Analytical Industries Inc.
Advanced Instruments Inc.

AII 3000 Series Oxygen Analyzers

Technical Specifications

Accuracy:	< ±2% of FS range under constant conditions
Analysis:	0-100% oxygen
Application:	Personnel safety Area monitoring O2 deficiency in confined spaces Checking breathing air tanks Checking tanks intended for scuba diving Confirming the O2 levels prior to welding
Approvals:	ISO 9001:2000, MDD 93/42/Annex II, ISO 13485:2003
Area Classification:	General purpose
Alarms:	A models: None; M models: User adjustable HI 1-100% and LO 0-99% alarms; 120 second alarm silence for calibration purposes; HI alarm defeat for 100% O_2 analysis
Calibration:	Air or certified 100% O_2 every 8 hours
Compensation:	Temperature compensated
Connections:	A/M models: 1x16 mm thread; HC models: Tubing 1/4"
Controls:	Soft touch keypad for ON/OFF and menu function
Dimensions:	3.6 x 5.9 x 1.6"; weight 10 oz. (280 grams)
Display:	3-1/2 digit backlit LCD 2.75 x 1.375; resolution 0.1% O_2
Flow Sensitivity:	None between 0.2 to 10 liters per minute
Humidity:	Non-condensing 0-95% RH
LED Indicators:	A models: None; M models: upon activation of alarms
Linearity:	± 1% under constant conditions
Pressure:	Inlet - A/M models ambient, HC models - regulate; Vent all models - atmospheric
Power:	2 AA Alkaline batteries; 1,200 hours continuous use
Response Time:	90% of final FS reading in 9 seconds
Sensitivity:	< 0.5% of FS range
Sensor:	A/M models: AII-11-60; HC models: AII-11-60-HC
Sensor Life:	60 months in air at 25ºC and 1 atmosphere
Signal Output:	None
Storage Temp.:	-20º to 60ºC (-4ºF to 140ºF) on intermittent basis
Temp. Range:	5º to 45ºC (41ºF to 113ºF)
Warm-up Time:	None
Warranty:	12 months analyzer; 12 months sensor

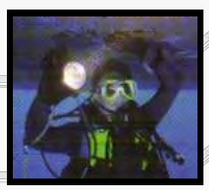
AII-3000 A

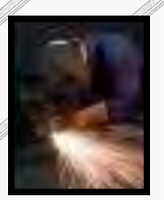
AII-3000 AHC

AII-3000 M

AII-3000 MHC

Accessories - see back page





ISO 9001:2008 Certified
INTERTEK Certificate No. 485

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 6/15

AII 3000 Series Optional Accessories

Spare Parts

AII-3000 A, AII-3000 M

AII-11-60 Oxygen Sensor
BATT-1008 Battery (2x) 1.5V AA
P-1087 Instructions for Use
A--1162 PCB Assy Main
CABL-1006 Coil Cable

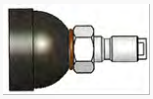
AII-3000 AHC, AII-3000 MHC

AII-11-60-HC Oxygen Sensor
BATT-1008 Battery (2x) 1.5V AA
P-1087 Instructions for Use
A-1162 PCB Assembly Main
TUBE-1019 7/32" OD Tubing 3'

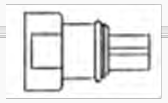
Diving
Industrial
Welding

A-3388 Adapter, Dome to Sensor

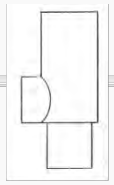
A-3675 Adapter 5/32" Tube to Sensor



A-3671 Adapter, BC with Restrictor to Sensor



FITN-1112-1 Flow Diverter



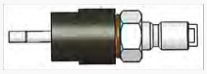
FITN-1009 Tee Adapter

A-3676 Adapter, 1/8" Tube to Sensor

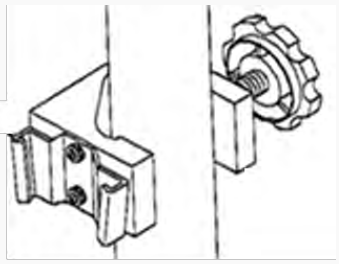
TUBE-1018 Tubing, 1/8" x 3'

A-3609 Adapter, Dome to 1/8" Tube

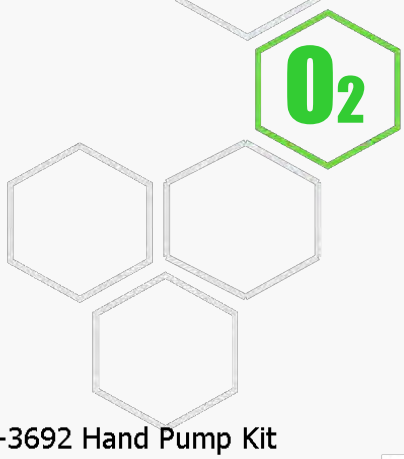
CC-1072 Carrying Case



A-3673 BC with Restrictor to 1/8" Tube



HRWR-1075 Dovetail Clamp Pole or Shelf



A-3692 Hand Pump Kit

A-3674 Adapter 5/16" Tube to Sensor

PUMP-1020 Pump, Hand

TUBE-1020 Tubing, 5/16" x 3' (2x pcs)

ISO 9001:2008, Certificate #485A

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Analytical Industries Inc.
Advanced Instruments Inc.

Instructions for Use

AII-3000 Series Oxygen Analyzers

AII-3000 AHC

AII-3000 A

AII-3000 MHC

AII-3000 M

Table of Contents

1 Introduction

Congratulations on your purchase, these Instructions for Use describe the precautions, set-up, operation, maintenance and specifications of the AII-3000 Series Oxygen Analyzers.

This symbol means CAUTION – Failure to read and comply with the Instructions for Use could damage the device and possibly jeopardize the well being of the user.

Note: Advanced Instruments Inc. cannot warrant any damage resulting from the misuse, unauthorized repair or improper maintenance of the device.

1.1 Indications for Use

The AII-3000 Series Oxygen Analyzers are intended to measure and display the concentration of oxygen in compressed breathing air tanks intended for scuba diving, for personnel safety, area monitoring, O2 deficiency in confined spaces, checking breathing air tanks and confirming the O2 levels prior to welding.

Users must read the following statements as they are essential to reducing the risk of use error due to ergonomic features of the device or the environment in which the device is intended to be used.

The devices have been designed and manufactured in such a way that when used under the conditions and for the purposes intended, they will not compromise the clinical condition or the safety of patients, or safety of the users or other persons.

Conformity with essential requirements has been demonstrated by verifying the performance of the device under normal conditions, bench testing and determining that undesirable malfunctions constitute minimal risk to users.

Do not sterilize, autoclave, liquid sterilize, immerse in any liquid or expose the device or accessories to steam, ethylene oxide or radiation sterilization.

The device is intended to be re-usable. Should the device or accessories come in contact with patient bodily fluids, either dispose of the device or clean with a soft cloth dampened with 70% isopropyl alcohol solution in water and allow the components to air-dry before re-use .

Do not operate the analyzer near equipment capable of emitting high levels of electromagnetic radiation as the reading may become unstable.

