inlet valves for auto-zero and auto-calibration at user specified intervals, data acquisition and temperature tracking all which can be controlled remotely. Analog outputs, 0-1V and an isolated 4-20mA, and an USB communication link are provided along with field selectable alarms with dry relay contacts, power and range identification. An unique algorithm predicts and display a message indicating a 'weak sensor' suggesting the sensor be replaced in the near future.

Sample System:

The GPR-3100 is supplied with stainless steel flow housing, fittings and tubing along with an integral flow meter to provide optimum percentage range oxygen measurements. As a rule of thumb, the sample must be properly presented to the sensor to ensure an accurate measurement. For optimum accuracy the overall performance is enhanced by an temperature controlled heater system that controls the

temperature around the sensor to eliminate drift and daily calibration requirements associated with competitive analyzers.

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 aii2@earthlink.net

Controlling Pressure & Flow

All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The inlet pressure must always be higher than the pressure at the outlet vent which is normally at atmospheric pressure. Despite the fact the oxygen reading is compensated for variations in barometric pressure (at the vent), it is extremely critical for measurements near 100% oxygen that backpressure be kept constant and to an absolute minimum. For this reason the analyzer is equipped with 1/8" inlet connections and ¼" vent connections.

Flow Through Configuration:

The sensor is exposed to sample gas that must flow or be drawn through sensor housing, see Application Pressure below, and is normally vented to atmosphere.

Flow rates of 1-3 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 rate of 2 SCFH or 1liter 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).

Application Pressure - Positive:

A flow indicator with an integral metering valve positioned upstream of the sensor is provided for controlling the sample flow rate between 1-5 SCFH. If necessary, a pressure regulator upstream of the flow control valve should be used to regulate the pressure.

Application Pressure - Atmospheric or Slightly Negative:

For accurate percentage range measurements, a sample pump should be positioned upstream of the sample inlet to push the sample through the analyzer's sample system and by the sensor. The sample flow should remain between 1-3 SCFH.

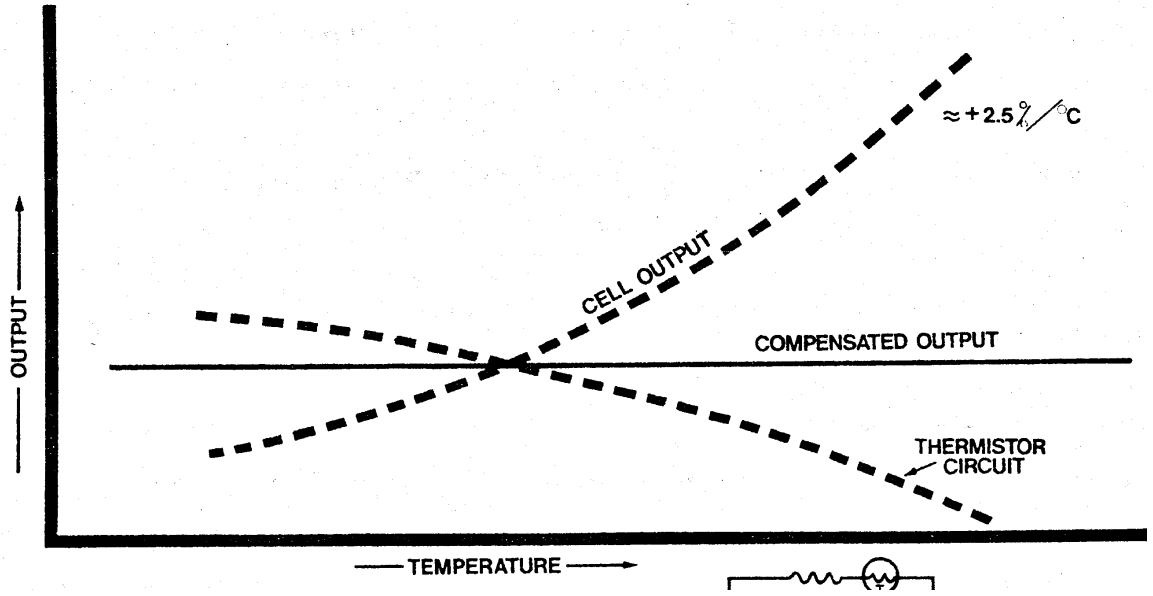
To avoid erroneous oxygen readings and damaging the sensor:

- Assure there are no restrictions in the sample line that could create and draw a vacuum exceeding 14" of water column on the sensor.
- Avoid excessive flow rates above 5 SCFH which generate backpressure on the sensor.
- Avoid sudden changes in pressure that can severely damage the sensor – assure a flow control valve is positioned upstream of the analyzer's inlet.
- Assure no particulates, liquids or condensation collect on the sensor that could block the diffusion of oxygen into 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).

