# *GPR-1500 A*

# *% Oxygen Transmitter with alarms*


Shown with optional sample system

# Owner's Manual

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# Table of Contents

# 1. Introduction

Your new oxygen analyzer/transmitter incorporated 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.

To obtain maximum performance from your new oxygen analyzer/transmitter, 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 transmitter for superior performance and minimal cost of ownership. This analyzer/transmitter was tested thoroughly by the manufacturer prior to shipment for 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 transmitter is your assurance that we stand behind every transmitter sold.

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

Serial Number: _____

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

See QC sheet attached to the packing slip

# 3. Safety

## General Considerations

This section summarizes the essential precautions applicable to the GPR-1500 A Oxygen Transmitter. Additional precautions specific to individual transmitter are contained in the following sections of this manual. To operate the transmitter 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 transmitter 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 transmitter, 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 transmitter.

Pressure and Flow

**Inlet Pressure:** GPR-1500A Oxygen Transmitters are designed for flowing samples, equipped with 1/8" bulkhead tube fitting connections on the side of the unit (unless otherwise indicated, either fitting can serve as inlet or vent) and are intended to operate at positive sample pressure regulated between 5-30 psig.

**Caution:** If equipped with a H2S scrubber as part of an optional sample conditioning system, inlet pressure must not exceed 30 psig.

**Outlet Pressure:** The sample gas must be vented to atmosphere or vent pipe with atmospheric pressure.

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.

**Mounting of the Transmitter:** The transmitter is approved for indoor or outdoor use. Mount the transmitter on a flat surface.

**Power Requirement:** Supply power to the transmitter only as rated by the specification or markings on the transmitter enclosure. The wiring that connects the transmitter 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 transmitter. Never yank wiring to remove it from an outlet or from the transmitter.

**Operating Temperature:** The maximum operating temperature is between $0^0$C to 45º C.

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

**Liquid and Object Entry:** The transmitter 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 transmitter.

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

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. 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 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.

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

# 4. Features and Specifications

**Advanced Instruments Inc.**

## Technical Specifications *

| | |
|---|---|
| Accuracy: | < 2% of FS range under constant conditions |
| Analysis: | 0-10, 0-100, 0-1000 PPM, 0-25% (CAL) FS<br>Auto-ranging or manual lock on a single range |
| Application: | Oxygen analysis in inert, hydrocarbon, helium, hydrogen, mixed and acid ($CO_2$) gas streams |
| Area Classification: | General purpose |
| Alarms: | Two user configurable alarms: relays rated 3A at 100 VAC, field programmable alarm time delays, alarm by-pass for calibration and power fail alarm |
| Calibration: | 1 month interval using certified span gas (preferred for fastest online time) or air with $O_2$ approximating 80% of full scale range balance N2 |
| Compensation: | Temperature compensated output |
| Connections: | 1/8" or 1/4"compression tube fittings |
| Controls: | Water resistant keypad; menu driven range selection, calibration and system functions |
| Display: | Graphical LCD 2.75" x 1.375"; resolution 0.01 PPM; displays real time ambient temperature and pressure |
| Enclosure: | Fiberglass NEMA 4X, 6.75 x 8.375 x 4.25", 8 lbs. |
| Flow Sensitivity: | Not flow sensitive, 1-2 SCFH recommended |
| Linearity: | ±2% of full scale |
| Pressure: | Inlet - regulate to 5-30 psig to deliver 1-2 SCFH flow; vent - atmospheric |
| Power: | 12-28 VDC non-loop or 110-220 VAC |
| Recovery Time: | 30 seconds in air to < 10 PPM in < 1 hour on $N_2$ purge |
| Response Time: | 90% of final reading in 10 seconds |
| Sample System: | None, Optional 4-way crossover Sample/Bypass valve, flow control valve |
| Sensitivity: | < 0.5% of FS range |
| Sensor Model: | GPR-12-333 for inert gas streams;<br>XLT-12-333 for gases containing > 0.5% CO2 |
| Sensor Life: | 24 months in < 1000 PPM O2 at 25ºC and 1 atm |
| Signal Output: | 4-20mA |
| Operating Range: | -10 ºC to 45ºC (GPR sensor), -20º to 45ºC (XLT sensor) |
| Warranty: | 12 months analyzer; 12 months sensor |
| Wetted Parts: | Stainless steel |

## Optional Equipment

Sample conditioning system - Contact factory.

* Subject to change without notice


Analyzer shown with optional sample system

***GPR-1500 A***
***PPM Oxygen Analyzer***

**12-28 VDC Non-Loop or 110-220 VAC Powered Oxygen Analyzer**

**Advanced Galvanic Sensor Technology with Optional Sample Systems**

**2 Field Selectable Alarm Setpoints**
**12-28 VDC or 110-220 VAC Power**
**4-20 mA Signal Output**
**Sensitivity 0.5% Full Scale**
**4 Ranges Standard**
**Auto Ranging or Single Fixed**
**Stainless Steel Wetted Parts**

**ISO 9001:2008 Certified**
**INTERTEK Certificate No. 485**

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# 3. Operation

## Principle of Operation

The GPR-1500 A oxygen transmitter incorporates a variety of advanced galvanic fuel cell type sensors. The transmitter is a compact efficient package configured with the oxygen sensor and separate circuit boards for signal processing and terminals for incoming power, power supply, signal output and alarm relay contacts housed in a general purpose NEMA 4X rated enclosure.

### 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.

### 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 or 4-20 mA signal output jack.

The analyzer is powered by either 100/230 VAC or 12-24 VDC power source (check the QC of the analyzer to confirm the power requirement). Separate wiring for the alarms and signal outputs are required.

**Caution: The** 4-20mA signal output does not require any external power (applying power to 4-20 mA terminal will permanently damage the transmitter and void transmitter warranty).