In order to obtain optimum performance, the operation of the device must be performed in accordance with these Instructions for Use. Maintenance should be performed only by trained personnel authorized by the manufacturer.

1.2 Intended Use

The AII-3000 Series Oxygen Analyzers are intended to measure and display the concentration of oxygen in compressed breathing air tanks intended for scuba diving, for personnel safety, area monitoring, O2 deficiency in confined spaces, checking breathing air tanks and confirming the O2 levels prior to welding.

1.3 Device Description

The AII-3000 Series Oxygen Analyzers can be positioned on a table top or pole (tripod wire stand and V-mount dovetail attachments are mounted on the back of the device) and are readily portable from one location to another. They provide continuous, fast, reliable and accurate oxygen measurements of up to respiratory care systems.

The devices utilize an electrochemical galvanic fuel cell type oxygen sensor of the type that is extensively used to measure oxygen concentrations from 0% to 100% in gas streams. Oxygen, the fuel for this electrochemical transducer, diffusing into the sensor through a gas permeable membrane reacts chemically at the sensing electrode to produce an electrical current output proportional to the oxygen concentration in the gas phase. The sensor has an absolute zero meaning that when no oxygen is present to be chemically reacted the LCD displays 00.0 oxygen.

The sensor's signal output is linear over the entire range, remains virtually constant over the specified useful life and drops off sharply at the end. The sensor itself requires no maintenance and is simply replaced at the end of its useful life like a battery. Inasmuch as the sensor is a transducer in its own right, its expected life is not affected by whether the analyzer is ON or OFF.

A battery powered state-of-the-art micro-processor converts the sensor's signal output representing the partial pressure of oxygen in the gas stream being analyzed. The resulting oxygen reading is displayed by a large easy to read backlit liquid crystal display (LCD) that has a resolution of 0.1% oxygen. The microprocessor is controlled from a keypad and provides features like system diagnostics, warning indicators, controls and an alarm capability for continuous monitoring that enhance both safety and effectiveness.

Prior to shipment, every device is thoroughly tested at the factory and documented in the form of a Quality Control Certification that is included in the Instructions for Use supplied with every device.

2 Quality Control Certification

Customer: _____ Order No. _____ Date: _____

Model: ( ) AII-3000 A Oxygen Analyzer
( ) AII-3000 M Oxygen Analyzer
( ) AII-3000 AHC Oxygen Analyzer
( ) AII-3000 MHC Oxygen Analyzer S/N _____

Sensor: ( ) AII-11-60 or ( ) AII-11-60-HC S/N _____

Electronics: A-1152 PCB Assembly Main Software Version _____

Accessories: AII-3000 A / M: CABL-1006 Cable, Coiled Phone Jack

AII-3000 AHC / MHC: TUBE-1019 7/32" OD Tubing 3 ft.

All units: BATT-1008 Battery, 1.5V AA (Qty 2)
P-0187 Manual, Instructions for Use ..... Included _____

		PASS
QC Test:	LCD display 3-1/2 digits	_____
	Battery symbol displays when battery is low	_____
	Span adjustment ±10-30% FS with 100% oxygen calibration	_____
	Following calibration with 99-100% oxygen and flushing with ambient air, oxygen reading as displayed by LCD 20.9% ±2%	_____
	Span adjustment ±10-30% FS with air calibration	_____
	Following calibration with air (20.9% oxygen) and exposing to 99-100% oxygen, LCD displays 100% ±2%	_____
	Overall inspection for physical defects	_____

		Qty
Options:	_____	_____
See Sec 8.1	_____	_____
	_____	_____
	_____	_____
	_____	_____
Delivery:	_____	

3 Safety Warnings

ALWAYS follow the statements below as they are essential to reducing the risk of use error due to ergonomic features of the device or the environment in which the device is intended to be used.

- Only trained personnel who have read, understand and agree to follow the Instructions for Use should operate the device.
- Retain the Instructions for Use for future reference.
- Refer service needs to trained authorized personnel. Failure to do so may cause the device to fail and void the warranty.
- Inspect the device and accessories before operating and ensure: (a) there is no evidence of physical damage; (b) the sensor (particularly the sensing surface) and electrical connections are dry; and, (c) the sensor is installed and upstream from any humidifying device for accurate calibration and oxygen readings.
- Calibrate: (a) with a known source of air or dry 100% oxygen before using each day or after 8 hours of continuous use; (b) when the temperature or pressure of the operating environment changes; (c) if the oxygen sensor has been disconnected and reconnected; (d) after the battery or oxygen sensor has been replace.
- Sampling flowing gas: (a) install the optional flow diverter and tee-adapter in a vertical position as shown in Section 4.3 and (b) assure there is a tight fit between the flow diverter and tee adapter.
- Sampling static, ambient or controlled atmospheres remove the flow diverter.
- Clean the device and accessories in accordance with Section 6.1.2.
- Battery replacement Section 6.2: (a) replace the batteries within twenty-four (24) hours of the battery symbol appearing on LCD display and (b) calibrate the analyzer after replacing the batteries.
- Oxygen sensor installation or replacement Section 6.3: allow the new sensor to stabilize for 15-20 minutes in ambient air before attempting to calibrate.
- Store the device by turning the power OFF and removing the batteries if the device will not be operated for over thirty (30) days.
- Attempt to repeat the procedure that caused a perceived malfunction and refer to troubleshooting hints in Section 7 before concluding the device is faulty. If in doubt, contact the manufacturer for assistance.

NEVER operate the device in any manner described below doing so may compromise the clinical condition or the safety of patients, users or other persons.

- If the reading is unstable or a malfunction is suspected.
- After the battery symbol appears in the LCD display.
- Near equipment capable of emitting high levels of electromagnetic radiation (EMI) or radio frequency interference (RFI).
- Expose the device; particularly the LCD display or sensor to sources of extreme heat, cold or excessive sunlight beyond the device's storage temperature range, refer to Section 8 for extended periods of time.
- In a gas stream with a vacuum greater than 14" water column.
- Immerse the device, oxygen sensor or coiled cable in any liquid.
- Outside of the parameters specified in Section 8 particularly at flow rates greater than 10 liters per minute - the backpressure generated produces erroneously high oxygen readings.
- Calibrate: (a) with 20.9% oxygen or room air with the intent of taking oxygen measurements at oxygen levels above 30% oxygen; (b) in a humidified gas stream or atmosphere; (c) without allowing a newly installed sensor to stabilize for 15-20 minutes in ambient air.
- Attempt to sterilize, autoclave, liquid sterilize, immerse in any liquid or expose the device or accessories to steam, ethylene oxide or radiation sterilization.
- In the presence of flammable gases.
- Open the main compartment of the device, except to change the integral oxygen sensor of the AII-3000 AHC or AII-3000 MHC Oxygen Analyzers.
- Open the oxygen sensor or probe the sensing surface, refer to Section 10 in the event the sensor should leak and someone comes in contact with the electrolyte from inside the sensor.
- Operate with a cable that appears worn, torn or cracked, or, allow an excess length of cable near the patient's head or neck; secure it to the bed rail or other suitable object to avoid the possibility of strangulation.
- Allow the device or oxygen sensor to be serviced, repaired or altered by anyone except trained personnel – failure to do so may endanger the patient or damage the device rendering the warranty null and void.

