



AI Analytical Industries Inc.



Owner's Manual



AI TruMix 4001

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Helium Oxygen Trimix Analyzer

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1 Introduction

Congratulations you have purchased the most advanced portable gas analyzer available. The AII TruMix 4001 provides unmatched sophisticated performance in a simple to use package. The advantages of the most advanced portable analyzer available include:

Precisely analyze dive gas mixes in any environment without charts.

Proprietary algorithms* and sensors provide extremely accurate one touch calibration. Note: Failure to account for environmental factors can produce up to 6.7% error.

- ◆ Oxygen value is compensated for temperature, barometric pressure and RH.
- ◆ Helium value is zeroed when the oxygen is calibrated with air or 100% oxygen.

Algorithms* compensate the Helium value for differences in the thermal conductivity of Oxygen and Nitrogen enabling the TruMix 4001 to precisely measure any combination of Helium, Oxygen and Nitrogen.

The large backlit LCD is easily read even in low light condition and provides additional information to the user:

- ◆ Temperature, barometric pressure and RH values of the sample gas.
- ◆ For added safety, the Maximum Operating Depth (MOD) PO₂ @ 1.4 ATA of the gas mix being sampled
- ◆ Imperial or Metric units at a touch

Rechargeable battery powers the TruMix 4001 for 16 hours of continuous use.

- ◆ 9 VDC power adapter 110/220 VAC is included, charges battery in 2 hours
- ◆ The adapter can safely remain connected for bench top operation
- ◆ Optional 9 VDC cigarette lighter adapter is available

Automatically conserves and protects battery life.

- ◆ The backlight turns off after 30 seconds and
- ◆ The TruMix completely powers itself off after 15 minutes of non-use
- ◆ The automatic turn-off features are disabled when externally powered
- ◆ The analyzer turns off 2-3 hours after the LOW BATTERY warning is displayed to prevent complete discharge and permanent damage to the battery

The AII TruMix 4001 and accessories are packaged in a rugged waterproof plastic enclosure designed specifically for hostile diving conditions. The unmistakable bright red color stands out in the shop, on the boat or in the water.

* Patent pending

1.1 Contents

Open the red case containing the AII TruMix 4001 and confirm you have received the standard accessories and any optional equipment ordered:

- 1) AII TruMix 4001 Helium Oxygen Trimix Analyzer
- 2) Flow Manifold (A-3582)
- 3) Adapter, Dome to 1/8" Tube (A-3609)
- 4) Tubing, 1/8" x 3 ft. (TUBE-1018)
- 5) Adapter, 9 VDC 110/220 VAC (PWRS-1003-1)
- 6) Owner's Manual



2 Quality Control Certification

Date: _____ Customer _____ Order _____

Model: AII TruMix 4001 Helium Oxygen Analyzer S/N _____

Sensors: AII-11-75D Oxygen Sensor S/N _____

AII-41-100 Helium Sensor S/N _____

AII-E3 Environmental Sensor Module S/N _____

Configuration: A-1185 PCB Assembly, Main Software Ver _____

Accessories: A-3582 Flow Manifold _____

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

TUBE-1018 Tubing 1/8" x 3 ft _____

PWRS-1003-1 Charger 9VDC 110/220 VAC Adapter _____

Instruction Manual _____

Testing: Mechanical: all screws, sensors and connectors secured _____

Labels: 3 labels applied to case _____

LCD display 3-1/2 digits _____

Backlight: on for 3 seconds after power-up _____

on for 15 seconds after key press _____

Battery icon: "LOW BATTERY" displays in reverse background in lower right hand corner when the battery icon displays < 30% charge _____

displays solid black when fully charged _____

Charging battery: "CHARGING" displays in lower right hand corner when the charge plug is connected to the analyzer and the adapter plugged into a 110/220 VAC outlet _____

Test (cont'd) Temperature: within 2°F of EXTECH RH300 Digital Psychrometer at ambient conditions _____

Relative Humidity: within 3% of EXTECH RH300 Digital Psychrometer at ambient conditions _____

Barometric Pressure: within 1 KPa of Accu Cal Plus Digital Precision Test Gauge _____

Calibration O2 Sensor: ±10-30% FS in ambient air _____
>98% in 100% oxygen _____

Zero He Sensor: ±1% FS in 100% oxygen _____
>98% in 100% helium span gas _____

O2 Sensor: within 0.5% of ambient air calibration value _____

Overall Appearance: clean, no physical defects _____


Options:

Part Number & Description	Qty
PWRS-1019 Adapter, 9VDC Cigarette Lighter _____	_____
A-3673 Adapter, BC with Flow Resistor to 1/8" Tube _____	_____
A-3677 Adapter, DIN to 1/8" Tube _____	_____
A-3678 Adapter, A-Yoke to 1/8" Tube _____	_____


Notes:

Delivery: _____

3 General Care & Safety

 This means CAUTION. Users must familiarize themselves with the instructions that accompany the use of this symbol.