### Sample System

The GPR-1500A is supplied without a sample conditioning system thereby giving users the option of adding their own or purchasing a factory designed sample conditioning system. Whatever the choice, 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

### Pressure and Flow Considerations

All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The inlet pressure must always be sufficiently higher to allow the sample to flow through the sensor housing and out vent which is normally at atmospheric pressure. Sample inlet pressure must be regulated between 5-30 PSIG.

The GPR-1500A internal sample system includes SS sample system with 1/8" compression tube fittings for sample inlet and vent and stainless steel sensor housing.

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

If the analyzer not equipped with external sample system, either of the two compression tube fittings on the side of the analyzer enclosure may be used as sample IN..

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 1-2 SCFH or 0.4-1 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).

## Sample Pressure - Positive:

Regulate the sample pressure between 5-30 PSIG. Use a flow indicator with integral metering valve positioned upstream of the sensor to control the sample flow rate between 1-5 SCFH.

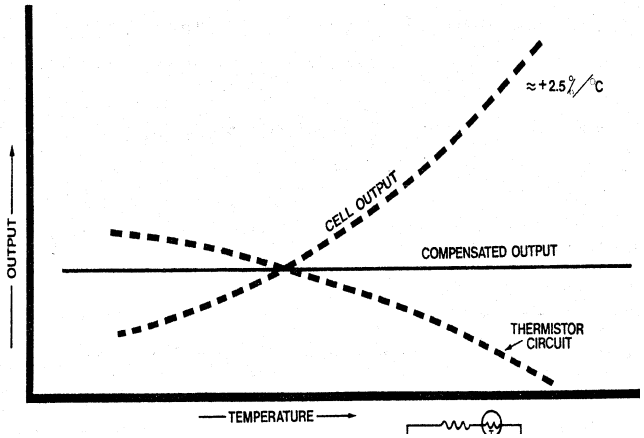
**Caution:** If equipped with a H2S scrubber as part of an optional sample conditioning system, inlet pressure must not exceed 30 psig.

## Sample Pressure - Atmospheric or Slightly Negative:

For sample at atmospheric pressure or under slight vacuum, an external sampling pump should be positioned upstream of the sensor to draw the sample from the process and push it through the sensor housing and out to atmosphere. Depending on the pump's ability to draw sample, a flow meter may or may not be necessary as long as the discharge of the sampling pump approximates the recommended 1-2 SCFH flow rate.

# Calibration & Accuracy of Analyzer

**Analyzer Calibration:** The analyzer must be calibrated with a known standard (a certified span gas) before use. As previously described, the galvanic type oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas. However, each oxygen sensor may exhibit a slightly different signal output with a know concentration of oxygen. Therefore, it becomes necessary to adjust the sensitivity of the analyzer electronics to nullify any variation in the signal output of a sensor. This is termed as Span Calibration




In the absence of oxygen, the sensor exhibits an absolute zero, e.g. the sensor does not generate a current output in the absence of oxygen. Given these linearity and absolute zero properties, single point calibration is possible.

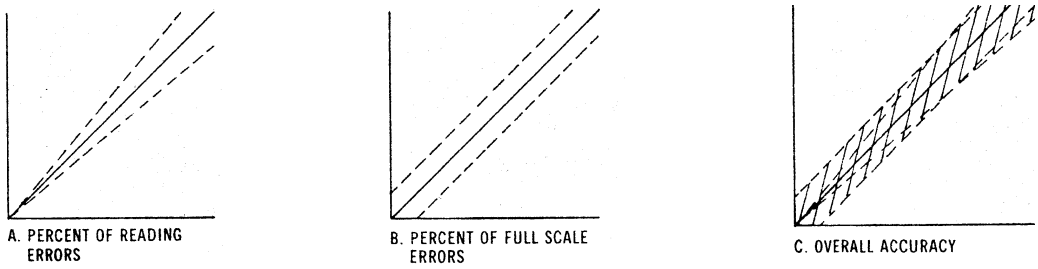
**Sample Pressure:** As described earlier, oxygen sensors are sensitive to the partial pressure of oxygen in a sample gas, in other words, the sensor output is a function of the number of oxygen molecules present 'per unit volume'. For accurate oxygen analysis, during analysis, the sensor must be maintained at a constant pressure. This can be easily attained by maintaining the sample flow rate constant.

For best accuracy, the pressure of the sample gas and that of the calibration gas must be within 1-2 PSIG (to ensure constant flow when switching sample/span gases).

**Sample and Ambient Temperature:** The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation is relatively constant (2.5% per ºC). A temperature compensation circuit employing a thermistor and a network of resisters offsets this effect with an accuracy of $\pm$5% or better over a wide operating temperature range e.g., 5-45 $^{o}$C can be obtained thus the signal output remains virtually independent of ambient temperature. There is extremely low error in measurement if the calibration and sampling are performed at similar temperatures (within +/- 5 ºC. Conversely, a temperature variation of 10 ºC may produce an error of < 2% of full scale.

**Analyzer Accuracy:** In light of the above parameters, the overall accuracy of an analyzer is affected by two types of errors: 1) 'percent of reading errors', illustrated by Graph A below, is contributed by the temperature compensation circuit (tolerance in the thermistor value, variation in temperature coefficient of the thermistor, tolerances in resistors values and the accuracy in the measuring devices, e.g., LCD display and 2) 'percent of full scale errors', illustrated by Graph B, such as1-2% offset errors in readout and calibration devices. Other errors are 'spanned out' during calibration, especially when analyzer is calibrated close to the top end of the measuring range.

Graph C illustrates these 'worse case' specifications that are typically used to develop an overall accuracy statement of < 1% of full scale at constant temperature or < 5% over the operating temperature range. The QC testing error is typically < 0.5% prior to shipment of analyzer from the factory.




**Example 1:** As illustrated by Graph A, any error during a span adjustment at lower end of the scale, e.g., 20.9% (air) on a 100% full scale range, would be multiplied by a factor of 4.78 (100/20.9) when making measurements close to 100% O2. Conversely, an error during a span adjustment close to the top end of the range, e.g., at 100% is reduced proportionately for measurements of oxygen concentrations near the bottom end of the range.

