Patient Monitoring

MiniOX® IA
Oxygen Analyzer

Operation Manual/Service Guide

⚠ WARNING

THIS MANUAL MUST BE CAREFULLY READ AND FOLLOWED BY ALL PERSONS WHO USE OR MAINTAIN THIS PRODUCT, INCLUDING THOSE WHO HAVE ANY RESPONSIBILITY INVOLVING ITS SELECTION, APPLICATION, SERVICE OR REPAIR. THIS OXYGEN ANALYZER WILL PERFORM AS DESIGNED ONLY IF USED AND SERVICED ACCORDING TO THE INSTRUCTIONS; OTHERWISE, IT COULD FAIL TO PERFORM AS DESIGNED AND JEOPARDIZE PATIENT WELL-BEING.

The warranties made by Mine Safety Appliances Company with respect to the product are voided if the product is not installed, used and serviced in accordance with the instructions in this manual. Please protect yourself and your patients by following them. We encourage our customers to write or call regarding this equipment for any additional information relative to use or repairs.

Customer Service: 1-800-851-4500
Service Support: 1-800-672-4678 extension 8642 or (412) 776-8642

Manufactured by
MINE SAFETY APPLIANCES COMPANY
PITTSBURGH, PENNSYLVANIA, U.S.A. 15230

(L) REV 1 806129

MSA
Medical Instrument Warranty

MSA warrants to the ultimate purchaser of this product that the MiniOX 1A Analyzer will be free from mechanical defect or faulty workmanship for a period of one (1) year on the instrument and on the internal electrochemical oxygen cell, provided they are maintained and used in accordance with MSA's instructions. MSA shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own or authorized service personnel or if the warranty claim results from physical abuse or misuse of the product. No agent, employee or representative of MSA has any authority to bind MSA to any affirmation, representation or warranty concerning this product.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. MSA SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

Exclusive Remedy

By acceptance and use of this product, purchaser agrees that its sole and exclusive remedy for breach of the warranty set forth herein, shall be the repair and/or replacement (at MSA's option) of any equipment or parts thereof, which after examination by MSA is proven to be defective. Replacement equipment and/or parts will be provided at no cost to Purchaser, F.O.B. MSA's customer service facility. Failure of MSA to successfully repair any nonconforming product shall not cause the remedy established hereby to fail of its essential purpose.

Exclusion of Consequential Damages

PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT UNDER NO CIRCUMSTANCES WILL MSA BE LIABLE TO PURCHASER FOR ECONOMIC, SPECIAL, INCIDENTAL OR CONSEQUENTAL DAMAGES OR LOSSES OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS AND ANY OTHER LOSS CAUSED BY NONOPERATION OF THE GOODS. THIS EXCLUSION IS APPLICABLE TO CLAIMS FOR BREACH OF WARRANTY, TORTIOUS CONDUCT OR ANY OTHER CAUSE OF ACTION AGAINST MSA.

⚠ CAUTION

1. The MiniOX IA Oxygen Analyzer will perform to specifications only if it is used and serviced in accordance with the manufacturer's instructions. This instrument is to be used only by qualified, trained personnel who have carefully read the operating manual and labels and who have observed the information set forth. If this instrument does not perform as described in this manual, the instrument must not be used until the condition is rectified.

2. The MiniOX IA Oxygen Analyzer should be calibrated prior to each use. A two point calibration check should be performed weekly. See Section 3, *Operation*. If the instrument can not be calibrated, the sensor must be replaced. If the instrument still is unable to be calibrated, the instrument must be serviced.

3. Use of devices generating or emitting electromagnetic radiation near the MiniOX 1A Oxygen Analyzer may interfere with the proper operation of the product, causing it to fail to perform as designed. Particularly, the electromagnetic radiation from the interfering device may cause the product to display incorrect/erratic values or to stop operating. Special attention should be paid to the patient if this occurs.