Users must read and understand this manual before using the AII TruMix 4001 Helium Oxygen Analyzer.

 The AII TruMix 4001 displays the MOD or maximum operating depth @ 1.4 ATA of the mix under analysis. To prevent oxygen toxicity or even death, do not exceed this depth when diving

Recommendations to ensure an accurate mix:

- Adapters, tubing, flow manifold and all three (3) sensors must be free of liquid before attempting to calibrate or use the AII TruMix 4001
- Avoid high flow rates which may cause inaccurate readings
- Expose the sensors to clean air for several minutes to vent previous mix
- Calibrate the AII TruMix 4001 as described in section 5.4
- Follow established guidelines for allowing the mix to cool after each transfer of helium and oxygen.

Do not leave the AII TruMix 4001 open. Liquid, exposure to direct sunlight, the environment or extreme temperatures can damage the electronics.

Clean the AII TruMix 4001 with a damp soft cloth and a mild cleaner.

The rugged plastic case is capable of absorbing abuse, however, the electronics and sensors are subject to damage from the excessive shock of being dropped.

The electrochemical galvanic oxygen sensor contains a mildly caustic clear liquid electrolyte that is very slick to the touch. If you should come in contact with the electrolyte flush the area immediately with large amounts of water and seek medical attention, refer to Section 10 MSDS for additional information.

Recharge the battery when the battery symbol on the LCD becomes empty and the LOW BATTERY warning is displayed. To prevent complete discharge and permanent damage to the battery, the analyzer turns off automatically 2-3 hours after the LCD displays the LOW BATTERY warning.

Calibrate and sample at very low pressure and flow rates (or regulate the pressure to 1-5 psi and control the flow rate to 1-2 lpm using optional equipment) to avoid inaccurate readings and damage to the sensors. For example, when using the dome adapter and tubing supplied, open the tank very slowly until you hear the gas hissing out.

4 Specifications

Application: Measure Helium in Oxygen and/or Nitrogen and Oxygen in Nitrogen and/or Helium and compute balance gas

Accuracy: < $\pm 1\%$ of FS range under constant conditions
< $\pm 5\%$ of FS range at constant pressure over operating temperature range of 0-45°C (0-113°F)

Analysis Range: 0-100% Helium, 0-100% Oxygen

Calibration: Dual mode: Ambient air or span gas

Compensation: Normal use: Temperature and barometric pressure
Calibration: O₂ sensor corrected for temperature, barometric pressure and relative humidity; He sensor corrected for differences in thermal conductivity of oxygen and nitrogen

Connections: 1/8" push-on fitting

Controls: Water resistant keypad with simple to use one touch keys for Power ON/OFF; Backlight ON/OFF; ZERO He/CAL O₂

Display: Graphical backlit LCD 2.5 x 2.5", backlight 30 sec auto OFF
% Helium, % Oxygen, % Bal Gas
Temperature, relative humidity, barometric pressure
MOD - Maximum Operating Depth @ PO2 1.4 ATA
Low battery warning

Enclosure: Watertight IP65, 221 x 190.5 x 96.5 mm (8.7 x 7.5 x 3.8")

Pressure/Flow: <5 psi/1-2 lpm or open tank slowly until hissing is heard

Power: Rechargeable battery with 15 minute auto OFF
9 VDC power adapter from 110/220 VAC or
9 VDC cigarette lighter adapter for continuous use
Approximately 16 hrs continuous use from 2 hr full charge

Resolution: 0.1% Helium, 0.1% Oxygen, 0.1% Balance Gas

Response Time: 90% of final FS reading < 10 seconds

Sensor Model: He: AII-41-100, O₂: AII-11-75D, Environmental: AII-E3

Sensor Life: He: 10 yrs; O₂: 60 mos in air at sea level and 25°C (77°F)

Temp. Range: Operating: 0-45°C (32-113°F), Storage: 0-50°C (122°F)

Warranty: Analyzer 12 mos; Sensors: He 12 mos, O₂ 36 mos prorated

5 Operation

5.1 Controls

The AII TruMix 4001 is equipped with a waterproof membrane type panel that contains three color coded push button keys for operating the analyzer.