Graph B represents a constant error over the entire measuring range. This error is generally associated with the measuring e.g., LCD and or calibrating devices, e.g., current simulator or current/voltage measuring devices.

Potential Explosion Hazard – See warning in Section 4 – Features and Specifications

**Analyzer Calibration Recommendation:** Calibrating with a span gas approximating 80% of the full scale range of interest or one range of interest is recommended for 'optimum calibration accuracy'. Always calibrate the analyzer at the same temperature and pressure as of the sample gas stream.

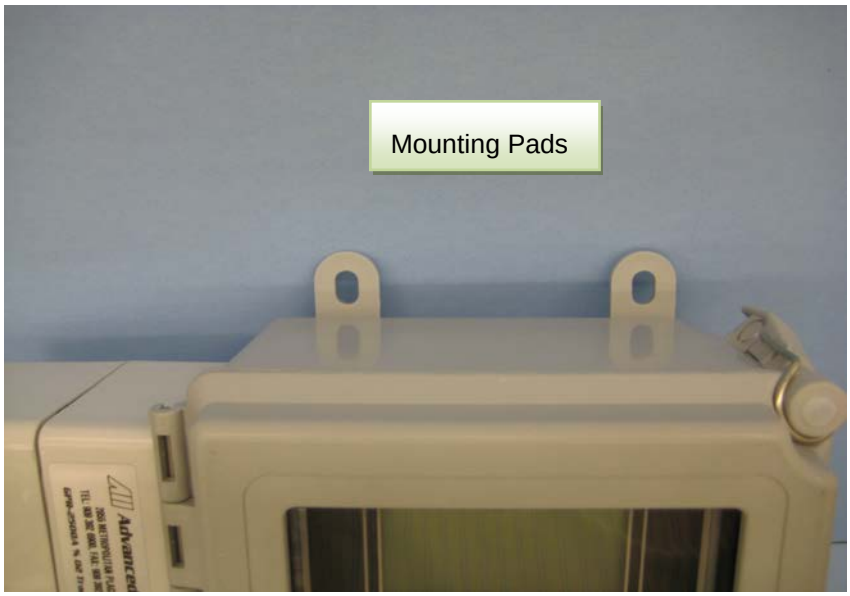
# Mounting the Analyzer

The GPR-1500 A is housed in a Fiber Glass NEMA 4 rated enclosure. This configuration is designed to be mounted directly to any flat vertical surface, wall or bulkhead plate with four (4) of the appropriate size screws. To facilitate servicing the interior of the transmitters, position it approximately 5 feet off ground level.

Loosen the four mounting pads at the rear of the enclosure.

Select four appropriate mounting screws (customer supplied).

Secure the enclosure to a vertical surface approximately 5 feet from the floor or a level accessible to service personnel. This requires the user to supply four (4) additional proper size screws and anchors.




**Caution:** Do not remove or discard the gaskets from either the enclosure or junction box.

The transmitters design provides protection from RFI that is maintained by leaving specific mating areas of the enclosure unpainted to maintain conductivity of the gasket, top and bottom sections of the smaller enclosure housing the electronics. These unpainted areas are protected by gaskets and contribute to maintaining the NEMA 4 rating as well as protection from RFI/EMI. Do not paint these areas.

# Gas Connections

The GPR-1500 A with its standard flow through configuration is designed for positive pressure samples and requires connections for incoming sample and outgoing vent lines. The user is responsible for calibration gases and other required components, see below.

Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH generate backpressure and erroneous oxygen readings because the diameter of the integral tubing cannot evacuate the sample gas at the higher flow rate. A flow indicator with an integral metering valve upstream of the sensor is recommended as a means of controlling the flow rate of the sample gas. A flow rate of 1-2 SCFH or 0.4-1 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).

# Procedure of Establishing Gas Connections

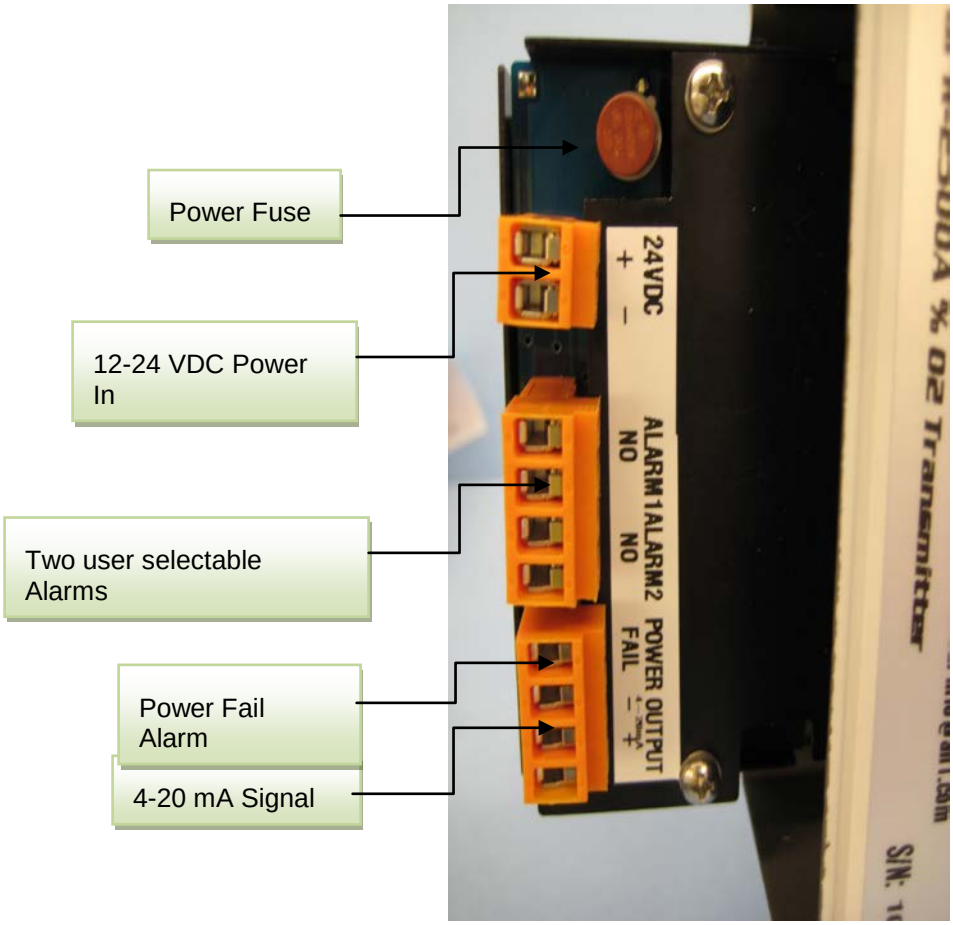
1. Designate one of the bulkhead tube fittings as the VENT and the other as SAMPLE.
2. Regulate the sample/span gas pressure to 5-30 PSIG.
3. Connect a 1/8” vent line to the compression fitting to be used for venting the sample.
4. Connect a 1/8” sample line to the fitting designated as SAMPLE.

