



**Advanced Instruments Inc.**

*Gas analysis solutions through advanced analyzer and sensor technology*

# ***GPR-1100***

## ***Portable ppm Oxygen Analyzer***



## **Owner's Manual**





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## **1 Introduction**

Your new portable 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 variety of industrial oxygen applications.

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; and, to design the analyzer for superior performance and minimal cost of ownership. This analyzer was tested thoroughly by the manufacturer prior to shipment for best performance.

However, modern electronic devices do require service from time to time. The warranty included herein plus a staff of trained professional technicians to quickly service your analyzer is your assurance that we stand behind every analyzer sold.

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

Serial Number: \_\_\_\_\_

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

<b>Date:</b>	<b>Customer:</b>	<b>Order No.:</b>	<b>Pass</b>
<b>Model</b>	GPR-1100 Portable ppm Oxygen Analyzer		_____
<b>Sensor</b>	( ) GPR-12-333 ppm Oxygen Sensor ( ) XLT-12-333 ppm Oxygen Sensor		_____
<b>Serial Nos.</b>	Analyzer _____ Sensor _____		_____
<b>Accessories</b>	Owner's Manual ( ) PWRS-1002 9VDC Battery Charger/Adapter 110VAC ( ) PWRS-1003 9VDC Battery Charger/Adapter 220VAC ( ) PWRS-1008 9VDC Battery Charger/Adapter 12VDC Auto Cigarette Lighter CONN-1034 Plug Mini Phone .141 dia. Black Handle FITN-1003 (3x) Plug Male Quick Disconnect Fittings TOOL-1001 5/16 Combination Wrench		_____
<b>Configuration</b>	A-1151-E-B1 PCB Assembly Range: 0-10 ppm, 0-100 ppm, 0-1000 ppm, 0-25% Wetted parts: stainless steel		_____
<b>Electronics Test</b>	LED indicators: Low battery, charge Electronic offset Analog signal output 0-1V		_____
<b>Gas Phase Test</b>	Recovery from air to < 10 ppm in < 1 hour Baseline drift on zero gas < ± 2% FS over 24 hour period on 0-1% range Noise level < ± 0.5% FS Span adjustment within 10-50% FS		_____
<b>Final</b>	Overall inspection for physical defects		_____
<b>Options</b>			_____
<b>Notes</b>			_____



## 3 Safety

### General

This section summarizes the essential precautions applicable to the GPR-1100 Series Portable ppm Oxygen Analyzer. Additional precautions specific to individual analyzer are contained in the following sections of this manual. To operate the analyzer safely and obtain maximum performance follow the basic guidelines outlined in this Owner's Manual.

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

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

**Read Instructions:** Before operating the analyzer read the instructions.

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

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

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

### Installation

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

**Inlet Pressure:** The analyzer is designed for flowing samples are intended to operate at positive pressure regulated to between 5-30 psig.

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

**Flow Rate:** Recommended – 2 SCFH or 1 liter per minute.

**Mounting:** Mount as recommended by the manufacturer. The analyzer is approved for indoor or outdoor use.

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

**Operating Temperature:** The maximum operating temperature is 45° C.

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

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

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



## **Maintenance**

**Serviceability:** Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service.

Only trained personnel with the authorization of their supervisor should conduct maintenance.

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

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

Do not attempt to service the analyzer beyond those means described in this Owner's Manual. Do not attempt to make repairs by yourself as this will void the warranty as per Section 10 and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

**Cleaning:** The analyzer should be cleaned only as recommended by the manufacturer. Wipe off dust and dirt from the outside of the unit with a soft damp cloth then dry immediately. Do not use solvents or chemicals.

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

## **4 Features & Specifications**

See last page, this page left blank intentionally.



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## **5 Operation**

### **Principle of Operation**

The GPR-1100 portable oxygen analyzer incorporates a variety of ppm range advanced galvanic fuel cell type sensors. The analyzer is configured in a general purpose NEMA 4 rated enclosure and meets the intrinsic safety



standards required for use in Class 1, Division 1, Groups A, B, C, D hazardous areas. Two integral sampling pump options are available – one that meets the intrinsic safety standards and a less expensive option for general purpose service.

### **Advanced Galvanic Sensor Technology:**

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

Proprietary advancements in design and chemistry add significant advantages to an extremely versatile oxygen sensing technology. Sensors for low ppm analysis recover from air to ppm levels in minutes, exhibit longer life and reliable quality. The expected life of our new generation of percentage range sensors now range to five and ten years with faster response times and greater stability. Another significant development involves expanding the operating temperature range for percentage range sensors from -30°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 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 LED.

### **Sample System:**

The GPR-1100 is supplied without a sample conditioning system for maximum portability. However the sample must be properly presented to the sensor to ensure an accurate measurement. Users interested in adding their own sample conditioning system should consult the factory. Advanced Instruments Inc. offers a full line of sample handling, conditioning and expertise to meet your application requirements. Contact us at 909-392-6900 or e-mail us at [aii2@earthlink.net](mailto:aii2@earthlink.net)

## **Pressure & Flow**

All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The inlet pressure must always be higher than the pressure at the outlet vent which is normally at atmospheric pressure.



## Flow Through Configuration:

The sensor is exposed to sample gas that must flow or be drawn through metal tubing inside the analyzer. The GPR-1100 internal sample system includes a quick disconnect female inlet fitting, a stainless steel sensor housing with an o-ring seal to prevent the leakage of air and another quick disconnect female vent fitting. Mating male quick disconnect fittings are provided for introducing sample and calibration gases, a third male fitting is provided for the vent line.

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

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



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

To avoid generating a vacuum on the sensor (as described above) during operation, always select and install the vent fitting first and remove the vent fitting last.

## Application Pressure - Positive:

A flow indicator with integral metering valve (GPR-1100M option) positioned upstream of the sensor is recommended for controlling the sample flow rate between 1-5 SCFH.

If necessary, a pressure regulator (with a metallic diaphragm is recommended for optimum accuracy, the use of diaphragms of more permeable materials may result in erroneous readings) upstream of the flow control valve should be used to regulate the inlet pressure between 5-30 psig.





## **Application Pressure - Atmospheric or Slightly Negative:**

For accurate ppm range oxygen measurements, an optional external sampling pump should be positioned downstream of the sensor to draw the sample from the process, by the sensor and out to atmosphere. A flow meter is generally not necessary to obtain the recommended flow rate with most sampling pumps, if the analyzer is equipped with a flow meter make sure the valve is completely open to avoid drawing a vacuum on the sensor.

**Caution:** If the analyzer is equipped with an optional flow indicator with integral metering valve (GPR-1100M) upstream of the sensor - open the metering valve completely to avoid drawing a vacuum on the sensor and placing an undue burden on the pump.

