GPR-35
Oxygen Analyzer
Ambient Area Monitoring

Owner's Manual

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1 Introduction

Your new oxygen analyzer incorporates an advanced electrochemical sensor specific to oxygen along with state-of-the-art 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, 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.

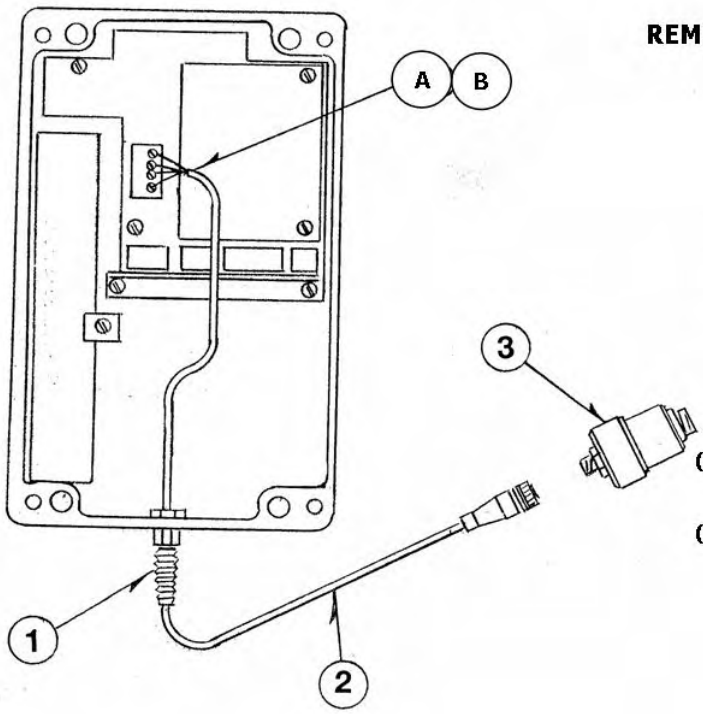
Serial Number: _____

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

Date:	**Customer:**	**Order No.:**	**Pass**
Model:	GPR-35 Oxygen Analyzer Ambient Area Monitoring	**S/N** _____	
Sensor:	( ) GPR-11-32-RTS Oxygen Sensor		
	( ) XLT-11-24-RTS Oxygen Sensor		
	( ) Remote above sensor -4R suffix	**S/N** _____	
Approvals:	CSA/NRTL and CE		
Accessories:	Owner's Manual		
	A-2344 Calibration Flow Through Adapter		
Configuration:	A-1113-C PCB Assembly Main/Display		
	A-1114-C PCB Assembly Power Supply		
	Range: 0-25%		
	Low and Low, Low Alarms: 20.0% CAUTION, 19.5% DANGER		
Test – AC Power	Calibrates at 20.9% oxygen in ambient air with adequate span		
	CAUTION/LOW O2 Alarms: LED green–safe/red–alarm, relay contact		
	DANGER/LOW, LOW O2 Alarms: LED green–safe/red–alarm, relay contact		
	Alarm relays activate/deactivate with changes in O_2 concentration		
	LED indicators: AC FAIL-red, LOW BATT-red		
	Sensor failure 5V +0.5V		
	Power failure relay alarm contacts		
	Analog signal output 0-1V		
Test – Battery	No interruption in operation when disconnecting AC power		
	Calibrates at 20.9% oxygen in ambient air with adequate span		
	CAUTION/LOW O2 Alarms: LED green–safe/red–alarm, relay contact		
	DANGER/LOW, LOW O2 Alarms: LED green–safe/red–alarm, relay contact		
	Alarm relays activate/deactivate with changes in O_2 concentration		
	LED indicators: AC FAIL-red, LOW BATT-red		
Final	Overall inspection for physical defects		
Options:	( ) High, Low Alarms: HIGH O2 23%, LOW O2 19.5%		
	( ) 4-20mA isolated signal output (0-1VDC negative ground standard)		
	( ) A-2501 Integral sampling pump		
	( ) Integral audible alarm		
	( ) Remote sensor: A-1114C-R PCB Assy; components see following page		
Notes:			

REMOTE OXYGEN SENSOR

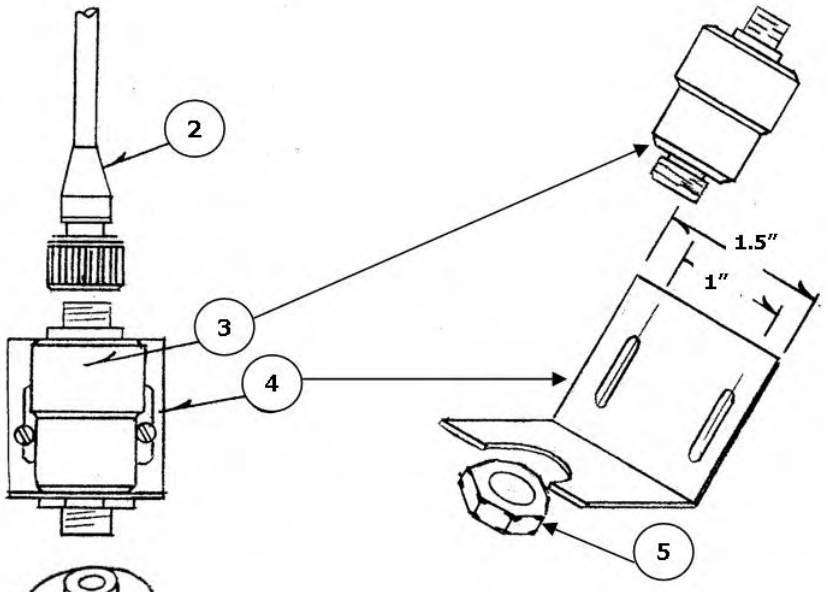


A	B
RD	GN
BK	RD
GN	RD/BK
WH	RD/WH

(A) WIRING - 4 CONDUCTOR GREY CABLE
(P/N CABL-1001)

(B) WIRING - 4 CONDUCTOR BLACK CABLE
(P/N CABL-1014)

Reference: A-2571



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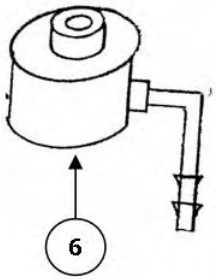


REF	ITEM NO.	DESCRIPTION
1	CABL-1012	STRAIN RELIEF GRIP W/NUT
2	CONN-1014	CABLE SENSOR W/PLUG & LOCK RING
3	GPR-11-32-4R	OXYGEN SENSOR
4	A-2079	BRACKET MOUNT REMOTE OXYGEN SENSOR
5	A-2781	NUT RETAIN REMOTE OXYGEN SENSOR
6	A-2344	FLOW ADAPATER CALIBRATION (REMOTE & INTEGRAL) (INCLUDES FITN-1029 BARBED TUBE FITTING) NOTE: INSERT TO CALIBRATE, REMOVE TO SAMPLE

3 General Safety & Installation

Safety

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

Caution: This symbol is used throughout the Owner's Manual 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 Instructions: Follow all warnings on the analyzer, accessories (if any) and in this Owner's Manual. Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the analyzer.

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

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

Cautions

Pollution degree, 2
Installation category, II
Altitude, 3000m
Humidity, non-condensing up to 95%
Suitable for indoor use only
Operating temperature range 5 to 45ºC
Power supply fluctuations are not to exceed +/- 10% of the nominal voltage specified in section 4.

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 this 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.

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 detailed by section 9, and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

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

Nonuse Periods: Disconnect the power when the analyzer is left unused for a long period of time.

Recommended Safety Checklist

The user is responsible for determining whether the unit will assure safety in his particular application and establishing safety precautions. It is strongly recommended the operator understands, tests the operation of this oxygen deficiency alarm and develop a safety checklist related to the use of this unit. The checklist should include but not be limited to:

1. Limiting access to unit to authorized and trained personnel.
2. Install a switch or circuit breaker near the equipment to disconnect the AC power during service intervals to prevent electric shock and possible damage to the equipment.
3. Follow the instruction for Electrical Connections and use a minimum of 18 AWG cable for AC power connections.
4. Test and calibration procedures are instituted and routinely followed.
5. Users understand the operation and functions of the unit.
6. The user consult a safety expert in the selecting the most appropriate location to install the unit and providing all necessary warning notices.
7. Source of AC power is reliable and adequate. In the event AC power is interrupted, users should not depend on the battery backup but correct the problem as quickly as possible.
8. Assure the battery is in good operating condition by periodically disconnecting the AC power and operating the unit for several hours under battery power verifying the various functions of the unit are operational and alarm indicators operate as intended.
9. Any sampling considerations are identified and resolved.
10. External environmental considerations are identified and resolved.

