NEUTRONICS INC.

Engineered Solutions for Gas Detection and Analysis

High Purity Instruments

MODEL N2
OPERATIONS MANUAL

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NTRON A DIVISION OF NEUTRONICS INC.

456 Creamery Way, Exton, PA 19341
Phone: 610.524.8800 • Fax: 610.524.8807 • Email: info@neutronicsinc.com
www.neutronicsinc.com

Introduction

Thank you for your purchase of the ***PureN2*** Pump Drive, High Sensitivity Parts Per Million Oxygen Analyzer .

The ***PureN2*** PPM Oxygen Analyzer is a user friendly, microprocessor controlled, oxygen measuring system. It has many features to offer the user which will be described in this manual. We recommend that all personnel who use this instrument read this manual to become familiar with the instrument's operation.

If you have any questions or concerns while using the ***PureN2***, please contact us.

Neutronics /Ntron Customer Service Department
456 Creamery Way
Exton, PA 19341
610-524-8800
610-524-8807 (f)
(800)-378-2287 Toll Free (US only)
info@neutronicsinc.com (email)
visit at www.neutronicsinc.com (web site)

Neutronics Inc.
Warranty Statement

Neutronics warrants to the original purchaser, that the Model PureN2, P/N C7-01-1000-16-0 Oxygen Analyzer to be free from defects in material and workmanship for a period of one (1) year from the date of shipment from Neutronics or from one of Neutronics' authorized dealers. Our liability will be limited to the repair or replacement, at our factory, of parts found to be defective within the warranty period, as determined by Neutronics. The parts will be repaired or replaced free of charge if shipped prepaid to the factory in the original shipping carton. This warranty is void if the product has been subject to misuse or abuse, including but not limited to: exposure to water, humidity- temperature- shock or pressure outside of the listed specifications, or has not been operated in accordance with operating and maintenance instructions, for repairs which were not performed by Neutronics or by one of its authorized dealers, or if the identifying markings on the product label have been altered or removed.

The seller assumes no liability for consequential damages of any kind, and the buyer, by acceptance through purchase of this product, will assume all liability for the consequences of its use or misuse by the buyer, his employees, or others.

Neutronics reserves the right to use any materials in the manufacture, repair or service of the products and to modify the design as deemed suitable, in so far as these materials or modifications maintain the stated warranty.

It is the sole responsibility of the buyer / user to determine if this product is suitable for the intended application.

THESE WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, OR IMPLIED INCLUDING WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE.

Intended Use and Important Notes for the Application of the Model *PureN2*

The model ***PureN2*** oxygen analyzer was designed to provide the trained operator with useful information relating to the concentration of oxygen. This information may be used in process control or to minimize possible hazardous conditions which may be present in various processes. Before implementation, the user must fully understand the operation and limitations of this instrument as well as the application for its use. The responsibility for the proper application, operation, and maintenance of the model ***PureN2*** oxygen analyzer is the sole obligation of the trained operator. The purchaser is required to ensure operators are properly trained in the use of this unit as well as in the possible hazards associated with its use or with the intended application. The purchaser must ensure that all of the proper warnings, labels, instruction manuals, lock outs, redundant components, hazard analysis, and system validation have been completed and provided to the trained operator before implementation of the model ***PureN2*** instrument.

For Your Safety:

PLEASE

- ***READ THIS MANUAL IN ITS ENTIRETY BEFORE ATTEMPTING INSTALLATION OR OPERATION!***
  Attempting to operate the Model ***PureN2*** without fully understanding its features and functions may result in unsafe conditions.

- Always use protective eye wear and observe proper safety procedures when working with pressurized gases.

- Always assure the pressure of gas entering the Model ***PureN2*** is in the range of 2mm Hg vacuum to 250mm Hg positive pressure (gage pressure) .

- Always calibrate the Model ***PureN2*** at an equivalent pressure and flow rate to the gas being measured.

- Always allow the Model ***PureN2*** sensor to cool down before attempting to access the sensor.

- Ensure the MODEL ***PureN2*** has been properly calibrated before use.

- Never expose the analyzer chassis or sensor to water, high humidity or moisture. The analyzer chassis is not watertight.

- Never expose the MODEL ***PureN2*** to flame or high temperatures.

- Never expose the MODEL ***PureN2*** directly to unregulated gas lines, cylinder gas, …

- Ensure the analyzer unit is mounted in an area of free air flow to prevent the chassis from exceeding the operating temperature specifications. Do not set the analyzer against hot surfaces. Do not block the ventilation louver on the analyzer chassis.

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*Changes may be made to this manual and to the specifications of the **PureN2** PPM Oxygen Analyzer without notice.*

Specifications

Dimensions	14.75" High x 9" Wide x 13.55" Long (375 mm x 229 mm x 344 mm)
Weight	12 lbs. (5.5 Kg)
Operating Conditions	Ambient Temperature: 0 to 122ºF (0 to 50ºC) Relative Humidity: 0 to 90% (Non-Condensing).
Range	Auto-ranging between .001 PPM to 99.9% O_2. Operator does not need to select the range. Indicator light specifies whether the reading is in percent or ppm.

Accuracy

1 to 100 ppm	+/- 5% of reading
101 to 999 ppm	+/- 2% of reading
.1 to 99.9 %	+/- 2% of reading

Response Time

Change response: 95% of step change in 5 seconds at 1 liter/min. sample flow rate.
90% of step change in 10 seconds below 999 PPM.

Recovery Time From Room Air To

. 1 PPM	~5 min
50 PPM	< 15 seconds
.1%	<5 sec

.

Operations	Pressure = 10mm Hg vacuum to 250mm Hg positive pressure (gage pressure) regulated to constant pressure. Flow rate = .5 to 1.5 liters/min.
Warm-up Time	Approximately 20 minutes
Power Supply	115 VAC +/- 20% 50 to 60 Hz Single phase (Selectable to 220 VAC operation with a change of internal and external switches).
Outputs	3-digit LED Display RS-232 Computer communications of the following data: Percentage, ppm, cell temperature, cell voltage, high/low alarm. Analog Output - Auto-ranging or operator may select ranges. 0 to 1+/-.5% VDC @ 10K input impedance minimum and a non-isolated 4 to 20+/-1% mA current output. Loop is powered by ***PureN2***, negative ground.
Hi/Lo Alarms	Operator selects high and low set-points with option key.
Contact Relays	Two available, 5 Amp @ 220 VAC rated.
Sampling System	316 S.S. Swagelok™ fittings and tubing, 316 SS / Teflon Diaphragm / Viton Seals High Purity Pump, 1 carbon cartridge filter supplied with unit.

