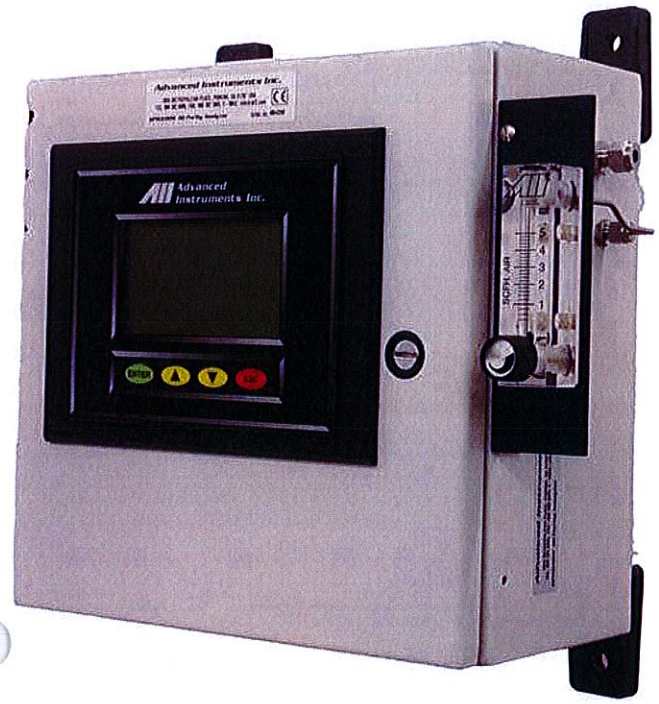
Analytical Industries Inc.
Advanced Instruments Inc.

"Innovative solutions to gas analysis"



GPR-3100 W

O_2

GPR-3100

Oxygen Purity Analyzer

Owner's Manual

CE Made in the USA

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Table of Contents

1 Introduction

Thank you for your purchase, this Owner's Manual describes the safety, operating considerations, troubleshooting and specifications of the GPR-3100 / GPR-3100 W (wall mount) Oxygen Purity Analyzer, hereinafter referred to as GPR-3100.

The specifications, see Attachment A, identify the normal operating parameters. Additional information is provided by:

- ⏭ Section 3.2 Analyzer Overview
- ⏭ Section 3.3 Accuracy Considerations
- ⏭ Section 4.2 Application Considerations
- ⏭ Section 4.7 Calibration Preparation
- ⏭ Section 5.1 Calibration Overview

Please do not hesitate to contact the factory to discuss the nature of your specific application, we have many years of expertise in designing sample conditioning systems for analyzers and optimizing sensors for OEM applications.

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

Serial Number: _____

Every effort has been made to select the most reliable materials and components; and, to design the analyzer for superior performance and minimal cost of ownership.

This analyzer including the accompanying sensor were tested thoroughly and calibrated prior to shipment. The results are documented in Attachment B.

All products manufactured by Analytical Industries Inc. comply with ISO 9001:2008; and FDA, Canadian and European Union ISO 13485:2012 standards for medical devices.

Your business is appreciated and every effort has been made to maintain the highest possible quality standards with respect to product design, manufacturing and service.

1.1 Intended Use

The design of the GPR-3100 / GPR-3100 W Oxygen Purity Analyzer is intended to confirm the oxygen concentration (gas phase) in percentage by volume according to the definitions of 2015 USP 38 and NF 33:

- ⏭ Oxygen not less than 99.0% oxygen by volume - medical grade oxygen
- ⏭ Oxygen 93 Percent 90.0% - 96.0% oxygen by volume - transfilling oxygen cylinders
- ⏭ Elevated oxygen levels between 80% - 100% in industrial applications

2 Safety

This section summarizes the basic precautions applicable to the analyzer. To operate the analyzer safely and obtain optimum 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: These symbols are used throughout the Owner's Manual to identify sources of immediate **Danger** such as the presence of hazardous voltages and electrostatic shock.

Read Instructions: Before operating the analyzer read the safety precautions and operating instructions herein. Retain for future reference. Heed 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: Keep the analyzer away from sources of heat.

Liquid and Object Entry: Do not immerse the analyzer in any liquid. Avoid spilling liquids or allowing objects to fall into the inside of the analyzer.

Handling: Do not use force when using the switches. When charging the battery with the AC adapter supplied, be sure to disconnect the adapter cord and any cables connected to the output terminals located on the analyzer before moving the analyzer. Do not drop the oxygen sensor.

Serviceability: Only trained personnel with the authorization of their supervisor should conduct maintenance. As described in Section 6, except for checking the contacts pins and o-ring seal when replacing the oxygen sensor, there are no serviceable parts inside the analyzer.

Oxygen Sensor: DO NOT open the sensor. The sensor contains a corrosive liquid electrolyte that causes irritation with contact and could be harmful if ingested, refer to Section 10 Safety Data Sheet.

Troubleshooting: See Section 8 for a summary of symptoms, possible causes and remedial action to investigate before concluding that your analyzer is faulty. Contact the Factory with any questions. Unauthorized repairs will void the warranty, as detailed by Section 9.

Cleaning: 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 not in use for long periods of time and place Sample/Bypass valve is in the bypass position.

3 Principles of Operation

3.1 Major Advancement in Sensor Technology

The GPR-3100 Oxygen Purity Analyzer is the only electrochemical oxygen sensor based analyzer capable of measuring 100% oxygen on a continuous 24/7 basis for the purpose of verifying the purity of medical grade oxygen transport vehicles and storage facilities. The inherent accuracy after calibration is 0.1% which is comparable with more expensive analyzers. The GPR-3100 is unaffected by vibration and its integral sample system make it ideal for continuous analysis.

Background: The production of high purity oxygen has been confined to medical grade oxygen not less than 99.0% oxygen and oxygen 93 Percent (90.0% - 96% oxygen). However, the demand for oxygen in industrial applications is expanding rapidly due largely to recent developments in chemical processes requiring elevated concentrations of oxygen (75 -95%) that boost yields and reduce emissions without significant cost increases. The oxygen supplied can be cryogenic or generated by pressure (PSA) and vacuum (VSA) swing adsorption methods.

Producers and users alike have relied on analyzers based on the paramagnetic sensing method for measuring oxygen purity. These sensors offer highly accurate results especially at a 98-100% oxygen suppressed range. However, they are very sensitive to changes in the flow rate of sample gas, the presence of minute particulates and moisture, temperature variations and especially vibration. Paramagnetic analyzers are expensive and require frequent two-point calibration especially after they have been moved or subject to vibration.

Electrochemical sensor based analyzers have generated interest for oxygen purity measurements because of their linear output proportional to oxygen, inherent absolute zero, versatility, unaffected by vibration, low maintenance and inexpensive cost. However, short sensor life (3-4 months) and the gradual drop (drift) in the signal output of the micro-fuel cell with time has precluded their use to this point.

Breakthrough Sensor Technology: To compete with paramagnetic devices and to assure a stable 'drift free' oxygen measurement the focus was the development of an advanced galvanic sensor capable of operating continuously 24/7 for two years 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 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.
- Compensating the sensor's signal output for changes in temperature and barometric pressure.

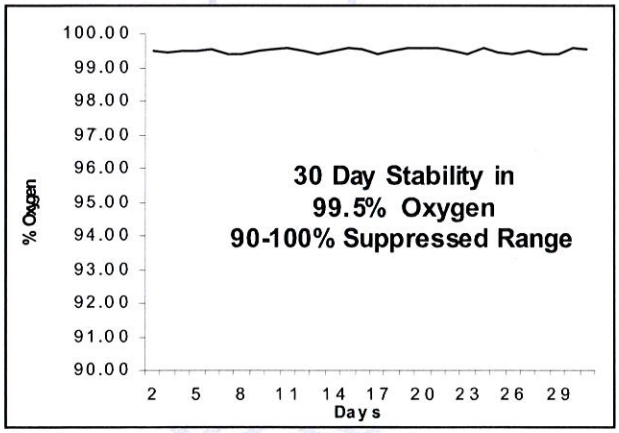
3 Principles of Operation

hrough 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 of the electrochemical based analyzers.

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 sensor, 99.5% oxygen was introduced (typically the threshold for gas manufacturers) for 30 days and the output plotted as shown below. 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.



3.2 Analyzer Overview

Sensor: The GPR-3100 analyzer employs an advanced electrochemical galvanic oxygen sensor that:

- is actually an transducer specific to oxygen that generates a current signal output which is both proportional and linear (over all ranges) to the oxygen concentration in the gas stream.
- possesses an absolute zero in the absence of oxygen.
- is capable of one point calibration.
- requires periodic, 1 month intervals, calibration to maintain accuracy and confirm signal output has not been adversely effected by unanticipated conditions.
- is extremely versatile and measures the partial pressure of oxygen in inert gases, gaseous hydrocarbons, helium, hydrogen, mixed gases, acid gases and ambient air.
- is not affected by vibration, motion or transport.
- is accurate at any pressure, if the pressure is constant.
- requires no maintenance and is easily replaced.
- has an expected life of 2 years when continuously exposed to 100% oxygen, which is is inversely affected by deviations from the temperature and pressure conditions specified in Attachment A.
- does not tolerate being dropped,.
- does not tolerate exposure to sulfur and acid gases; or, prolonged exposure outside the temperature range specified in Attachment A without optional sample conditioning. Contact the factory for solutions.
- is not damaged by liquids, however, if the sensing surface is covered entirely the flow of gas will be blocked causing the reading to gradually decline until removed.