Installation

Gas Sample Stream: Ensure the gas stream composition of the application is consistent with the specifications and review the application conditions before initiating the installation. Consult the factory to ensure the sample is suitable for analysis. **Note:** In natural gas applications such as extraction and transmission, a low voltage current is applied to the pipeline itself to inhibit corrosion. As a result, electronic devices can be affected unless adequately grounded.

Contaminant Gases: A gas scrubber and flow indicator with integral metering valve are required upstream of the of the analyzer to remove interfering gases such as oxides of sulfur and nitrogen or hydrogen sulfide that can produce false readings, reduce the expected life of the sensor and void the sensor warranty if not identified at time of order placement. 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.

Expected Sensor Life: With reference to the publish specification located as the last page of this manual, the expected life of all oxygen sensors is predicated on oxygen concentration (< 1000 ppm or air), temperature (77°F/25°C) and pressure (1 atmosphere) in “normal” applications. Deviations are outside the specifications and will affect the life of the sensor. As a rule of thumb sensor life is inversely proportional to changes in the parameters.

Accuracy & Calibration: Refer to section 5 Operation.

Materials: Assemble the necessary zero, purge and span gases and optional components such as valves, coalescing or particulate filters, and, pumps as dictated by the application; stainless steel tubing is essential for maintaining the integrity of the gas stream for ppm and percentage range (above or below ambient air) analysis; hardware for mounting.

Operating Temperature: The sample must be sufficiently cooled before it enters the analyzer and any optional components. A coiled 10 foot length of ¼” stainless steel tubing is sufficient for cooling sample gases as high as 1,800ºF to ambient. The maximum operating temperature is 45º C on an intermittent basis unless the user is willing to accept a reduction in expected sensor life – refer to analyzer specification - where expected sensor life is specified at an oxygen concentration less than 1000 ppm oxygen for ppm analyzers and air (20.9% oxygen) for percent analyzers, but in all instances at 25°C and 1 atmosphere of pressure. Expected sensor varies inversely with changes in these parameters.

Pressure & Flow

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

The GPR-35 designed for in-situ ambient or area monitoring and has no sample system because the sensor is intended to be exposed directly to the surrounding ambient atmosphere which it is sampling and to operate at atmospheric pressure, however, slightly positive pressure has minimal effect on accuracy.

A certified span gas is recommended for calibration purposes, part number A-2344 Flow Through Adapter is supplied with the GPR-35 and provides: a hose connection for piping the calibration gas (see positive pressure see below) to the sensor, an o-ring seal to isolate the sensor from the atmosphere being monitored and outlet to vent the calibration gas.

Further, applications situations may dictate that the sample be transported from a semi-sealed area to a safe area where the analyzer is located. In these cases the analyzer can be readily adapted to include optional pumps, tubing and connection fittings. Users interested in adding their own sample conditioning system should consult the factory.

Analyzers designed for flowing samples under positive pressure or pump vacuum (for samples at atmospheric or slightly negative atmospheres) that does not exceed 14" water column are equipped with 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 pressure regulated to between 5-30 psig although their particular rating is considerably higher. In positive pressure applications the vent pressure must be less than the inlet, preferably atmospheric.

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 tube fitting can serve as the inlet or vent – just not simultaneously. A flow indicator with an integral metering valve upstream of the sensor is provided 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 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: An optional external sampling pump should be positioned upstream of the sensor to draw the sample from the process, introduce it at a predetermined flow rate of 2 SCFH to the sensor and out to atmosphere. A flow meter is generally not necessary to obtain the recommended flow rate with most sampling pumps.

Caution: If the analyzer is equipped with an optional flow indicator with integral metering valve or a metering flow control valve 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.

Recommendations 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 (thus 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 liquids or particulates on the sensor, they block the diffusion of oxygen into the sensor - wipe away.
- If the analyzer is equipped with an optional integral sampling pump (positioned downstream of the sensor) and a flow control metering valve (positioned upstream of the sensor), completely open the flow control metering valve to avoid drawing a vacuum on the sensor and placing an undue burden on the pump.
- Calibrate ambient area monitors with a certified span gas.
- Avoid calibration of ambient area monitors with the surrounding atmosphere unless assured the oxygen content is 20.9%.
- Optionally, to confirm the span gas calibration or air calibration of the GPR-35, the user can use an inexpensive battery powered hand held analyzer (such as the AII-3000A pictured at right) that is easily air calibrated in a "safe remote area" and carried to the area being monitored by the GPR-35 where readings can be compared.

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

Moisture and/or particulates generally can be removed from the sensor by opening the sensor housing and either blowing on the the sensing surface or gently wiping or brushing the sensing surface with damp cloth. **Caution:** Minimize the exposure of ppm sensors to air during this cleaning process. Air calibration followed by purging with zero or a gas with a low ppm oxygen concentration is recommended following the cleaning process. Moisture and/or particulates generally can be removed from the sample system by flowing the purge gas through the analyzer at a flow rate of 4.5-5 SCFH for an hour.

Mounting: The analyzer is approved for indoor use, outdoor use requires optional enclosures, consult factory. Mount as recommended by the manufacturer.

Gas Connections: Analyzers designed for in-situ ambient or area monitoring have no sample system because the sensor is intended to be exposed directly to the surrounding ambient atmosphere which it is sampling and to operate at atmospheric pressure, however, slightly positive pressure has minimal effect on accuracy. Further, applications situations may dictate that the sample be transported from a semi-sealed area to a safe area where the analyzer is located. In these cases the analyzer can be readily adapted to include optional pumps, tubing and connection fittings.

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. Ensure that is properly grounded and meets the requirements for area classification. Never yank wiring to remove it from a terminal connection. AC powered analog analyzers consume 5 watts.

4 Features & Specifications

Technical Specifications

Accuracy:	< 1% of reading under constant conditions
Analysis:	0-25% FS ranges
Application:	Monitor oxygen content of ambient atmospheres or confined spaces where oxygen depletion is a concern.
Approvals:	CE, CSA
Area Classification:	General purpose
Alarms:	Two adjustable SPDT Form C non-latching relay contacts, preset to OHSA 20.0% Caution, 19.5% Danger settings
Calibration:	Certified gas of O_2 balance N_2 approximating 80% of range above analysis range recommended for optimum results. Supplied with flow through adapter with tube connections
Compensation:	Barometric pressure and temperature
Connections:	None unless equipped with optional 4-20mA output
Controls:	Tamper proof potentiometer for span calibration
Display:	3-1/2 digit LCD display; resolution .1%
Enclosure:	NEMA 4X, 4x9x3", 8 lbs.; suitable for indoor use only
Flow Sensitivity:	None between 0.5-5 SCFH, 2 SCFH recommended for cal
Humidity	Non-condensing up to 95%
Installation	Category, II; pollution degree, 2; altitude < 3000m
Linearity:	> .995 over entire range
Pressure:	Ambient
Power:	100/110/220/240 VAC with fluctuation not to exceed ±10%; battery back-up on trickle charge; battery life 30 days normal mode or 12 hours in alarm mode
Response Time:	90% of final FS reading in 13 seconds
Sample System:	None - exposed to ambient atmosphere
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-11-32-4 - requires no maintenance
Sensor Life:	36 months in air at 25ºC and 1 atm
Signal Output:	0-1V
Temp. Range:	5º to 45ºC
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Corrosion resistant material

Optional Equipment

Remotely located sensor
19.5% LO and 23.% HI alarm configuration
Integral sampling pump
4-20mA isolated signal output

GPR-35
Ambient Oxygen Monitor

CSA and CE Approved

Pressure Compensated=No False Alarms

Advanced Sensor Technology
- **Accuracy < 1% FS Range**
- **Sensitivity < 0.5% FS Range**
- **Fast Response**
- **Extended Operating Range**
- **36 Month Expected Life**
- **No Maintenance**

Dual OHSA Alarms 20.0%, 19.5%
Dual Red-Green LED Alarm Indicators
LED Indicators for AC Failure, Low Batt
NEMA 4X Enclosure
Optional HI, LO Alarms
Optional Integral Pump, 4-20mA Output
Certified ISO 9001 QA System

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 7/12

5 Operations

Principle of Operation

The GPR-35 oxygen analyzer incorporates a variety of percentage range advanced galvanic fuel cell type sensors. In compliance with OSHA specifications, the standard unit is configured with two oxygen alarms which have been set by the factory to energize audio and visual alarms when oxygen levels fall below CAUTION (20.0% O_2) and DANGER (19.5% O_2) housed in a general purpose NEMA 4 rated wall mount enclosure.

