Advanced Instruments Inc.

GPR-1200 MS
Portable ppm Oxygen Analyzer

Owner's Manual

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1 Introduction

Your new portable oxygen analyzer incorporates an advanced electrochemical sensor specific to oxygen along with state-of-the-art digital electronics designed to give you years of reliable precise oxygen measurements in variety of industrial oxygen applications. To obtain maximum performance from your new oxygen analyzer, please read and follow the guidelines provided in this Owner's Manual.

Every effort has been made to select the most reliable state of the art materials and components; and, to design the analyzer for superior performance and minimal cost of ownership. This analyzer was tested thoroughly by the manufacturer prior to shipment for best performance.

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

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

Serial Number: _____

Advanced Instruments Inc. appreciates your business and pledges to make every effort to maintain the highest possible quality standards with respect to product design, manufacturing and service.

2 Quality Control Certification

Date:	**Customer:** **Order No.:**	**Pass**
Model	GPR-1200 MSMS Portable ppm Oxygen Analyzer	
Sensor	( ) GPR-12-2000MS ppm Oxygen Sensor	
Serial Nos.	Analyzer_____ Sensor _____	
Accessories	Owner's Manual	
	( ) PWRS-1002 9VDC Battery Charger/Adapter 110VAC	
	( ) PWRS-1003 9VDC Battery Charger/Adapter 220VAC	
	( ) PWRS-1008 9VDC Battery Charger/Adapter 12VDC Auto Cigarette Lighter	
	CONN-1034 Plug Mini Phone .141 dia. Black Handle	
	TOOL-1001 5/16 Combination Wrench	
Configuration	A-1151-E-B6-NB PCB Assembly Main/Display	
	Range: 0-1 ppm, 0-1 ppm, 0-100 ppm, 0-1000 ppm	
	Wetted parts: Stainless steel	
	Crossover bypass/shut off valve	
Electronics Test	LED indicators: Low battery, charge	
	Electronic offset	
	Analog signal output 0-1V	
Gas Phase Test	Baseline drift on zero gas < ± 2% FS over 24 hour period on 0-1% range	
	Noise level < ± 0.5% FS	
	Span adjustment within 10-50% FS	
Final	Overall inspection for physical defects	
Options		NA
Notes	1 of 1 analyzers due ASAP	

3 Safety

General

This section summarizes the essential precautions applicable to the GPR-1200 MS Series Portable ppm Oxygen Analyzer. Additional precautions specific to individual analyzer are contained in the following sections of this manual. To operate the analyzer safely and obtain maximum performance follow the basic guidelines outlined in this Owner's Manual.

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

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

Read Instructions: Before operating the analyzer read the instructions.

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

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

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

Installation

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

Exposure to air: Minimize the time the sensor is exposed to air during installation.

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

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

Flow Rate: Recommended – 1 SCFH

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

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

Operating Temperature: The maximum operating temperature is 45º C.

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

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

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

Maintenance

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

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

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

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

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

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

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

4 Specifications *

Accuracy:	< 1% of FS range under constant conditions
Analysis:	0-1 ppm, 0-10, 0-100, 0-1000 ppm FS ranges; auto-ranging or manually lock on single range
Application:	Analyze oxygen concentrations from 10 ppb to 1000 ppm in inert, hydrocarbon, helium, hydrogen and gas streams
Approvals:	CE, Intrinsic Safety (pending)
Area Classification:	Meets recognized intrinsic safety standards for use in Class 1, Division 1, Group C, D hazardous areas (see Options)
Calibration:	Certified gas of O_2 balance N_2 approximating 80% of analysis range or one range above analysis range
Compensation:	Temperature and barometric pressure
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration and system functions
Display:	Graphical LCD 2.75 x 1.375; resolution .001 ppb; displays real time ambient temperature and pressure
Enclosure:	Painted aluminum NEMA 4X, 8.6x9x3", 12 lbs.
Flow Sensitivity:	None between 1-3 SCFH, 1 SCFH recommended
LED Indicators:	LOW BATT (72 hr. warning); CHARGE mode
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig; vent - atmospheric
Power:	Rechargeable battery, 60 day duty cycle (pump 1 day)
Recovery Time:	60 seconds in air to < 1 ppm in < 20 minutes on N_2 purge
Response Time:	90% of final FS reading in 10 seconds
Sample System:	Flow control, bypass and isolation valves; flow indicator
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-12-2000MS
Sensor Life:	24 months at 25ºC and 1 atm; average O_2 < 100 ppm
Signal Output:	0-1V
Temp. Range:	5º to 45ºC
Warranty:	12 months analyzer; 12 months sensor
Wetted Parts:	Stainless steel

Optional Equipment

Integral sampling pump - general purpose or intrinsically safe designs

Carrying case with custom foam insert

Sample conditioning accessories - contact factory

* Specifications subject to change without notice

GPR-1200 MS
Portable ppm O_2 Analyzer

Advanced Sensor Technology
- **Accuracy < 1% FS Range**
- **Sensitivity < 0.5% FS Range**
- **Fast Recovery to < 1 ppm**
- **24 Month Expected Life**
- **No Maintenance**

Intrinsically Safe Design

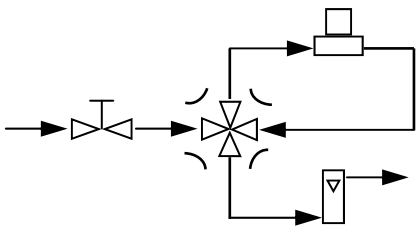
4 Standard Analysis Ranges

Auto or Manual Ranging

SS Bypass Sample System

Water Resistant Enclosure

ISO 9001:2008 Approved QA System



Integral bypass sample system increases productivity.

5 Operation

Principle of Operation

The GPR-1200 MS portable oxygen analyzer incorporates a proprietary Pico-Ion oxygen sensor. The analyzer is configured in a general purpose NEMA 4 rated enclosure and meets the intrinsic safety standards required for use in Class 1, Division 1, Groups A, B, C, D hazardous areas. Two integral sampling pump options are available – one that meets the intrinsic safety standards and a less expensive option for general purpose service.

Breakthrough Sensor Technology:

A breakthrough sensor technology measures the partial pressure of oxygen from less than 10 ppb to 1000 ppm level in inert gases, gaseous hydrocarbons, helium, hydrogen and mixed gas streams. The “Pico-Ion” sensor design and chemistry have been combined to produce a significant advancement in oxygen sensor technology.

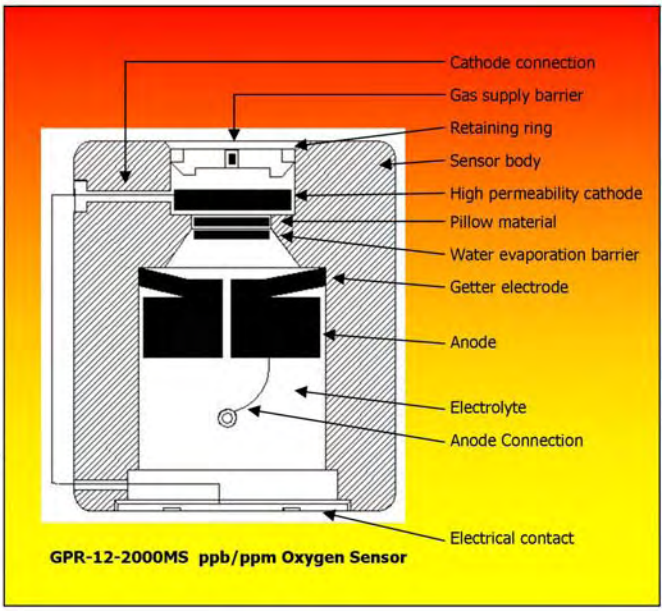
Pico-Ion ‘MS’ Oxygen Sensor

Design Criteria

The evolution of electronics influences virtually every aspect of our personal and business lives. The world of industrial gas analyzers is no exception. However, often overlooked is the fact that the heart of any analyzer is the sensor. Thus advancing the sensor technology is a critical element in the development of analyzers.

