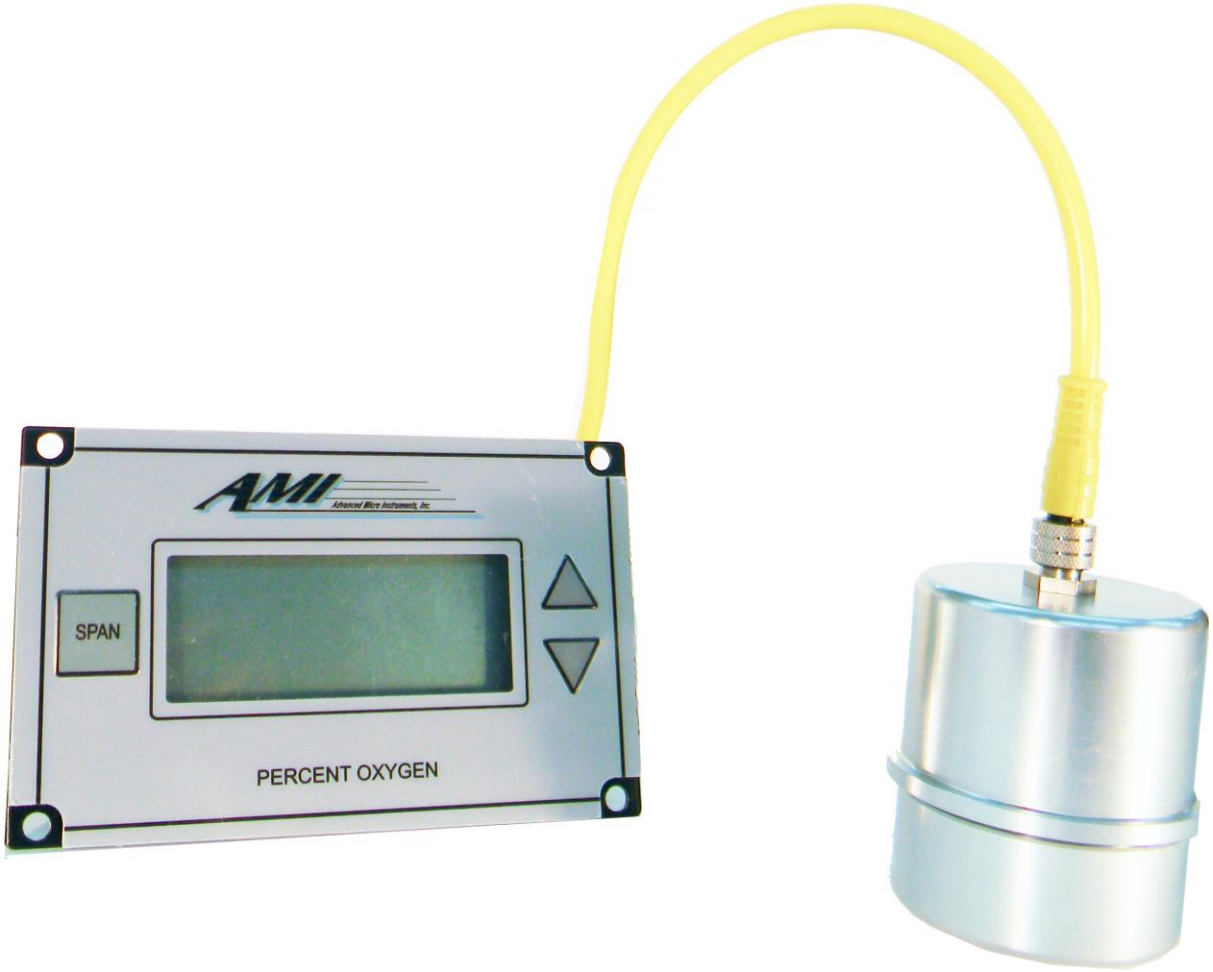
MODEL 60
Operator Manual



AMI, Costa Mesa, CA

Contents

Preface

The AMI story

The AMI series of analyzers provide the latest in high-definition oxygen analysis. The series includes trace oxygen, percent oxygen and portable trace and percent oxygen models. All of them share the same basic design, using time proven oxygen sensors and advanced high definition electronics for noise and interference free performance. Certain aspects of the design are the subject of a patent, number 5,728,289.