Optional equipment includes a remote sensor, 19.5% low and 23.0% high alarm configuration, an integral sampling pump, 4-20mA isolated signal output, integral audible alarm or external audible and/or visual alarms.

The GPR-35 is CE certified and manufactured along with the sensors under a Quality Assurance System certified by an independent agency to ISO 9001:2000 standards.

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, extended operating range of -20°C to 50°C, excellent compatibility with CO_2 and acid gases (XLT series) and reliable quality giving them a significant advantage over the competition.

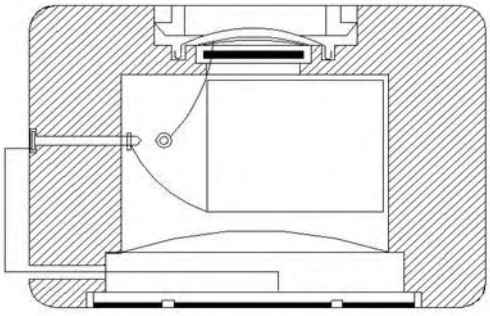
The expected life of our new generation of percentage range sensors now range to five and ten years with faster response times and greater stability. Other significant developments involve the first galvanic oxygen sensor capability of continuous oxygen purity measurements and expanding the operating temperature range from -40°C to 50°C.

Design Objectives

- Improve quality and reliability through a proprietary controlled manufacturing process . . .
- Comply with domestic and international quality standards
- Compact disposable dimensions
- No sensor maintenance
- Improve performance over replacement sensors - sensitivity, stability, response, recovery
- Longer operating and shelf life - translate into longer warranty period
- Low cost of ownership

% Oxygen Sensors

- Extend operating life to 10 years in air (20.9% O_2) . . .
  24 months in continuous 100% O_2
- Extended operating range to –40º C/F to 50º C
- Excellent stability at elevated pressure . . .
  Up to 10 atmospheres in hyperbaric chambers
- Superior compatibility with 0.5 - 100% CO_2 gas streams
  24 month operating life in traditional dimensions
- Develop special sensor for fast response and long life
  Large cathode with proprietary electrolytes and anodes



GPR/XLT 11 Series % Oxygen Sensor

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 for the on-line analyzers is supplied by an integral universal 100/110/220/230VAC power supply that is backed up by a standby rechargeable lead acid battery that in the event the AC power is interrupted provides enough power to operate the unit continuously for 8 hours in the alarm mode. **Note:** compliance with CE certification requires the installation of power and signal output cables through separate metal conduit. Connections of the appropriate AC line voltage are made with either standard computer type power cords through a universal power entry module.

In compliance with OSHA specifications, the standard is configured with two oxygen alarms which have been set by the factory to energize audio and visual alarms when oxygen levels fall below CAUTION (20.0% O_2) and DANGER (19.5% O_2). Optionally, these alarms can be configured as HIGH O2 and LOW O2 based on customer requirements. The two-color alarm LED indicators display green for safe and red for alarm conditions. The alarms remain energized until the oxygen level rises above (and/or below with the optional high, low configuration) the alarm set points. Power interruptions do not interfere with the alarms of a unit installed and operated properly.

The GPR-35 is unique in that it automatically compensates the sensor output for pressure changes thereby eliminating the false alarms. Unlike competitive analyzers the GPR-35 is not affected by changes in the barometric pressure that can temporarily impact the sensor output and analyzer reading to the extent that most analyzers produce false alarms. In addition to being irritating, false alarms can be costly in terms of interrupting projects, tests or production processes.

Sample System

The GPR-35 is designed for in-situ ambient or area monitoring and has no sample system because the sensor is intended to be exposed directly to the surrounding ambient atmosphere which it is sampling and to operate at atmospheric pressure, however, slightly positive pressure has minimal effect on accuracy.

A certified span gas is recommended for calibration purposes. A Calibration Flow Adapter (see illustration in section 2) is supplied with the GPR-35 and provides a barbed hose connection for piping the calibration gas (see positive pressure see below) to the sensor, an o-ring seal to isolate the sensor from the atmosphere being monitored and outlet to vent the calibration gas.

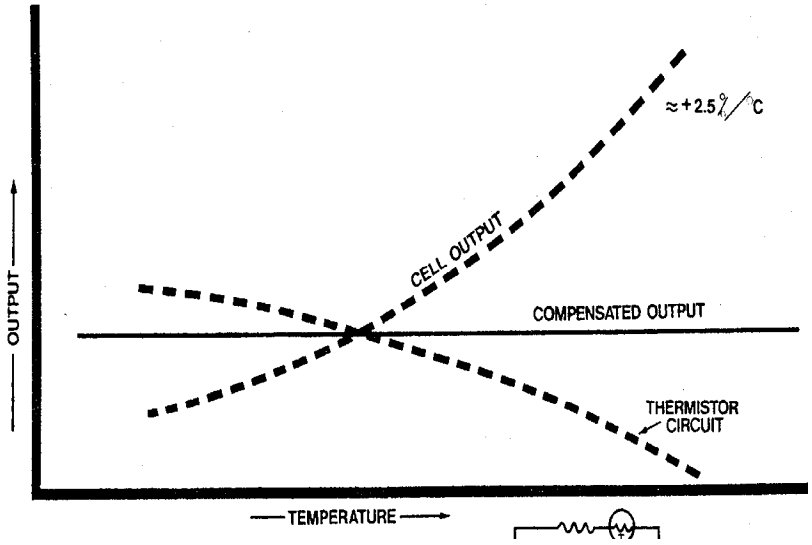
Further, applications situations may dictate that the sample be transported from a semi-sealed area to a safe area where the analyzer is located. In these cases the analyzer can be readily adapted to include optional pumps, tubing and connection fittings. Users interested in adding their own sample conditioning 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 info@aii1.com

Accuracy & Calibration

Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas.

Absolute Zero: 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.

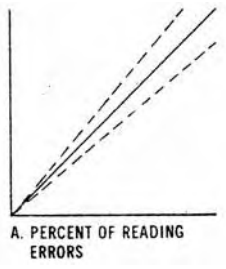
Pressure: Because sensors are sensitive to the partial pressure of oxygen in the sample gas their output is a function of the number of molecules of oxygen 'per unit volume'. Readouts in percent are permissible only when the total pressure of the sample gas being analyzed remains constant. The pressure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

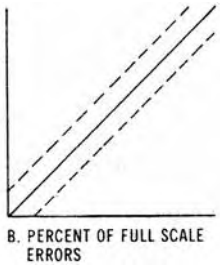


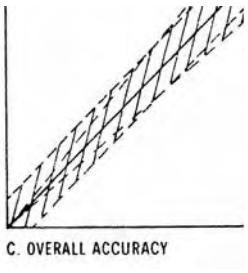
Temperature: The rate oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation is relatively constant 2.5% per ºC.

A temperature compensation circuit employing a thermistor offsets this effect with an accuracy of better than ±5% (over the entire Operating Range of the analyzer) 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 10-15º 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 ±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 transmitter's overall accuracy statement of < 1% 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.

Span Calibration

Span Calibration involves adjusting the transmitter electronics to the sensor's signal output at a given oxygen standard. Maximum drift from calibration temperature is approximately 0.11% of reading per °C. The frequency of calibration varies with the application conditions, the degree of accuracy required by the application and the quality requirements of the user. However, the interval between span calibrations should not exceed three (3) months.