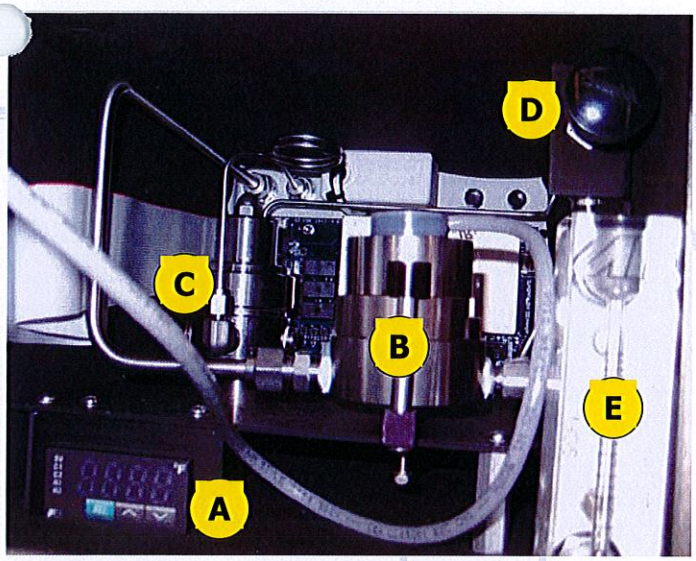
Electronics: The accuracy and stability the oxygen readings are ensured by state of the art micro-processor based digital circuitry. The first stage amplifies the signal output of the sensor. The second eliminates low frequency noise. The third stage employs a high frequency filter and compensates for signal output variations caused by changes in ambient temperature and barometric pressure.

Other standard features include 0-100% full scale range, 3 suppressed ranges: 0-50%, 0-80%, 0-90%, a 4-1/2 digit LCD display, auto ranging or manually selected fixed range, 3 analog outputs (isolated 4-20mA, 0-1V, 1-5V), a choice of range ID outputs (non-isolated 4-20mA or 1-5V), RS-232 and USB ports, 2 field selectable alarms with dry relay contacts, data acquisition, temperature tracking all of which can be controlled remotely. An algorithm displays a "WEAK SENSOR" message indicating the sensor should be replaced in the near future.

Optional equipment includes auto-zero and auto-span functions which require a 3 port inlet module.

Power to the analyzer electronics is supplied by an universal 100-240 VAC power entry module that requires a standard computer-type power cord. However, the heater section of the temperature control feature must be configured to the local power supply 100-110 or 220-240 VAC and specified at time of order.

3 Principle of Operation



Sample System: To ensure the accuracy of the reading, the analyzer features an integral temperature controlled (**A**) sample conditioning system consisting of a sensor housing (**B**), pressure regulator (**C**), flow valve (**D**), flow indicator (E), and, 10 ft. of coiled tubing which stabilizes the temperature of the sample gas before introduction to the oxygen sensor.

Wetted parts are stainless steel and have been leaked tested and proven capable of measuring 1 part per billion (PPB) oxygen by an APIMS mass spectrometer.

3.3 Accuracy Considerations

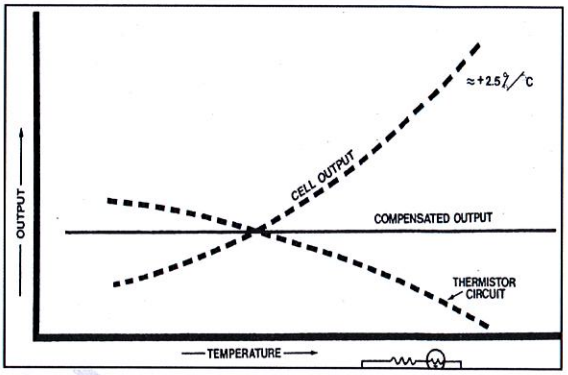
General: Calibrate at the temperature and pressure of the sample gas (within 1-2 psi). Flow rates should be set at the lowest pressure anticipated in the sample mode.

Allow the oxygen reading to stabilize before initiating the calibration routine (digit to the right of the decimal can flicker back and forth). Failure to do so will introduce an electronic offset and result in erroneous readings.

Single Point Calibration: The specificity to oxygen and the inherent absolute zero discussed in the previous section make single point calibration 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.

Temperature: The rate oxygen molecules diffuse into the sensor is controlled by a Teflon 'oxygen diffusion limiting barrier' or membrane which is temperature dependent. The fact the sensor's signal output varies with temperature is normal. This variation is relatively constant 2.5% per °C and is offset by a temperature compensation circuit with an accuracy <±5% over the analyzer's operating temperature range. Minor variations of 5-10°F produce < ±2% error.

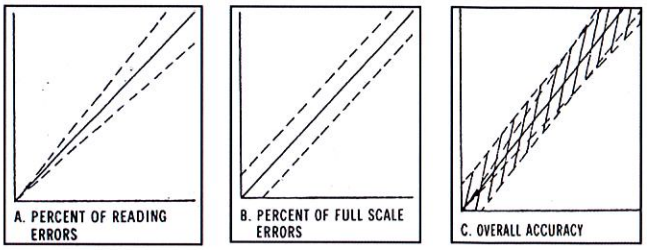


The overall accuracy of an analyzer is affected by two types of errors as illustrated by Graphs A and B below left.

Graph A: **'percent of reading errors'** such as the ±5% accuracy of the temperature compensation circuit over the entire operating temperature range, tolerances of range resistors and the dynamic range in the software routine for calibration adjustments.

Graph B: **'percent of full scale errors'** such as ±1-2% linearity errors in readout devices, which are minimal given today's technology and the fact these errors are eliminated by span calibration.

Graph C below right illustrates the the combination of Graphs A and B or 'worse case' error that are typically used to develop an analyzer's overall accuracy specification. Quality Control testing of analyzers prior to shipment is typically less than ±0.5% under ideal conditions.



Conclusion: Graph A illustrates two important points:

When the measurement is made at the lower more sensitive end of the scale, the calibration gas should approximate 80% of full scale. For optimum accuracy, apply this guideline and calibrate one range higher than the actual measuring range (to further reduce the error).

When the measurement is made at the upper end of scale such as 90% to 100% oxygen, calibrate as close to 100% as possible.

⚠ Do not calibrate at the lower end of the range (e.g. air 20.9% oxygen) for measurements above 30% oxygen

Note: The inherent accuracy of the analyzer following calibration is 0.1% because the temperature and pressure conditions are temporarily eliminated by span calibration (but will inevitably change with time).

4 Start-Up

4.1 Contents of Shipping Container

GPR-3100 Oxygen Purity Analyzer includes the following integral components:

- Pressure Regulator (10 psig fixed outlet)
- Flow Control Valve
- Bypass Valve
- GPR-11-120-OP Oxygen Purity Sensor installed in . .
- Stainless Steel Sensor Housing
- Flow Indicator
- Temperature controller and heater

Owner's Manual on CD

Quality Control & Calibration Certification (Attachment B)

Chart Recording of Qualification Test

P/N A-1008 Power Cord (analyzer only)

4.2 Application Considerations

Ascertain whether the composition of the sample gas stream and conditions are consistent with the specifications in Attachment A. The presence of interfering gases in the sample gas, elevated temperature, presence of particulates and/or moisture, and, the lack of positive pressure require sample conditioning. Contact the factory for solutions.

Materials: Stainless steel tubing is recommended for connecting to the analyzer to maintain the integrity of the gas stream when measuring 90-100% oxygen.

Pressure: Accuracy requires constant pressure. The incoming pressure must be at least 10 psig for the integral pressure regulator to maintain constant pressure. The outlet of the 1/4" diameter vent should be to atmosphere.

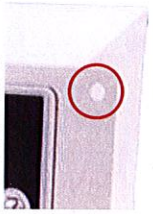
Flow: A flow rate of 1-2 SCFH is recommended for optimum performance. To avoid erratic readings due to pressure variations, set the pressure regulator at the lowest pressure (above the fixed 10 psig of the integral pressure regulator) anticipated during sampling and then set the flow meter.

Recommendations to avoid erroneous oxygen readings and damaging the sensor:

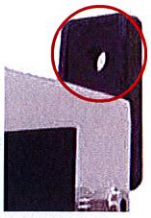
- The collection of liquids or particulates on the sensor's sensing surface block the diffusion of oxygen into the sensor resulting in a gradual loss of signal output and low readings. Most can be simply blown or wiped away.
- Avoid restrictions in the vent line that can generate backpressure on the sensor and incorrect high readings.
- Avoid sudden releases of backpressure (such as removing a finger that covers the vent line to confirm the flow rate) that can severely damage the sensor and void the warranty.

4.3 Mounting the Analyzer

The GPR-3100 is approved for indoor use only, however, it may be installed outdoors inside a secondary enclosure or analyzer shelter.



Dimensions of the panel mount configuration (right) are 10.8"W x 7.5"H x 12.25"D. It is designed for mounting using 4 bolts to a flat vertical surface the appropriate cutout. An optional panel is available for installing the analyzer into a 19" rack. The panel mount configuration requires access from the front and rear (gas and electrical connections).



Dimensions of wall mount configuration are 12"W x 12"H x 8"D. It is designed for mounting to a flat vertical surface using 4 bolts without the need for a cutout. The wall mount configuration requires access from the front, bottom (electrical) and side (gas connections).

In either case to facilitate servicing the analyzer, position it approximately 3-6 feet off the floor and allow sufficient room to access the interior, make electrical and gas connections.

4.4 Electrical Connections

With reference to the illustration on the following page, the electrical connections will be addressed from top to bottom and left to right.