CHAPTER 1

Description

The Model ***PureN2*** is a microprocessor based portable instrument intended to accurately measure oxygen in the range of 100% to 0.1 PPM. At the heart of the ***PureN2*** is the Neutronics Industrial/Ntron exclusive ***Rapid Response Zirconium Oxide Sensor.*** Because the sensor is a solid state device, it offers many unique advantages over other sensor technologies.

- Rapid response: from air to 50 ppm in less than 15 seconds
- Wide measurement operating range: 100% to 0.1 ppm
- Immune to oxygen shock: can be exposed to air and within seconds read ppm
- Unaffected by position or motion
- Can be exposed to a wide range of operating gas temperatures
- Long Life (5-10 years expected) Low maintenance: no regular service required

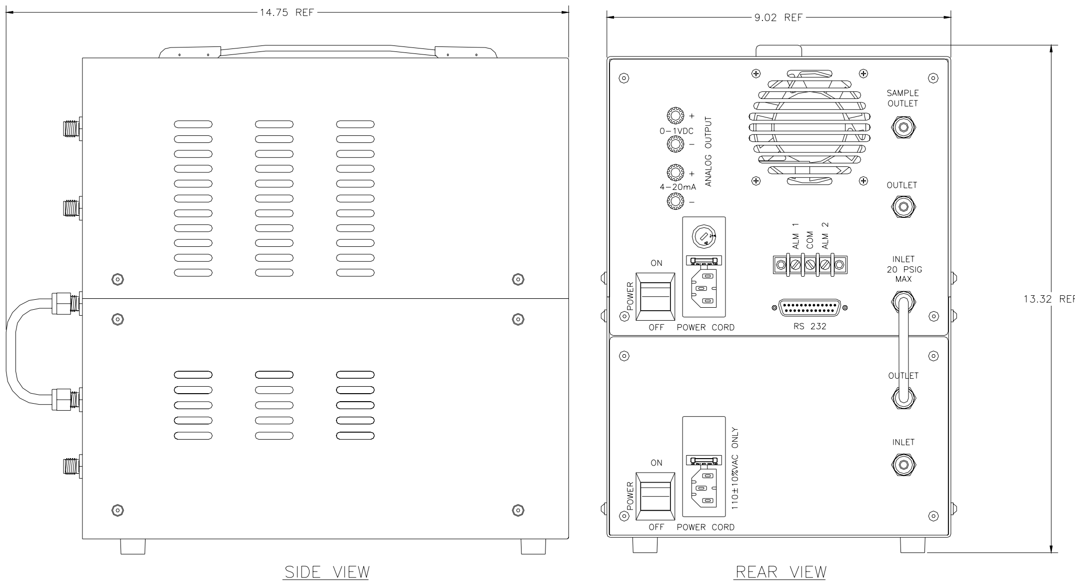
The ***PureN2*** offers two displays: a large LED digital display of oxygen concentration and a Dot Matrix display to guide the user through modes of operation and diagnostics. The ***PureN2*** also offers a state of the art microprocessor based electronics with user friendly software interface via an easy to use keypad.

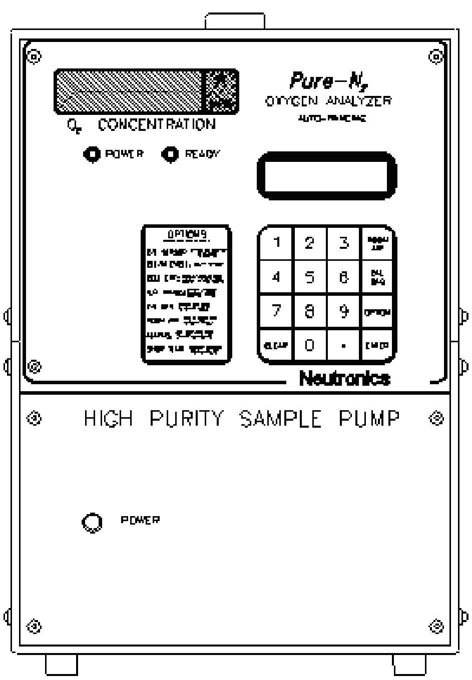
The Model ***PureN2*** operates on 110/220 VAC 50/60 Hz. Power source. A power cord is provided for connection into a standard U.S. socket.

The Model ***PureN2*** analyzer is supplied with a built-in high purity sample pump. The pump is an oiless type, manufactured of high quality materials for use in a variety of applications where the sample gas must be extracted from a process point. Because of the unique design, the ***PureN2*** may be used in applications including:

- Solder Reflow Ovens
- Wire Annealing
- Metal Heat Treating
- Glove Boxes
- Crystal Growth Chambers
- RTP Furnaces
- High Purity Welding Chambers
- High Purity Orbital Welding of SS or Titanium Tubing
- Aerospace
- Laboratory Use

To better understand the operation and maintenance of the Model ***PureN2*** oxygen analyzer, please read this manual in its entirety


14.75 REF
9.02 REF
13.32 REF
0-1VDC
4-20mA
ANALOG OUTPUT
SAMPLE OUTLET
OUTLET
INLET 20 PSIG MAX
ALM 1
COM
ALM 2
RS 232
ON
POWER
OFF
POWER CORD
110±10%VAC ONLY
INLET
SIDE VIEW
REAR VIEW


Pure-N2
OXYGEN ANALYZER
O2 CONCENTRATION
POWER
READY
OPTIONS
1
2
3
4
5
6
7
8
9
0
CLEAR
OPTION
ENTER
Neutronics
HIGH PURITY SAMPLE PUMP
POWER

Principles of Operation

Theoretical Basis

The sensor used in the ***PureN2*** PPM Oxygen Analyzer is made of the solid state oxygen ion conducting (electrolyte) zirconium oxide. Due to oxygen vacancies in the ceramic lattice, at temperature over 450 degree Centigrade, oxygen ions are mobile in the solid material. It is this property that enables the measurement of oxygen in a gas of unknown composition. When two gases of differing oxygen concentrations are on opposite sides of a zirconium oxide membrane, each side with a conductive (platinum) electrode material, a DC voltage is generated that is a function of the difference in oxygen concentration. In practice, one side of the membrane is a known reference gas, typically air, and the opposite side is the unknown sample gas to be measured.

In 1899 Nernst defined the relationship between the measured voltage and the unknown oxygen concentration:

$$\mathbf{E=(RT/nF)\ln(P1/P2)}$$

Where:

E is the measured voltage.
R universal gas constant 8.314 joule/mole ^{o}K.
T is the temperature in ^{o}K.
n is number of electrons transferred (4).
F Faraday's constant 96,500 coul./mole.
P1 - Oxygen partial pressure in air reference (20.9% O_2).
P2 - Oxygen partial pressure in sample gas.

