Advanced Instruments Inc.

Technical Specifications

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-10 ppm, 0-100, 0-1000 ppm, 0-1%, 0-25% FS ranges
Application:	Oxygen analysis from 100 ppb to 1% in inert, helium, hydrogen, mixed and CO_2 acid (XLT sensor) gas streams
Approvals:	ATEX Certified explosion proof Ex d IIB+H_2 T6, CE
Area Classification:	As above; meets standards for Class 1, Division 1, Groups B, C, D NEMA4/7 hazardous areas
Alarms:	2 adjustable form C relay contacts non-latching; sensor and power failure
Calibration:	Certified gas of O_2 balance N_2 approximating 80% FS on analysis range or next higher range
Compensation:	Temperature
Connections:	1/8" compression tube fittings
Controls:	Explosion proof actuators for range selection, zero and span calibration adjustments
Display:	3-1/2 digit bright red LCD; resolution .01 ppm
Enclosure:	Painted aluminum 16" x 18" x 11" wall mount, 70 lbs.
Flow Sensitivity:	None between 1-5 SCFH, 2 SCFH recommended
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig, max 100 psig; vent - atmospheric not to exceed ±14" water column
Power:	Specify 100/120 or 220/240 VAC

Recovery Time:

O_2 Level	Duration	O_2 Target	Recovery on N_2
Air	2 minutes	10 ppm	60 minutes *
Air	2 minutes	1 ppm	20 minutes **

* Installation ** In service for 2 weeks at 1 ppm

Response Time:	90% of final FS reading < 10 seconds
Sample System:	Flow control and bypass valves; flow indicator
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-333 - requires no maintenance
Sensor Life:	24 months at 25ºC and 1 atm; average O_2 < 100 ppm
Signal Output:	4-20mA isolated and 0-1V
Temp. Range:	GPR Sensor 5º to 45ºC; XLT Sensor –20º to 45ºC
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

XLT-12-333 ppm Oxygen Sensor (continuous in CO_2 gas above 0.5%)

Temperature controlled heater system (recommended for analysis < 1 ppm)

Sample conditioning accessories - contact factory

GPR-18 ATEX Explosion Proof ppm O_2 Analyzer

ATEX Directive 94/9/EC

EEx d IIB+H_2 T6

Certificate: INERIS 07ATEX0025X

QA Notification: INERIS 07ATEXQ712

Advanced Galvanic Sensor Technology

- **Accuracy < 2% FS Range**
- **Sensitivity < 0.5% FS Range**
- **Excellent Stability**
- **24 Month Expected Sensor Life**
- **5 Standard Analysis Ranges**
- **Flame Arrestors (standard)**

CE 0080

ISO 9001:2008 QA System

INTERTEK Certificate No.485

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 9/15

GPR-18 ATEX Explosion Proof PPM Oxygen Analyzer

Owner's Manual

Revised February 18, 2015

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

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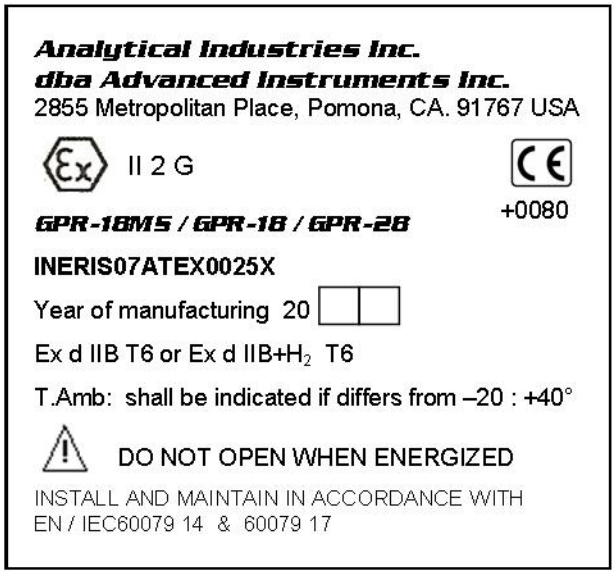
Analyzer Label



ATEX Directives

The analyzer conforms to the following ATEX Directives

EN 60079-0 : 2009
EN 60079-1 : 2007

The analyzer carries the following rating for hazardous locations

II 2 G
Ex d IIB or Ex d IIB + H_2 T6 or T5

The analyzer must be installed per the following directives

EN 60079-14 and
EN 60079-17

1. Introduction

The GPR-18 ATEX analyzer is fully explosion proof and conforms to the following AREX Directives 94/9/EC for Zone 0 and carries the following rating

Ex II 2 G
Ex d IIB or Ex d IIB + H_2 T6 or T5

Your new oxygen analyzer is a precision device designed to give you years of use for analyzing low PPM (parts per million) level oxygen concentrations. This analyzer features the use of Sensor Technology developed exclusively by Advanced Instruments Inc. A discussion of this sensor and its performance is located in section 4 Features & Specifications of this Owner's Manual.

This analyzer is designed to measure the oxygen concentration in inert gases, gaseous hydrocarbons, hydrogen and a variety of gas mixtures. To obtain maximum performance from your new oxygen analyzer, please read and follow the guidelines provided in this Owner's Manual.

Every effort has been made to select the most reliable state of the art materials and components; and, to design the analyzer for superior performance and minimal cost of ownership. This analyzer was tested thoroughly by the manufacturer prior to shipment for best performance. However, modern electronic devices do require service from time to time. The warranty included herein plus a staff of trained professional technicians to quickly service your analyzer is your assurance that we stand behind every analyzer sold.

The serial number of this analyzer may be found on the side 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

			Pass
Date:	Customer:	Order No.:	
Model:	GPR-18 Explosion Proof PPM O2 Analyzer	**S/N** _____	
Sensor:	( ) GPR-12-333 PPM Oxygen Sensor		
	( ) XLT-12-333 PPM Oxygen Sensor	**S/N** _____	
Approvals:	( ) ATEX Ex II 2 G		
	Ex d IIb + H_2 T6 or T5		
Accessories:	Owner's Manual		
	5/16 Open end wrench		
Configuration:	A-1107-M PCB Assembly Main / Display		
	A-1106-M PCB Assembly Power / Relay		
	Range: 0-10 PPM, 0-100 PPM, 0-1000 PPM, 0-1%, 0-25%, CAL		
	Wetted parts: stainless steel		
	Standard power: ( ) 100/110 VAC or ( ) 220/240 VAC		
	Heater system: ( ) 100/110 VAC or ( ) 220/240 VAC; controller set at 85° F		
Test – Electronics:	LED indicators: range, alarms		
	4-20mA offset		
	Alarm relays activate/deactivate with changes in O_2 concentration		
	Analog signal output 0-1V and 4-20mA		
	Range ID contacts (optional)		
Test – Gas:	Baseline drift on zero gas < ± 2% F.S. over 24 hour period		
	Noise level < ± 1.0% F.S.		
	Span adjustment within 10-50% F.S.		
	Peak to peak over / under shoot < 0.5% F.S.		
Final:	Overall inspection for physical defects		
	Close flow control valve and close shut off valve for shipment		
Options:			
Notes:			

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

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

Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service.
In the event of a component failure, only trained personnel with the authorization of their supervisor should conduct repair/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. Spent sensors and or 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 prior to authorization from the factory. Failure to do so will void the warranty, as detailed by section 9, and may result in electrical shock, injury or permanent damage to the analyzer. All servicing should be referred to qualified service personnel authorized by the factory.

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 only. Do not use any solvents or chemicals to clean any surface of the analyzer..

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

Installation

Before installing the analyzer, please review the following section for a thorough understanding of the analyzer mounting, power requirement, sample system/sample conditioning requirements, sample gas compatibility and analyzer calibration requirements.
Installation must follow ATEX Directives

EN 60079-14 and
EN 60079-17

Mounting of Enclosure

Only trained, qualified and competent personnel must install this analyzer. Installation must comply with local, state and country regulations, as well as ATEX installation Directives for this analyzer.
Warning: Electrical power must be OFF during installation.
Securely fasten the analyze enclosure to the mounting location, using up to 1/2" or M12 diameter steel bolt and washer See section 5 pages 15-16.
Install cable glands or conduit using an approved electrical conducting type lubricant on the threads. The glands and conduit must be either a tapered type thread conforming to ANSI/ASME B1.20.1 standard or a ISO metric thread standard.
Note: Inspect and clean the machined surfaces of both the box and the cover (upper lid) . Clean surfaces by wiping with a clean lint-free cloth. Apply a light coating of Killark "LUBG" lubricant to the flanges. Install and tighten cover bolts to the bottom of enclosure and torque the bolts to 30ft/ibs

After installation, the unit must be inspected regularly to verify the cover bolts are tight, all conduit or gland connections are intact and free of corrosion and that the enclosure mounting bolts are tight and in good condition. The sealing surfaces must be inspected; surfaces must be free of nicks, dirt or any foreign particle build-up that would prevent a proper seal.
Warning: Should the flange surface be damaged, consult factory. Never attempt to rework the surface of flange in the field. Apply a light coating of Killark "LUBG" lubricant to the enclosure surface flange before re-installing. Wrench down the bolts and torque the bolts to 30ft/ibs

Power Requirement

Supply power to the analyzer only as rated by the specification and markings on the analyzer enclosure. The wiring that connects the analyzer to the power source should be installed by using approved cable glands and or conduits in accordance with recognized electrical standards. Ensure that the analyzer enclosure is properly grounded and meets the requirements of recommended local electrical standards.

To maintain ATEX certification, bring power to the analyzer through ATEX approved conduit/cable gland only.

The analyzers has a universal AC power supply that operates with 110/230 VAC power and provides power to analyzer electronics. The analyzers with optional heater requires 110 VAC or 230 VAC. Read power rating near the power input terminal for proper power rating of this analyzer.

Power Consumption
The analyzer consumes a maximum 30 watts of power without the optional heater and 230 watts with the built-in optional heater system.

Sampling System Requirement

Sample Gas Stream: Ensure that the sample gas composition and application conditions are consistent with the specifications of the analyzer. If in doubt, consult factory to ensure the analyzer is suitable for specific gas analysis.