Power: Consumption is approximately 30 watts without optional heater and 150-200 watts with the heater system. As illustrated on the following page, universal 100-240 VAC power is supplied to (1) the panel mount unit by connecting a filtered power cord, (P/N A-3941) supplied with the analyzer, to the power entry module **(A)** or (2) the wall mount unit by hard wired to push-open terminals **(B)**.

The power entry module includes a fuse **(C)** on the following page) that can be accessed by lifting the cover with a thin bladed screwdriver. The fuse for the wall mount unit is mounted separately with a twist off cap on the electrical panel **(D)**.

Note: Despite the fact both units accept universal 100-240 VAC power albeit from different components, the heater element of the temperature control feature is selected based the local power supply of 100-110 or 220-240 VAC, and, therefore requires the power be specified at time of order.

Making Connections: Power inputs for the wall mount unit, all output connections and alarm relays are hard wired to push-open terminals located on the rear panel.

1. Strip no more than 3/16" from the end of the wire,
2. Select the desired connection from the legend **(E)**,
3. Depress the appropriate spring loaded terminal **(F)** with a small thin bladed screwdriver,
4. Insert the stripped end of the wire completely ensuring there is no contact with the rear panel,
5. Remove the screwdriver to secure the wire.

4 Start-Up

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

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.

Range ID (identification): At time of order, users can select one of the following:

4-20mA isolated
1-5V

Optional outputs:

4-20mA non-isolated with relay contacts
1-5V with relay contacts

A voltage output corresponding to each range is provided:

5V = 0-100% range
4V = 50-100% suppressed range
3V = 80-100% suppressed range
2V = 90-100% suppressed range

The dry contacts are rated at 30VDC @ 1A.

Analog Signal Outputs: 3 analog signal outputs are provided with analyzer:

4-20mA full scale fully isolated ground
0-1V with negative ground
0-5V with negative ground

for external recording devices such as PLCs, RTUs, DCS.

An E/I integrated circuit on the main PCB provides a 4-20mA isolated signal for the signal output and Range ID, above.

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

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 ±0.1mA of 4mA (without sensor installed or with the sensor Bypass switch to OFF position).

A finer adjustment of the zero offset of the 4-20mA converter can be achieved by using AII Configuration Software via a PC. Consult factory.

Low Flow Alarm (optional): The contact closes when the gas flow exceeds the 1.5 SCFH set point and opens below it. To prevent false alarms, set the flow rate above 2 SCFH. Do not exceed the 1A@30VDC rating.

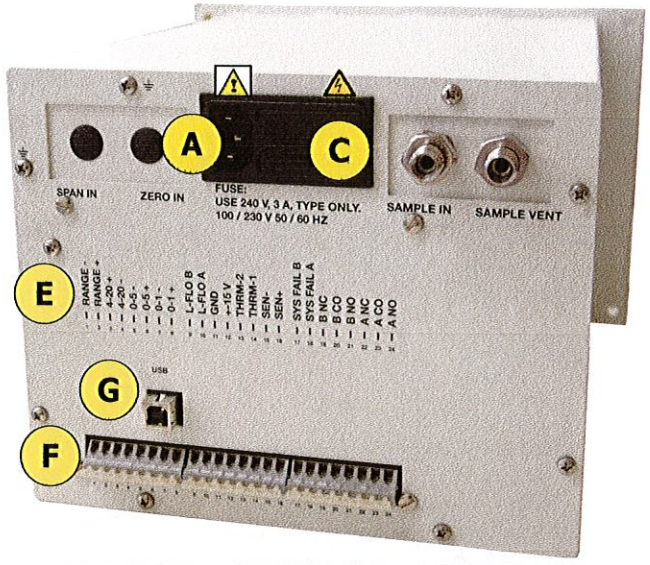
These terminals are used for Range ID options that call for relay contacts.

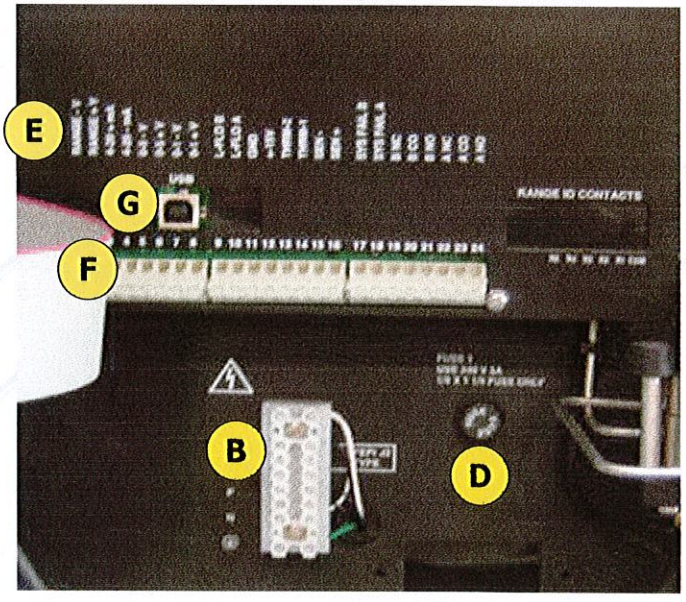
Weak Sensor Indicator: A "Weak Sensor" warning message is displayed by the LCD during calibration when the sensor output drops 20-25% from a baseline established at a previous calibration.

System (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.

Alarms (Oxygen Level): Two user adjustable threshold alarm relays are provided which can be configured in the field. **Note:** When making connections the user must decide and configure the alarms for the desired mode Failsafe or Non-Failsafe. Refer to section **4.10.4** Alarms for detailed description and setup instructions.

Digital Communications: An USB communications link **(G)** is provided for use with optional software. Contact factory for more information. Also, RS-232 and RS-485 connections are available options.





4 Start-Up

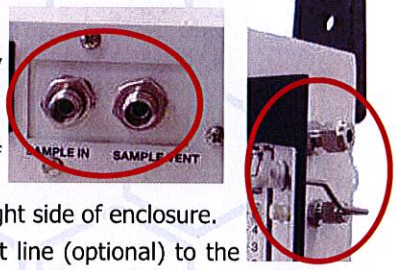
.5 Oxygen Sensor

As noted in Section 4.1 the standard procedure is to ship the GPR-3100 with the oxygen sensor (the analyzer was qualified with at the factory) installed in the sensor housing and the Sample/Bypass Valve placed in the Bypass position. DO NOT change from the Bypass position until instructed.

If the oxygen sensor was shipped separately, install it as described in Section 6.2 Installing a New Oxygen Sensor.

4.6 Gas Connections

The GPR-3100 is designed for positive pressure samples and requires 1/4" compression fittings and SS tubing for the Sample In and Sample Vent lines.



Procedure:

1. Locate the 1/4" tube fittings: panel mount unit - upper right hand corner of the rear panel, and, wall mount unit - right side of enclosure.
2. Connect a 1/4" vent line (optional) to the bulkhead compression fitting designated as the VENT.
3. Connect a 1/4" incoming line to the bulkhead compression fitting designated SAMPLE.

.7 Preparation for Calibration

Users are responsible for supplying the appropriate to the intended application as described in this section.

Do not contaminate the span gas cylinder: The regulator and sample lines, especially between the cylinder valve and regulator, must be bled to purge trapped air.

Procedure:

1. Install the pressure regulator to the cylinder.
2. Attach a sample line with a flow control valve installed at the farthest end.
3. Open the flow control valve slightly.
4. Open the cylinder valve (apply pressure to regulator).
5. Set the pressure regulator to at least 10 psig.
6. Close the cylinder valve.
7. Open the cylinder valve to fully pressurize the regulator.
8. Close the cylinder valve.
9. Open the flow control valve fully and allow the regulator to bleed down and vent to a safe area.
10. As the secondary (low pressure side) gauge on the regulator starts to fall, close the flow control valve.
11. Repeat steps 7 thru 10 several times to complete purge.
12. Leave the cylinder valve open to maintain system pressurization.

Calibration Gases: Users are responsible for supplying calibration gases appropriate to the intended application. As described in section 3.3 Accuracy Considerations, the electrochemical galvanic oxygen sensor has an absolute zero and requires only single point calibration.

Oxygen 99.0%: Defined by USP 38 for Oxygen as "not less than" 99.0% Oxygen by volume. Certified span gas is required for the calibration of analyzers used in certifying medical grade oxygen. As the analyzer manufacturer, we recommend calibrating the analyzer with a certified span gas of "not less than" 99.99% oxygen with the balance nitrogen.

Oxygen 93 Percent: Defined by USP 38 as "not less than" 90.0% to 96.0% Oxygen. Certified span gas is required for the calibration of analyzers used in certifying Oxygen 93 Percent. As the analyzer manufacturer, we recommend calibrating the analyzer with a certified span gas of 93.0% +0.1% oxygen with the balance nitrogen.

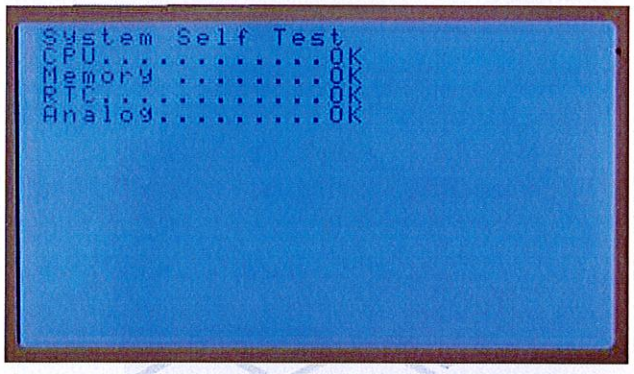
Non-USP 38 oxygen applications: Generally require calibration once a week or even monthly at the users discretion. In most cases calibrating the analyzer with a certified span gas of 95-100% oxygen with the balance nitrogen is sufficient.

