ISO$_2$

Isolated dissolved oxygen meter and oxygen electrode

www.wpiinc.com

INSTRUCTION MANUAL

Serial No.______________________

Important Notice:
Before using the ISO$_2$ dissolved oxygen meter for the first time, connect the probe and apply power to the instrument overnight before use.

The OXELP oxygen probe is specifically designed to be used with WPI's ISO$_2$ dissolved oxygen meter. Users who wish to employ OXELP with other instruments should see Fig. 2, page 7 for plug information.

World Precision Instruments

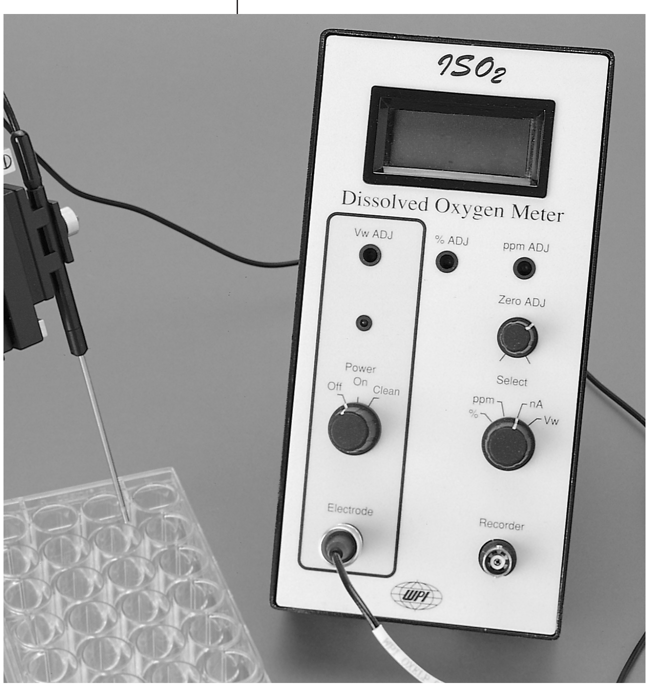
Contents

Copyright © 2001 by World Precision Instruments, Inc. All rights reserved. No part of this publication may be reproduced or translated into any language, in any form, without prior written permission of World Precision Instruments, Inc.

Introduction

ISO_2 and its associated OXELP probe provide accurate, stable and electrically isolated oxygen measurements. The recorder output is not electrically connected to the OXELP electrode circuitry. This offers the important advantage that other electrodes may be used in the same sample as the OXELP without interfering with one another, and background noise is greatly reduced. With a probe tip diameter of just 2 mm and low oxygen consumption, **ISO_2** and its associated probe excel in making measurements in small sample volumes. Other features include a fast response time and a sturdy stainless steel probe body.

The instrument amperometrically measures the concentration of oxygen in aqueous solutions and gas mixtures. Measurements can be displayed either as a percentage of atmospheric pressure, parts per million (ppm), or as a redox current in nanoamperes (nA). The oxygen probe houses a platinum working electrode and a silver counter/reference electrode inside a stainless steel sleeve. A gas permeable polymer membrane fits over the end of the sleeve which allows oxygen to pass while blocking liquids, ions and particulate matter. Oxygen diffuses through the membrane and is reduced at the platinum cathode which is held at -0.7 V when the instrument is on. This results in an electrical current being generated, the magnitude of which is determined by the rate of diffusion to the electrode which is proportional to the partial pressure of oxygen outside the membrane. Thus the current serves as a measure of the partial pressure of oxygen.



ISO_2 comes ready to use. All the user must do is attach the oxel probe to the meter, turn the power on and wait for the current to decay to a stable value. This usually takes a couple of hours. The current can be monitored by setting the **ISO_2** to the nA setting. Once the current stabilizes the user may then calibrate the instrument.

Calibration

For accurate results the sensor probe should be calibrated as closely as is possible to the temperature and medium at which the measurement is to be made (if measurements are in gas, calibrate in gas).