If pump loading is a consideration, a second throttle valve on the pump's inlet side may be necessary to provide a bypass path so the sample flow rate is within the above parameters.

## **To avoid erroneous oxygen readings and damaging the sensor:**

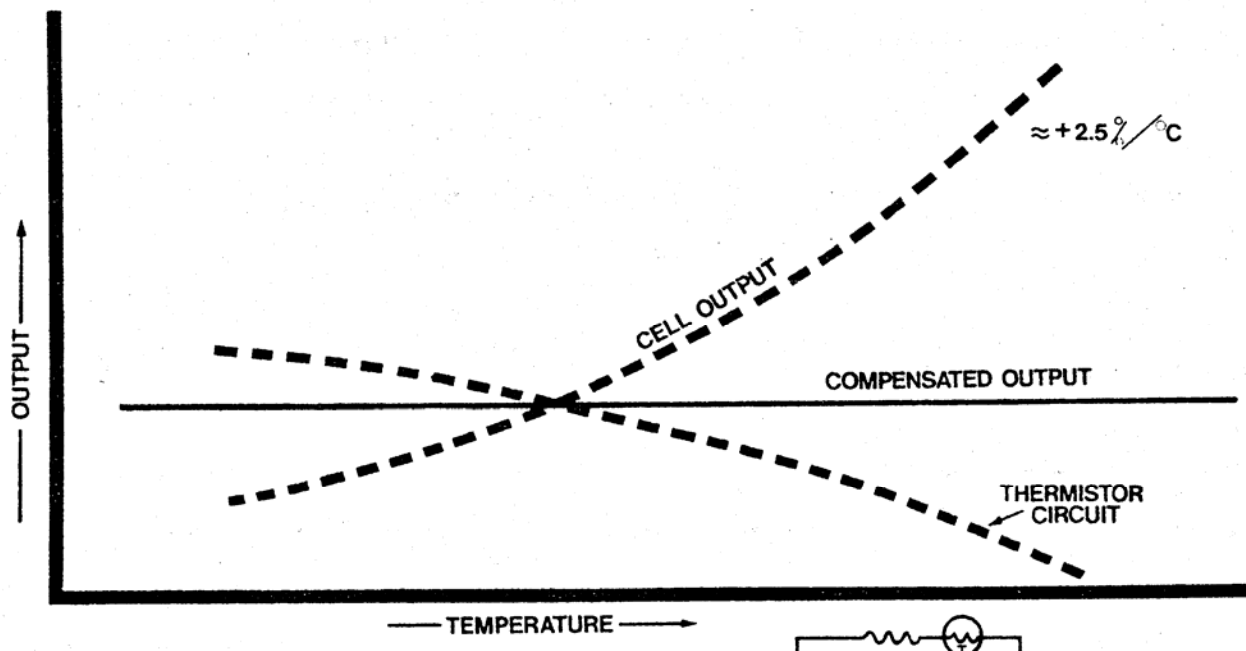
- Do not place your finger over the vent (it pressurizes the sensor) to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor (voiding the sensor warranty).
- Assure there are no restrictions in the sample or vent lines
- Avoid drawing a vacuum that exceeds 14" of water column pressure – unless done gradually
- Avoid excessive flow rates above 5 SCFH which generate backpressure on the sensor.
- Avoid sudden releases of backpressure that can severely damage the sensor.
- Avoid the collection of particulates, liquids or condensation collect on the sensor that could block the diffusion of oxygen into the sensor.



## Calibration & Accuracy

**Single Point Calibration:** As previously described the galvanic oxygen sensor generates an electrical current sensor exhibiting an absolute zero, e.g. the sensor does not generate a current output in the absence of oxygen. Given these linearity and absolute zero properties, single point calibration is possible.

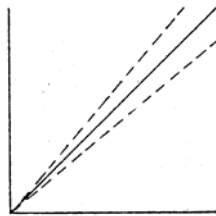
**Pressure:** Because sensors are sensitive to the partial pressure of oxygen in the sample gas their output is a function of the number of molecules of oxygen 'per unit volume'. Readouts in percent are permissible only when the total pressure of the sample gas being analyzed remains constant. The pressure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



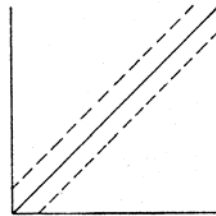
**Temperature:** The rate oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation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

**Accuracy:** In light of the above parameters, the overall accuracy of an analyzer is affected by two types of errors: 1) those producing 'percent of reading errors', illustrated by Graph A below, such as  $\pm 5\%$  temperature compensation circuit, tolerances of range resistors and the 'play' in the potentiometer used to make span adjustments and 2) those producing 'percent of full scale errors', illustrated by Graph B, such as +1-2% linearity errors in readout devices, which are really minimal due to today's technology and the fact that other errors are 'spanned out' during calibration.

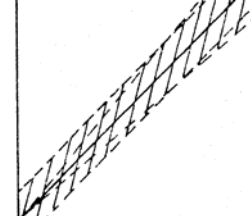
Graph C illustrates these 'worse case' specifications that are typically used to develop an analyzer's overall accuracy statement of +2% of full scale at constant temperature or +5% over the operating temperature range. QC testing is typically < +0.5% prior to shipment.



A. PERCENT OF READING ERRORS



B. PERCENT OF FULL SCALE ERRORS



C. OVERALL ACCURACY

**Example:** As illustrated by Graph A any error, play in the multi-turn span pot or the temperature compensation circuit, during a span adjustment at 20.9% (air) of full scale range would be multiplied by a factor of 4.78 ( $100/20.9$ ) if used for measurements of 95-100% oxygen concentrations. Conversely, an error during a span adjustment at 100% of full scale range is reduced proportionately for measurements of lower oxygen concentrations.

**Recommendation:** Calibrating with a span gas approximating 80% of the full scale range one or two ranges higher than the full scale range of interest is recommended for 'optimum calibration accuracy'.



## **Start-up**

The GPR-1100 Portable ppm Oxygen 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 30 minutes and then recalibrate the device as instructed below.

Assemble the necessary hardware for mounting the analyzer and optional components - such as coalescing or particulate filters and pumps, 1/8" metal or plastic tubing for interconnecting the analyzer and optional components.

Review the application conditions to ensure the sample is suitable for analysis.