Recommendations General:

- The interval between span calibrations should not exceed three (3) months.
- **Caution:** Prematurely initiating the SPAN CALIBRATION function before the analyzer reading has stabilized can result in erroneous readings. This is especially true when installing a new sensor that must adjust to the difference in oxygen concentrations. It should take about 2 minutes for the sensor to equilibrate in ambient air from storage packaging.
- Always calibrate at the same temperature and pressure of the sample gas stream.
- For 'optimum calibration accuracy' calibrate with a span gas approximating 80% of the full scale range one or a higher range than the full scale range of interest (normal use) to achieve the effect of "narrowing the error" by moving downscale as illustrated by Graph A in the Accuracy & Calibration section.
- Calibrating with a span gas approximating 5-10% of the full scale range near the expected oxygen concentration of the sample gas is acceptable but less accurate than 'optimum calibration accuracy' method recommended – the method usually depends on the gas available.
- Calibrating at the same 5-10% of the full scale range for measurements at the higher end of the range (example: calibrating an Oxygen Purity Analyzer in air at 20.9% oxygen with the intention of measuring oxygen levels of 50-100%) results in the effect of "expanding the error" by moving upscale as illustrated by Graph A and Example 1 in the Accuracy & Calibration section above and is not recommended. Of course the user can always elect at his discretion to accept an accuracy error of $\pm$2-3% of full scale range if no other span gas is available.
- Calibrate ambient area monitors with a certified span gas or clean source of instrument air.

Recommendations Air Calibration:

The inherent linearity of the galvanic fuel cell type oxygen sensor enables the user to calibrate any analyzer with ambient air (20.9% oxygen) and operate the analyzer within the stated accuracy spec on the lowest most sensitive range available with the analyzer – it is not necessary to recalibrate the analyzer with span gas containing a lower oxygen concentration.

- Avoid calibration of ambient area monitors with the surrounding atmosphere unless assured the oxygen content is 20.9%.
- When certified span gas is not available.
- When installing or replacing the oxygen sensor.

Mounting the Analyzer

The GPR-35 Oxygen Analyzer has been calibrated at the factory prior to shipment and is fully operational from the shipping container. The 4x9x3.5" configuration is designed to be mounted directly to any flat vertical surface, wall or bulkhead plate with the appropriate screws.

Procedure:

1. Remove the four (4) screws securing the top section of the enclosure, set them aside for reinstallation and open the hinged top section as you would a door.
2. Locate the mounting holes cast into the bottom section of the enclosure and the black sensor. Orient the enclosure by locating the sensor at six (6) o'clock.
3. To facilitate servicing the interior of the monitors, position it approximately 5 feet off the floor.
4. Secure the bottom section of the enclosure to a vertical surface. This requires the user to supply four (4) additional proper size screws and anchors.
5. **Caution:** Do not remove or discard the gasket from the front panel. Failure to reinstall either gasket will void the NEMA 4 rating and RFI protection.
6. The design provides protection from RFI that is maintained by leaving specific mating areas of the enclosure unpainted to maintain conductivity between the gasket, top and bottom sections of the enclosure. These unpainted areas are protected by gaskets and contribute to maintaining the NEMA 4 rating. Do not paint these areas. Painting will negate the RFI protection.
7. As illustrate, the power connection is made through the right side of the enclosure.

Gas Connections

The GPR-35 is designed for in-situ ambient or area monitoring and has no sample system because the sensor is intended to be exposed directly to the surrounding ambient atmosphere which it is sampling and to operate at atmospheric pressure, however, slightly positive pressure has minimal effect on accuracy.

A certified span gas is recommended for calibration purposes. A Calibration Flow Adapter (P/N A-2344 see illustrations) is supplied with the GPR-35 and provides a barbed hose connection for piping the calibration gas (see positive pressure see below) to the sensor, an o-ring seal to isolate the sensor from the atmosphere being monitored and outlet to vent the calibration gas.

Further, applications situations may dictate that the sample be transported from a semi-sealed area to a safe area where the analyzer is located. In these cases the analyzer can be readily adapted to include optional pumps, tubing and connection fittings.

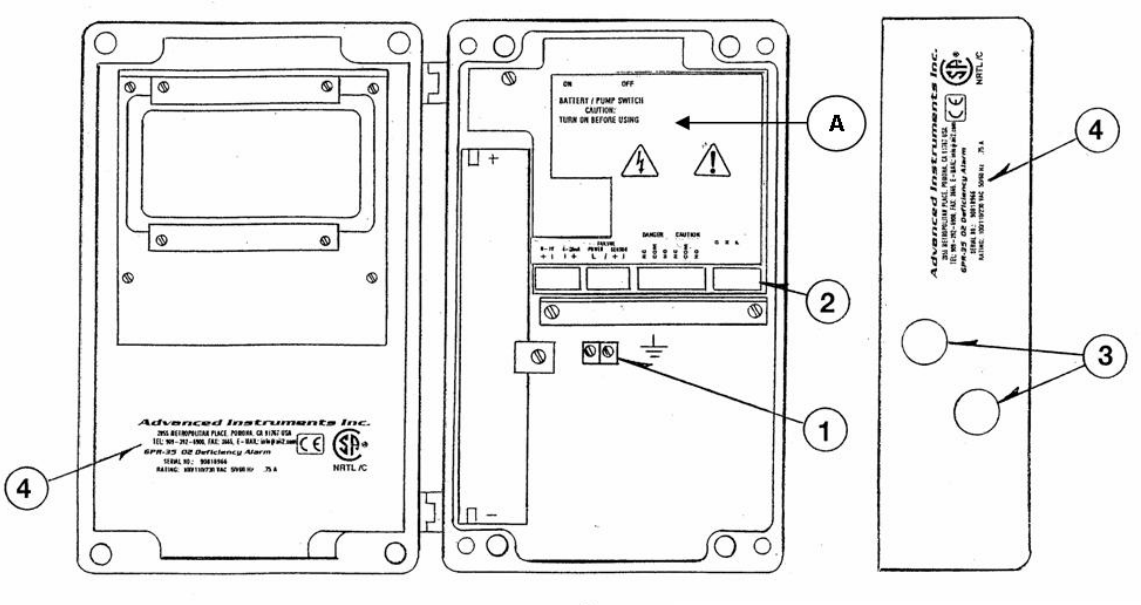
Electrical Connections

The electronics are rated for a universal power input of 100-230 +/-10% VAC 50-60 Hz. Connect one end of the power cable to the analyzer's terminals but do not connect the other end to a source of power.

Danger: To avoid electric shock exercise extreme caution when servicing the analyzer. Disconnect the AC power source before removing the protective plexiglas panel that covers the terminal block. If the AC power source is connected to the terminal block, touching any terminal connections where AC power is present such as transformer pins and AC connector on the PCB Assembly would result in an electric shock. **Note:** There is no AC power present on the circuit board assemblies found on the backside of the analyzer's front cover.
In the event the AC power is interrupted it is backed up by a standby rechargeable lead acid battery that provides enough power to operate the unit continuously for 8 hours in the alarm mode. **Caution:** Continuous use of the analyzer beyond the low battery warning may result in permanent damage to the battery.

The analyzer has been fully tested, the dual oxygen alarms set according to OSHA or optional customer specifications, the battery fully charged and the oxygen sensor installed prior to shipment. Without AC power the electronic circuit switches to the standby battery power source. To avoid draining the battery during the transit period, if the analyzer is equipped with the optional integral sampling pump, the BATTERY / PUMP switch has been placed in the OFF position for shipping.

As illustrated below the protective panel contains the wiring connections. **Caution:** Always replace the protective plexiglas panel after servicing AND before establishing power to the analyzer electronics.



1. CONNECT PROTECTIVE GROUND TO #1.
2. FOR POWER, USE 18 AWG WIRES
   USE BRAIDED SHEILDED CABLE
3. INSTALL POWER AND SIGNAL CABLE
   THROUGH SEPARATE METAL CONDUIT
4. LABL-1005-CSACE0-3 LABEL CSA CE S/N GPR-35

A **SPECIFY PANEL & ALARM CONFIGURATION SEE BELOW**

Reference: A-2572

Caution: To maintain the NEMA rating of the enclosure the user must seal all conduits in accordance with applicable local requirements. Additional penetrations to the enclosure may only be made by U/L or CSA certified personnel.

Caution: Compliance with CE certification requires installing power and signal output cables through separate metal conduit.

Signal Outputs

The analyzer provides a 0-1V full scale signal output and an optional isolated 4-20mA signal output for external recording devices. With the 4-20mA option, an integral IC on the main PCB converts the 0-1V signal with negative ground to a 4-20mA fully isolated signal. A finer adjustment of the zero offset of the 4-20mA converter can be provided by a potentiometer mounted on the main PCB Assembly. Consult factory for instructions. **Caution:** The optional integral 4-20mA converter is internally powered and does not require external power. DO NOT supply any voltage to either of the two terminals of the 4-20mA converter.