Using this relationship, the unknown oxygen concentration can be determined by simply measuring the voltage across the cell. Once the sensor is heated to a temperature of 725^{o}C, the voltage is measured, and the oxygen concentration information is sent to the display and other outputs. The instrument is calibrated using air and a low level calibration gas for improved accuracy. This calibration corrects for small effects of non-ideal sensor behavior.

Due to the high operating temperature and use of platinum electrode, the presence of reducing agents such as hydrocarbons, carbon monoxide, hydrogen etc. interferes with the measurement of oxygen. The analyzer will display lower than actual oxygen concentration in the presence of reducing agents.

(For example: 2 H_2 plus 1 O_2 forms 2 H_2 O and thus reduces the O_2 the analyzer reads by a ratio of 0.5 for every 1 H_2 molecule. 2CO plus $1)_2$ forms $2CO_2$ which also reduces O_2 o.5 for every 1 CO molecule. Data shows that hydrocarbons reduce O_2 by 0.1 for every hydrocarbon molecule.)

Caution should be taken to use the OA series analyzers to measure inert gases only. **Do not attempt to measure gases containing sulfur gases like H_2 S.** The sulfur reacts with the platinum electrode to form platinum sulfide. This reaction degrades the electrochemical properties of the sensor.

System Components

The four basic components in the analyzer are described below and shown schematically in Fig.# 1.

Sensor

The solid electrolyte (Zirconium Oxide) electrochemical sensor consists of a closed end ceramic (Zirconium Oxide) tube coated inside and outside with two porous platinum electrodes. When heated above 600^{o}C ionic conductivity of the Zirconium Oxide becomes high enough to generate a voltage as described by the Nernst equation. The outside electrode is exposed to air and acts as a reference. The sample gas flows inside the tube and the inner electrode acts as the sensing electrode.

The sensor measures oxygen partial pressure and the voltage output is affected by the change in total pressure. To reduce sensor error, maintain the outlet at approximately ambient pressure.

The sample gas flow into the analyzer is controlled at a rate on .5 to 1.5 liter(s)/minute by a needle valve and rotometer on the front of the analyzer. The outlet must be maintained at approximately ambient pressure to insure sensor accuracy. Included in this part of the system is an O-ring fitting which connects the electrochemical sensor tube to the rest of the sampling system; specifically the gas sampling inlet and outlet tubes.

Electronics/Display System

The microprocessor-based system controls the operation of the ***PureN2*** PPM Analyzer and displays relevant information. It consists of a CPU board, an Analog board, a Power Supply board and a user interface board with LED display, LCD display, and a control key pad.

Furnace/Heater

This is the metal box within the instrument which is an electrical resistance heater. It heats the electrochemical ceramic sensor to the operational temperature of 725^{o}C. It also has a type K thermocouple to sense temperature for controlling the furnace.

Sampling System

The ***PureN2*** consists of a high purity pump which extracts a gas sample from the process point. The gas is pressurized and directed to a tubing junction. The gas is directed in two directions: one through a bypass valve as a slipstream; the remaining gas is directed through a fixed orifice to the sensor. The pressure release bypass valve controls system back pressure onto the sensor and also allows a slipstream flow (for faster response time). The fixed orifice is used to reduce the pressure/flow of the sample gas as it flows to the zirconia sensor. Gas released by the bypass valve exhausts through the outlet fitting, while the sample stream (approximately 120 cc/min) is discharged through a bulkhead fitting outside the back of the analyzer.

