Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis Ranges:	0-1%, 0-5%, 0-10%, 0-25%, FS Auto-ranging or manual lock on a single range
Application:	Oxygen analysis in inert, helium, hydrogen, mixed and acid (CO_2) gas streams
Approvals:	Certified for use hazardous areas - see lower right
Area Classification:	Class I, Division 1, Groups C, D
Calibration:	Max interval—3 months. Air calibrate with clean source of certified span gas, compressed, or ambient (20.9% O2) air on 0-25% range.
Compensation:	Temperature
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration and system functions
Display:	Graphical LCD 2.75 x 1.375"; resolution .001%
Enclosure:	Painted aluminum, 4 x 9 x 3", 8 lbs.
Flow:	Not flow sensitive; recommended flow rate 2 SCFH
LED Indicators:	LOW BATT (72 hr. warning); CHARGE mode
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig to deliver 2 SCFH flow; vent - atmospheric
Power:	Rechargeable battery, 60 day cycle, 8 hrs with pump
Response Time:	90% of final FS reading in 10 seconds
Sample System:	None; optional integral sample pump and panel mounted flow meter and/or coalescing filter
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-11-32-RTS for non-acid (CO2) gas streams XLT-11-24-RTS for gas mixture with > 0.5% CO_2
Sensor Life:	GPR-11-32-RTS 32 months in air at 25°C and 1 atm XLT-11-24-RTS 24 months in air at 25°C and 1 atm
Signal Output:	0-1V FS
Temp. Range:	5° to 45°C (GPR sensor), -10° to 45°C (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel flow housing, tubing and fittings

Optional Equipment

Carrying case with custom foam insert

Sample conditioning - contact factory

* Subject to change without notice.

ATEX Certified for Hazardous Areas

GPR-2000 ATEX

Portable O_2 Analyzer

Rechargeable Battery Powered

Optional Integral Pump

Advanced Sensor Technology

- **Sensor Life, Warranty and Performance is Unmatched**
- **Excellent Compatibility in 0-100% CO_2**
- **Extended Operating Temperature –10°C**

Sensitivity 0.5% Full Scale

ATEX Certified - Directive 94/9/EC

Examination Cert: INERIS 10ATEX0020

II 2 G
Ex ib IIB T4
T_{amb} -20°C to +50°C

0080

ISO 9001:2008 Certified

INTERTEK Certificate No. 485

GPR-2000/2000P
Portable % Oxygen Analyzer

Owner's Manual

Revised Aug 2013

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1. Introduction

Your new oxygen analyzer incorporates an advanced electrochemical sensor specific to oxygen along with state-of-the-art digital electronics designed to give you years of reliable precise oxygen measurements in a variety of industrial oxygen applications. More importantly, it has been constructed as intrinsically safe in accordance with ATEX Directives 94/9/CE for use in hazardous areas in zone 1 Group C and D when used in conjunction with the recommended operating instructions in this manual. The analyzer meets the following area classification.

Analytical Industries, Inc.
dba Advanced Instruments Inc.
2855 Metropolitan Place, Pomona, CA 91767 USA

GPR-2000/2000P
CE 0080
Serial No.:
Year of Manufacture:
INERIS 10ATEX0020

Ex II 2 G
Ex ib IIB T4
T_{amb} -20ºC to +45ºC

WARNING: POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE INSTRUCTIONS

The design also meets NEC intrinsic safety standards for use in Class 1, Division 1, Group C, D hazardous areas. Please refer to Appendix A for information on making electrical connections that will maintain the desired level of protection.

To obtain maximum performance from your new oxygen analyzer, please read and follow the guidelines provided in this Owner's Manual.

Every effort has been made to select the most reliable state of the art materials and components to design the analyzer for superior performance and minimal cost of ownership. This analyzer was tested thoroughly by the manufacturer prior to shipment for the best performance. However, all 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.

The serial number of this analyzer may be found on the inside as well as on the outside wall of the analyzer enclosure. 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: _____

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

2. Quality Control Certification

3. General Safety & Installation

Safety

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

Caution: This symbol is used throughout the Owner's Manual 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.

Electrostatic Discharge Hazard: This symbol is used to caution the user to take all necessary steps to avoid generating electrostatic discharge.

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

Heed Warnings and Follow Instructions: Follow all warnings on the analyzer, accessories (if any) and in this Owner's Manual. Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the analyzer.
Heat: Situate and store the analyzer away from sources of heat.

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

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

Maintenance

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

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

Troubleshooting: Consult the guidelines in Section 8 for advice on the common operating errors before concluding that your transmitter is faulty. Do not attempt to service the transmitter beyond those means described in this Owner's Manual, Section 10.

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 transmitter 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.
Non-use Periods: Turn the power OFF when the analyzer is left unused for a long period of time.

Installation

This analyzer has been constructed in compliance with the following EN directives

EN 60079-0 : 2009
EN 60079-11 : 2012

The analyzers must be used in accordance with the guidelines delineated in this instruction manual.

Gas Sample Stream: Ensure the gas stream composition of the application is consistent with the specifications and if in doubt, review the application and consult the factory before initiating the installation.

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

Contaminant Gases: A gas scrubber and flow indicator with integral metering valve are required upstream of the analyzer to remove any interfering gases such as oxides of sulfur and/or hydrogen sulfide that can interfere with measurement and cause reduction in the expected life of the sensor. Consult factory for recommendations concerning the proper selection and installation of components.

Expected Sensor Life: With reference to the published specification, the expected life of all oxygen sensors is predicated on the basis of average oxygen concentration, sample temperature of 77°F/25°C and sample pressure of 1 atmosphere in "normal" applications. Deviations from standard conditions will affect the life of the sensor. As a rule of thumb sensor life is inversely proportional to changes in oxygen concentration, sample pressure and temperature.

Accuracy & Calibration: Refer to section 5 Operation.

Operating Temperature: The sample must be sufficiently cooled before it enters the analyzer and any optional components. A coiled 10 foot length of ¼" stainless steel tubing is sufficient to cool sample gases as high as 1,800 ºF to ambient temperature. The recommended operating temperature is below 35 ºC. However, the analyzer may be operated at temperature up to 45 ºC on an intermittent basis but the user is expected to accept a reduction in expected sensor life –as a rule of thumb, for every degree ºC increase in temperature (above 25 ºC), the sensor life is reduced by approximately 2.5%.

Heat: Situate and store the analyzer away from direct 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 analyzer.