4. The MiniOX IA Oxygen Analyzer must never be immersed in any cleaning solution, autoclaved, or exposed to high temperatures.

5. The sensor is a sealed unit containing a potassium hydroxide electrolyte. If the sensor should develop a leak, dispose of it immediately, as the sensor contains caustic material. It must be disposed of in accordance with all applicable federal, state, and local regulations. Should contact occur with skin or clothing, rinse area immediately with large quantities of water. In case of eye contact, immediately flush eyes with water for at least 15 minutes, holding eyes open. Call a physician.

6. The oxygen sensor has a minimal response to certain gases other than oxygen. Be aware of these gases and their interference levels. See Section 5, *Performance Specifications*.

7. The oxygen sensor is affected by changes in barometric pressure. Refer to Section 3, *Effects of Pressure,* for the effects of pressure.

8. Never operate the MiniOX IA Oxygen Analyzer if it is suspected that water or other liquids have entered into the case. If this occurs, immediately turn unit OFF and contact your nearest MSA Service Center for additional information.

Table of Contents

Section 1
Introduction

The MiniOX IA Oxygen Analyzer is designed to provide spot checking of oxygen concentrations from pressure swing absorptive devices (e.g. oxygen concentrators).

⚠ CAUTION

This instrument is not equipped with an audible or visual alarm, and is therefore must not be used in a life-support system.

The MiniOX IA Oxygen Analyzer (FIGURE 1-1):

Operates by a single push of a switch.

Calibrates with the turn of a dial.

Features an easy-to-read digital display.

The galvanic oxygen sensor measures oxygen concentrations from 0 to 100%. The sensor is maintenance-free and will operate one year, in normal medical use.

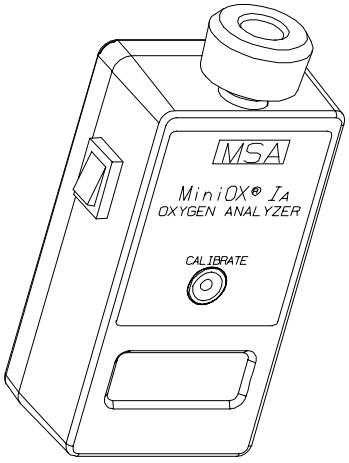

Figure 1-1.
MiniOX IA Oxygen Analyzer.

Section 2
Principle of Operation

Each MiniOX IA Oxygen Analyzer uses a galvanic oxygen sensor which is long-lived and maintenance-free.

The sensor consists of two electrodes:

a cathode

an anode.

The gold cathode is exposed to the atmosphere through a fluoropolymer membrane. The lead anode is submersed in a potassium hydroxide solution.

When oxygen diffuses through the membrane, the electrochemical reduction of oxygen on the cathode and the corresponding oxidation of the anode generate an electrical current. The current produced is proportional to the partial pressure of oxygen in the sample atmosphere. The resulting electrical current is monitored, temperature compensated, and amplified to drive the display.

The sensor is self-zeroing; when no oxygen is present to be chemically reduced, minimal current is produced. Thus, approximately zero percent oxygen is displayed.

Section 3
Operation

Set-up Procedures

1. Remove the contents from the shipping carton and verify that you have one each of the following items:

   MiniOX IA Oxygen Analyzer

   9-Volt Alkaline Battery

   Oxygen Sensor in its container

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2. Remove the sensor from its container.
3. Remove the four screws holding the back panel in place.
4. Install the battery.
5. Screw the sensor into the flow block and hand-tighten; DO NOT OVERTIGHTEN OR CROSS THREAD.
6. Plug the sensor connector into the printed circuit board connector mate labelled **J1**.
7. Replace the back panel and screws.
8. Proceed to *Calibration* procedures.

Calibration

The most accurate method to calibrate the MiniOX IA Oxygen Analyzer is with 100% oxygen. Calibrating with room air, is less desirable, but still acceptable, assuming the concentration of oxygen in room air is 20.8%.