PureN2 PPM O_2 ANALYZER SYSTEM CONFIGURATION

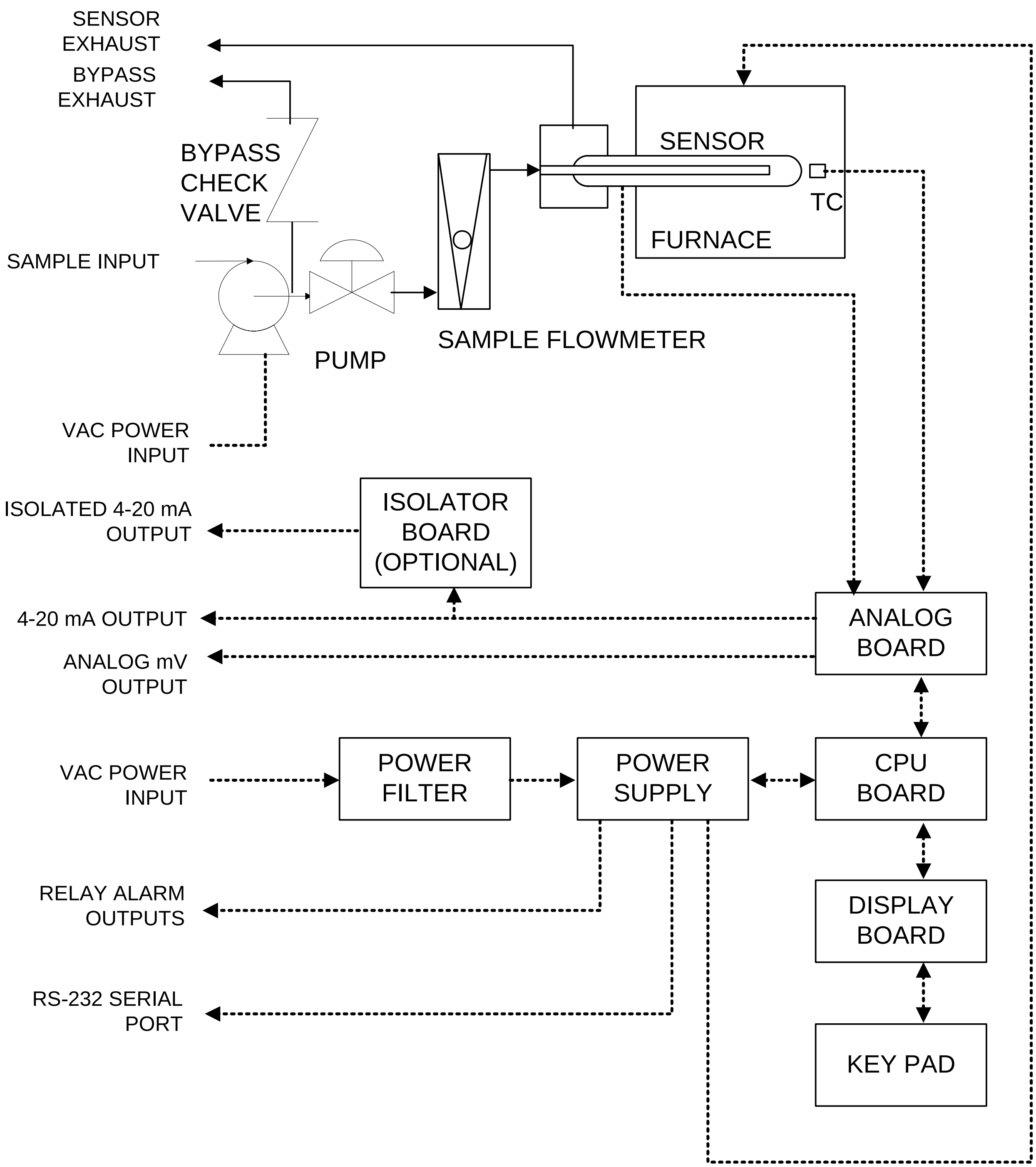


FIGURE 1

CHAPTER 2

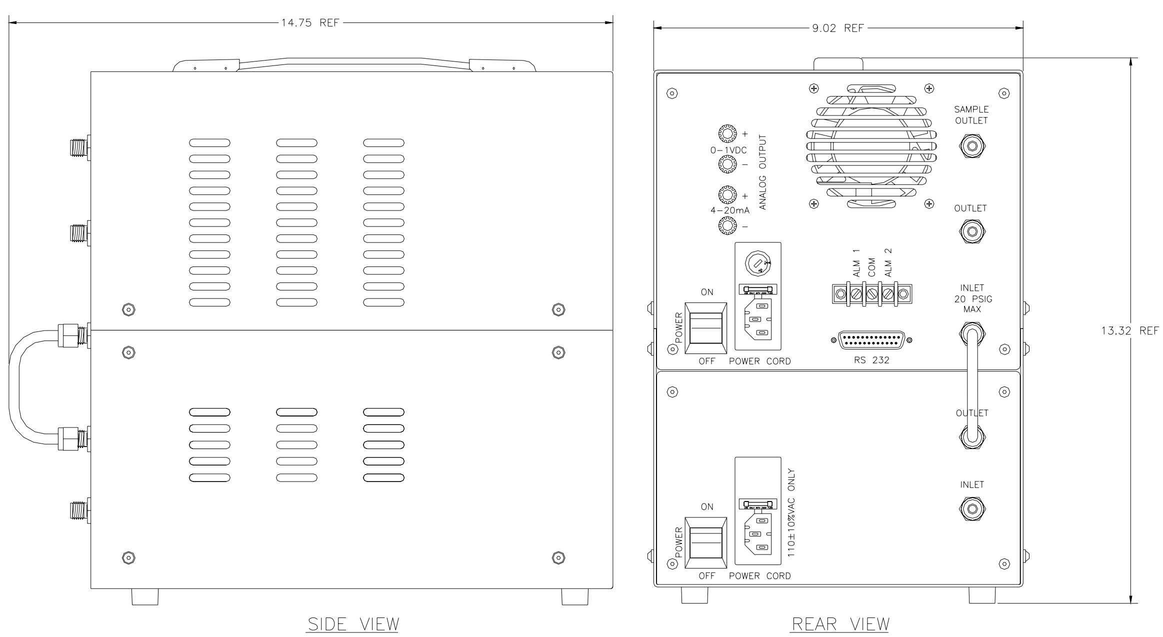
Installation and Start-up

Installation

The ***PureN2*** Oxygen Analyzer is a completely self contained instrument. The only requirement to operate it is a source of power. Set selector switches on the rear of the unit to the 110 setting for 120 VAC + 20%, or the 220 setting. Internal and external switch changes are required for 220 VAC. Contact Neutronics for instructions. This analyzer has been designed for analyzing O_2 in clean gases that contain no hydrocarbon or CO components.

The ***PureN2*** Oxygen Analyzer utilizes 1/4 inch Swagelok fittings and connections throughout the system. Inlet and outlet ports are located as shown in Fig 2. The ports are 1/4 inch tube Swagelok fittings. Gas inlet flow requirements are .5 to 1.5 liter(s)/minute. A flow control valve is supplied in the front panel with a rotameter to indicate flow rates of gas being supplied to the analyzer.

FIGURE 2



Start-up

When the instrument is connected to power and turned on, the green POWER indicator lights illuminate (main analyzer power lamp & Pump power lamp), the electronic display illuminates, and the LED display counts up to test the LED segments.

The warm-up time before the instrument is operational is approximately 20 minutes.

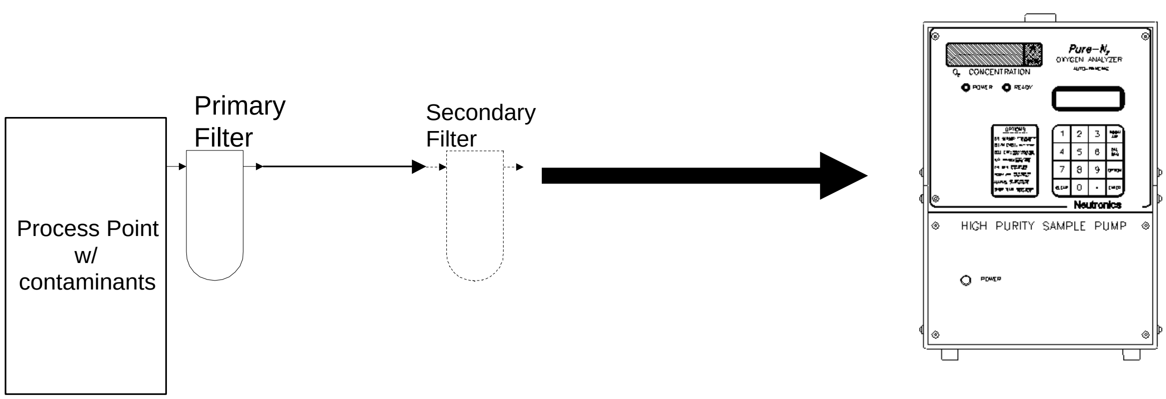
As the analyzer is warming up, the green READY light flashes and heater temperature is shown on the LED display. The secondary display reads *OVEN WARMING UP. When the sensor temperature reaches the operating range, the secondary display reads STABILIZING.* When the sensor temperature has stabilized the READY light stops blinking and remains in a steady on state. O_2 concentration is shown on the LED display with the appropriate range light illuminated (%, PPM).

Special Situations

When attempting to measure gases with oxygen concentrations of less than 10 ppm, the user must carefully evaluate the entire system including the analyzer AND all external components such as gas plumbing, regulators, etc. It is important to remember that all surfaces in contact with the gas to be measured will have some adsorbed oxygen on the surface. Purging the system with the low-oxygen inert gas to be measured will eventually clean the surfaces of adsorbed oxygen. Once cleaned, they will remain clean unless exposed to a high-oxygen gas such as air. The choice of gas line materials is very important when measuring low ppm oxygen gases. For the best results, use cleaned stainless steel tubing.