Every effort is made to ensure that AMI products provide reliable, effective performance. However there are many pitfalls in achieving correct oxygen analysis, particularly at low ppm levels, and AMI stands ready to provide a complete solution to the analysis problem, from sample system design to on-site troubleshooting and problem analysis. Please feel free to call AMI for help should your results not meet your expectations.

Caution

Read and understand this manual fully before attempting to use the instrument. In particular understand the hazards associated with using flammable or poisonous gases, and associated with the contents of the sensor used.

Address

Advanced Micro Instruments

225 Paularino Ave

Costa Mesa, CA 92626

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(714) 848-5533

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OM-300-020 Rev C

The AMI Oxygen Probe Analyzer

Introduction

The Advanced Micro Instruments Oxygen Probe is designed for monitoring of oxygen content in a nitrogen or similar inert gas stream. It operates on a single range, normally 0-25% oxygen, and produces an output typically 0-2.5V DC over this range. It uses 12-24V DC power, and it provides a regulated 5VDC output as an auxiliary for low power devices such as LCD panel meters. No calibration is provided internally: calibration is performed either by the host system to which it is attached or else by the optional meter display unit.

Features:

Compact size

- Single range operation
- Probe may be mounted up to 100ft from a suitable display unit.
- Air calibration, no zero or span gases required
- Virtually unaffected by hydrocarbons or other oxidizable gases
- High accuracy and fast response

Options:

- Meter display unit with analog voltage output from 4-20 mA

Oxygen sensor:

AMI uses an industry standard electrochemical sensor. This measures the concentration of oxygen in a gas stream, using an oxygen specific chemistry. It generates an output current in proportion to the amount of oxygen present, and has zero output in the absence of oxygen, thus avoiding any requirement to zero the analyzer. The cell is linear throughout its range. The span calibration may be performed using standard span gases or ambient air.

Percent level analyzers are routinely calibrated on air. Air has a reliable 20.94% oxygen in it at 50% relative humidity at 0°C (32°F), when dry. In the case of its use as an area monitor it is advisable to use a known high quality air supply for calibration since the room air may not contain 20.94% of oxygen!

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Installation and Operation

Receiving the analyzer

Precaution

When you receive the instrument, check the package for evidence of damage and if any is found, contact the shipper.

Installation

Location:

Install the probe with the electrical connection pointing upwards and the gas connections downwards in a suitable bracket.

Mount the display unit (if used) in a suitable panel opening with 8-32 (or equivalent) screws. This unit should be within about 6 feet of the probe.

Connect the cable provided to the probe and to the display unit, or suitable power supply (12-24V DC) and monitoring system.

If the display unit is used, connect it to a suitable power supply (12 –24V DC), and connect the output if desired to a suitable monitoring system.

Figure 1. Probe showing preferred mounting

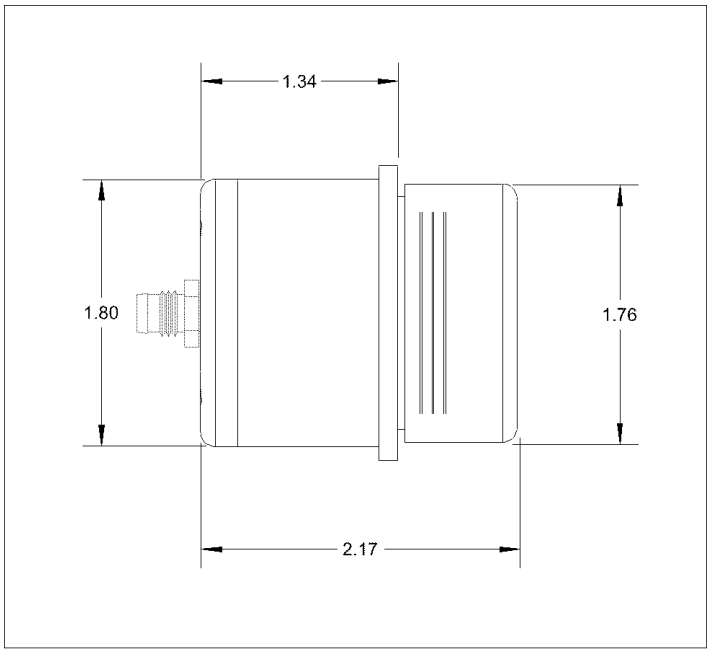

Figure 2. Probe dimensions

Probe connection:

(Probe mounted without display unit)

The unit requires a DC power supply between about 12 and 24 volts, at less than 10 mA. The supply should be free of high frequency noise - if it is derived from a switching power supply it is advisable to use a series inductor and parallel capacitors to filter it. The unit provides a regulated 5V DC output at up to 50 mA for external use. If the display unit is used, connect the power to it.

