# Advanced Instruments Inc.

## Technical Specifications

| | |
|---|---|
| Accuracy: | < 2% of FS range under constant conditions |
| Analysis: | 0-1%, 0-5%, 0-10%, 0-25% FS ranges |
| Application: | Oxygen analysis from 0.001% to 25% in inert, helium, hydrogen, CO2 and mixed gas streams |
| Approvals: | ATEX Certified explosion proof Ex d IIB+$H_2$ T6 or T5 Gb |
| 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, 1-2 SCFH recommended |
| Linearity: | > .995 over all ranges |
| Pressure: | Inlet - regulate to 5-30 psig, max 100 psig; vent - atmospheric not to exceed ±5" water column |
| Power: | Specify 100/120 or 220/240 VAC |

Recovery Time:

| $O_2$ Level | Duration | $O_2$ Target | Recovery on $N_2$ |
|---|---|---|---|
| Air | 30 sec | 0.1% | 30 Sec* |

* At sensor Installation

| | |
|---|---|
| Response Time: | 90% of final FS reading < 20 seconds |
| Sample System: | Flow control and bypass valves; flow indicator |
| Sensitivity: | < 0.5% of FS range |
| Sensor Model: | GPR-11-32 |
| Sensor Life: | 36 months at 25ºC and 1 atm; average $O_2$ < 100 ppm |
| Signal Output: | 4-20mA isolated and 0-1V |
| Temp. Range: | 5º to 45ºC |
| Warranty: | 12 months analyzer; 12 months sensor |
| Wetted Parts: | Stainless steel |

## Optional Equipment

XLT-11-24 sensor for gases containing >0.5% CO2

Temperature controlled heater system (recommended for analysis < 0.01%)

Sample conditioning accessories - contact factory


# GPR-28 ATEX Explosion Proof ppm $O_2$ Analyzer

## ATEX Directive 94/9/EC

**II 2 G**
**Ex d IIB or d IIB+$H_2$ T6 or T5 Gb**

**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)**

**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-28 ATEX Explosion Proof % Oxygen Analyzer

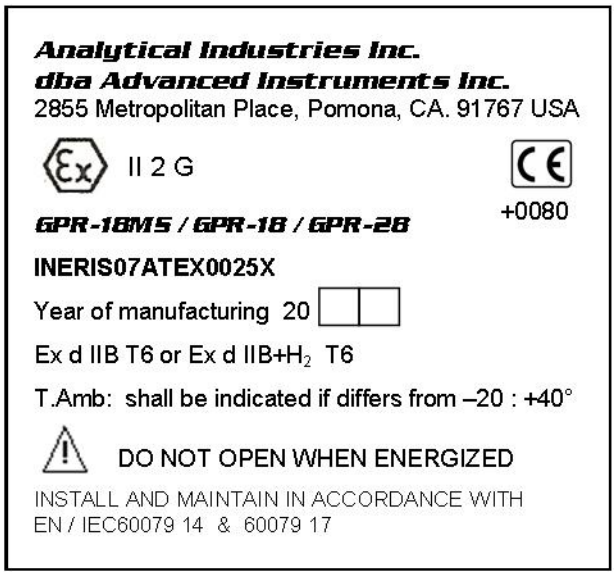

# Owner's Manual

Revised Feb 12, 2015

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

# Table of Contents

# 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 ATEX 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-28 Explosion Proof PPM O2 Analyzer | **S/N** _____ | |
| **Sensor:** | ( ) GPR-11-32 % Oxygen Sensor | | |
| | ( ) XLT-11-24 % 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-C PCB Assembly Main / Display | | |
| | A-1106-C PCB Assembly Power / Relay | | |
| | Range: 0-1%, 0-5%, 0-10%, 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 | | |
| **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 recommended to maintain 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

The analyzer is supplied with either a GPR Series or XLT series % 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 0.5%

**Note:** With reference to the published specification (see section 4), the expected life of oxygen sensor is stated on the basis of average oxygen concentration of 20.9%, 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°C.