Using the Pump / Filter Package Effectively

The PureN2 system is equipped with a built in high purity pump. The pump will allow sample to be drawn from ambient air applications. The pump can also work with sample pressures ranging from a slight vacuum to positive pressure (see specifications). The PureN2 system is also supplied with two carbon filters. The filters may be used for applications such as solder reflow ovens where some contaminates may be present (flux, oils, etc…). Typically, one filter is installed between the process point and the PureN2 analyzer. The second filter is held as a spare. In certain instances, both filters may be installed. The primary filter will be installed close to the process point. The secondary filter will be mounted close to the PureN2 analyzer.



CHAPTER 3

Operation

Display
The oxygen analyzer has a three-digit LED display for showing the temperature and oxygen content. When the display is showing oxygen content, one of the range indicators is on. When the display is showing temperature, the range indicators are off. The three digit display automatically switches to the proper range to display the oxygen concentration of the gas being measured. The bottom range indicator will illuminate to show parts-per-million range and the top indicates percent range. The display automatically switches from percent to PPM when the sample oxygen concentration decreases from .100% to 999PPM (.1% equals 1000 parts per million).

PureN2 FRONT PANEL

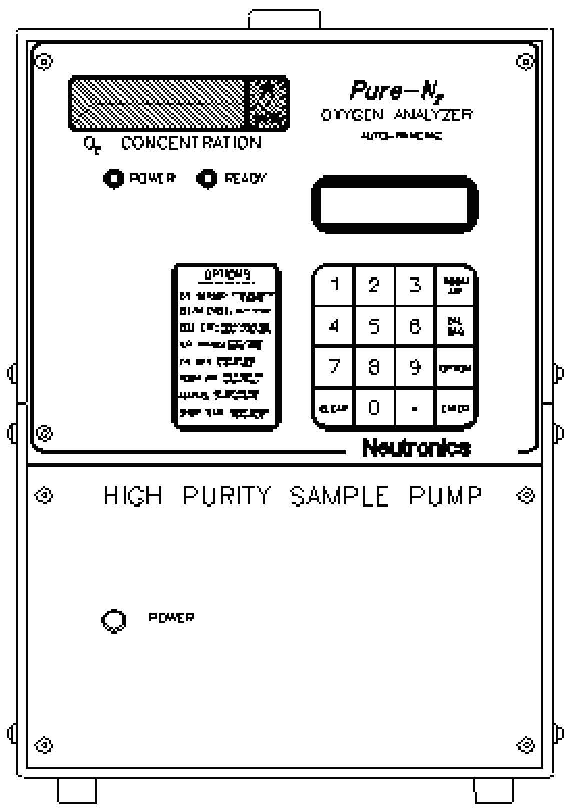


FIGURE 3

Option Modes

The ***PureN2*** Oxygen Analyzer has several options. These options are accessed by using the OPTION key on the keypad. The user scrolls through the options by pressing the OPTION key. Options are displayed on the secondary display during scrolling. Choices are made by pressing the ENTER key when the desired option is shown on the display. Brief descriptions of the options are printed on the front panel to the left of the key pad. The option modes are described in more detail on the next page of this manual.

Calibration Mode

The secondary display reads "Cal Sensor?". This option allows the user to recalibrate the instrument. Calibration steps are listed on the secondary display.

Clean Mode

The secondary display reads "Clean Cycle?". This option signals the device to pass oxygen from the reference side of the sensor to the measurement side. This helps accelerate the combustion of impurities that may have accumulated on the inner surface of the sensor.

Display Sensor Cell EMF Voltage

The Secondary display reads "Cell EMF?". This option lets the user see the actual voltage output of the sensor cell. This function works like a digital volt meter.

List Analog Output Range

The secondary display reads "D/A Range?". This option lets the user select the range over which the analog output(0-1 VDC or 4-20 mA) operates. The display will also read "Auto Range On" or "Auto Range Off" depending on the operators specific selection. (See chapter 5)

Set the Calibration Gas O_2 Partial Pressure Value

The secondary display reads "Cal Gas?". This option lets the user see the entered value for the calibration gas and change that value if required before calibration. This value is determined by the specification of the user's calibration gas. Accuracy of the analyzer is a function of the accuracy of the calibration gas certification. Values are entered in PPM O_2.

Set the Room Air O_2 Partial Pressure Value for Calibration

The secondary display reads "List Room Air?". This option allows the user to see what value for room air has been entered and change that value if required before calibration. Values are entered in % O_2.

Set the Two Alarm Limits

The secondary display reads "Alarms?". The analyzer is equipped with the flexibility to set the alarms for high/low, high/higher, low/lower as is needed for use in specific applications. The alarm option allows the user to view the values and high/low settings that have been entered for the two alarms. When the oxygen concentration goes outside the set alarm limits, the audible alarm sounds. This option also allows the user to change alarm values and to turn the alarms on or off. Alarm contact relay #1 & relay #2 are located on the back panel and will energize when the analyzer detects oxygen concentrations outside the alarm conditions.

Show Temperature

The secondary display reads "Show Temperature?". This option signals the analyzer to display the temperature of the sensor cell heater in ^{o}C on the three digit LED display. Normal operation range is 725^{o}C +/- 5^{o}.

Communications Interface

The electronics have been designed for communication with a host computer over a standard RS-232 serial interface. The host computer can inquire about temperature, oxygen concentration, sensor voltage, and other parameters. The host computer may control analyzer electronics, via the communications interface, by turning the communications line on and off. It is recommended that the communications line be turned off when not in use to speed up the analyzer's response time.

NOTE!! **If a computer is on line with the analyzer, a restart may be accomplished either by sending the analyzer a Ctrl-C instruction from the computer or by turning the analyzer off and then on.**

The commands are:

			Limits		
Letter	**Command**	**Format**	**Min**	**Max**	**Units**
A	Send Software Version	x.xx	1.00	9.99	n/a
C	Send Unit Configuration	x	0	3	note#1
D	Send Sensor Reading ppm	xxxEsx	001E-3	999E+3 ppm	
E	Send Sensor Reading %	xxxEsx	0.1	99.9	%
F	Send Oven Temperature	xxx	000	999	C
G	Send Sensor Voltage	sxxxEsx -999E-3	+999E-3 volts		
H	Send Error Number	xx	00	02	n/a
X	Enable Communications Link via RS 232 port				
x	Disable Communications Link via RS 232 port				
Z	Send Error Message	X	n/a	n/a	Alphanumeric

Note: bit 0: 0=torr, 1=ppm bit 1: 0=air reference, 1=absolute reference

The communications Interface operates at 1200 Baud, 8 data bits, 1 stop bits, no parity. To operate the interface, the host sends an ASCII command letter to the analyzer. The host computer then waits for the analyzer to respond. The analyzer responds no later than 1.0 second after it receives the command letter. All responses are terminated with a carriage return. Use the "X" command to start continuous communication. O_2 concentration, **in PPM with 1 decimal place (10.5 = 10.5 PPM)**, will be sent out the RS232 to the host terminal every 1.5 seconds. To end the communication send "x" (small letter x). The default at power up is communication off.