5. If equipped with optional fittings and/or sample system, connect the span gas line to the fitting designated as SPAN.
6. Set the gas flow  rate to 1-2 SCFH.

# Establishing Electrical Connections

All electrical connections are located in a small junction box located on the side of the larger enclosure. Power at the specified rating must be supplied via a two wire shielded cable. A safety fuse is also mounted in the junction box.

Do not supply power beyond the rating. Failure to do so may permanently damage the analyzer.




**Note:** The power fail alarm is an optional feature. Consult factory for this option.

The integral 4-20mA converter is internally powered and does not require external power. **DO NOT** supply any voltage to either of the two terminals of the 4-20mA output connector. Failure to do so will permanently damage the 4-20mA converter.

# Procedure

1. Remove the front cover of the junction box located on left side of the transmitters by removing the four (4) screws securing the cover and set them aside for reinstallation.
2. Loosen the nut of the cable gland (customer provide and mounted at the bottom of the smaller enclosure).
3. Insert power and alarm and signal output wires through the cable gland. Strip ~ ¼ inch of the wires. Insert the stripped end of wires to the appropriate terminals and secure them by tightening the screws of the terminal block. **Note:** Use wires that comply with local regulatory requirements.
4. Thread the wires through the cable gland into the inside of the junction box.

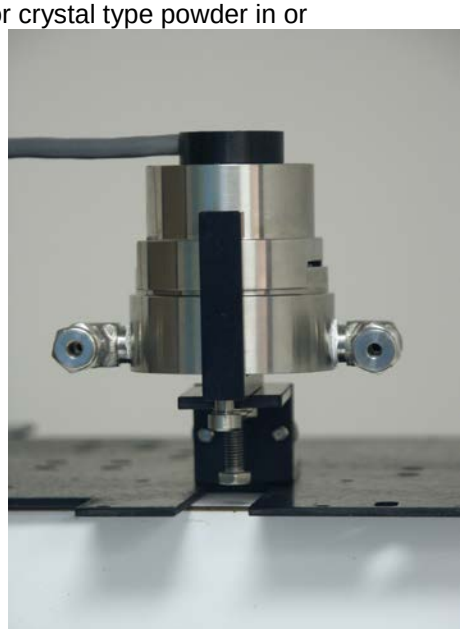
5. Ensure the positive and negative terminals of the power supply are connected to the appropriate terminals.
6. If using shielded cables, connect the shielding of the cable to the copper ground screw inside the junction box.
7. Replace the junction box cover ensuring the gaskets are in place and tighten the four (4) screws.
8. Tighten the cable gland to maintain NEMA 4 rating.

# Installation of Sensor

The GPR-1500 A Oxygen Analyzer is equipped with a SS sensor housing. This housing offers ease of replacement of sensor and at the same time prevents any leakage into the system. The two sections of the sensor are held together be a metal clamp secured in place by easily accessed bolt. The integrity of the sensor housing has been tested at the factory prior to shipment and is fully operational from the shipping container.

Caution**:** All analyzers must be calibrated once the installation has been completed and periodically thereafter as described below. Following the initial installation and calibration, allow the transmitters to stabilize for 12-24 hours and re-calibrate the transmitter with a certified span gas.

**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 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 off in a manner similar to that of a common battery in accordance with local regulations.



Avoid electrostatic discharge – Clean all surfaces with a damp cloth only.

# Procedure

Remove the two (2) clamps securing the right side corners and open the door of the fiber glass enclosure.

Loosen the bolt at the bottom of the sensor housing by using 5/16 ranch provided.

Twist the upper section of the housing 90 degree and pull it up until it clears the bottom section of the sensor housing.

Remove the old sensor (if previously installed) from the sensor housing

Remove the oxygen sensor from the bag and remove the two red shorting taps from the two ring gold color contact plate of the sensor.

Insert the sensor into the upper section of the sensor housing with gold contact plate facing towards two gold contact pins of the sensor housing

By holding the sensor and the upper section of the sensor housing in your hand, allow 2-3 minutes for the analyzer to respond to the new sensor. The analyzer should display oxygen around 21% with factory default span setting (see below)

You may perform a quick air calibration to ensure that the analyzer accepts the air calibration confirming that the sensor out put is within the recommended limits.

Place the sensor in the bottom section of the sensor housing with the two ring gold contact plate facing up. Place the upper section of the sensor housing over the sensor. Slightly push it down and twist 90 degree.