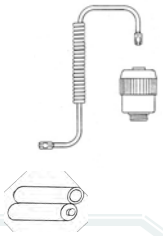
4 Start-Up

4.1 Contents of Shipping Container:

4.1.1 AII-3000 A, AII-3000 M:

ENCL-1061 V-mount retainer (attached)
ENCL-1066 Tripod wire stand (attached)
AII-11-60 Oxygen Sensor
BATT-1008 Battery, AA 1.5V Alkaline (Qty 2)
CABL-1006 Cable, Coiled Phone Jack
P-1087 Instructions for Use


OR

AND


4.1.1 AII-3000 AHC, AII-3000 MHC:

ENCL-1061 V-mount retainer (attached)
ENCL-1066 Tripod wire stand (attached)
AII-11-60-HC Oxygen Sensor (installed inside analyzer)
BATT-1008 Battery, AA 1.5V Alkaline (Qty 2)
TUBE-1019 Tubing, 7/32" OD Tubing 3 ft.
P-1087 Instructions for Use



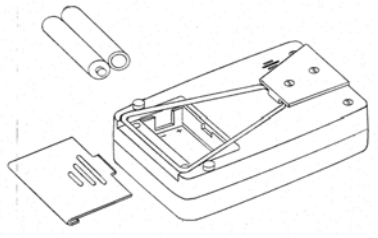
AND


Inspect the box and contents for shipping damage. If the device or components appear damaged, do not attempt to operate the device - contact the manufacturer immediately, refer to section 9.

4.2 Install Batteries

All devices are powered by two 1.5V AA alkaline batteries which must be installed before the device can be operated.

The battery compartment is located at the rear of all devices. Initially this procedure can be somewhat difficult. Care should be taken not to damage the case when removing the battery compartment cover.



4.2.1 Procedure:

1. Remove the device and the (2) AA 1.5V Alkaline batteries from the foam shipping container.
2. Turn the device over so the shortest raised line on the battery compartment cover is pointing away from you.
3. Lift the tripod wire stand up and away from the case.
4. Grasp the case with both hands, use your thumbs press down firmly on the raised lines and push the battery compartment cover away from you.
5. Locate the positive (+) and negative (-) terminals on the battery.
6. Assure the battery contacts are clean.
7. Align one battery's positive (+) terminal with the corresponding (+) battery symbol molded into the case.
8. Insert the battery into the compartment.
9. Repeat with the remaining battery.
10. Replace the battery compartment cover, make sure it snaps into position and is secured flush against the case. Replace the wire stand as required.

Replace the batteries within twenty-four (24) hours of the battery symbol appearing on LCD display because batteries decline at different rates. Calibrate the device after replacing the batteries.

4.3 Install Oxygen Sensor

The device cannot function until the oxygen sensor is installed. Once installed, allow the sensor to stabilize for 15-20 minutes in ambient air before attempting to calibrate the device.

NEVER - Attempt to open, repair or service the oxygen sensor. Refer to Section 3 for hints and warnings concerning the handling and environmental considerations of the oxygen sensor and the device.

4.3.1 AII-3000 A/M:

1. Remove the contents from the shipping container as shown in section 4.1 and check for damage.
2. The coiled cable uses a common RJ11 phone jack at both ends, making a bad connection impossible.
3. Install the sensor away from any humidifying device to prevent moisture from condensing on the sensing surface and assure accurate calibration and oxygen readings.
4. Connect one end of the cable to the device in the same manner you would connect a telephone. Simply find and register the male plug at the end of the coiled cable and insert it into the mating female jack on the side of the device.
5. Connect the other end of the cable to the sensor in the same manner.
6. For diffusion sampling of static, ambient or controlled atmospheres – simply expose the oxygen sensor to the atmosphere to be sampled.
7. For sampling breathing circuits with flowing gas, position the sensor vertically for optimum results. Avoid letting the gas stagnate and facilitates the flow of gas across the sensing area of the sensor to produce a more accurate measurement of the gas stream to be measured.
8. Install the tee-adapter in the breathing circuit.
9. Screw the flow diverter to the sensor.
10. Ensure the o-ring is lightly lubricated for ease of entry and a tight seal between the flow diverter and tee adapter.
11. Insert the assembled flow diverter/sensor into the tee allowing air or 100% oxygen (dry, non-humidified) to flow past the sensor at a rate less than 10 liters per minute.

4.3.2 AII-3000 AHC/MHC:

When the HC (hose connection) version is ordered, the device is shipped with the sensor installed.

4.4 Controls

4.4.1 AII-3000 A/AHC Oxygen Analyzers

These analyzers employ a micro-processor that is controlled by five (5) pushbuttons located on the keypad attached to front cover.

1. ON/OFF provides power to the electronics
2. ESCAPE aborts a previous selected option
3. ENTER selects a menu option
4. 100% initiates the routine for CALIBRATION with 100% oxygen. The sensor must be exposed to 100% oxygen.
5. 21% initiates the routine for CALIBRATION with air or 21% oxygen. The sensor must be exposed to air or 21% oxygen.

4.4.2 AII 3000 M/MHC Oxygen Analyzers

The monitor employs a menu driven micro-processor that is controlled by five (5) pushbuttons located on the keypad attached to front cover.

1. ON/OFF provides power to the electronics
2. MENU accesses the MAIN MENU
3. ENTER selects a menu option, and, enables the user to silence the audible alarm quickly without having to navigate through the menu(s)
4. DOWN ARROW scrolls down the menu options
5. UP ARROW scrolls up the menu options

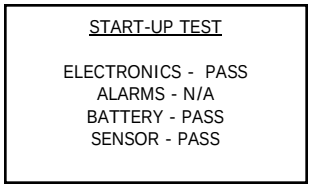
Note: The monitor is equipped with visual and audible HIGH and LOW (minimum set point of 15%) alarms which are controlled through the MAIN MENU and are activated when the oxygen value is 0.1% below the LO alarm set point or 0.1% above the HI alarm set point, refer to section 4.6 below.

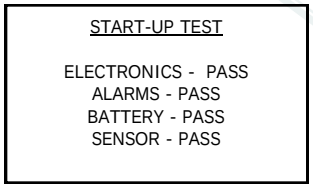
4.4.3 Instructions and Warnings displayed by LCD

- START-UP TEST – diagnostic tests of the electronics, alarm circuit (monitors only), battery voltage and the sensor's signal output.
- SERVICE DEVICE – non-sensor failures during the start-up test.
- CHECK SAMPLE GAS, CHECK CABLE, CHECK SENSOR – sensor fails the start-up test or becomes disconnected during operation, or if an alarms is activated (monitor).
- SAMPLING – oxygen concentration from 0-100% in the sample gas during the normal operation.
- BAT LOW – battery voltage is not adequate, replace batteries.
- ALARM SET POINTS, CONDITION (set point reverses color and red LED indicator turns on) for monitor only.