Cable requirements for two-way communications are a non-MODEM 25-pin female/male sub-D connector terminated cable. The non-MODEM feature denotes that pins 2 and 3 are reversed on each end. Currently, only 3 pins are used: pin 2=transmit, pin 3=receive, pin 7=digital ground.

When an alarm is activated, the analyzer sends, to the remote computer, either an "H" if the oxygen concentration is above a HIGH alarm setting, or an "L" if the oxygen concentration is below a LOW alarm setting. Alarm characters are also terminated with a carriage return and are sent once per second as long as the alarm condition persists. If the analyzer receives a command while the alarm is active, the alarm character is sent first followed by the command response.

Access to the Serial interface may made through a terminal emulator program such as HYPERTERMINAL available in Windows 95:

Procedure for RS-232 Interface using
***"HYPERTERMINAL"* from Microsoft Windows 95**

1. From the Windows menu, select ***"Start"***.

2. Then, select ***"Programs"***.

3. Then, select ***"Accessories"***.
4. Then, select ***"HYPER TERMINAL"***.

5. Double click on the HYPERTERMINAL Icon.

6. Choose name "Model ***PureN2***".

7. Choose code: none required.

8. Choose area code: none required.

9. Connect Using:

    Direct to SERIAL COM 1 or SERIAL COM 2 (as applies)
    BPS: 1200 BAUD
    Data Bits: 8
    Stop Bits: 1
    Parity: none
    Flow Control: none

10. Click "OK"

Notes:

If serial communications has not been established with model ***PureN2*** analyzer, make certain that the PC SERIAL COM port is functional. This can be accomplished by jumping pins 2&3 on the RS 232 cable leading to the PC. To accomplish this test, disconnect the RS 232 cable from the model ***PureN2*** analyzer port and insert a jumper between pins 2&3 on the cable connector or directly at the PC serial COM port. Then, enter a letter from the PC keyboard : push an alpha-character key and then "enter" key. The PC monitor should display the corresponding alpha-characters as they are typed. If the alpha-characters do not echo on the monitor screen, there is a problem with the RS 232 cable, the PC serial COM port, or the HYPERTERMINAL setup.

If the letter does echo on the monitor screen and serial communications with the model ***PureN2*** analyzer still has not been established, then pins 2&3 (xmtr & rcv.) may be reversed. First try reversing pins 2 & 3 on the RS - 232 cable connector. Then go back to the beginning of step #1 and try again. If the model ***PureN2*** analyzer still does not re-boot, call the Neutronics Industrial/Ntron Service Department for further assistance.

CHAPTER 4

Calibration

The ***PureN2*** Oxygen Analyzer is calibrated at the factory at a flow rate of 1 liter/min. It is important to calibrate the device at your facility to compensate for atmospheric pressure variation between the point of manufacture and the end use site. After completion of the calibration sequence, the display readout will correspond to the cylinder analysis of the user's certified calibration gas.

Temperature

The Analyzer thermocouple is completely factory calibrated before shipping and requires no calibration when received.

Sensor

To calibrate the zirconium oxide sensor, two reference points are required. The recommended calibration procedure is to use compressed air and a calibration gas near your range of operation, as the two reference points.

It is important to remember that the calibration will only be as accurate as the certification of the reference gas you use.

The calibration sequence is semi-automatic. This means that the electronics adjust the offset and gain, rather than requiring the user to adjust potentiometers. The user must flow gases as indicated by the secondary display and push either the Room Air or Cal Gas buttons when the reading is stable. This is two stage process that does not require repetition for both room air and calibration gas.

See next page for detailed step by step Calibration Instructions.

NOTES:

It is best to calibrate the ***PureN2*** Oxygen Analyzer at an identical flow rate for both calibration gases and at the expected sample gas flow rate.

We recommend calibrating with room air first. When directed to "Flow 20.9% Gas" (on secondary display), flow the room air or regulated source of instrument air. **IT IS IMPORTANT TO ALLOW THE READING TO STABILIZE** before the ENTER key is pressed to complete the calibration sequence.

Repeat this process using the low end O_2 concentration calibration gas to complete the two point calibration. Flow the calibration gas from a cylinder of certified gas into the analyzer, **ALLOW THE READING TO STABILIZE**, and press the ENTER key to complete the calibration.

STEP BY STEP CALIBRATION INSTRUCTIONS FOLLOW:

Step One: Be sure that the ***PureN2*** Oxygen Analyzer has been warmed up for approximately 20 minutes before attempting calibration.

Step Two: Be sure the correct values for both Room Air and Calibration Gas are entered in the device memory. Values may be viewed and changed if required by pressing the ROOM AIR or CAL GAS key. The current value appears on the secondary display with directions to "Press 1 To Change Value" or "Press Any Other Key To Accept" the current value.

An alternate method to view and/or change the Room Air and Calibration Gas values is to press the OPTION key until "Cal Gas?" or "Room Air?" appears on the secondary display. Press the ENTER key to view. The current value appears on the secondary display with directions to "Press 1 To Change Value" or "Press Any Other Key To Accept" the current value.

Calibration gas and room air values may also be entered during the calibration sequence. "Press ROOM AIR or CAL GAS to Begin Cal". Once the ROOM AIR or CAL GAS key has been pressed, the current value is displayed on the secondary display with instructions to "Press Enter to Start Cal" or "Press 1 to Change Gas Value" or "Press Any Other Key to Exit". The user may accept or change values during this sequence.

Step Three: Press the OPTION key until "Cal Sensor?" appears on the secondary display. Press ENTER to initiate the calibration sequence. "Calibration Mode" will appear on the secondary display & instruct you to"Press ROOM AIR or CAL GAS to begin Cal".

Once the ROOM AIR or CAL GAS key has been pressed, the secondary display reads "Room Air Cal" or ""CalGas Cal" and "Press Enter to Start Cal". The user is then instructed to flow the appropriate calibration air or gas and "Press Enter to Start Cal Cycle". Press ENTER to initiate the calibration sequence. The adjustment factors are calculated and are displayed as "Gain" and "Offset".