4 Start-Up

.8 Establishing power to the analyzer

Connect one end of the power cord (standard computer type) to the universal power entry module located at the rear of the analyzer. Connect the other end of the power cord to an AC outlet. There is no ON/OFF switch.

Each time power is applied to the analyzer **including interruptions of power,** the software performs a diagnostic 'Start-up Test' and displays the results.



If any of the tests indicate 'FAIL' disconnect the power cord from the outlet for 15 seconds and turn it back ON to reset the software. If the 'FAIL' repeats contact the factory.

successful 'Start-up Test' is immediately followed by an informational display:

After 3 seconds, the informational display defaults to the standard menu format in the STANDBY mode as follows:

Note: Following an interruption of power:

1. Advance the cursor (*) with a yellow <ARROW> key to the <SAMPLE> option,
2. Press the blue <ENTER> key,
3. Select the <RANGE> mode from the <SAMPLE MENU> as described below.

Temperature Controlled Heater System: The GPR-3100 is equipped with a controlled heater system and 10 ft. of coiled tubing to stabilize the temperature of the sample gas before introduction to the oxygen sensor and thereby ensure the accuracy of the resulting oxygen readings.

When power is applied, 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 changing temperature set point to 60°F to prevent overheating the analyzer.

As previously illustrated in section 3.2 Analyzer Overview, the temperature controller is accessed by opening the front panel and is located in the lower left hand corner.

This unit is a PID controller which operates between 0-99°F. The controller is programmed at the factory to maintain the temperature at 85°F, the recommended temperature for operating the analyzer under normal conditions.

Do not change this setting. A higher temperature setting will significantly reduce sensor life and possibly cause damage the circuitry of both the controller and the analyzer.

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

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

4 Start-Up

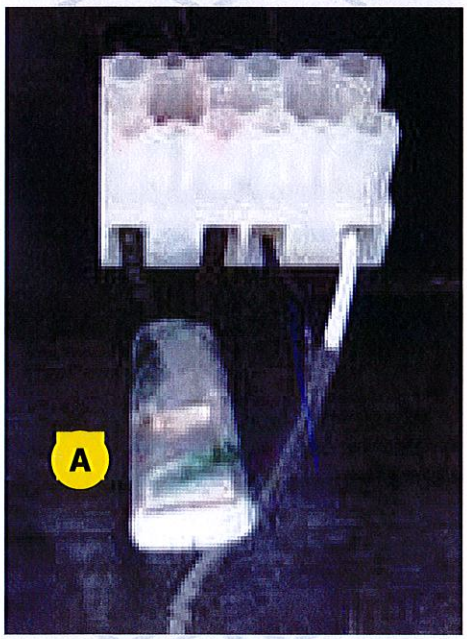
Heater Runaway Protection: The temperature controlled heater system includes a heater runaway protection circuit that prevents damage to the electronics in the event the temperature controller fails.

The runaway protection is provided by a J2 type device (**A** below) positioned between the temperature controller and the heater that cuts-off power to the heater if the temperature inside the analyzer exceeds 70°C.

The J2 conducts under normal conditions and should it cut-off power to the heater, correct the problem with the heater and reset the J2 device by removing it from the analyzer (as described below) and exposing it to 0°C for a few minutes in a refrigerator freezer.

Replace the J2 device if it fails to reset itself.

To access the J2 device remove the rear panel of the analyzer. The J2 device which is mounted on a white terminal block as illustrated below.



4.9 Analyzer Controls

Navigation Keypad: The GPR-3100 is menu driven from a multi-colored key pad located on the front panel.

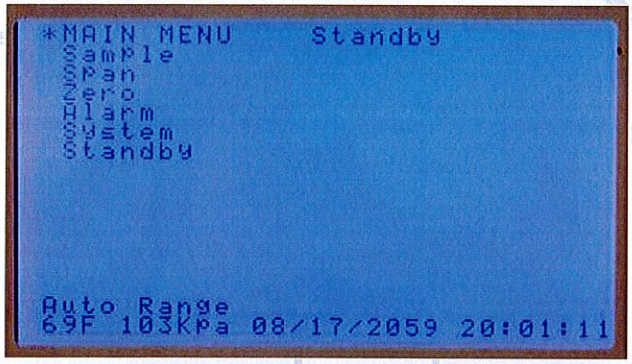
Blue:	ENTER (select the option next to (*) cursor)
Yellow:	UP ARROW (scroll cursor (*) up)
Yellow:	DOWN ARROW (scroll cursor (*) down)
Red:	ESC (escape or abort previous selection)

Pressure Regulator: This integral component is rated for 3600 psig inlet and has a fixed outlet of 10 psig.

Flow Control Valve: The round knob located behind the front panel in the upper right hand corner controls the flow rate of the gas stream. It is positioned between the pressure regulator and the sample/bypass valve in the sample system scheme.

4 Start-Up

4.10 Menu Options



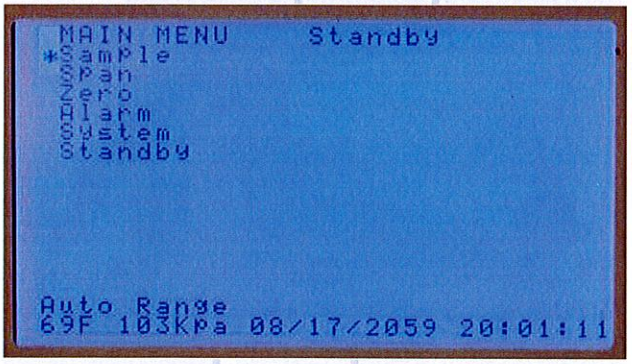
Menu Format (above):

- MENU TITLE - 1st line of text at top left corner of display
- MENU OPTIONS - appear below MENU TITLE
- ANALYZER MODE - top center of display
- (*) - cursor appears to the left of option selected
- RANGE MODE - 1st line of text at the bottom of display
- INFORMATION - 2nd line text at the bottom of display and reflects the TEMPERATURE (inside the analyzer), AMBIENT PRESSURE, DATE and TIME

4.10.1 Sample Menu

The analyzer is equipped with four (4) standard measuring ranges (Attachment A) and provides users with a choice of sample modes.

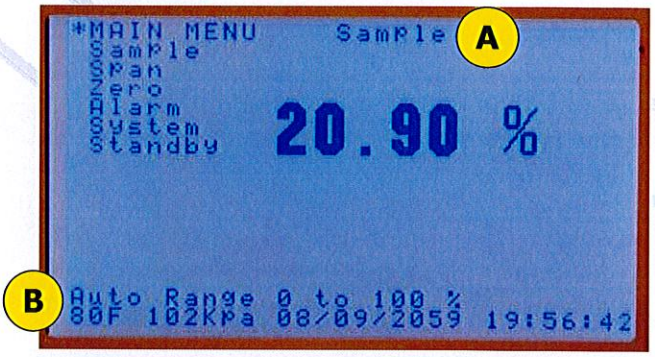
1. Press the yellow <UP/DOWN ARROW> key to advance the cursor (*) to <SAMPLE>.



2. Press the blue <ENTER> key to display the SAMPLE menu and the sample modes available:

   - Auto Range
   - Manual Range
   - Bypass (N/A, use with optional sample system)
   - Standby (N/A, use with optional sample system)

3. To select one of the sampling modes described above, press the yellow <UP/DOWN ARROW> key to advance the cursor (*) to the desired sample mode.
4. Press the blue <ENTER> key to select the sample mode.
5. Within seconds:
   - the microprocessor assesses the selection,
   - takes the necessary action,
   - returns to the MAIN MENU in the Sample mode (**A**)
   - displays the sample mode selected on the 1st line of text at the bottom of display (**B**)



Auto Range: The microprocessor automatically selects the appropriate full scale range depending on the concentration of oxygen in a sample gas. The display will shift to the next higher range when the oxygen level exceeds 99.9% of the current range and to the next lower range when the oxygen level drops below 85% of the next lower range.

During span calibration, the microprocessor defaults to the AUTO RANGE mode.

Manual Range: Once this option is selected, the user makes a 2nd selection from one (1) of the available standard ranges (Attachment A) and fixes or locks the oxygen reading on the range selected.

When the oxygen reading exceeds 125% of the upper limit of the range selected, an OVER RANGE warning will be displayed under the oxygen value. Once the OVER RANGE warning appears the user must advance the analyzer to the next higher range.

Bypass and Standby: These sample mode apply only to analyzers equipped with optional automated sample systems.

4.10.2 Zero Menu

Not applicable, see section 5.2 Zero Calibration

4.10.3 Span Menu

See section 5.3 Span Calibration

4 Start-Up

.10.4 Alarm (Oxygen Level) Menu: Two user adjustable threshold alarm relays are provided which can be configured in the field. Both alarms may be temporarily suspended using the timeout (set by the user normally in minutes) feature to avoid false alarms during calibration and maintenance.

The alarm set point represents an oxygen value. When the oxygen reading exceeds (Alarm Hi) or falls below (Alarm Lo) the alarm set point, the relay is activated and the LCD displays the alarm condition. Once activated, the alarm function triggers the corresponding SPDT Form C non-latching relay rated @ 5A, 30VDC or 240VAC resistive.

To prevent chattering of the relays, a 2% hysteresis is added to the alarm set point. As a result, the alarm remains active until the oxygen reading has fallen 2% below the Alarm Hi set point or risen 2% above the Alarm Lo set point after the alarm was activated.