The probe is provided with a length of cable attached. If this length is not sufficient, an additional length may be added up to a distance of about 100ft. Make the connection in a suitable connection box. The cable used must be a pair of shielded twisted pairs, of any gauge from about 16AWG to about 26 AWG.

Wire Color	Connection
Brown	+12 to +24VDC, 5 to 55mA
Black	Ground/Return
Blue	+5V, 50ma max
White	Voltage output

Display unit connections:

The Display unit is designed to be connected to the probe, and to provide a calibrated output signal. It needs between 12 and 24V DC power as above, and uses the 5V supply from the probe as the power for its meter.

IMPORTANT: CONNECT THE POWER SUPPLY TO THE CHANNEL DISPLAY. THE PROBE WILL GET POIWER THROUGH THE DISPLAY.

The first four connections are connections to the probe; the second four are user connections.

Back Panel Connections	**Model 60 Wires / Connections**
Probe 1	Brown **(+) Power for the Probe**
Probe 2	Black **Ground Power for the Probe**
Probe 3	Blue **(Auxillary: 5V)**
Probe 4	White **(Voltage Output from the Probe)**
PWR + (Input Power Supply)	+12-24V DC
PWR - (Ground Input Power Supply)	Ground
O/P +	4-20mA +
O/P-	4-20mA -

Initial test:

Install the unit as desired, and connect it to some form of monitoring system. Install the oxygen sensor, making sure that it is the right way up. The sensing surface (and therefore the whole probe) should be pointing downwards.

Expose the unit to air, and calibrate the monitoring system to 20.9% oxygen (or equivalent nitrogen for nitrogen purity systems). The unit should be recalibrated after about one day, and thereafter at a rate determined by usage, though once a month is typical.

Output connections:

The voltage output circuit is capable of driving an input resistance of 10K Ohms or more. Lower input resistances will degrade the accuracy of the circuit.

Sample connection:

The sample may be introduced to either of the two barbed fittings on the cap of the unit. It may be desirable to provide a tee in the line for calibration - see the discussion below. Sample flow rate should be between 0.1 SCFH to 2.1 SCFH, the exact amount not being critical. Avoid back-pressuring the sensor with excess flow if there is any restriction on the exhaust.

Sensor Installation:

Open the probe cap, and remove the sensor from its bag. Place the sensor inside the probe in such a way that the electrodes on the sensor (the little circuit board with the central gold-plated disk, and annular gold-plated ring) are facing the connection springs within the probe.

Notes:

The unit is designed to be mounted on a suitable bracket in a general purpose area. It is not suitable for installation in a hazardous area though it may be mounted outdoors if the temperature range does not exceed the 25°F to 115°F (-4°C to 46°C) for which it is rated. The probe should be mounted in such a way that the gas fittings are on the bottom. The cable supplied is approximately 6 ft. long.

Do not mount it close to sources of electrical interference such as large transformers, motor start contactors, relays etc. Also avoid subjecting it to significant vibration. Make sure that the sensor cable does not run next to high-current cables, or AC cables. Preferably the sensor cable should be in its own conduit.

Avoid mounting it in such a way that it will be subject to rapid temperature changes. For example, do not mount it close to an outside door or air conditioning duct that will allow a sudden draft of cold or hot air to blow on it.

If used as an area monitor the probe should be mounted where it will sense a representative sample of the room air. If the room has no natural circulation, you may want to install a fan to make sure that there is some air movement. The nature of the possible asphyxiating gas also should affect its placement - if the danger is from a heavy gas such as CO_2 or SF_6, the sensor should be mounted low down so that it detects the gas before people start breathing it, while if the gas is light such as helium, the sensor should be mounted higher. Otherwise it should normally be mounted at head height.

Operation

Calibration:

The sensor will stabilize within a few minutes, and it may be calibrated almost as soon as it has been installed.

Probe only option:

No provision is made in the probe itself for calibration. It is expected that the display or monitoring device will perform this function. The output of the sensor will vary by about +/- 20% between units, in other words air will make the output come to somewhere between about and on a nominally output unit. The following section is intended to provide tips on performing calibration.