Sample System Material and Components

The analyzer is equipped with necessary sample handling components. However, if the analyzer was purchased without a sample handling system, the user may be required to install the necessary sample handling components such as valves, coalescing and/or particulate filters, flow control valve and sample pumps (when analyzing sample at atmospheric or slight negative pressure). When building a sample system, use of stainless steel tubing, fittings and valves is essential for maintaining the integrity of the sample gas stream.

Removal of Contaminant Gases: In certain application, it may be necessary to remove any contaminants that may interfere with measurements. Typically, a gas-specific scrubber is used to remove interfering gases such as oxides of sulfur and nitrogen or hydrogen sulfide. Presence of such interfering gases can result in false oxygen readings and reduction in the expected life of the sensor. Consult factory for recommendations concerning the proper selection and installation of scrubber/filter components.

Sample Inlet Pressure
The analyzer is designed for flowing samples under positive pressure or for samples at atmospheric or slightly negative atmospheres (for samples at atmospheric or slightly negative pressure, an external sample pump is required), is equipped with bulkhead tube fitting connections at the rear or on the side of the analyzers panel. The recommended operating sample pressure is between 5-30 PSIG (although the rating of the fittings itself is considerably higher, the 5-30 PSIG is recommended for ease of control of sample flow).

Caution: If the analyzer is equipped with an optional H2S scrubber and or a coalescing filter , inlet sample pressure must not exceed 30 PSIG
Note: For sample gas at atmospheric pressure or under slight vacuum , an external sampling pump should be positioned upstream of the sensor to pull the sample from the process, push it through analyzer sample system, across the sensor and vent out to atmosphere

Sample Vent Pressure
In positive sample pressure applications, the sample must be vented to ambient or in a vent line with pressure less than the sample inlet pressure. If the sample is vented to a line at pressure slightly above or below ambient, a back pressure regulator set at 0.2-0.5 PSIG must be installed on the downstream of the sensor to ensure a constant pressure on the sensor.

Sample Flow Rate
The analyzer is equipped with a flow control valve with flow indicator to control the sample flow rate. A flow rate of 2 SCFH (~1 liter per minute) is recommended for optimum performance.
Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH may generate a slight backpressure on the sensor and result in erroneous reading.

Sensor Compatibility and Operating Conditions

Sensor Model Number:
The analyzer is supplied with either a GPR Series or XLT series PPM sensor The GPR series sensor is recommended for all inert and hydrocarbon gas streams where as the XLT series sensor is recommended for gas streams containing CO_2 above 1%
Caution: – continuous exposure to ambient air will reduced sensor life and loss of low end sensitivity. The GPR series PPM sensors will last approximately 6-8 months in air but a prolonged exposure to air will generate a low end offset (> 1-2 PPM) when a sample gas with no oxygen (zero gas) is analyzed.
XLT Series PPM sensors will last approximately 6-7 days in air and eventually will lose its sensitivity to oxygen.

Note: With reference to the publish specification (see section 4), the expected life of oxygen sensor is stated on the basis of average oxygen concentration (< 1,000 PPM) the sensor will see, ambient temperature (77°F/25°C) and ambient pressure (1 atmosphere). As a rule of thumb, sensor life is inversely proportional to changes in the above parameters.

Operating Temperature
The temperature of the sample gas must be within the recommended operating range (see specifications in section 4) before it enters the analyzer and any optional analyzer components. Hot sample gases can easily be cooled to ambient temperature by using a coiled 10 foot length of ¼" stainless steel tubing. On an intermittent basis, the analyzer may be operated at 50 degree C.

Caution: At temperatures above 25^{o}C, the user can expect a reduction in sensor life of ~ 2.5% per degree C increase in temperature. As an example, if the analyzer is continuously operated at 35 C, the expected sensor life will be reduced by ~30%

4. Features & Specifications

Advanced Instruments Inc.

Technical Specifications

Accuracy:	< 1% of FS range under constant conditions
Analysis:	0-10 ppm, 0-100, 0-1000 ppm, 0-1%, 0-25% FS ranges
Application:	Oxygen analysis from 100 ppb to 1% in inert, helium, hydrogen, mixed and CO_2 acid (XLT sensor) gas streams
Approvals:	ATEX Certified explosion proof Ex d IIB+H_2 T6, CE
Area Classification:	As above; meets standards for Class 1, Division 1, Groups B, C, D NEMA4/7 hazardous areas
Alarms:	2 adjustable form C relay contacts non-latching; sensor and power failure
Calibration:	Certified gas of O_2 balance N_2 approximating 80% FS on analysis range or next higher range
Compensation:	Temperature
Connections:	1/8" compression tube fittings
Controls:	Explosion proof actuators for range selection, zero and span calibration adjustments
Display:	3-1/2 digit bright red LCD; resolution .01 ppm
Enclosure:	Painted aluminum 16" x 18" x 11" wall mount, 70 lbs.
Flow Sensitivity:	None between 1-5 SCFH, 2 SCFH recommended
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig, max 100 psig; vent - atmospheric not to exceed ±14" water column
Power:	Specify 100/120 or 220/240 VAC

Recovery Time:

O_2 Level	Duration	O_2 Target	Recovery on N_2
Air	2 minutes	10 ppm	60 minutes *
Air	2 minutes	1 ppm	20 minutes **

* Installation ** In service for 2 weeks at 1 ppm

Response Time:	90% of final FS reading < 10 seconds
Sample System:	Flow control and bypass valves; flow indicator
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-333 - requires no maintenance
Sensor Life:	24 months at 25ºC and 1 atm; average O_2 < 100 ppm
Signal Output:	4-20mA isolated and 0-1V
Temp. Range:	GPR Sensor 5º to 45ºC; XLT Sensor –20º to 45ºC
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

XLT-12-333 ppm Oxygen Sensor (continuous in CO_2 gas above 0.5%)

Temperature controlled heater system (recommended for analysis < 1 ppm)

Sample conditioning accessories - contact factory

GPR-18 ATEX Explosion Proof ppm O_2 Analyzer

ATEX Directive 94/9/EC

EEx d IIB+H_2 T6

Certificate: INERIS 07ATEX0025X

QA Notification: INERIS 07ATEXQ712

Advanced Galvanic Sensor Technology

- **Accuracy < 1% FS Range**
- **Sensitivity < 0.5% FS Range**
- **Excellent Stability**
- **24 Month Expected Sensor Life**

5 Standard Analysis Ranges

Flame Arrestors (standard)

CE 0080

ISO 9001:2000 QA System

INTERTEK Certificate No.485

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5. Operation

Principle of Operation

The GPR-18 ATEX oxygen analyzer incorporates a variety of PPM range advanced galvanic fuel cell type sensors. The analyzer suitable for use in hazardous area and is configured with an explosion proof enclosure, flame arrestors and actuators approved to comply with

Area Classification

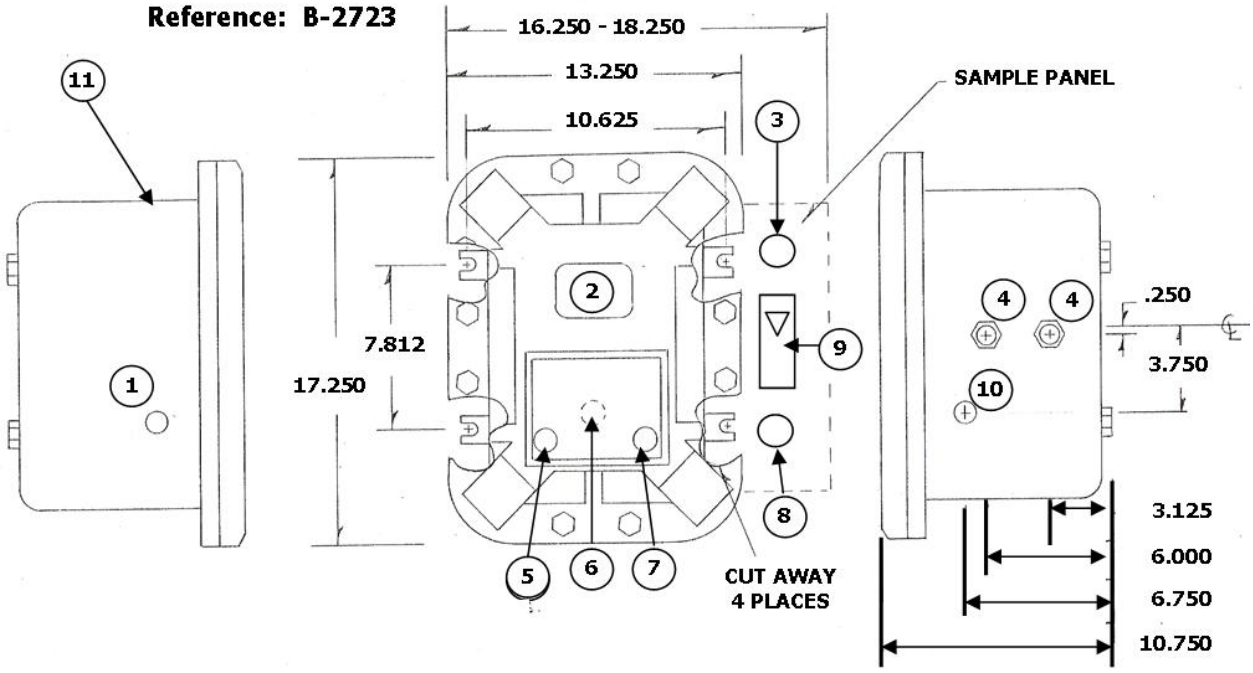
Analyzer conforms to ATEX Directive 94/9/EC and carries the following hazardous area rating.

EX II 2 G
Ex d IIB or d IIB + H_2 T6 or T5

Mounting the Analyzer

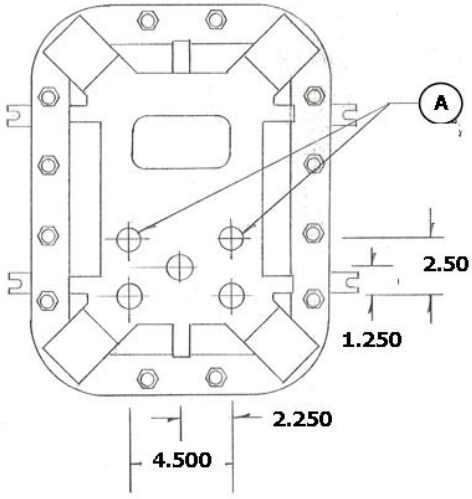
The GPR-18 PPM ATEX Oxygen Analyzer consists of two PCB assemblies, sensor housing and sample system including sample flow control valve and flow meter. An optional temperature controlled heater system is available that enhances the analyzer stability during low PPM measurements. In standard configuration the alarm controls are integral to the main PCB and cannot accessed from outside of analyzer (to prevent tampering with alarm set points), however, as an option, the alarm controls can be accessed externally when fitted with approved actuators.