The secondary display will then say "Cal Completed" and will display the initial calibration level of "Room Air Cal" or "CalGas Cal" that was chosen by the user. Repeat above procedures on the second calibration gas to complete two point calibration. Press any key to exit to the initial "Calibration Mode" display and press any key to exit options. Calibration should be complete and the analyzer will be ready to measure the user's sample gas.

NOTE: If the air or calibration gas flowed during the calibration sequence is *not* what is entered into the analyzer for O_2 content value (outside +/- 25% of expected value), the secondary display will read "Calibration Fail Check Gas". This function is designed to safeguard against calibrating with a gas that has a different O_2 content than what is certified. (For Example: Message will appear if 10 ppm is entered as the cal gas value and yet the analyzer reads 100 ppm based on the mV potential and theoretical calculated O_2 content).

CHAPTER 5

Analog output

The ***PureN2*** Oxygen Analyzer is equipped to output oxygen readings via an analog output through two sets of analog output posts on the rear panel of the unit. Available analog outputs are 0-1 VDC, and 4-20 mA*. Range values are set to Auto-Range. The user, however, may disable the Auto-Range feature and set the ranges as needed for specific applications. See figure 2 for the location of the posts.

Ranges for Analog Output while in Auto-range.
The following information is provided to show how the analog outputs function

Oxygen Range	Voltage Range	Current Range
0 to-9.99 ppm	0 to .999V	4 - 20ma
10 – 99.99 ppm	.1 to .999V	5.6 – 20ma
100 – 999 ppm	.1 to .999V	5.6 – 20ma
1000 – 9,999 ppm	.1 to .999V	5.6 – 20ma

NOTE: The PureN2 auto-ranges to a maximum of 1% or 9,999 ppm. To configure analog outputs beyond these ranges, the user must turn auto-range off and set the maximum reading in ppm.

Instructions for Setting the analog outputs manually

Step 1: Press the OPTION key until the message "D/A Range?" appears on the secondary display. Line 2 of the secondary display will read "Auto-Range On". Press “CLEAR” to toggle auto-range on and off.

Step 2: Press ENTER to save the current value. "Press 1 to Change the Value" (to change the value of the 1 volt end point).

The PureN2 may be adjusted to output 0-1 volt and 4-20 mA based on a fixed range scale. It is adjustable from 10 ppm to 999,999 ppm for full scale output, (.001% to 99.99%). For example, to set up full scale analog output, for 25%, the setting would be 250,000 ppm. 25% equals full scale and 0 = minimum scale. This must be in the “Auto-Range Off” setting. NOTE: 4 and 20 mA outputs correspond to 0 and 1 VDC outputs respectively. Both analog outputs will automatically range with the front panel display.

NOTE: 4 and 20 mA outputs correspond to 0 and 1 VDC outputs respectively. Both analog outputs will automatically range with the front panel display. In the 0-100 ppm range the 1 VDC and 20 mA levels will represent 100 ppm. In the 0-.1% range 1 VDC and 20 mA levels will represent .1%.

When the analyzer is in "Auto-Range" option, line 2 of the LCD display will read "Auto-Range On". The auto-range function is controlled by pressing the CLEAR key. The secondary display will toggle between "Auto-Range On" and "Auto-Range Off" indicating which mode the analog output is set to. The default setting is "Auto-Range On".

4-20 mA analog board is non-isolated.

The analog output is calibrated at analyzer start up. During the calibration sequence the user has the option to recalibrate the analog output. This is a self calibration operation if chosen.

CHAPTER 6

Alarm Function

Set the Two Alarm Limits

The ***PureN2*** Oxygen Analyzer has an audible alarm system which also controls contact closures for integrating this alarm function into a customer's process control system. The audible alarm sounds when the oxygen concentration goes outside the preset alarm set points.

The secondary display reads "Alarms?". The analyzer is equipped with the flexibility to set the alarms for high/low, high/higher, low/lower as is needed for use in specific applications. The alarm option allows the user to view the values and high/low settings that have been entered for the two alarms. When the oxygen concentration goes outside the set alarm limits, the audible alarm sounds. This option also allows the user to change alarm values and to turn the alarms on or off. Alarm contact relay #1 and relay #2 are located on the back panel and will energize when the analyzer detects oxygen concentrations outside the preset alarm conditions.

Instructions

Step 1: Press the OPTION key until the message "Alarms?" appears on the secondary display. Line 2 of the secondary display reads "Enter or Option" instructing the user to press enter to engage the alarm set option.

Step 2: Press ENTER. Line 1 of the secondary display reads "Set Alarms" and line 2 reads "Press 1 to Change Alarm #1 <u>or</u> Press 2 to Change Alarm #2 <u>or</u> Press Enter to Accept the Current Setup".

NOTE: As is described above, the analyzer alarms can be set to alarm in the high/low, high/higher, or low/lower modes as is required for a user's specific application. While in the alarm set option, press 1, 2 or ENTER to view and/or change the alarm settings.

Step 3: If a change to the alarm settings is desired, press 1 or 2 to set alarms #1 or #2 respectively. Press ENTER to save the current alarm settings if no changes are required.

NOTE: The following scenario will be described for setting alarm #1 to a low setting. If other scenarios are required specific to a user's application, follow the same procedure and tailor the alarm settings to the specific application need.

Step 4: Press 1 to change alarm #1. Line 1 of the secondary display shows the "Alarm is Low (or high)". Line 2 shows current alarm value and instructs the user to "Press 1 to Vary High/Low, Press CLEAR to Vary On/Off, Press 2 to Change Value or Press ENTER to Accept Setup" and then shows the alarm status as On or Off. Make the desired selection, view current settings, and change as is needed and press ENTER to accept the setup.

Step 5: Repeat as is required for alarm # 2.

Dry Contact Closures

The ***PureN2*** Oxygen Analyzer comes with two dry contact relays. Contact closure #1 is the relay for alarm #1. Contact closure #2 is the relay for alarm #2. Access to the relay terminals is inside the analyzer on the power supply board. The connectors are marked NC (normally closed), NO (normally open), and C (common). Please contact the customer service department identified in the introduction at the front of this manual if this alarm feature is needed for a specific application.

CHAPTER 7

Trouble-Shooting

In some cases problems can be easily diagnosed and corrected. In other cases problems will require the user to return the analyzer to the factory for repair. Contact the customer service department identified at the front of this manual with any questions or when uncertainty arises.

Problem 1: **Display reads too high.**

Cause: Upset system condition indicates gas source contamination or gas delivery system integrity failure. Check gas source. Check gas delivery system for leaks.