Display option:

Use the span button then up/down arrows provided on the display unit to calibrate the output. Expose the probe to air or 100% oxygen, and adjust the span up/down arrows until the meter reads the correct value (20.9% or 100.0%). The voltage output will then be calibrated to 1V full scale.

Be absolutely sure that you are using at least a certified, and preferably a primary standard span gas supply as the span gas. Alternatively use known fresh air. So called "Manufactured air" or bottled compressed air often has an oxygen content that is significantly different from its label.

If the calibration is to be performed in software, bear in mind the following points.

1. The most common error is that the user attempts to span the system on an incorrect gas, often nitrogen. Some limitation must be made therefore in the permissible gain of the system so that this condition is detected. Typically the gain is allowed to vary no more than 25% between calibrations. However it is still possible for a calibration to be sufficiently in error that the system cannot be recalibrated again once it has been messed up. Therefore it must be possible to force a calibration no matter the apparent error.
2. The calibration routine should detect an excessive drift and delay calibration until the drift has stopped, or abort the process if no good reading can be obtained. This might happen because of an inadequate calibration gas flow, due perhaps to an empty cylinder.
3. If the sensor chosen has a time constant of 13 seconds, the calibration routine should allow at least 65 seconds for the reading to stabilize.
4. If the system performs an automatic calibration, some means of alerting the user to calibration failure must be made.

Maintenance and troubleshooting

Maintenance:

The AMI oxygen probe is virtually maintenance free other than for periodic calibration and occasional sensor replacement.

Sensor Replacement:

This should be done on a regular schedule, rather than as a response to a dead sensor. See the chart below for recommended sensor replacement.

Sensor	Part number	Description	Expected life
P2	4SEN03-1	0-50% oxygen - inert background	12-15 months
P3	4SEN04	0-25% oxygen – inert or CO2 background	9-12 months
P5	4SEN19	0-25% oxygen – H_2S resistance for 0-500ppm	9-12 months

Table 1. AMI sensor types

Sensor replacement cautions:

CAUTION: If using compressed air for cleaning, proper eye protection must be worn.

CAUTION: The sensor contains a caustic liquid. Do not allow this to come into contact with your skin. If it does, immediately flush the affected area with water for a period of at least 15 minutes. Refer to the Material Safety Data Sheet provided.

Dispose of leaking or used sensors in accordance with local regulations. Sensors usually contain lead which is toxic, and should generally not be thrown into ordinary trash. Refer to the MSDS to learn about potential hazards and corrective actions in case of any accident.

Figure 4. Inserting sensor in probe

Sensor replacement procedure:

The sensor is provided in a special sealed bag. Do not open this until you are totally ready to install the sensor.

Before installing sensor, turn ON power.

1. Unscrew the sensor unit cap.
2. Carefully remove old cell.
3. Inspect the sensor unit cavity, and if any sign of moisture clean it out with a Q tip or similar. Make sure that the contact springs inside the sensor unit are intact. Be careful not to snag them with the Q tip.
4. Carefully open the bag using a pair of scissors or a knife. Make sure you don't stab the sensor! Make sure that there is no sign of any liquid in the bag, if so do not proceed, you need a new sensor. Be careful that you don't poke anything such as a fingernail through the membrane.
5. Remove shorting clip. This may be found on the top of the sensor.
6. Slide the sensor into the sensor unit (gold plated contact side of sensor should be facing up touching the sensor unit contacts. The membrane side is covered by a convex gold plated mesh). Be careful not to touch the membrane while doing this - if the membrane is punctured the sensor must be replaced.
7. Carefully replace the cap, making sure that you do not cross thread it, and tighten firmly by hand. Do not over-tighten.
8. Allow the sensor to stabilize for a few minutes and then calibrate it preferably using known fresh air as the calibration gas.

Calibration:

For percent level analyzers, the sensor will stabilize within a few minutes, and it may be calibrated almost as soon as it has been installed.

1. Either expose the sensor unit to known good fresh air, or using a user-supplied valve, flow a known good span gas past the sensor.
2. If calibrating on air, adjust the system gain so that the reading on system display is 20.9%.
3. If using a calibration gas, read the value on the gas bottle label.
4. Adjust the system gain until the reading on the system display corresponds to the value on the gas bottle.