Power Fail Alarm

A dry contact rated at 30VDC @ 1A is provided as a power failure alarm. The contact is normally closed but opens when the power to the analyzer is switched off or interrupted.

Procedure:

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

Sensor Fail Alarm

A 5V output with negative ground is provided when the sensor is operational. The output is 0V when the sensor fails and its output goes to zero.

Alarms
The alarm comparator section of the electronics consists of an IC (integrated circuit) with internal references. The comparator compares the oxygen signal with the internal reference point. Two alarm points are set at 20.0% oxygen CAUTION (or optional HIGH O2 setpoint) alarm and 19.5% oxygen DANGER (or optional LOW 02 setpoint) alarm in compliance with OSHA specifications.

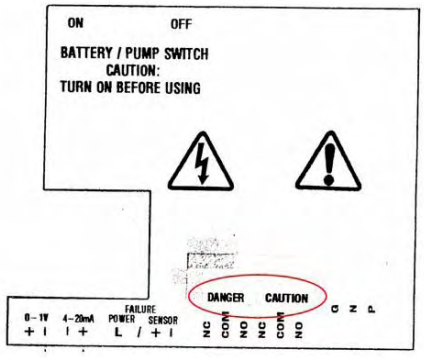
Danger: To avoid the possibility of electric shock exercise extreme caution when connecting the external power cables to the alarm relay terminal block illustrated below. The user supplied external cables should:
1. Never be connected to their power source during installation or service.
2. Never have their ends stripped more than 1/4"
3. Always be fully inserted into the Alarm Relay Contact Terminal Block and the screws tightened securely.

When the relay contacts are switched by the comparator, the normally open (NO) contact is turned into normally closed (NC) and vice versa. When the oxygen level goes beyond the CAUTION alarm set point, the comparator triggers the alarm and the corresponding red LED on the front panel and switches the relay contacts. When the oxygen concentration falls below the DANGER alarm set point, the comparator turns on the corresponding red LED on the front panel and switches the contacts of the second relay. The red LED indicator alarms and relays remain energized until the oxygen level rises above the alarm set points.

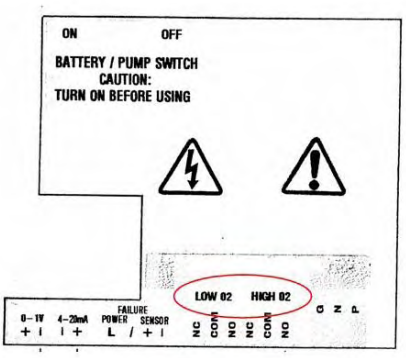
The alarm comparators have a 2% of full scale (0.4% O2) hysteresis to prevent chattering of the alarm relays. Once the 20.0% CAUTION alarm is activated, the audio alarm and relay will not deactivate until the oxygen level reaches 20.4%.

Alarm Bypass
An alarm bypass toggle switch is mounted on the main circuit board. By placing the switch knob to the OFF position will deactivate the relays but the red LED indicators will continue to operate until the oxygen concentration exceeds the alarm set point and the 2% hysteresis described above. The alarm bypass feature is useful in preventing false alarms when changing or replacing the oxygen sensor.

Caution: Again, we recommend the user exercise extreme caution not only in using this feature but granting access to it.



Reference: A-2505



Reference: A-2505

Installing the Oxygen Sensor

GPR-35 Oxygen Analyzers are 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 analyzers 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.

Required components:

- Certified span gas cylinder with an oxygen concentration, balance nitrogen, approximating 80% of the full scale range above the intended measuring range.
- Regulator to reduce pressure to between 5 and 30 psig, 30 psig recommended.
- Flow meter to set the flow between 1-5 SCFH, 2 SCFH recommended.
- 1 length of 1/8" dia. metal tubing measuring 4-6 ft. in length.
- 1 length of ¼" OD diameter Tygon or other plastic tubing, with a low permeability factor, measuring 4-6 ft. in length.
- Suitable fittings and 1/8" diameter metal tubing to connect the regulator to the flow meter inlet
- Suitable fitting and ¼" diameter plastic tubing to connect from the flow meter vent to the barbed fitting on the Calibration Flow Adapter (P/N A-2344) or tube fitting designated SAMPLE IN.

Procedure:

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

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

The analyzer has been fully tested, the dual oxygen alarms set according to OSHA or optional customer specifications, the battery fully charged and the oxygen sensor installed prior to shipment. With one end of the power cable connected to the analyzer's terminals, as above which also includes the alarms and output connections, connect the other end of the power cable to the appropriate source of AC power.

Procedure:

1. Remove the four screws located in the corners of the front panel.
2. **Caution:** Do not remove or discard the gasket from the front panel. Failure to reinstall the gasket will void the NEMA 4 rating and RFI protection.
3. As discussed above, place the BATTERY/ PUMP switch in the ON position before operating.
4. Without AC power the AC FAIL red LED will light up and flash.
5. Once the power cable is properly connected a suitable AC power supply:
   - The digital LCD display responds instantaneously,
   - The LOW BATT LED may come on if trickle charging is required
   - The AC FAIL LED goes out
   - The alarm LED's light up, until calibrated the LED's can be either GREEN or RED in color
6. Close the unit ensuring the gasket is in place and tighten the screws.
7. Calibrate the unit as described below.

Battery Back-up

In the event of an AC power interruption or failure, the unit will continue to operate through the standby battery power connected to the main circuit board. The AC FAIL red LED indicator will light and flash warning of the AC failure. The battery backup will power the unit for 12 hours under the worst conditions (alarms on) and up to 48 hours (alarms off).

Caution: In the event of an AC power failure, users should correct the problem as quickly as possible and not depend on the battery backup.

If the AC power is not restored within the time specified above, the battery will be drained to the point the LOW BATT red LED indicator will light. At this time, we recommend either the AC power be restored or disconnecting the battery from the main circuit board to prevent permanent damage to the battery.

The battery is a 12V sealed rechargeable lead-acid battery and is continuously trickle charged to keep the battery functional at all times. The battery has a finite life of approximately 3-5 years and should be replaced periodically.

Recommendation: Assure the battery is in good operating condition by periodically disconnecting the AC power and operating the unit for several hours under battery power verifying the various functions of the unit are operational and alarm indicators operate as intended.

Caution: Continuous use of the analyzer beyond the low battery warning may result in permanent damage to the battery.

Display Mode

The GPR-35 has a single safety related purpose and thus has been designed accordingly as a single range analyzer with a single display mode.

Setting Alarm Values

The alarm setpoint represents a value. The alarm comparator section of the electronics consists of an IC (integrated circuit) with internal references. The comparator compares the oxygen signal with the internal reference point. Two alarm points are set at 20.0% oxygen CAUTION (or optional HIGH O2 setpoint) alarm and 19.5% oxygen DANGER (or optional LOW 02 setpoint) alarm in compliance with OSHA specifications. The alarm comparators have a 2% of full scale (0.4% O2) hysteresis to prevent chattering of the alarm relays. Once the 20.0% CAUTION alarm is activated, the audio alarm and relay will not deactivate until the oxygen level reaches 20.4%.

Procedure:

The relays are Form C SPDT, normally closed, non-latching, rated at 5A, 30VDC, or 240VAC resistive. **Although not recommended,** changes in the alarm set points may be achieved through potentiometers P2 (CAUTION) and P3 (DANGER). In order to set alarm points other than those set at the factory:

1. Adjust potentiometer P1 (SPAN) to obtain the desired value.
2. Adjust P2 or P3 until the alarm comparator triggers the alarms.
3. Adjust P1 back to 20.9%.

Range Selection

As a single range analyzer there are no other ranges available.

Installation is complete . . .

Span Calibration

Span Calibration involves adjusting the transmitter electronics to the sensor's signal output at a given oxygen standard. Maximum drift from calibration temperature is approximately 0.11% of reading per °C. The frequency of calibration varies with the application conditions, the degree of accuracy required by the application and the quality requirements of the user. However, the interval between span calibrations should not exceed three (3) months.

Note: Regardless of the oxygen concentration of the standard used, the span calibration process takes approximately 10 minutes.