1. **Temperature:** The sample must be sufficiently cooled before it enters the analyzer and any optional components. A coiled 10 foot length of 1/4" stainless steel tubing is sufficient for cooling sample gases as high as 1,800°F to ambient.
2. **Pressure & Flow:** As described above.
3. **Moisture & Particulates:** Prevent water and/or particulates from entering the sample system. They can clog the tubing and damage the optional components such as pumps, scrubbers or sensors. Installation of a suitable coalescing or particulate filter is required to remove condensation, moisture and/or particulates from the sample gas to prevent erroneous analysis readings and damage to the sensor or optional components. Consult the factory for recommendations concerning the proper selection and installation of components.
4. **Contaminants:** A gas scrubber and flow indicator with integral metering valve are required upstream of the analyzer to remove interfering gases such as oxides of sulfur and nitrogen or hydrogen sulfide that can produce false readings and reduce the expected life of the sensor. Installation of a suitable scrubber is required to remove the contaminant from the sample gas to prevent erroneous analysis readings and damage to the sensor or optional components. Consult the factory for recommendations concerning the proper selection and installation of components.
5. Gas connections: Inlet and outlet vent gas lines require 1/8" diameter tubing preferably metal.
6. Power connection: Locate a source of AC power to meet area classification and to plug in the charging adapter.
7. Zero calibration (required only for very low percentage range measurements).
8. Span calibration – Users are responsible for certified span gas cylinder, regulator and flow control valve.

## **Mounting the Analyzer:**

Normally mounting a portable analyzer is not a consideration. However, the GPR-1100 analyzer can operate continuously when connected to AC power using the appropriate charging adapter. The analyzer enclosure is cast with four (4) holes in the bottom section specifically intended for wall mounting.



## Gas Connections:

The GPR-1100 flow through configuration is designed for positive pressure samples and requires connections to incoming sample and vent female quick disconnect fittings. The user is responsible for making provision for introducing gases for calibration purposes.

Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH generate backpressure and erroneous oxygen readings because the diameter of the integral tubing cannot evacuate the sample gas at the higher flow rate.

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

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

To avoid generating a vacuum on the sensor (as described above) during operation, always select and install the vent fitting first and remove the vent fitting last.



## Procedure:

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



## **Power connection:**

Locate a source of AC power to meet the area classification, plug in the appropriate charging adapter to the outlet and connect the jack at the other end to the mating receptacle identified on the analyzer.

## **Output connection:**

The analyzer provides a 0-1V full scale with negative ground signal output for external recording devices.

## **Procedure:**

Connect the lead wires from the external recording device to the male phone plug supplied with 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-1100 Portable ppm Oxygen Analyzer is equipped with an integral oxygen sensor. They are fully operational from the shipping container with the oxygen sensor installed, tested and calibrated by the manufacturer prior to shipment. Should it be necessary to install the oxygen sensor – see section 6 Maintenance which covers replacing the oxygen sensor.

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

**Caution:** DO NOT open the oxygen sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet 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.

## **Span Gas Preparation**

**Caution:** Do not contaminate the span gas cylinder when connecting the regulator. Bleed the air filled regulator (faster and more reliable than simply flowing the span gas) before attempting the initial calibration of the instrument.

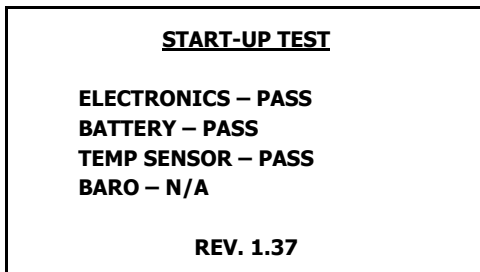
1. With the span gas cylinder valve closed, install the regulator on the cylinder.
2. Open the regulator's exit valve and partially open the pressure regulator's control knob.
3. Open slightly the cylinder valve.
4. Loosen the nut connecting the regulator to the cylinder and bleed the pressure regulator.
5. Retighten the nut connecting the regulator to the cylinder
6. Adjust the regulator exit valve and slowly bleed the pressure regulator.
7. Open the cylinder valve completely.
8. Set the pressure between 5-30 psig using the pressure regulator's control knob.

**Caution:** Do not exceed the recommended flow rate. Excessive flow rate could cause the backpressure on the sensor and may result in erroneous readings and permanent damage to the sensor.



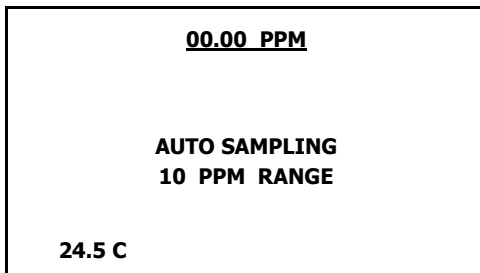
## Establishing Power to the Electronics:

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:



In the unlikely event the LED warning indicator LOW BATT comes on when the analyzer is turned on – proceed immediately to the sub-section on Battery Considerations at the end of section 5 Operation.

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



## Menu Navigation:

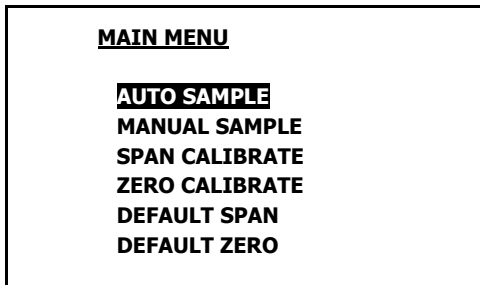
The five (5) pushbuttons located on the front of the analyzer operate the micro-processor:

1. green ENTER (select)
2. yellow UP ARROW
3. yellow DOWN ARROW
4. blue MENU (escape)
5. red ON/OFF



## Main Menu:

Access the MAIN MENU by pressing the MENU key:



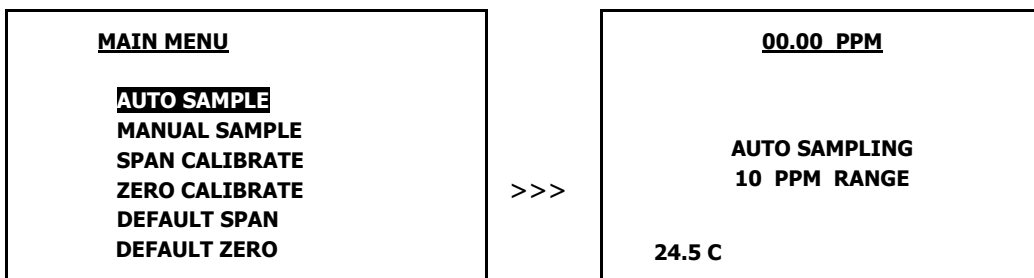
## Range Selection:

The GPR-1100 analyzer is equipped with five (5) standard measuring ranges (see specification) and provides users with a choice of sampling modes. By accessing the MAIN MENU, users may select either the AUTO SAMPLING (ranging) or MANUAL SAMPLING (to lock on a single range) mode.