Handling: Do not use force when operating the switches or any other mechanical components. Before moving your analyzer be sure to disconnect the wiring/power cord and any cables connected to the output terminals of the analyzer.

Sample Pressure and Flow

All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The sensors are equally capable of analyzing the oxygen content of a flowing sample gas stream or monitoring the oxygen concentration in ambient air (such as a confined space in a control room or an open area around a landfill or bio-pond). The following is applicable to analyzers equipped with fuel cell type oxygen sensors.

Inlet Pressure: For the analyzers designed to measure oxygen in a flowing gas stream, the inlet sample pressure must be regulated between 5-30 psig (for Model equipped with integral sample flow meter or H2S scrubber only). Although the rating of the SS tubing and tube fittings/valves itself is considerably higher (more than 100 psig), a sample pressure of 5-30 psig is recommended for ease of control of sample flow.
Caution: If the analyzer is equipped with an optional H2S scrubber, sample inlet pressure must not exceed 30 psig.

Outlet Pressure: In applications where sample pressure is positive, the sample must be vented to atmosphere or into a pipe at atmospheric pressure.

Flow rates of 1-5 SCFH (0.5-2 SLPM) cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH may generate a slight backpressure on the sensor resulting in erratic oxygen readings.

Caution: Do not place your finger over the vent (it pressurizes the sensor) to test the sample 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 integral metering valve positioned upstream of the sensor is recommended for controlling the sample flow rate between 1-5 SCFH (0.5-2 SLPM). If a separate flow control valve and a flow indicator is used, position flow control valve upstream of the sensor and position a flow indicator downstream of the sensor. If necessary, a pressure regulator upstream of the flow control valve should be used to regulate the inlet pressure between 5-30 psig.

Application Pressure - Atmospheric or Slightly Negative: The GPR-2000P is equipped with integral sample pump. The pump is capable of pulling sample from atmosphere to a pressure down to 40 inches of water column. For analyzer without a sample pump, external sample pump may be deployed. However, user must ensure that by using external pump, the intrinsic safety of the analyzer is not compromised.

Positioning of a Sampling Pump: For % oxygen measurements, an optional external sample pump may be used upstream of the sensor to push the sample across the sensor and out to atmosphere.

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

Mounting: The analyzer is approved for indoor as well as outdoor use. However, avoid using the analyzer in an area where direct sun might heat up the analyzer beyond the recommended operating temperature range.

Gas Connections: The Inlet gas line requires 1/8" or ¼" stainless steel compression type tube fittings (or a good quality plastic tubing attached to the sample inlet).

Power: The analyzer is powered by an integral lead-acid rechargeable battery. The analyzer will continue to run for a minimum of 30-60 days after the battery is fully charged without the pump. If the pump is used, the battery will continue to power the pump and the analyzer for up to 8 hours. The battery's optimal charge time is 24 hours.

WARRNING: THE ANALYZER BATTERY MUST BE CHARGED IN A SAFE AREA ONLY BY USING FACTORY PROVIDED WALL PLUG-IN CHARGER.

4. Features & Specifications

Advanced Instruments Inc.

Technical Specifications

Accuracy:	< 2% of FS range under constant conditions
Analysis Ranges:	0-1 %, 0-5 %, 0-10 %, 0-25% FS Auto-ranging or Manually lock on a single range
Application:	Oxygen analysis down to 0.005 % in inert, helium, hydrogen, mixed and acid (CO_2) gas streams
Approvals:	EC TYPE EXAMINATION CERTIFICATE: INERIS 08ATEX0036 II 2 G Ex ib IIB T4 T_{amb} -20°C to +50°C
Area Classification:	Meets standards for Class 1, Division 1, Group C, D hazardous areas
Calibration:	Air or Certified gas of O_2 balance N_2 approximating 80% of range of analysis or one range above range of interest
Compensation:	Internally compensated for ambient Temperature variations
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration and system functions
Display:	Graphical LCD 2.75 x 1.375"; resolution .001 % on 0-1 % range
Enclosure:	Painted aluminum NEMA 4X, 8.6 x 9 x 3", 12 lbs.
Flow Sensitivity:	None between 0.5-5 SCFH (0.5-2 SLPM), 2 SCFH recommended
LED Indicators:	LOW BATT (72 hr. warning); CHARGE mode
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig; vent - atmospheric
Power:	Rechargeable battery, 60 day duty cycle (pump 8 hours)
Recovery Time:	From air to < 0.1 % in < 30 seconds
Response Time:	90% of final FS reading in 10 seconds
Sample System:	None, Flow control and flow indicator optional
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-11-32-RT
Sensor Life:	Expected 32 months at 25°C, 1 atm with average O_2 < 20.9%
Signal Output:	0-1V FS
Temp. Range:	5° to 45°C (GPR sensor), -20° to 45°C (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel and or Delrin

Optional Equipment

XLT-11-24-RT sensor for analysis of a gas mixture with > 0.5% CO_2

Integral sampling pump - intrinsically safe design

Carrying case with custom foam insert

Sample conditioning accessories - contact factory

GPR-2000/2000P
Portable % O_2 Analyzer

Shown with optional flow meter

Intrinsically Safe, Conforms to
ATEX Directive 94/9/EC
INERIS 10ATEX0020

II 2 G
Ex ib IIB T4
T_{amb} -20°C to +50°C

ISO 9001:2008 QA System
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 06/13

5. Operation

Principle of Operation

The GPR-2000 series of portable oxygen analyzers incorporate a variety of % range advanced galvanic fuel cell type oxygen sensors. The analyzer is configured in a general purpose enclosure and meets the intrinsic safety ATEX Directive 94/9/EC for use in Zone 1 Groups C and D hazardous areas. The integral sampling pump (GPR-2000P) also meets the intrinsic safety standards.

Advanced Galvanic Sensor Technology

All galvanic type sensors function on the same principle and are very specific to oxygen. They measure the partial pressure of oxygen from low PPM to % 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 and reacts chemically at the sensing electrode to produce an electrical current output proportional to the oxygen concentration in the gas phase. The sensor's signal output is linear and remains virtually constant over its useful life. The sensor requires no maintenance and is easily and safely replaced at the end of its useful life.

Proprietary advancements in the design and chemistry add significant advantages to an extremely versatile oxygen sensing technology. Sensors for low PPM analysis recover from air to low PPM levels in minutes, exhibit longer life, extended operating temperature range of -18°C to 50°C, excellent compatibility with CO_2 and other acid gases (XLT series sensors only) and reliable quality giving them a significant advantage over the competition.