Calibration and Accuracy

Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current sensor exhibiting 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.

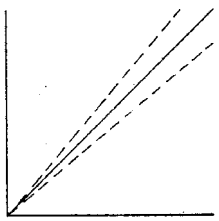
Pressure: Because sensors are sensitive to the partial pressure of oxygen in the sample gas their output is a function of the number of molecules of oxygen 'per unit volume'. Readouts in percent are permissible only when the total pressure of the sample gas being analyzed remains constant. The pressure of the sample gas and that of the calibration gas(es) must be the same (reality < 1-2 psi).

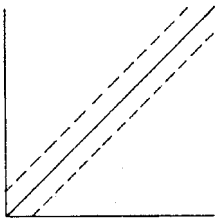


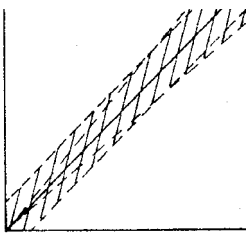
Temperature: The rate oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation 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.

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 +2% 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: 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.

Installation

The GPR-3100B Oxygen Analyzer consists of an electronic module, sensor housing and sample system housed in a 10.8"W x 7.5"H x 12.25"D enclosure suitable for panel mounting or 19" rack mounting with the optional panel. A 12"W x 12"H x 8"D wall mount configuration is also available.

An optional integral temperature controlled heating system maintains the temperature of the sensor at a pre-set temperature and assures the stability not found in competitive analyzers. The analyzer has been tested and calibrated by the manufacturer prior to shipment.

Installation Considerations:

The GPR-3100B is fully operational from the shipping container with the oxygen sensor installed and calibrated at the factory prior to shipment. Once installed, we recommend the user allow the analyzer to stabilize for 30 minutes and then recalibrate the device as instructed below.

- Mounting the analyzer and optional components such as coalescing or particulate filters and pumps.
- Assemble the necessary hardware for mounting the analyzer and optional components, 1/8" stainless steel tubing for interconnecting the analyzer and optional components.
- Pressure & Flow: As described above.
- Moisture & Particulates: Prevent water and/or particulates from entering the sample system. They can clog the tubing and damage the optional components such as pumps or sensors. Installation of a suitable coalescing or particulate filter is required to remove condensation, moisture and/or particulates from the sample gas to prevent damage to the sensor or optional components. Consult factory for recommendations concerning the proper selection and installation of components.
- Gas connections: Inlet gas lines require 1/8" diameter metal tubing whereas ¼" diameter tubing is required for the vent. Span gas and required accessories are the responsibility of the user.
- Output connections. To assure proper grounding, connect the 4-20mA signal output to the external power source before attempting calibration adjustments.
- Establishing power to the electronics.
- Setting the alarm values (if applicable).
- Zeroing the analyzer (required only for very low percentage range measurements).
- Calibrating the analyzer.