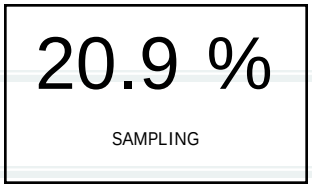
4.5 Start-Up Test

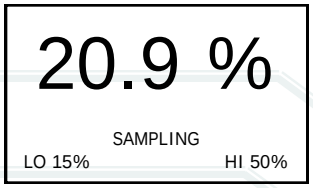
Press the ON/OFF key on the front panel to apply power to the device and initiate a complete diagnostic test of all system functions: the electronics, feeds voltage and tests the alarm circuit (monitor only below right) internally, confirms the battery voltage is adequate to power the circuit, and, the sensor's signal output is within specifications.





Following successful Start-Up Test the devices default to the SAMPLING mode.



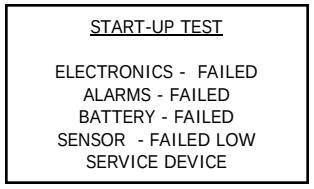


With the exception of the ALARMS for the AII-3000 M/MHC (above left) the tests and resulting displays are the same.

Note: Any START-UP TEST failure requires the user to take corrective action before continuing or attempting to use any device.

4.5.1 Electronics, Alarms (AII-3000 M/MHC) or Battery Failure

If any of these START-UP TESTs are unsuccessful, the following display instructs the user to SERVICE DEVICE. The following display is the same for all models.



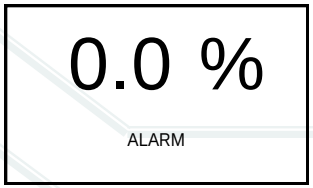
4.5.2 Sensor Failure

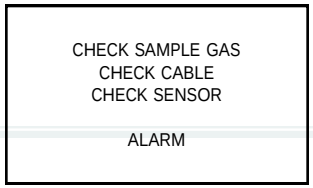
Sensor failure can result from multiple causes; the user's failure to connect a sensor or sensor cable, a defective sensor cable or a sensor with an output outside specification.

SENSOR - FAILED LOW is one of the possible unsuccessful START-UP TESTs as illustrated previously and displays additional warnings as follows.

4.5.2.1 AII-3000 A/AHC Oxygen Analyzers

The LCD alternately displays the following until the problem is corrected.

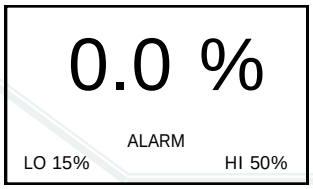


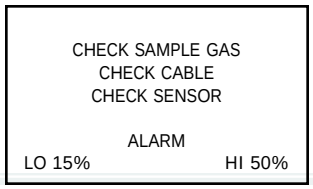


Corrective action:
1.Expose the sensor to air or a gas containing approximately 20.9% oxygen
2.Connect or replace the cable connecting the sensor to the analyzer
3.Connect or replace the oxygen sensor

4.5.2.2 AII-3000 M/MHC Oxygen Analyzers

Performs the same routine and requires the same corrective action as the analyzers above with additional indicators related to the monitor's alarm feature.





In addition to the alternating LCD display, the LO ALARM becomes active and:
- LO ALARM value and background alternately reverse colors on the LCD
- RED LED below the LO ALARM value lights up and begins flashing
- Audible alarm begins beeping

The audible alarm can be disabled for two (2) minutes (unlimited times) by:
1.Press the MENU key on the front panel
2.Press the UP/DOWN arrow to select ALARMS AUDIBLE
3.Press the ENTER key to toggle to ALARMS SILENT mode

4.6 Alarms AII-3000 M/MHC Oxygen Analyzers

The monitor is equipped with user selectable HI and LO alarm set points which are displayed at the bottom of the LCD. The default alarm set points are 15% LO and 50% HI. The LO alarm set point can be set between 15% and 99% and the HI alarm set point can be set between 16% and 100%.

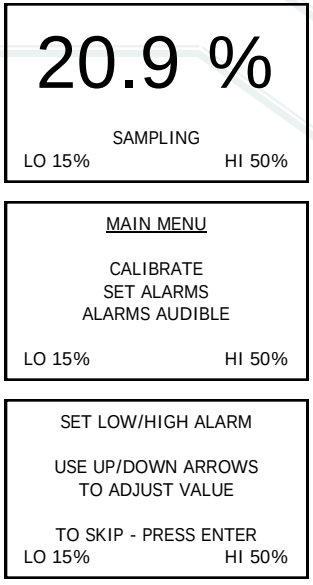
Alarm set points may be adjusted in 1% increments by pressing and holding the UP/ DOWN ARROW keys, see below. The ARROW keys are disabled when the alarm set points are within 1% of each other to prevent the HI alarm from being set below the LO alarm. The HI alarm may be disabled by attempting to select a HI alarm set point above 100% to facilitate flushing patients after anesthesia. In this mode the LCD continually displays HI OFF.

The AII-3000 M/MHC Oxygen Analyzers are equipped with four (4) indicators that activate when oxygen concentrations are 0.1% below the LO alarm set point or 0.1% above the HI alarm set point.

1. LCD alternates between the ALARM mode with an oxygen reading 0.0% and recommendation as illustrated in sections 4.5.2.1 and 4.5.2.2
2. Alarm value and background alternately reverse color on LCD
3. Red LED below the alarm value lights up and begins flashing
4. Audible alarm begins beeping

4.6.1 Setting Alarm Set Points

1. From the SAMPLING mode press MENU to display the MAIN MENU
2. Press the UP/DOWN arrow keys to highlight SET ALARMS
3. Press ENTER to select SET ALARMS
4. LO alarm value is highlighted by default
5. Press ENTER to skip the LO alarm (and proceed to the HI alarm) or press the UP/DOWN arrow keys to change the alarm set point
6. Press ENTER to save LO alarm set point and move to select the HI alarm
7. Press ENTER to skip the HI alarm (and return to SAMPLING mode) or press the UP/DOWN arrow keys to change the alarm set point
8. Press ENTER to save HI alarm set point and return to SAMPLING mode
9. If no key is pressed within 5 seconds, the LCD returns to the SAMPLING mode



4.7 Calibration

Electrochemical oxygen sensors generate slightly different signal outputs under identical conditions due to variations in the thickness of the sensing membrane and manufacturing process.

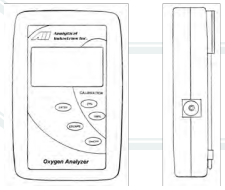
Simulate the application for optimum accuracy: Review Sections 3 Safety Warnings and 5.2 Application Considerations before proceeding.

The devices are designed to meet the requirements for both ambient and elevated oxygen measurements but should **NEVER** be calibrated with air or 21% oxygen with the intent of taking oxygen measurements at oxygen levels above 30% oxygen.

Accordingly, the devices may be calibrated with either air (20.9%) or 100% oxygen which requires the user to make a conscious decision to bypass or skip the recommended 100% oxygen calibration.

Set-Up:

AII-3000 A and AII-3000 M refer to section 5.4.1 Flowing Gas Streams or 5.4.2 Static Atmospheres (shown with optional flow diverter and tee).



AII-3000 AHC and AII-3000 MHC refer to section 5.4.3.