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. Other significant developments involve the first galvanic oxygen sensor capability of continuous oxygen purity measurements and expanding the operating temperature range from -40°C to 50°C.

Electronics

The signal generated by the sensor is processed by state of the art low power micro-processor based digital circuitry. The first stage amplifies the signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for signal output variations caused by ambient temperature changes. The result is a very stable signal. Sample oxygen is analyzed very accurately. Response time of 90% of full scale is less than 10 seconds (actual experience may vary due to the integrity of sample line connections, dead volume and flow rate selected) on all ranges under ambient monitoring conditions. Sensitivity is typically 0.5% of full scale low range. Oxygen readings may be recorded by an external device via the 0-1V signal output jack.

Power is supplied by an integral rechargeable lead acid battery which provides enough power to operate the analyzer continuously for approximately 60 days. An LED located on the front panel provides a blinking 72 hour warning to recharge the battery. A 9VAC adapter (positive pole located on the inside of the female connector) can be used to recharge the battery from a 110V or 220V convenience outlet. The analyzer is designed to be fully operational during the 8-10 hour charging cycle which is indicated by a second continuously lit CHARGE LED.

Sample System

The GPR-2000 is supplied without any sampling system except for a gas inlet and vent line. Optional sample system with a sample flow control valve, a coalescing filter and an integral sample pump is available. Consult factory for any specific sample system requirements.

Span Calibration

Span Calibration involves adjusting the analyzer electronics gain to match with the sensor's signal output at a given oxygen standard. After span calibration, the analyzer output will reflect accurately the oxygen content in a sample gas. The signal output may drift with changes in the ambient temperature. Maximum drift from calibration temperature is approximately 0.11% of reading per °C. The frequency of calibration varies with the application

conditions, the degree of accuracy required by the application and the Quality Assurance Protocol requirements of the user. However, the interval between span calibrations should not exceed beyond three (3) months.

Note: Regardless of the oxygen concentration of the standard used, the span calibration process takes approximately 10-15 minutes. However, the time required to bring the analyzer back on-line (within 10% of the original reading) can vary. As a rule of thumb, the span gas concentration must be 50-80 of the full scale range of analysis or one range above the range of interest. For example, when using the analyzer on a 1% range, the span gas concentration must be below 0.5 to 0.8% or 5 to 8% (for calibration on 0-10% range). For most applications, calibration with ambient air (20.9%) will be sufficient.

The interval between span calibrations should not exceed three (3) months.
Initiate the DEFAULT SPAN procedures before performing SPAN CALIBRATION. This procedure clears up previous calibration data from the analyzer internal memory.

Air Calibration

The inherent linearity of the galvanic fuel cell type oxygen sensor enables the user to calibrate any analyzer with ambient air (20.9% oxygen) and operate the analyzer within the stated accuracy spec on the lowest most sensitive range available with the analyzer.

Gas Connections

The GPR-2000 has one Sample In and one Sample out port. Ensure that sample pressure to the analyzer is at lower level to allow a sample flow of 1-2 SCFH. Higher sample pressure (with higher sample flow) may cause a back pressure on the sensor causing possible erroneous readings. The Sample must be vented to atmosphere or a vent pipe at atmospheric pressure.

Procedure

Locate the sample inlet and vent ports of the analyzer.
Regulate the sample pressure and flow as described in Pressure & Flow above.
Connect a tube to VENT (or leave it open to vent to atmosphere).
Connect the Sample gas to SAMPLE IN.
Set the flow rate to 2 SCFH (user provided)

Power

Power is supplied by an integral rechargeable lead acid battery which provides enough power to operate the analyzer continuously for approximately 45-60 days. An LED located on the front panel provides a blinking 72 hour warning to recharge the battery when the battery voltage drops below a pre-determined value. A 9 V AC/DC adapter (with positive pole located on the inside of the female connector) can be used to recharge the battery from a 110V or 220V convenience outlet. The battery will be fully charged within 8-10 hours. The analyzer is designed to be fully operational during the 8-10 hour charging cycle. When the adapter is connected to the analyzer, the battery charging process is indicated by a second continuously lit LED.

CAUTION: The battery must be charged in a safe area only. Do not leave the charger connected to the analyzer for more than 24 hours.

Charging Battery

Locate a source of AC power to meet the area classification, plug in the 9 VDC charging adapter provided with the analyzer to the outlet. Connect the jack at the other end to the mating receptacle identified as CHARGE on the analyzer.
Note: Charge the battery with the 9 VDC adapter provided with the analyzer only. Failure to do so may void area classification.

Analog Signal Output

A separate receptacle is provided for signal output. The analyzer signal output is 0-1 V full scale selected. The signal output must be connected to an external recording device in accordance with local safety directives.

Connect the lead wires from the external recording device to the male phone plug supplied with the analyzer. (Note: Connect the positive lead to the center terminal of the male phone plug.)
Insert the male phone plug into the integral female OUTPUT jack located on the side of the enclosure.

Installing the Oxygen Sensor

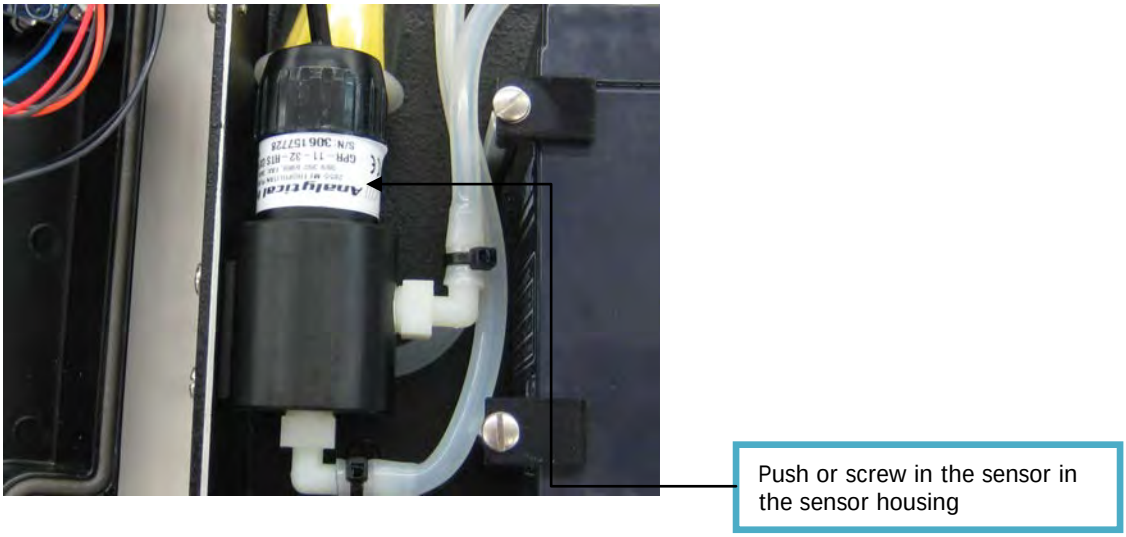
GPR-2000 Oxygen Analyzer is equipped with an integral oxygen sensor that has been tested and calibrated by the manufacturer prior to shipment and is fully operational from the shipping container. Should it be necessary to install a new oxygen sensor, follow the procedure described below.