Recommendations General:

- The interval between span calibrations should not exceed three (3) months.
- **Caution:** Prematurely initiating the SPAN CALIBRATION function before the analyzer reading has stabilized can result in erroneous readings. This is especially true when installing a new sensor that must adjust to the difference in oxygen concentrations. It should take about 2 minutes for the sensor to equilibrate in ambient air from storage packaging.
- Always calibrate at the same temperature and pressure of the sample gas stream.
- For 'optimum calibration accuracy' calibrate with a span gas approximating 80% of the full scale range one or a higher range than the full scale range of interest (normal use) to achieve the effect of "narrowing the error" by moving downscale as illustrated by Graph A in the Accuracy & Calibration section.
- Calibrating with a span gas approximating 5-10% of the full scale range near the expected oxygen concentration of the sample gas is acceptable but less accurate than 'optimum calibration accuracy' method recommended – the method usually depends on the gas available.
- Calibrating at the same 5-10% of the full scale range for measurements at the higher end of the range (example: calibrating an Oxygen Purity Analyzer in air at 20.9% oxygen with the intention of measuring oxygen levels of 50-100%) results in the effect of "expanding the error" by moving upscale as illustrated by Graph A and Example 1 in the Accuracy & Calibration section above and is not recommended. Of course the user can always elect at his discretion to accept an accuracy error of $\pm$2-3% of full scale range if no other span gas is available.
- Calibrate ambient area monitors with a certified span gas or a clean source of instrument air.

Recommendations Air Calibration:

The inherent linearity of the galvanic fuel cell type oxygen sensor enables the user to calibrate any analyzer with ambient air (20.9% oxygen) and operate the analyzer within the stated accuracy spec on the lowest most sensitive range available with the analyzer – it is not necessary to recalibrate the analyzer with span gas containing a lower oxygen concentration.

- Avoid calibration of ambient area monitors with the surrounding atmosphere unless assured the oxygen content is 20.9%.
- When certified span gas is not available.
- When installing or replacing the oxygen sensor.

Required components: Refer to Installing Span Gas section above.

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

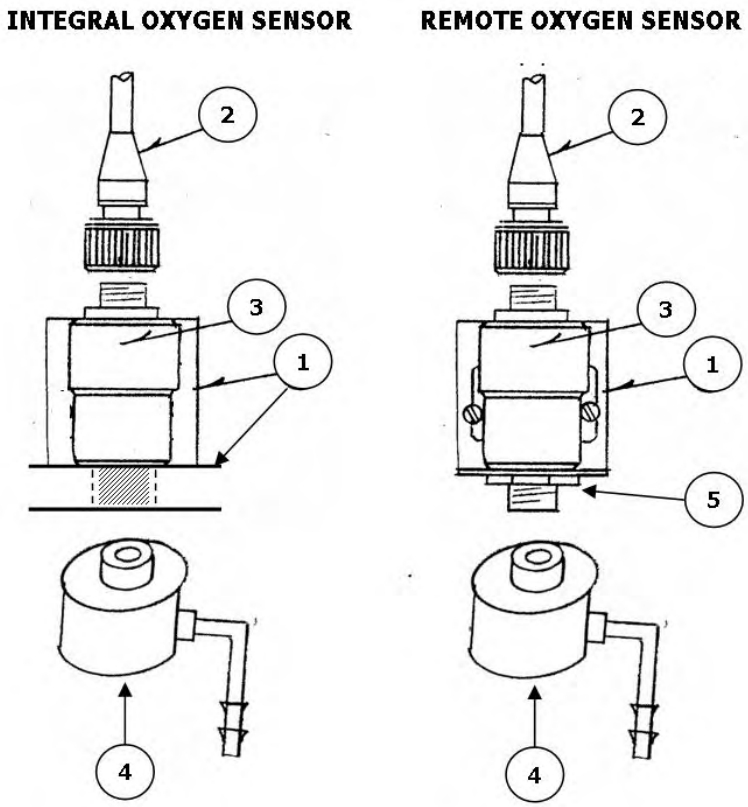
The GPR-35 designed for in-situ ambient or area monitoring and has no sample system because the sensor is intended to be exposed directly to the surrounding ambient atmosphere which it is sampling and to operate at atmospheric pressure, however, slightly positive pressure has minimal effect on accuracy.

A certified span gas is recommended for calibration purposes, part number A-2344 Flow Through Adapter is supplied with the GPR-35 and provides: a hose connection for piping the calibration gas (see positive pressure see below) to the sensor, an o-ring seal to isolate the sensor from the atmosphere being monitored and outlet to vent the calibration gas

Procedure Calibration with Span Gas or Instrument Air:

1. Use the following procedure regardless of the sensor housing included with the analyzer.
2. Refer to Span Gas Preparation above and regulate the pressure (30 psig) and flow rate (2 SCFH) as recommended.
3. Introduce a certified span gas of oxygen in nitrogen where the oxygen value is 20.9%.
4. Connect the 1/4'' diameter plastic tubing by pushing it over the barbed fitting (P/N FITN-1029).

5. Ensure the span gas flows freely: check for obvious leaks and make sure the vent hole in the Calibration Flow Adapter (P/N A-2344) is not blocked and the gas exits easily.
6. If equipped with SS bulkhead tube fittings on the side of the analyzer remove the nut and ferrules of the tube fitting and push the plastic tubing over the male threads.
7. Insert the flow through adapter into the opening of the sensor as illustrated below. Skip this step if the analyzer is equipped with SS bulkhead tube fittings.
8. Gently seat the flow through adapter and ensure a good o-ring seal. Skip this step if the analyzer is equipped with SS bulkhead tube fittings.
9. Allow the span gas to flow until the reading stabilizes before adjusting the SPAN potentiometer.
10. The analyzer should stabilize in 10-15 minutes.
11. If after 30 minutes the oxygen value displayed is not stable perform a complete check of all external sample system connections before concluding the sensor is defective and notifying the factory.
12. After the reading stabilizes, turn the SPAN potentiometer ½ turn at a time until the LED display reads the desired span gas value of 20.9%
13. **Caution:** Turning the potentiometer more the ½ turn recommended does not allow the electronics sufficient time to keep pace with the adjustment. And since adjustments are rarely made in one consecutive turn – there is a real possibility that the 2nd and 3rd part of the adjustment could unknowingly be based on "values that have not stabilized" thereby resulting in an inaccurate calibration.
14. After calibration is complete, remove the Calibration Flow Adapter and store it.
15. Proceed to SAMPLING.



REF	ITEM NO.	DESCRIPTION
1	NA	WALLS OF ENCLOSURE (INTEGRAL)
	A-2079	BRACKET MOUNTING (REMOTE)
2	CONN-1014	CABLE SENSOR W/PLUG & LOCK RING
3	GPR-11-32-4R	OXYGEN SENSOR
4	A-2344	FLOW ADAPATER CALIBRATION (INCLUDES FITN-1029 BARBED TUBE FITTING)
5	A-2781	NUT RETAINING

NOTE: INSERT A-2344 TO CALIBRATE, REMOVE TO SAMPLE

Procedure Air Calibration for Above Sensors:

Not recommended unless user confirms the ambient air or atmosphere surrounding the analyzer is not contaminated.

1. The reading should be stable, turn the SPAN potentiometer ½ turn at a time until the LED display reads 20.9%
2. **Caution:** Turning the potentiometer more the ½ turn recommended does not allow the electronics sufficient time to keep pace with the adjustment. And since adjustments are rarely made in one consecutive turn – there is a real possibility that the 2nd and 3rd part of the adjustment could unknowingly be based on "values that have not stabilized" thereby resulting in an inaccurate calibration.
3. Ensure the reading is stabilizes at 20.9%.
4. Proceed to SAMPLING.

Procedure Air Calibration Sensor Flow Housing :

Not recommended unless user confirms the ambient air or atmosphere surrounding the analyzer is not contaminated.