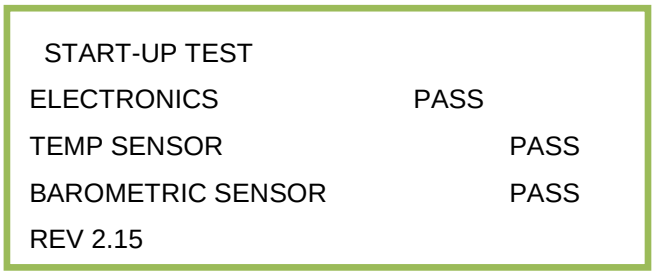
By using the 5/16 ranch, tighten the bolt securing the two section together



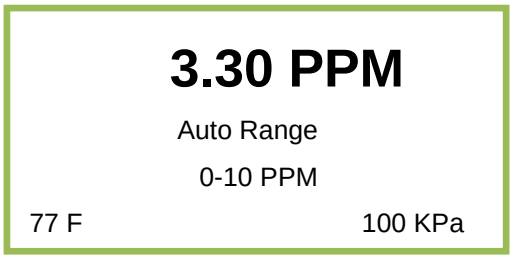
Sequence of installation of PPM sensor; remove sensor from bag, place sensor in the sensor housing, remove the RED shorting ribbons and place the upper section of sensor housing back on the lower section of the sensor housing and secure two sections of the sensor housing with the clamp

# Establishing Power to Electronics

Once the two wires bringing power to the transmitter are properly connected to the terminals inside the junction box, the digital display responds instantaneously. At power-up, the transmitter performs several diagnostic system status checks termed “START-UP TEST” as illustrated below:




After initial self diagnostics, the display shows the actual oxygen concentration and analysis range along with ambient temperature and pressure




# Menu Navigation

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

Green ENTER (select)

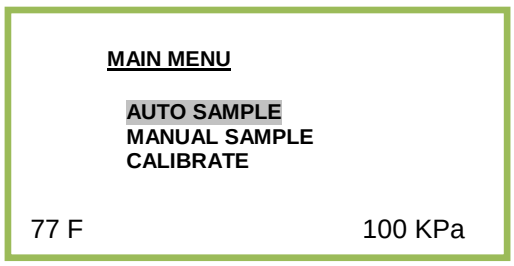
Yellow UP ARROW

Yellow DOWN ARROW

Blue MENU (escape)

Main Menu

Access the MAIN MENU by pressing the MENU key



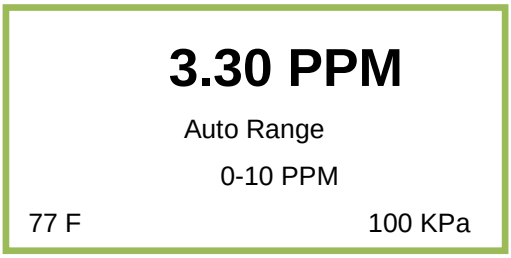
# Range Selection

The GPR-1500 A transmitter 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.

Procedure – Auto Sampling

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

The display returns to the sampling mode:



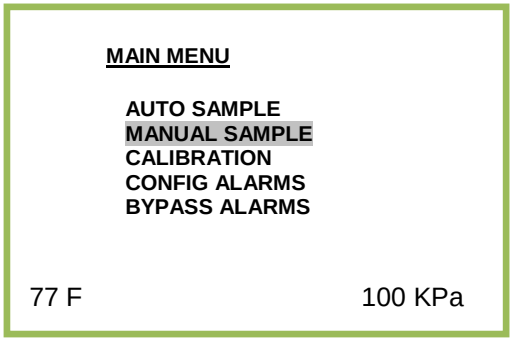

The display will shift to the next higher range when the oxygen reading (actually the sensor's signal output) exceeds 99.9% of the upper limit of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the upper limit of the next lower range.

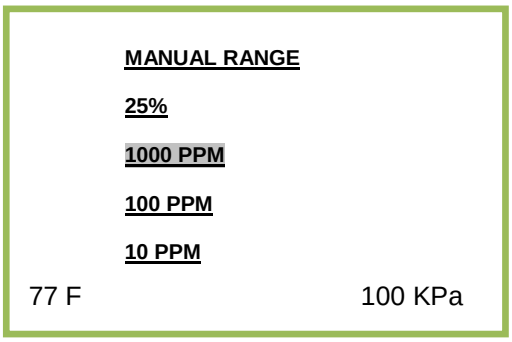
For example, if the transmitter is reading 1 PPM on the 0-10 PPM range and an upset occurs, the display will shift to the 0-100 PPM range when the oxygen reading exceeds 9.9 PPM. Conversely, once the upset condition is corrected, the display will shift back to the 0-10 PPM range when the oxygen reading drops to 8.5 PPM

Procedure – Manual Sampling

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

The following displays appears:

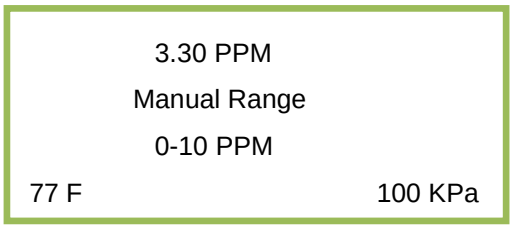


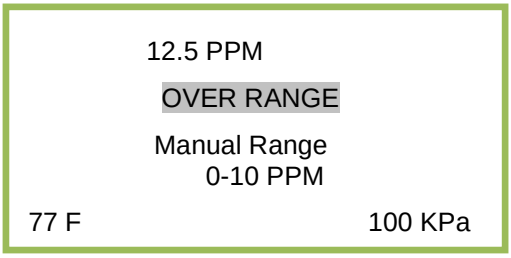

Advance the reverse shade cursor using the ARROW keys to highlight the desired RANGE.

Press the ENTER key to select the highlighted menu option.

The following display appears with the range selected and oxygen concentration of the sample gas:




The display will not shift automatically. Instead, when the oxygen reading (actually the sensor's signal output) exceeds 112% of the upper limit of the current range an OVER RANGE warning will be displayed.




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

Calibration of Analyzer

Zero Calibration

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

1. Contamination or quality of the zero gas.
2. Minor leakage in the sample line connections
3. Residual oxygen dissolved in the sensor's electrolyte
4. Tolerances of the electronic components

Therefore, it may be necessary to perform a ZERO calibration.