- Proprietary metal catalyzed cathode . . .
  - High signal output 10x greater than galvanic sensors
  - High signal to noise ratio
  - Fast response time
- Maximize the rate oxygen is reacted . . . Minimize oxygen dissolving into electrolyte
- Fast recovery from exposure to oxygen

O_2 Exposure	Duration	O_2 Target	Recovery
Air	30 sec	10 ppm	15 min
Air	30 sec	1 ppm	45 min
9 ppm	2 min	100 ppb	3 min
9 ppm	2 min	10 ppb	10 min
1 ppm	5 min	10 ppb	15 min



- Lower detectable limit < 10 ppb
- High accuracy and repeatability < ±1%
- Employ a water evaporation limiting barrier
- Employ a barrier to limit the amount of oxygen dissolving into electrolyte
- Operating life minimum 36 month target
- No sensor maintenance
- Compact disposable design
- Long term stability less than 5% drift from span over 6 months
- Extended intervals between calibration minimum 3 months to 6 month target
- Readily transportable and insensitive to minor mechanical shock
- Low cost of ownership

Oxygen, the fuel for this electrochemical transducer, 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 four ranges and remains virtually constant over its useful life. The sensor requires no maintenance or electrolyte addition and is easily and safely replaced at the end of its useful life.

The signal generated by the sensor is processed by state of the art low power micro-processor based digital circuitry. The first stage amplifies the signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for signal output variations caused by ambient temperature changes. The result is a very stable signal. Several selectable averaging modes are available to enhance the stability of the analyzer and eliminate anomalies if desired. Sample oxygen is analyzed very accurately. Response time of 90% of full scale is less than 10 seconds on the 0-1 ppm range (actual experience may vary due to the integrity of sample line connections, dead volume and flow rate selected).

Electronics:
The signal generated by the sensor is processed by state of the art low power micro-processor based digital circuitry. The first stage amplifies the signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for signal output variations caused by ambient temperature changes. The result is a very stable signal. Sample oxygen is analyzed very accurately. Response time of 90% of full scale is less than 10 seconds (actual experience may vary due to the integrity of sample line connections, dead volume and flow rate selected) on all ranges under ambient monitoring conditions. Sensitivity is typically 0.5% of full scale low range. Oxygen readings may be recorded by an external device via the 0-1V signal output jack.

Power is supplied by an integral rechargeable lead acid battery which provides enough power to operate the analyzer continuously for approximately 60 days. An LED located on the front panel provides a blinking 72 hour warning to recharge the battery. A 9VAC adapter (positive pole located on the inside of the female connector) can be used to recharge the battery from a convenience outlet. The analyzer is designed to be fully operational during the 8-10 hour charging cycle which is indicated by a second continuously lit LED.

Sample System:
The GPR-1200 MS is supplied with a bypass sample system which enables the user to isolate the sensor from exposure to high oxygen concentration which results is a substantial increase is user productivity. The bypass feature has two important features: One, the sensor can be isolated from exposure to high oxygen levels when changing sample lines, during transport and during standby intervals making it ideal for mobile cart applications. Two, it enables the user to purge newly connected gas lines of the oxygen trapped inside. The result is an analyzer that comes on-line at ppb levels in a matter of minutes and provides users with a significant increase in productivity.

However the sample must be properly presented to the sensor to ensure an accurate measurement. Users interested in adding their own sample conditioning system should consult the factory. Advanced Instruments Inc. offers a full line of sample handling, conditioning and expertise to meet your application requirements. Contact us at 909-392-6900 or e-mail us at info@aii1.com

Pressure & Flow

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

The sensor is exposed to sample gas that must flow or be drawn through the analyzer's internal sample system. Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH generate backpressure and erroneous oxygen readings because the diameter of the integral tubing cannot evacuate the sample gas at the higher flow rate.

A flow control valve upstream of the sensor controls the flow rate of the sample gas which is displayed by the flow indicator downstream of the sensor. A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

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

Positive Pressure Applications:
If the sample pressure is greater than 30 psig an external pressure regulator (optional) is required upstream of the analyzer to control of sample flow. A pressure regulator with a metallic diaphragm is recommended to prevent high oxygen readings that could result from the use of diaphragms constructed of more gas permeable materials.

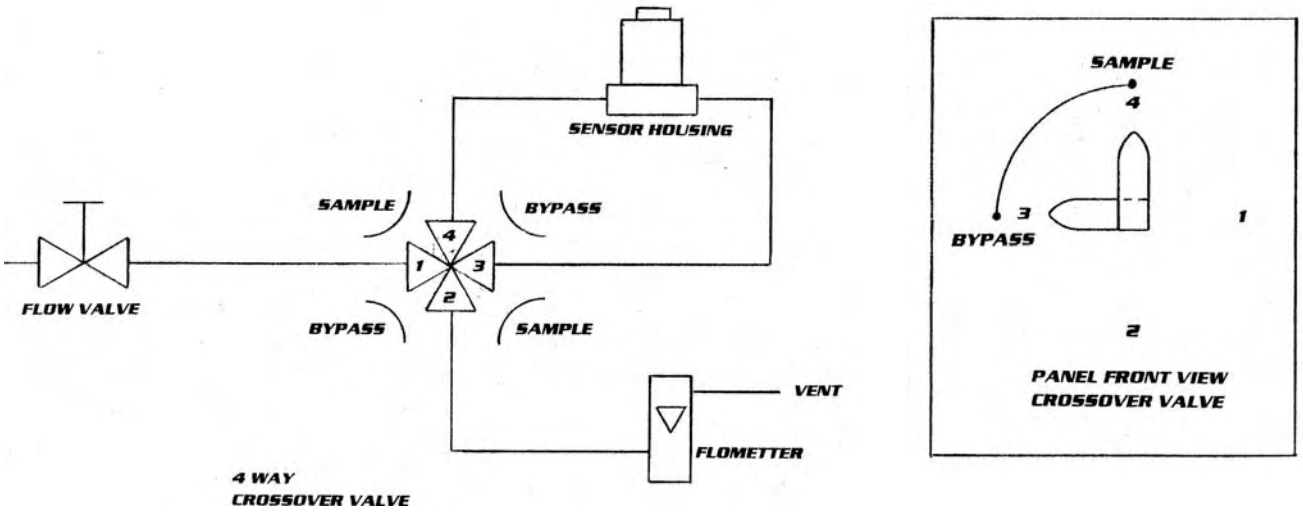
If other optional sample system components such as coiled metal tubing (samples must be cooled to at least 35-40º C for continuous use), coalescing filters, scrubbers, etc. are required install the pressure regulator after the coiled tubing and before the other components and the analyzer. Note: A scrubber requires a flow valve upstream for optimum efficiency and response time and that the analyzer flow valve is opened completely.

Atmospheric or Slightly Negative Pressure Applications:
For accurate high ppb and/or low ppm range measurements, an optional sample pump is required downstream of the analyzer to draw the sample through the analyzer. The vacuum drawn on the analyzer and sensor should not exceed 4" of water.

Caution: Use of pump downstream of the sensor requires the flow control valve upstream of the sensor be completely opened to avoid drawing excessive vacuum on the sensor, which can damage the sensor.

If pump over-loading (due to the limitation of low flow rate of the sample gas) is a consideration, a second throttle valve on the pump's inlet side may be necessary to provide a bypass path, as illustrated below, to prevent the pump from over-loading and over-heating while maintaining the required sample flow rate within the above-mentioned parameters.

Standard Bypass Sample System
The GPR-1200MS Portable 0-1 ppm Oxygen Analyzer is equipped with a bypass sample system featured below:
1. Manufacturer supplies the analyzer with the sensor it was qualified with.
2. Isolate the sensor during transport and maintenance intervals and extend sensor life.
3. Isolate the sensor from exposure to high oxygen levels during upset conditions and extend sensor life.
4. Purge the high oxygen levels or air trapped in the sample system following a process upset, changing sample gas lines or connecting span gas lines.
5. Increase productivity by complimenting the recovery capability of the sensor to reduce downtime.



The sample system may include optional additional components such as a 3-way sample/span valve, a pressure regulator, coiled metal tubing (samples must be cooled to at least 35-40º C for continuous use), coalescing filters, scrubbers, 3-way sample/return valve, backpressure regulator, etc.