1. Review the above Span Calibration procedure and the following instructions before proceeding.
2. Access the interior of the analyzer by removing the four (4) screws securing the front panel.
3. Unscrew the knurled lock nut connecting the cable to the sensor.
4. Disconnect and remove the female plug (including the knurled lock nut) molded to the cable from the male receptacle attached to the sensor.
5. Unscrew the sensor from the threaded hole in the sensor flow housing.
6. Immediately re-connect and insert the female plug (including the knurled lock nut) molded to the cable from the male receptacle attached to the sensor.
7. Re-tighten the knurled lock nut connecting the cable to the sensor.
8. The sensor is now exposed to ambient air, connected to the analyzer electronics and ready for calibration.
9. With the sensor exposed to ambient air – allow the reading to stabilize before adjusting the SPAN potentiometer.
10. After the reading stabilizes, turn the SPAN potentiometer ½ turn at a time until the LED display reads the 20.9 oxygen content of ambient air.
11. **Caution:** Turning the potentiometer more the ½ turn recommended does not allow the electronics sufficient time to keep pace with the adjustment. And since adjustments are rarely made in one consecutive turn – there is a real possibility that the 2nd and 3rd part of the adjustment could unknowingly be based on "values that have not stabilized" thereby resulting in an inaccurate calibration.
12. Reinstall the sensor as follows:
13. Unscrew the knurled lock nut connecting the cable to the sensor.
14. Disconnect and remove the female plug (including the knurled lock nut) molded to the cable from the male receptacle attached to the sensor.
15. Screw the sensor into the threaded hole in the sensor flow housing.
16. Immediately re-connect and insert the female plug (including the knurled lock nut) molded to the cable from the male receptacle attached to the sensor.
17. Re-tighten the knurled lock nut connecting the cable to the sensor.
18. Replace the SENSOR panel or close the door of the analyzer.
19. Wait 5-10 minutes to ensure the reading is stable and proceed to sampling.

Sampling

The GPR-35 is designed for in-situ ambient or area monitoring and has no sample system because the sensor is intended to be exposed directly to the surrounding ambient atmosphere which it is sampling and to operate at atmospheric pressure, however, slightly positive pressure has minimal effect on accuracy.

Applications situations may dictate that the sample be transported from a semi-sealed area to a safe area where the analyzer is located. In these cases the analyzer can be readily adapted to include optional pumps, tubing and connection fittings.

Application Pressure - Positive:
A FLOW valve positioned upstream of the sensor controls the sample flow rate to the recommended 2 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 measurements under these conditions, an optional integral sampling pump is positioned downstream of the sensor to draw the sample from the process, by the sensor and out to atmosphere. Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH can generate erroneous oxygen readings. A FLOW valve upstream of the sensor controls the flow rate of the sample gas which is displayed by the flow indicator downstream of the sensor. A flow rate of 2 SCFH is recommended for optimum performance.

Procedure:
1. Review the end of the Span Calibration procedure and Pressure & Flow in section 3.
2. Select the desired sampling range that provides maximum resolution.
3. Use metal tubing to transport the sample gas to the analyzer. The main consideration is to eliminate air leaks which can affect oxygen measurements.
4. Ensure the sensor is tightly secured in the sensor housing, do not over tighten (evidenced by a deformed o-ring).
5. Ensure the sample gas tube fittings are properly installed with both ferrules, finger tightened and ¾ of a turn for 1/8" tubing and 1-1/4 of a turn for ¼" tubing.
6. Assure there are no restrictions in the sample gas lines – inlet or vent.

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.

Recommended Safety Checklist

The user is responsible for determining whether the unit will assure safety in his particular application and establishing safety precautions. It is strongly recommended the operator understands, tests the operation of this oxygen deficiency alarm and develop a safety checklist related to the use of this unit. The checklist should include but not be limited to:
1. Limiting access to unit to authorized and trained personnel.
2. Install a switch or circuit breaker near the equipment to disconnect the AC power during service intervals to prevent electric shock and possible damage to the equipment.
3. Follow the instruction for Electrical Connections and use a minimum of 18 AWG cable for AC power connections.
4. Test and calibration procedures are instituted and routinely followed.
5. Users understand the operation and functions of the unit.
6. The user consult a safety expert in the selecting the most appropriate location to install the unit and providing all necessary warning notices.
7. Source of AC power is reliable and adequate. In the event AC power is interrupted, users should not depend on the battery backup but correct the problem as quickly as possible.
8. Assure the battery is in good operating condition by periodically disconnecting the AC power and operating the unit for several hours under battery power verifying the various functions of the unit are operational and alarm indicators operate as intended.
9. Any sampling considerations are identified and resolved.
10. External environmental considerations are identified and resolved.

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

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

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

Sensor Replacement

Periodically, the oxygen sensor will require replacement. The operating life is determined by a number of factors that are influenced by the user and therefore difficult to predict. The specification defines the normal operating conditions and expected life of the sensors utilized by this analyzer. Expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature. Section 5 Operation describes the sensor's operating characteristics and section 8 Troubleshooting addresses both common operating errors, corrective action and the sensor's actual mode of failure.

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. Access the interior of the analyzer by removing the four (4) screws securing the front panel.
2. **Caution:** Do not remove or discard the gasket from the front panel. Failure to reinstall either gasket will void the NEMA 4 rating and RFI protection.
3. Unscrew the knurled lock nut connecting the cable to the sensor.
4. Disconnect and remove the female plug (including the knurled lock nut) molded to the cable from the male receptacle attached to the sensor.
5. Remove the old sensor from any of the following: (a) unscrew it from the threaded hole in the bottom of the enclosure, (b) unscrew it from the threaded hole in the sensor flow housing or (c) unscrew the retaining nut securing the remote sensor to the mounting bracket.
6. Open the barrier bag containing the new sensor.
7. If the sensor is equipped with a shorting loop, remove the shorting wire from the pins of the female socket attached to the new sensor.
8. **Note:** Before attempting to air calibrate the analyzer refer to section 5 Operation, Span Calibration, Air Calibration Recommendations at this time; otherwise skip this step.
9. Install the new sensor into any of the following: (a) screw it into the threaded hole in the bottom of the enclosure, (b) screw it into the threaded hole in the sensor flow housing or (c) screw the retaining nut securing the remote sensor to the mounting bracket, finger tighten plus 1/2 turn and ensure the o-ring seal is engaged.
10. Assure the keyway registration of the female plug on the cable and male receptacle on the sensor match up.
11. Push the female plug (including the knurled lock nut) molded to the cable into the male receptacle attached to the new sensor.
12. Screw and tighten the knurled lock nut attached the cable onto to the male connector attached to the sensor.
13. Replace the front panel or close the door and allow the reading to stabilize.
14. Calibrate the analyzer as described in section 5 Operation.