**Caution:** At temperatures above 25°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: | < 2% of FS range under constant conditions |
| Analysis: | 0-1%, 0-5%, 0-10%, 0-25% FS ranges |
| Application: | Oxygen analysis from 0.001% to 25% in inert, helium, hydrogen, CO2 and mixed gas streams |
| Approvals: | ATEX Certified explosion proof Ex d IIB+$H_2$ T6 or T5 Gb |
| 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 .001 % |
| Enclosure: | Painted aluminum 16" x 18" x 11" wall mount, 70 lbs. |
| Flow Sensitivity: | None between 1-5 SCFH, 1-2 SCFH recommended |
| Linearity: | > .995 over all ranges |
| Pressure: | Inlet - regulate to 5-30 psig, max 100 psig; vent - atmospheric not to exceed ±5" water column |
| Power: | Specify 100/120 or 220/240 VAC |
| Recovery Time: | $O_2$ Level: Air; Duration: 30 sec; $O_2$ Target: 0.1%; Recovery on $N_2$: 30 Sec* |
| | * At sensor Installation |
| Response Time: | 90% of final FS reading < 20 seconds |
| Sample System: | Flow control and flow indicator |
| Sensitivity: | < 0.5% of FS range |
| Sensor Model: | GPR-11-32 |
| Sensor Life: | 36 months at 25ºC and 1 atm |
| Signal Output: | 4-20mA isolated and 0-1V |
| Temp. Range: | 5º to 45ºC |
| Warranty: | 12 months analyzer; 12 months sensor |
| Wetted Parts: | Stainless steel |

## Optional Equipment

XLT-11-24 sensor for gases containing >0.5% CO2

Temperature controlled heater system (recommended for analysis < 0.1%)

Sample conditioning accessories - contact factory


*GPR-28 ATEX*
*Explosion Proof*
*ppm $O_2$ Analyzer*

**ATEX Directive 94/9/EC**

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

**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 8/2013

# 5. Operation

## Principle of Operation

The GPR-28 ATEX oxygen analyzer incorporates a variety of % range advanced galvanic fuel cell type oxygen sensors. The analyzer is suitable for use in hazardous area and  is configured with an explosion proof enclosure, flame arrestors and actuators approved to comply with ATEX Directive 94/9/EC

## Area Classification

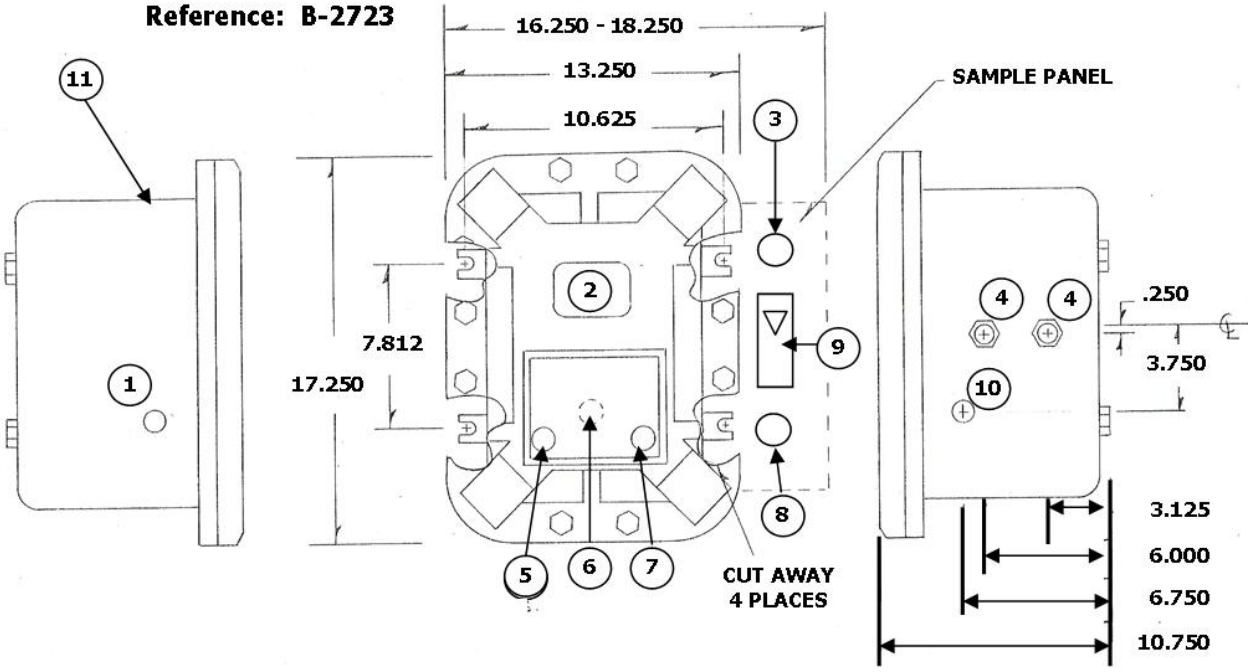
Analyzer conforms to ATEX Directive 94/9/EC and carries the following hazardous area rating.