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

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

Procedure

1. Do not remove sensor from its original package until the analyzer is ready to accept sensor installation.
2. Open analyzer enclosure by removing four screws.
3. Disconnect sensor cable from the sensor (if previously installed). Pull or unscrew the old sensor from its housing.
4. Push or screw in the new sensor in the sensor housing. Connect the sensor cable to the sensor



5. Connect the sensor cable to the rear of the sensor
6. Check the oxygen reading; it should reach close to 20.0% (+7% -3%) indicating that the sensor has proper signal output. At this time, you may perform air calibration.

Establishing Power to Analyzer

The analyzer 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 10-15 minutes before analyzing a sample gas.

Establish power to the analyzer electronics by pushing the red ON/OFF key. The digital display responds instantaneously. When power is applied, the analyzer performs several diagnostic system status checks termed "START-UP TEST" as illustrated below.

If equipped with an optional integral sampling pump, it is operated by a separate toggle switch located on the front of the analyzer.

Note: In the unlikely event, the LOW BATTERY warning LED comes on when the analyzer is turned on – proceed immediately to section 6 Maintenance Battery.

The analyzer is supplied with a 9 V AC/DC adapter for recharging the batteries or operating the analyzer continuously. The analyzer's charging circuit accepts only 9 VDC from any standard AC 110V or 220V adapter (with positive supply in the center of the female charging jack). The electronic design enables the analyzer to remain fully operable during the 8-10 hour charging cycle. However, the analyzer must be charged in safe areas only.

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

START-UP TEST

ELECTRONICS – PASS
BATTERY- PASS
TEMP SENSOR – PASS
BARO SENSOR – N/A

S10101.17

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

20.09%

AUTO SAMPLING
25% RANGE

76 F

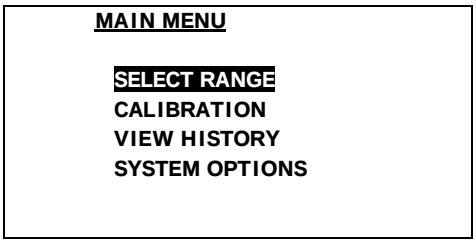
Menu Navigation

The four (4) pushbuttons located on the front of the transmitter control all of the micro-processor functions:

Blue ENTER (select)
Yellow UP ARROW
Yellow DOWN ARROW
Green MENU (escape)

Main Menu

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

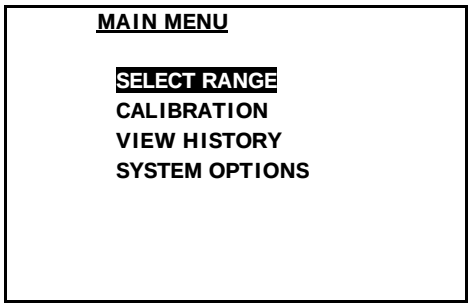


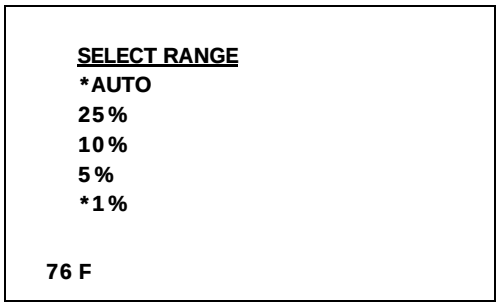
This screen show various option available. You can use the UP and DOWN arrow key to move the cursor and highlight the desired function. After moving the cursor to the desired function, you can press ENTER to get to that function.

Range Selection

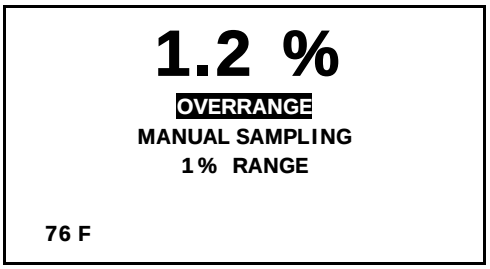
The GPR-2000 analyzer is equipped with four (4) standard measuring ranges (see specification) and provides users with a choice of sampling modes. By accessing the MAIN MENU, users may select either the AUTO SAMPLING (ranging) or MANUAL SAMPLING (to lock on a single range) mode.

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





In the AUTO range, the display will shift to the next higher range when the oxygen reading exceeds 99.9% of the upper limit of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the upper limit of the next lower range. In MANUAL range, the analyzer will be locked on the selected range. If the oxygen value goes above 110% of the upper limit of the MANUAL selected range, an OVER RANGE warning will be displayed.



Once the OVER RANGE warning appears the user must advance to the next higher range.
NOTE: With oxygen reading above 110% of the selected range, the analog signal output will increase but will freeze at a maximum value of 1.2 V. After the oxygen reading falls below the full scale range, the voltage signal will become normal.

Calibration of Analyzer

The electrochemical oxygen sensors generate an electrical current that is **linear** or proportional to the oxygen concentration in a sample gas. In the absence of oxygen the sensor exhibits an **absolute zero**, i.e., the sensor does not generate a current output in the absence of oxygen. Given the properties of linearity and an absolute zero, a single point calibration is possible.