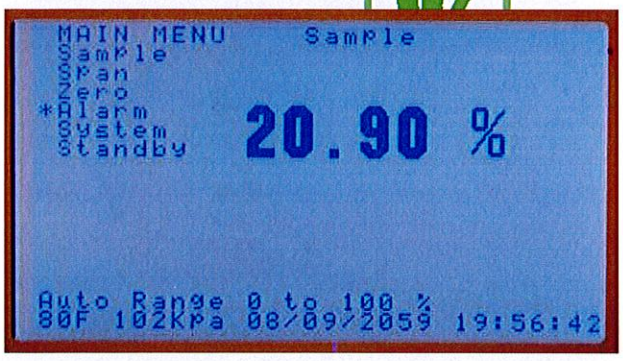
Note: When making connections the user must decide and configure the alarms for the desired mode as follows:

Failsafe Mode: Alarm relay is normally open (NO) when energized, and, when the alarm is activated de-energizes and closes in an alarm condition.
- Connect Alarm 1 and Alarm 2 to NO and common C

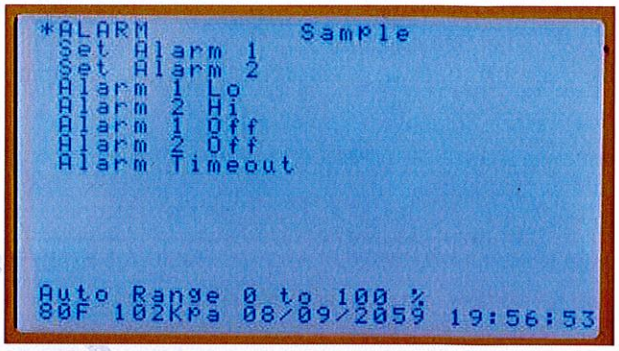
Non-Failsafe Mode: Alarm relay is normally closed (NC) when energized, and, when the alarm is activated -energizes and opens in an alarm condition.
- Connect Alarm 1 and Alarm 2 to NC and common C

Procedure for Configuring the Alarms:

1. With reference to section **4.9 Analyzer Controls**, from the MAIN MENU press the yellow <UP/DOWN ARROWS> to move the cursor (*) to ALARM:

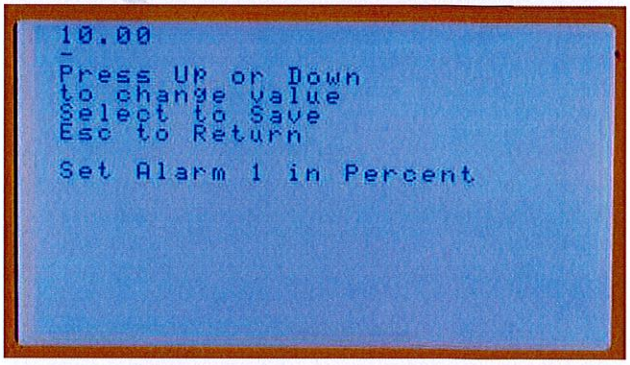


2. Press the blue <ENTER> key to display the ALARM menu illustrated at top of next column.
3. Use this menu to control the alarm functions provided.



Establish alarm set points as oxygen value:

4. Press the yellow <UP/DOWN ARROWS> and move the cursor (*) to Set Alarm 1
5. Press the blue <ENTER> key to display the following:



6. Press the yellow <UP/DOWN ARROW> key to change the value of the 1st digit, SKIP if value is correct.
7. Press the blue <ENTER> key to advance the cursor to the next digit, PERFORM even if the value is correct
8. Repeat #6 and #7 until the appropriate 'Percent' oxygen value is displayed.
9. Press the blue <ENTER> key after the last digit to return to the ALARM menu.
10. Repeat #4 through #9 to Set Alarm 2.

Configure alarms as Hi or Lo oxygen level:

11. Press the yellow <UP/DOWN ARROW> and move the cursor (*) to Alarm 1 Lo.
12. Press the blue <ENTER> key to toggle between Hi/Lo.
13. Repeat #11 and #12 to configure Alarm 2 Hi/Lo.

Enable alarms:

14. Press the yellow <UP/DOWN ARROW> and move the cursor (*) to Alarm 1 Off.
15. Press the blue <ENTER> key to toggle between On/Off.
16. Repeat #11 and #12 to configure Alarm 2 On/Off.

Alarm Timeout - enter time alarms will be defeated:

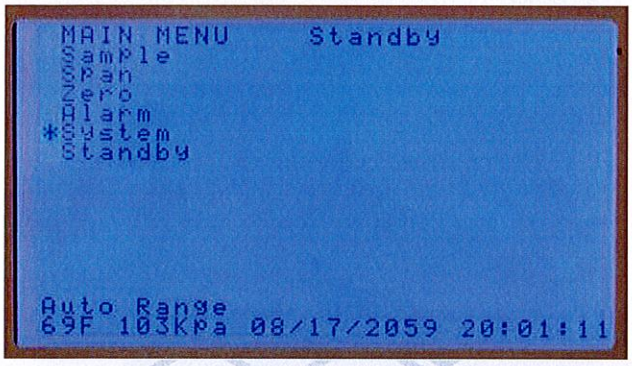
17. Press the yellow <UP/DOWN ARROW> and move the cursor (*) to Alarm Timeout.
18. Press the blue <ENTER> key to display the sub-menu for entering the time period in minutes.
19. Press the yellow <UP/DOWN ARROW> key to change the value of the 1st digit, SKIP if value is correct.
20. Press the blue <ENTER> key to advance the cursor to the next digit, PERFORM even if the value is correct.
21. Repeat #19 and #20 until the desired time is entered
22. Press the red <ESC> key to return to the MAIN MENU.

.10.5 System

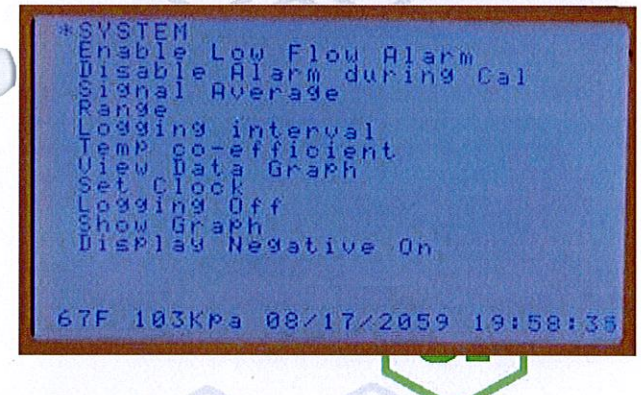
The analyzer is equipped with a numerous features that enables users to enhance performance and tailor their interface with the analyzer.

Procedure:

1. With reference to section **4.9 Analyzer Controls**, from the MAIN MENU press the yellow <UP/DOWN ARROWS> to move the cursor (*) to SYSTEM:



2. Press the blue <ENTER> key to display the SYSTEM menu and the available features.



3. Advance the cursor (*) to the desired option, press the blue <ENTER> key to select.
4. **Follow the instructions below using the blue <ENTER> key to toggle between options.**

Enable Low Flow Alarm: This feature is not controlled by the microprocessor, so if the the analyzer is equipped with this option toggle between ENABLE and DISABLE.

Disable Alarm During Cal: Toggle between ENABLE and DISABLE.

Signal Average: Toggle to select user preference for the trade-off between response time and noise filtering:

- ⏭ LOW filtering with 5 second response time
- MEDIUM filtering with 8 second response time
- ⏭ HIGH filtering with 10 second response time

Range: Same options as SAMPLE menu, section 4.10.1

Logging Interval: Set the minutes between data points.

1. Press the yellow <UP/DOWN ARROW> and move the cursor (*) to Logging Interval.
2. Press the blue <ENTER> key to display the sub-menu for entering the minutes between data points captured.
3. Press the yellow <UP/DOWN ARROW> key to change the value of the 1st digit, SKIP if value is correct.
4. Press the blue <ENTER> key to advance the cursor to the next digit, PERFORM even if the value is correct.
5. Repeat #3 and #4 until the desired time is entered.
6. Press the red <ESC> key to return to the MAIN MENU.

Temp Co-efficient: An option requiring factory assistance that enables fine tuning of the temperature compensation.

View Data Graph: Functions only with the Logging feature below toggled ON. Upon selection displays a graph of the data points captured and stored in memory.

Set Clock (and Date): Set the Time or Date.

1. Press the yellow <UP/DOWN ARROW> and move the cursor (*) to Time or Date.
2. Press the blue <ENTER> key to display the sub-menu for entering the hour/minute/second or year/month/day.
3. Press the yellow <UP/DOWN ARROW> key to change the value of the 1st digit, SKIP if value is correct.
4. Press the blue <ENTER> key to advance the cursor to the next digit, PERFORM even if the value is correct.
5. Repeat #3 and #4 until the desired info is entered.
6. Press the red <ESC> key to return to the MAIN MENU.

Logging: Toggle between ON and OFF. Functions in conjunction with the **Logging Interval** and **View Data Graph** features previously described. The internal memory stores a maximum of 5500 data points in 32K of memory.

Show (Display): Toggle to select TEXT or GRAPH option for the LCD display.

- ⏭ **Text:** Displays the oxygen reading in large size font as illustrated in section 10.4.1 Sample Menu.
- ⏭ **Graph:** Useful for trending the oxygen reading when installing a new sensor, after calibration or process upset. The display presents the oxygen reading in small size font and as a moving graphical trend of data points. For presentation purposes, only a portion of the data points are displayed at a time. The microprocessor refreshes the display and moves on to the next portion of data points.