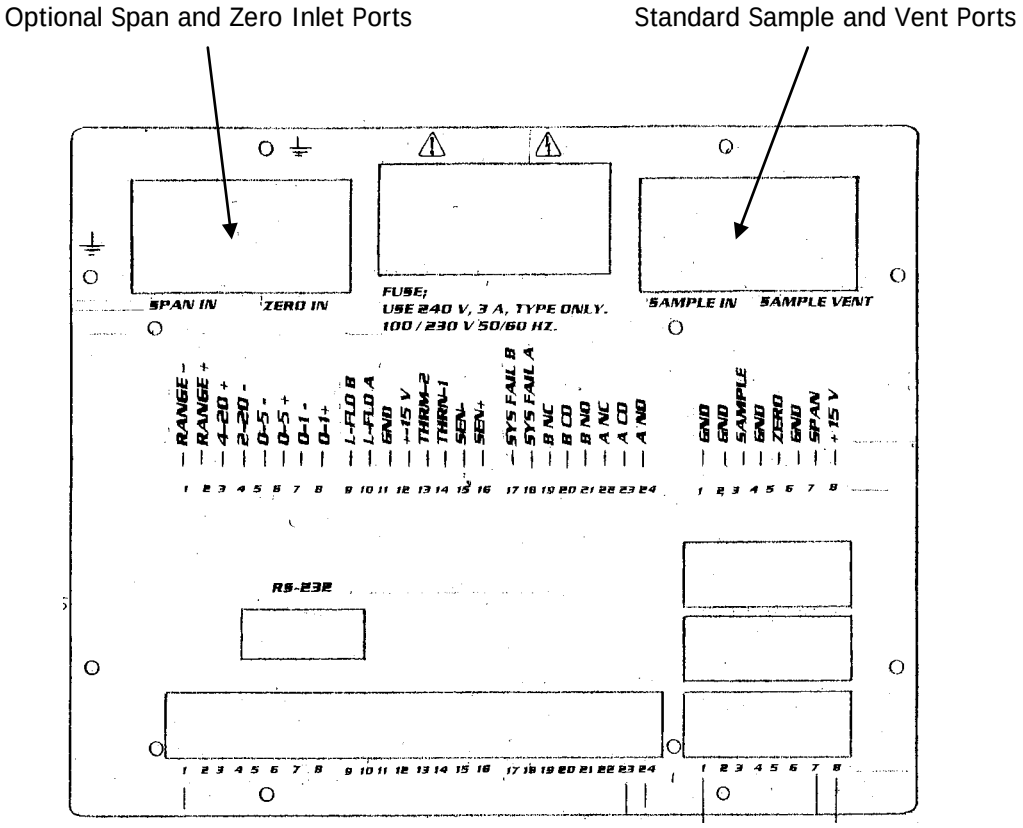
Mounting the Analyzer:

The GPR-3100B 10.8”W x 7.5”H x 12.25”D configuration is designed for panel mounting directly to any flat vertical surface, wall or bulkhead plate with the appropriate cut out. To facilitate servicing the interior of the analyzer, position it approximately 5 feet off the floor. It can also be mounted in a standard 19” rack with an optional panel.

When mounting the analyzer in a 19” rack, allow sufficient room for access to the terminal connections at the rear of the enclosure.

Gas Connections:

The GPR-3100B is designed for positive pressure samples and requires connections for incoming sample and vent lines. Optional zero and span inlet ports are provided as part of the optional sample systems.



The user is responsible for making provision for introducing gases for calibration purposes. Flow rates of 1-3 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 rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

Procedure:

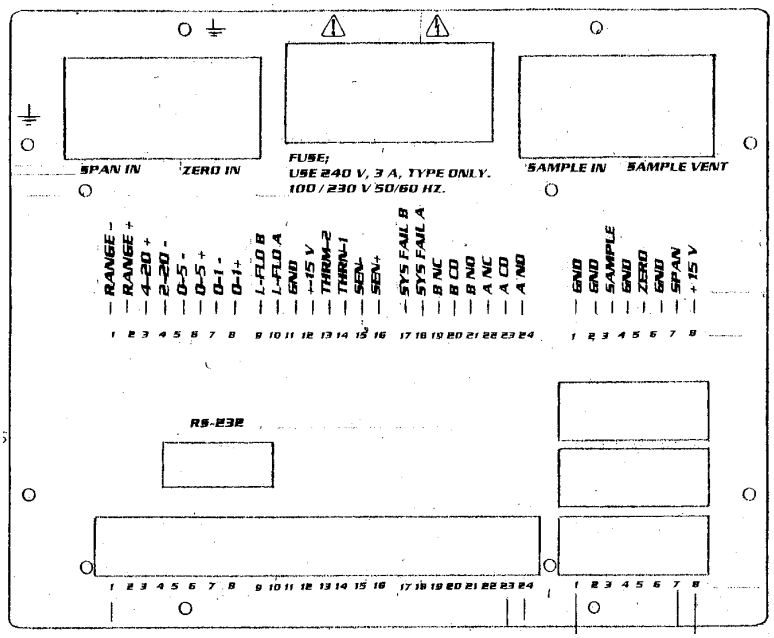
Caution: Do not change the factory setting until instructed to do in this manual.