Periodic Calibration

You should calibrate as shown in the previous sections every 6 months until the expected end of life. At this point it is recommended that you replace the sensor, rather than try to eke the last few days of life from it. The sensor life typically ends when you run out of span adjustment.

Specifications and Disclaimer

Specifications:

Standard ranges:

Single range: 0 - 25% (optional: 0 – 1.0%, 0 – 2.5%, 0 – 50%, and 0 – 100%)

Sensitivity: 0.5% of full scale

Repeatability: +/- 0.1% of full scale at constant temperature

Operating temperature: 25°F to 115°F (-4°C to 46°C)

Humidity: < 85%, non-condensing

Operational conditions: Pollution degree 2, Installation category I I.

Drift: +/- 1% of full scale in 4 weeks at constant temperature (dependent on sensor)

Response times: 90% of full scale < 13 seconds

Outputs: 0-2.5V nominal (un-calibrated).

Power requirements: Between 12 and 24 VDC, <10 mA

Dimensions: 2.15 Dia x 2" high (not including fittings or leads).

Weight less than 1 lbs.

Disclaimer

Although every effort has been made to assure that the AMI analyzers meet all their performance specifications, AMI takes no responsibility for any losses incurred by reason of the failure of its analyzers or associated components. AMI's obligation is expressly limited to the analyzer itself.

In particular, the AMI analyzer is designed for operation with non-flammable samples in a general purpose, i.e. non-hazardous area. Any damage resulting from its use in a hazardous area or with flammable or explosive samples is expressly the responsibility of the user.

The AMI analyzer is not designed as a primary safety device, that is to say it is not to be used as the primary means of assuring personnel safety. In particular it is not designed to act as a medical instrument, monitoring breathing air for correct oxygen concentration, and should not be used as such when it is the only safety device on the gas system.

Material safety data sheets (MSDS)

Sensor type P3, P4, P5

Product Identification

Product name:	Oxygen sensor, class P3, P4, P5
Manufacturer:	Advanced Micro Instruments
Address:	
Phone:	(714) 848-5533
Date of last revision:	1/11/2013
Emergency phone number:	(714) 848-5533

Physical and chemical data

Composition:

The sensor body is made of metal and glass-epoxy GR4 circuit board material, with a Mylar covering.
It contains the following substances:

Common name	Formula	Concentration	CAS number
Acetic acid	$HC_2H_3O_2$	5% w/v	64-19-7
Potassium acetate	$KC_2H_3O_2$	5% w/v	4251-29-0
Lead	Pb	Pure	7439-92-1
(P5 only) Silver oxide	Ag2O	Pure	20667-12-3

Character of individual components:

Component	$HC_2H_3O_2$ (99%+)	Pb (pure)	$NaC_2H_3O_2$ (97%)	Ag_2O
Melting point/range	16.6°C	328°C	292°C	Decomposes 100°C
Boiling point/range	118°C	1744°C	N/A	N/A
Specific gravity	1.05	11.34	1.57	7.22
pH	N/A	N/A	N/A	N/A
Solubility in water	Infinite	Insoluble	72% @ 25°C	Very slightly soluble
Appearance and odor	Clear colorless solution with a strong vinegar-like odor	odorless gray metal	Odorless, large white melting crystal	Black powder
Flash point	40°C	N/A	N/A	N/A
Auto ignition temperature:	427°C	N/A	N/A	N/A

Physical hazards

Potential for fire and explosion:

The contents of the sensor are not flammable. There are no fire or explosion hazards associated with the sensor.

Potential for reactivity:

The sensor is stable under normal conditions of use. Avoid contact between the sensor electrolyte and strong acids and oxidizing agents.