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

# Mounting the Analyzer

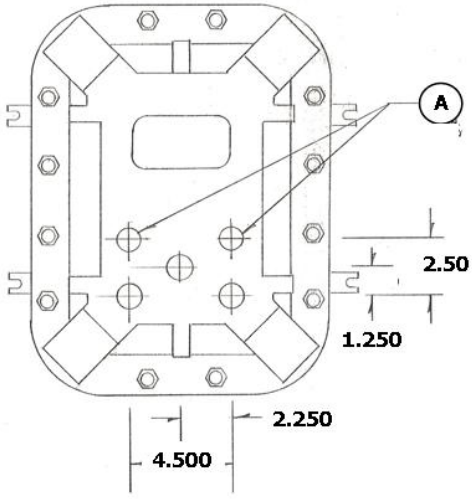
The GPR-28 % ATEX Oxygen Analyzer consists of two PCB assemblies, sensor housing and sample system including sample flow control valve and flow meter. An optional temperature controlled heater system is available that enhances the analyzer stability in changing ambient temperature environment. In standard configuration the alarm controls are integral to the main PCB and cannot be 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 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. 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**.

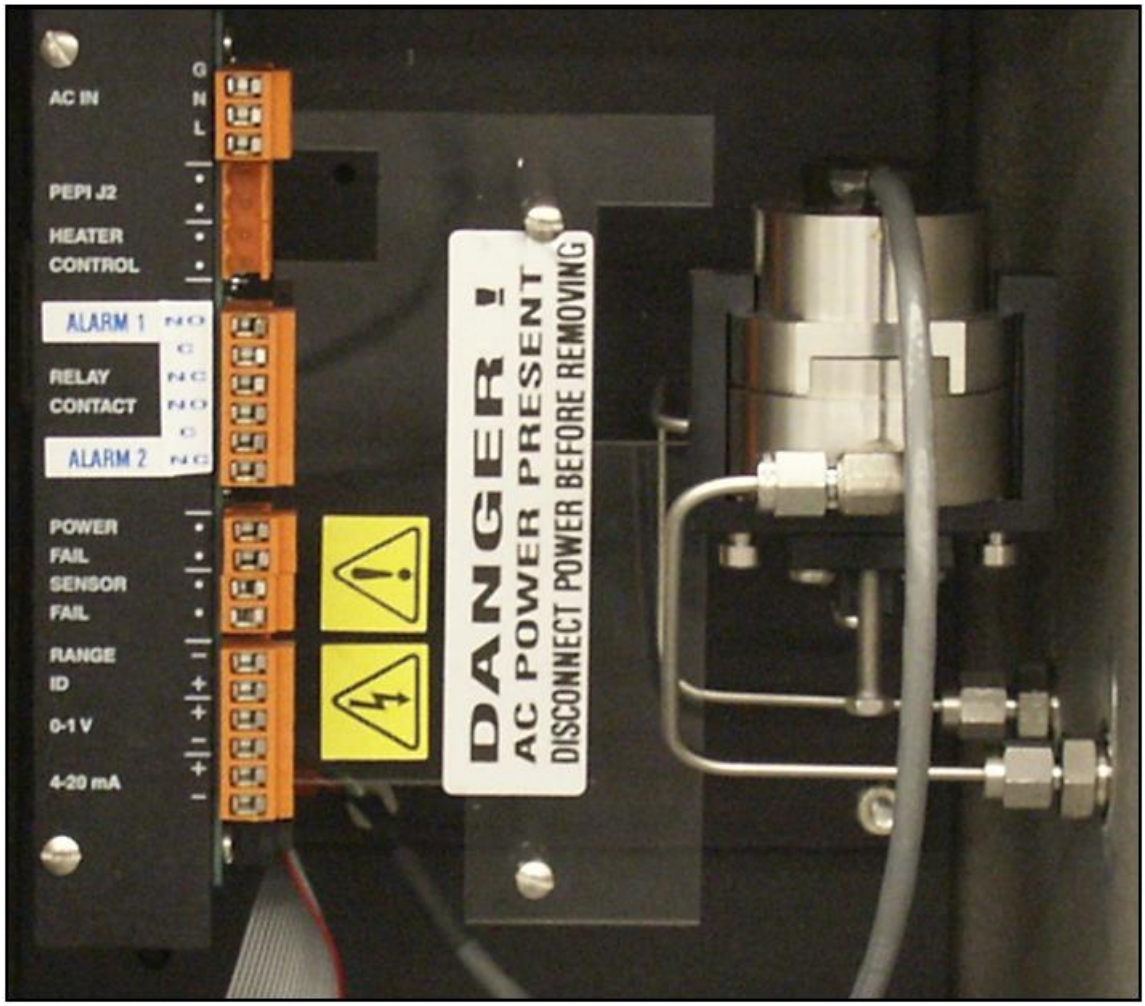
# Electrical Connections

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 System 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, a sample flow control valve and a flow meter. Optional coalescing filter and H2S scrubber are available Check your analyzer QC certificate to confirm the sample system option purchased.

**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-28 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 marked on the analyzer integral Sample Panel

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

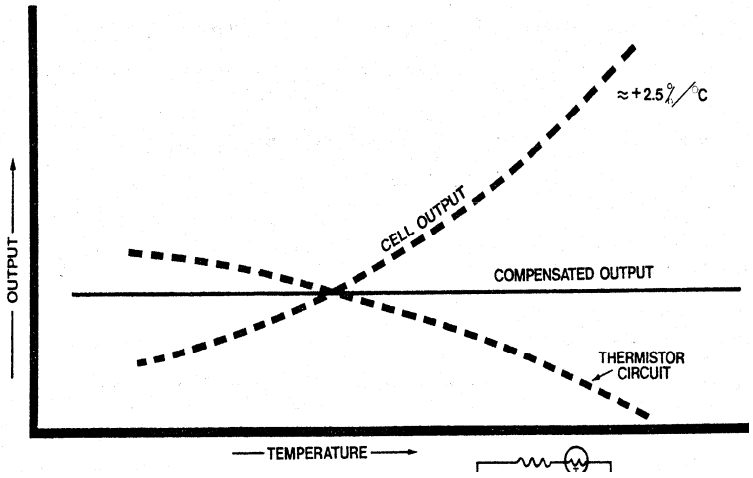
# Sensor Technology

All galvanic type sensors function on the same principle and are specific to oxygen. They measure the partial pressure of oxygen in a gas stream. 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.

# Accuracy & Calibration of Analyzer

**Single Point Calibration:** As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in sample gas. In the absence of oxygen the sensor exhibits an absolute zero; the sensor does not generate current in the absence of oxygen. Given the linearity and absolute zero properties, a single point calibration of analyzer is possible.




**Pressure:** Since the sensor is sensitive to the partial pressure of oxygen, its output is a function of the number of oxygen molecules per unit volume of a gas stream. The number of oxygen molecules per unit volume will increase proportionally with pressure. For best accuracy, the pressure at the sensor must remain constant during analysis.

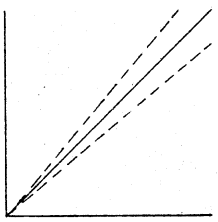
**Temperature:** The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier. The fact that all diffusion processes are temperature sensitive, the sensor's electrical output also varies with temperature. This variation 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). 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.