The analyzer components are packaged in a 13.250x17.250x10.750" wall mount enclosure with ATEX certification and IP66 rating. The analyzer is designed for mounting on a flat vertical surface (mount approximately 5 feet above the floor) by bolting the mounting feet attached to the rear of the enclosure.



REF	DESCRIPTION
1	3/4"NPT-F POWER INPUT
2	LCD DISPLAY 3.5 DIGITS; MODE & ALARM LED's
3	SHUT OFF VALVE (P/N VALV-1014)
4a	FLAME ARRESTORS CL I, DIV I, GRP C, D (P/N FITN-1032)
4b	FLAME ARRESTORS ATEX CERTIFIED (P/N FITN-1032-1)
5	ACTUATOR CONTROL ZERO POTENTIOMETER ATEX
6	ACTUATOR CONTROL RANGE SWITCHING ATEX (P/N A-2610)
7	ACTUATOR CONTROL SPAN POTENTIOMETER ATEX
8	FLOW CONTROL VALVE (P/N VALV-1004)
9	FLOW INDICATOR (P/N FMTR-1004)
10	3/4"NPT-F OUTPUT & ALARMS INPUT
11a	ENCLOSURE ALUM. EX-PROOF CENELEC (P/N ENCL-1012)
11b	ENCLOSURE ALUM. EX-PROOF ATEX (P/N ENCL-1012-1)

(A) OPTIONAL: ACTUATOR CONTROLS - ALARM 1, ALARM 2
DRILL & TAP 3/4"-14 NPSM THRU, SPOT FACE 2" DIAMETER
(INSIDE COVER), MIN. SPOT FACE DEPTH - 360° CLEAN-UP,
MIN. COVER THICKNESS REMAINING - 27/32", 2 PLACES



Reference: A-3437

Installation & Maintenance of Analyzer Enclosure

Only trained, qualified and competent personnel must install this analyzer. Installation must comply with local, state and country regulations, as well as ATEX installation Directives for this analyzer.

Installation directives

EN 60079-14 and
EN 60079-17

Warning: Electrical power must be OFF during installation.
Securely fasten the analyze enclosure to the mounting location, using up to 1/2" or M12 diameter steel bolt and washer.
Install cable glands or conduit using an approved electrical conducting type lubricant on the threads. The glands snd conduit must be either a tapered type thread conforming to ANSI/ASME B1.20.1 standard or a ISO metric thread standard.
Note: Inspect and clean the machined surfaces of both the box and the cover (upper lid) . Clean surfaces by wiping with a clean lint-free cloth. Apply a light coating of Killark "LUBG" lubricant to the flanges. Install and tighten cover bolts to the bottom of enclosure and torque the bolts to 30ft/ibs

After installation, the unit must be inspected regularly to verify the cover bolts are tight, all conduit or gland connections are intact and free of corrosion and that the enclosure mounting bolts are tight and in good condition. The sealing surfaces must be inspected; surfaces must be free of nicks, dirt or any foreign particle build-up that would prevent a proper seal.
Warning: Should the flange surface be damaged, consult factory. Never attempt to rework the surface of flange in the field. Aplly a light coating of Killark "LUBG" lubricant to the enclosure surface flange before re-installing. Wrench down the bolts and torque the bolts to 30ft/ibs.

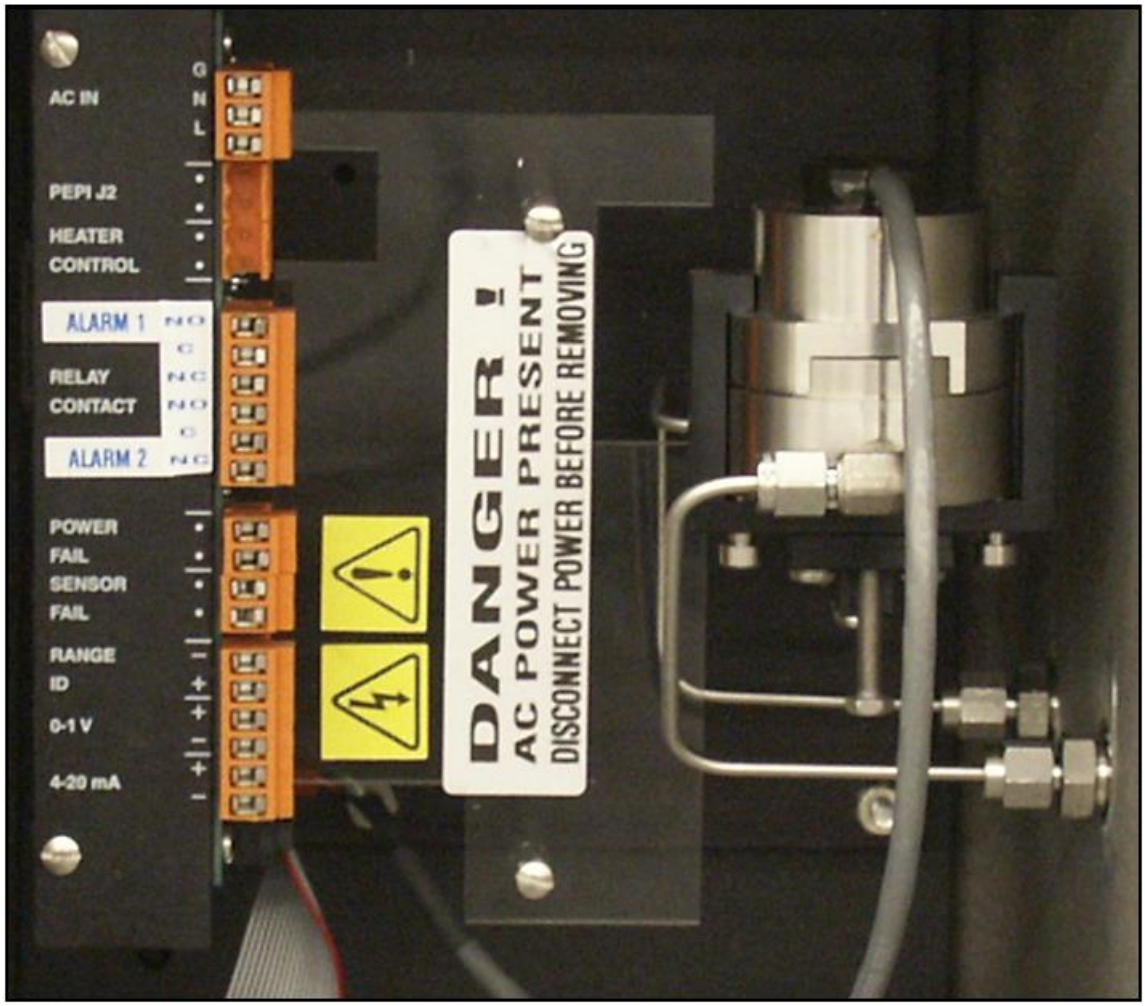
Electrical Connections

Power must be supplied through a separate conduit on the left side of the enclosure, see above #1. Use a shielded power cord with minimum of 18 gauge wires. If equipped with the optional temperature controlled heater system, the required internal wiring to the heater and controller has been installed at the factory. The user simply connects an appropriate source of AC power (determined by the requirements specified for the heater) to the power terminal as illustrated below. Bring the output and alarm connections through an approved 3/4" conduit on the right side of the enclosure, see above #10.

Danger: To prevent external fire or explosion, user must seal all conduits in accordance with applicable local requirements, seal both power and output wiring as described in Appendix A.

Note: The heater system is rated for 100/110 VAC or 220/230 VAC only. Supply appropriate AC power of the power. An improper voltage could permanently damage the heating system. Do not remove the protective Plexi-glass panel that covers the PCB. The cover prevents the user from touching any of the LIVE circuitry on the PCB.

Danger: To service the analyzer, disconnect the AC power source before removing the protective plexi-glass cover to avoid electric shock. **Note:** There is no AC power present on the circuit board assemblies mounted on inside of analyzer door.



Procedure

1. Insert the power cable through the user supplied ATEX approved conduit fitting on the left side of the analyzer.
2. Insert the signal output cable(s) through the user supplied ATEX approved conduit fittings on the right side of the analyzer.
3. Strip the ends of the wires approximately ¼ inch.
4. Loosen the terminal screws, insert the bare wire into the appropriate terminals and re-tighten with a small bladed screwdriver.
5. **Note:** If equipped with the optional temperature controlled heater system, the necessary wiring to the heater and controller has been installed at the factory and no additional connections are required. The power connection services both the analyzer electronics and temperature controlled heater system.
6. **Caution:** Connect the power ground directly to the ground terminal on the inside of the analyzer case.
7. Pack and seal the seal fittings bringing power to and taking signal/alarm interconnection wiring from the analyzer as described in Appendix A.
8. Establish power as directed below but only after installation is complete.

Signal Processing Electronics

The signal generated by the sensor is processed by an integrated electronic circuit. 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 30 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 an isolated 4-20mA and 0-1V signal output.

Overall performance is enhanced by an optional temperature controlled heater system that controls the temperature around the sensor at a pre-set temperature.

