
SERIES 2520 PORTABLE PERCENT OXYGEN ANALYZER

INSTRUCTION MANUAL



AΩ ALPHA OMEGA
INSTRUMENTS

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WARRANTY

Alpha Omega Instruments Corp. warrants the products delivered to be free from defects in material and workmanship at the time of delivery to the FOB. point specified in the purchase order, its liability under this warranty being limited to repairing or replacing, at Alpha Omega Instruments option, items (excluding the oxygen sensor) which are returned to it **prepaid** within two (2) years from the date of shipment and found to Seller's satisfaction to be defective.

Alpha Omega Instruments one (1) year sensor warranty offers protection for one full year from the date of shipment of the Series 2520 Portable Oxygen Analyzer. Any sensor from a Series 2520 Portable Oxygen Analyzer that fails under normal use must be returned to Seller prepaid and, if such sensor is determined by Seller to be defective, Seller shall provide Buyer a replacement sensor. Buyer must provide the serial number of the analyzer from which the sensor has been removed. If a sensor is found to be defective and a new one issued, the warranty of the replacement sensor (s) is for a period of one year from the date of shipment. At times, it may be necessary to ship a replacement sensor in advance of receiving one returned for warranty claim. In such cases, if the returned sensor is not covered under warranty, the user will be charged the full price of a replacement sensor. **In no event shall Alpha Omega Instruments Corp. be liable for consequential damages. NO PRODUCT IS WARRANTED AS BEING FIT FOR A PARTICULAR PURPOSE AND THERE IS NO WARRANTY OF MERCHANTABILITY.**

This warranty applies only if:

- (i) the items are used solely under the operating conditions and manner recommended in this manual, specifications, or other literature;
- (ii) the items have not been misused or abused in any manner or repairs attempted thereon;
- (iii) written notice of the failure within the warranty period is forwarded to Alpha Omega Instruments Corp. and, the directions received for properly identifying items returned under warranty are followed;
- (iv) the return notice authorizes Alpha Omega Instruments Corp. to examine and disassemble returned products to the extent the Company deems necessary to ascertain the cause of failure.

The warranties stated herein are exclusive. THERE ARE NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, BEYOND THOSE SET FORTH HEREIN, and Alpha Omega Instruments Corp. does not assume any other obligation or liability in connection with the sale or use of said products.

Disclaimer of Warranty

Alpha Omega Instruments Corp. makes no representation or warranties, either expressed or implied, by or with respect to anything in this manual, including, but not limited to, implied warranties of merchantability or fitness for a particular purpose. In no event will Alpha Omega Instruments Corp. be liable for any damages, whether direct or indirect, special, consequential, or incidental arising from the use of this manual. Some states in the USA do not allow the exclusion of incidental or consequential damages. Alpha Omega Instruments Corp. also reserves the right to make any changes to improve the performance of its products at any time and without notice.

**ALPHA OMEGA INSTRUMENTS CORP.
SERIES 2520 BATTERY OPERATED OXYGEN ANALYZER**

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**SECTION 1.0
SPECIFICATIONS**

PERFORMANCE

Measurement Ranges in Percent 0-2, 0-5, 0-10, 0-25, 0-50, and 0-100.

Accuracy ¹	± 1% of full scale.
Linearity	± 1% of full scale.
Response Time	90% of full scale in less than 20 seconds (typical).
Sensor Type	Patented Electrochemical Sensor.
Temperature Compensation	Standard.
Operating Temp. Range	32° to 122°F (0° to 50°C)
Sample Gas Pressure Limits	0.1 psig to 1.0 psig (1.4 to 14.2 kg/cm ²). Vacuums to 12.5 psia are permissible. There is no automatic pressure compensation.
Sample Flow Rate	1.0 to 2.0 standard cubic feet per hour (SCFH) 0.5 to 1.0 liters/ minute (LPM)
Input Power	NICAD Batteries recharged with an AC to DC adapter.
Warranty	Two years for the electronics and one year for the sensor.

CONSTRUCTION

Enclosure	Polycarbonate, rated NEMA 1 General Purpose.
Display	3-1/2 digit liquid crystal display
Gas Connections	Quick connect 1/4" OD for plastic tubing or compression fittings depending on options purchased.
Dimensions	6.3 in height 7.8 in width. 4.2 in depth.

¹ Stated at constant temperature and pressure.