Polarization

The OXELP probe should always remain connected to the **ISO_2**. When the ISO2 is turned off a potential of -0.2 V is applied to the platinum working electrode. This is done so as to minimize the time required for the current to decay when the instrument is turned on and a potential of -0.7 V is applied to the working electrode. The user can determine whether or not the correct potential is being applied to the working electrode when the instrument is on by placing the instrument in the Vw setting. The LCD display will then show the potential being applied. If the potential is not -0.7 V then the user may change the potential to the correct value by using a small screw driver to adjust the Vw ADJ screw on the front panel of the instrument.

The probe current will at first be high, but it then falls,and settles to a stable value after a period of time usually not in excess of two hours. Once the current does stabilize one then proceeds to calibrate the instrument.

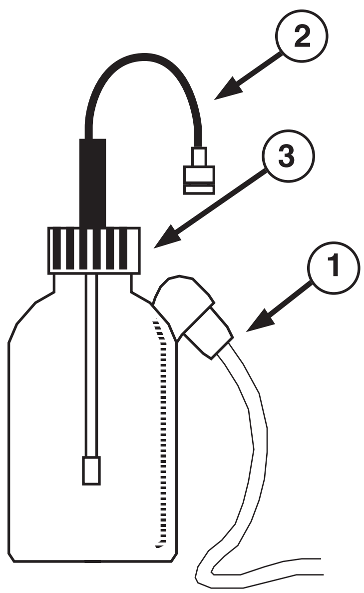


Fig. 1

Zero (oxygen) Point Calibration

After polarization of the OXELP probe as described above, a calibration for zero oxygen may be carried out in pure nitrogen gas or in water saturated with nitrogen. With stirring, the complete saturation of water with nitrogen may take more than ten minutes. Calibration in pure nitrogen gas is much faster and generally considered more reliable. A plastic calibration bottle (Fig.1) is supplied with the utility kit. Connect a plastic tube (1) from the side tube to a pure nitrogen gas source at a low pressure (less than 5 psi) and purge the bottle with nitrogen gas. Insert the OXELP probe (2) into the bottle through the top vent hole on the bottle cap (3). The current should be observed to drop rapidly (a few seconds) to a value of zero nA. If the current value is not zero use the Zero ADJ knob to get a zero reading. This procedure to obtain a zero reading may be done on any scale setting (nA, ppm, %). Do not rotate the zero adjust knob after the zero calibration has been done.

Scale Factor Adjustment

After the instrument has been zeroed, the user must adjust the scale factor according to whether or not the intended measurements are to be made in the gas phase or aqueous medium.

Gas Phase Measurements

Probe calibration for gas phase measurements can be accomplished using the calibration bottle,as described above for zeroing the instrument with nitrogen, using a tank of known oxygen composition, for example 100 % O_2.

Turn the Select knob to %. With the bottle purged with nitrogen the display should read 0. With the bottle purged with oxygen the display should read 100. If the display does not show the correct value, use a small screwdriver to adjust the % adjustment screw so that the meter reads 100%.

Alternatively, air can be used as the calibration standard but since water vapor does affect the probe reading it is best to use dry air unless the ambient humidity is accurately known. Dry air can be obtained by passing room air through a column containing a solid drying agent such as silica gel or calcium chloride and then into the calibration bottle for calibration. Turn the Select knob to %. The display should read 21. If not, use a small screwdriver to adjust the % adjustment screw so that the meter reads 21. If ambient air is used to calibrate at 21 %, ambient humidity may cause a calibration error of as much as 1% O_2. The user may judge if this is acceptable.

The physical interpretation of the % reading of the **ISO$_2$** is the percentage of atmospheric pressure that the oxygen present exerts. For example in a 100% oxygen environment the display will read 100 which means that the partial pressure of oxygen is 1 atm (760 mm Hg). If the display reads 21, then this means that the partial pressure of oxygen is 0.21 atm (160 mm Hg).

Aqueous measurements

For aqueous calibration, fill the calibration bottle with distilled water to approximately two thirds of its full volume. Immerse the probe tip into the water via the top hole. Aerate, for a few minutes, by bubbling air through the side arm of the bottle at a low pressure using a simple aquarium aeration pump. Turn the Select knob to %. The scale reading should be allowed to settle to a stable reading. Dissolved oxygen calibration is corrected for the effect of water vapor by the following equations :

$$\textbf{(1)}\ pO_2 = 21\% \times (1 - pH_2O)$$

or

$$\textbf{(2)}\ pO_2 = 21\% \times (1 - p'H_2O/760)$$

where pH_2O and $p'H_2O$ are the partial pressure of water vapor at standard atmospheric pressure in atmospheres and in mm Hg, respectively (see Table 3).