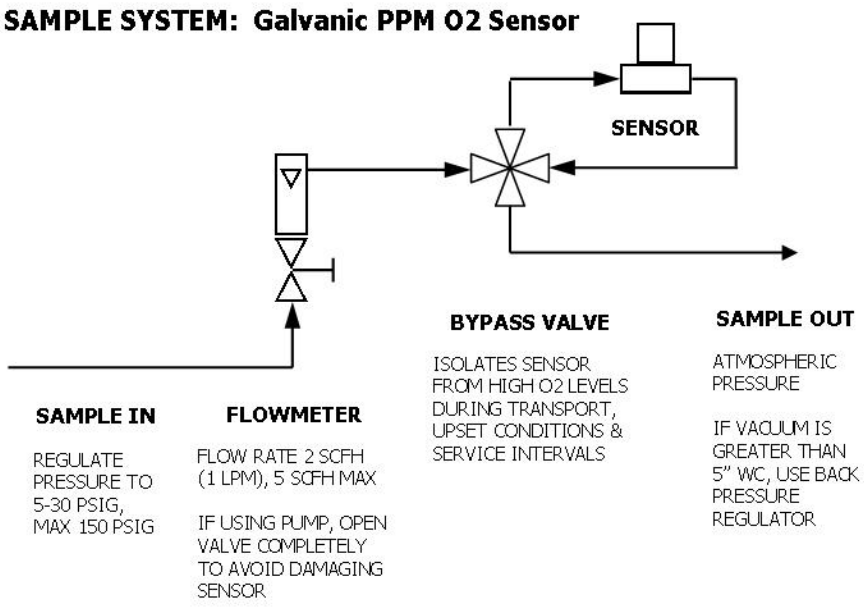
Power to the analyzers is supplied by an integral universal 110/230 VAC power supply. Connections of the appropriate AC line voltage are hard wired to screw type terminal blocks. Power requirement related to the optional heater system is specific to 100/110VAC or 220/230VAC, supply power as indicated near the power input terminal.

Sample Gas Analysis Options

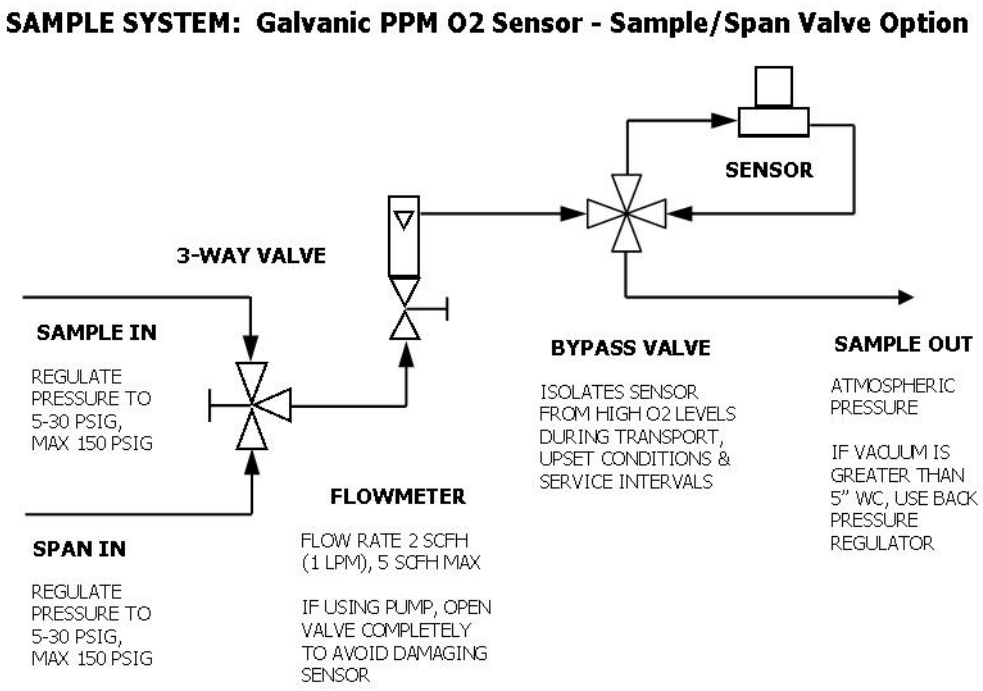
For oxygen measurements, the sensor is exposed to the sample gas that must flow or be drawn through the analyzer's internal sample system. When operated according to the instructions in this Owner's Manual, the user can expect increased performance of the analyzer.

Complementing the performance capabilities of the oxygen sensor is a sample system consisting of stainless steel and glass wetted parts, a unique proven leak-tight sensor housing design and a 4-way sample/bypass valve. As a result, the user can isolate the sensor from exposure to high oxygen concentration during transport, upset conditions and routine maintenance and bring the analyzer on-line at PPM levels very quickly.

There are two sample system options (Please check your analyzer QC certificate to confirm the sample system option purchased). The first option includes a 4-way sample/bypass valve that can be used to isolate the sensor during transportation or maintenance.



The second sample system option is with a 3-way Sample/Span valve added to the standard samples system.



Note: For sample at ambient pressure or slightly at negative pressure, an explosion proof high integrity valve must be installed upstream of the flow control valve. This will allow the pump to pull the sample from atmospheric/negative sample pressure, push it through the sample system, across sensor and vent it out to atmosphere.

Gas Connections

The GPR-18 analyzer's flow through configuration is designed for positive pressure samples and requires connection to 1/8"or 1/4'" diameter compression tube fittings to the sample inlet and sample vent (see illustration in Section 5).

Optional sample system features include a 3-way Sample/Span valve. Check the QC to verify the options included in this analyzer

The user is responsible for making provision for calibration gases and regulating the sample and span gas pressure and flow as described below.

Recommendation:
If the analyzer is not equipped with a Sample/Span valve, consider installing a 3-way valve before the sample inlet to provide a permanent connection for Sample and Span gas and means of switching from SAMPLE to SPAN gas and vise versa without breaking gas line connections. This arrangement eliminates the possibility of exposing the sensor to high O2 when switching between Sample and Span thus shortening the span calibration time.

Procedure

1. Locate the sample inlet and outlet connections on the side panel of the analyzer. If equipped with Sample/Span Valve, locate the Span inlet connection as well.
2. Regulate the Sample/Span gas pressure between 5- 30 psig
3. Assure there are no restrictions in the vent line.

4. Connect the 1/8" or ¼" dia. metal vent line to the fitting designated SAMPLE OUT or VENT.
5. Switch 4-way Sample/Bypass crossover valve to Bypass.
6. Start the flow of sample gas through the line to be connected to the analyzer SAMPLE IN and let it flow for approximately 1-2 minutes to purge the air trapped inside the line. Repeat this procedure to purge air from Span gas line.
7. With the Sample gas flowing, connect the 1/8" or 1/4" dia. metal tubing carrying sample gas to the fitting marked as SAMPLE IN. Repeat this procedure for Span gas connection to the fitting marked as SPAN IN.
8. Slowly open the FLOW valve until the recommended flow rate of 2 SCFH is reached.
9. Allow the Sample gas line to purge for 1-2 minutes. Repeat this step for Span gas line.
10. After purge, switch the Sample/Bypass valve to Sample position
11. Sensor will immediately detect oxygen contents in the sample gas and send an electrical signal to the analyzer signal processing electronics (see details later in this section of the manual).

Note: If the sensor is shipped separately, see section "Installing the Oxygen Sensor" below for detailed instruction

Sensor Technology

The galvanic type sensors function on the same principle and are specific to 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.

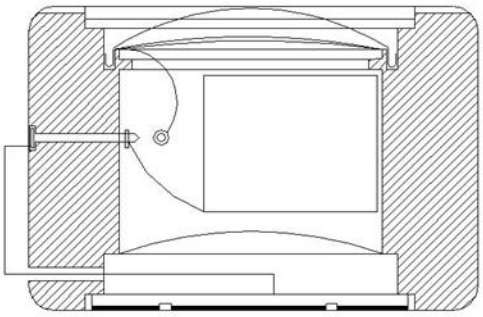
Proprietary advancements in design and chemistry add significant advantages to an extremely versatile oxygen sensing technology. Sensors for low PPM analysis recover from air to PPM levels in minutes, exhibit longer life, extended operating range of -20°C to 50°C (XLT series sensors only) excellent compatibility with CO_2 and other acid gases (XLT series sensors) giving the user a significant advantage over the competition.

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

ppm Oxygen Sensors

- Shorten manufacturing cycle from 4-6 weeks to 3-4 days
- Recovery to 10 ppm from oxygen shock or air . . .
  in less than 1 hour on nitrogen purge
- Higher signal output to achieve . . .
  50 ppb sensitivity
  Enhanced stability, less temperature dependent
- Superior compatibility with 0.5 to 100% CO_2 gas streams
  ppm O_2 contamination in natural gas
  ppm O_2 contamination in beverage grade pure CO_2
- Operating life of 24 months in ppm O_2 concentrations
- Extended operating range –4ºF to 50º F
- Develop special sensor for high ppm/low % applications



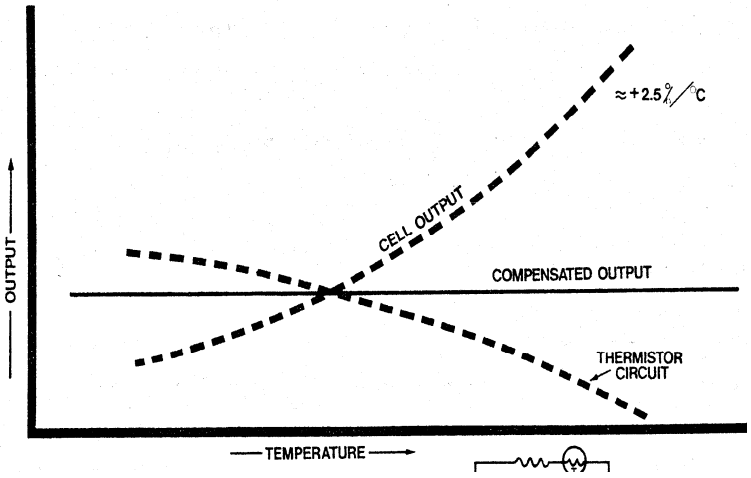
GPR/XLT 12 Series ppm Oxygen Sensor

Accuracy & Calibration of Analyzer

Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas. 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 the linearity and absolute zero properties, a single point calibration of analyzer is possible.

Pressure: Since the sensors are sensitive to the partial pressure of oxygen in the sample gas, their output is a function of the number of oxygen molecules 'per unit volume' of the sample gas. The number of oxygen molecules per unit volume will increase proportionally with pressure.