Note: The standard sample system is designed for positive pressure applications as described below under the Installation section. From the factory the sensor is isolated inside the analyzer, sample system in the BYPASS position, and the FLOW control valve set between 1 SCFH.

Caution: To avoid damaging the sensor comply with the following guidelines - failure to do so will possibly damage the sensor and/or voiding the sensor warranty.

1. Drawing a vacuum on the sensor by pressurizing the analyzer: Results when sample gas flows into the analyzer, builds up within the analyzer sample system because the outlet vent is restricted, and, is suddenly released when the blockage is removed. This sudden release of backpressure draws a vacuum on the sensor stressing the sensor's front and rear seals to the point they rupture and the sensor leaks (voiding the sensor warranty).

2. Drawing a vacuum on the sensor when using a sampling pump downstream of the analyzer: Assure the FLOW valve is completely open. If the FLOW valve is not completely open, the resulting vacuum drawn on the analyzer may exceed the recommended limit and damage the sensor by stressing the sensor's front and rear seals to the point they rupture and the sensor leaks (voiding the sensor warranty).

3. Subjecting the analyzer to high positive pressure can damage to the pumps or other flow system components.

4. Introducing calibration span gas from a pressurized cylinder without pressure regulation: Adversely affects the accuracy of the calibration. Follow above recommendations.

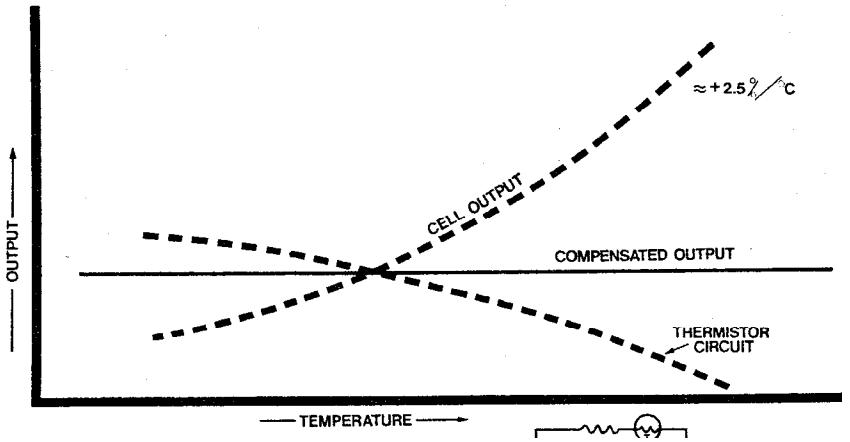
5. NEVER block the outlet vent of the sample gas on the side of the analyzer: This includes pressing your finger over the outlet vent to confirm the flow indicator is operating.

Calibration & Accuracy

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

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

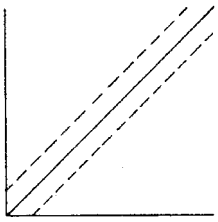
Temperature: The rate oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation is relatively constant 2.5% per ºC. A temperature compensation circuit employing a thermistor offsets this effect with accuracy of +5% or better and

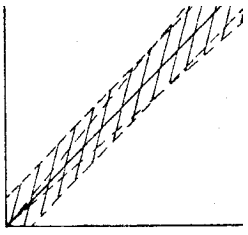


generates an output function that is independent of temperature. There is no error if the calibration and sampling are performed at the same temperature or if the measurement is made immediately after calibration. Lastly, small temperature variations of 10-15º produce < +1% error.

Accuracy: In light of the above parameters, the overall accuracy of an analyzer is affected by two types of errors: 1) those producing 'percent of reading errors', illustrated by Graph A below, such as +5% temperature compensation circuit, tolerances of range resistors and the 'play' in the potentiometer used to make span adjustments and 2) those producing 'percent of full scale errors', illustrated by Graph B, such as +1-2% linearity errors in readout devices, which are really minimal due to today's technology and the fact that other errors are 'spanned out' during calibration.
Graph C illustrates these 'worse case' specifications that are typically used to develop an analyzer's overall accuracy statement of +2% of full scale at constant temperature or +5% over the operating temperature range. QC testing is typically <+0.5% prior to shipment.


A. PERCENT OF READING ERRORS


B. PERCENT OF FULL SCALE ERRORS


C. OVERALL ACCURACY

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

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

Start-up

The GPR-1200 MS Portable ppm Oxygen Analyzer is fully operational from the shipping container with the oxygen sensor installed and calibrated at the factory prior to shipment. Once installed, we recommend the user allow the analyzer to stabilize for 30 minutes and then recalibrate the device as instructed below.

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

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

- Temperature: The sample must be sufficiently cooled before it enters the analyzer and any optional components. A coiled 10 foot length of ¼" stainless steel tubing is sufficient for cooling sample gases as high as 1,800ºF to ambient.

- Pressure & Flow: As described above.

- Moisture & Particulates: Prevent water and/or particulates from entering the sample system. They can clog the tubing and damage the optional components such as pumps, scrubbers or sensors. Installation of a suitable coalescing or particulate filter is required to remove condensation, moisture and/or particulates from the sample gas to prevent erroneous analysis readings and damage to the sensor or optional components. Consult the factory for recommendations concerning the proper selection and installation of components.

- Contaminants: A gas scrubber and flow indicator with integral metering valve are required upstream of the analyzer to remove interfering gases such as oxides of sulfur and nitrogen or hydrogen sulfide that can produce false readings and reduce the expected life of the sensor. Installation of a suitable scrubber is required to remove the contaminant from the sample gas to prevent erroneous analysis readings and damage to the sensor or optional components. Consult the factory for recommendations concerning the proper selection and installation of components.

- Gas connections: Inlet and outlet vent gas lines require 1/8" diameter tubing preferably metal.

- Power connection: Locate a source of AC power to meet area classification and to plug in the charging adapter.

- Zero calibration (required only for very low percentage range measurements).

- Span calibration – Users are responsible for certified span gas cylinder, regulator and flow control valve.

Mounting the Analyzer:
Normally mounting a portable analyzer is not a consideration. However, The analyzer enclosure is cast with four (4) holes in the bottom section specifically intended for wall mounting. The GPR-1200MS analyzer can operate continuously when connected to AC power using the appropriate charging adapter.

Gas Connection:
The GPR-1200MS flow through configuration is designed for positive pressure samples and requires connections to incoming sample and vent 1/8" diameter tube fittings. The user is responsible for making provision for calibration gases, see Calibration section of the analyzer specification and Installing Span Gas below.

Flow rates of 1-3 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH generate backpressure and erroneous oxygen readings because the diameter of the integral tubing cannot evacuate the sample gas at the higher flow rate.

A flow control valve upstream of the sensor controls the flow rate of the sample gas which is displayed by the flow indicator downstream of the sensor. A flow rate of 1 liter per minute (.5-1 SCFH) is recommended for optimum performance.

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

Procedure:
1. **Caution:** Do not change the factory setting until instructed, leave the SHUT OFF valve closed and 3-way valve in the BYPASS position.
2. Locate the inlet and vent fittings respectively on the right side of the analyzer. Note: The instructions related to proper operation of the valves is silk-screened on the right side of the analyzer.
3. Regulate the pressure and flow as described in Pressure & Flow above.
4. Install the 1/8" dia. metal vent line to the fitting designated VENT.
5. Install the 1/8" dia. metal sample gas line to the fitting designated SAMPLE IN.
6. Set the flow rate to 2 SCFH (open the flow control valve completely if using an external sampling pump positioned downstream of the sensor).
7. Allow gas to flow through the analyzer for 3-5 minutes in the BYPASS mode to purge air trapped in the sample gas line before proceeding to Calibration or Sampling.

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

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

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

Installing the Oxygen Sensor

GPR-1200 MS Portable ppm Oxygen Analyzer is equipped with an integral oxygen sensor. They are fully operational from the shipping container with the oxygen sensor installed, tested and calibrated by the manufacturer prior to shipment. Should it be necessary to install the oxygen sensor – see section 6 Maintenance which covers replacing the oxygen sensor.