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

## Procedure - Auto Sampling:

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



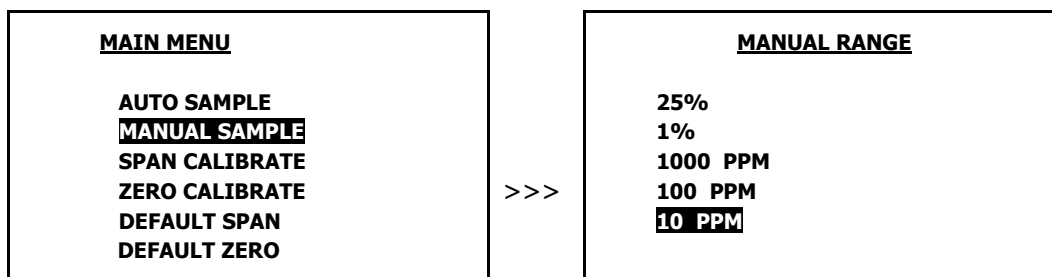
The display will shift to the next higher range when the oxygen reading (actually the sensor's signal output) exceeds 99.9% of the upper limit of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the upper limit of the next lower range.



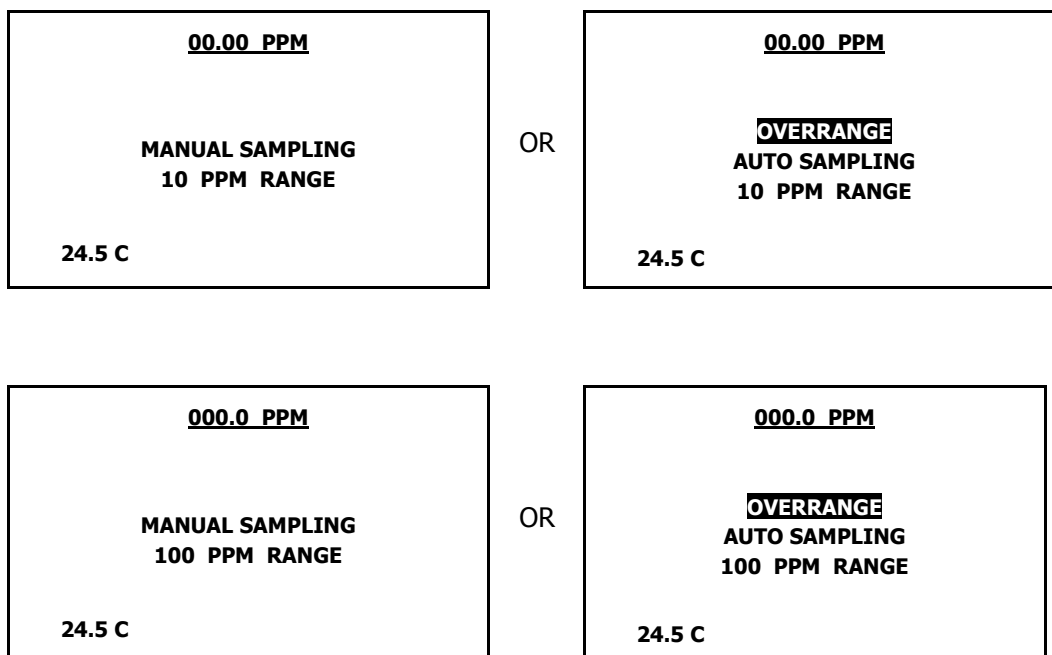
For example, if the analyzer is reading 1% on the 0-10% range and an upset occurs, the display will shift to the 0-25% range when the oxygen reading exceeds 9.9%. Conversely, once the upset condition is corrected, the display will shift back to the 0-10% range when the oxygen reading drops to 8.5%.

## Procedure - Manual Sampling:

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



5. Advance the reverse shade cursor to highlight the desired RANGE.
6. Press the ENTER key to select the highlighted menu option.
7. The following display(s) appear depending on the range selected and oxygen concentration of the sample gas:





0.000 PPM  
  
MANUAL SAMPLING  
1000 PPM RANGE  
  
24.5 C

OR

0.000 PPM  
  
OVERRANGE  
AUTO SAMPLING  
1000 PPM RANGE  
  
24.5 C

0.000 %  
  
MANUAL SAMPLING  
1% RANGE  
  
24.5 C

OR

0.000 %  
  
OVERRANGE  
AUTO SAMPLING  
1% RANGE  
  
24.5 C

00.00 %  
  
MANUAL SAMPLING  
25% RANGE  
  
24.5 C

OR

00.00 %  
  
OVERRANGE  
AUTO SAMPLING  
25% RANGE  
  
24.5 C

The display will not shift automatically. Instead, when the oxygen reading (actually the sensor's signal output) exceeds 110% of the upper limit of the current range an OVER RANGE warning will be displayed.

Once the OVER RANGE warning appears the user must advance the analyzer to the next higher range via the menu and keypad Press MENU, select MANUAL SAMPLING, press ENTER, select the appropriate MANUAL RANGE and press ENTER again.

**Start-Up is complete ... proceed to Calibration**



## Zero Calibration

In theory, the oxygen sensor produces no signal output when exposed to an oxygen free sample gas. However, the analyzer will generate an oxygen reading when sampling oxygen free sample gas due to:

- Contamination or quality of the zero gas
- Minor leakage in the sample line connections
- Residual oxygen dissolved in the sensor's electrolyte
- Tolerances of the electronic components

**Recommendation:** Zero calibration is recommended for measurements below 1 ppm on the 10 ppm range only, as it is not practical on higher ranges as described below.

### Procedure:

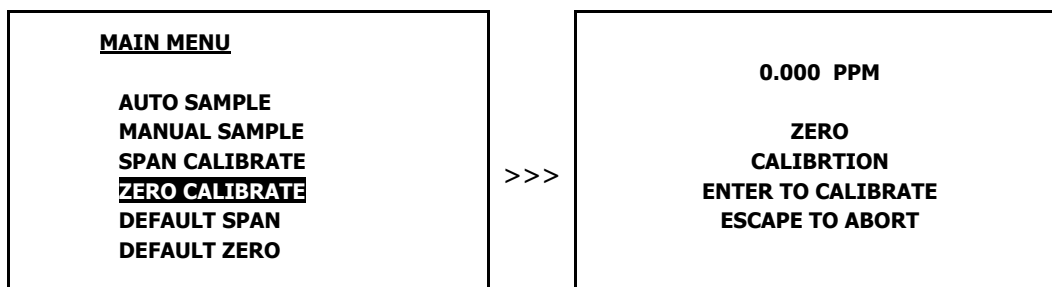
Zero calibration should precede the span calibration and once performed should not have to be repeated with subsequent span calibrations. Normally, zero calibrations are performed when a new sensor is installed or changes are made in the sample system connections.