**Note:** ZERO calibration is recommended only if the analysis is to performed below 5% of full scale of the lowest range of the analysis. At ranges above the lowest (most sensitive) range, the overall zero offset is negligible and does not contribute any error in measurements.

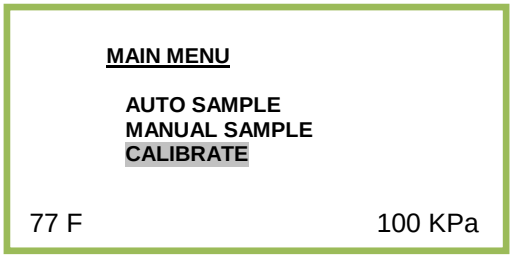
Zero calibration should precede the span calibration. After first zero calibration, subsequent zero calibration is not required. Normally, zero calibrations is performed when a new sensor is installed or changes are made in the sample system connections.

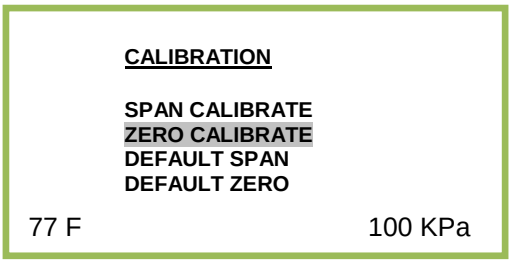
**Caution:** Prematurely zeroing the transmitter may result in a negative oxygen reading. If this occurs, repeat zero calibration.

To perform zero calibration

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

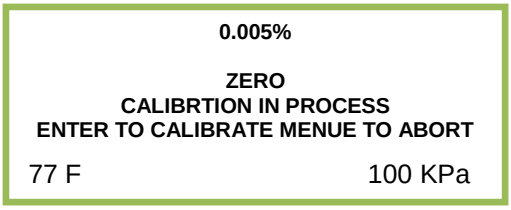
4. Select ZERO CALIBRATE. The following display appears



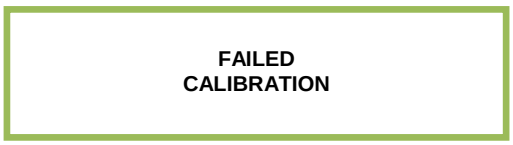




Allow the zero gas to flow through the transmitter until a stable oxygen reading is obtained. This may take from several minutes to a few hours. It is highly recommended to monitor oxygen trend on a chart recorder to ensure that the oxygen reading has stabilized; evidenced by a horizontal trend.

Press the ENTER key to ZERO calibrate or MENU key to abort and return to SAMPLING mode.



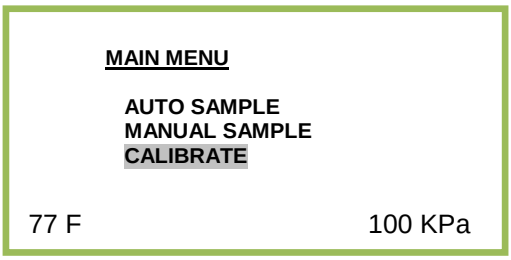

Pressing ENTER, the analyzer will complete ZERO calibration and return to Sample mode. If you press ENTER when the oxygen reading is outside of the acceptable zero offset limit, the analyzer will fail ZERO calibration and return to the Sample mode.

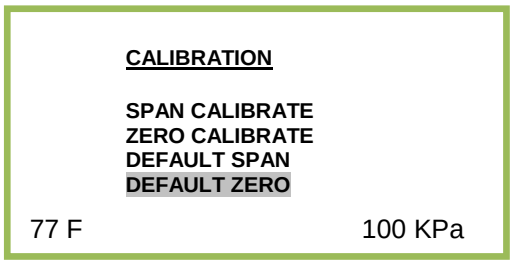




**Note:** The maximum zero calibration adjustment permitted is approximately 60% of the lowest full scale range available. Thus the maximum zero calibration adjustment or zero offset for this analyzer is 0.6% oxygen.

# Factory Default Zero

The software will eliminate any previous zero calibration adjustment and display the actual 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 zero oxygen contents. However, a small oxygen reading contributed by the sensor and electronics may be seen (typically less than 2% of the full scale of the most sensitive range of the transmitter. This feature allows the user to test the integrity of the sample system, sensor and electronics without removing the sensor from the sensor housing.



# Span Calibration

The transmitter is generally delivered calibrated and ready to use. However, in order to obtain reliable data, the transmitter must be calibrated at the initial start-up and periodically thereafter. The maximum calibration interval recommended is approximately 1-3 months, or as determined by the user's application.

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

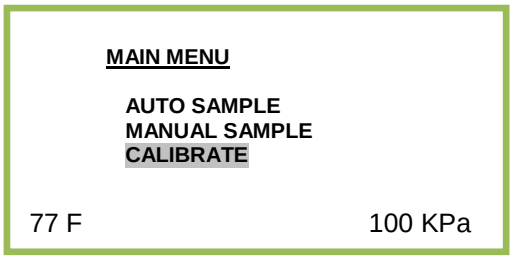
The user must ascertain that the oxygen reading (actually the sensor's signal output) has reached a stable value within the acceptable limits before completing the span adjustment. Failure to do so will result in an error.

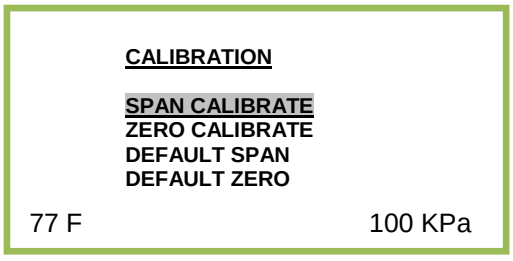
# Calibration Procedure

For calibration purposes, use of AUTO SAMPLE mode is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE – for example, a span gas with an 8 PPM oxygen concentration with the balance nitrogen would dictate the use of the 0-10 PPM full scale range for calibration.