Display Negative (Reading): Toggle to select ON or OFF. Except for low PPM measurements where calibration errors can introduce electronic offsets to the oxygen reading, the recommendation is to select OFF.

5 Operation

Attachment B documents the quality control and calibration certification of the GPR-3100 Oxygen Purity Analyzer at the factory prior to shipment.

5.1 Calibration Overview

Calibration involves adjusting the analyzer electronics to the sensor's signal output at an oxygen standard and environmental conditions, see Section 3.3 Accuracy Considerations.

Calibration is the recommended first step in operating the analyzer for the following reasons:

- The electrochemical oxygen sensor is a partial pressure device and pressure varies with altitude.
- Maximum drift from calibration temperature is approximately 0.11% of reading per °C.
- Accurate readings depend on following the 'general rule of thumb' that calibration should be performed at the temperature and pressure of the gas to be sampled.

To provide reliable data thereafter calibrate periodically, at least monthly, to confirm the sensor's signal output has not dropped significantly due to unanticipated conditions.

Allow the oxygen reading to **stabilize** before initiating the SPAN CALIBRATE function. Stabilize means the digit to the left of the decimal does not change, however, the digit to the right of the decimal point may flicker back and forth, not down or up.

Failure to allow the oxygen reading to stabilize before initiating the SPAN CALIBRATE function will introduce a fixed calibration offset error resulting in erroneous oxygen readings.

Time Required: Once the reading stabilizes performing a calibration takes less than 5 minutes.

As described in Section 4.7 Preparation for Calibration, users are responsible for selecting the calibration method, gases and ancillary equipment.

5.2 Zero Calibration

The manufacturer's product line of oxygen analyzers utilizes a common electronics platform that encompasses measurements ranging from PPM (parts-per-million) to oxygen purity.

Zero calibration quantifies and subtracts the background oxygen reading so the analyzer reads 0.00 before span calibration. The purpose is to optimize the accuracy of the span calibration for PPM measurements below 1 PPM .

Inasmuch as the typically zero subtraction value of 0.0001% has no impact on an oxygen purity analyzer with a 100.00% (or 4-1/2 digit) readout **the zero calibration section is not applicable to the GPR-3100 Oxygen Purity Analyzer.** And, with the exception of the DEFAULT ZERO function (described on the next section) has been omitted from this manual.

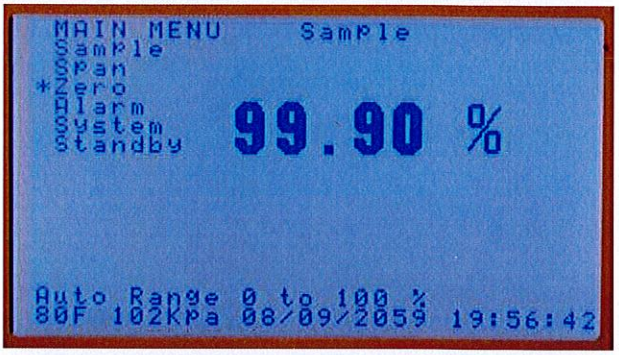
5.3 Span Calibration

Before proceeding, it is recommended the user review the preceding sections addressing:

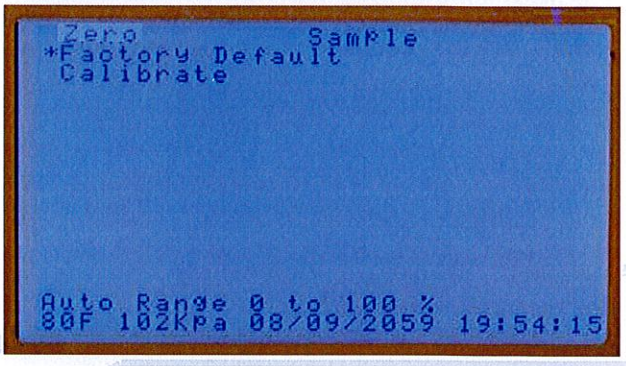
Analyzer Overview (3.2),
Accuracy Considerations (3.3),
Application Considerations (4.2),
Calibration Preparation (4.7),
Calibration Overview (5.1).

Procedure:

1. Place the analyzer in the SAMPLE / AUTO RANGE mode.
2. Connect the stainless steel gas lines.
3. Initiate the flow of certified span gas, e.g. 99.99%.
4. Set the pressure above 10 psig and flow rate to 2 SCFH.
5. Allow the oxygen reading to stabilize before proceeding.
6. From the MAIN MENU / SAMPLE mode, press the yellow <UP/DOWN ARROW> key and move the cursor (*) to ZERO.



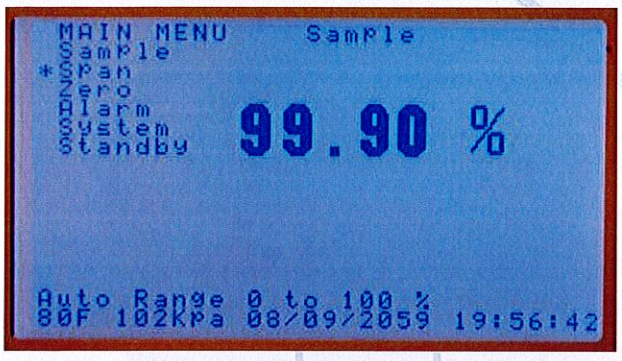
7. Press the blue <ENTER> key to select and display the ZERO menu.



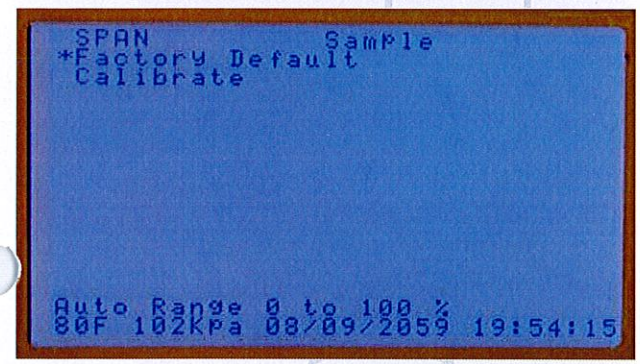
8. Press the yellow <UP/DOWN ARROW> key and move the cursor (*) to FACTORY DEFAULT. The purpose of this function is to remove the possibility of any accidental offset adversely affecting the accuracy of the span calibration.
9. Press the blue <ENTER> key to initiate the function.
10. After several seconds, the display returns to the MAIN MENU / SAMPLE mode.

5 Operation

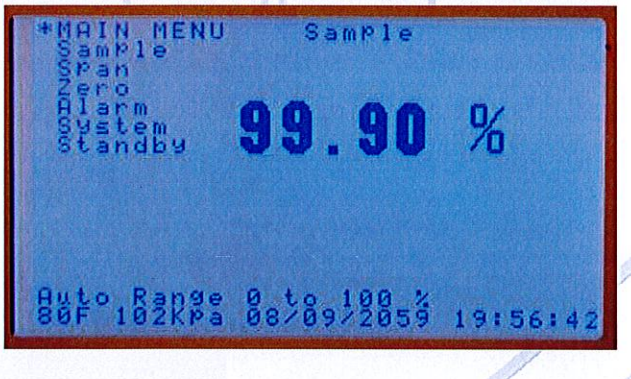
11. From the MAIN MENU / SAMPLE mode, press the yellow <UP/DOWN ARROW> key and move the cursor (*) to SPAN.



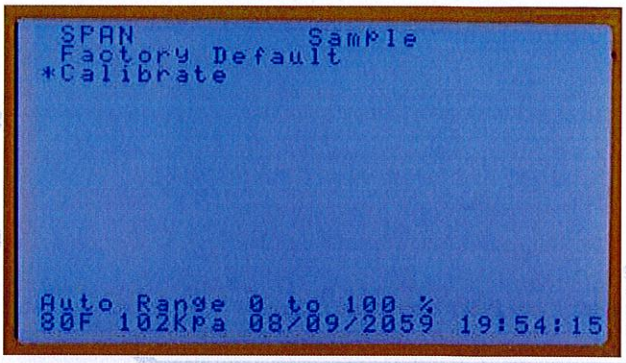
12. Press the blue <ENTER> key to select and display the SPAN menu.



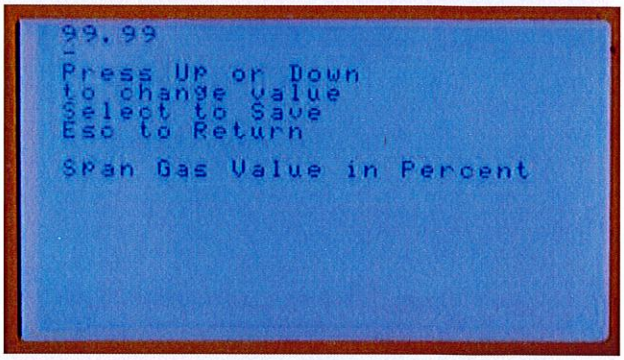
13. Press the yellow <UP/DOWN ARROW> key and move the cursor (*) to FACTORY DEFAULT. The purpose of this function is to remove the possibility of any accidental offset adversely affecting the accuracy of the span calibration.
14. Press the blue <ENTER> key to initiate the function.
15. After several seconds, the display returns to the MAIN MENU / SAMPLE mode.