For best accuracy, the pressure at the sensor (in other words, sample flow rate) must remain constant during analysis.



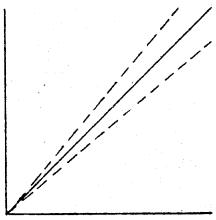
Temperature: The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier. The fact that all diffusion processes are temperature sensitive, the sensor's electrical output also varies with temperature. This variation is relatively constant (2.5% per ºC change in temperature). A temperature compensation circuit employing a thermistor offsets this effect with an accuracy of ±5% of full scale range or better (over the operating temperature range of the analyzer) and generates an output signal that is virtually independent of small ambient temperature variations. To minimize error in oxygen measurement, the calibration of the analyzer should be carried out as close as possible to the temperature during sampling. From calibration temperature, a variation of ~10º F ambient temperature will produce < 2% of full scale error in O2 measurement.

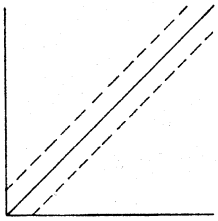
Accuracy: The overall accuracy of an analyzer over its operating temperature is affected by two factors:

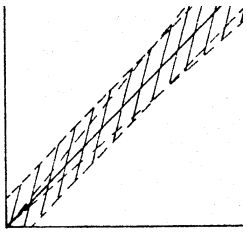
1) 'Percent of reading errors', illustrated by Graph A below, such as ±5% inherited error in the temperature compensation circuit due to the tolerances of the resistors and thermistor used in the temperature compensation circuit.

2) 'Percent of full scale errors', illustrated by Graph B, such as ±1-2% errors associated with actual methods employed during signal processing, measurement and display.

Graph C illustrates these 'worse case' errors that are typically used to develop analyzer's overall accuracy statement of <2% of full scale at constant temperature or < 5% of full scale over the operating temperature range (after the analyzer calibration with a certified span gas).


A. PERCENT OF READING ERRORS


B. PERCENT OF FULL SCALE ERRORS


C. OVERALL ACCURACY

Example 1: Graph A, percent of reading error, Graph B, constant percent of full scale error associated with methods of signal processing, measurements and digital display, Graph C, combined error as a sum of percent of reading error and measurement method error; central line passing through the origin illustrates accuracy after calibration with a certified span gas.

Zero Calibration

In theory, the galvanic fuel cell type oxygen has an absolute zero meaning it produces no signal output when exposed to an oxygen free sample gas. In reality, the analyzer may generate an oxygen reading when sampling a zero gas due to:

1. Minor leakage in the sample line connections
2. Residual oxygen dissolved in the sensor's electrolyte
3. Tolerances of the electronic components

The Zero Offset feature eliminates any signal contributed by the above possible causes. The zero offset capability, however, is limited to 50% of the lowest most sensitive range of the analyzer. As part of the Quality Control Certification process, the zero offset of every PPM analyzer is checked prior to shipment. However, due to the fact that factory sampling conditions may differ from that of the user, no ZERO OFFSET adjustment is made at the factory.

Once the ZERO OFFSET adjustment has been made, subsequent zero calibration is generally not required until the sample system connections are modified or when installing a new oxygen sensor.

Span Calibration

Span Calibration involves adjusting the analyzer electronics to the sensor's signal output at a given oxygen concentration. The frequency of calibration varies with the application conditions, the degree of accuracy required and the Quality Assurance System of the user in place. However, the interval between span calibrations should not exceed three (3) months.

The analyzer may be calibrate with a certified span gas or if a certified span gas is not available, in ambient air that contains known oxygen concentration of 20.9%

Allow the analyzer sufficient time to equilibrate with span gas before adjusting the span of the analyzer.

Note: Regardless of the oxygen concentration of the known standard used, the span calibration process takes approximately 10-15 minutes. However, the time required to bring the analyzer back on-line can vary depending on the span gas used. In theory, higher is span gas value, the longer the analyzer will take to recover/settle from span to sample.

Follow the detailed instructions to perform ZERO and SPAN calibration as described later in this manual.

Analyzer Main Features

Oxygen Display

The analyzer is equipped with a 3-1/2 digit LED display that shows oxygen concentration from PPM to % level depending on the range of analysis selected.

Display Mode Selection

The DISPLAY SELECT slide switch is located on the main signal processing PCB A-1106 mounted on the inside of analyzer front door. The slide switch has been set to the O2 position at the factory. Advance this slide switch to select one of the three available DISPLAY modes:

OXYGEN to display the oxygen reading
ALARM 1 to set Alarm 1 Set point
ALARM 2 to set Alarm 2 Set point

Oxygen Alarms

The analyzer is equipped with two user adjustable alarms controls located on the interior panel attached to the front door. When activated, the alarms trigger SPDT Form C, normally closed, non-latching relays rated @ 5A, 30VDC or 240VAC resistive. The alarms are fully adjustable by the two potentiometers accessible from the auxiliary panel on the inside of the door with a small bladed screwdriver. Optionally, the alarm controls might have been installed external to the analyzer by using actuators.

Note: To configure alarms as “Fail safe” - connect positive lead to NO and negative to the C, common or neutral. To connect to an active relay, connect the live cable to the common terminal C and the secondary cable to the normally open NO terminal. To break the connection upon relay activation, connect the secondary cable to the normally closed NC terminal.

Power Fail Alarm

A dry contact ratedat 1A @ 30 VDC is provided as a power failure alarm. The contact is normally open but closes when the power to the analyzer is switched off or interrupted.

Sensor Fail Alarm

A relay contact rated at 1A @ 30 VDC is provided for sensor fail alarm. The contact is normally open but closes when oxygen signal goes to zero or falls below zero.
Note: Adjusting the ZERO OFFSET to 00.00 activates the Sensor Failure Alarm (the alarm activation may cause a momentary spike in the trend analysis). To avoid the momentary spike, set the ZERO OFFSET to 0.01 PPM

Caution: The sensor failure alarm becomes active when the display indicates ‘000’ on any range of the analyzer.

Range ID

A voltage output corresponding to each range is provided. The output of the highest range (normally CAL) is 5V. The range ID voltage will change by 1V with each remaining ranges.

Signal Outputs

The analyzer provides an isolated 4-20mA signal output and a 0-1V full scale signal output for external recording devices. The 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, R99, mounted on the main PCB Assembly. Consult factory for instructions.

Caution: 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 converter. Supplying power to 4-20 mA IC will permanently damage the IC.

Temperature Controlled Heater System

If the optional temperature controlled heater system is installed, the temp controller is accessible only by opening the front door of the enclosure. The controller is PID and is set at the factory to maintain the analyzer interior temperature at 85°F.

Caution: Do not change this setting. A higher temperature setting may drastically reduce sensor life and possibly cause damage to the electronic circuitry of both the controller and the analyzer.
When power is applied to the temperature controller, the controller initially tunes itself and then maintains the temperature at the set point.

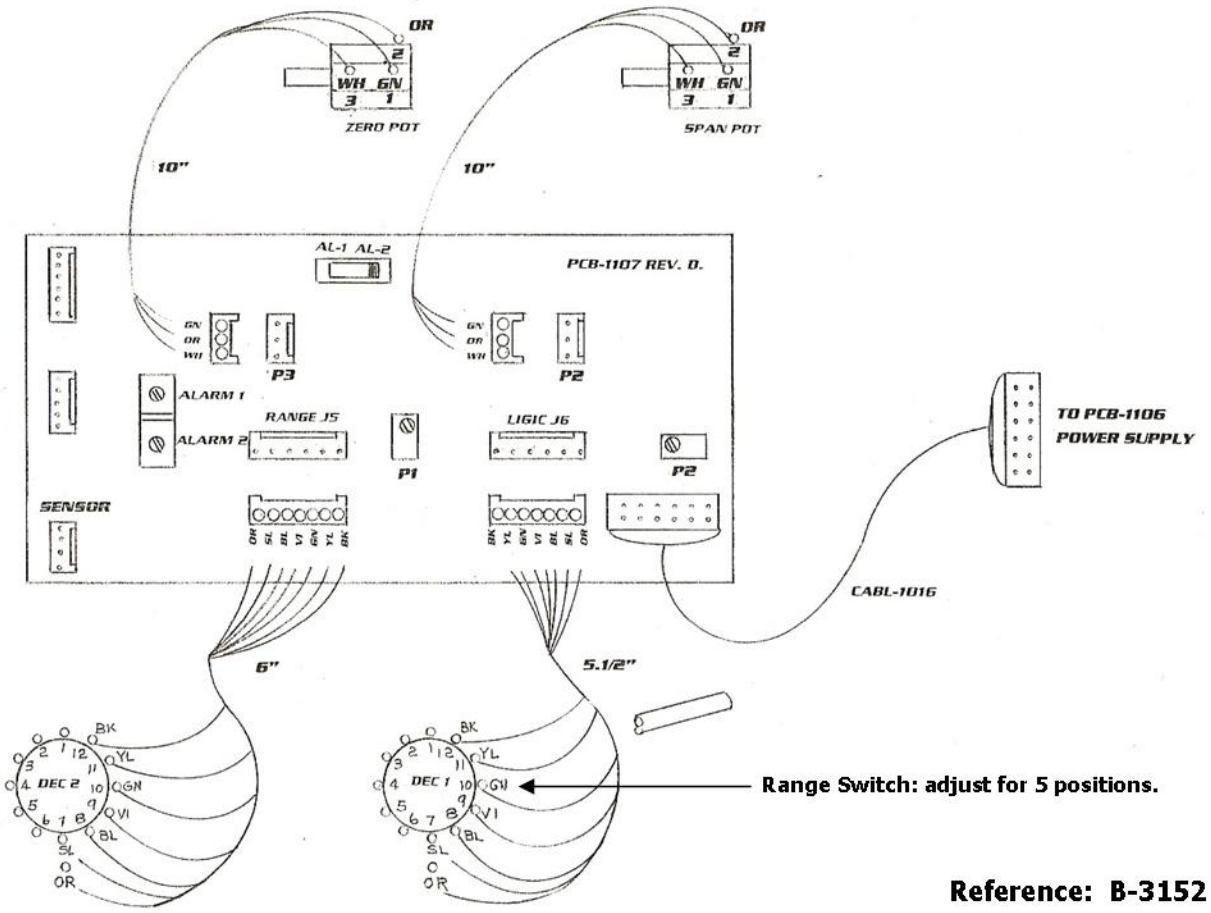
It is recommended that at initial start-up, or when replacing oxygen sensor or when trouble shooting, set the set point around 60°F to turn heater off (to prevent overheating of heater element).