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

Caution: DO NOT open the oxygen sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet in section 10. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

Span Gas Preparation

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

Required components:

- Certified span gas cylinder with an oxygen concentration, balance nitrogen, approximating 80% of the full scale range above the intended measuring range.
- Regulator to reduce pressure to between 5 and 30 psig.
- Flow meter to set the flow between 1-5 SCFH,
- 2 lengths of 1/8" dia. metal tubing measuring 4-6 ft. in length.
- Suitable fittings and 1/8" dia. metal tubing to connect the regulator to the flow meter inlet
- Suitable fitting and 1/8" dia. metal tubing to connect from the flow meter vent to tube fitting designated SAMPLE IN on the GPR-1200 MS.

Procedure:

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

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

Establishing Power to the Electronics:
Establish power to the analyzer electronics by pushing the red ON/OFF key. The digital display responds instantaneously. When power is applied, the analyzer performs several diagnostic system status checks termed "START-UP TEST" as illustrated below:

START-UP TEST
ELECTRONICS – PASS
BATTERY – PASS
TEMP SENSOR – PASS
BARO – N/A
REV X.XX

In the unlikely event the LED warning indicator LOW BATT comes on when the analyzer is turned on – proceed immediately to the sub-section on Battery Considerations at the end of section 5 Operation.
Note: The analyzer display defaults to the sampling mode when 30 seconds elapses without user interface.

0.000 PPM
AUTO SAMPLING
1 PPM RANGE
24.5 C

Menu Navigation:
The five (5) pushbuttons located on the front of the analyzer operate the micro-processor:
1. green ENTER (select)
2. yellow UP ARROW
3. yellow DOWN ARROW
4. blue MENU (escape)
5. red ON/OFF

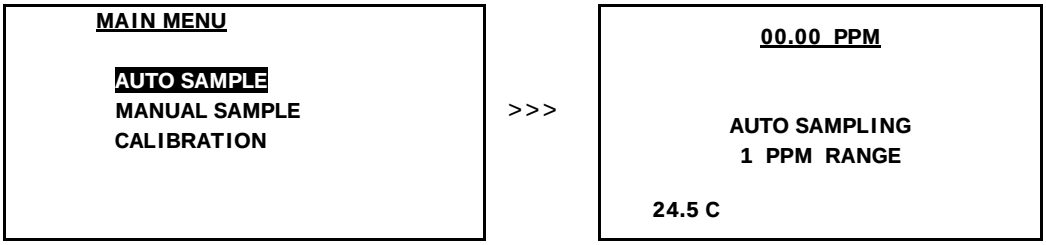
Main Menu:
Access the MAIN MENU by pressing the MENU key:

MAIN MENU
AUTO SAMPLE
MANUAL SAMPLE
CALIBRATION

Range Selection:
The GPR-1200 MS analyzer is equipped with five (5) standard measuring ranges (see specification) and provides users with a choice of sampling modes. By accessing the MAIN MENU, users may select either the AUTO SAMPLING (ranging) or MANUAL SAMPLING (select one fixed range) mode.

Note: For calibration purposes, use of the AUTO SAMPLE mode is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE for calibration as dictated by the accuracy of the analysis required – for example, a span gas with an 80 ppm oxygen concentration with the balance nitrogen would dictate the use of the 0-100 ppm full scale range for calibration and a 0-1 ppm measuring range.

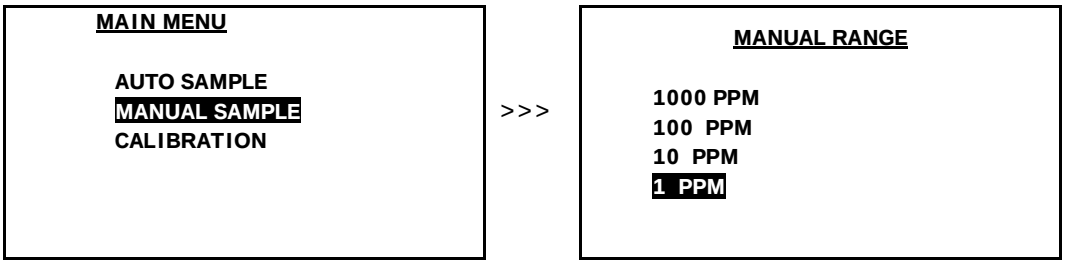
Procedure - Auto Sampling:
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor to highlight AUTO SAMPLE.
3. Press the ENTER key to select the highlighted menu option.
4. The display returns to the sampling mode:



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

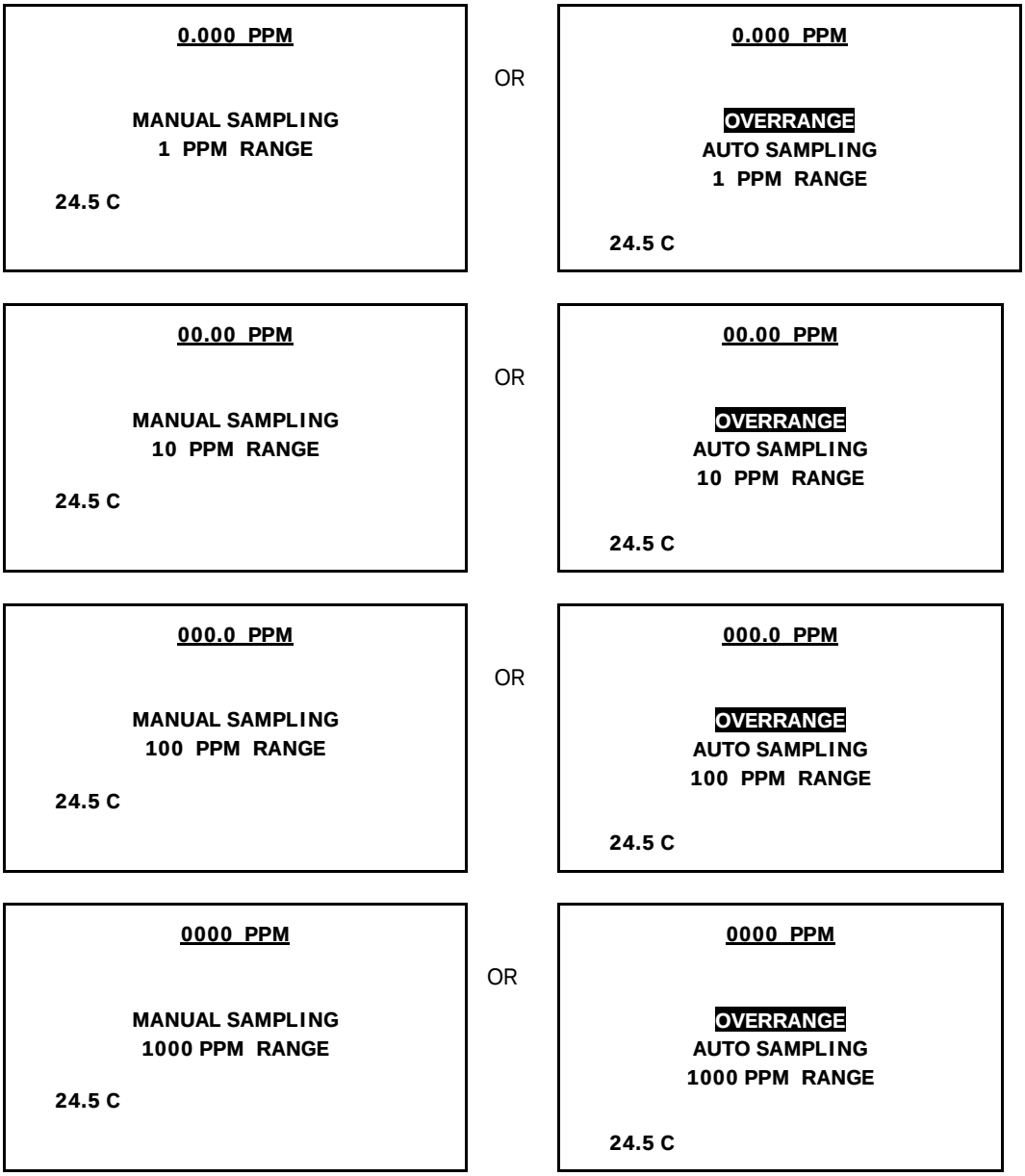
For example, if the analyzer is reading 1% on the 0-10% range and an upset occurs, the display will shift to the 0-25% range when the oxygen reading exceeds 9.9%. Conversely, once the upset condition is corrected, the display will shift back to the 0-10% range when the oxygen reading drops to 8.5%.