1. Regulate the pressure and flow of the incoming sample and zero/span calibration gas(es) as described in Controlling Pressure & Flow above.
2. Connect the ¼" vent line to the compression fitting labeled VENT.
3. Connect the 1/8" sample line to the fitting labeled SAMPLE.
4. Connect the 1/8" ZERO and SPAN gas lines as labeled, if equipped with optional sample system(s).
5. Allow gas to flow through the analyzer for 3-5 minutes and set the flow rate to 2 SCFH. The analyzer is now ready for calibration and sample analysis.

Power Connections:

Power for the on-line analyzers is supplied by an integral universal (100-240V AC) power supply. The appropriate AC line voltage is supplied with a standard power cord through a universal power entry module. A standard computer type power cord (P/N A-1008 is required for the universal power entry module.

Note: While the power entry module is universal, the heater is not. The heater must be configured to the local power supply (100-110 or 220-240V AC) at time of order.



Power Connections for External Calibration Valves

Output Connections

As illustrated above the sensor, alarm relays and signal output connections are hard wired to screw type terminal blocks located at the rear of the analyzer.

1. Strip the wires of the cable no more than 3/16 inch. Use a small bladed screwdriver to push the lever of the appropriate terminal to open the terminal. Insert the stripped end of the wire into the terminal and release the terminal lever. The wire should be firmly secured in the terminal.

3. 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.

4. To break the connection upon relay activation, connect the secondary cable to the normally closed NC terminal.

Danger: While connecting the cables to the relay terminals, ensure there is no power 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

The four alarm circuit connectors are spring loaded terminals for making connections to internal alarm relay contacts.

Alarm 1 and Alarm 2 - Represents two threshold type alarms that can be set and configured in the field from the analyzer's display menu 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 Off mode, the timeout feature is useful while replacing the oxygen sensor or during calibration when the oxygen reading might well rise above or fall below 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 interrupted. The contact is normally closed but opens when the power to the analyzer is switched off or interrupted and cannot be disabled.

4-20mA and 0-1V Signal Outputs

The analyzer provides 0-1V full scale with negative ground and a 4-20mA full scale fully isolated ground signals for external recording devices. The integral IC on the main PCB converts the 0-1V signal with negative ground to a 4-20mA fully isolated signal.

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

Range ID (identification)

A voltage output corresponding to each range is provided. The output of the highest range (normally CAL) is 5V and the remaining three ranges 4V, 3V and 2V for the low range.

USB Port

A bi-directional data line is provided via a USB port to access analyzer controls via a computer; the USB control enables the user to obtain status information and initiate analyzer functions through a computer terminal.

The user must use Analytical Industries, Inc. Configuration software to access the analyzer through USB interface.

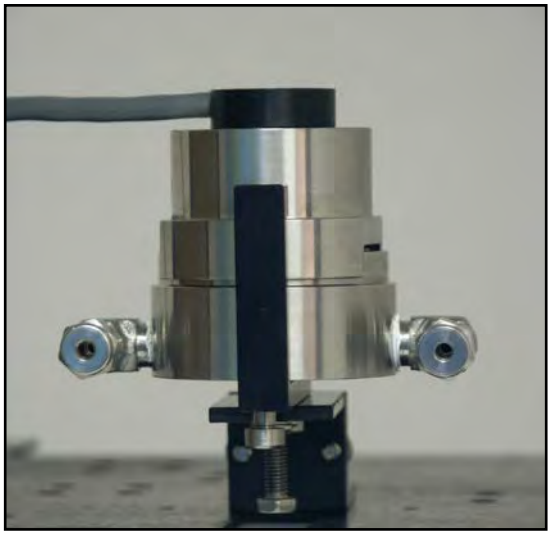
Installing the Oxygen Sensor

The GPR-3100B is equipped with an integral oxygen sensor that is fully operational from the shipping container with the oxygen sensor installed, tested and calibrated by the manufacturer prior to shipment. However, for a variety of reasons it may be necessary to ship the oxygen sensor separately.