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

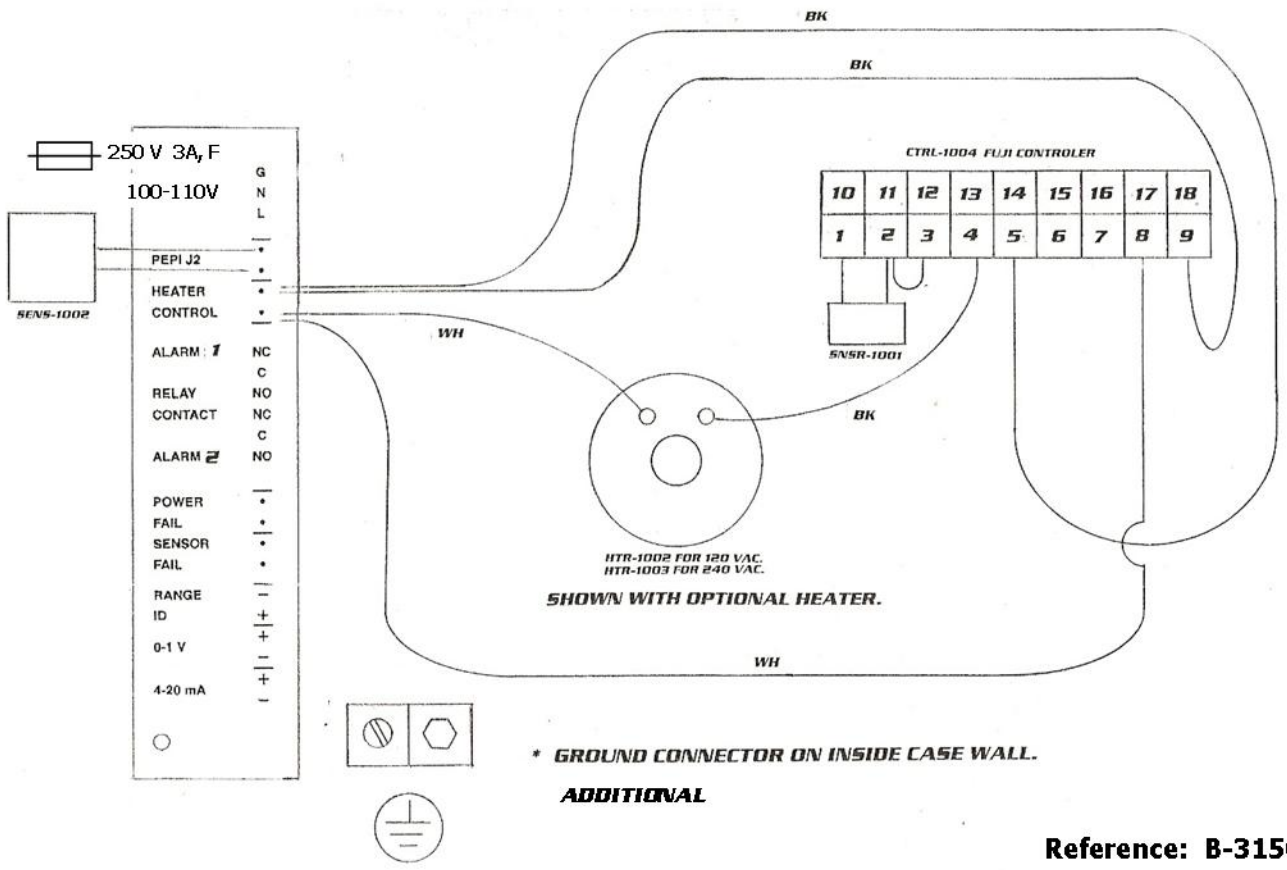
Heater Runaway Protection
As part of the optional temperature controlled heater system, the analyzer is protected in the event the temperature controller should fail and thereby allowing the heater to runaway damaging the interior of the analysis unit. The runaway protection is provided by a J2 type device positioned between the temperature controller and the heater. This device cuts off power to the heater if temperature inside the enclosure exceeds 70°C (158 °F). Should the F2 device fail, correct the problem and replace J2.

Additional electrical diagrams are provided for reference purposes. The user is not required to establish any of the wiring shown in the diagrams below.

Range switch wiring schematic:

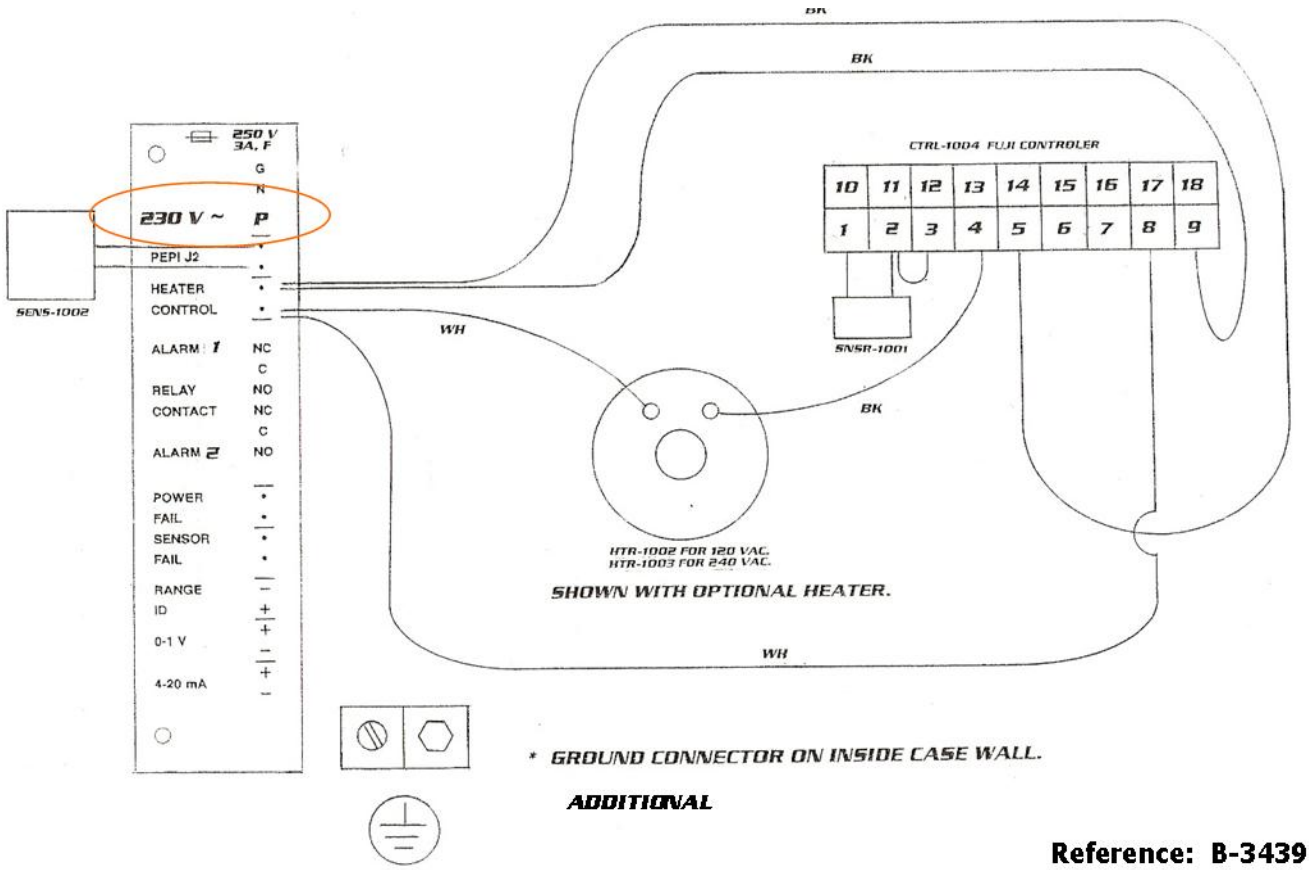


Optional 110 VAC temperature controlled heater wiring:



Reference: B-3150

Optional 220-240VAC temperature controlled heater system wiring:



Reference: B-3439

Establishing Power to Electronics

Establish power to the electronics by connecting a power cable to analyzer's power terminal block. The electronics are rated for a universal power input of 100-230 +/-10% VAC 50-60 Hz. With optional temperature controlled heater system, however, supply only the voltage noted near the power terminal.

The LCD display will light up when power is applied to the analyzer. Assuming the analyzer has been installed as directed above, and the sensor has been installed at the factory, the reading displayed when the analyzer is turned on, reflects the oxygen value under static condition (i.e. the axiom that all valves and fittings leak, the sensor is looking at equilibrium point of oxygen diffusing into the sample system and oxygen consumed by the sensor).

Range Selection

The analyzer is equipped with five (5) standard measuring ranges (see specification). The ranges available are indicated around the RANGE selector switch (actuator) located in the center of the control panel of the analyzer (refer to the illustration above under Mounting the Analyzer section). Simply turn the RANGE selector switch to the desired range.

Note: If the oxygen concentration is higher than the selected range, the display will show 1---- indicating over-range condition. If this occurs, select a higher range until the display shows oxygen reading.

Note: Before concluding the sensor is not "coming down to expected ppb or PPM levels" or "is not responding to sample gas", please check and confirm that the analyzer is in OXYGEN DISPLAY mode before contacting the factory.

Setting Alarm Values

The analyzer is equipped with one high and one low fully adjustable alarm. When activated, the alarms trigger SPDT Form C non-latching relays @ 5A, 30VDC or 240VAC resistive. The alarms are fully adjustable by the two potentiometers accessible from the auxiliary panel on the inside of the door. Optionally, alarm control actuators can be mounted externally as illustrated in the Mounting

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The alarm set point represents a value. When the oxygen reading exceeds ALARM 2 (high alarm) or falls below ALARM 1 (low alarm) set point, the corresponding relay is activated.