1. Press the ON/OFF switch on the side panel to turn on the instrument.
2. Place the sensor in a flow of air with a known oxygen concentration or in room air.
3. Wait for a least one minute, or until the reading has stabilized.
4. If the reading on the display is other than the known or assumed oxygen concentration, adjust the reading using the calibration dial. Turn clockwise to increase the reading, or counter clockwise to decrease the reading.
5. If the reading cannot be adjusted to the known concentration value, the sensor or instrument is malfunctioning and must be serviced.

NOTE: To ensure accurate operation, the instrument should be calibrated at the flow rate of intended use.

Two-point Calibration Check

The purpose of a two-point check is to determine the linearity of the sensor. Serious deviation from linearity (> ±2%) indicates the sensor is nearing end-of-life. To perform a two-point linearity check:

1. Place the sensor in a stream of a known oxygen concentration between 90-100% until the reading stabilizes.
2. Calibrate to match this concentration.
3. After calibration, measure room air; the reading should be 20.8% ±2%. (A ±2% linearity variation is allowed for differences due to the method of sample introduction, the accuracy of gas concentration, and the precision of initial setting.) If the variation is greater than 2%, repeat the two-point linearity check. If the variation remains greater than 2%, replace the sensor.

Instrument Operation

The MiniOX IA Oxygen Analyzer has a low battery indicator. When the Low Battery indicator is activated, **LO BAT** appears on the top left of the display. The instrument functions normally for approximately eight hours; however, replace the battery as soon as possible.

If the battery is not replaced, the instrument's display will go blank.

If the sensor becomes disconnected while the instrument is in use, the instrument displays between -0.2 and +0.2.

The instrument is designed to read in percent from 0 to 100%; however, if incorrectly calibrated, it displays up to 199.

To maximize battery life, turn OFF the MiniOX IA Oxygen Analyzer when not in use.

Instructions for Use

Installation (FIGURE 3-1)

1. If so equipped, remove the humidifier from the oxygen concentrator.

2. If the concentrator is equipped with a male DISS fitting, thread the female DISS fitting of the MiniOX IA analyzer onto it and proceed to Step 5.

3. If the concentrator is equipped with a nipple adapter, thread the provided male universal nipple adapter into the female DISS fitting of the MiniOX IA analyzer and proceed to Step 4.

4. Connect the nipple adapter on the MiniOX IA analyzer to the nipple adapter on the concentrator using the oxygen tubing provided.