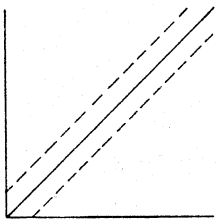
**Accuracy:** The overall accuracy of an analyzer over its operating temperature is affected by two factors:

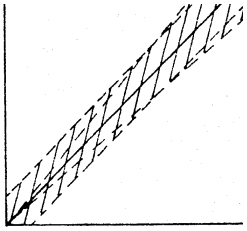
1) 'Percent of reading errors', illustrated by Graph A below, such as ±5% inherited error in the temperature compensation circuit due to the tolerances of the resistors and thermistor used in the temperature compensation circuit.

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.

# 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

Optional Feature; 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.

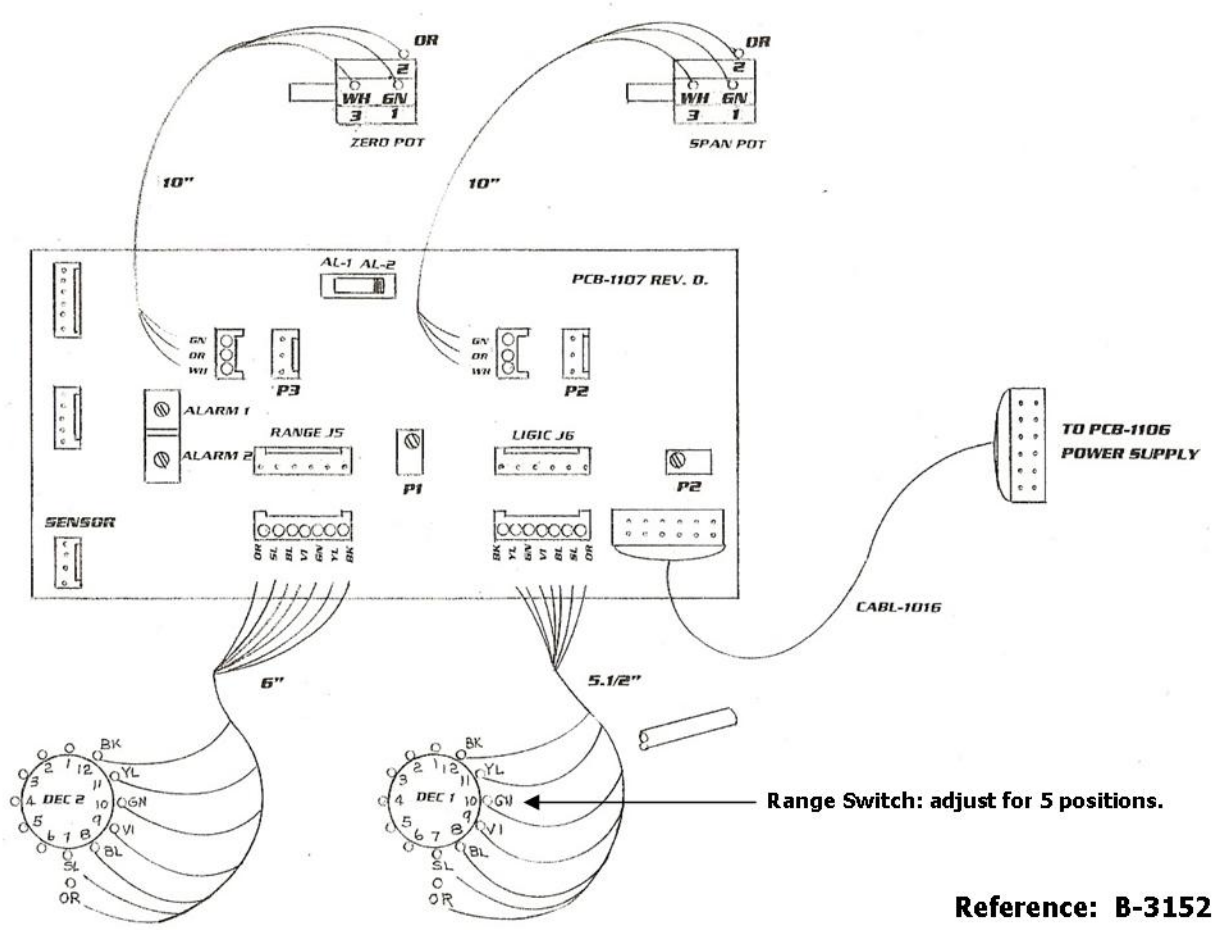
It is recommended that at initial start-up, or when replacing oxygen sensor or when trouble shooting, set the set point around 60°F to turn heater off (to prevent overheating of heater element).