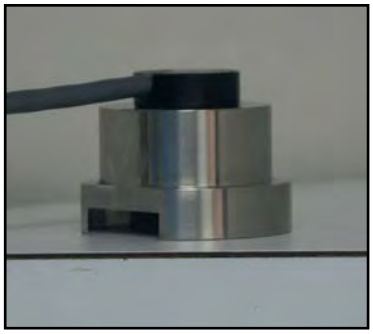
Caution: DO NOT dissect the oxygen sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to section **10 Material Safety Data Sheet** of this manual. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

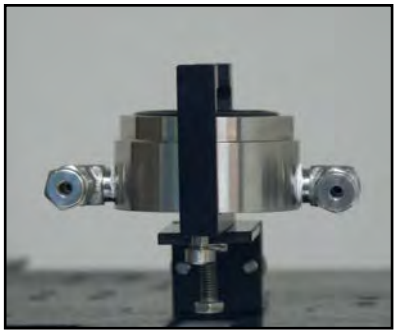
Note: All analyzers must be calibrated once the installation has been completed and periodically thereafter as described below.

Procedure:



1. Using the 5/16 wrench supplied loosen but do not remove the clamp bolt – the long one located in the center under the bottom section of the sensor housing.
2. Rotate the upper section of the sensor housing 90º to disengage from the clamp.
3. Remove the upper section by pulling it straight up and place it on a smooth surface.
4. Open the barrier bag containing the new sensor.
5. Remove the new oxygen sensor from the shipping bag and remove the red label and the gold ribbon (shorting device) from the PCB at the rear of the sensor.
6. **Caution:** Minimize the time the sensor is exposed to ambient air.
7. Place the new sensor in the bottom section of the sensor housing with the PCB facing up.
8. Place the upper section of the sensor housing over the sensor.
9. Gently push the upper section downward and rotate 90º to engage the clamp.
10. Finger tighten the clamp bolt and one full turn with the 5/16 wrench to compressed the o-ring seal.





Installing Span Gas

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. Connect the span gas to the span port of the analyzer (if equipped) or use a three way valve at the sample inlet to control the flow of sample/span.

Establishing Power to the Electronics:

Once the power cord is connected into to the power entry module at the rear of the enclosure as illustrated above, connect the plug end to the appropriate AC outlet.

When power is applied to the analyzer, the analyzer performs diagnostic status checks and the 5" x 2.75" graphical LCD displays the following:

Note: After establishing power to the analyzer, place the SENSOR BYPASS SWITCH (SW1) in the ON position. SW1 has been placed on the OFF position prior shipment as a precautionary measure to isolate the sensor from the electronics. SW1 is located near the ribbon cable connector on the right side of the Main Micro-processor / Display PCB Assembly attached to the front door of the analyzer.

System Self Test

CPU	OK
Memory	OK
RTC	OK
Analog	OK

A few seconds after the completion of the status checks the LCD will display the following information:

GPR Series Oxygen Analyzer
Serial No.
Advanced Instruments Inc.
2855 Metropolitan Place
Pomona, CA 91767
Tel: 909-392-6900
Fax: 909-392-3665

A few seconds after the information display appears the LCD will display the MAIN MENU.

Operating the Menu Driven Controls –

The appendix details the entire menu layout and functional operation of the GPR-1600 when equipped with either the standard bypass or optional zero and span inlets sample systems with manual valves.

1. The menu options at the upper left corner are as simple and straightforward as possible.
2. The current MODE of the analyzer is indicated at the top center of the LCD.
3. The upper line across the bottom of the LCD reflects information related to the analyzer's range:
   a. 'Auto Range' indicates whether the user has selected manual (MAN) or auto (AUTO) ranging.

c. '0 to 1000 PPM' reflects the current range of measurement.

4. The bottom line across the bottom of the LCD reflects information utilized by the micro-processor:
   a. Temperature inside the insulated analyzer enclosure
   b. Ambient pressure
   c. Date
   d. Time

Menu Navigation:

The cursor indicates the menu option selected with an asterisk (*).

Press the yellow UP or DOWN arrow keys to move the cursor and select a menu option.

Press the green ENTER key to accept the menu option selected with the (*) cursor.

Press the red ESC escape key to return to the previous menu.

Note: If a selection is not made within 30 seconds, the display returns to the MAIN MENU.

Range Selection:

The analyzer display defaults to the sampling mode when 30 seconds elapses without user interface.

The GPR-3100B analyzer provides four (4) standard ranges and gives users 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.

Auto Sampling

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

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.

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.

Temperature Controlled Heater System with Runaway Protection Circuit

If the analyzer is equipped with an optional temperature controlled heater system, open the front door of the analyzer to access it. This unit is a PID controller which operates between 0-99°F. The controller is programmed to maintain the temperature at 85°F.