Procedure - Manual Sampling (Lock on Single Range):
1. Access the MAIN MENU by pressing the MENU key.
2. Advance the reverse shade cursor to highlight MANUAL SAMPLE.
3. Press the ENTER key to select the highlighted menu option.
4. The following displays appear:



5. Advance the reverse shade cursor to highlight the desired RANGE.
6. Press the ENTER key to select the highlighted menu option.

The following display(s) appear depending on the range selected and oxygen concentration of the sample gas:



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

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

Start-Up is complete . . . proceed to Calibration

Zero Calibration

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

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

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

Procedure:

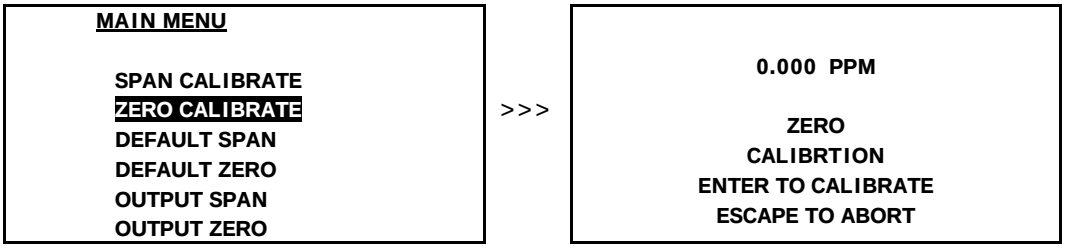
Zero calibration should precede the span calibration and once performed should not have to be repeated with subsequent span calibrations. Normally, zero calibrations are performed when a new sensor is installed or changes are made in the sample system connections, especially impractical in the case of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

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

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

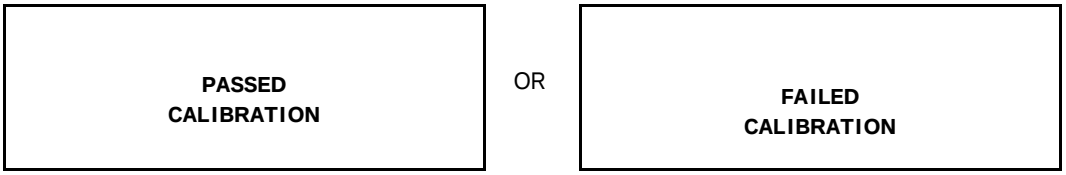
Note: Prematurely zeroing the analyzer can cause a negative reading in both the ZERO and SAMPLE modes.

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



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

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



Note: Satisfying users that the zero offset is reasonably acceptable for their application can be accomplished much quicker. Unless the zero gas is contaminated or there is a significant leak in the sample connections, the analyzer should read less than 10 ppm oxygen within 5 minutes after being placed on zero gas.

The maximum zero calibration adjustment permitted is 60% of the lowest full scale range available, which normally is 1 ppm. Thus the maximum zero calibration adjustment or zero offset is 0.6 ppm oxygen. Accordingly, the analyzer's ZERO has not been adjusted prior to shipment because the factory conditions are different from the application condition at the user's installation.

Factory Default Zero:
The software will eliminate any previous span calibration adjustment and display the actual the signal output of the sensor at a specified oxygen concentration.

For example, assuming a zero gas is introduced, the display will reflect an oxygen reading representing basically the zero calibration adjustment as described above. This feature allows the user to test the sensor's signal output without removing it from the sensor housing.

Span Calibration

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

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

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

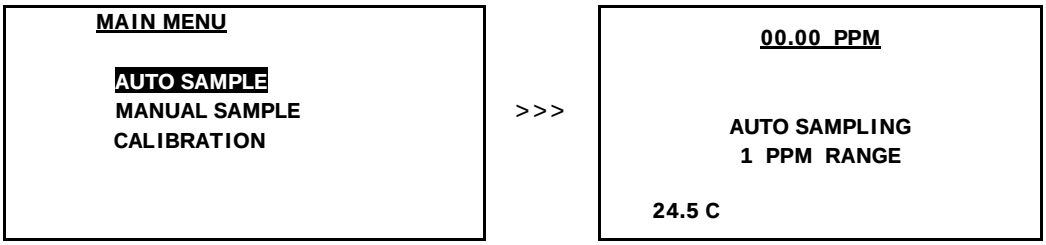
Manual Span
The user must ascertain that the oxygen reading (actually the sensor's signal output) has reached a stable value within the limits entered below before entering the span adjustment. Failure to do so will result in an error.

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

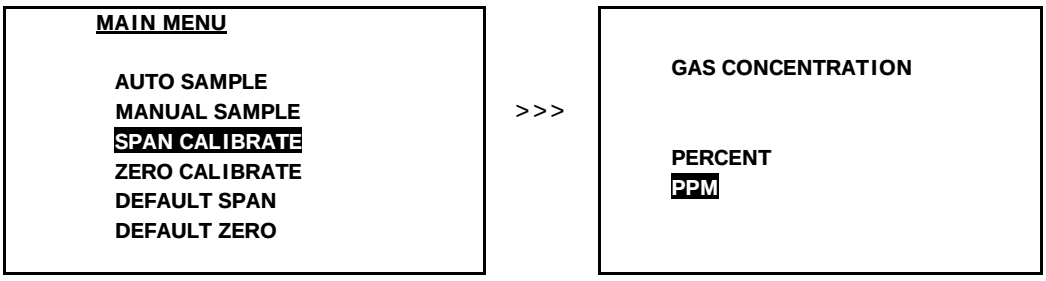
1. **Caution:** To assure an accurate calibration, the temperature and pressure of the span gas must closely approximate the sample conditions.
2. For calibration purposes, use of the AUTO SAMPLE mode is recommended. However, the user can select the full scale MANUAL SAMPLE RANGE for calibration as dictated by the accuracy of the analysis required – for

example, a span gas with an 80 ppm oxygen concentration with the balance nitrogen would dictate the use of the 0-100 ppm full scale range for calibration and a 0-1 ppm measuring range. Select as described above.

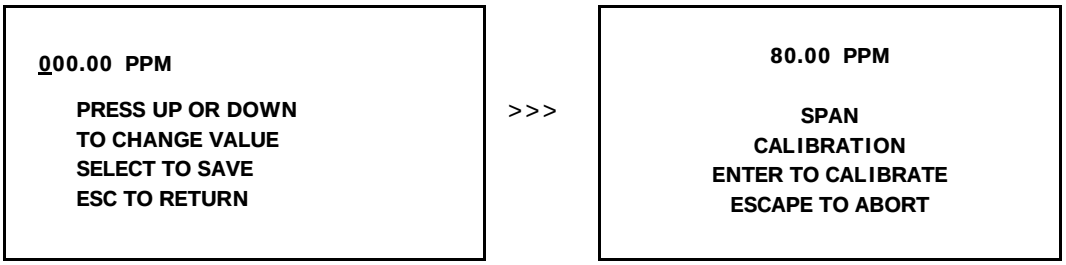
3. Refer to Span Gas Preparation section above.
4. Access the MAIN MENU by pressing the MENU key.
5. Advance the reverse shade cursor to highlight AUTO SAMPLE with the ARROW keys.
6. Press the ENTER key to select the highlighted menu option.
7. The following displays appear:



8. Assure there are no restrictions in the span gas line.
9. Regulate the pressure and the flow rate of the span gas to 5-30 psig and 2 SCFH flow rate, as above.
10. Place the 3-way valve in the BYPASS position.
11. Disconnect the sample gas line and install the purged span gas line.
12. Adjust the analyzer's FLOW control valve until the FLOW INDICATOR reads 2 SCFH, as above.
13. Allow the span gas to flow for 1-2 minutes to purge the air trapped in the span gas line.
14. Place the 3-way valve in the SAMPLE position.
15. **Caution: Allow the span gas to flow and wait until the reading is stable before proceeding with calibration**. The wait time will vary depending on the amount oxygen introduced to the sensor when the gas lines were switched.
16. Access the MAIN MENU by pressing the MENU key.
17. Advance the reverse shade cursor to highlight CALIBRATION with the ARROW keys.
18. Press the ENTER key to select the highlighted menu option.
19. **Note:** A span gas concentration above 1000 ppm dictates the selection of the PERCENT option.
20. Advance the reverse shade cursor to highlight SPAN CALIBRATE with the ARROW keys.
21. Press the ENTER key to select the highlighted menu option.
22. Advance the reverse shade cursor to highlight desired GAS CONCENTRATION with the ARROW keys.
23. Press the ENTER key to select the highlighted menu option.