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

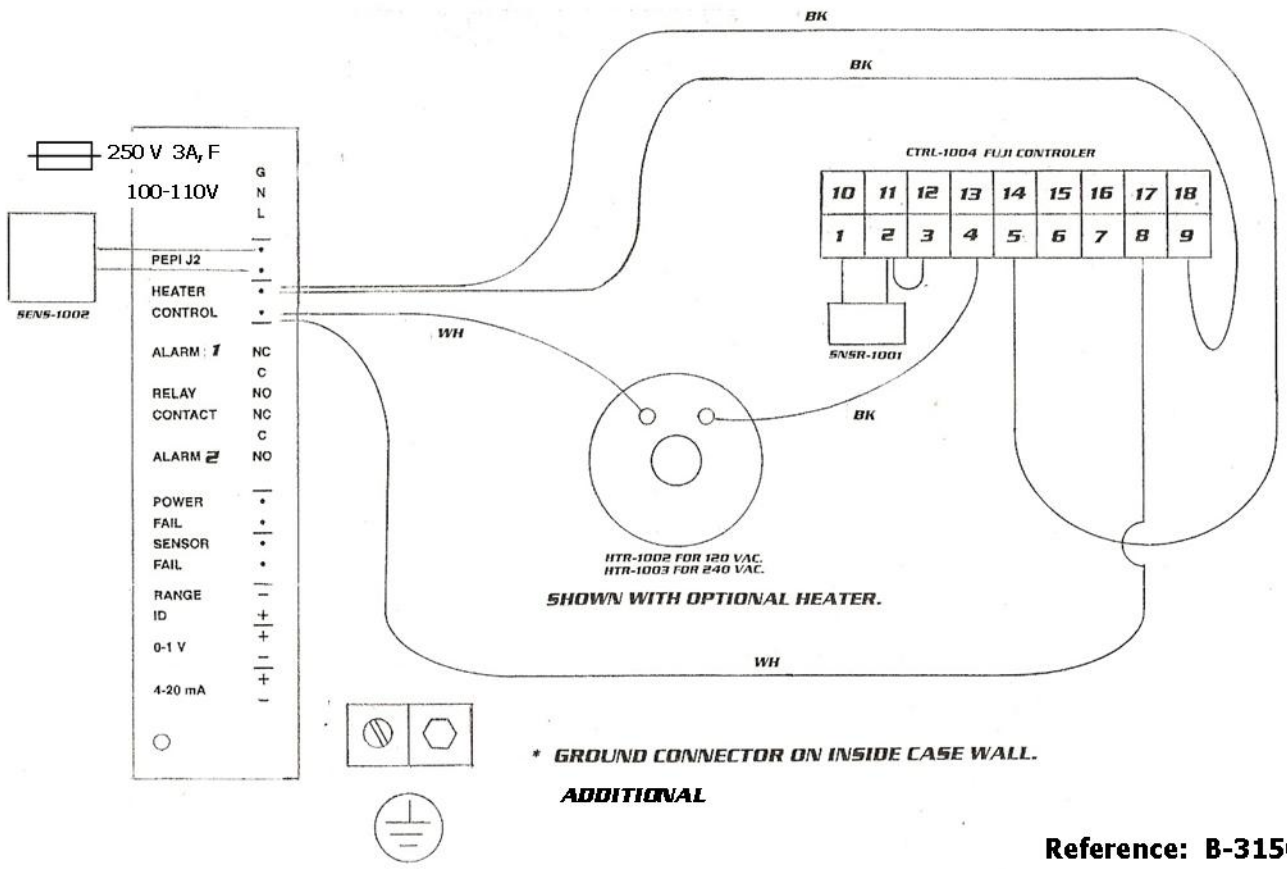
**Heater Runaway Protection**
As part of the optional temperature controlled heater system, the analyzer is protected in the event the temperature controller should fail and thereby allowing the heater to runaway damaging the interior of the analysis unit. The runaway protection is provided by a J2 type 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 only. The user is not required to establish any of the wiring shown in the diagrams below.**