5. Analyze the oxygen concentration, ensuring that the flow rate does not exceed four liters-per-minute.

6. When the oxygen analysis is complete, remove the sampling apparatus and reinstall the humidifier, if so configured.

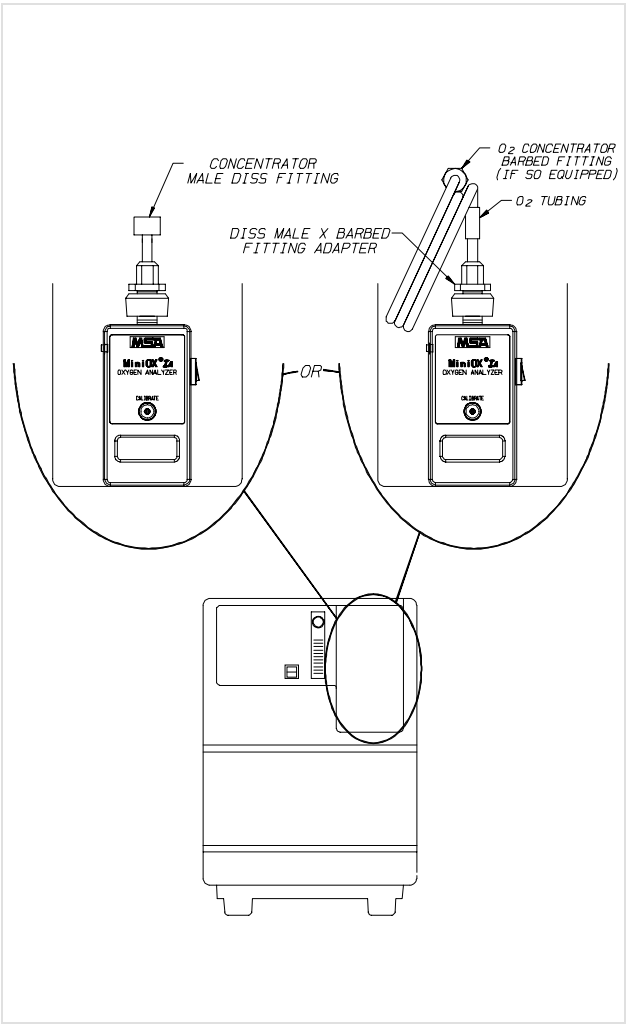

Figure 3-1.
MiniOX IA Installation

Sensor Operation

The oxygen sensor has a minimal response to certain gases other than oxygen. Be aware of these gasses and their interference levels. See Section 5, *Interferent Gases and Vapors.*

The sensor is a sealed unit containing a potassium hydroxide electrolyte.

⚠ CAUTION

If the sensor develops a leak, dispose of it immediately as sensor contains caustic material; it must be disposed of in accordance with all applicable federal, state and local regulations.

⚠ CAUTION

Should contact occur with skin or clothing, rinse area with large quantities of water. In case of eye contact, immediately flush eyes with water for a least 15 minutes, holding eyes open. Call a physician.

Effects of Pressure, Humidity and Temperature

⚠ CAUTION

To ensure accurate and reliable oxygen analysis, a thorough understanding of the effects of pressure, humidity, and temperature on the sensor is necessary.

Effects of Pressure

The sensor actually senses partial pressure of oxygen, not percentage. Changes in barometric pressure change the reading, even if the percent of oxygen in the sample remains constant.

Partial pressure of oxygen (PO_2) equals the percent of oxygen ($\%O_2$) times (x) the pressure at which the sample is measured (mmHg-mercury):

$$PO_2 = (\%O_2)\ (mmHg)$$

For example:

At sea level the pressure equals 760 mmHg and dry air contains 21% O_2. Therefore;

$$PO_2 = (21\%)\ (760\ mmHg)$$
$$PO_2 = 160\ mmHg$$

If the instrument is calibrated to read 21% at 160 mmHg partial pressure, and the instrument is then moved to an area above sea level where the atmospheric pressure is 700 mmHg, a lower reading is found due to a lower partial pressure.

$$PO_2 = (21\%)\ (700\ mmHg)$$
$$PO_2 = 147\ mmHg$$

The percent reading on the instrument is derived by the following formula:

$$X = \frac{(21\%)\ (147\ mmHg)}{(160\ mmHg)} = 19.3\%$$

Therefore, to eliminate error caused by pressure changes, the instrument must be calibrated at the pressure and flow rate at which it is to be used.

⚠ CAUTION

Do not expose the sensor to pressure outside the range of 600 to 900 mmHg, (23.62 to 35.43 inches Hg.)

Effects of Humidity

The presence of humidity in an oxygen sample decreases the actual concentration of oxygen. Humidity in a sample has the same effects as diluting the sample with another gas.

For example:

If 100% oxygen is saturated with 100% humidity, the actual concentration of oxygen drops from 100% to 96-97%. The instrument indicates this drop in concentration.

Effects of Temperature

Each MiniOX IA sensor is desensitized to temperature changes using a thermistor (temperature variable resistor) located within the sensor. Variations in the sensor reading due to temperature changes, are less than 3% when used or calibrated between 0 to 40 degrees centigrade. By using the instrument close to the temperature at which it is calibrated, variations can be minimized.