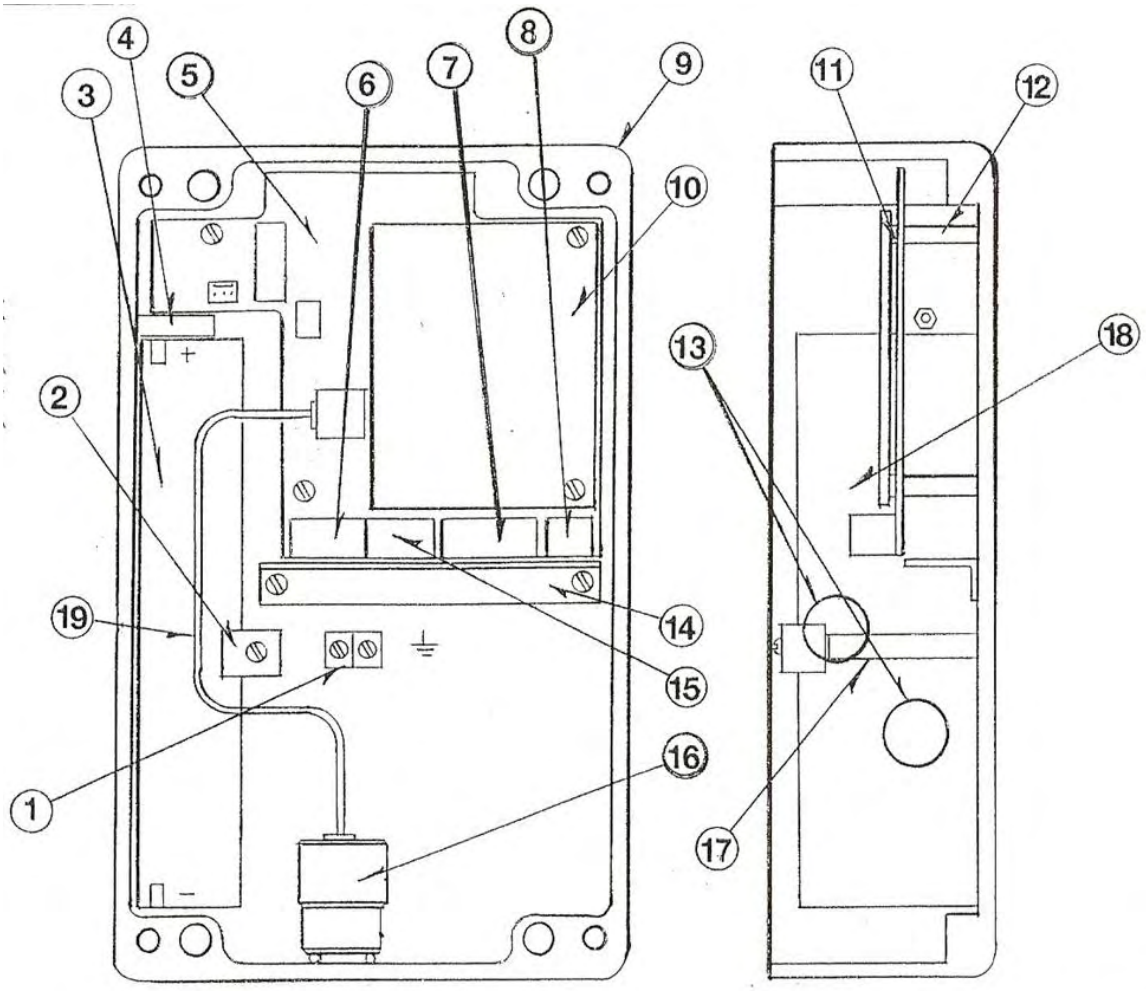
7 Spare Parts

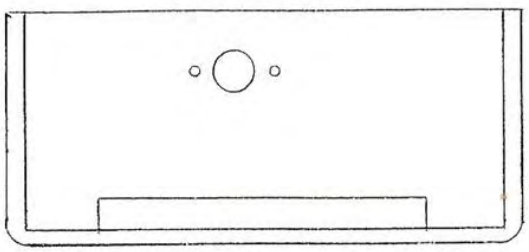
Recommended spare parts for the GPR-35 Series Portable Oxygen Analyzer:

Item No.	Description
GPR-11-32-4	Oxygen Sensor
XLT-11-24-4	Oxygen Sensor

Other spare parts:

Item No.	Description
IC-1007	Amplifier E/I Converter 4-20mA Isolated
A-2376	Battery Assembly Lead Acid (LC-R122R2P)
CONN-1014	Connector 4 Conductor Shielded Cable w/Plug
A-2340	Flow Through Adapter Assembly Calibration
FUSE-1003	Fuse Wickman TR5 19370 Series
FUSE-1004	Fuse Holder Wickman TR5
A-2568	Housing Flow Delrin 1/8 SS Fittings (pump)
MTR-1002	Meter Digital Panel LCD
A-1113C	PCB Assembly Main / Display
A-1114C	PCB Assembly Power / Relay (integral)
A-1114C-R	PCB Assembly Power / Relay (remote)
A-2462	Mounting Kit Remote Sensor Bracket, Nut
CABL-1012	Strain Relief Black ¼" OD with Nut





1. CONN-1049 GROUND CONN 1 CONDUCTOR (16w)
2. A-2341 CLAMP BATTERY (35)
3. A-2376 BATTERY ASSEMBLY
4. HRWR-1023 STANDOFF ¼HEXx1-¼x6-32 (32)
5. A-1114-C PCB ASSY PWR SUPPLY REV A (35).
6. OUTPUT CONNECTOR **
7. ALARM CONNECTOR
8. POWER CONNECTOR*
9. B-2336 ENCLOSURE BOTTOM DETAIL (35)
10. A-2505 PANEL SAFETY CLR ACRYLIC (35)
11. HRWR-1024 STANDOFF ¼HEXx3/16x6-32 (35)
12. HRWR-1025 STANDOFF ¼ HEXx1x6-32 (35)
13. 7/8 DIA. HOLES FOR CONDUIT ***
14. A-2542 PANEL SAFETY ANGLE (35)
15. FAILURE, POWER/SENSOR CONNECTOR
16. GPR-11-32-RTS OXYGEN SENSOR (35)
17. HRWR-1026 STANDOFF ¼HEXx2-1/8x6-32 (35)
18. LABL-1005-CSACE0-3 LABEL CSA CE S/N GPR-35
19. A-2569 CABLE ASSY SENSOR (35,980,990)

* FOR POWER, USE 18 AWG WIRES
CONNECT PROTECTIVE GROUND TO #1.
** USE BRAIDED SHEILDED CABLE
*** INSTALL POWER AND SIGNAL CABLE
THROUGH SEPARATE METAL CONDUIT

Reference: B-2570

8 Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery or response time	At installation, defective sensor	Replace sensor if recovery unacceptable or O_2 reading fails to reach 10% of lowest range
	Failure to purge gas lines with Bypass, air leak in connections, dead legs, distance of sample line, low flow rate, volume of optional filters and scrubbers	Leak test the entire sample system: Vary the flow rate, if the O_2 reading changes inversely with the change in flow rate indicates an air leak - correct source of leak
	Abnormality in zero gas	Qualify zero gas (using portable analyzer)
	Damaged in service - prolonged exposure to air, electrolyte leak	Replace sensor
	Sensor nearing end of life	Replace sensor
High O_2 reading after installing or replacing sensor	Analyzer calibrated before sensor stabilized caused by: 1) Prolonged exposure to ambient air, worse if sensor was **unshorted** 2) Air leak in sample system connection(s) 3) Abnormality in zero gas	Allow O_2 reading to stabilize before making the span/calibration adjustment Continue purge with zero gas Leak test the entire sample system (above) Qualify zero gas (using portable analyzer)
High O_2 reading Sampling	Flow rate exceeds limits	Correct pressure and flow rate
	Pressurized sensor	Remove restriction on vent line, replace sensor
	Improper sensor - CO_2 affects GPR sensor	Use XLT sensor when CO_2 or acid gases are present
	Abnormality in gas	Qualify the gas (use a portable analyzer)
Reading doesn't agree to expected O_2 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 (air calibrate and/or use portable analyzer)
	Failure to allow reading to stabilize before zero and/or span calibration adjustments	Repeat calibration procedure and allow reading (sensor) to stabilize
	Calibration error caused by turning the zero and/or span potentiometer more than ½ turn at a time (electronics need time to keep up	Repeat calibration, allow reading to stabilize and make adjustments ½ turn at a time

Symptom	Possible Cause	Recommended Action
Erratic O_2 reading	Change in sample pressure	Repeat calibration at the temperature and pressure of sample
	Liquid covering sensing area	Wipe with alcohol and lint free towel or flow sample or zero gas for 2-3 hours to flush
	Presence of interference gases	Consult factory
	Presence of sulfur gases and/or CO_2	Replace sensor and install scrubber, contact factory
	Unauthorized maintenance	Replace sensor, obtain authorized service
	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
No O_2 reading Negative O_2 reading	Failure of an electronic component or power surge that sends a charge to the sensor	Service the analyzer, check the power source and THEN replace the sensor
	Pressurizing the sensor by:	Introduce span gas to determine if the sensor responds.
	a) Flowing gas to the sensor with the vent restricted or SHUT OFF valve closed and suddenly removing the restriction draws a vacuum and can damage the sensor and/or cause electrolyte leakage	If successful calibrate the analyzer and resume sampling
	b) Drawing a vacuum on the sensor by partially opening the FLOW valve upstream of the sensor when using a pump downstream to draw sample from a process at atmospheric pressure or a slight vacuum can damage the sensor and cause it to leak electrolyte	If not successful, inspect for electrolyte leakage, check and clean the contacts in the upper section of the sensor housing, flow a little warm water followed by air or clean sample through the analyzer for 2-3 hours to push the electrolyte through the sample system and THEN replace the sensor

9 Warranty

The design and manufacture of Advanced Instruments Inc. oxygen analyzers and oxygen sensors are performed under a certified Quality Assurance System that conforms to established standards and incorporates state of the art materials and components for superior performance and minimal cost of ownership. Prior to shipment every analyzer is thoroughly tested by the manufacturer and documented in the form of a Quality Control Certification that is included in the Owner's Manual accompanying every analyzer. When operated and maintained in accordance with the Owner's Manual, the units will provide many years of reliable service.

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

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

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

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

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

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

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

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

10 MSDS – Material Safety Data Sheet

Product Identification

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

Specific Generic Ingredients

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

General Requirements

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

Physical Properties

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

Fire and Explosion Data

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

Reactivity Data

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

Spill or Leak

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

Disposal

In accordance with federal, state and local regulations.

Health Hazard Information

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

Special Protection

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

Special Precautions

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