**Range switch and span/zero potentiometer wiring schematic**

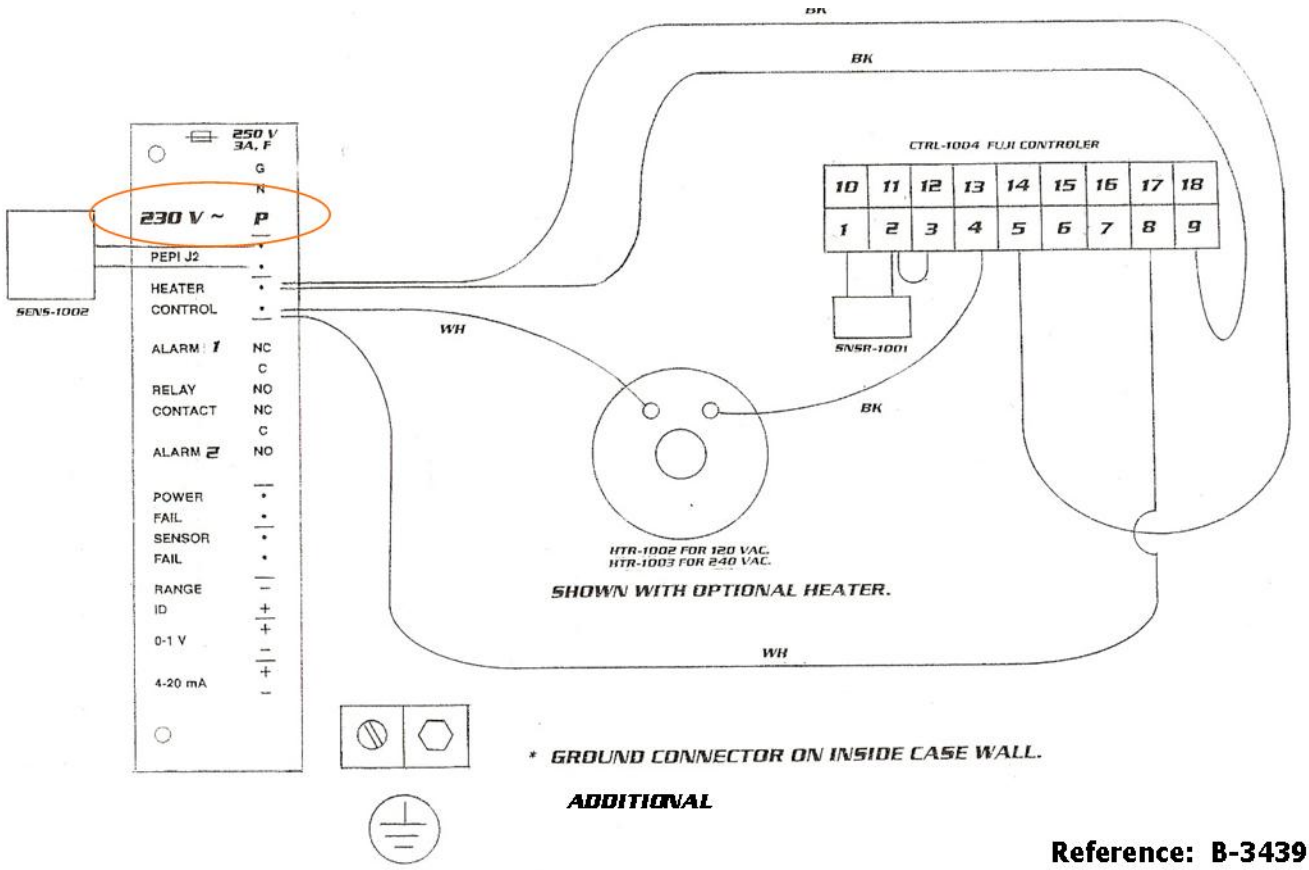


**Optional 110 VAC temperature controlled heater wiring:**




**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 four (4) 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 Section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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.