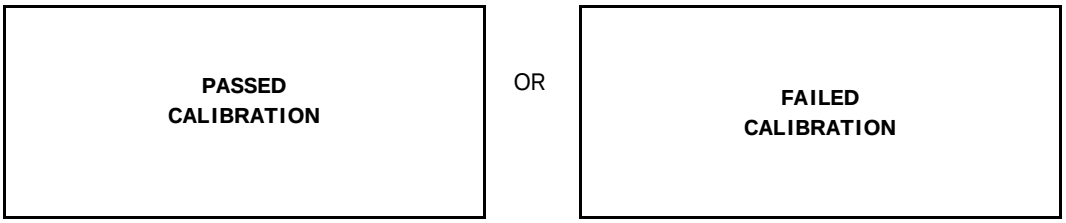


The following displays appear:



24. Press the ARROW keys to enter the first digit of the span value.
25. Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to change the next digit of the span value.
26. Repeat steps 20 and 21 until the complete span value has been entered.
27. Press ENTER to save the span value and proceed to the display on the right.
28. Press ENTER to begin the calibration function.

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



29. Should the “FAILED CALIBRATION” display appear, consult section 8 Troubleshooting and repeat the process before concluding the analyzer or sensor is defective, or contact the factory.
30. The analyzer returns to the AUTO SAMPLING mode after 30 seconds.
31. Before disconnecting the span gas line and connecting the sample gas line, place the 3-way valve in the BYPASS position.
32. Disconnect the span gas line and replace it with the sample gas line.
33. Adjust the analyzer’s FLOW control valve until the FLOW INDICATOR reads 2 SCFH, as above.
34. Allow the sample gas to flow for 1-2 minutes to purge the air trapped in the sample gas line.
35. Place the 3-way valve in the SAMPLE position
36. Wait 10 minutes to ensure the reading is stable and proceed to SAMPLING.

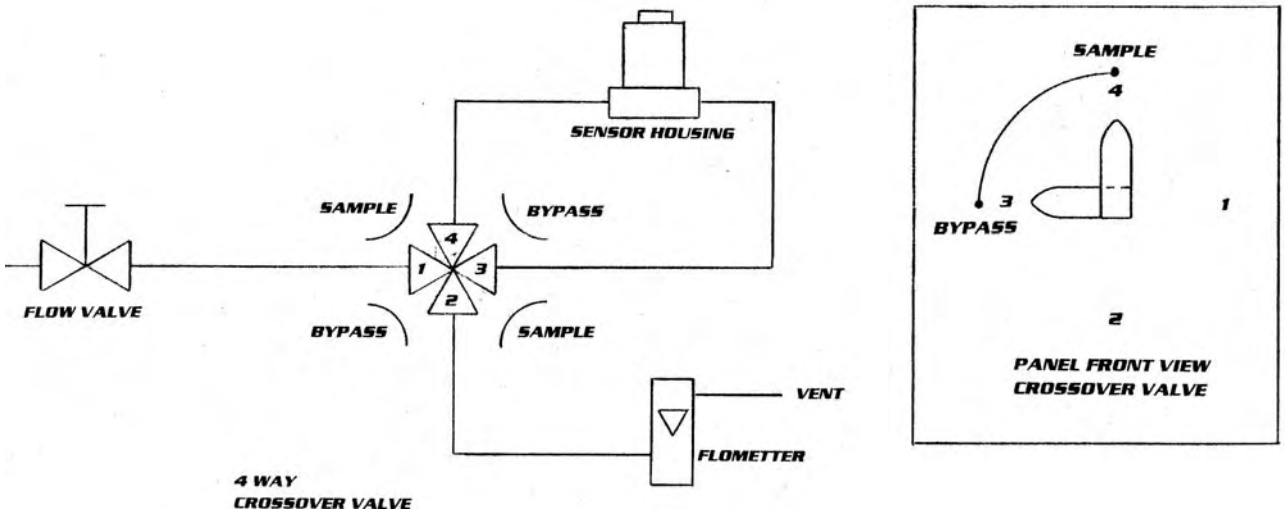
Sampling

The benefits of the bypass sample system featured below:

1. Manufacturer supplies the analyzer with the sensor it was qualified with.
2. Isolate the sensor during transport and maintenance intervals and extend sensor life.
3. Isolate the sensor from exposure to high oxygen levels during upset conditions and extend sensor life.
4. Purge the high oxygen levels or air trapped in the sample system following a process upset, changing sample gas lines or connecting span gas lines.
5. Complimenting the recovery capability of the sensor to increase operator productivity.

The sensor is exposed to sample gas that must flow or be drawn through the analyzer's internal sample system. The sample system may include optional additional components such as a 3-way sample/span valve, a pressure regulator, coiled metal tubing (samples must be cooled to at least 35-40º C for continuous use), coalescing filters, scrubbers, 3-way sample/return valve, backpressure regulator, etc.

Note: The standard sample system is designed for positive pressure applications as described below under the Installation section. From the factory the sensor is isolated inside the analyzer, sample system in the BYPASS position, and the FLOW control valve set approx at 1 lpm (.5-1 SCFH).



As illustrated above, the GPR-1200 MS's internal sample system includes:

- 1/8" tube fittings for the inlet and outlet
- flow control metering valve
- 3-way sample/bypass valve
- Stainless steel sensor housing with an o-ring seal for ppb capability
- Flow indicator common to bypass and sample paths

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

Procedure:

1. Review the end of the Span Calibration procedure beginning with step #28.
2. Select the desired sampling mode - auto or if manual, the range that provides maximum resolution.
3. Use metal tubing to transport the sample gas to the analyzer.
4. The main consideration is to eliminate air leaks which can affect oxygen measurements above or below the 20.9% oxygen concentration in ambient air - ensure the sample gas tubing connections fit tightly into the 1/8" male NPT to tube adapter, and, the NPT end is taped and securely tightened into the mating male quick disconnect fittings which mate with the female fittings on the analyzer
5. Assure there are no restrictions in the sample gas lines – inlet or vent.
6. Refer to the section on Pressure & Flow:

7. For sample gases under positive pressure the user must provide a means of regulating the inlet pressure between 5-30 psig and the flow of the sample gas between 1-5 SCFH, a flow rate of 2 SCHF is recommended.
8. For sample gases under atmospheric or slightly negative pressure an optional sampling pump is recommended to draw the sample into the analyzer. Generally, no pressure regulation or flow control device is involved.
9. **Caution:** If the analyzer is equipped with both a FLOW valve and an integral SAMPLING PUMP, always open the FLOW valve completely before operating the pump (avoid drawing a vacuum on the sensor).
10. Assure the sample is adequately vented for optimum response and recovery – and safety.

Caution: To avoid damaging the sensor comply with the following guidelines - failure to do so will possibly damage the sensor and/or voiding the sensor warranty.

1. Drawing a vacuum on the sensor by pressurizing the analyzer: Results when sample gas flows into the analyzer, builds up within the analyzer sample system because the outlet vent is restricted, and, is suddenly released when the blockage is removed. This sudden release of backpressure draws a vacuum on the sensor stressing the sensor's front and rear seals to the point they rupture and the sensor leaks (voiding the sensor warranty).

2. Drawing a vacuum on the sensor when using a sampling pump downstream of the analyzer: Assure the FLOW valve is completely open. If the FLOW valve is not completely open, the resulting vacuum drawn on the analyzer may exceed the recommended limit and damage the sensor by stressing the sensor's front and rear seals to the point they rupture and the sensor leaks (voiding the sensor warranty).