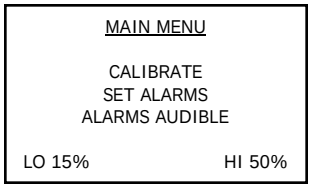
Procedure

AII-3000 Series Oxygen Analyzers employ the identical calibration routine and displays but they differ slightly in the way they arrive at the display that initiates calibration routine. Refer to Set-Up illustration and references above for gas connections.

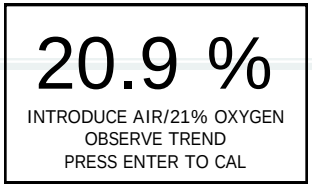
1. AII-3000 A/AHC - Press the 21% key under the word CALIBRATION on the front panel.

1a. AII-3000 M/MHC - Requires navigating its menu to reach the display that initiates the calibration routine.

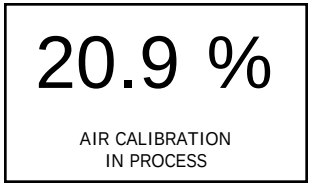
   a. From the SAMPLING menu, press MENU to display the MAIN MENU
   b. Press the UP/DOWN arrow keys to highlight CALIBRATE
   c. Press ENTER to select CALIBRATE (the four (4) alarm indicators are disabled during the calibration routine)



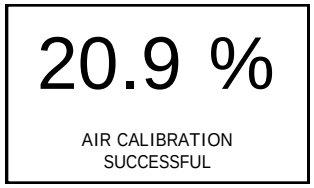
Both of the above produce the following display which initiates the calibration routine.

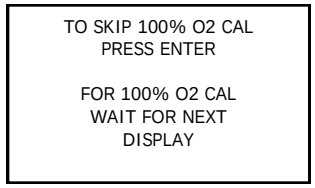


3. The above prompt remains on the display until:
   a. The operator presses ENTER to proceed or
   b. The ESCAPE key on the AII-3000 A/A HC or the MENU key on the AII-3000 M/MHC to abort and return to the SAMPLING mode.
4. Expose the sensor to a known source of fresh ambient air or certified 21% (dry, non-humidified) oxygen nitrogen mix but not the oxygen enriched room air commonly found in hospitals.
5. Once a suitable calibration gas is introduced, press ENTER to initiate calibration as displayed right and disable the key pad (to prevent the calibration routine from being interrupted).
6. This display appears for sixty (60) seconds to allow the sensor to stabilize before the microprocessor takes the final reading.



7. If the calibration is successful, the display below left appears for three (3) seconds before defaulting to the display below right:

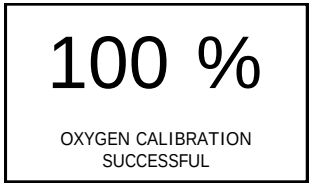




8. The display above right requires a decision by the user (refer to warnings at the beginning of section 4.7) to press ENTER and skip the 100% O2 calibration and return to the SAMPLING mode; or, wait ten (10) seconds for the following display:

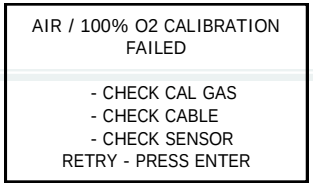
9. Repeat steps #3 through #6 using a certified source of 100% oxygen.

10. If the calibration is successful, the display at right appears for five (5) seconds before defaulting to the SAMPLING mode.



Calibration Fails

An unsuccessful calibration can be caused by several problems as displayed at right:



If after three (3) unsuccessful attempts to calibrate: review section 7 for possible causes and corrective action or contact Advanced Instruments Inc. at 909-392-6900.

To abort the RETRY press ESCAPE (analyzer) or MENU (monitor). Do not proceed until the analyzer is calibration successfully.

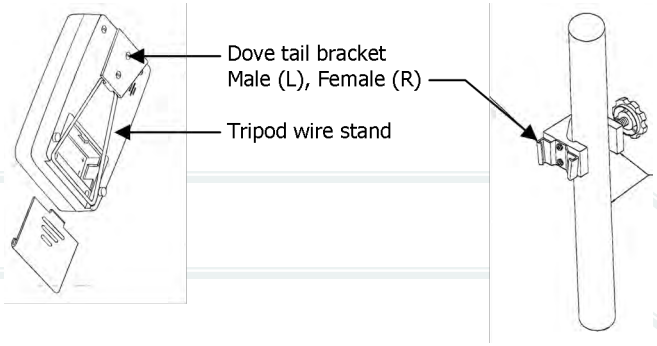
4.8 Mounting

Every analyzer and monitor is equipped with a male dove tail bracket and triangular shaped thick metal wire stand secured to the rear of the enclosure.

Tripod Wire Stand

Secured between bumper feet on either side of the battery compartment is a triangular shaped thick metal wire stand that is hinged under the dove tail bracket secured at the opposite end of enclosure.

Unsnap the triangular thick metal wire stand from between the bumper feet and pull it away from the enclosure to form a tripod which allows the device to sit upright on any flat surface



Dove Tail Bracket

The male dove tail bracket is secured to the rear of the enclosure with two screws. The 1" female dove tail pole bracket (HRWR-1075) is an optional accessory that is commonly found in medical applications. The v-shaped male component simply slides into and out of the pole mounted female section.

5 Operation

5.1 Principle of Operation

The AII-3000 Series Oxygen Analyzers utilize an electrochemical galvanic fuel cell type oxygen sensor of the type that is extensively used to measure oxygen concentrations from 0% to 100% in gas streams. Oxygen, the fuel for this electrochemical transducer, diffusing into the sensor through a gas permeable membrane reacts chemically at the sensing electrode to produce an electrical current output proportional to the oxygen concentration in the gas phase. The sensor has an absolute zero meaning that when no oxygen is present to be chemically reacted the LCD displays 00.0 oxygen.

The sensor's signal output is linear over the entire range, remains virtually constant over the specified useful life and drops off sharply at the end. The sensor itself requires no maintenance and is simply replaced at the end of its useful life like a battery. Inasmuch as the sensor is a transducer in its own right, its expected life is not affected by whether the analyzer is ON or OFF.

The relationship between the sensor's signal and changes with the oxygen concentration is both proportional and linear, thus allowing single point calibration. Other factors that can affect the signal output are described in Section 5.2 Application Considerations and Section 3 Safety Warnings which should be read before use.

Historically, the expected life of galvanic fuel type sensors has been specified as "in air (20.9% O_2) at 25°C and 760mm Hg". The actual life of any galvanic fuel type sensor is inversely affected by changes in the average oxygen concentration, temperature and pressure it is exposed to during its useful life. For example, the AII-11-60 sensor has a 60 months expected life in air (20.9% oxygen) at 25°C and ambient pressure, however, in a 100% oxygen atmosphere the expected life is 12.6 months [60mo/(100%/20.9%)].

AII-3000 Series Oxygen Analyzers are battery powered by (2) AA alkaline batteries and controlled by a state-of-the-art microprocessor. The batteries provide enough power to operate the analyzer continuously for approximately 1,200 hours. Both devices utilize a membrane type keypad for users to communicate commands to the microprocessor. The monitor is menu driven to accommodate the alarm functions. The digital electronics provide features such as system diagnostics, warning indicators, controls and an alarm capability for continuous monitoring that enhance both safety and effectiveness. The design criteria, quality program and performance features ensure reliable and accurate oxygen measurements.