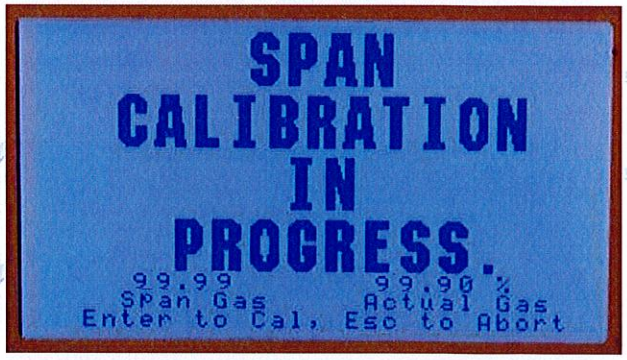
16. Press the yellow <UP/DOWN ARROW> key and move the cursor (*) to SPAN.
17. Press the blue <ENTER> to select and display the SPAN menu again.
18. Press the yellow <UP/DOWN ARROW> key and move the cursor (*) to CALIBRATE.



19. Press the blue <ENTER> key to select and move to the display for entering the span gas value:



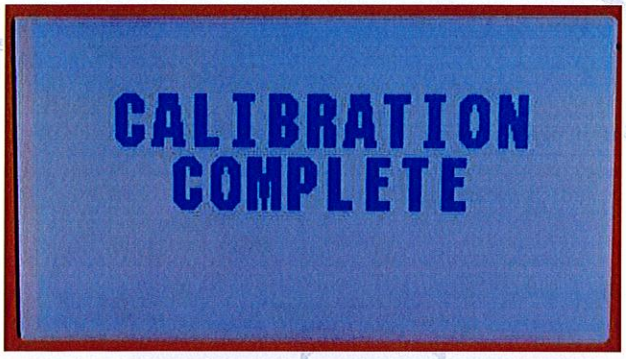
20. Press the yellow <UP/DOWN ARROW> key to change the value of the 1st digit, SKIP if value is correct.
21. Press the blue <ENTER> key to advance the cursor(_) to the next digit, PERFORM even if the value is correct
22. Repeat #20 and #21 until the appropriate 'Span Gas Value in Percent (oxygen)' is displayed.
23. Pressing the blue <ENTER> key after the last digit displays the following:



24. Allow the oxygen reading to **stabilize** before initiating the SPAN CALIBRATE function.

⚠ Failure to do so will introduce an offset and erroneous oxygen readings.

25. Press the blue <ENTER> key to complete the function.

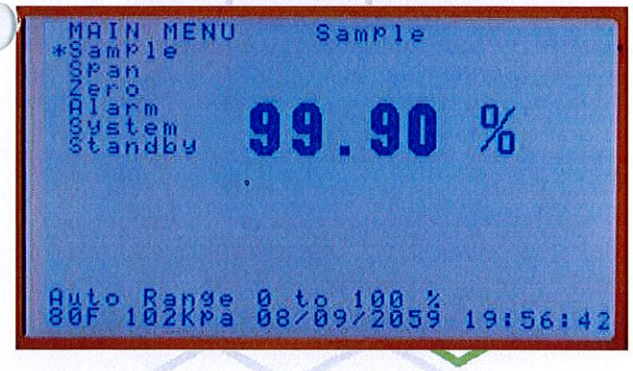


26. After several seconds the display returns to the default MAIN MENU / SAMPLE mode:

27. In the event 'CALIBRATION FAILS':
    - Repeat the SPAN CALIBRATE
    - Replace the sensor and repeat SPAN CALIBRATE
    - If failure persists contact factory.

5.4 Sampling

As discussed previously, MAIN MENU / SAMPLE is the default mode that follows the completion of any function.



The ability of the analyzer to provide accurate readings and optimum performance depends on a number of factors:

- Analyzer Overview (3.2)
- Accuracy Considerations (3.3)
- Application Considerations (4.2)
- Calibration Preparation (4.7)
- Calibration Overview (5.1)

Following completion of the SPAN CALIBRATE function, the analyzer will immediately begin analyzing the gas sample and display the real time oxygen concentration.

Refer to section 4.10.1 SAMPLE MENU and select the desired mode: AUTO RANGE or MANUAL RANGE.

When switching between gas streams it is normal for the oxygen reading suddenly rise. This is normal due to differences in pressure and/or air in the gas lines. Allow the oxygen reading to stabilize before collecting the real time data.

The analyzer data may be:

- Stored in the analyzer's internal memory using the Logging feature described in section 4.10.5 SYSTEM menu.
- Output and recorded on an external recording device using the Analog Signal Outputs described in section 4.4 Electrical Connections. **Note:** When connecting an analog output to an external recording device, limit the length of cable to less than 6 feet using a shielded cable with the shield connected to the ground of the recording device.

5.5 Standby & Storage

The guidelines for standby, storage or other non-use periods are straightforward:

- Disconnect the power to analyzer.
- Leave the oxygen sensor inside of the sensor housing which in turn should remain connected to the analyzer electronics.
- If storing for an extended period of time, protect the analyzer from dust, excessive heat (no more than 45 degree C) and moisture (non-condensing atmosphere).

Notes:

6 Maintenance

.1 Serviceability

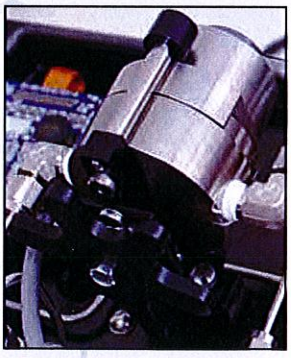
With the exception of cleaning the gold contact pins and lubricating theo-ring below, there are no serviceable parts inside the analyzer. Only factory trained personnel with the authorization of their supervisor should conduct maintenance.

6.2 Installing a New Oxygen Sensor

Preparation:

1. Initiate the flow of a certified span calibration gas through the analyzer as described in section 5.3 Span Calibration

Remove the old sensor:



2. Loosen the 4 point wing nut located under the bottom section of the sensor housing.
3. Rotate the upper section of the sensor housing 90º to disengage from the clamp.
4. Remove the upper section of the sensor housing by pulling it straight up and place it on a smooth surface.
5. Remove the old oxygen sensor and dispose of it in accordance with section 10 MSDS and/or regulations.

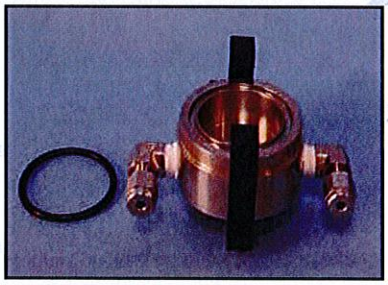
Inspect the 2 gold pin contacts in the upper section:

6. If dirty wipe with a damp lint free cloth.
7. If the contacts pins are corroded, it will be necessary to replace (P/N B-2762-A-3-14) the upper section of the sensor housing (as the contact pins are epoxy sealed to prevent the leakage of air).

   Corrosion indicates the presence of contaminants in the gas stream or a leaking sensor (vacuum being drawn on the sensor) which will result in erroneous readings. Consult with factory.

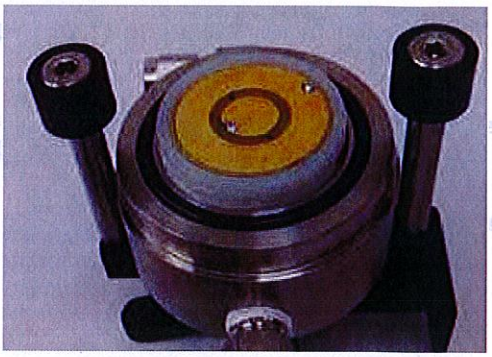
Inspect the o-ring seal:

8. Remove the o-ring from the groove in the bottom section of the sensor housing.
9. DO NOT nick the groove or the o-ring (causes air leaks).
10. Inspect the o-ring, it should be moist not dry with no nicks or obvious cracks.
11. If the o-ring appears nicked or cracked, replace the o-ring (P/N ORNG-1007).
12. Wipe the o-ring with a damp lint free cloth.
13. Lightly lubricate the o-ring with vacuum grease.
14. Re-install the o-ring in the groove in the bottom section of the sensor housing.



Install the new oxygen sensor:

15. Remove the new oxygen sensor from its shipping bag.
16. DO NOT remove the 2 red tapes from the PCB.
17. With the PCB and 2 red tapes facing up, immediately install the other (sensing area) end of the new oxygen sensor into the bottom section of the sensor housing.
18. Remove the 2 red tapes.