For example, the pH_2O in water- saturated air at 24 deg is 22 mm Hg. Therefore the $pO_2 = 21\% \times (1 - 22/760) = 20.4\ \%$. Note that for purposes of oxygen measurements liquid water is considered to be "water-saturated air". The display should thus read 20.4%. If it does not, use a screwdriver to adjust the % adjustment screw so that the meter reads the correct calibration value. The values of water vapor pressures at different temperatures can be found in Table 3.

To measure dissolved oxygen in parts per million (ppm), switch the select knob to ppm. Refer to Table 1a. This table gives the solubility of oxygen in water at different temperatures at an ambient pressure of 1 atm. If the solution temperature is 25°C, for example, the proper oxygen reading when the probe is in water should be 8.4 ppm. If the display does not show this value, adjust the ppm screw with a screwdriver so that the meter displays the correct value. You do not need to correct for the water-vapor effect for a ppm calibration since the values in Table 1a are obtained in "water-saturated air" at an atmospheric pressure of 760 mm Hg.

The unit ppm is equivalent to mg/l. This is illustrated as follows. The solubility of oxygen in water at 0 deg according to the Merck index is 4.889 mL per 100 mL. Using the ideal gas law we can calculate the number of moles of oxygen present in 100 mL :

$$PV = nRT$$

$$n = P \times V/R^{*}T$$

$$n = (0.21) \times (4.889\text{x}10^{-3}) / (0.08206) \times (273)$$

$$n = 45.8 \times 10^{-6}\ \text{moles}$$

Where P is the partial pressure of oxygen, V is the volume of oxygen, n is the number of moles of oxygen, R is the universal gas constant, and T is the absolute temperature. From the number of moles of oxygen we can calculate the number of grams of oxygen :

$$45.8 \times 10^{-6} \text{ mol} \times 32 \text{ g / mol}$$

$$1.46 \times 10\text{-}3 \text{ g}$$

Therefore there will be (1.46 x 10-3 g / 0.1 L) 14.6 mg of oxygen per liter. Since 1 L of water has a mass of 1000 g, and there are 1 million mg in 1000 g, the concentration in ppm shall be:

$$(14.6 \times 10\text{-}3 \text{ g/L}) / (1000 \text{ g/L}) = 14.6 \text{ ppm}$$

Note that this value corresponds to that given in Table 1a.

For accurate results the temperature of the water sample and the fluid being tested should be identical. They should be continuously stirred using a magnetic stirrer. Redox current can be measured by switching the Select switch to nA.

When measuring fluid samples for dissolved oxygen, periodically rinse the exterior of the probe with distilled water, blot the membrane dry and recheck the electrode's calibration as described above.

Calibration Method for O_2 Measurements in Living Tissue or Blood

The **ISO$_2$** meter and OXELP probe may be used extensively in applications involving O_2 measurements *in vitro* or *in vivo* in living tissue or fluids such as blood. You may still use the calibration procedure in this manual for these measurements since a membrane-covered amperometric oxygen electrode will always measure oxygen activity, not concentration. Although it is normal to think in terms of dissolved oxygen concentration, it is actually more appropriate to define oxygen in solution in terms of activity, since this is the "effective concentration". For example, in distilled water the activity coefficient, γ_C, is close to unity; but in solutions with high salt concentration the activity coefficient is different from unity and concentration and activity of dissolved oxygen are no longer equal, the concentration falling while activity remains constant. For a membrane-covered oxygen electrode this is an important effect since an oxygen detector only responds to the difference in activity across the membrane rather than the concentration difference. So in samples containing an electrolyte, while the oxygen concentration falls with increasing salt concentration the probe current remains constant.