Health hazard data

Primary route of entry:	Ingestion, eye/skin contact
Exposure limits:	OSHA PEL: 0.05 mg/cu. M. (Pb) ACGIH TLV: 0.15 mg/cu.m. (Pb) OSHA PEL: 10ppm (TWA) (Acetic acid) ACGIH TLV: 10ppm (TWA), 15 ppm (STEL) (Acetic acid)
Effect of overexposure: Ingestion:	The electrolyte could be harmful or fatal if swallowed Acetic acid Oral LD50 (RAT) = 3310 mg/kg Potassium acetate Oral LD50 (RAT) = 3.25 g/kg
Effect of overexposure: Eye:	The electrolyte is corrosive. Eye contact may lead to permanent loss of vision. Silver oxide is an irritant.
Effect of overexposure: Dermal:	The electrolyte is corrosive. Skin contact may lead to a chemical burn. Silver oxide is an irritant.
Effect of overexposure: Inhalation:	Unlikely, but avoid it anyway. Vapors are very irritating to eyes and nose.
Signs/symptoms of exposure:	Contact with skin or eyes will cause a burning sensation.
Medical conditions aggravated by exposure:	Persons with pre-existing skin disorders, eye conditions or impaired respiratory function may be more susceptible to these substances.
Carcinogenity:	IARC: lead is classified as a class 2B carcinogen - possibly carcinogenic to humans.
Other health hazards:	Lead is a chemical known to the State of California to cause birth defects or other reproductive harm. As the sensor is used, lead acetate is formed. Lead acetate is known to the State of California to cause cancer.

Emergency and first aid procedures

Eye contact:	Flush eyes with water for at least 15 minutes and get immediate medical attention.
Skin contact:	Wash affected area with plenty of water and remove contaminated clothing.
Ingestion:	Give plenty of cold water. Do not induce vomiting. Seek medical attention. Do not administer liquids to an unconscious person.
Inhalation:	Liquid inhalation is unlikely. If it occurs, move to fresh air and seek immediate medical attention.

Handling information

NOTE: Oxygen sensors are sealed and under normal circumstances their contents do not present a health hazard. The following information is given as a guide in the event of a leak.

Hygienic practices: Wash hands after handling
Protective clothing: Rubber gloves, chemical splash goggles.
Clean up procedures: Wipe down the area several times with a wet paper towel, using a fresh towel each time.
Protective measures during cell replacement: Before opening the bag containing the sensor, check the sensor for leakage. If any is found, do not open the bag. If there is liquid around the sensor installed in the instrument, put on gloves and eye protection before removing it.
Disposal: Must be in accordance with all applicable federal, state and local regulations.
EPA waste number: D008
California waste number: 181
DOT information: RQ Hazardous Waste Solid N.O.S. (lead), 9, UN3077, PG III

Advanced Micro Instruments. Inc. shall not be held liable for any damage arising out of using or abusing this product.

Sensor type P2

Product Identification

Product name: Oxygen sensor, class P2
Manufacturer: Advanced Micro Instruments
Address:
Phone: (714) 848-5533
Date of last revision: 11/08/2004
Emergency phone number: (714) 848-5533

Physical and chemical data

Composition:

The sensor body is made of metal and glass-epoxy GR4 circuit board material, with a Mylar covering.
It contains the following substances (other than various plastics):

Common name	Formula	Concentration	CAS number
Potassium hydroxide solution 15%	KOH	15%; 1-5ml	1310-58-3
Lead	Pb	pure, 3-20 g	7439-92-1

Character of individual components:

Component	*KOH (pure)*	*Pb (pure)*
Melting point/range	360°C	328°C
Boiling point/range	1320°C	1744°C
Specific gravity	2.04	11.34
pH	N/A	N/A
Solubility in water	Infinite	Insoluble
Appearance and odor	Odorless white or yellowish crystals	odorless gray metal

Fire and explosion hazard data

Flash point: **N/A** **Flammable limit** **N/A** **LEL:** **N/A** **UEL** **N/A**

Extinguishing media: No special agents recommended.

Special fire fighting equipment: Wear NIOSH/OSHA approved self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

Unusual fire and explosion hazards: Emits toxic fumes under fire conditions.

Reactivity data

Stability: Stable

Incompatibilities: Aluminum, organic materials, acid chlorides, acid anhydrides, magnesium, copper. Avoid contact with acids and hydrogen peroxide > 52%

Hazardous decomposition byproducts: Toxic fumes

Hazardous polymerization: Will not occur

Emergency and first aid procedures

Eye contact: Flush eyes with water for at least 15 minutes and get immediate medical attention.

Skin contact: Wash affected area with plenty of water and remove contaminated clothing.

Ingestion: Give large amounts of cold water. Do not induce vomiting. Seek medical attention. Do not administer liquids to an unconscious person.

Inhalation: Liquid inhalation is unlikely. If it occurs, remove to fresh air and seek immediate medical attention.