⚠ CAUTION

Do not handle the sensor more than necessary during calibration or use. Body heat can cause the sensor's thermistor to change disproportional to the change in gas sample temperature at the sensing electrode. This can produce some error, until thermal equilibrium is restored.

Section 4
Maintenance and Care

⚠ WARNING

Use only genuine MSA replacement parts when performing any maintenance procedures provided in this manual. Failure to do so may seriously impair the instrument's performance. Repair or alteration of the MiniOX IA Oxygen Analyzer beyond the scope of these maintenance instructions could cause the product to fail to perform as designed and may jeopardize patient well-being.

This section is designed to lead qualified technicians through the general maintenance, care and repair of the MiniOX IA Oxygen Analyzer.

⚠ CAUTION

Repair should only be made by a qualified technician familiar with electronic devices. Servicing performed by others may result in the warranty being voided. This section should be used in conjunction with the operating instructions of this manual. The technician should be thoroughly familiar with the principle of operation and operating procedure for this instrument.

Equipment Required

The following tools are needed to perform the maintenance and care procedures described in this section:

Square blade screwdriver - 3/32" blade

5/16" nut driver

3/16" hex wrench

1/2" nut driver

Desoldering tool

Soldering iron, 25-40 watts, with a fine point

Solder (Rosin core)

Grounded workstation

Grounded wrist-strap.

⚠ CAUTION

Technicians should use a grounded workstation and be grounded by a wrist strap when disassembling and reassembling instruments to prevent damage from electrostatic discharge (ESD) to the printed circuit boards.

Battery Replacement

The MiniOX IA Oxygen Analyzer requires one 9-volt alkaline battery. To replace the battery:

1. Verify the instrument is turned OFF. If it is ON, press the ON/OFF switch on the side panel to turn the instrument OFF.
2. Remove the back panel, which is held in place by four small screws.
3. Remove and discard the old battery; replace with a new battery.
4. Replace the back panel and reinstall the screws.
5. Wait 10 seconds after connecting the new battery before turning the instrument ON.
6. **Recalibrate the instrument.** See Section 3, *Calibration.*

Sensor Replacement

When the MiniOX IA Oxygen Analyzer is unable to be calibrated, or gives erratic readings, the sensor must be replaced. To replace the sensor:

1. Verify the instrument is turned OFF. If it is ON, press the ON/OFF switch on the side panel to turn the instrument OFF.
2. Remove the old sensor by unthreading the sensor from the flow block.
3. Thread the new sensor into the flow block and hand-tighten.

⚠ CAUTION

Do not overtighten or cross thread.

4. **Recalibrate the instrument.** See Section 3, *Calibration.*

⚠ CAUTION

The sensor must never be immersed in any cleaning solution, autoclaved, or exposed to high temperatures.

Instrument Disassembly

To disassemble the MiniOX IA Oxygen Analyzer, perform the following steps to the extent necessary for replacing the desired part (FIGURE 4-1 and TABLE 4-1).

1. Remove the back cover by removing the four screws.
2. Remove the battery.
3. Remove the four screws that secure the circuit board in place.
4. Lift the circuit board out of the case.
5. Remove the label from the front of the instrument.
6. Remove the DISS fitting from the flow block using the 3/16" hex wrench.
7. Remove the flow block by removing the four flow block mounting screws located underneath the label. Remove the flow block from the instrument.
8. If it is necessary to replace the LCD, gently remove the LCDs pins from the holder and replace the LCD (P/N 637419), taking care not to damage or bend the pins. Note the location and orientation of the LCD position on the printed circuit board.
9. The instrument is now disassembled.

   NOTE: Reassemble in reverse order.

Calibration Potentiometer Replacement

To replace the CALIBRATION potentiometer:

1. Disassemble the instrument as described in *Instrument Disassembly*.
2. Using a desoldering tool and a soldering iron, desolder the three (3) leads that connect the CALIBRATION potentiometer to the circuit board.