Refer to Span Calibration below for the detailed procedure. Differences include substituting a suitable zero gas for the span gas and allowing the analyzer 24 hours with flowing zero gas to determine the true zero offset (a stable reading evidenced by a horizontal trend on an external recording device) of the system before conducting the zero calibration. **Note:** 24 hours is required for the sensor to consume the oxygen that has dissolved into the electrolyte inside the sensor (while exposed to air or percentage levels of oxygen).

Thus, for this reasons above, it is not practical to zero a portable analyzer every time it is moved from one sample point to another. Finding the true zero offset is not always necessary particularly in the case of applications requiring higher level oxygen measurements because of the low offset value, normally < 0.1 ppm, is not material to the accuracy of higher level measurements.

**Note:** Prematurely zeroing the analyzer can cause a negative reading in both the ZERO and SAMPLE modes.

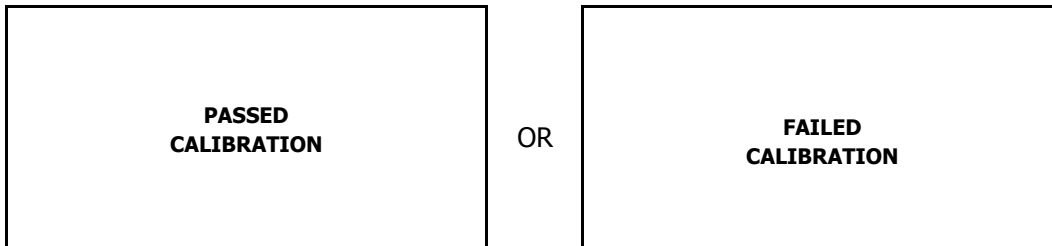
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor to highlight ZERO CALIBRATE.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:



5. Press the ENTER key to calibrate, refer to the Span Calibration section for the detailed procedure.



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



Satisfying users that the zero offset is reasonably acceptable for their application can be accomplished much quicker. Unless the zero gas is contaminated or there is a significant leak in the sample connections, the analyzer should read less than 100 ppm oxygen within 5 minutes after being placed on zero gas.

The maximum zero calibration adjustment permitted is 60% of the lowest full scale range available, which normally is 1 ppm. Thus the maximum zero calibration adjustment or zero offset is 6 ppm oxygen. Accordingly, the analyzer's ZERO has not been adjusted prior to shipment because the factory conditions are different from the application condition at the user's installation.

### **Factory Default Zero:**

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

## **Span Calibration**

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

Calibration involves adjusting the analyzer electronics to the sensor's signal output at a given oxygen standard, e.g. a certified span gas with an oxygen content (balance nitrogen) approximating 80% of the next higher full scale range above the intended measuring range is recommended for optimum accuracy, see Calibration and Accuracy. Calibration with ambient or instrument air (20.9% or 209,000 ppm) is recommended when installing a new sensor or when a certified gas is not available.

### **Factory Default Span**

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



## Manual Span

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

### Preparation - Required components:

Refer to Installing Span Gas section above.

1. Certified span gas cylinder with an oxygen concentration, balance nitrogen, approximating 80% of the full scale range above the intended measuring range.
2. Regulator to reduce pressure to between 5 and 30 psig.
3. Flow meter to set the flow between 1-5 SCFH,
4. 2 lengths of 1/8" dia. metal tubing measuring 4-6 ft. in length.
5. Suitable fittings and 1/8" dia. metal tubing to connect the regulator to the flow meter inlet
6. Suitable fitting and 1/8" dia. metal tubing to connect to the flow meter vent
7. 1/8" male NPT to tube adapter fitting to connect the 1/8" dia. metal tubing from the flow meter vent to the mating male quick disconnect fitting supplied with the GPR-1100.

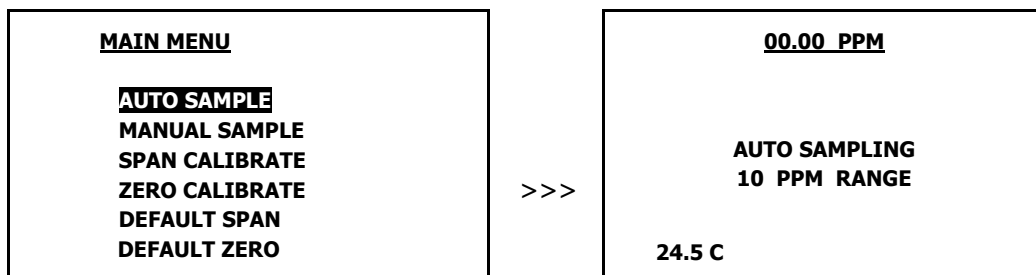
### Procedure:

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

To assure an accurate calibration, the temperature and pressure of the span gas must closely approximate the sample conditions.

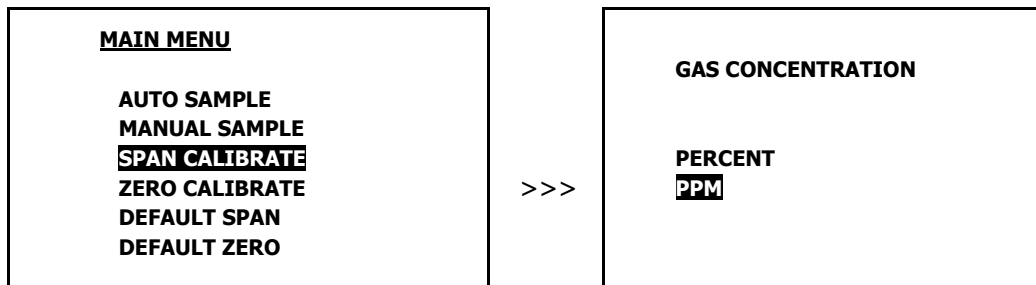
For calibration purposes, use of the AUTO SAMPLE mode is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE for calibration as dictated by the accuracy of the analysis required – for example, a span gas with an 80 ppm oxygen concentration with the balance nitrogen would dictate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

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

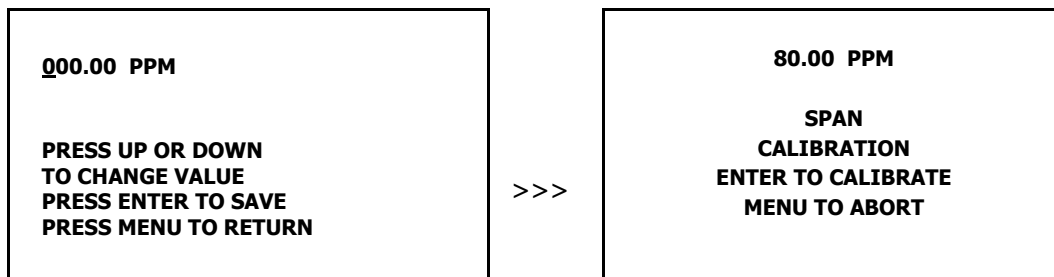




5. Assure there are no restrictions in the span gas line.
6. Assure the male fitting designated for the vent is installed and the vent is open.
7. Regulate the pressure and control the flow rate as described above, 5-30 psig and 2 SCFH flow rate.
8. Allow the span gas to flow for 1-2 minutes to purge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