1. Regulate the span gas pressure between 5-30 psig and set flow rate between 1-2 SCFH.
2. Allow the span gas to flow for 1-2 minutes to purge the air trapped in the span gas line.
3. Disconnect the sample gas line and connect the span gas line to the sample IN.
4. The transmitter will immediately respond to the span gas. Typically, within 5-10 minutes, oxygen reading will stabilize. To perform span calibration
5. Access the MAIN MENU by pressing the MENU key.
6. Advance the reverse shade cursor using the ARROW keys to highlight AUTO SAMPLE.
7. Press the ENTER key to select the highlighted menu option.
8. Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATE and press ENTER.

The following displays appear:



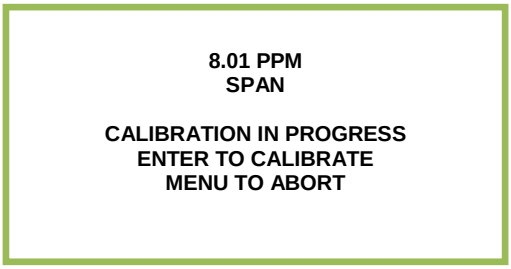




Press the ENTER key to select the SPAN CALIBRATE option. The following display will appear.

Move the cursor under the desired digit. The use the UP or DOWN ARROW keys to enter value of the digit of the span value.

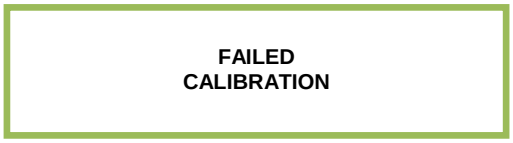
**Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left.**

**Repeat steps until the complete span value has been entered. After entering the span value, the following display appears**




Allow approximately 5-10 min for oxygen to stabilize and the press ENTER to complete span gas calibration

Both the Zero Calibrate and Span Calibrate functions result in the following displays showing either 'PASSED CALIBRATION" OR "FAILED CALIBRATION"


In either case, the transmitter returns to the SAMPLING mode and resume sampling.

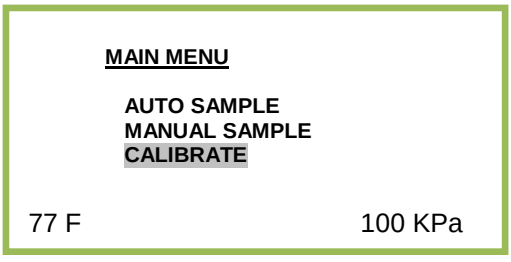
Disconnect the span gas line and replace it with sample gas line.

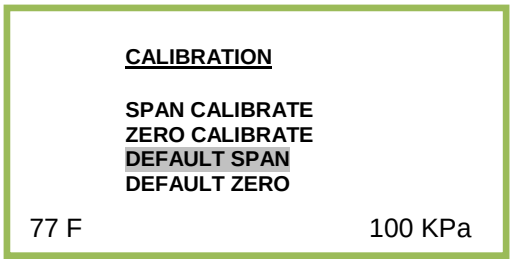
Wait 10-15 minutes to ensure the reading is stable and then proceed to sampling

# Factory Default Span

The embedded software will remove previous span calibration data and reset the SPAN adjustment to the factory default value based on the average oxygen sensor's signal output. For example, after factory default span, when a span gas is introduced, the micro-processor will display oxygen reading within ±50% of the span gas value when the sensor signal output is within its specification. If the sensor's signal output is outside of its specification, the oxygen reading will be beyond +/-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.

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

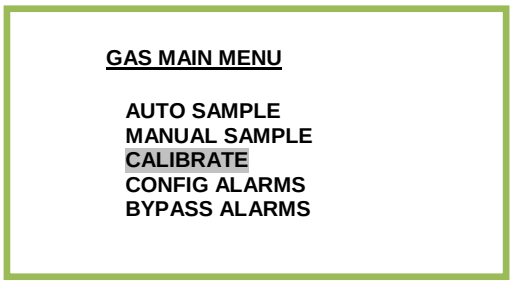


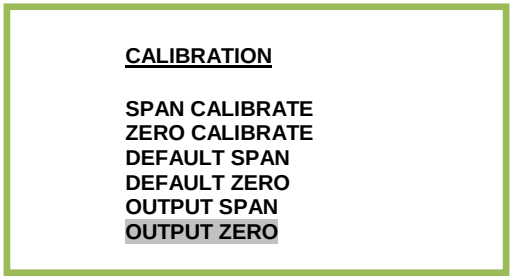



# 4-20 mA Signal Output Adjustment

In rare instances the 4-20mA signal output may not agree to the reading displayed on the LCD. This feature enables the user to adjust the 4mA signal output when the LCD displays 00.00. **Note:** Adjust the 20mA signal output with the OUTPUT SPAN option described below.

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 and the following displays appear:
4. Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT ZERO.
5. Press the ENTER key to select the highlighted menu option and the following display appears:




The default setting of 100 illustrates no adjustment to the analog output signal. Compute the adjustment value as described in Appendix B or consult the factory. The true adjustment value must be determined empirically by trial and error. Adjust the initial value to above 100 to increase the analog signal value or decrease it below 100 to decrease the analog signal.

1. 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 OUTPUT ZERO OFFSET value.
2. Press the ARROW keys to enter the OUTPUT ZERO OFFSET value.
3. Repeat the OUTPUT ZERO OFFSET routine until the output is 4 mA .
4. Save the adjustment value by pressing the ENTER key or abort by pressing the MENU key. After adjustment, the system returns to the SAMPLING mode.
5. Repeat the above procedure for 20 mA signal adjustment by selecting OUTPUT SPAN adjustment instead of OUTPUT ZERO adjustment.

# Analyzing Sample

GPR-1500 A Oxygen Transmitter requires positive pressure to flow the sample through the sensor housing to measure the oxygen concentration in a sample gas.

# Procedure

Following calibration, the transmitter returns automatically to the SAMPLE mode.

Select the desired sampling mode - Auto or if Manual, the range that provides maximum resolution – as described above.