Table 4-1. Parts List
(Refers to FIGURE 4-1)

ITEM NO.	DESCRIPTION
1	Case
2	Instrument Cover
3	Flow Block
4	Calibration Knob
5	Printed Circuit Board Assembly
6	Gasket, Calibration Knob
7	Flow Block Mounting Screws, (4) #2 x 5/16" Long
8	Cover Screws, (4) 4-40 x 3/8" Long
9	Power Switch
10	DISS Fitting
11	Front Label
12	Rear Label

3. Place the circuit board so the component side of the Printed Circuit Assembly faces up.
4. Remove the locknut from the CALIBRATION potentiometer using a 1/2" nut driver.
5. Replace the CALIBRATION potentiometer.
6. Insert the calibration post through the hole in the circuit board.
7. Replace the lock nut using a 1/2" nut driver.
8. Using a solder iron, solder the three (3) leads back to the appropriate connections on the printed circuit board.

   NOTE: Reassemble instrument in reverse order.

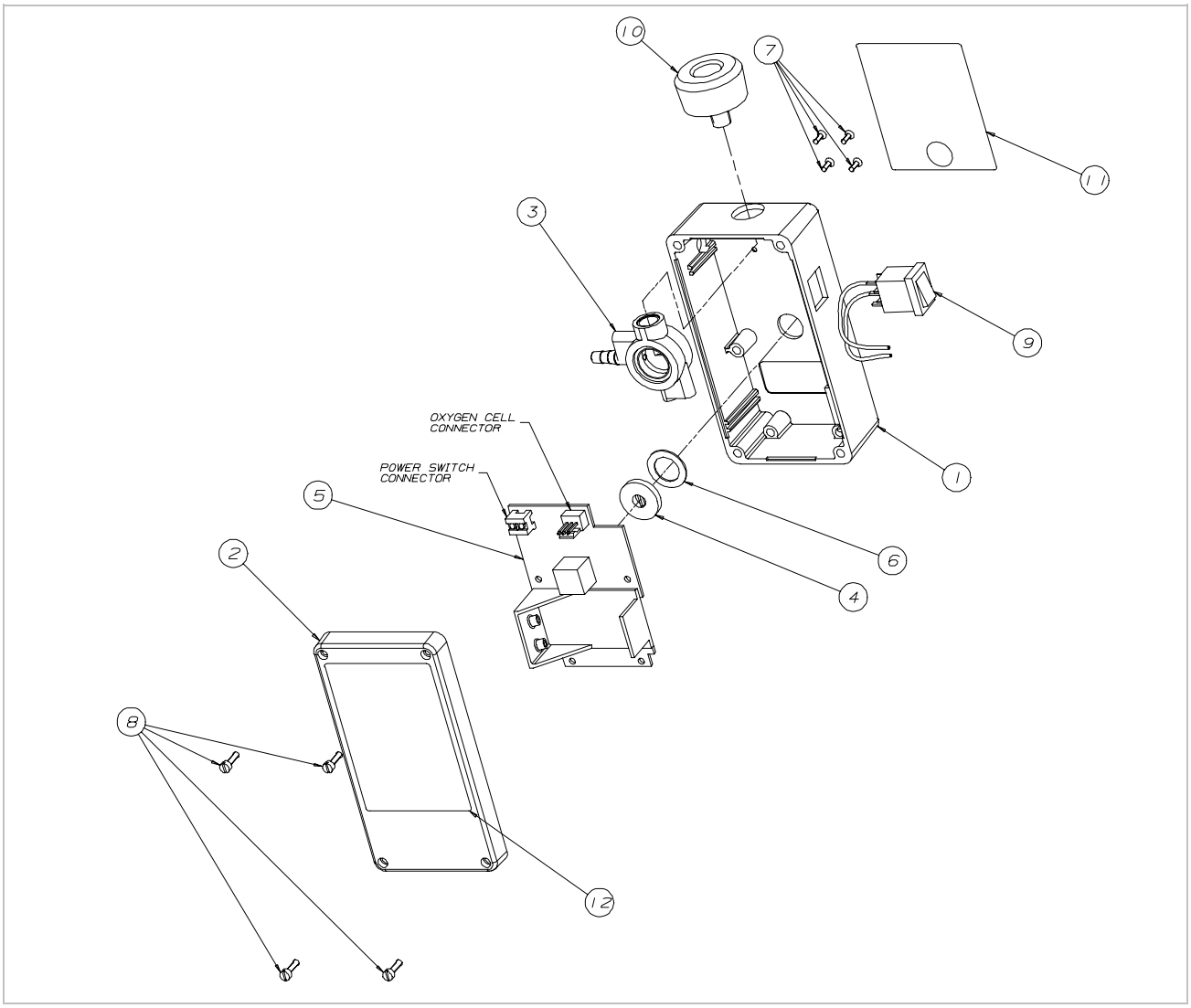

Figure 4-1.
MiniOX IA Oxygen Analyzer Exploded Assembly

Section 5
Specifications

Performance Specifications			
Range	0-100% O_2		
Display Resolution	0.1% O_2 increments		
Linearity	±2% of full scale		
Accuracy	±2% of full scale		
Low Battery Indicator	"LO BAT" appears on the display.		
Warm-up Time	None required		
Operating Temperature Range	0° to 40°C (32° to 104°F)		
Storage Temperature Range	-20° to 55°C (-4° to 131°F)		
Humidity	0 to 95% RH (non-condensing)		
Power Requirements	One 9-volt alkaline battery		
Battery Life	Approximately 1,400 hours		