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

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

Zero Calibration

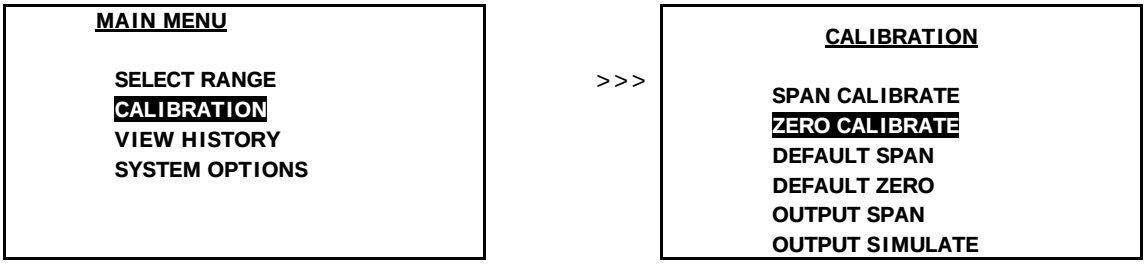
Zero calibration of a %O2 analyzer is not necessary. This may be required only when the analyzer is to be used to measure oxygen less than 0.1% oxygen

The maximum zero offset correction is limited to a maximum of 10% of the lowest (most sensitive) range for positive zero offset and 10% of the lowest range for negative zero offset.

Zero calibration should be carried out after the span calibration and once performed should not have to be repeated with subsequent span calibrations. Normally, zero calibrations are performed when a new sensor is installed or changes are made in the sample system connections. Allow the ZERO gas to flow through the analyzer and wait until the signal has dropped to a low value and is stable.

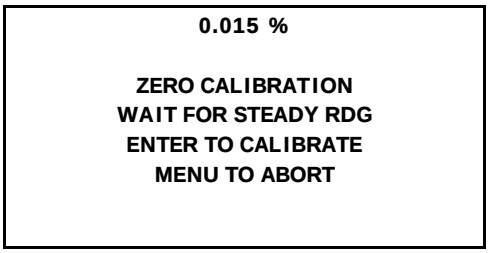
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.

The following displays appear:



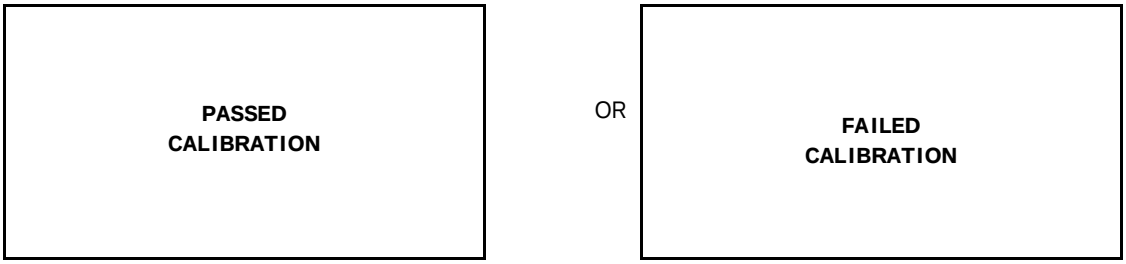
4. Advance the reverse shade cursor using the ARROW keys to highlight ZERO CALIBRATE.
5. Press the ENTER key to select the highlighted menu option.

The following displays appear:



6. Wait until the analyzer reading stabilizes (depending on the history of the sensor, it may take a few minutes to several hours) and then press the ENTER key to calibrate (or MENU key to abort).
7. If the offset is less than 50% of the lowest range, by pressing ENTER will pass the calibration and the analyzer will return to the Sample mode. On the other hand, if the offset is above 50%, pressing ENTER will fail calibration and the analyzer will return to Sample mode without completing the Zero calibration.

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

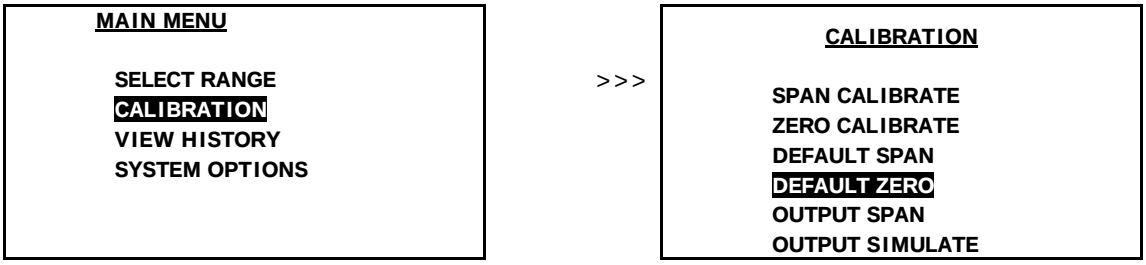


Default Zero

This feature will eliminate any previous zero calibration adjustment and display the actual signal output of the sensor at a specified oxygen concentration. This feature allows the user to ensure that the accumulative zero offset never exceeds 50% of the lowest range limit. To perform Default Zero,
Access the MAIN MENU by pressing the MENU key.

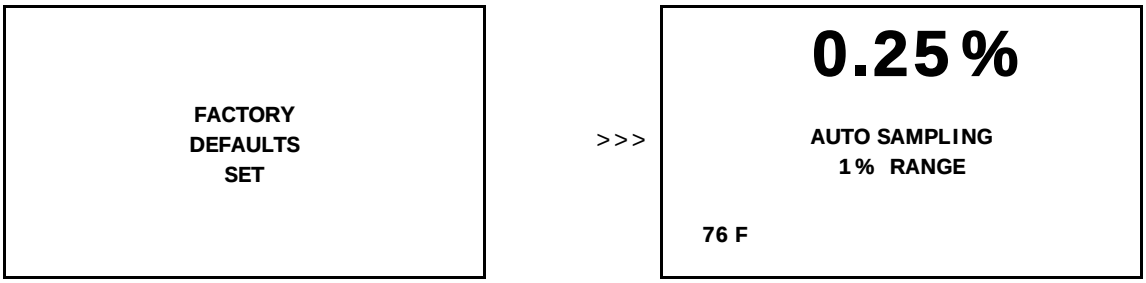
1. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
2. Press the ENTER key to select the highlighted menu option.

The following displays appear:



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

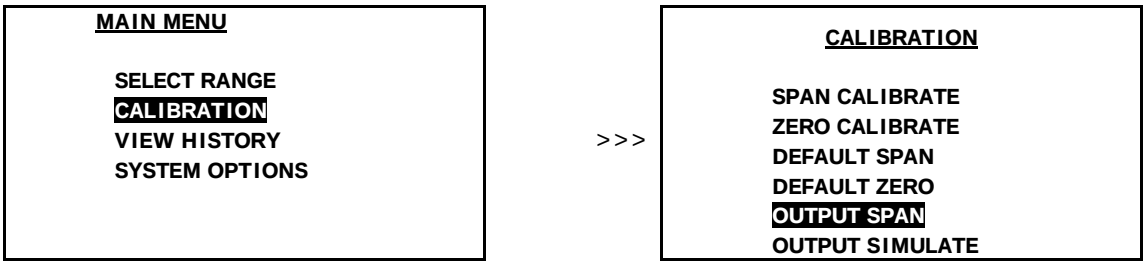
The following display appears and after 3 seconds the system returns to the SAMPLING mode:



Analog Output Adjustment-Calibrate Output Span

In rare instances the 0-1 V signal output may not agree with the reading displayed on the LCD. This feature enables the user to adjust the 0-1 V signal output.