Thus, if it is necessary to have a measure of dissolved oxygen in terms of concentration, then the calibration is somewhat more complicated since the relationship between activity and concentration may change with the change of salt concentration in the samples. The activity coefficient, a ratio of the activity to the concentration, generally cannot be predicted and one must rely on empirical determinations since the compositions of living fluids such as blood are extremly complicated. One may directly use the fluid to be tested as a "solvent" to prepare a calibration stantard. Alternatively, one may use the Bunsen absorption coefficient, a, to calculate oxygen concentration in blood in terms of the results with the oxygen electrode. The equation is:

$$C = \frac{\alpha}{\text{molar volume} \times K} \times (p_t - p_{H_2O}) \times p_{O_2}$$

where **K** is a conversion factor depending on the unit of pressure chosen (1 for atm), $\mathbf{p_t}$ and $\mathbf{p_{H_2O}}$ are the total pressure of gas and the partial pressures of water, respectively. $\mathbf{p_{O_2}}$ is the partial pressure of oxygen in blood obtained from the measurements with the oxygen electrode. Bunsen Coefficients for solubility of oxygen in plasma and blood can be found in Table 4. However, it is very important to calibrate at the same temperature as that of the measurement site.

Probe Structure and Assembly

Fig. 2 shows the principal components of an OXELP probe. A gas permeable membrane (3) is cemented to the tip of the outer stainless steel sleeve (1). The interior of the probe is a slender wand containing the platinum cathode and silver counter / reference electrode inside the sleeve. The wand is permanently mounted in the probe's plastic handle (2). After electrolyte has been deposited inside the sleeve (see below), the wand is slowly inserted into the sleeve and secured by screwing the sleeve cap (4) gently into the probe handle. If the membrane on the stainless steel sleeve becomes damaged, the entire sleeve must be replaced. Two spare sleeves are provided with the ISO2 kit, and the user may purchase more. Should the user wish to sterilize the probe this should be done with alchohol or some other chemical for an assembled probe. The membrane sleeves can be autoclaved seperately from the probe should the user desire to do this and then place the sterilized membrane sleeve onto the probe.