POWER - press and release the RED key to turn the unit ON or OFF

BACK LIGHT - the YELLOW key has two functions:

- 1) press and release it to turn the backlight ON or OFF
- 2) press and hold the YELLOW key for 3 seconds to switch the LCD display between Imperial and Metric units

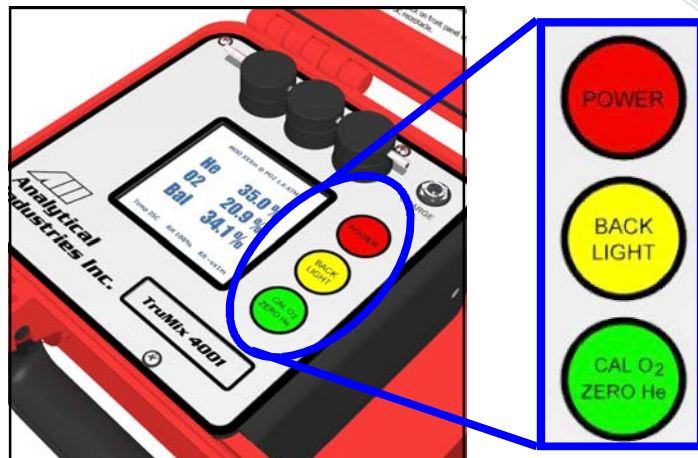
CAL O₂ ZERO He - press and release the GREEN key to calibrate the oxygen sensor, zero the helium sensor and compute the balance gas in the mix being sampled.

To conserve battery life, the AII TruMix 4001 automatically:

- Turns off the POWER after 15 minutes of non-use
- Turns off the BACK LIGHT after 30 seconds.

Press and release the appropriate RED or YELLOW key to reactivate.

The automatic turn-off features are disabled during charging and when externally powered.

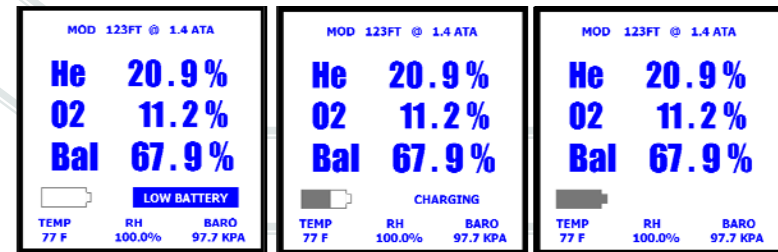


7

5.2 Power

The AII TruMix 4001 is equipped with a rechargeable battery that provides approximately 16 hours of continuous from a 2 hour full charge. It is supplied with a 9 VDC power adapter 110/220 VAC for charging the battery and operating the analyzer from external power. An optional 9 VDC cigarette lighter adapter is available.

When the battery is in need of charging the LCD displays an empty battery symbol and a warning that reads LOW BATTERY as shown below:



Recharge the battery when the battery symbol on the LCD becomes empty and the LOW BATTERY warning is displayed. To prevent complete discharge and permanent damage to the battery, the analyzer turns off automatically 2-3 hours after the LCD displays the LOW BATTERY warning.

To charge the battery or operate the AII TruMix 4001 from external power, insert the male plug into the CHARGE jack located in the upper right hand corner of the front panel and connect the adapter to the appropriate AC outlet or DC receptacle.



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5.3 O₂ Calibration and He Zero

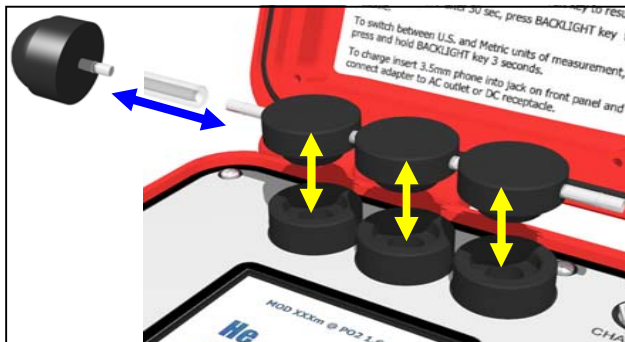
The AII TruMix 4001 employs proprietary maintenance free long life Helium and Oxygen sensors that measure in the 0-100% range. The Oxygen sensor is automatically compensated during calibration for temperature, relative humidity and pressure, thereby eliminating the need for conversion charts. The Helium sensor is characterized using a six point linearization curve. Further, the Helium output is compensated for differences in thermal conductivity of Oxygen and Nitrogen. Whether the source is ambient air or compressed gas, the AII TruMix 4001 enables the user to automatically calibrate the Oxygen sensor and zero the Helium sensor with a single touch. The result is the most accurate analysis of your trimix.