SECTION 2.0 SYSTEM DESCRIPTION

General Description

The Series 2520 Portable Oxygen Analyzer is a portable percent oxygen analyzer designed to provide accurate and dependable percent oxygen measurements in a variety of gases. The analyzer enclosure is made from durable polycarbonate, and is rated NEMA 1, for general purpose service. The instrument is powered from eight AA NICAD batteries that are mounted internal to the analyzer. Recharging of the batteries is done with a 115 VAC/60 Hz adapter that is shipped with the instrument. Options include a pressure regulator, flowmeter, in-line filter, and pump.

Patented Ambient Temperature Electrochemical Sensor with EES

The Series 2520 Portable Oxygen Analyzer features an extended life oxygen sensor with EES (enhanced electrolyte system) a patented weak acid electrolyte system. The weak acid electrolyte system retards passivation of the sensor anode by allowing the products of oxidation to dissolve in the acid electrolyte. In effect, the sensor is renewed continuously as the weak acid electrolyte tolerates over 20 times the lead oxide (PbO) than potassium hydroxide (KOH) based sensors. The result is a sensor with a greatly extended useful life.

The extended life sensor is a lead-oxygen battery comprised of a lead anode, and gold cathode, and a weak acid electrolyte. A gold electrode is bonded onto a non-porous Teflon (FEP) membrane. A small amount of oxygen permeating through the membrane is reduced electrochemically at the gold electrode. A resistor and a thermistor (for temperature compensation) are connected between the cathode and anode. As a result, the lead-oxygen battery is always discharged.

Current flowing through the resistor and thermistor is proportional to the oxygen concentration of the gas in contact with the Teflon membrane. By measuring the voltage between the between the resistor and the thermistor, oxygen concentration can be accurately determined. The two electrode reactions are depicted below:



If PbO generated at the anode remains on the anode, the anode's potential will change and the output voltage of the sensor would become extremely low. However, in actuality the surface of the lead anode is continuously renewed because PbO is dissolved back into the electrolyte. There is a maximum level to the solubility of PbO in the weak acid electrolyte. As a result, when the electrolyte becomes saturated with PbO, the sensitivity of the sensor will begin to drop signaling time for replacement of the sensor. When the extended life oxygen sensor is used in ambient air monitoring applications, carbon dioxide (CO₂) that is present will not adversely affect the sensor's performance. Due to the weak acid electrolyte, CO₂ will not react with the electrolyte to form potassium carbonate as it does with KOH based sensors. As a result, there is no loss in output due to the presence of CO₂.

**SECTION 3.0
INSTALLATION PROCEDURES**

Unpacking the Instrument

Upon opening the shipping container, carefully unpack the analyzer to check if the outer surfaces have been damaged. If so, report the findings immediately to Alpha Omega Instruments who will provide further instructions. If there is no apparent damage, check the contents to ensure all items were shipped. In some cases, items may be backordered.



All damage and shortage claims must be made known to Alpha Omega Instruments within 10 days after receipt of shipment.

Powering the Series 2520 Oxygen Analyzer

The Series 2520 Portable Oxygen Analyzer is powered from eight AA NICAD batteries that are mounted internal to the instrument. Recharging of the batteries is done with a 115 VAC/60 Hz adapter that is shipped with the analyzer. To power up the instrument, place the front panel on/off switch to the "ON" position. When the Series 2520 Portable Oxygen Analyzer is attached to the AC/DC adapter, the NICAD batteries are being charged at the same time. If the batteries are allowed to run below the level where normal operation can be sustained, the charge time will be approximately 16 hours. In the event the batteries need to be replaced, **use only NICAD batteries** (Panasonic Type P-60AAR or equivalent). Use of any other type of battery may damage the instrument and void the warranty.

Recharging the NICAD Batteries

The Series 2520 will provide in excess of 48 hours (without the optional pump) of continued operation before battery recharging is required. If the pump is in use, up to 12 hours of continued use can be achieved. To recharge the NICAD batteries, connect the 3.5 mm plug from the 12 VDC wall mounted AC/DC adapter to the jack located on the rear of the instrument (see Figure 1.0). Allow 16 hours to fully recharge the batteries. Though the analyzer can be used while recharging, if the optional pump is in use during this time recharging will take an additional 5-10% longer.