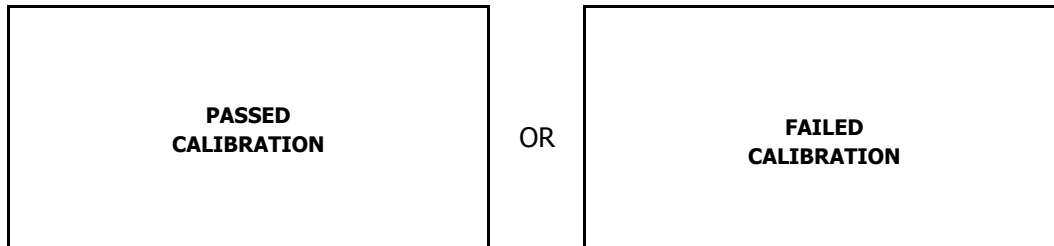
17. The following displays appear:



18. Press the ENTER key to advance the underline cursor to the first digit of the span value.
19. Press the UP/ DOWN ARROWS to enter the first digit of the span value.
20. Repeat steps 18 and 19 until the complete span value has been entered.



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



22. The analyzer returns to the AUTO SAMPLING mode after 30 seconds.
23. Before disconnecting the span gas line and connecting the sample gas line, restart if necessary the flow of sample gas and allow it to flow for 1-2 minutes to purge the air inside the line.
24. Disconnect the span gas line and replace it with the purged sample gas line.
25. Wait 10-15 minutes to ensure the reading is stable and proceed to sampling.

## Sampling

GPR-1100 Portable ppm Oxygen Analyzer requires positive pressure to flow the sample gas by the sensor to measure the oxygen concentration in a sample gas. If not available see Pressure & Flow section.

**Note:** Prematurely zeroing the analyzer can cause the analyzer to display a negative reading in both the ZERO and SAMPLE modes.

### Procedure:

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

1. Select the desired sampling mode - auto or if manual, the range that provides maximum resolution.
2. Use metal tubing to transport the sample gas to the analyzer.
3. The main consideration is to eliminate air leaks which can affect oxygen measurements above or below the 20.9% oxygen concentration in ambient air - ensure the sample gas tubing connections fit tightly into the 1/8" male NPT to tube adapter, and, the NPT end is taped and securely tightened into the mating male quick disconnect fittings which mate with the female fittings on the analyzer
4. Assure there are no restrictions in the sample line.
5. Refer to the section on Pressure & Flow to determine the appropriate Application Pressure considerations.
6. For sample gases under positive pressure the user must provide a means of controlling the inlet pressure between 5-30 psig and the flow of the sample gas between 1-5 SCFH, a flow rate of 2 SCHF is recommended
7. For sample gases under atmospheric or slightly negative pressure an optional sampling pump is recommended to draw the sample into the analyzer. Generally, no pressure regulation or flow control device is involved.



8. **Caution:** If the analyzer is equipped with an optional sampling pump and is intended for use in both positive and atmospheric/slightly negative pressure applications where a flow meter valve is involved – ensure the valve is completely open when operating the sampling pump.
9. Assure the sample is adequately vented for optimum response and recovery – and safety.
10. Allow the oxygen reading to stabilize for approximately 10 minutes at each sample point.

### To avoid erroneous oxygen readings and damaging the sensor:

- Do not place your finger over the vent (it pressurizes the sensor) to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor (voiding the sensor warranty).
- Assure there are no restrictions in the sample or vent lines
- Avoid drawing a vacuum that exceeds 14" of water column pressure – unless done gradually
- Avoid excessive flow rates above 5 SCFH which generate backpressure on the sensor.
- Avoid sudden releases of backpressure that can severely damage the sensor.
- Avoid the collection of particulates, liquids or condensation collect on the sensor that could block the diffusion of oxygen into the sensor.

## Battery Considerations

Charging the battery requires a common 9VDC adapter (positive pole located inside the female connector) supplied with the analyzer and a convenience outlet. The analyzer's charging circuit accepts 9VDC from any standard AC 110V or 220V adapter. The electronic design enables the analyzer to remain fully operable during the 8-10 hour charging cycle.

### Procedure:

1. Unless the analyzer is to be operated while charging, turn the analyzer OFF when charging the battery for the shortest charging cycle.
2. Connect the appropriate 9VDC adapter supplied with the analyzer to an 110V or 220V outlet.
3. Insert the male phone plug from the 9VDC adapter into the integral female CHARGE jack located on the bottom of the enclosure.
4. **Caution:** 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-1100 Series analyzer continuously for a period of 60 days.

### Warning indicators:

1. An LED indicator located on the front panel will light continuously during the CHARGE cycle.
2. A second LED indicator located on the front panel provides a blinking 72 hour warning LOW BATT of the need to recharge the battery. **Caution:** Operating the analyzer beyond this 72 hour warning may permanently damage the battery.



## **Standby**

- The analyzer has no special storage requirements.
- The sensor should remain connected during storage periods.
- Store the analyzer with the power OFF.
- If storing for an extended period of time, charge before operating.



## 6 Maintenance

Generally, cleaning the electrical contacts or replacing filter elements is the extent of the maintenance requirements of this analyzer.

### Sensor Replacement

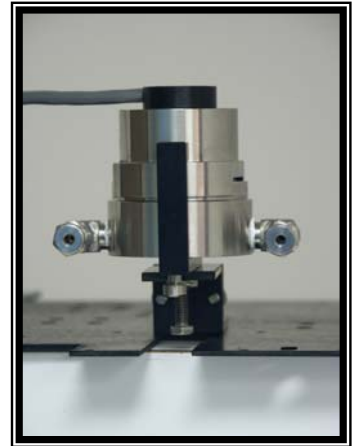
Periodically, the oxygen sensor will require replacement. The operating life is determined by a number of factors that are influenced by the user and therefore difficult to predict. The Features & Specifications define the normal operating conditions and expected life of the standard sensor utilized by the GPR-2000 Series analyzer. Expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.