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

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

When power is applied to the temperature controller, the controller TUNES itself to eliminate and/or minimize the over/under shoot of temperature from the set point.

It is recommended that at initial start-up, when replacing the oxygen sensor or when trouble shooting, turn off the power to the heater by set the temperature set point at 60°F.

Changing the display value from °F to °C:

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

Part of the optional temperature controlled heater system is a heater runaway protection circuit that protects the electronics in the event the temperature controller should fail and thereby allowing the heater to runaway damaging the interior of the analysis unit.

The runaway protection is provided by a J2 type device positioned between the temperature controller and the heater.

This device cuts of power to the heater if the temperature inside the analysis unit exceeds 70°C.

Should the J2 device cut power to the heater, correct the problem and replace the J2.

Installation is complete . . . proceed to Calibration

Calibration - General Guideline

Zeroing the analyzer is recommended for oxygen measurements requiring accuracy greater than +/- 0.5% oxygen and when the analysis is carried out on 0-100% range.

Caution: Do not attempt to calibrate the unit in the atmosphere air (20.9% oxygen) and use the analyzer for high purity oxygen measurements.

Certifying Medical Grade Oxygen:

The FDA requires the use of certified gases for zeroing and calibrating analyzers used in certifying medical grade oxygen.

The analyzer zero gas must be a certified cylinder of nitrogen with a minimum purity of 99.9%.

Once the analyzer has been zeroed (as described below), calibrate (as described below) with a certified cylinder of oxygen with a minimum purity of 99.2%.

Non-medical grade oxygen applications:

In non-medical applications the analyzer does not require zeroing before every calibration. It is recommended the analyzer be calibrated at least monthly. In most cases a nitrogen zero gas of 99.9% minimum purity and a span gas of 95-100% oxygen purity is sufficient.

Zero Calibration

Procedure:

The maximum zero calibration adjustment permitted is 50% of the lowest full scale range available, which normally is 1%. Thus the maximum zero calibration adjustment or zero offset is 0.5% oxygen. 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.

Factory Default Zero

This feature eliminates any previous zero calibration adjustment and display the actual the signal output of the sensor at a specified oxygen concentration. For example, assuming a zero gas is introduced, the display will reflect an oxygen reading representing basically before the zero calibration adjustment was made, as described above.

Span Calibration

Refer to the **Installing Span Gas** and **Calibration – General Guideline** sections above.

In order to obtain reliable data, the analyzer must be calibrated at installation and periodically thereafter; recommended calibration interval 1-3 months, or as determined by the user's application. This involves calibrating the analyzer electronics to the sensor's signal output at a given oxygen standard, e.g. instrument air or a certified span gas.

In standard configuration, the GPR-3100B can be calibrated by exposing the sensor to the readily available cost effective and reliable 20.9% oxygen in atmospheric air or a certified span gas with an oxygen concentration of 80-100% of full scale range balance nitrogen. For example, for a 0-25% range, the span gas should be a certified grade between 19-23% oxygen.

Factory Default Span

This feature eliminates previous span calibration data and sets the SPAN adjustment based on the average oxygen reading (actually the sensor's signal output) at a specified oxygen concentration. For example, after Factory Default Span, when a span gas is introduced, the micro-processor will display an oxygen reading within $\pm$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. Select the RANGE dictated by the accuracy of the analysis required, see **Calibration – General Guideline** above
2. Advance the cursor (*) on the MAIN MENU to SAMPLE and press ENTER to accept the selection.
3. From the above SAMPLE menu advance the cursor (*) to MANUAL RANGING and press ENTER.
4. Advance the cursor (*) on the MAN RANGE menu the RANGE dictated by the span gas and press ENTER to select.
5. Return to the MAIN MENU and display the oxygen concentration of the span gas.
6. Regulate the Span gas pressure and control the flow rate as described above; 5-30 psig and 2 SCFH flow rate.
7. Disconnect the sample gas and connect the span gas to "Sample In" of the analyzer.
8. Allow the oxygen reading to stabilize. The analyzer would typically stabilize in 5-15 minutes.
9. Advance the cursor (*) on the MAIN MENU to SPAN and press ENTER to accept the selection.
10. From the SPAN menu advance the cursor (*) to Calibrate and press ENTER to select.
11. Enter and accept the span gas value.
12. After analyzer reading has stabilized, press ENTER to accept span calibration
13. The analyzer returns to the SAMPLE mode in a few seconds.
14. Disconnect the span gas line and replace it with the purged sample gas line.
15. Wait 10-15 minutes to ensure the reading is stable and proceed to sampling.
16. Once calibrated, the analyzer is ready for SAMPLING