5.2 Application Considerations

Effect of Temperature
All membrane clad electrochemical sensors are temperature dependent due to the expansion and contraction of the Teflon sensing membrane. As result more or less of the sample gas including oxygen to be reacted diffuses into the sensor. The oxygen sensor's electrical current signal output varies linearly with oxygen concentration. The signal also varies with changes in ambient temperature. The temperature coefficient is typically 2.54% of the signal or reading per degree C change in temperature.

The temperature dependent current signal output is compensated by using a resistor-thermistor network. With a proper resistor-thermistor network, the signal can be compensated to within ±5% of the oxygen reading over the 5-45°C temperature range. This is the worse case situation when going from one extreme of the operating temperature range to the other. The error will be eliminated when the thermistor in the temperature compensation network and the electrolyte inside the sensor reach thermal equilibrium in approximately 45-60 minutes.


Erroneous oxygen readings can result if the gases flowing over the sensing area of the sensor are not at ambient temperature. This occurs because the sensor is exposed to different temperatures. The sensing area of the sensor is o-ring sealed in the heated breathing circuit and the temperature compensation network at the rear of the sensor is exposed to ambient temperature.

Effect of Pressure
Electrochemical sensors actually measure the partial pressure, not the percentage, of oxygen in the gas stream they are exposed to. These sensors are accurate at any pressure provided the pressure is constant and the analyzer has been calibrated at the same pressure as the sample gas measured.

For example, when moving an analyzer calibrated at sea level into the mountains causes the analyzer to display an decrease in the oxygen reading displayed. When if fact, the decrease in the reading displayed is not related to a change in the oxygen percentage but to the decrease in partial pressure (corresponding to the increase in total pressure) at altitude.


Calibrate at the temperature and pressure (altitude) at which the analyzer will be operated.

Effect of Humidity
The analyzer is not affected by non-condensing relative humidity (RH). However, the use of a humidifier to introduce water vapor and increase the moisture level of the gas mixture does affect the oxygen concentration and the resultant reading displayed by the analyzer. The addition of water vapor increases the total pressure thereby diluting or decreasing the oxygen concentration of the gas mixture resulting in a lower oxygen reading.

Effect of Condensation
Excessive condensation collecting on the sensing area or the electrical connections at the rear of the sensors can adversely impact the performance of electrochemical sensors. Condensation blocks the diffusion path of oxygen into the sensor and can reduce the oxygen reading to 00.0 if the condensation covers the entire sensing area. Condensation on the electrical connections at the rear of the sensor can affect oxygen readings. Remedy either situation by shaking out the condensation and allowing the sensor to air dry.

Erroneously characterized in many instances as a sensor failure, excessive condensation is remedied by gently wiping away the condensation with a soft cloth or simply allowing the sensor to air dry.

Effect of Electromagnetic Radiation
Tested over a 26 MHz to 1000 MHz electromagnetic field, the analyzer is susceptible at all frequencies tested except those between 930 and 990 MHz.


Never operate the analyzer near equipment capable of emitting high levels of electromagnetic radiation. Do not continue to operate the analyzer if the reading becomes unstable.

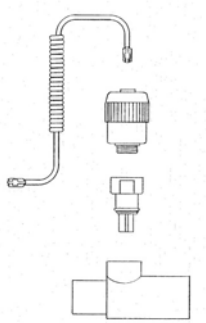
5.3 Calibration
Calibrating the analyzer or monitor during normal operation involves the same precautions and procedures as those described in Sections 4.7 Start-up Calibration with the same cautions to review Sections 3 Safety Warnings and 5.2 Application Considerations.

5.4 Sampling
Assuming the START-UP instructions are followed and the tests are completed successfully the devices default to the SAMPLING mode.


Never operate the analyzer if the reading is unstable or if a malfunction is suspected. If calibration is required as indicated herein, do not proceed until the analyzer is calibration successfully.

5.4.1 Flowing Gas Streams

1. Place the sensing area of the sensor into the gas stream to be analyzed upstream of any humidification equipment.
2. Assure that the flow rate of the gas stream does not exceed ten (10) liters per minute. Exceeding ten (10) liters per minute generates backpressure.
3. Check the gas stream and particularly the mechanical connection for leaks that dilute the gas stream with ambient air.
4. Assure there are no restrictions in the circuit downstream of the sensor that could generate backpressure on the sensor.
5. Use the optional flow diverter along with the optional tee adapter and position the sensor vertically for optimum results, as shown right. The flow diverter avoids stagnation and facilitates the movement of gas to and from the sensing area of the sensor thereby producing a more accurate measurement of the gas stream to be measured.



6. Install the tee-adapter in the breathing circuit.
7. Screw the flow diverter to the sensor.
8. Ensure the o-ring is lightly lubricated for ease of entry and a tight seal between the flow diverter and tee adapter.
9. Insert the assembled flow diverter/sensor into the tee allowing air or 100% oxygen (dry, non-humidified) to flow past the sensor at a rate of 5-8 liters per minute.
10. Once the sensing area of the sensor is exposed to the gas stream allow approximately sixty (60) seconds for the reading to stabilize and observe the reading displayed by the LCD.
11. Refer to Section 8.1 for a variety of accessories that provide a several methods of sampling flowing gas streams.

5.4.2 Static Atmospheres

Remove the flow diverter, not needed. Failure to remove the flow diverter will dramatically slow the response time of the sensor.

Expose the sensing area of the sensor to the atmosphere allowing approximately sixty (60) seconds for the reading to stabilize and observe the reading displayed by the LCD.

If placing the entire sensor inside the controlled atmosphere review Section 5.2 Application Consideration, Effect of Temperature.

5.4.3 AII-3000 AHC and MHC (Integral Oxygen Sensor)

AII-3000 AHC and MHC with their integral oxygen sensor requires connecting the ¼" tubing supplied (section 4.2.1 above) with the device to a ¼" hose barb attached to a pressure regulator controlling a source of gas flowing at less than 10 liters per minute.

5.5 Alarms (AII-3000 M/MHC):

The monitor is equipped with user selectable HI and LO alarm set points which are displayed at the bottom of the LCD. Section 4.6 describes the operation and procedure for setting the alarms in detail.

6 Maintenance

Review Section 3 Safety Warnings and Section 7 Troubleshooting for guidelines on servicing the devices.

6.1 Serviceability

Do not open the main compartment of the analyzer, as it contains no serviceable parts inside. Never attempt to repair the analyzer or sensor by yourself as you may damage the analyzer which could void the warranty.

6.1.2 Cleaning / Reuse Instructions

Clean the device, oxygen sensor and accessories with a soft cloth dampened with either water or mild isopropyl alcohol solution (70% isopropyl alcohol solution in water), if necessary, before re-use. Allow the components to air-dry after cleaning.

Note: The Home Care Kit is not intended for patient use, it is intended solely for confirming the O_2 concentration in Oxygen Concentrators. Accordingly, no cleaning instructions apply.