**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.

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

#### Procedure:

1. Remove the four (4) screws securing the analyzer's front panel.
2. **Caution:** Do not discard the gaskets from the enclosure.
3. Using the 5/16 wrench supplied loosen but do not remove the clamp bolt located in the center of the housing with the elbows attached.
4. Rotate the upper section of the sensor housing 90° to disengage from the clamp.
5. Remove the upper section by pulling it straight up and place it on a smooth surface.
6. Remove the old oxygen sensor and dispose of it as you would a battery.
7. Remove the new oxygen sensor from the shipping bag.
8. Remove the red label and the gold ribbon (shorting device) from the PCB at the rear of the sensor.
9. **Caution:** Minimize the time the sensor is exposed to ambient air.
10. Place the new sensor in the bottom section of the sensor housing with the PCB facing up.
11. Place the upper section of the sensor housing over the sensor.
12. Gently push the upper section downward and rotate 90° to engage the clamp.
13. Finger tighten the clamp bolt and one full turn with the 5/16 wrench to compressed the o-ring seal.
14. Connect zero gas or low oxygen content sample gas line to purge the sensor of oxygen.
15. Span Calibrate the analyzer in approximately 1 hour, once the reading stabilizes.





## **7 Spare Parts**

Recommended spare parts for the GPR-1100 Series Portable Oxygen Analyzer:

<b>Item No.</b>	<b>Description</b>
GPR-12-333	ppm Oxygen Sensor
XLT-12-333	ppm Oxygen Sensor

Other spare parts:

<b>Item No.</b>	<b>Description</b>
A-2244	Battery Assembly
A-1004	Housing Sensor Stainless Steel
A-1016A-SS	Housing Sensor Bottom Assembly Stainless Steel
A-1017A-SS	Housing Sensor Upper Assembly Stainless Steel
MTR-1011	Meter Digital Panel LCD Backlight
ORNG-1007	O-ring 3/32 x 1-3/8 x 1-9/16 Viton
A-1151-E	PCB Assembly Main / Display
PWRS-1002	Power Source Plug-in 9VDC 110V Battery Charger
PWRS-1003	Power Source Plug-in 9VDC 220V Battery Charger



## 8 Troubleshooting

<b>Symptom</b>	<b>Possible Cause</b>	<b>Recommended Action</b>
Slow recovery	At installation, defective sensor	Replace sensor if recovery unacceptable or O <sub>2</sub> 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 <sub>2</sub> reading changes inversely with the change in flow rate indicates an air leak - correct source of leak
	Abnormality in zero gas	Qualify zero gas (using portable analyzer)
	Damaged in service - prolonged exposure to air, electrolyte leak	Replace sensor
	Sensor nearing end of life	Replace sensor
High O <sub>2</sub> reading after installing or replacing sensor	Analyzer calibrated before sensor stabilized caused by:	Allow O <sub>2</sub> reading to stabilize before making the span/calibration adjustment
	1) Prolonged exposure to ambient air, worse if sensor was <b>unshorted</b>	Continue purge with zero gas
	2) Air leak in sample system connection(s)	Leak test the entire sample system (above)
High O <sub>2</sub> reading Sampling	3) Abnormality in zero gas	Qualify zero gas (using portable analyzer)
	Flow rate exceeds limits	Correct pressure and flow rate
	Pressurized sensor	Remove restriction on vent line or open SHUT OFF valve completely
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO <sub>2</sub> or acid gases are present
Abnormality in gas		Qualify the gas (use a portable analyzer)
Response time slow	Air leak, dead legs, distance of sample line, low flow rate, volume of optional filters and scrubbers	Leak test (above), reduce dead volume or increase flow rate



<b>Symptom</b>	<b>Possible Cause</b>	<b>Recommended Action</b>
O <sub>2</sub> reading doesn't agree to expected O <sub>2</sub> values	Pressure and temperature of the sample is different than span gas	Calibrate the analyzer (calibrate at pressure and temperature of sample)
	Abnormality in gas	Qualify the gas (use a portable analyzer)
Erratic O <sub>2</sub> reading or No O <sub>2</sub> reading	Test sensor independent from analyzer	Remove sensor from housing. Using a voltmeter set to $\mu$ A output; apply the (+) lead to the outer ring of the sensor PCB and the (-) lead to the center circle to obtain the sensor's output in air. Contact factory with result. Sensors without PCB use mV setting.
	Change in sample pressure	Calibrate the analyzer (calibrate at pressure and temperature of sample)
	Dirty electrical contacts in upper section of sensor housing	Clean contacts with alcohol (minimize exposure time of MS sensor to ambient air to extent possible)
	Corroded solder joints on sensor PCB from corrosive sample or electrolyte leakage from sensor	Replace sensor and return sensor to the factory for warranty determination
	Corroded spring loaded contact in upper section of sensor housing from liquid in sample or electrolyte leakage from sensor	Upper section of sensor housing: Clean contacts with alcohol, flow sample or zero gas for 2-3 hours to flush sample system and sensor housing Sensor: Replace if leaking and return it to the factory for warranty determination
	Liquid covering sensing area	Wipe with alcohol and lint free towel or flow sample or zero gas for 2-3 hours to flush
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO <sub>2</sub> or acid gases are present
	Presence of interference gases	Consult factory
	Presence of sulfur gases	Replace sensor and install scrubber
	Unauthorized maintenance	Replace sensor, obtain authorized service
Sensor nearing end of life	Replace sensor	



Symptom	Possible Cause	Recommended Action
Erratic O <sub>2</sub> reading or Negative O <sub>2</sub> reading or No O <sub>2</sub> reading possibly accompanied by electrolyte leakage	<p>Pressurizing the sensor by flowing gas to the sensor with: the vent restricted or SHUT OFF valve closed and suddenly removing the restriction draws a vacuum on the sensor</p> <p>or</p> <p>partially opening the valves upstream of the analyzer when using a pump downstream of the analyzer to draw sample from a process at atmospheric pressure or a slight vacuum</p> <p>A pressurized sensor may not leak but still produce negative readings.</p> <p>Placing a vacuum on the sensor in excess 4" of water column is strongly discouraged. The front sensing membrane is .000625 thick, heat sealed to the sensor body and subject to tearing when vacuum is suddenly applied.</p> <p>A premature adjustment of the ZERO OFFSET potentiometer is a common problem</p>	<p>Zero the analyzer. If not successful replace the sensor</p> <p>Avoid drawing a vacuum on the sensor</p> <p>From MAIN MENU select DEFAULT ZERO</p>



## **9 Warranty Policy**

### **What is covered:**

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Any defect in material and workmanship from normal use in accordance with the Owner's Manual.

This warranty applies to all analyzer purchased worldwide. Advanced Instruments Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

### **For how long:**

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One year from shipment by manufacturer or purchase from a distributor with proof of purchase.

### **Who is warranted:**

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This warranty is limited to the first customer who submits a claim. Under no circumstances will the warranty extend to more than one customer.

### **What we will do:**

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If your Advanced Instruments Inc. analyzer is defective with respect to material and workmanship, we will repair it or, at our option, replace it at no charge to you.