Cause: Improper calibration. This can be checked by flowing a certified gas through the analyzer to compare the reading with the O_2 concentration documented on the gas certification tag. If needed, recalibrate the analyzer as described in Chapter 4.

Problem 2: **Display reads too low.**

Cause: Reducing gas contamination (CO, H_2, or hydrocarbons) in the sample gas will lower the O_2 concentration readout of the analyzer. These reducing gases will combine with the free oxygen in a sample gas in the high temperature (725^o C) environment that the sensor operates. The result is a lower free oxygen concentration readout on the analyzer LED output. The presence of a significant amount of a combustible gas such as CO, H_2, or any hydrocarbon component relative to the O_2 component in the sample gas will cause the display to read lower than actual oxygen concentrations.

Cause: Improper calibration (See Cause #2 under Problem #2).

Problem 3: **Erratic or intermittent display or continuous beeping.**

Cause: If line power has been temporarily interrupted, the analyzer will restart itself. During this period the display reads "000".

Cause: Failure of an electronic component. It is always possible for a component to fail and render the analyzer inoperable. While the Neutronics Industrial/Ntron Oxygen Analyzer has been designed with rugged components, the possibility of failure is always present. In the event of component failure, we suggest the device be returned to the manufacturer's facility for repairs.

ERROR CODES FOR VERSION 6.50 FIRMWARE

Error conditions in the analyzer are reported in two ways. First the error is displayed on the front panel LCD and also logged in the computer's memory. The information in the memory can be retrieved via the RS232 port using the "Z" command. Following is a list of the errors that may be experienced by the system:

ERROR	LCD DISPLAY	ERROR LOG	SYSTEM HALT
1	OFFSET CAL ERROR 0	CALIBRATION FAILURE DAC CHANNEL 0	NO

Definition: The microprocessor was unable to adjust the offset of DAC channel 0 to within 50 uV of 0V.

	GAIN CAL ERROR 0	CALIBRATION FAILURE DAC CHANNEL 0	NO

Definition: The microprocessor was unable to adjust the gain of DAC channel 0 to within 50 uV of 0V.

2	OFFSET CAL ERROR 1	CALIBRATION FAILURE DAC CHANNEL 1	NO

Definition: The microprocessor was unable to adjust the offset of DAC channel 1 to within 50 uV of 0V.

	GAIN CAL ERROR 1	CALIBRATION FAILURE DAC CHANNEL 1	NO

Definition: The microprocessor was unable to adjust the gain of DAC channel 1 to within 50 uV of 0V.

3	ERROR 3 HALT	ANALOG FAILURE ZERO = *	YES

Definition: The microprocessor detected the zero volt reference voltage on the analog board to be greater than or less than 750 uV. * = the value read.

4	ERROR 4 HALT	ANALOG FAILURE VREF = *	YES

Definition: The microprocessor detected the +2.5 volt reference voltage on the analog board to be greater than or less than 12 mV. * = the value read.

5	ERROR 5 HALT	OVEN OVERTEMP AT POWER UP	YES

Definition: The microprocessor detected a temperature greater than 800 ^{o}C after analyzer start or restart.

6	ERROR 6 HALT	OVEN TEMPERATURE NOT INCREASING DURING START UP	YES

Definition: The microprocessor failed to see the temperature increase normally after analyzer start or restart.

7	ERROR 7 HALT	OVEN OVER TEMP WHILE STABILIZING	YES

Definition: The microprocessor detected a temperature greater than 800 ^{o}C during stabilization.

8	ERROR 8 HALT	TEMPERATURE TOO LOW DURING OPERATION *	YES

Definition: The microprocessor detected a temperature lower than 700 ^{o}C during operation. * = the temperature read.

9	ERROR 9 HALT	TEMPERATURE TOO HIGH DURING OPERATION *	YES

Definition: The microprocessor detected a temperature greater than 780 ^{o}C during operation. * = the temperature read.

10	ERROR 10 HALT	THERMOCOUPLE OR HEATER FAILURE	YES

Definition: The microprocessor detected an uncontrollable heater or thermocouple due to unstable readings from the oven.

When an error described above halts the system, a soft restart can be initiated by pressing the CLEAR key on the front panel key board.

PureN2
Spare Parts List

Neutronics Industrial/Ntron Replacement Part	Part Number
Boards	
CPU Board	R200P50-002
Analog Board	R202P50-002
Power Supply Board	R203P30-001
Display Board	R206P10-001
Current Output Board	R208P60-001
Sensor	
Sensor Replacement Kit	R102P70
Sensor Mount	R100P90
Purge Tube Kit	R103P20
Furnace	
Furnace	R100P18
Thermocouple	R102P60
Miscellaneous	
Power Cord	RP02P01
Fuse	RP68P07
Pump	RP98P01
Pump Rebuild Kit	R207P47

Maintenance

	Upon Commissioning Unit	At Least Every 6 months	Whenever the O2 Reading is Suspect	As Required
Calibrate on certified span gas	♦	♦	♦	♦
Set alarm points and analog output scales	♦			♦
Replace Sensor				♦
Replace Furnace				♦
Check Alarms and analog outputs	♦			♦
Rebuild Pump				♦ Yearly

REFERENCE CHART FOR USE WITH:
NEUTRONICS INDUSTRIAL/NTRON ZIRCONIUM OXIDE OXYGEN ANALYZERS
SENSOR VOLTAGE vs OXYGEN CONCENTRATION ACCORDING TO THE NERNST EQUATION
(Within Analyzer Calibration)

SENSOR VOLTAGE POTENTIAL (in Mv)	PERCENT OXYGEN CONCENTRATION	PPM OXYGEN	PPB OXYGEN
0.0	20.90%	209,000	209,000,000
15.8	10.00%	100,000	100,000,000
30.7	5.00%	50,000	50,000,000
65.3	1.00%	10,000	10,000,000
80.2	0.50%	5,000	5,000,000
114.8	0.10%	1,000	1,000,000
129.7	0.05%	500	500,000
164.3	0.01%	100	100,000
179.2	0.005%	50	50,000
213.8	0.001%	10	10,000
228.7	0.0005%	5	5,000
263.3	0.0001%	1	1,000
278.2	0.00005%	0.5	500
312.8	0.00001%	0.1	100
327.7	0.000005%	0.05	50
362.3	0.000001%	0.01	10
377.2	0.0000005%	0.005	5
411.8	0.0000001%	0.001	1
426.7	0.00000005%	0.0005	0.5
461.3	0.00000001%	0.0001	0.1
476.2	0.00000005%	0.00005	0.05
510.8	0.00000001%	0.00001	0.01

TEMPERATURE IN CENTIGRADE	TEMPERATURE	TEMPERATURE IN KELVIN (ADD 273)	IN FAHRENHEIT
725		998	1337