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER and then advance the cursor to OUTPUT SPAN and press ENTER. The following displays appear:



4. Press the ENTER key to select the highlighted menu option and the following display appears:

OUTPUT SPAN
1 V ADJUST
PRESS UP OR DOWN
TO ADJUST OUTPUT
ENTER/ MENU TO SAVE

5. By pressing UP or DOWN arrow, the signal output will change. Keep pressing the Up or DOWN key until the output is 1V. **Note: To perform "Calibrate-Output Span", an external recording device must be connected to the signal output port of the analyzer.**
6. Press ENTER to SAVE the changes.

Span Calibration Procedure
Air Calibration

This procedure requires only a source of clean ambient air and removal of the sensor from its flow housing.

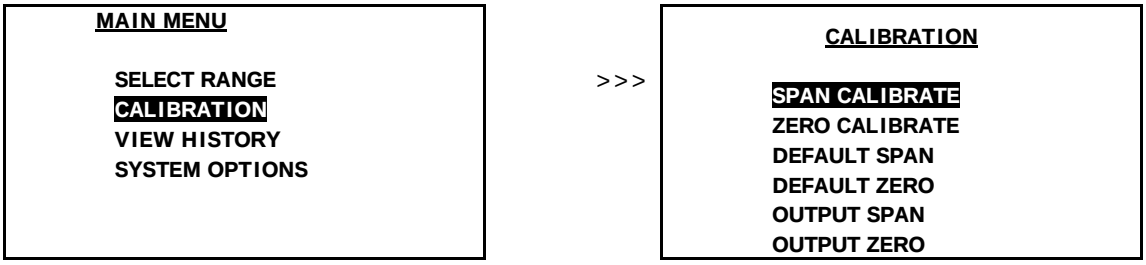
1. Access the interior of the analyzer by removing the 4 clamps securing the door of the analyzer.

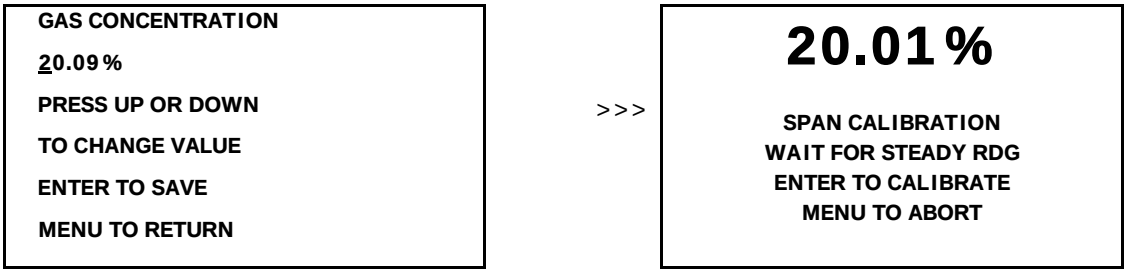
Caution: Do not remove the gaskets from the enclosure. Failure to do so will void the NEMA rating.

2. Remove the sensor from the screw-in sensor housing or push the air through the analyzer SAMPLE IN thus exposing the sensor to ambient air or alternatively, flow a certified span gas through the analyzer.

3. Advance the cursor on the MAIN MENU to CALIBRATE and press ENTER.
4. Advance the cursor to SPAN CALIBRATION and press ENTER

The following displays appear:



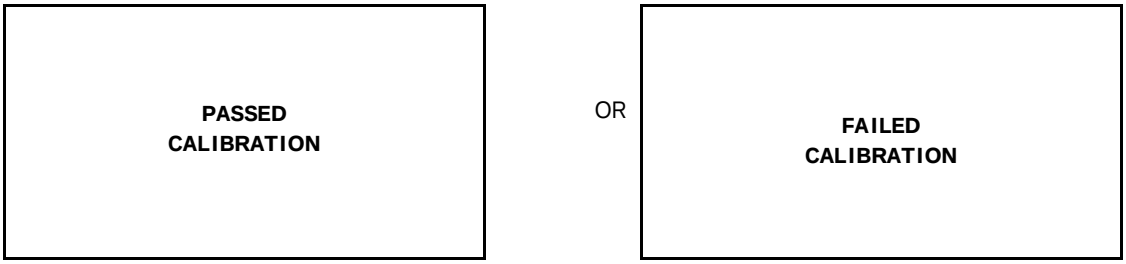


1. By using the UP or DOWN arrow keys, enter the appropriate digit where the cursor is blinking
2. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the gas value.
3. Repeat until the complete span value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

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

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

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

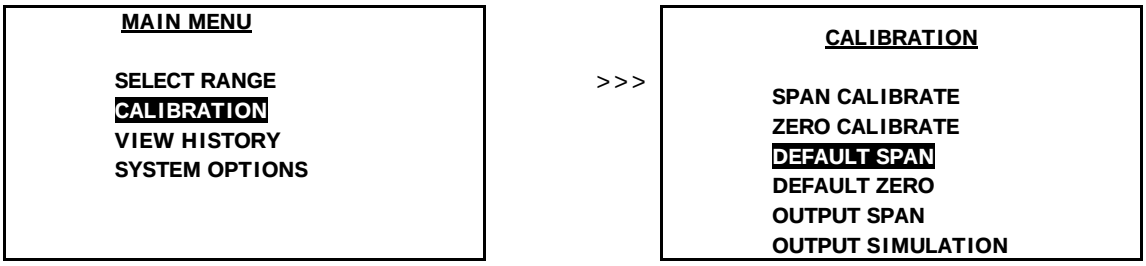


Default Span

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

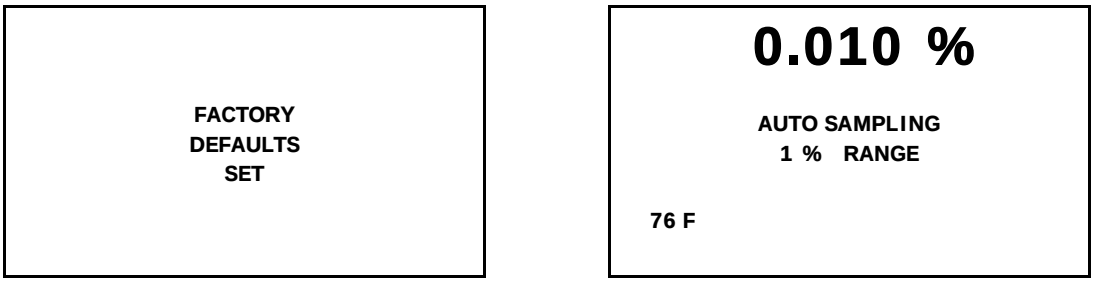
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
3. Press the ENTER key to select the highlighted menu option.