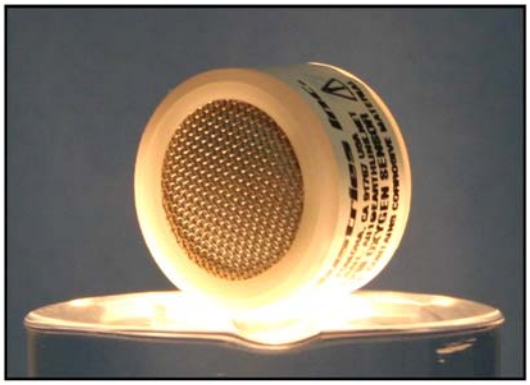
# Procedure

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**

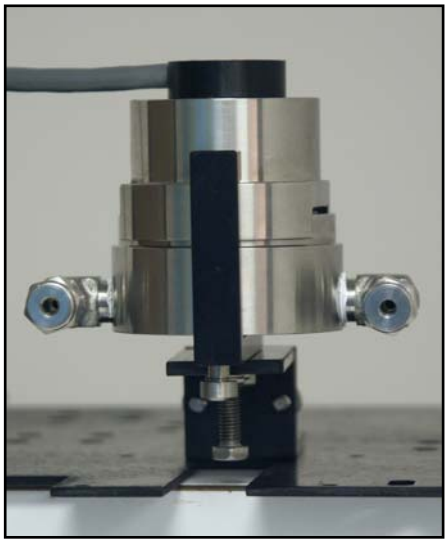
# Installing the Oxygen Sensor

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

The analyzer is generally shipped with the sensor installed. If it becomes necessary to install a sensor in the field, follow the procedure below.

1. Turn the Sample/Bypass valve to Bypass position.
2. Set Sample flow between 2 SCFH.
3. 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 replaced with a 5-wings hand-operated knob that clamps the two sections of the sensor housing.
4. After loosening the bolt, rotate the upper section of the sensor

housing 90º to disengage it from the clamp.

5. Remove the upper section of the sensor housing by pulling it straight up and place it on a smooth surface.



Sequence of installation of sensor 1) remove sensor from bag, 2) place sensor in the sensor housing, 3) 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 clamp

6. Select the CAL (25%) range of the analyzer.
7. 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.
8. 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.
9. Tighten the clamp bolt.
10. The analyzer will immediately begin sampling and display oxygen contents in the gas.
11. With sample gas flowing, the display will show the oxygen reading that will gradually trend down.
12. 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.
13. 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. Span calibration adjusts the analyzer electronics sensitivity when sensor is exposed to a known standard (a certified span gas). 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 one (1) months.

**Note**: Regardless of the oxygen concentration of the standard used, the span calibration process takes approximately 10-15 minutes,

# 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.

## Calibration with Ambient Air

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

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 or turning thumb knob, 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 sensor PCB contacts the two gold pins in the sensor housing. 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.

## Sampling

After 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.

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.

**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.

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.
Store the analyzer away from heat.
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/lbs**.

## 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-11-32 | % Oxygen Sensor |
| XLT-11-24 | % 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 |
| 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-C | PCB Assembly Main / Display |
| A-1107-C | 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 |
| FMTR-1002 | 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, air leakage in connections, too long sample line, low flow rate, high volume of optional filters and scrubbers | Leak test the entire sample system:<br>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 |
| | Damaged in service | 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: | Allow $O_2$ reading to stabilize before making the span/calibration adjustment |
| | | Leak test the entire sample system |
| High $O_2$ reading Sampling | Flow rate exceeds limits | Correct pressure and flow rate |
| | Pressurized sensor | Remove restriction on vent line, replace sensor |
| | Abnormality in gas | Qualify the gas (use a portable analyzer) |
| 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 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<br>**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 |

| Symptom | Possible Cause | Recommended Action |
|---|---|---|
| No $O_2$ reading<br>Negative $O_2$ reading | Failure of an electronic component or power surge that sends a charge to the sensor<br><br>Pressurizing the sensor by:<br><br>a) Flowing gas to the sensor with the vent restricted<br><br>b) Drawing a vacuum on the sensor | Introduce span gas to determine if the sensor responds.<br><br>If successful calibrate the analyzer and resume sampling<br><br>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.<br>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.**