Replacing the NICAD Batteries

The internal NICAD batteries are located in two banks of 4 size AA NICAD battery trays accessible on the right side of the instrument. If battery replacement becomes necessary the following steps should be followed:



Use only Panasonic Type P-60AAR or equivalent NICAD batteries with the Series 2520 Portable Oxygen Analyzer

To remove a battery pack tray, push the tabs (located at each end of the tray) towards each other to release the latches and pull the trays out from the enclosure.

Replace the defective batteries immediately and properly dispose of them. Be sure the replacement batteries are Panasonic Type P-60AAR or equivalents. Do not mix battery

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types and use only the NICAD types described in this manual. Use of other types of batteries may result in damage to the analyzer and will void its warranty. After replacing the batteries, install the trays making sure that they are fully inserted into their holder and that the tabs have fully latched.

Battery Status Check

The Series 2520 Portable Oxygen Analyzer is equipped with an analyzer on/off power switch. This switch serves three functions. When placed in the middle "OFF" position, all power to the instrument has been removed. This is the recommended position for storage or when recharging the batteries. When placed in the "ON" position, the analyzer is powered and will display the measured oxygen value of the sample gas. If the optional pump has been included with the Series 2520, placing the switch in the "ON" position also energizes the pump on/off switch. The third position associated with this switch allows the user to check the status of the batteries. By placing the switch in the "Battery" position, the digital display indicates the voltage of the battery pack. If the battery voltage indicated in the panel meter is 6 volts or less, recharging is necessary. Caution: If the Series 2520 is equipped with a pump, be sure the pump is operating when checking the batteries. **Note: The "Battery" check position is designed to be momentary so it cannot be left in that position permanently.**

SECTION 4.0 OPERATING PROCEDURES

Gas System Pressure Limits

For sample gases and/or calibration gases that are under pressure, it is imperative that the sample gas pressure to the sensor be kept to under **1 pound per square inch**. If it is expected to be in excess of 1.0 psi, a pressure regulator should be used. There is no automatic pressure correction so operation at a constant pressure will provide optimum measuring conditions. Vacuums to 12.5 psia are permissible. Any vacuum level greater than that should be avoided as it will cause irreparable damage to the sensor.

Caution: Normally, if the Series 2520 is equipped with a sample pump, a pressure regulator is not used. However, there may be times when sample conditions change and a pressure regulator is required. If the Series 2520 is equipped with a DC sample pump and a pressure regulator is being used to reduce the inlet pressure to the analyzer, the front panel pump switch must be in the "OFF" position. Operating the pump with a pressure regulator in-line may damage the pump and void the warranty.

Range Identification

The Series 2520 Portable Oxygen Analyzer is available in six (6) different ranges. To identify the specific range of the analyzer in question, please refer to the original purchase order document or invoice from Alpha Omega Instruments. In it, you will find a model number starting with the number 2520. The letter immediately following "2520" is the range identifier. The various ranges, with their associated identifier, are as follows:

<u>Range (%)</u>	<u>Identifier</u>
0-2	A
0-5	B
0-10	C
0-25	D
0-50	E
0-100	F

Sample Connections

The sample flow connections to the Series 2520 Percent Oxygen Analyzer are normally quick connect fittings that are used with 1/4" OD flex tubing such as polypropylene, nylon, etc. When specified in the order, other types of input fittings may be used such as 1/4" compression fittings for connection to copper or stainless steel tubing.

Electrical Output

The Series 2520 Percent Oxygen Analyzer is not equipped with an analog output for use with a recorder, datalogger, etc.

Analyzer Storage

When the Series 2520 Portable Oxygen Analyzer is not in use, it may be stored in any position. If stored in an atmosphere where the temperature is greatly different from the temperature where it will be used, the instrument should be allowed to come into equilibrium with the operating ambient temperature before use. Under **no circumstances** should the Series 2520 be exposed to temperatures below 32°F. Doing so will damage the sensor and void the warranty.

**SECTION 5.0
CALIBRATION PROCEDURES****Routine Span Gas Calibration Checks**

The Series 2520 Portable Oxygen Analyzer has been calibrated at the factory prior to shipment. However, with the potential hazards associated with shipping instrumentation, it is advisable that the analyzer be given a system calibration check prior to startup. Alpha Omega Instruments percent oxygen sensors feature high accuracy and excellent long term stability characteristics. As a result, routine maintenance is kept to a minimum. As is the case with all gas analyzers, it is advisable to periodically check the overall system calibration. The frequency of these checks is often determined by in-house calibration protocols. If none exists, Alpha Omega Instruments Corp. recommends a calibration check be made once every 2-3 months.