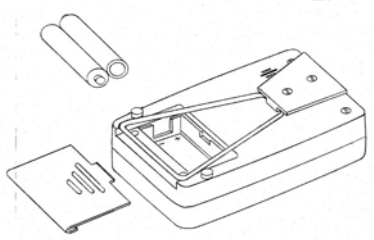
6.2 Battery Replacement

The analyzers and monitor are powered by two AA alkaline batteries with an approximate life of 1,200 hours. A low battery indicator circuit monitors the battery supply voltage and sends a signal directly to the LCD when the battery voltage reaches a preset level that activates the battery symbol in the LCD.

The batteries are housed in a separate compartment located at the rear of the device and are accessible by sliding the removable cover.

Initially this procedure can be somewhat difficult. Care should be taken not to damage the case when removing the battery compartment cover.

6.2.1 Procedure:



1. Turn the device over so the shortest raised line on the battery compartment cover is pointing away from you.
2. Lift the tripod wire stand up and away from the case.
3. Grasp the case with both hands and using your thumbs press down firmly on the raised lines and push the battery compartment cover away from you.
4. Locate the positive (+) and negative (-) terminals on the battery.
5. Assure the battery contacts are clean.
6. Align one battery's positive (+) terminal with the corresponding (+) battery symbol molded into the case.
7. Insert the battery into the compartment.
8. Repeat with the remaining battery.
9. Replace the battery compartment cover, make sure it snaps into position and is secured flush against the case. Replace the wire stand as required.
10. Calibrate the device after replacing the batteries.

6.3 Oxygen Sensor Replacement

The design of the electronics is intended for only the Analytical Industries Inc. AII-11-60 or AII-11-60-HC Oxygen Sensors. Use of a different oxygen sensor may result in an erroneous oxygen reading.

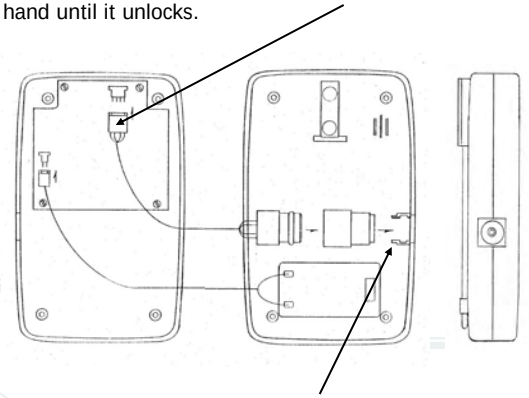
NEVER - Open the oxygen sensor or probe the sensing surface, refer to Section 10 in the event the sensor should leak and someone comes in contact with the electrolyte from inside the sensor.

6.3.1 Procedure AII-3000 A and AII-3000 M - External Sensor

1. Disconnect the cable from the old sensor just as you disconnect a telephone jack from a wall plug.
2. To connect the new sensor simply find and register the male plug at the end of the coiled cable and insert it into the mating female jack at the rear of the sensor until it mates or snaps into place.
3. Calibrate the device after replacing the oxygen sensor.

6.3.2 Procedure AII-3000 AHC and AII-3000 MHC - Integral Sensor

1. Tools required: small bladed screwdriver.
2. Place the device face down on a flat surface.
3. Remove the two (2) screws from the upper corners of the rear of the device.
4. Move the tripod up, remove the battery compartment cover (see Battery Replacement) and remove the two (2) screws located on either side.
5. Pull the rear section up ¼"-½", turn it over and lay it next to the other section.
6. Locate the white connector at the end of the four (4) wires running from the sensor (the cylinder with the white label) to the top of the PCB.
7. With your left for finger and thumb, grasp the sides of the back end of the white connector where it is soldered to the PCB.
8. With your right fore finger and thumb, grasp the sides of the section of the white connector where the four (4) wires from the sensor terminate.
9. Separate the connector - hold the white connector section your left hand while gently pulling and wiggling the white connector section with your right hand until it unlocks.



10. The oxygen sensor inserts into an adaptor (identified by a round recess with a cylindrical hose adapter in the center) that slides into grooves molded into the side of the case.
11. Hold the rear section of the case down, grasp the square edges of the adaptor, lift up (lift straight up so as not to strip the grooves molded into the adaptor and case) and remove the adaptor and oxygen sensor as a single component.

12. Once the adapter and old sensor have been removed from the case, hold the label of the sensor, again grasp the square edges of the adaptor and pull – to separate the old sensor from the adaptor.
13. Remove the new oxygen sensor from the plastic shipping container.
14. Install the new oxygen sensor by reversing steps 12 through 3.
15. Calibrate the device after replacing the oxygen sensor.

7 Troubleshooting

If the recommended corrective action does not resolve the problem return the device to the factory for service.

Symptom	Corrective Action
Device appears to be physically damaged	Turn device ON – if it successful passes START-UP TEST and calibrates – proceed.
No digital display when analyzer is turned ON	Install battery Replace battery Check battery polarity Check and/or clean battery contacts
Battery symbol on LCD display	Replace battery and calibrate device
LCD display reads 00.0	Install sensor Check electrical connections Assure electrical connections are dry
No response to keypad command	Replace battery
Cannot turn device OFF	Calibration routine in process – escape or wait until completed

Symptom	Corrective Action
Reading displayed by LCD drifts during calibration	Wait 5 minutes and repeat calibration with sensor placed on flat surface (not in your hand) Check integrity of gas delivery system Check sensor's front o-ring seal Verify calibration gas in not humidified Remove moisture covering sensor Replace sensor, repeat calibration
Analyzer reading climbs after calibration in 100% dry oxygen when exposed to air 20.9%	Allow the sensor to stabilize for 5 minutes in 100% dry oxygen and recalibrate
After calibration in 100% dry oxygen, analyzer reading drifts more than 2% over 8 hours	Check primary oxygen delivery device Replace sensor that is nearing the end of its useful life
Reading displayed by LCD does not change when oxygen level changes	Replace sensor
Reading does not stabilize or fluctuates erratically	Relocate analyzer away source of radio frequency or electromagnetic radiation emissions. Tested over a 26 MHz to 1000 MHz electromagnetic field, the analyzer is susceptible at all frequencies tested except those between 930 and 990 MHz. Check sensor connection Check cable connection Wait 5 minutes and repeat calibration Replace sensor, repeat calibration Do not attempt to use the analyzer and return the analyzer for service.