Note: To prevent chattering of the relays, a 2% hysteresis is added to the alarm set point. This means that the alarm will remain active until the oxygen reading has fallen 2% below the alarm set point (high alarm) or risen 2% above the alarm set point (low alarm) after the alarm was activated.

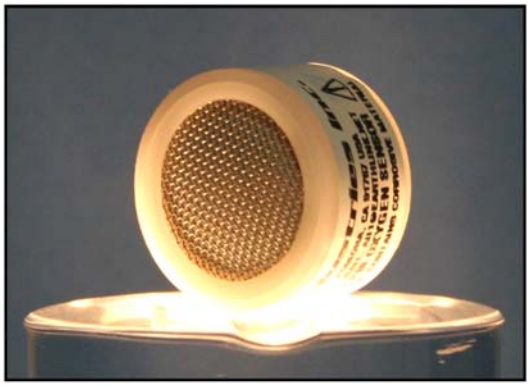
Procedure

1. Open the front door to access the DISPLAY SELECT slide switch located on the A-1107 PCB Assembly Main/Display.
2. Advance the selector switch to the ALM1 (high alarm) or ALM2 (low alarm).
3. The digital LED display will indicate the current alarm set point.
4. The alarm set point is expressed as a value on a given range.
5. Adjust the potentiometer slowly, a ½ a turn at a time to allow the electronic processing to catch up . . . until the display reads the desired alarm set point value. **Note:** External alarm control actuators are optional and if ordered, would be located on the front panel outside of analyzer.
6. **Caution:** Use a small bladed screwdriver to change Alarm potentiometer setting.
7. Once the alarm values are set, advance the DISPLAY SELECT slide switch back to OXYGEN position.

Analyzer Installation is now complete . . .
If necessary, prepare to install oxygen sensor

Installing the Oxygen Sensor

The analyzer is generally shipped with an oxygen sensor installed that has been tested and calibrated and the analyzer is fully operational out of the box. However, if the sensor was shipped separately, or the sensor has been used to its useful limit, it would be necessary to install a new sensor.

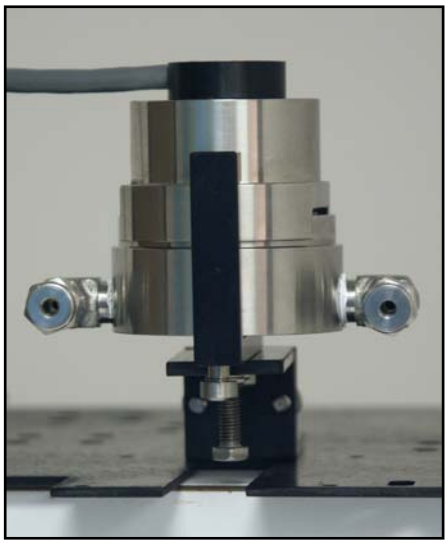


Caution: The sensor is sealed in a metalized bag under nitrogen. DO NOT open the bag until ready to install the sensor.

Warning: Do not cut/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 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. Spent sensor or a leaking sensor should be disposed of in accordance with local regulations.

Procedure

1. The standard analyzer configuration is equipped with a 4-way sample/bypass valve that isolates the sensor from ambient air during transportation or loss of sample during for example, maintenance. If it becomes necessary to install a sensor in the field, follow the procedure below.
2. Turn the Sample/Bypass valve to Bypass position.
3. Set Sample flow between 2 SCFH.
4. Purge the sample line for 1-2 minutes.
5. Turn the Sample/Bypass valve to Sample Position.
6. Using the 5/16 wrench supplied, loosen the clamp bolt (but do not remove it) located under the sensor housing, see photo. In some sensor housing, the bolt is a 5-wings hand-operated bolt that clamps the two sections of the sensor housing.
7. After loosening the bolt, rotate the upper section of the sensor housing 90º to disengage it from the clamp.
8. Remove the upper section of the sensor housing by pulling it straight up and place it on a smooth surface.



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

9. Select the CAL (25%) range of the analyzer.
10. Remove the oxygen sensor from the bag and immediately place the sensor in the bottom section of the sensor housing. Remove the red shorting device (including the gold ribbon) from the sensor PCB.
11. Immediately place the upper section of the sensor housing over the sensor, gently push the upper section downward and rotate 90º to engage the clamp.
12. Tighten the clamp bolt.
13. The analyzer will immediately begin sampling and display oxygen contents in the gas.
14. With sample gas flowing, the display will show the oxygen reading that will gradually trend down.
15. The trending of the analyzer should be recorded on an external recording device to ensure that the trending is as expected. Wait until the display shows a meaningful oxygen reading and begins to approach the expected oxygen content of the sample gas.
16. After sensor installation, the analyzer must be calibrated to ensure correct sample analysis.

Installation of sensor is now complete, prepare to calibrate the analyzer

Calibration of Analyzer

Before analyzing sample stream, it is necessary to calibrate the analyzer. Calibration involves Zero and Span adjustment. Zero calibration eliminates any residual signal generated by analyzer electronics and or due to residual oxygen dissolved in the sensor or from a minor leakage. Zero calibration, however, is recommended only when analyzing a sample on the most sensitive range available and the accuracy required less than 5% of the most sensitive range.
Span calibration is required to adjust the sensitivity of the sensor by exposing the sensor to a known standard (a certified span gas).

Span Gas Preparation

It is essential that when using a certified span gas to adjust the analyzer sensitivity, the integrity of the span gas is maintained during installation of a pressure regulator (on span gas cylinder) to regulate span gas pressure and making span gas connection to the analyzer.

Required Components

1. Certified span gas cylinder with an oxygen concentration, balance nitrogen, approximating 50-80% of the full scale range or one range above the intended measuring range.
2. Regulator to set Span gas pressure to 5-30 psig.
3. Suitable fittings and 1/8” or 1/4" dia. metal tubing to connect the regulator to the flow meter/analyzer Span inlet
4. Suitable fitting and 1/8” or 1/4" metal tubing to connect from the flow meter vent to the analyzer tube fitting designated as SAMPLE IN (Use additional flow meter only if the analyzer is not equipped with an integral flow meter.

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 and then close the regulator exit valve.
8. Set the pressure between 5-30 psig using the pressure regulator’s control knob.
9. **Caution:** Do not exceed the recommended flow rate. Excessive flow rate could cause backpressure on sensor and may result in erroneous readings and permanent damage to sensor.

After successful SPAN calibration, the analyzer is ready to analyze sample. In certain applications, the analyzer may be required to certify oxygen contents in a gas stream below 0.5 PPM. Under such requirements, it may be necessary to perform a ZERO calibration as well (see details below).

Zero Calibration

In theory, the galvanic fuel cell type oxygen has an absolute zero meaning it produces no signal output when exposed to an oxygen free sample gas. In reality, expect the analyzer to generate an oxygen reading when sampling a zero gas due to:

1. Minor leakage in the sample line connections
2. Residual oxygen dissolved in the sensor's electrolyte
3. Tolerances of the electronic components

Technically, the zero offset is achieved by feeding a negative or positive signal to the last stage of amplification. The offset is a value in PPM and remains constant when a range is changed. For example, with a zero offset of 5 PPM on 0-10 PPM range (50% of the 10 PPM range), when the analyzer is switched to 100 PPM range, the offset will still be 5 PPM (only 5% of the 100 PPM range). The zero offset, therefore, is useful only on the most sensitive range of the analyzer (for example 10 PPM range). At higher ranges, the zero offset potentiometer will have very little effect.

Recommendations

1. Zero calibration is recommended only for analyzers performing continuous analysis below 5% of the lowest most sensitive range of the analyzer, e.g. analysis below 0.5 PPM on the 0-10 PPM range.
2. Determining the true Zero Offset requires approximately 12-24 hours stabilization period to ensure that the sensor has consumed oxygen that was dissolved in sensor's electrolyte when exposed high levels of oxygen. Allow the analyzer to stabilize with zero gas as evidenced by a stable reading or horizontal trend on an external recording device.
3. **Caution:** Prematurely adjusting the ZERO OFFSET actuator/potentiometer can result in negative readings near zero sample.
4. Once the zero offset adjustment is made, zero calibration is normally not required again until the sample system connections are modified or when installing a new oxygen sensor.
5. Zero calibration should precede span calibration

Procedure

After installation has been completed, the sensor replaced or the sample system modified, perform the ZERO CALIBRATION to resume low level oxygen analysis. Do not adjust the factory set positions of the potentiometers (ZERO OFFSET or SPAN) on the front panel until instructed to do so.

1. Connect the 0-1V or 4-20 mA signal output to an external recording device to monitor the trend of the reading.
2. Refer to the Gas Connections section – the pressure and flow rate have been set within the recommended range.
3. Introduce ultra-pure quality nitrogen zero gas to the analyzer.
4. Allow the zero gas to flow until (approximately 12-24 hours after initial start up or until the reading stabilizes as evidenced by a horizontal line parallel to the X axis on a chart recorder) before adjusting the ZERO OFFSET potentiometer.
5. The analyzer may demonstrate a downward trend for several hours (4-6 hours from air to less than 1 PPM).
6. If after 2 hours, the oxygen value displayed is not below 5 PPM, perform a complete check of all external sample system connections and allow the zero gas to flow overnight before concluding the sensor is defective and notifying the factory.
7. Once the sensor stabilizes, the oxygen reading should be well below 50% of the most sensitive range, e.g. less than 5 PPM on the 10 PPM range.
8. Turn the ZERO OFFSET potentiometer ½ turn at a time until the LED display reads 00.0
9. Close the FLOW control valve, disconnect the ZERO gas line and connect the SPAN gas line as described above.
10. Proceed to SPAN CALIBRATION

Caution: This “stabilization time” or clean-up time” or “recovery time” or “purge down time” depends on several factors such as, whether the gas lines were adequately purged, the quality of the zero gas, the length of time the sensor was exposed to ambient air while in an un-shorted condition, e.g. shorting device removed before installing the sensor in the sensor housing.

Eliminating the Zero Offset
If for any reason it becomes necessary to eliminate the previous zero offset adjustment, use the following procedure.