Calibration Gas

The oxygen sensor used in the Series 2520 Portable Oxygen Analyzer has a linear output. As a result, it can be calibrated using a single calibration gas as long as the test is performed accurately. The calibration gas should contain a defined concentration of oxygen with a balance of nitrogen (N₂). For analyzers with full scale ranges of 25% or greater, use of clean ambient air for calibration is recommended. The actual concentration of oxygen should be chosen based on the range of the analyzer. Alpha Omega Instruments recommendation is to obtain a calibration gas that has a concentration of oxygen somewhere between 60-90% of full scale. For instance, if the analyzer has a measuring range of 0-10 percent, a calibration gas containing 6-9 percent oxygen/balance nitrogen should be used.

Procedure for Checking Calibration

1. Select a cylinder of calibration gas as described above and install a pressure regulator to regulate the input pressure to the sensor. If the regulator is not equipped with a pressure indication, a quick and efficient way of determining the required flow rate and pressure to the analyzer is to first process the calibration gas through a flow meter (**with no flow restrictions**) and obtain a flow rate of 0.5 liters per minute (LPM). If plastic tubing is going to be used to transport the calibration gas, be sure it is of good quality.
2. Begin flowing the calibration gas to the analyzer by connecting the gas to the inlet connection. The flow of calibration gas should be increased from 0.5 LPM to 1 LPM. If the optional flow meter has not been purchased, it is advisable to secure one for use during calibration. Monitor the reading from the front panel meter waiting until a stable reading has been established.
3. The oxygen value should be within $\pm 1\%$ of the calibration gas. If not, the user may elect to recalibrate by using the calibration potentiometer located on the front panel of the instrument. To adjust the meter reading, slide the locking mechanism located at the base of the potentiometer to the left. Turn the adjustment knob so that the value from the meter equals that of the calibration gas and allow the reading to stabilize for 2-3minutes. Lock the adjustment knob by sliding the locking mechanism to the right being careful not to inadvertently turn the adjustment knob in the process. Calibration has been completed and normal operation can be resumed.

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Zero Adjustment

Alpha Omega Instrument's Percent Oxygen Sensor is specific for oxygen. When there is no oxygen present, the output from the sensor is zero. This coupled with the inherent linear characteristics of the sensor allow the user to use a single point calibration as means of calibrating the system. NO ZERO CALIBRATION IS REQUIRED.

SECTION 6.0

REPLACEMENT OF THE OXYGEN SENSOR

Alpha Omega Instruments oxygen sensor is designed to operate for prolonged periods of time without needing replacement. However, in time the sensor's output will drop to a level where replacement becomes the prudent course of action. A good indication of this is a marked increase in calibration frequency. When this happens, a replacement sensor should be ordered directly from the factory.

To install a new sensor follow the directions below:

- 1.0 Remove all power from the instrument.
- 2.0 Locate the brass sensor housing located on the side of the analyzer.
- 3.0 Remove the cover from the analyzer by loosening the four screws at each of the four corners of the cover. **Caution. There are wires connected to the front panel from the main printed circuit board. When removing the cover be careful not to disconnect the wires.**
- 4.0 Locate the oxygen sensor inside the analyzer and remove the two-wire connector.
- 5.0 Turn the sensor counterclockwise to unscrew it from its holder. Discard the old sensor (see precautionary note below) and install the replacement sensor being careful not to over-tighten the sensor. The sensor has an "O" ring seal that when **finger tightened**, will provide the required seal. Reattach the electrical connector and reinstall the cover.