3. Subjecting the analyzer to high positive pressure can damage to the pumps or other flow system components.

4. Introducing calibration span gas from a pressurized cylinder without pressure regulation: Adversely affects the accuracy of the calibration. Follow above recommendations.

5. NEVER block the outlet vent of the sample gas on the side of the analyzer: This includes pressing your finger over the outlet vent to confirm the flow indicator is operating.

Battery Considerations

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

Procedure:

1. Unless the analyzer is to be operated while charging, turn the analyzer OFF when charging the battery for the shortest charging cycle.
2. Connect the appropriate 9VDC adapter supplied with the analyzer to an 110V or 220V outlet.
3. Insert the male phone plug from the 9VDC adapter into the integral female CHARGE jack located on the bottom of the enclosure.
4. **Caution:** The analyzer is designed to operate in the charging mode, however, operating the analyzer in hazardous or explosive atmospheres while charging the battery IS NOT recommended despite the instrinsically safe design.

Service: A single charge is sufficient to operate the GPR-1200MS analyzer continuously for a period of 60 days, 1 day when operating the optional integral sampling pumps continuously.

Warning indicators:

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

Standby

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

6 Maintenance

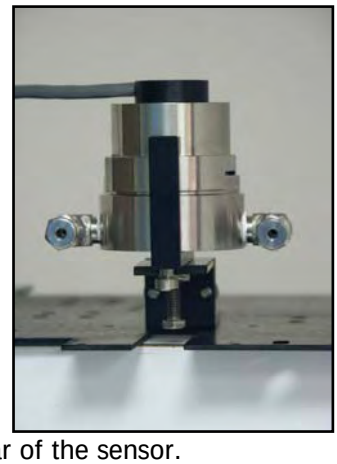
Generally, cleaning the electrical contacts or replacing filter elements is the extent of the maintenance requirements of this analyzer.

Sensor Replacement

Periodically, the oxygen sensor will require replacement. The operating life is determined by a number of factors that are influenced by the user and therefore difficult to predict. The Features & Specifications define the normal operating conditions and expected life of the standard sensor utilized by the GPR-1200 MS Series analyzer. Expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.

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

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



Procedure:

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

7 Spare Parts

Recommended spare parts for the GPR-1200 MS Series Portable Oxygen Analyzer:

Item No.	Description
GPR-12-2000MS	ppm Oxygen Sensor

Other spare parts:

Item No.	Description
A-2244	Battery Assembly
A-2474-3-14	Housing Sensor Stainless Steel
A-1016-A-1	Housing Sensor Bottom Assembly Stainless Steel
B-2762-A-3-14	Housing Sensor Upper Assembly Stainless Steel
MTR-1011	Meter Digital Panel LCD Backlight
ORNG-1007	O-ring 3/32 x 1-3/8 x 1-9/16 Viton
A-1151-E-B1	PCB Assembly Main / Display
PWRS-1002	Power Source Plug-in 9VDC 110V Battery Charger
PWRS-1003	Power Source Plug-in 9VDC 220V Battery Charger

8 Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery	At installation, defective sensor	Replace sensor if recovery unacceptable or O_2 reading fails to reach 10% of lowest range
	Air leak in sample system connection(s)	Leak test the entire sample system: Vary the flow rate, if the O_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 or open SHUT OFF valve completely
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO_2 or acid gases are present
	Abnormality in gas	Qualify the gas (use a portable analyzer)
Response time slow	Air leak, dead legs, distance of sample line, low flow rate, volume of optional filters and scrubbers	Leak test (above), reduce dead volume or increase flow rate
O_2 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)

Symptom	Possible Cause	Recommended Action
Erratic O_2 reading or No O_2 reading	Test sensor independent from analyzer	Remove sensor from housing. Using a volt-meter set to uA output; apply the (+) lead to the outer ring of the sensor PCB and the (-) lead to the center circle to obtain the sensor's output in air. Contact factory with result. Sensors without PCB use mV setting.
	Change in sample pressure	Calibrate the analyzer (calibrate at pressure and temperature of sample)
	Dirty electrical contacts in upper section of sensor housing	Clean contacts with alcohol (minimize exposure time of MS sensor to ambient air to extent possible)
	Corroded solder joints on sensor PCB from corrosive sample or electrolyte leakage from sensor	Replace sensor and return sensor to the factory for warranty determination
	Corroded spring loaded contact in upper section of sensor housing from liquid in sample or electrolyte leakage from sensor	Upper section of sensor housing: Clean contacts with alcohol, flow sample or zero gas for 2-3 hours to flush sample system and sensor housing Sensor: Replace if leaking and return it to the factory for warranty determination
	Liquid covering sensing area	Wipe with alcohol and lint free towel or flow sample or zero gas for 2-3 hours to flush
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO_2 or acid gases are present
	Presence of interference gases	Consult factory
	Presence of sulfur gases	Replace sensor and install scrubber
	Unauthorized maintenance	Replace sensor, obtain authorized service
	Sensor nearing end of life	Replace sensor
Erratic O_2 reading or Negative O_2 reading or No O_2 reading possibly accompanied by electrolyte leakage	Pressurizing the sensor by flowing gas to the sensor with: the vent restricted and suddenly removing the restriction draws a vacuum on the sensor or partially opening the valves upstream of the analyzer when using a pump downstream of the analyzer to draw sample from a process at atmospheric pressure or a slight vacuum. A pressurized sensor may not leak but still produce negative readings.	Zero the analyzer. If not successful replace the sensor Avoid drawing a vacuum on the sensor. Placing a vacuum on the sensor in excess 4" of water column is strongly discouraged.
	A premature adjustment of the ZERO OFFSET potentiometer is a common problem	From MAIN MENU select DEFAULT ZERO

9 Warranty

The design and manufacture of our oxygen sensors and analyzers is 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 monitor, analyzers and sensor 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. Analytical Industries Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your Analytical Industries Inc. monitor, analyzer and/or oxygen sensor is determined to be defective with respect to material and/or workmanship, we will repair it or, at our option, replace it at no charge to you. If we choose to repair your purchase, we may use new or reconditioned replacement parts. If we choose to replace your Analytical Industries 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

Analytical Industries Inc. will not pay for: loss of time; inconvenience; loss of use of your Analytical Industries Inc. analyzer or property damage caused by your Analytical Industries 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 Analytical Industries Inc. at 909-392-6900 (or e-mail sales-medical@aii1.com) between 8:00am and 5:30pm Pacific Time Monday thru Thursday or before 12:00 pm on Friday. Trained technicians will assist you in diagnosing the problem and arrange to supply you with the required parts. You may obtain warranty service by returning you analyzer, postage prepaid to:

Analytical Industries 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 Analytical Industries 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	KOH = Colorless, odorless aqueous solution or Acetic Acid = Colorless, vinegar-like odor aqueous solution