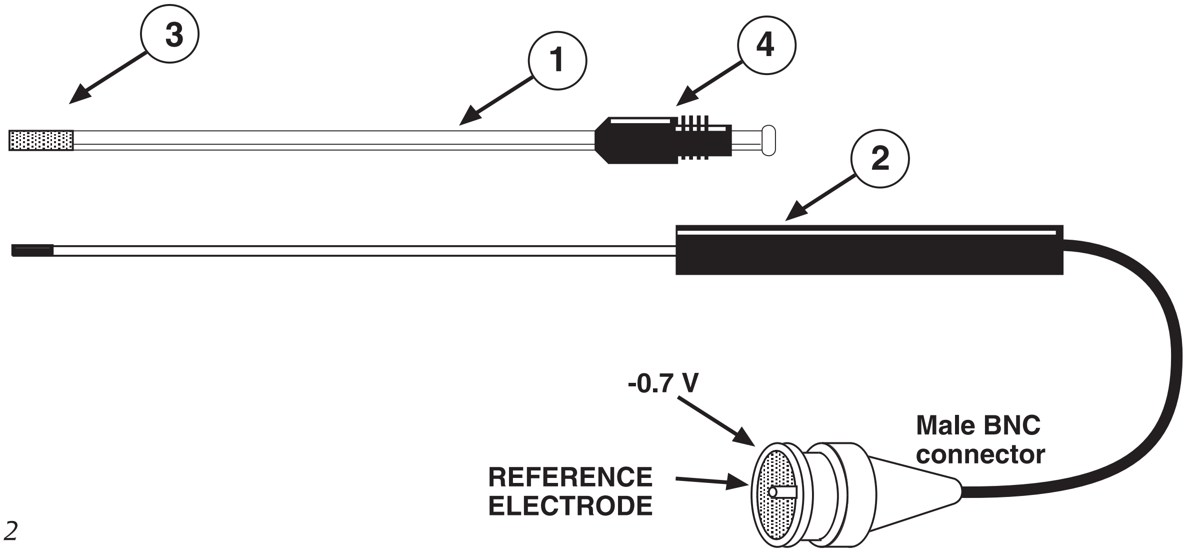


Fig. 2

Changing the Membrane Sleeve

Membrane sleeves need to be replaced occassionally. This can be due to the membrane breaking, or the electrolyte drying out. To change the membrane sleeve simply unscrew it from the handle and slide it off of the probe. Rinse the electrodes with some distilled water and wipe them dry with a sof tissue. Remove the plastic screw cap from the sleeve and slide it onto one of the new replacement sleeves. Using the plastic syringe and filling solution supplied in the start up kit, fill the sleeve with filling solution. This is done by slowly inserting the filling syringe into the sleeve, bringing the tip of the syringe needle as close as possible to the membrane. Gently inject the filling solution from the syringe, then slowly withdraw the syringe. Be particularly careful not to puncture or damage the probe tip membrane. Insert the electrode into the sleeve slowly and gently screw the sleeve onto the handle. You should observe the electrode extending slightly out of the sleeve and pushing against the membrane. Wipe off any excess filling solution. This procedure should result in the capture of a very thin layer of filling solution between the membrane and the end of the probe tip.

At first the current will be high and unstable. Leaving the instrument on the current should decay to a stable value within two hours. At this point the instrument can be calibrated.

Cleaning the Electrode Surface

The reduction of oxygen causes a decrease in the surface activity of the working electrode which will gradually over time "poison" it. This poisoning reduces the redox current from the reduction of oxygen. In order for the **ISO_2** to function properly the minimum current required at room temperature and 21% oxygen (air) is 15 nA. Should the reduction current drop below this value then the instrument will no longer function properly.

It is possible however to maximize the life of the electrode by making sure that the power is turned off when the instrument is not in use (the probe should however remain connected to the meter). If the electrode is not to be used for an extended period of time then refer to the section on storage for proper storage instructions.

Once the reduction current does drop below 15 nA, there is a CLEAN function which may be used to reverse some of the damage and restore activity so that the electrode can continue to be used. This is done by switching the power knob to the CLEAN setting. When this is done the potential applied to the platinum electrode is changed to +0.9 V. This causes changes to occur to the surface which help to restore the electrode activity. The user should leave the instrument on this setting for a period of 30 minutes. Note that the LCD display output in this setting is meaningless and should be ignored. After the thirty minutes have elapsed, turn the instrument off and leave it off for a period of time not less than 1 hour, after which use the instrument as you normally would. Note that it may be necessary to experiment with the cleaning process somewhat for the best time since each electrode is unique.

The cleaning process will not indefinitely extend the life of an electrode and eventually the electrode will have to be replaced, but if well cared for an electrode can last for a long time.

Recorder Output

The recorder output terminal is not electrically connected to the probe's electrode structure. This offers an important recording advantage because other electrodes in the same test medium will not interact adversely with OXELP. **The output signal from the Recorder connector is 1 millivolt per nanoampere of electrode current regardless of whether the selector switch is in the %, ppm or nA range.**

Handling Precautions

The OXELP electrode is designed to be used in buffered aqueous solutions and in gasses at ambient pressure. The use of the electrode in other fluids may damage the membrane. Organic solvents must not be used. If you have a particular solution that may be in question, please contact WPI for information.

Storage

The ISO2 meter will keep the OXELP electrode polarized if left on the meter, even when switched off. Store the electrode with the meter attached. For long-term storage (more than a week), unplug and store with the tip immersed in water in a closed container (supplied).

Batteries

Battery operated, the ISO2 should work for hundreds of hours before its two batteries require replacement. A low battery indicator on the panel LCD will appear if the batteries should be replaced. To replace the batteries, first turn the power off. Remove the four screws on the bottom of the instrument case and then remove the entire front panel assembly. Replace the batteries and secure the case.

Remember to turn the instrument power off for economical long lasting battery service.

Polarization

The ISO2 meter will keep the OXELP electrode polarized if left on the meter, even when switched off. For best results, polarization of a new electrode should be performed over a 24-hour period. However, a 2-hour period will polarize the electrode enough for 95% accuracy.

Electrode Life

Electrodes in long-term storage (30 to 60 days) should be refitted with a new sleeve and electrolyte solution. See page 7 for details on changing the membrane sleeve.