If we choose to replace your Advanced Instruments Inc. analyzer, 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.

### **Limitations:**

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Implied warranties, including those of fitness for a particular purpose and merchantability (an unwritten warranty that the product is fit for ordinary use), are limited to one year from the date of shipment by manufacturer or purchase from a distributor with proof of purchase.

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, so the above exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state and province to province.



## **What is not covered:**

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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 attachment not provided with the analyzer; fire, flood, or acts of God; or other failure to follow the Owner's Manual.

## **Sole Warranty**

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This warranty is the only one we will give on your Advanced Instruments Inc. analyzer, and it sets forth all our responsibilities regarding your Advanced Instruments Inc. analyzer.

There are no other express warranties.

## **How to obtain warranty service:**

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Do-It-Yourself-Service:

Call Advanced Instruments Inc. at 909-392-6900 between 8:00am and 5:00pm Pacific Time weekdays. Trained technicians will assist you in diagnosing the problem and arrange to supply you with the required parts.

Service from Distributors:

If warranty service is provided by a distributor, Advanced Instruments Inc. will provide all required parts under warranty at no charge to you, but the distributor is an independent business and may render a service charge for their services. Advanced Instruments Inc. will not reimburse you or otherwise be responsible for those charges.

Return to Advanced Instruments Inc.:

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, proof of date of purchase 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.

Your choice of any one of the service options described above is your exclusive remedy under this warranty.



# 10 Material Safety Data Sheet (MSDS)

## Product Identification

Product Name	Oxygen Sensor Models CAD, GPR, PSR, SAF, 67013
Synonyms	Galvanic Fuel Cell, Electrochemical Transducer
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, Lead
CAS Number	Potassium Hydroxide = KOH 1310-58-3, Lead = Pb 7439-92-1
Chemical (Synonym) and Family	Potassium Hydroxide (KOH) - Base, Lead (Pb) - Metal

## Physical Properties

Boiling Point Range	100 to 115° C
Melting Point Range	KOH -10 to 0° C, Lead 327° C
Freezing Point	-40 to 0° C
Molecular Weight	KOH = 56, Lead = 207
Specific Gravity	1.09 @ 20° C
Vapor Pressure	Not applicable
Vapor Density	Not applicable
pH	> 14
Solubility in H <sub>2</sub> O	Complete
% Volatiles by Volume	None
Evaporation Rate	Similar to water
Appearance and Odor	Colorless, odorless aqueous solution



## General Requirements

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

## 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	Avoid contact with strong acids
Hazardous Decomposition Products	None
Conditions to Avoid	None

## Spill or Leak

Steps if material is released	<p>Sensor is packaged in a sealed protective plastic bag, check the sensor inside for electrolyte leakage.</p> <p>If the sensor leaks inside the protective 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.</p> <p>Flush or wipe all surfaces repeatedly with water or wet paper towel. Use a fresh towel each time.</p>
Waste Disposal Method	In accordance with federal, state and local regulations for battery disposal

## Health Hazard Information

Primary Route(s) of Entry	Ingestion, eye and skin contact
Exposure Limits	Potassium Hydroxide - ACGIH TLV 2 mg/cubic meter; Lead - OSHA PEL .05 mg/cubic meter
Effects of Exposure -	
Ingestion	Electrolyte could be harmful or fatal if swallowed. Oral LD50 (RAT) = 2433 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	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.

## Emergency First Aid

Ingestion	Do not induce vomiting; Give plenty of cold water; Seek medical attention immediately.
Skin Contact	Wash affected area repeatedly with plenty of water; Remove contaminated clothing; If burning persists, seek medical attention.
Eye Contact	Flush repeatedly with plenty of water for at least 15 minutes; Seek medical attention immediately.
Inhalation	Liquid inhalation is unlikely.

## Special Protection Information

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

## Special Precautions

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



## Product Identification

Product Name	Oxygen Sensor Models XLT
Synonyms	Galvanic Fuel Cell, Electrochemical Transducer
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%	Acetic Acid, Lead
CAS Number	Acetic Acid = 64-19-7, Lead = Pb 7439-92-1
Chemical (Synonym) and Family	Acetic Acid (CH <sub>3</sub> CO <sub>2</sub> H) - Acid, Lead (Pb) - Metal

## Physical Properties

Boiling Point Range	100 to 117° C
Melting Point Range	Acetic Acid = not applicable, Lead 327° C
Freezing Point	-40 to -10° C
Molecular Weight	Acetic Acid = not applicable, Lead = 207
Specific Gravity	1.05 @ 20° C
Vapor Pressure	11.4 @ 20° C
Vapor Density (air = 1)	2.07
pH	2-3
Solubility in H <sub>2</sub> O	Complete
% Volatiles by Volume	None
Evaporation Rate	Similar to water
Appearance and Odor	Colorless, vinegar-like odor aqueous solution

## General Requirements

Use	Acetic Acid - electrolyte, Lead - anode
Handling	Rubber or latex gloves; Safety glasses
Storage	Indefinitely



## 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	Avoid contact with strong bases
Hazardous Decomposition Products	Emits toxic fumes when heated
Conditions to Avoid	Heat

## Spill or Leak

Steps if material is released	Sensor is packaged in a sealed protective plastic bag, check the sensor inside for electrolyte leakage. If the sensor leaks inside the protective plastic bag or inside an analyzer sensor housing do not remove it without rubber or latex gloves, safety glasses and a source of water. Flush or wipe all surfaces repeatedly with water or wet paper towel. Use a fresh towel each time.
Waste Disposal Method	In accordance with federal, state and local regulations for battery disposal.

## Health Hazard Information

Primary Route(s) of Entry	Ingestion, eye and skin contact
Exposure Limits	Acetic Acid - ACGIH TLV / OSHA PEL 10 ppm (TWA); Lead - OSHA PEL .05 mg/cubic meter
Effects of Exposure -	
Ingestion	Electrolyte could be harmful or fatal if swallowed; 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 - burning sensation.
Medical Conditions Aggravated	None



Carcinogenic Reference Data      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. Lead acetate formed as the sensor is used is listed as a chemical known to the State of California to cause cancer.

## **Emergency First Aid**

Ingestion      Do not induce vomiting; Give plenty of cold water or if available milk; Seek medical attention immediately.

Skin Contact      Wash affected area repeatedly with plenty of water; Remove contaminated clothing; If burning persists, seek medical attention.

Eye Contact      Flush repeatedly with plenty of water for at least 15 minutes; Seek medical attention immediately.

Inhalation      Liquid inhalation is unlikely.

## **Special Protection Information**

Ventilation Requirements      None

Eye      Safety glasses

Hand      Rubber or latex gloves

Respirator Type      Not applicable

Other Protective Equipment      None

## **Special Precautions**

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

Transportation      Not applicable