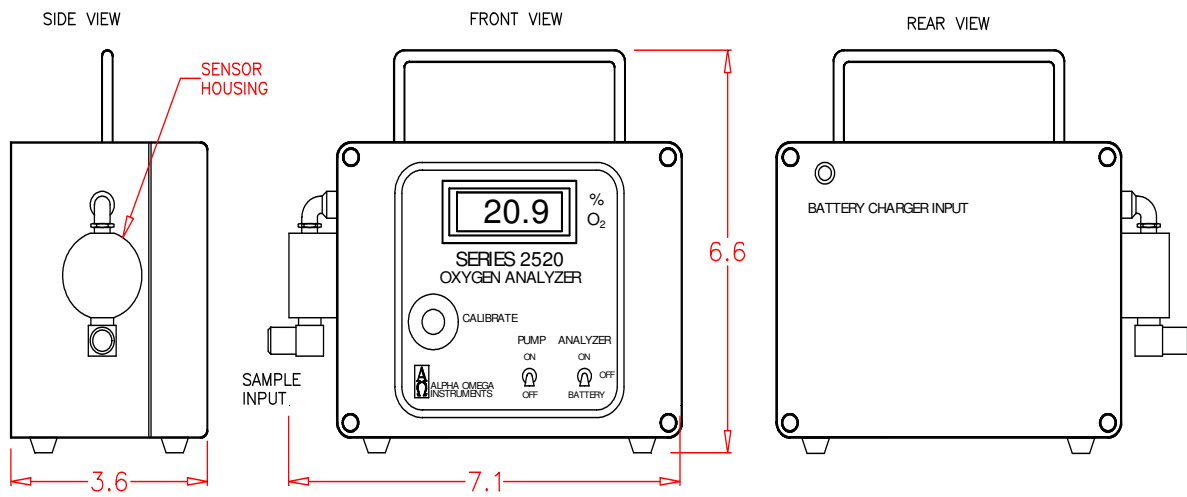


THE SENSOR CONTAINS A SMALL AMOUNT OF WEAK ACID. WHEN DISCARDING SPENT SENSORS, CARE SHOULD BE GIVEN NOT TO PUNCTURE THE SENSOR OR TO TAKE IT APART. DISPOSE OF THE SPENT SENSOR ACCORDING TO LOCAL, COUNTY, OR STATE GUIDELINES.

- 6.0 Fasten the front cover to the analyzer.
- 7.0 Apply power and calibrate according to Section 5.0.

Figure 1.0

SERIES 2520 PORTABLE PERCENT OXYGEN ANALYZER
 SHOWN WITHOUT ACCESSORIES
 AND WITH QUICK-CONNECT GAS FITTING



VALDES COMPANY SPECIFICATIONS DRAWING NO. 11080 SCALE 1:1 DATE 02/14/00		ALPHA OMEGA INSTRUMENTS CORPORATION 20 North Street Cheshire, CT 06114 Tel: (860) 333-8851 Fax: (860) 333-8852	
SERIES 2520 / REV1 CONFIGURATION DRAWING			
DRAWN KEES	DATE 02/14/00	SIZE A	DRAWING No. 11080
CHECKED KEES	DATE 02/14/00	SCALE 1:1	SHEET 1 OF 1

Appendix A
Material Safety Data Sheet for the 2SEN Oxygen Sensor

Manufacturer's Name: Alpha Omega Instruments Corp
Address 30 Martin Street
Telephone 401-333-8580
Date Prepared September 3, 1998
Date Revised April 12, 2001
Trade Name 2SEN and 1SEN
Description Weak acidic solution encapsulated in plastic housing.

Lead Acetate, Trihydrate CAS # 6080-56-4
OSHA/PEL 0.05 mg/m3
ACGIH/TLV 0.15 mg/m3
TLV and PEL are for lead, inorganic dusts and fumes, as Pb
Note: Lead has been reported as causing cancer in laboratory animals, exercise due care.
Acetic Acid, Glacial CAS # 64-19-7
OSHA/PEL 10 PPM
ACGIH/TLV 10 PPM
NOTE: TLV and PEL are for concentrated (90% - 100%) Acetic Acid, actual solution is less than 50%.
Lead CAS # 7439-92-1
OSHA/PEL 0.03mg/m3

Boiling Point: Not Available Specific Gravity: Not Available
Vapor Pressure: Not Available Vapor Density: Not Available
Evaporation Rate: Not Available Physical State: Liquid
Melting Point: Not Available pH: 3.5 - 7.0 Flash Point: > 100 degrees C
Appearance & Odor: Colorless Liquid: Vinegar like odor
Extinguisher Media: Use water spray, alcohol foam, dry chemical or carbon dioxide
Special Fire Fighting Procedures: Respiratory protection should be used to avoid breathing fumes.
Unusual Fire & Explosion Hazards:
Lead acetate decomposes at boiling point and toxic gases are produced. Acetic acid vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode.

Stability Stable