15. Immediately replace the upper section of the sensor housing (reverse steps #2 thru #4 above).
16. Allow the oxygen reading to stabilize on the certified calibration gas selected in step #1 and proceed to calibration, section 5.3

7 Spare Parts

Item No.	Description
CTRL-1004	Controller, Temperature PID
HTR-1002	Heater 110 VAC
HTR-1003	Heater 220 VAC
FMTR-1007-3	Flow Indicator 1/8" FNPT Viton O-rings
MTR-1008	Meter Digital Panel LED 3.5 Digit
ORNG-1007	O-ring 3/32 x 1-3/8 x 1-9/16 Viton
A-1146-50	PCB Assembly Main / Display
A-1147-50	PCB Assembly Main / Display
A-3941	Power Cord, Filtered 100-240 VAC
REG-1021	Regulator, Pressure 10 psig Fixed Outlet
GPR-11-120-OP	Sensor, Oxygen Purity
SNSR-1001	Sensor, Temperature RTD
SNSR-1002	Sensor, Thermal Runaway Protector J-2
A-1004-3-14	Sensor Housing Assembly SS
A-1016-A	Sensor Housing Bottom Assembly SS
B-2762-A-3-14	Sensor Housing Upper Assembly SS
VALV-1004	Valve, 2-Way SS Metering Flow

8 Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery or response time	Defective sensor, nearing end of life or damaged in service	Replace sensor if response/recovery unacceptable.
	Failure to purge gas lines, dead legs, distance of sample line, low flow rate, volume of optional filters and scrubbers	Replace sensor if response/recovery unacceptable.
	Air leak in sample system	**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 gas	Qualify the gas
	O-ring seal in sensor housing is nicked, dried out cracked or twisted.	Check the o-ring (section 6.2) and service or repair as necessary. Minimize the time the sensor is exposure to air.
High/Low O_2 reading after installing new sensor	Analyzer calibrated before sensor stabilized.	Allow O_2 reading to stabilize before making the span/calibration adjustment
	Air leak in sample system connection(s)	Leak test the entire sample system (above)
	Abnormality in gas	Qualify the gas
High O_2 reading Sampling	Flow rate exceeds limits	Correct pressure and flow rate
	Pressurized sensor	Remove restriction on vent line, replace sensor
	Abnormality in gas	Qualify the gas
	O-ring seal in sensor housing is nicked, dried out, cracked or twisted	Check the o-ring (section 6.2) and service or repair as necessary. Minimize the time the sensor is exposure to air.
Reading doesn't agree to expected O_2 values	Pressure and temperature of the sample is different than span gas	Calibrate the analyzer at sample pressure and temperature
	Abnormality in gas	Qualify the gas
	Failure to allow oxygen reading to stabilize before zero and/or span calibration adjustments	Repeat calibration procedure and allow reading to stabilize
	O-ring seal in sensor housing is nicked, dried out, cracked or twisted	Check the o-ring (section 6.2) and service or repair as necessary. Minimize the time the sensor is exposure to air
No O_2 reading Negative O_2 reading	Failure of an electronic component or power surge that sends a charge to the sensor	Allow oxygen reading (sensor) to stabilize and repeat the calibration procedure
	Drawing a vacuum on the sensor by glowing gas to the sensor with the vent restricted and suddenly removing the restriction can rupture a sealing membrane causing the leakage of electrolyte.	Inspect for electrolyte leakage, check and clean the contacts in the upper section of the sensor housing, flow a little warm water followed by air or clean sample through the analyzer for 2-3 hours to push the electrolyte through the sample system and THEN replace the sensor
Erratic O_2 reading	Change in sample pressure	Repeat calibration at the temperature and pressure of sample
	Dirty electrical contacts in upper section of sensor housing	Inspect electrical contacts in upper section of sensor housing (section 6), if necessary replace upper section.
	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	Flow sample or zero gas for 2-3 hours to flush, DO NOT remove sensor from sensor housing and expose to air
	Presence of interference gases	Replace sensor and install scrubber, contact factory

9 Warranty

Coverage

Under normal operating conditions, the analyzer and sensors are warranted to be free of defects in materials and workmanship for the period specified in the current published specifications. To make a warranty claim, you must return the item properly packaged and postage prepaid to:

Analytical Industries Inc.
dba Advanced Instruments Inc.
2855 Metropolitan Place
Pomona, Ca 91767 USA
T: 909-392-6900, F: 909-392-3665
E: sales-industriall@aii1.com or info@aii1.com
W: www.aii1.com

Analytical Industries in their sole discretion shall determine the nature of the defect. If the item is determined to be eligible for warranty we will repair it or, at our option, replace it at no charge to you. If we choose to repair your item, we may use new or reconditioned replacement parts of the same or upgraded design. This is the only warranty we will give and it sets forth all our responsibilities, there are no other express or implied warranties.

The warranty begins with the date of shipment from Analytical Industries Inc., is limited to the first customer who submits a claim for a given serial number which must be in place and readable to be eligible for warranty and will not extend to more than one customer or beyond the warranty period under any conditions.

Exclusions

This warranty does not cover normal wear and tear; corrosion; damage while in transit; damage resulting from misuse or abuse; lack of proper maintenance; unauthorized repair or modification of the analyzer; fire; flood; explosion or other failure to follow the Owner's Manual.

Limitations

Analytical Industries Inc. shall not liable for losses or damages of any kind; loss of use of the analyzer; incidental or consequential losses or damages; damages resulting from alterations, misuse, abuse, lack of proper maintenance; unauthorized repair or modification of the analyzer.

Service

Contact us: Monday thru Thursday 7:30am to 5:00pm PST
Friday 8:00am to 12:00pm PST

Trained technicians will assist you in diagnosing the problem and determining the appropriate course of action.

10 Safety Data Sheet

Name	Electrochemical Galvanic Fuel Cell Oxygen Sensor
Exposure	Sealed device with protective coverings, normally no hazard
Ingredients	Carcinogens - none Potassium Hydroxide (KOH), Lead (Pb)
Properties	Completely soluble in H2O; evaporates similar to H2O
Flash Points	Not applicable, non-flammable
Reactivity	Stable, avoid strong acids, emits fumes when heated
Health Hazard	KOH via ingestion: harmful or fatal if swallowed Eyes: corrosive, possible loss of vision Skin: corrosive, possible chemical burn Liquid inhalation is unlikely Lead: known to cause birth defects, contact unlikely
Contact Symptoms	Eyes: burning sensation Skin: slick feeling
Protection	Ventilation-none; eyes-safety glasses; hands-gloves
Precautions	Do not remove Teflon and PCB coverings; do not probe with sharp objects; avoid contact with eyes, skin and clothing.
Action KOH Leak	Use rubber gloves, safety glasses and H2O and flush all surfaces repeatedly with liberal amounts of H2O

10.1 Disposal

Oxygen sensors and batteries should be disposed of in accordance with local regulations for batteries.

WEEE regulations prohibit electronic products including the Helium and environmental sensors from being placed in household trash bins.

Electronic products should be disposed of in accordance with local regulations.

Attachment A - Specification

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:	Suppressed ranges: 90-100%, 80-100%, 50-100% and 0-100% FS range; Auto-ranging or fixed single range
Application:	Continuous analysis of high purity oxygen concentrations up to 100% oxygen in inert, He, H2 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:	Monthly. FDA compliance: (a) medical grade O2, not less than 99.99% O2 (balance N2); (b) Oxygen 93 Percent (transfilling), 93% ±0.1% O2 (balance N2). Non-medical use, 97-100% O2 (balance N2).
Compensation:	Electronic barometric pressure and temperature; temperature controlled heated sample system, see below
Connections:	Compression tube fittings 1/4" 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 Painted aluminum 12" x 12" x 8" wall mount (W)
Flow:	Recommended flow rate 2 SCFH
Linearity:	> .995 over all ranges
Pressure:	Inlet - integral regulator with fixed outlet of 10 psig vent - atmospheric
Power:	Universal 100-240 VAC; specify 110 or 220 VAC for heater in temperature control section
Range ID:	4-20mA non-isolated or 1-5V; optional relay contacts with either the 4-20mA or 1-5V
Response Time:	90% of final FS reading < 13 seconds
Sample System:	Stainless steel wetted parts, integral pressure regulator, flow control valve, flow indicator, equalization coil temperature equalization system
Sensitivity:	< 0.1% oxygen
Sensor Model:	GPR-11-120-OP
Sensor Life:	24 months in 100% oxygen at 25°C and 1 atm
Signal Output:	4-20mA isolated, 0-1V, and 0-5V
Temp. Range:	5°C to 45°C
Warranty:	12 months analyzer; 12 months sensor

Optional Equipment

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

* Specification subject to change without notice.

Electrochemical Oxygen Sensor based Oxygen Purity Analyzer

GPR-3100 W

GPR-3100

Oxygen Purity Analyzer

Breakthrough Sensor Technology

CE

Advanced Electrochemical O_2 Sensor

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

Temperature Controlled Sample System

Pressure & Temperature Compensation

Stainless Steel Wetted Parts

Integral Pressure Regulator

3 Suppressed Ranges + 0-100% FS Range

4½ Digit Display with 0.01% Resolution

Insensitive to Vibration and Moisture

Options: Auto-Zero and Auto-Cal
Remote Communication via USB, RS232, RS485

ISO 9001 Certified Quality System

Quality Control & Calibration Certification

Date:	Customer: Order No.:	Pass
Model:	GPR-3100 / 3100 W Oxygen Purity Analyzer **S/N** _____	
Sensor:	GPR-11-120-OP Oxygen Purity Sensor **S/N** _____	
Accessories	Owner's Manual A-3491 Filtered Power Cord (FLTR-1014 & CABL-1008)	
Configuration	Ranges: 0-100%; suppressed 50-100%, 80-100%, 90-100% A-1146-50 PCB Assembly Micro-processor / Display **Software Ver**: _____ A-1147-50 PCB Assembly Power Supply / Interconnection Enclosure: ( ) Panel mount 10.8" x 7.5"; optional ( ) Rack 19" x 12" ( ) Wall mount 12" x 12" x 8" (GPR-3100 W) Wetted parts: Stainless steel sensor housing, flow valve, pressure Regulator, 10 psig fixed outlet Temperature controlled sample system Power: 100-240 VAC; specify for standard heater ( ) 100/120 VAC; ( ) 220/240 VAC	
Test - Electronics	Factory default zero (without sensor)	
	Factory default span @ 20 uA	
	Alarm relays activate/deactivate to changes in O_2 concentration	
	Sensor failure alarm	
	Power failure alarm	
	Analog signal output 0-1V and 4-20mA	
	Range ID voltage output	
Test - Gas Phase	Baseline drift < ± 1% FS 90-100% range over 24 hour period	
	Noise level < ± 1.0% FS	
	Span adjustment within 10-50% FS	
	Temperature controller (CNTL-1004) set at 85°F	
Final	Overall inspection for physical defects	
Options:		NA
Other:		NA
Delivery:		