O₂ Calibration/He Zero with Ambient Air:

- 1) Remove the flow manifold, if necessary, as illustrated below.
- 2) Expose sensors to clean ambient air for several minutes.
- 3) Press GREEN CAL O₂ ZERO He key.

O₂ Calibration/He Zero with Span Gas:

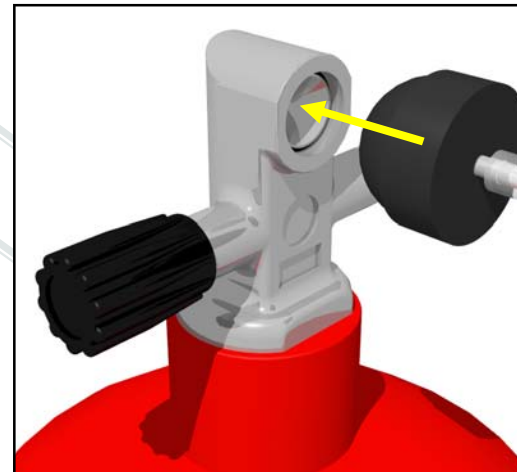
- 1) Adapters, tubing, flow manifold and all three (3) sensors must be free of liquid before attempting to calibrate or use the AII TruMix 4001.
- 2) Avoid high flow rates which may cause inaccurate readings
- 3) Install the bi-directional flow manifold as illustrated below.
- 4) Connect tubing to the dome adapter and the flow manifold. (Note: Dome adapter may be replaced by other optional equipment, in that case regulate pressure to <5 psi and control flow rate between 1-2 lpm.)
- 5) Open the tank very slowly until you hear the gas hissing out.
- 6) Press the dome adapter tightly against the tank outlet as illustrated right on page 8.
- 7) Allow the air to flow for several minutes.
- 8) Press the GREEN CAL O₂ ZERO He key.



5.4 Analysis

Recommendations to ensure an accurate mix:

- Adapters, tubing, flow manifold and all three (3) sensors must be free of liquid before attempting to calibrate or use the AII TruMix 4001
 - Avoid high flow rates which may cause inaccurate readings
 - Expose the sensors to clean air for several minutes to vent previous mix
 - Calibrate the AII TruMix 4001 as described in Section 5.3
 - Follow established guidelines for allowing the mix to cool after each transfer of helium and oxygen.
- 1) Install the flow manifold (Note: the flow manifold is bi-directional) as illustrated at left on page 7.
 - 2) Connect tubing to the dome adapter and the flow manifold. (Note: Dome adapter may be replaced by other optional equipment, in the case regulate pressure to <5 psi and control flow rate between 1-2 lpm.)
 - 3) Open the tank valve very slowly until you hear the gas hissing out.
 - 4) Press the dome adapter tightly against the tank outlet as illustrated below.
 - 5) Allow sufficient time, approximately 30 seconds, for the readings helium, oxygen and balance gas to stabilize.
 - 6) Record your readings and close the tank valve.
 - 7) For multiple cylinder checks,
 - a. Remove the bi-directional flow manifold.
 - b. Expose the sensors to clean air for several minutes to allow the previous mix to vent into the atmosphere.
 - c. Repeat steps 1 through 7.



6 Maintenance

The AII TruMix 4001 contains no moving parts and other than a periodic wipe down requires no routine maintenance.

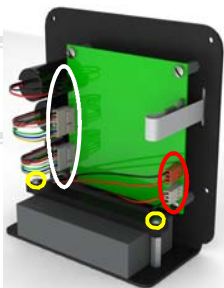
The expected life of the Helium sensor is 10 years and along with the environmental sensor module should last for the life of the analyzer, unless subjected to contact with liquids or excessive shock from the analyzer being dropped.

The expected life of the Oxygen sensor is 5 years in air (20.9%) at 25°C (77°F) and 1 atm. To obtain maximum sensor life, avoid subjecting the analyzer to high temperatures any longer than necessary and expose or flush the Oxygen sensor with clean air after analysis of high oxygen concentrations.

Sensors and the battery are easily replaced in the field. Dispose of old sensors and batteries in accordance with local regulations.