The following display appears:



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

The following displays appear and after 3 seconds the system returns to the SAMPLING mode:

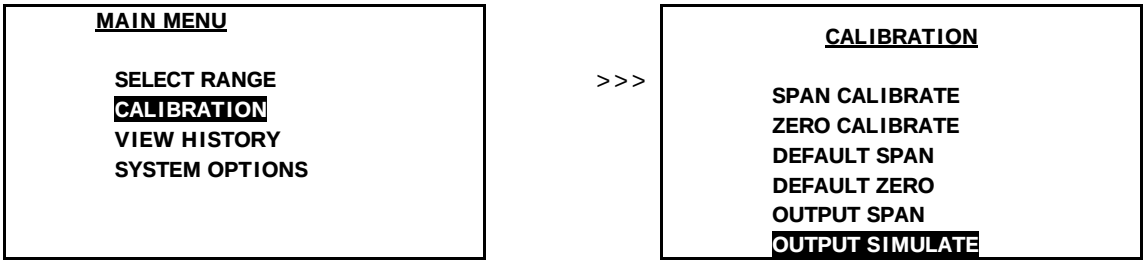


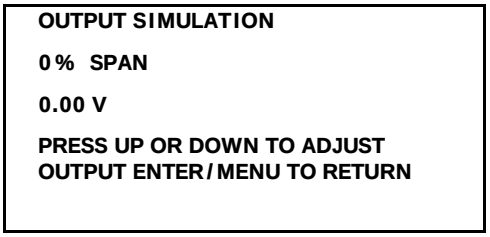
Analog Output Check- Output Simulation

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

1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION and then select OUTPUT SIMULATE.
3. Press the ENTER key to select the highlighted menu option.

The following displays appear:





Pressing UP or DOWN key will increase or decrease the output by 5% of the full scale signal each time. Check the output on the external recording device or voltmeter/ammeter. The output on the external recording would be the % of the full scale signal selected, for example, 0% will represent 0.00 V, 25% value will represent 0.25 V and 50% span value will represent 0.5 V of the 0-1 V full scale. After SIMULATION is complete, press ENTER/MENU key to return to SAMPLE mode.

Note: To perform "Calibrate-Output Simulation", an external recording device must be connected to the signal output port of the analyzer.

Sampling a Gas

GPR-2000 Oxygen Analyzer requires a positive pressure to flow the sample gas across the sensor to measure the oxygen concentration in a sample gas except with analyzer equipped with integral sample pump. If a positive sample pressure is not available and the analyzer is not equipped with integral sample pump, install an external sample pump to push the sample through the analyzer; see the option of using a sample pump as described above.

Procedure

Following calibration, the analyzer will return to the SAMPLE mode.

1. Select the desired sampling mode - auto or manual – as described above.
2. Use a suitable tubing to transport the sample gas to the analyzer
3. The main consideration is to eliminate any air leaks which can affect oxygen measurements.
4. For sample gases under positive pressure, the user must provide a means of controlling the inlet pressure between 5-30 psig.
5. For sample gases under atmospheric or slightly negative pressure, an optional integral sampling pump or an external pump is necessary to push the sample through the sensor housing. Generally, when using a low voltage DC pump, no pressure regulation or flow control device is involved. However, a flow meter upstream of analyzer is recommended to ensure that the sample flow is adequate and steady.
6. Assure the sample is adequately vented for optimum response and recovery – and safety.
7. Allow the oxygen reading to stabilize for approximately 2 minutes at each sample point.

View History

This feature allows the user to view the maximum, minimum and average O2 concentration, maximum ambient temperature, the number of days the sensor has been in service (at the time of installation and first calibration, the user must enter YES to confirm "new sensor") and the number of days since the last calibration was done.

System Options

This features allows the user to

1. Set security; password protected operation
2. Define ranges; choose a range between two ranges, for example, 2% full scale instead of 5% full scale.
3. Display signal below 0.00; negative signal, yes or no.

To enter password, from system option menu, select SECURITY, then enter four digit PASS CODE, numeral numbers only and press ENTER. Then select AUTO LOCK option and enter the number of minutes after which access to MENU options will be locked (access allowed only after entering the PASS CODE).

In the event the PASS CODE is lost, enter the factory default PASS CODE 2855 to access the MENU and then renter the new PASS CODE.

Choosing the option to display negative number will allow the user to see the display below 0.00 but the output will be locked at 0.00 VDC.

Standby

The analyzer has no special storage requirements.
The sensor should remain connected during storage periods.
Store the analyzer with the power OFF at a safe location and away from a direct heating source.
If storing for an extended period of time, protect the analyzer from dust, heat and moisture.

6. Maintenance

With exception of components related to optional equipment and charging the battery of portable analyzers, cleaning the electrical contacts when replacing the sensor is the extent of the maintenance requirements of this analyzer as there are no serviceable parts in the analyzer given the nature of the solid state electronics and sensor.

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

Sensor Replacement

Periodically, the oxygen sensor will require replacement. The operating life is determined by a number of factors that are influenced by the user and therefore difficult to predict. The Features & Specifications define the normal operating conditions and expected life of the standard sensor utilized by the GPR-2000 Series analyzer. Expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.
To install/replace a sensor, access the interior of the analyzer by removing the four screws securing the front panel to the bottom of enclosure, remove the sensor cable from the rear of the sensor, pull out or unscrew the old sensor from the sensor housing. Push or screw in the new sensor. Connect the sensor cable to the rear of the sensor. Close the analyzer case.

Caution: DO NOT dissect the oxygen sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in the Owner's Manual.