Use metal tubing to transport the sample gas to the transmitter.

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 securely connected

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 1-2 SCHF is recommended.

For sample gases under atmospheric or slightly negative pressure an optional sampling pump is recommended to push the sample through the transmitter. Ensure that sample flow is within the recommended range; if necessary, use a flow control valve to set the sample flow.

Assure the sample is adequately vented for optimum response and recovery – and safety.

Allow the oxygen reading to stabilize for approximately 10 minutes at each sample point.

Avoid drawing a vacuum on the sensor that exceeds 14” of water column pressure.

Avoid excessive flow rates above 5 SCFH which generate backpressure on the sensor.

Avoid the collection of particulates, liquids or condensation collect on the sensor that could block the diffusion of oxygen into the sensor.

# Standby

The transmitter has no special storage requirements.

The sensor should remain connected during storage periods.

Store the transmitter with the power OFF.

If storing for an extended period of time, store at temperature below 45 degree C and away from direct heat.

# 6. Maintenance

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

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-1500 A transmitter. Expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature. To replace sensor, follow the procedure outlined in the section “Operation”

**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.

**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.

# 7. Spare Parts

Recommended spare parts for the GPR-1500 A Oxygen Transmitter:

| Item No. | Description |
|---|---|
| GPR-12-333 | Oxygen Sensor for Inert gases |
| XLT-12-333 | Oxygen Sensor for Gases containing acid gases such as CO2 |

Other spare parts:

| Item No. | Description |
|---|---|
| A-1016-A | Sensor Housing Assembly Stainless Steel, Bottom Section only |
| B-2762-A-2-14 | Sensor Housing Assembly Stainless Steel, Upper Section only |
| A-1004-2-14 | Sensor Housing Assembly Stainless Steel, Bottom and Upper Sections |
| MTR-1010 | Meter Digital Panel LCD Backlight |
| A-1161-AIS2-Rev C4 | PCB Assembly Main / Display |
| A-1166-AIS-2 Rev H | PCB Assembly Power Supply (use Extension AC for PCB powered by AC) |

# 8. Trouble Shooting

| **Symptom** | **Possible Cause** | **Recommended Action** |
|---|---|---|
| No Display | Inadequate power supply<br>Incorrect polarity of power input | Ensure that power to the transmitter is within the recommended range<br>Ensure that the polarity of the input power matches with the designation on the power input terminal |
| Reading does not reflect expected values | Sensor was not calibrated at similar vent pressure, flow rate and temperature anticipated in the sample gas stream | Recalibrate the analyzer at ambient conditions that resemble with sampling conditions. |
| Unable to span calibrate the sensor with ambient air or with a certified span gas | Indication sensor signal output is outside the acceptable limit | Replace sensor, see Section 6 - Maintenance. |
| Slow response time | Longer sample line<br>Low sample flow<br>Liquid covering sensing membrane | Reduce the sample tubing to a minimum, set sample flow between 1-2 SCFH, gently remove any liquid that might have accumulated on the sensor's sensing side. If condensable components are present, use a coalescing filter upstream of sensor |
| Erratic oxygen reading | Presence of interference gases.<br>Damaged sensor cable and or sensor housing bring signal to the PCB | Consult factory, interfering gas such as H2S might need to removed from the sample gas, replace sensor.<br>Replace sensor cable<br>Replace upper section of sensor housing |
| No oxygen reading | No signal from sensor possibly due to defective/used up sensor or broken wire connections from sensor cable or sensor housing to PCB | Check for any physical damage to sensor cable and or sensor housing. Use a voltmeter and check continuity from sensor housing to the Molex connector (the connector from sensor housing to the PCB)<br>Check sensor signal output in air (by using a voltmeter (set to measure micro-amp current). Sensor signal in air must be within 40-60 uA (% sensor) or 450-900 uA (PPM sensor). |
| High oxygen reading | Inadequate control of pressure and sample flow rate<br>Excessive back pressure on sensor caused by high sample flow | Set sample gas pressure within recommended range of 5-30 PSIG<br>Set sample flow between 1-2 SCFH<br>Vent sample to atmosphere |

| | | |
|---|---|---|
| Cannot perform Zero calibration | Obstruction on sample vent line | If venting sample to a vent pipe with pressure above atmosphere, consult factory for recommendations. |
| | Abnormality in span gas | Qualify span gas with a secondary analyzer |
| | Leak in sample/zero gas line | Check for any leakage in sample/zero gas line |
| | Inadequate zero gas flow | Check the integrity of zero gas |
| | Contaminated zero gas | Set the gas flow rate between 1-2 SCFH |
| | Attempting to Zero calibrate prematurely | Allow sufficient time for the oxygen reading to stabilize before attempting Zero calibration. |

# 9. Warrant Policy

**What is covered:**

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

This warranty applies to all transmitter 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 transmitter.

**For how long:**

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

**Who is warranted:**

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:**

If your Advanced Instruments Inc. transmitter 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. transmitter, we may use new or reconditioned replacement parts.

If we choose to replace your Advanced Instruments Inc. transmitter, we may replace it with a new or reconditioned one of the same or upgraded design.

**Limitations:**

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. transmitter or property damage caused by your Advanced Instruments Inc. transmitter 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 transmitter; affixing of any attachment not provided with the transmitter 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:**

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

**Sole Warranty**

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

There are no other express warranties.

**How to obtain warranty service:**

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 transmitter, postage prepaid to:

Advanced Instruments Inc.

2855 Metropolitan Place

Pomona, Ca  91767 USA

Be sure to pack the transmitter 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. transmitter, 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 $H_2O$ | 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 | Sensor is packaged in a sealed protective plastic bag, check the sensor inside for electrolyte leakage.<br>If the sensor leaks inside the protective plastic bag or inside a transmitter sensor housing do not remove it without rubber or latex gloves and safety glasses and a source of water.<br>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 | 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 ($CH_3CO_2H$) - 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 $H_2O$ | 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 transmitter 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 (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 |