Sensor Replacement:

- 1) Open the case in a clean dry environment.
- 2) Remove the manifold from the sensors, if necessary.
- 3) Remove the 4 screws securing the front panel
- 4) Remove the front panel from the case
- 5) Stand the front panel on the side panel
- 6) Unplug the sensor from the PCB using small thin blade screwdriver, white oval illustrated at right
- 7) Unscrew the nut securing the sensor to the front panel
- 8) Pull the threaded end of the sensor out of the front panel
- 9) To install a new sensor, reverse the steps above



Battery Replacement:

- 1) Open the case in a clean dry environment.
- 2) Follow the sensor replacement procedure to gain clear access to screws securing the battery clamp.
- 3) Disconnect battery (4 pin) and charge (3 pin) jacks at the PCB using small thin blade screwdriver, red oval illustrated above.
- 4) Loosen battery clamp screws, yellow oval illustrated above.
- 5) Slide battery out of clamp to remove.
- 6) To install a new battery, reverse the steps above.

Note: Discharging the battery 50% before charging yields approx 500 cycles.
Discharging the battery 30% before charging yields approx 1,200 cycles.

7 Replacement Parts & Optional Accessories

To maintain optimum performance service the AII TruMix 4001 using only OEM parts obtained from Analytical Industries Inc.

Replacement Parts

AII-11-75D	Oxygen Sensor
AII-41-100	Helium Sensor
AII-E3	Environmental Sensor
A-1185	PCB Assembly, Main
A-3606	Battery Assembly
A-3582	Flow Manifold
A-3609	Dome Adapter
TUBE-1018	Sample Tubing 1/8" ID 1/4" OD
PWRS-1003-1	9 VDC Charger 110/220 VAC Adapter
MANL-4001	AII TruMix 4001 Owner's Manual
A-3607	Charger Wiring Assembly
A-3597	Case Lid Instruction Panel

Optional Accessories

PWRS-1019	9 VDC Cigarette Lighter Adapter
A-3673	Adapter, BC with Restrictor to 1/8" Tube
A-3677	Adapter, DIN to 1/8" Tube
A-3678	Adapter, A-Yoke to 1/8" Tube

8 Troubleshooting

Symptom	Possible Cause	Recommendation
Display blank	15 min auto turn off feature Battery protection auto turn off Bad connection Other component failure	Press red POWER key Charge analyzer for 2 hrs Check battery connection Return to factory
Display dark	Auto turn off feature Exposure to high temperature	Press yellow BACK LIGHT key Move the unit to cooler place
Display segment missing	LCD component failure	Return to factory
Display reflects empty battery symbol	LOW BATTERY warning	Charge battery
Readings unstable	Bad electrical connection Ignore LOW BATTERY warning Backpressure on sensor RF/Electro-mag interference O ₂ sensor nearly expired He sensor faulty	Check connections Charge or replace battery Check pressure, flow and vent (remove any restriction) Move unit away from source Replace O ₂ sensor Check with known He % mix Replace He sensor
Reading drifts	Leak in gas path connections Liquid covering sensing areas Ignore LOW BATTERY warning Temperature change >10°C O ₂ sensor nearly expired He sensor faulty	Check connections Remove liquid Replace O ₂ sensor Charge or replace battery Stabilize 30 min at new temp Replace O ₂ sensor Check with known He % mix Replace He sensor
Reading zero O ₂	Bad electrical connection Liquid covering sensing area No oxygen present Shock from being dropped O ₂ sensor expired	Check O ₂ sensor connection Remove liquid Expose to air Replace PCB or O ₂ sensor Replace O ₂ sensor
Reading +/- He in air	He zero required He sensor fault	Perform CAL O ₂ ZERO He Replace He sensor
O ₂ Calibration failed	No oxygen present O ₂ sensor nearly expired Shock from being dropped	Expose to air, repeat Replace O ₂ sensor Replace PCB, sensors
He Zero failed	He sensor disconnected He sensor faulty	Check He sensor connection Check with known He % mix

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:

Analytical Industries Inc.
2855 Metropolitan Place
Pomona, Ca 91767 USA

Analytical Industries 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. If we choose to replace your item, we may replace it with new or reconditioned components 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 period begins with the date of shipment from Analytical Industries and 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. Under no circumstances will the warranty extend to more than one customer or beyond the warranty period.

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

Analytical Industries 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

Telephone 909-392-6900, fax 909-392-3665 or e-mail diveaii@a11.com 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 MSDS - Material Safety Data Sheet

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 ₂ O; evaporation similar to H ₂ O
Flash Points	Not applicable, non-flammable
Reactivity	Stable; avoid mixing strong acids, emits fumes when heated
Health Hazard	KOH entry via ingestion - harmful or fatal if swallowed; eye - corrosive, possible loss of vision; and, skin contact - corrosive, possible chemical burn. Liquid inhalation is unlikely. Lead - known to cause birth defects, but 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 ₂ O and flush all surfaces repeatedly with liberal amounts of H ₂ O

Disposal

O₂ sensor and battery 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.

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* Patent pending