Charging Battery

Charging the battery requires a common 9VDC adapter (positive pole located inside the female connector) supplied with the analyzer and a convenient outlet. The adapter supplied with the analyzer will accept 110V or 220V AC 50-60 Hz. Charge battery with the adapter provided with the analyzer only. The electronic design enables the analyzer to remain fully operable during the 8-10 hour charging cycle.

Unless the analyzer is to be operated while charging, turn the analyzer OFF when charging the battery for the shortest charging cycle.

Connect the 9 VDC adapter supplied with the analyzer to an 110V or 220V outlet.
Insert the male phone plug from the 9 VDC adapter into the integral female CHARGE jack located on the bottom of the enclosure.

The analyzer is designed to operate in the charging mode, however, operating the analyzer in hazardous or explosive atmospheres while charging the battery IS NOT recommended despite the intrinsically safe design.

Service

A single charge is sufficient to operate the GPR-2000 analyzer continuously for a period of 60 days but 1 day when operating the optional integral sampling pumps continuously.

Warning LED indicators

An LED indicator located on the front panel will light continuously during the CHARGE cycle.
A second LED (LOW BATTERY) indicator located on the front panel provides a blinking 72 hour warning when battery voltage drops below a certain level. Operating the analyzer beyond this 72 hour may permanently damage the battery.

7. Spare Parts

Recommended spare parts for the GPR-2000 Series Portable Oxygen Analyzer:

Item No.	Description
GPR-11-32-RT	% Oxygen Sensor
GPR-11-32-RTS	% Oxygen Sensor, screw-in
XLT-11-24-RT	% Oxygen Sensor, for CO2 background gas
XLT-11-24-RTS	% Oxygen Sensor, screw-in for CO2 background gas

Other spare parts:

Item No.	Description
A-3666	Battery Assembly
B-3652	Battery Assembly for analyzer with integral sample pump
A-2166-1	Pump Assembly General Purpose
A-2166-5	Pump Assembly Intrinsically safe
MTR-1010	Meter Digital Panel LCD
A-1161-C3-B2	PCB Assembly Main / Display
PWRS-1002	Plug-in 9VDC 110V Battery Charger
PWRS-1003	Plug-in 9VDC 220V Battery Charger

8. Troubleshooting

Symptoms	Possible Cause	Recommended Actions
Slow recovery	At installation, defective sensor	Replace sensor if recovery unacceptable or O_2 reading fails to reach 10% of lowest range
	Air leak in sample system connection(s)	Leak test the entire sample system: Vary the flow rate, if the O_2 reading changes inversely with the change in flow rate indicates an air leak - correct source of leak
	Abnormality in zero gas	Qualify zero gas (using a secondary analyzer)
	Sensor damaged in service - electrolyte leak	Replace sensor
	Sensor nearing end of life	Replace sensor
High O_2 reading after installing or replacing sensor with zero gas	1) Air leak in sample system connection(s) 2) Abnormality in zero gas	Allow O_2 reading to stabilize before making any calibration adjustment Continue purge with zero gas Leak test the entire sample system (above) Qualify zero gas (using a secondary analyzer)
High O_2 reading When sampling gas	Flow rate exceeds limits Pressurized sensor	Correct pressure and flow rate Remove restriction on vent line
	Abnormality in sample gas	Use XLT sensor when CO_2 or acid gases are present Qualify sample gas independently
Response time slow	Air leak, dead legs, longer distance of sample line, low flow rate, high volume of optional filters and scrubbers	Leak test sample system bringing sample gas to analyzer, reduce dead volume and/or increase sample flow rate
O_2 reading doesn't agree with expected O_2 values	Pressure and temperature of the sample may be different than the span gas used for calibration Abnormality in the sample gas	Calibrate the analyzer (calibrate close to the pressure and temperature of the sample gas) Qualify sample gas independently

Erratic O_2 reading or No O_2 reading	Test sensor signal output independent from analyzer	Remove sensor from housing. Consult factory for checking sensor signal output in air.
	Abrupt changes in sample pressure	Regulate sample gas pressure and flow. Clean contacts with alcohol (minimize exposure time of sensor to ambient air to extent possible) Replace sensor and return damaged sensor to the factory for warranty determination
	Defective sensor cable or bad sensor cable connection	Check sensor cable connections
	Leaking sensor	If electrolyte leakage from sensor is evident, replace sensor and return leaking sensor to the factory for warranty determination
	Liquid covering sensing area	Wipe sensor and sensor housing and sensor with a damped towel.
	Improper sensor selection	Replace GPR/PSR series sensor with XLT sensor when CO_2 or other acid gases are present, consult factory
	Presence of other interference gases; presence of sulfur gases	Replace sensor and install H2S scrubber
	Unauthorized maintenance	Replace sensor, obtain authorized service
	Sensor nearing end of life	Replace sensor
Fail span calibration	Defective sensor/Sensor nearing end of life	Replace sensor
Analyzer does not power up	Low battery	Recharge battery for 24 hours, if analyzer does not power up after 24 hours charge, replace battery

9. Warranty

The design and manufacture of Advanced Instruments Inc. oxygen analyzers 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 analyzers and sensors are warranted to be free of defects in materials and workmanship for the period specified in accordance with the most recent published specifications, said period begins with the date of shipment by the manufacturer. The manufacturer information and serial number of this analyzer are located on the rear of the analyzer. Advanced Instruments Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your Advanced Instruments Inc. monitor, analyzer and/or oxygen sensor is determined to be defective with respect to material and/or workmanship, we will repair it or, at our option, replace it at no charge to you. If we choose to repair your purchase, we may use new or reconditioned replacement parts. If we choose to replace your Advanced Instruments Inc. analyzer, we may replace it with a new or reconditioned one of the same or upgraded design. This warranty applies to all monitors, analyzers and sensors purchased worldwide. It is the only one we will give and it sets forth all our responsibilities.

There are no other express warranties. This warranty is limited to the first customer who submits a claim for a given serial number and/or the above warranty period. Under no circumstances will the warranty extend to more than one customer or beyond the warranty period.

Limitations

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

Exclusions

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

Service

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

Advanced Instruments Inc.
2855 Metropolitan Place
Pomona, Ca 91767 USA

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

10. MSDS – Material Safety Data Sheet

Product Identification

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

Specific Generic Ingredients

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

General Requirements

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

Physical Properties

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

Fire and Explosion Data

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

Reactivity Data

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

Spill or Leak

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

time).

Disposal

In accordance with federal, state and local regulations.

Health Hazard Information

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

Special Protection

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

Special Precautions

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