Sampling

Procedure Following Span Calibration

1. Reconnect the sample gas line as described above (the analyzer returns to the SAMPLE automatically).
2. Set the sample gas pressure between 5 and 30 psig.
3. Set the sample gas flow rate to approximately 2 SCFH.
4. Advance the cursor (*) on the SAMPLE menu to select either AUTO or MANUAL RANGING
5. Press ENTER to accept the selection.
6. Allow the oxygen reading to stabilize, the analyzer would typically stabilize in 5-15 minutes.

Advance the cursor (*) on the MAIN MENU to SYSTEM and press ENTER to accept the selection.

From the above SYSTEM menu advance the cursor (*) to DISPLAY NEGATIVE and press ENTER to select/toggle between ON and OFF (default). The default or OFF selection causes the analyzer to

Standby & Storage

The analyzer has no special storage requirements. If storing for an extended period of time, disconnect the power to the analyzer.

Store in cool environment and away from direct sun.

6. Maintenance

Periodic replacement of the sensor is the extent of maintenance. There are no serviceable parts inside of the analyzer. Any service performed must done under the supervision of factory trained personnel. To replace sensor, follow instructions in section 5. Operation.

7. Recommended Spare Parts

Recommended spare parts for the GPR-3100 % High Purity O_2 Analyzer include:

Item No.	Description
GPR-11-120-OP	Oxygen Sensor (standard)

Other spare parts

CTRL-1004	Temperature Controller (Fuji)
HTR-1002	Heater 110 VAC
HTR-1003	Heater 220 VAC
A-1004-1-24	Housing Sensor Stainless Steel
MTR-1011	Meter LCD Digital Display
A-1146-E-50	PCB Assembly Micro-processor / Display
A-1147-E-50	PCB Assembly Power Supply / Interconnection
SNSR-1001	RTD Temperature Sensor
SNSR-1002	Runaway Protector J-2
TOOL-1001	5/16 Wrench Combination

8. Trouble shooting

Symptom	*Possible Cause*	*Recommended Action*
Reading does not reflect expected values	Sensor was not calibrated at the pressure, flow rate and temperature anticipated in the sample gas stream	Recalibrate the analyzer
Oxygen reading drifts toward lower oxygen	Indication sensor is nearing the end of its useful life	Replace sensor, see Section 6 - Maintenance.
Slow response time	Liquid covering sensing membrane	Gently remove with damp cloth or lint free towel.
Erratic oxygen reading	Varying sample flow.	Set flow rate as recommended,
	Unauthorized maintenance	Consult factory, replace sensor, see Section 6 - Maintenance.
No oxygen reading	Defective electrical connection	Use current meter to determine uA output is with in range, contact factory.
	Sensor failure	Replace sensor
High oxygen reading	Inadequate control of pressure and flowrate	See Section 5 - Operation, Getting Started, Control of Pressure and Flow
	Abnormality in span gas	Qualify source

9 Warranty

The design and manufacture of AII 3000 Series Oxygen Analyzers and 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. Analytical Industries Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your Analytical Industries 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 Analytical Industries Inc. analyzer, we may replace it with a new or reconditioned one of the same or upgraded design. This warranty applies to all monitors, analyzers and sensors purchased worldwide. It is the only one we will give and it sets forth all our responsibilities. There are no other express warranties. This warranty is limited to the first customer who submits a claim for a given serial number and/or the above warranty period. Under no circumstances will the warranty extend to more than one customer or beyond the warranty period.

Limitations

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

Exclusions

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

Service

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

Analytical Industries Inc.

2855 Metropolitan Place

Pomona, Ca 91767 USA

Be sure to pack the analyzer securely. Include your name, address, telephone number, and a description of the operating problem. After repairing or, at our option, replacing your Analytical Industries 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	KOH = Colorless, odorless aqueous solution or Acetic Acid = Colorless, vinegar-like odor aqueous solution

Fire and Explosion Data

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

Reactivity Data

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

Spill or Leak

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

Disposal

In accordance with federal, state and local regulations.

Health Hazard Information

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

Special Protection Information

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

Special Precautions

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