Symptom	Corrective Action
Reading displayed by LCD does not change when calibration control is adjusted	Replace sensor
Reading displayed by LCD is very low	Check sensor connection Check cable connection Replace sensor
Alarms continuously activated	None – Normal operation, confirm set points Abnormal - Adjust alarm set points Remove moisture covering sensor Check sensor connection Check cable connection Check integrity of gas delivery system Check sensor's front o-ring seal Verify calibration gas in not humidified Verify flow rate is 4-5 liters per minute Replace sensor Replace cable

8 Specifications

Accuracy:	±2% of FS range under constant conditions
Analysis:	0-100% oxygen
Area Classification:	General purpose
Alarms:	A models – none; M models - User adjustable HI 1-100% and LO 0-99% alarms; 120 second alarm silence; HI alarm defeat for 100% O_2 measurements
Calibration:	Air or 100% oxygen after 8 hours of continuous use.
Compensation:	Temperature compensated
Connections:	A/M models: 1x16mm thread; HC models: Tubing 1/4"
Controls:	Soft touch keypad for ON/OFF and menu function
Dimensions:	3.6 x 5.9 x 1.6"; weight 10 oz. (280 grams)
Display:	3-1/2 digit backlit LCD 2.5" x 1.5"; resolution 0.1% O_2
Flow Sensitivity:	None between 0.2 to 10 liters per minute
Humidity:	Non-condensing 0-95% RH
LED Indicators:	A models - none; M models - upon activation of alarms
Linearity:	± 1% under constant conditions
Pressure:	Inlet – (A/M) ambient, (HC) regulate; Vent - atmospheric
Power:	2 AA Alkaline batteries; 1,200 hours continuous use
Response Time:	90% of final FS reading in 9 seconds
Sensitivity:	< 0.5% of FS range
Sensor:	A/M models: AII-11-60 or HC models: AII-11-60-HC
Expected Life:	60 months in air at 25ºC and 1 atmosphere
Storage Temp.:	-20º to 60ºC (-4ºF to 140ºF) on intermittent basis
Temp. Range:	5º to 45ºC (41ºF to 113ºF)
Warm-up Time:	None
Warranty:	12 months analyzer; 12 months sensor

Expected Sensor Life
Considers the full range of the sensor's signal, example 7-13 mV. Oxygen sensors are configured to meet the published, see preceding page, specification which distributes the overall sensor life as follows:

- 60 months Expected Service Life (915,420 oxygen % hours)
- 6 months Recommended Storage Life period (91,542 % oxygen hours)
- 2 months margin of error

Therefore, the Recommended Storage life period should not be considered a perishable shelf life. Operating at the specified parameters of oxygen concentration (air 20.9%), temperature (25ºC/77ºF) and pressure (1 atm/bar), the sensor will operate for approximately 68 months whether in storage or in use.

The purpose of the Recommended Storage Life period is to ensure the user derives the Expected Life of 60 months (915,420 % oxygen hours) and does not lose the benefit of the warranty.

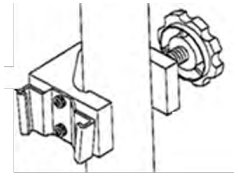
Warranty
The 12 month (183,084 % oxygen hours) warranty period (begins with shipment from the factory and is limited to the first claim submitted) is based on:

8.1 Spare Parts & Accessories

AII-3000 A, AII-3000 M	**AII-3000 AHC, AII-3000 MHC**
Spare Parts:	**Spare Parts:**
AII-11-60 Oxygen Sensor	AII-11-60-HC Oxygen Sensor
BATT-1008 Battery (2x) 1.5V AA	BATT-1008 Battery (2x) 1.5V AA
P-1087 Instructions for Use	P-1087 Instructions for Use
A-1162 PCB Assy Main	A-1162 PCB Assy Main
CABL-1006 Coil Cable	TUBE-1019 7/32" OD Tubing 3'

Optional Accessories - **See opposing page**

CC-1072 Carrying Case



HRWR-1075 Dovetail Clamp Pole or Shelf

A-3388 Adapter, Dome to Sensor

A-3675 Adapter 5/32" Tube to Sensor

A-3671 Adapter, BC with Restrictor to Sensor

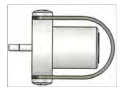
A-3676 Adapter, 1/8" Tube to Sensor

TUBE-1018 Tubing, 1/8" x 3'

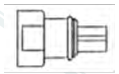
A-3609 Adapter, Dome to 1/8" Tube

A-3673 BC with Restrictor to 1/8" Tube

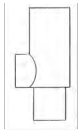
A-3678 Adapter, A-Yoke to 1/8" Tube



A-3677 Adapter, DIN to 1/8" Tube



FITN-1112-1 Flow Diverter



FITN-1009 Tee Adapter

A-3692 Hand Pump Kit

A-3674 Adapter 5/16" Tube to Sensor

PUMP-1020 Pump, Hand

TUBE-1020 Tubing, 5/16" x 3' (2x pcs)

9 Warranty

Coverage
Under normal operating conditions, the analyzer and sensors are warranted to be free of defects in materials and workmanship for the period specified in the current published specifications. To make a warranty claim, you must return the item properly packaged and postage prepaid to:

Advanced Instruments Inc.
2855 Metropolitan Place
Pomona, Ca 91767 USA
T: 909-392-6900, F: 909-392-3665
E: sales-industrial@aii1.com, W: www.aii1.com

Advanced Instruments in their sole discretion shall determine the nature of the defect. If the item is determined to be eligible for warranty we will repair it or, at our option, replace it at no charge to you. If we choose to repair your item, we may use new or reconditioned replacement parts of the same or upgraded design. This is the only warranty we will give and it sets forth all our responsibilities, there are no other express or implied warranties.

The warranty begins with the date of shipment from Advanced Instruments, is limited to the first customer who submits a claim for a given serial number which must be in place and readable to be eligible for warranty and will not extend to more than one customer or beyond the warranty period under any conditions.

Exclusions
This warranty does not cover normal wear and tear; corrosion; damage while in transit; damage resulting from misuse or abuse; lack of proper maintenance; unauthorized repair or modification of the analyzer; fire; flood; explosion or other failure to follow the Owner's Manual.

Limitations
Advanced Instruments shall not liable for losses or damages of any kind; loss of use of the analyzer; incidental or consequential losses or damages; damages resulting from alterations, misuse, abuse, lack of proper maintenance; unauthorized repair or modification of the analyzer.

Service
Contact us between 8:00am and 5:00pm PST Monday thru Thursday or before 12:00pm on Friday. Trained technicians will assist you in diagnosing the problem and determining the appropriate course of action.

10 Material Safety Data Sheet (MSDS)

Product name	Electrochemical Galvanic Fuel Cell Oxygen Sensor
Exposure	Sealed device with protective coverings, normally no hazard
Ingredients	Carcinogens - none; Potassium Hydroxide (KOH), Lead (Pb)
Properties	Completely soluble in H_2O; evaporation similar to H_2O
Flash Points	Not applicable, non-flammable
Reactivity	Stable; avoid strong acids, emits fumes when heated
Health Hazard	KOH entry via ingestion - harmful or fatal if swallowed; eye - corrosive, possible loss of vision; skin contact - corrosive, possible chemical burn. Liquid inhalation is unlikely. Lead - known to cause birth defects, contact unlikely
Symptoms	Eye contact - burning sensation; skin contact - slick feeling
Protection	Ventilation - none; eye - safety glasses; hands - gloves
Precautions	Do not remove Teflon and PCB coverings; do not probe with sharp objects; avoid contact with eyes, skin and clothing.
Action KOH Leak	Use rubber gloves, safety glasses and H_2O and flush all surfaces repeatedly with liberal amounts of H_2O

10.1 Disposal
Oxygen sensors and batteries should be disposed of in accordance with local regulations for batteries.

WEEE regulations prohibit electronic products including the Helium and environmental sensors from being placed in household trash bins.

Electronic products should be disposed of in accordance with local regulations.