Fire and Explosion Data

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

Reactivity Data

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

Spill or Leak

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

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 Information

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

Special Precautions

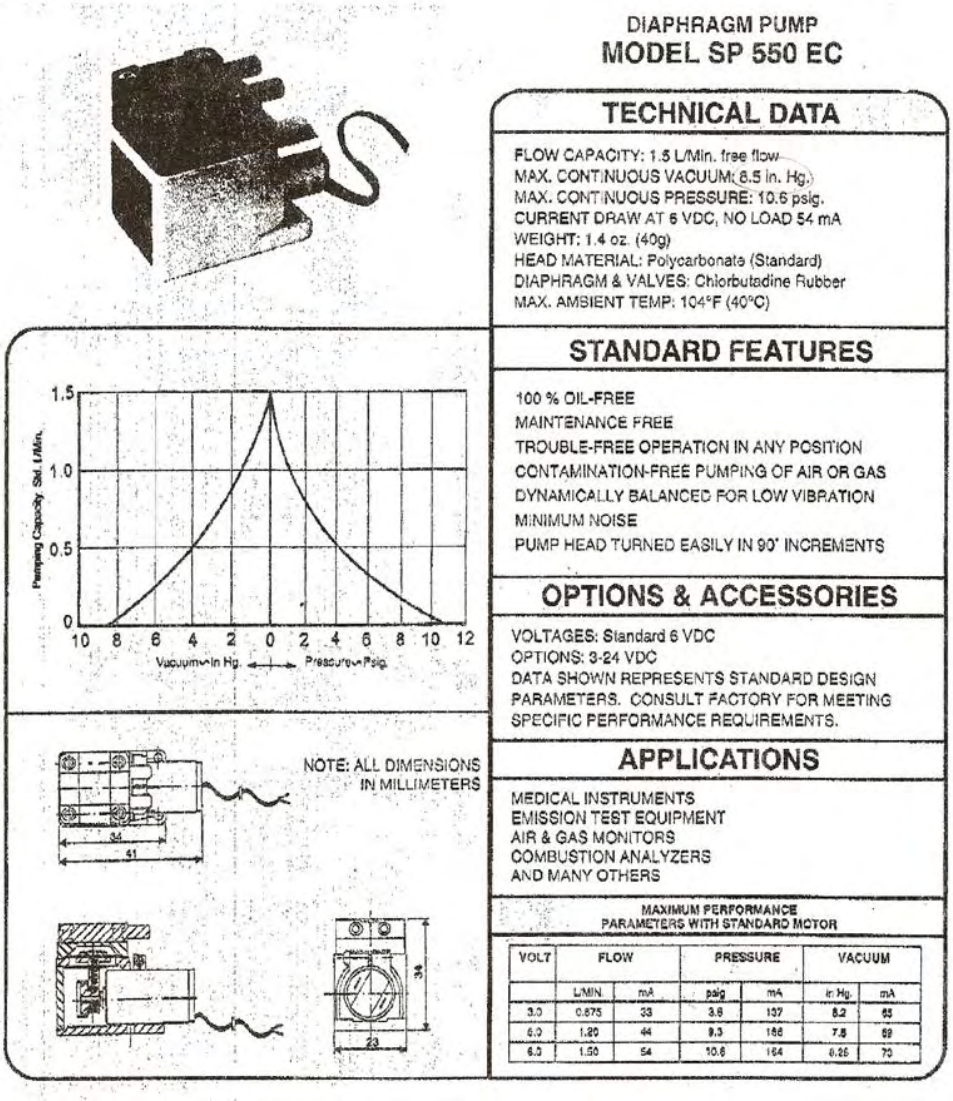
Precautions	Do not remove the sensor's protective Teflon and PCB coverings. Do not probe the sensor with sharp objects. Wash hands thoroughly after handling. Avoid contact with eyes, skin and clothing. Empty sensor body may contain hazardous residue.
Transportation	Not applicable

Appendix C

Portable Pump Options

Coreless skew wound motors are used in all these standard the eccentric driven diaphragm pumps. Features include small compact size, high efficiency, low noise operation, low power consumption, chemically resistant materials, oil free operation and no maintenance. The compact size and low power consumption are ideal for installation in portable analyzer enclosures:

Analyzer	Assembly P/N	Component P/N	Area Class
GPR-1200	A-2166-4	PUMP-1013	General Purpose
	A-2166-5	PUMP-1010	Intrinsically Safe
GPR-35	A-2501	PUMP-1005	General Purpose



DIAPHRAGM PUMP
MODEL SP 550 EC

TECHNICAL DATA

FLOW CAPACITY: 1.5 L/Min. free flow
MAX. CONTINUOUS VACUUM: 8.5 in. Hg.
MAX. CONTINUOUS PRESSURE: 10.6 psig.
CURRENT DRAW AT 6 VDC, NO LOAD 54 mA
WEIGHT: 1.4 oz. (40g)
HEAD MATERIAL: Polycarbonate (Standard)
DIAPHRAGM & VALVES: Chlorbutadine Rubber
MAX. AMBIENT TEMP: 104°F (40°C)

STANDARD FEATURES

100 % OIL-FREE
MAINTENANCE FREE
TROUBLE-FREE OPERATION IN ANY POSITION
CONTAMINATION-FREE PUMPING OF AIR OR GAS
DYNAMICALLY BALANCED FOR LOW VIBRATION
MINIMUM NOISE
PUMP HEAD TURNED EASILY IN 90° INCREMENTS

OPTIONS & ACCESSORIES

VOLTAGES: Standard 6 VDC
OPTIONS: 3-24 VDC
DATA SHOWN REPRESENTS STANDARD DESIGN PARAMETERS. CONSULT FACTORY FOR MEETING SPECIFIC PERFORMANCE REQUIREMENTS.

NOTE: ALL DIMENSIONS IN MILLIMETERS

APPLICATIONS

MEDICAL INSTRUMENTS
EMISSION TEST EQUIPMENT
AIR & GAS MONITORS
COMBUSTION ANALYZERS
AND MANY OTHERS

MAXIMUM PERFORMANCE PARAMETERS WITH STANDARD MOTOR

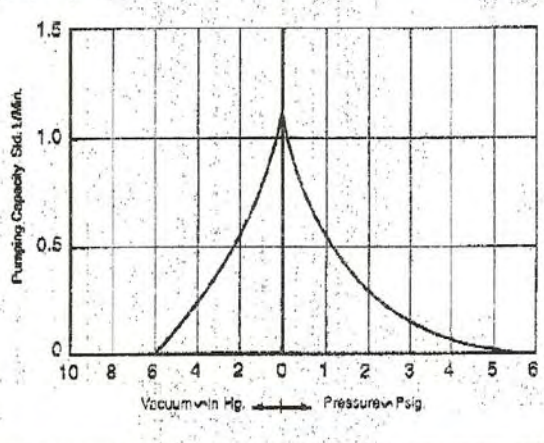
VOLT	FLOW		PRESSURE		VACUUM	
	L/MIN.	mA	psig	mA	in Hg.	mA
3.0	0.675	33	3.8	107	8.2	65
6.0	1.20	44	9.3	166	7.8	92
6.0	1.50	54	10.6	164	8.25	70

Analyzer	Assembly P/N	Component P/N	Area Class
GPR-2000 / 980	A-2166-1	PUMP-10011	General Purpose
	A-2166-5	PUMP-1010	Intrinsically Safe

DIAPHRAGM PUMP
MODEL SP 500 EC-LC

TECHNICAL DATA

FLOW CAPACITY: 1.1 L/Min. free flow
MAX. CONTINUOUS VACUUM: 6 in. Hg.
MAX. CONTINUOUS PRESSURE: 5.5 psig.
CURRENT DRAW AT 4.5 VDC, NO LOAD 70 mA.
WEIGHT: 1.1 oz. (30g)
HEAD MATERIAL: Polycarbonate (Standard)
DIAPHRAGM & VALVES: Chlorbutadine Rubber
MAX. AMBIENT TEMP: 104°F (40°C)

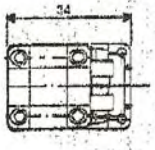


STANDARD FEATURES

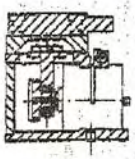
100 % OIL-FREE
MAINTENANCE FREE
TROUBLE-FREE OPERATION IN ANY POSITION
CONTAMINATION-FREE PUMPING OF AIR OR GAS
DYNAMICALLY BALANCED FOR LOW VIBRATION
MINIMUM NOISE
PUMP HEAD TURNED EASILY IN 90° INCREMENTS

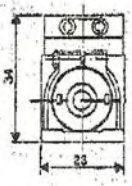
OPTIONS & ACCESSORIES

VOLTAGES: Standard 4.5 VDC
DATA SHOWN REPRESENTS STANDARD DESIGN PARAMETERS. CONSULT FACTORY FOR MEETING SPECIFIC PERFORMANCE REQUIREMENTS.



NOTE: ALL DIMENSIONS IN MILLIMETERS





APPLICATIONS

MEDICAL INSTRUMENTS
EMISSION TEST EQUIPMENT
AIR & GAS MONITORS
COMBUSTION ANALYZERS
AND MANY OTHERS

MAXIMUM PERFORMANCE PARAMETERS WITH 4.5 VDC MOTOR

VOLT	FLOW		PRESSURE		VACUUM	
	L/MIN.	mA	psig	mA	in Hg.	mA
3.0	0.65	51	3.30	82	5.10	80
4.5	1.15	70	5.50	102	9.30	97
6.0	1.50	78	5.20	114	8.90	108