Health hazard data

Primary route of entry:	Ingestion, eye/skin contact
Exposure limits:	OSHA PEL: 0.05 mg/cu. M. (Pb) ACG1H: 0.15 mg/m^3 Pb; 2 mg/m^3 KOH
Effect of overexposure: Ingestion:	May be fatal if swallowed. The electrolyte will cause a burning sensation; the lead will lead to symptoms such as loss of sleep, loss of appetite, metallic taste and fatigue.
Effect of overexposure: Eye:	The electrolyte is corrosive: it will produce a burning, soapy sensation, irritation or severe chemical burns.
Effect of overexposure: Dermal:	The electrolyte will cause a soapy, slippery feel, and eventually a burning sensation. It may cause irritation and chemical burns.
Effect of overexposure: Inhalation:	Inhalation of the electrolyte will cause severe irritation and chemical burns.
Signs/symptoms of exposure:	The electrolyte is harmful if swallowed, inhaled or absorbed through the skin. It is extremely destructive to the mucous membranes, stomach, mouth, upper respiratory tract, eyes and skin. The lead will lead to symptoms such as loss of sleep, loss of appetite, metallic taste and fatigue.
Medical conditions aggravated by exposure:	Persons with pre-existing skin disorders, eye conditions or impaired respiratory function may be more susceptible to these substances. Lead exposure may aggravate disease of the blood and blood forming organs, hypertension, kidney damage, nervous and possibly reproductive damage.
Carcinogenity:	IARC: lead is classified as a class 2B carcinogen - possibly carcinogenic to humans.
Other health hazards:	Lead is a chemical known to the state of California to cause birth defects or other reproductive harm.

Handling information

NOTE: Oxygen sensors are sealed and under normal circumstances their contents do not present a health hazard. The following information is given as a guide in the event of a leak.

Hygienic practices: Wash hands after handling

Protective clothing: Rubber gloves, chemical splash goggles.

Clean up procedures: Wipe down the area several times with a wet paper towel, using a fresh towel each time.

Protective measures during cell replacement: Before opening the bag containing the sensor, check the sensor for leakage. If any is found, do not open the bag. If there is liquid around the sensor installed in the instrument, put on gloves and eye protection before removing it.

Disposal: Must be in accordance with all applicable federal, state and local regulations.
Both lead and potassium hydroxide are considered poisonous substances and are regulated under TSCA and SARA title III.

EPA waste number: D008

California waste number: 181

DOT information: RQ Hazardous Waste Solid N.O.S. (lead), 9, UN3077, PG III

NOTE: The above information is derived from the supplier's MSDS. This information is believed to be correct, but is not necessarily inclusive and should be used only as a guide. Advanced Micro Instruments shall not be held liable for any damage arising out of using or abusing this product.

AMI® WARRANTY & SUPPORT

LIMITED WARRANTY/DISCLAIMER

The warranty period is **TWO YEARS** for the Analyzer. Any failure of material or workmanship will be repaired free of charge for that specified period from the original purchase (shipping date) of the instrument. AMI will also pay for 1-way ground shipment back to the customer.

The warranty period for the electrochemical oxygen sensor is 6 months.

The warranty period for the electrochemical H_2S sensor is 6 months.

The warranty period for the zirconium oxide sensor is 2 years.

Any indication of abuse or tampering of the instrument will void the warranty.

Receiving the Analyzer
When you receive the instrument, check the package for evidence of damage and if any is found contact the shipper. Although every effort has been made to assure that the Analyzer meets all performance specifications, AMI takes no responsibility for any losses incurred by reason of the failure of this analyzer or associated components. AMI's obligation is expressly limited to the Analyzer itself.

EXCEPT FOR THE FOREGOING LIMITED WARRANTY, AMI MAKES NO WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, AS TO THE NON-INFRINGEMENT OF THIRD-PARTY RIGHTS, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE. IF APPICABLE LAW REQUIRES ANY WARRANTIES WITH RESPECT TO THE SYSTEM, ALL SUCH WARRANTIES ARE LIMITED IN DURATION TO TWO (2) YEARS FROM THE DATE OF DELIVERY.

LIMITATION OF LIABILITY

IN NO EVENT WILL AMI BE LIABLE TO YOU FOR ANY SPECIAL DAMAGES, INCLUDING ANY LOST PROFITS, LOST SAVINGS, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EVEN IF THE COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

LIMITATION OF REMEDIES

AMI's entire liability and your exclusive remedy under the Limited Warranty (see above) shall be the replacement of any Analyzer that is returned to the Company and does not meet the Company's Limited Warranty.