Instrument Dimensions	5-11/16" x 2-1/2" x 1-3/4"		
Instrument Weight	11 oz.		
Sensor Type	Galvanic fuel sensor 0-100% O_2		
Sensor Life	One year in normal medical conditions.		
Sensor Shelf Life	Sensors, as shipped, can be stored for a maximum of 6 months without degradation of life.		
Response Time Measured @ 25°C	**FLOW RATE LITERS/MIN.**	**90% OF CHANGE (IN SECONDS)**	**97% OF CHANGE (IN SECONDS)**
	2	14	22
	4	13	21
	6	12	20

Interferent Gases and Vapors		
INTERFERENT	**% BY VOLUME (DRY GAS)**	**INTERFERENT EQUIVALENT OF PERCENT O_2**
Carbon Dioxide	12%	<0.1%
Cyclopropane	50%	<0.1%
Diethyl Ether	20%	<1.5%
Enflurane	4%	<0.5%
Halothane	5%	<0.9%

Interferent Gases and Vapors		
INTERFERENT	**% BY VOLUME (DRY GAS)**	**INTERFERENT EQUIVALENT OF PERCENT O_2**
Helium	80%	<0.2%
Methoxyflurane	4%	<2.3%
Nitrogen	80%	<0.2%
Nitrous Oxide	80%	<0.8%

Instrument Replacement Parts	
DESCRIPTION	**PART NO.**
Back Cover	806264
Battery Retainer	637943
Calibration Knob	473036
Case, Instrument	806136
Case Screw	637408
DISS Fitting	637281
Flow Block	806265
Flow Block Mounting Screw	637355
Gasket, Calibration Knob	473048
Label (O_2% Oxygen)	473051
Label (MiniOX IA Nomenclature)	804175
Lens Plate	807918
Liquid Crystal Display (LCD)	637419
Potentiometer	637302
Power Switch	637248
Rear Label	804176
Alkaline Battery, 9-Volt	637412
Operating/Maintenance Manual	806129
Oxygen Sensor	806572
MiniOX IA Unit	804174
Oxygen Tubing	637258
Adapter DISS	638064
Physician Label	812969