Table 1a *— Solubility of oxygen in parts per million (ppm) in fresh water at different temperatures, in equilibrium with air at barometric pressure of 760mm Hg (101.3 kPa) and oxygen partial pressure of 159mm Hg (21.1 kPa).*

Solubility of Oxygen in Fresh Water
Table 1a

°F	°C	ppm	°F	°C	ppm
32	0	14.6	66	19	9.4
34	1	14.2	68	20	9.2
35	2	13.8	70	21	9.0
37	3	13.5	72	22	8.8
39	4	13.1	73	23	8.7
41	5	12.8	75	24	8.5
43	6	12.5	77	25	8.4
45	7	12.2	79	26	8.2
46	8	11.9	81	27	8.1
48	9	11.6	82	28	7.9
50	10	11.3	84	29	7.8
52	11	11.1	86	30	7.6
54	12	10.8	88	31	7.5
55	13	10.6	90	32	7.4
57	14	10.4	91	33	7.3
59	15	10.2	93	34	7.2
61	16	10.0	95	35	7.1
63	17	9.7	97	36	7.0
64	18	9.5	99	37	6.9

Table 1b *— Solubility of oxygen (milligrams/liter) in seawater of different salinities, in equilibrium with air at barometric pressure of 760 mm Hg (101.3 kPa) and oxygen partial pressure of 159 mm Hg (21.2 kPa).*

Solubility of Oxygen in Seawater
Table 1b

°C	5 g/l	10 g/l	15 g/l	20 g/l
0	13.8	13.0	12.1	11.3
1	13.4	12.6	11.8	11.0
2	13.1	12.3	11.5	10.8
3	12.7	12.0	11.2	10.5
4	12.4	11.7	11.0	10.3
5	12.1	11.4	10.7	10.0
6	11.8	11.1	10.5	9.8
7	11.5	10.9	10.2	9.6
8	11.2	10.6	10.0	9.4
9	11.0	10.4	9.8	9.2
10	10.7	10.1	9.6	9.0
11	10.5	9.9	9.4	8.8
12	10.3	9.7	9.2	8.6
13	10.1	9.5	9.0	8.5
14	9.9	9.3	8.8	8.3
15	9.7	9.1	8.6	8.1
16	9.5	9.0	8.5	8.0
17	9.3	8.8	8.3	7.8
18	9.1	8.6	8.2	7.7
20	8.7	8.3	7.9	7.4
21	8.6	8.1	7.7	7.3
22	8.4	8.0	7.6	7.1
23	8.3	7.9	7.4	7.0
24	8.1	7.7	7.3	6.9
25	8.0	7.6	7.2	6.7
26	7.8	7.4	7.2	6.7
27	7.7	7.3	6.9	6.5
28	7.5	7.1	6.8	6.4
30	7.3	6.9	6.5	6.1

Table 2 *— Oxygen solubility obtained from Table 1a or Table 1b should be corrected if barometric pressure is different than 760 mm Hg or at altitudes other than sea level.*

Oxygen Solubility vs. Altitude
Table 2

Altitude (feet)	Pressure (mm Hg)	Solubility Correction Factor
-540	775	1.02
Sea Level	760	1.00
500	746	0.98
1000	732	0.96
1500	720	0.95
2000	707	0.93
2500	694	0.91
3000	681	0.90
3500	668	0.88
4000	656	0.86
4500	644	0.85
5000	632	0.83
5500	621	0.82
6000	609	0.80

Water-vapor Partial Pressure
Table 3

Temp. °C	Pv mm Hg	Temp. °C	Pv mm Hg
0	5	20	18
2	5	22	20
4	6	24	22
6	7	26	25
8	8	28	28
10	9	30	32
12	11	32	36
14	12	34	40
16	14	36	45
18	16	38	50
		40	55

Bunsen Coefficients (α) for Solubility of Oxygen in Plasma and Blood
Table 4

Temp		Blood Hb g/100 mL			
°C	Plasma	5 g	10 g	15 g	20 g
15	0.0302	0.0310	0.0312	0.0316	0.0323
20	0.0277	0.0282	0.0284	0.0287	0.0293
25	0.0257	0.0261	0.0263	0.0265	0.0271
28	0.0246	0.0249	0.0251	0.0253	0.0259
30	0.0238	0.0241	0.0243	0.0245	0.0251
35	0.0220	0.0226	0.0227	0.0229	0.0234
37	0.0214	0.0220	0.0221	0.0223	0.0228
40	0.0208	0.0221	0.0212	0.0214	0.0219

Specifications

Modes..% O_2: 0-100%
ppm: 0-20
Current: 0-199.9 nA

Resolution ....0.1 ppm

Accuracy...± 1.5%

Output Resistance ....1000 Ohms

Display ....3.5-digit LCD

Recorder Output ....1 mv = 1 nA (i.e., 10 mV = 10% O_2 = 10 ppm = 10 nA)

Power ....Two 9V alkaline batteries (included) NEDA: MN1604, 6LR61

Battery Life......................................1000 hours (approx.)