Either remove the sensor from the sensor housing or loosen the top section of the sensor housing, twist it 90 degree and gently pull it upwards until the sensor housing loose electrical connection with the sensor OR

Turn the sensor switch SW3 (just below the sensor cable connector on PCB A-1107 to OFF position, then turn the analyzer to the most sensitive range' for example 10 PPM range of GPR-18 ATEX analyzer and adjust the zero offset potentiometer mounted on the analyzer door (not on the PCB) until the display reads 00.00. Turn the SW3 switch to ON position or reinstall the sensor if it was removed.

After eliminating the zero offset, the reading on all ranges should be zero with +/- one digit of the range

Span Calibration

Span Calibration involves adjusting the analyzer electronics to the sensor’s signal output at a given oxygen standard. The frequency of calibration varies with the application conditions, the degree of accuracy required and the Quality Assurance System of the user in place. 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 10-15 minutes, however, the time required to bring the analyzer back on-line can vary depending on a combination of factors, for example, the value of span gas used and for how long the sensor was exposed to a particular gas:

General Recommendations

1. **Caution:** Do not adjust the SPAN before the analyzer reading has stabilized with span gas.
2. Always calibrate as close as possible to the temperature and flow of the sample gas stream.
3. For 'optimum accuracy' calibrate with a span gas approximating 50-80% of the full scale range of the intended range or one range above the intended range.
4. Calibrating with a span gas approximating 20% of the full scale range is acceptable but analysis will be less accurate.
5. When installing analyzer, consider installing an optional 3-way valve before the FLOW valve to provide a permanent connection for span gas and means of switching from SAMPLE to SPAN gas and vise versa without breaking gas line connections. This arrangement would eliminate the possibility of exposing the sensor to high O2 and shorten the calibration time. Place the SAMPLE /BYPASS valve in the BYPASS position before switching gases. After the switch allow the gas to flow for about 2 minutes to purge the gas line before switching to/from SAMPLE.

Calibration with Span Gas

1. After connecting SPAN gas, set the flow rate as close as possible to the flow rate of SAMPLE under normal use.
2. Allow the span gas to flow. Wait until the reading stabilizes before adjusting the SPAN actuator/potentiometer.
3. The analyzer reading should stabilize within 10-15 minutes.
4. If after 30 minutes the oxygen value displayed is not stable perform a complete check of all external sample/span system connections before concluding the sensor is defective and notifying the factory.
5. After the reading stabilizes, turn the SPAN actuator/potentiometer slowly until the LED display reads the desired span gas value.
6. After completing span, switch analyzer to sample gas.

If a certified span gas is not available, the analyzer may be calibrated with ambient air with known oxygen contents (20.9%).To perform calibration with ambient air, follow the procedure described below

Calibration with Ambient Air

1. Place the analyzer in the OXYGEN mode and select CAL (0-25%) range.
2. Access the interior of the analyzer by removing the bolts securing the front door.
3. Using the 5/16 wrench supplied, loosen but do not remove the clamp bolt holding the two sections of the sensor housing.
4. Rotate the upper section of the sensor housing 90º to disengage from the clamp.
5. Remove the upper section by pulling it straight up and let it rest on your 1st and 2nd fingers.
6. With your other hand, remove the oxygen sensor from the bottom section of the housing, place it in the upper section of the sensor housing ensuring the PCB contacts the two gold pins and use your thumb to hold the sensor and upper section of the sensor housing together.
7. With the sensor exposed to ambient air – allow the reading to stabilize for 1-2 minutes.
8. After the reading stabilizes, turn the SPAN actuator/potentiometer until the LED display reads the 20.9%.
9. After air calibration, reinstall the sensor as previously described.
10. With sample gas flowing, the oxygen reading will start trending down. Manually turn the RANGE selector switch to lower ranges and follow the progress of the sensor's recovery. Recover from air to low PPM (Less than 10 PPM) may take up to one hour.

Sampling

After ZERO and SPAN calibration, the analyzer is ready to analyze sample stream. Select the appropriate range of interest by turning the RANGE selector switch to the desired range.

Note: If the oxygen concentration is higher than the selected range, the display will show 1---- indicating over-range condition. If this occurs, select a higher range until the display show oxygen reading.

Set the sample flow rates between 1-2 SCFH; a flow rate of 2 SCFH is recommended. Record the signal output on any external recording device; the analog signal output, 0-1V or 4-20mA, will change linearly with oxygen concentration in the sample stream.

Should the oxygen reading goes above the alarm set point, corresponding relay will activate.

Standby

The analyzer has no special storage requirements.
The sensor should remain installed in the sensor housing during storage periods – place the 4-way SAMPLE/BYPASS crossover valve in the BYPASS position.
Store the analyzer with power OFF.

6. Maintenance

With exception of components related to optional equipment, replacing the sensor is the extent of the maintenance requirements of this analyzer. There are no serviceable parts in the analyzer.

Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service. In the event an analyzer component fails, it must be serviced only by a trained personnel and with prior authorization from the factory maintenance.

Maintenance of Analyzer Enclosure

After installation, the unit must be inspected regularly to verify the cover bolts are tight, all conduit or gland connections are intact and free of corrosion and that the enclosure mounting bolts are tight and in good condition. The sealing surfaces must be inspected; surfaces must be free of nicks, dirt or any foreign particle build-up that would prevent a proper seal.

Warning: Should the flange surface be damaged, consult factory. Never attempt to rework the surface of flange in the field. Apply a light coating of Killark "LUBG" lubricant to the enclosure surface flange before re-installing. Wrench down the bolts and torque the bolts to 30ft/ibs.

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 used under ambient conditions. Expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.

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.

To replace sensor, follow steps delineated in section 5 Operation under “installation of the Oxygen Sensor”

7. Spare Parts

Recommended spare parts for the GPR-18 Explosion Proof ppm Oxygen Analyzer:

Item No.	Description
GPR-12-333	PPM Oxygen Sensor
XLT-12-333	PPM Oxygen Sensor (for sample gas containing CO2)

Other spare parts:

Item No.	Description
IC-1007	Amplifier E/I Converter 4-20mA Isolated
CTRL-1004	Controller Temperature Proportional Fuji
A-3290	Flow Indicator 1/4" FNPT SS Glass Viton O-rings 2x10"
FUSE-1010	Fuse 3A 240V TR5
FUSE-1003	Fuse Holder TR5
HTR-1006	Heater 110VAC
HTR-1007	Heater 220VAC
MTR-1002	Meter Digital Panel LED 3.5 Digit
ORNG-1007	O-ring 3/32 x 1-3/8 x 1-9/16 Viton
A-1106-M	PCB Assembly Main / Display
A-1107-M	PCB Assembly Power Supply / Interconnection
A-1016-A	Sensor Housing Assembly Stainless Steel, Bottom Section only
B-2762-A-2-28	Sensor Housing Assembly Stainless Steel, Upper Section only
A-1004-2-28	Sensor Housing Assembly Stainless Steel, Bottom and Upper Sections
SNSR-1001	Sensor Temperature RTD
SNSR-1002	Sensor Temperature Runaway Protector J-2 PEPI
A-2610	Range Switch Assembly
TOOL-1001	Tool 5/16" Combination Wrench
VALV-1031	Cross-over Valve SS
FMTR-1004	Flow Meter SS Glass

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 (use a 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
	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	**Upper section of sensor housing:** Clean contacts with

	sensor housing from liquid in sample or electrolyte leakage from sensor	alcohol, flow sample or zero gas for 2-3 hours to flush sample system and sensor housing **Sensor:** Replace if leaking and return it to the factory for warranty determination
	Liquid covering sensing area	Wipe with alcohol and lint free towel or flow sample or zero gas for 2-3 hours to flush
	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
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: 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 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	Introduce span gas to determine if the sensor responds. If successful calibrate the analyzer and resume sampling 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. 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 7:30 AM and 5:00 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	If the sensor leaks inside the plastic shipping bag or inside an analyzer sensor housing do not remove it without rubber or latex gloves and safety glasses and a source of water. 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

Appendix A

Electrical connections require approved explosion proof sealing fittings and packing around wires and cables coming into or going out of the enclosure. Conduit seals and fittings must be certified "Ex d" components per EN60079-1 whose design and installation comply with ATEX standards for hazardous locations

Warning: Seal fittings must be installed within 18" of this enclosure for IIB + H_2 locations.

All unused opening must be closed with a Killark CUP, CUPX, PLUG, GO-8177 series close=up plug or an Ex d certified close-up plug or sealing plug.

Hazardous area electrical code requires that the wires and cables be protected by conduit. Advanced Instruments recognizes the need of safe operation of this analyzer and strongly recommends the user to adhere to all safety related directives during installation and operation

Explosion Proof Packing Fiber (non-asbestos)

For use as packing at the hub of sealing fittings. Use only ATEX approved packing fiber.
Note: These instructions are supplied from information and data which we believe is reliable and is given in good faith. Since our methods of application and conditions under which our products are put to use are beyond our control, we are not able to guarantee the application and/or use of same. The user assumes all risks and liability in connection with the application, installation and use of our products.

Directions: Tamp packing fiber between and around conductors where they enter fitting to prevent leakage of the liquid cement. Make sure conductors are **not** in contact with each other or with fitting wall. Leave enough space in the fitting - space/ length equivalent to the inside diameter of the conduit but not less than 5/8".

Caution:
Use gloves and long sleeve overhaul to protect yourself from any dust or fiber that might be generated during packing.
Avoid contact with skin.
Do not breath over/close to packing fiber; prolonged contact/exposure may cause lung, eye or skin irritation.

Explosion Proof Sealing Cement

Directions: After tamp packing fiber between and around conductors, prepare the sealing resin.
Warning: Use only ATEX approved sealant and prepare the sealant by mixing the resin cathalizing agent as recommended by the manufacturer and apply the resin as recommended by the manufacturer.

The following sealant for sealing fittings is ATEX approved.

ELFIT RESIN (Component A)	CRV420
ELFIT CATHALIZING AGENT (Component B)	CRV420H72

Mixing ration: 100 g Component A
25 g Component B

Mix component A and B to obtain a homogeneous compound.
Pour the mixture into the sealing connection immediately
Allow the mixture to cure for 72 hours

Caution: Follow manufacturer procedure for more details of mixing two components and pouring the resulting resin in the sealing fittings.

Warning: At least five threads must engage on all fill plugs.