Dimensions ....20.3 x 10.2 x 5.1 cm (8 x 4 x 2 in.)

Weight...2 lb (0.9 kg)

Shipping Weight............................5 lb (2.3 kg)

OXELP Specifications

Tip Length....................................... 76 mm

Overall Length............................... 137 mm

Tip Diameter.................................. 2 mm

Cable Length.................................. 22 cm (4 ft), including BNC connector

Response Time.............................. 10 seconds, 90% response in well-stirred solution

Accessories

OXELP	Oxygen electrode in sealed bottle
5378	Package of 4 replacement sleeves with membranes; includes 10 mL refill solution
7326	**ISO_2** refill solution (10 mL)
5377	Replacement Startup kit: T-Adaptor Flow-Through Kit (see below) Calibration bottle 10 mL refill solution 1 cc syringe 2 replacement sleeves with membranes 1 MicroFil 28 gauge
5399	T-Adaptor Flow-Through Kit: 3 luer female T's 3 luer lock fittings 3 2 mm gaskets 6 luer male luer to 1/8" tubing 3 Luer lock fittings
5381	Rack Mount Kit

Warranty

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

• Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within 10 days after receipt of shipment. Claims for lost shipments must be made within 30 days of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim settles. In some instances, photographic documentation may be required. Some items are time sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container.

• WPI cannot be held responsible for items damaged in shipment en route to us. Please enclose merchandise in its original shipping container to avoid damage from handling. We recommend that you insure merchandise when shipping. The customer is responsible for paying shipping expenses including adequate insurance on all items returned.

• Do not return any goods to WPI without obtaining prior approval and instructions (RMA#) from our returns department. Goods returned unauthorized or by collect freight may be refused. The RMA# must be clearly displayed on the outside of the box, or the package will not be accepted. Please contact the RMA department for a request form.

• Goods returned for repair must be reasonably clean and free of hazardous materials.

• A handling fee is charged for goods returned for exchange or credit. This fee may add up to 25% of the sale price depending on the condition of the item. Goods ordered in error are also subject to the handling fee.

• Equipment which was built as a special order cannot be returned.

• Always refer to the RMA# when contacting WPI to obtain a status of your returned item.

• For any other issues regarding a claim or return, please contact the RMA department

Warning: This equipment is not designed or intended for use on humans.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

World Precision Instruments, Inc.
International Trade Center, 175 Sarasota Center Blvd., Sarasota FL 34240-9258
Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com
UK: Astonbury Farm Business Centre • Aston, Stevenage, Hertfordshire SG2 7EG • Tel: 01438-880025 • Fax: 01438-880026 • E-mail: wpiuk@wpi-europe.com
Germany: Liegnitzer Str. 15, D-10999 Berlin • Tel: 030-6188845 • Fax: 030-6188670 • E-mail: wpide@wpi-europe.com

WORLD PRECISION INSTRUMENTS, INC.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA
Telephone: (941) 371-1003 Fax: (941) 377-5428
e-mail wpi@wpiinc.com

DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota FL 34240-9258
USA

as the manufacturers of the apparatus listed, declare under sole responsibility that the product(s):

Title:	**ISO2**

to which this declaration relates is/are in conformity with the following standards or other normative documents:

Safety: EN 61010-1:1993 (IEC 1010-1:1990)

EMC: EN 50081-1:1992
EN 50082-1:1992

and therefore conform(s) with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility and Council Directive 73/23/EEC relating to safety requirements.

Issued on:	**18th February 2000**

Dr. Mark P. Broderick
President and COO
World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA

Mr. Glen Carlquist
Production Manager
World Precision Instruments, Inc.
175 Sarasota Center Boulevard
Sarasota, FL 34240-9258 USA