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MAN9146 05/04

Instruction Manual

HI 9146

Portable Waterproof Microprocessor Dissolved Oxygen Meter

HANNA instruments
www.hannacan.com

CE
This Instrument is in Compliance with the CE Directives

Dear Customer,

Thank you for choosing a Hanna Product.

Please read this instruction manual carefully before using the instrument.

This manual will provide you with the necessary information for a correct use of the instrument, as well as a precise idea of its versatility.

If you need additional technical information, do not hesitate to e-mail us at:

techserv@hannacan.com

This meter is in compliance with CE directives.

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CE DECLARATION OF CONFORMITY

HANNA instruments

CE

DECLARATION OF CONFORMITY

We

Hanna Instruments Italia Srl
viale delle Industrie, 12/A
35010 Ronchi di Villafranca - PD
ITALY

herewith certify that the Dissolved Oxygen meter:

HI 9146

has been tested and found to be in compliance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normatives:

EN 50082-1: Electromagnetic Compatibility - Generic Immunity Standard
IEC 61000-4-2 Electrostatic Discharge
IEC 61000-4-3 RF Radiated
IEC 61000-4-4 Fast Transient

EN 50081-1: Electromagnetic Compatibility - Generic Emission Standard
EN 55022 Radiated, Class B

EN61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use

Date of Issue: 12.5.2004

A.Marsilio - Technical Director
On behalf of
Hanna Instruments S.r.l.

Recommendations for users

Before using these products, make sure that they are entirely suitable for the environment in which they are used.

Operation of this instrument in residential area could cause unacceptable interference to radio and TV equipment, requiring the operator to take all necessary steps to correct interferences.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

To avoid electrical shock, do not use these instruments when voltage at the measurement surface exceeds 24VAC or 60VDC.

To avoid damage or burns, do not perform any measurement in microwave ovens.

WARRANTY

All Hanna **meters are warranted for two years** against defects in workmanship and materials when used for their intended purpose and maintained according to the instructions. **Probes are warranted for six months**.

This warranty is limited to repair or replacement free of charge.

Damages due to accidents, misuse, tampering or lack of prescribed maintenance are not covered.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charge for repair or replacement. If the instrument is to be returned to Hanna Instruments, please obtain a Return Goods Authorization from the Customer Service Department and then send it with shipment cost prepaid.

When shipping any instrument, make sure it is properly packaged for complete protection.

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it to make sure that no damage has occurred during shipping. If there is any damage, notify your dealer.

The meter is supplied complete with:

- **HI 76407/4F** DO Probe with 4 m cable for HI 9146-04 model
- **HI 76407/10F** DO Probe with 10 m cable for HI 9146-10 model
- 2 spare membranes (**HI 76407A**)
- 2 O-rings
- Protective cap
- 30 ml electrolyte solution (**HI 7041S**)
- 4 x 1.5V AA batteries
- Instruction manual
- Rugged carrying case

Note: Save all packing material until you are sure that the instrument functions correctly. Any defective items must be returned in the original packing with the supplied accessories.

GENERAL DESCRIPTION

The Hanna **HI 9146** is a water-resistant, microprocessor-based, auto-calibrating Dissolved Oxygen meter with ATC. It has been developed for dissolved oxygen and temperature measurement in water and wastewater as well as other applications such as fish farming.

Dissolved Oxygen is indicated in hundredths of parts per million (ppm=mg/l) or in % of saturation .

The temperature range is indicated in centigrade from 0 to 50°C with 0.1°C resolution.

The ppm and the % saturation are both compensated for changes in solubility of oxygen in water and for permeability of the membrane as well as the temperature effect.

Salinity compensation in water allows determination of mg/l of Dissolved Oxygen in salty waters and the altitude compensation readjusts for the altitude variance.

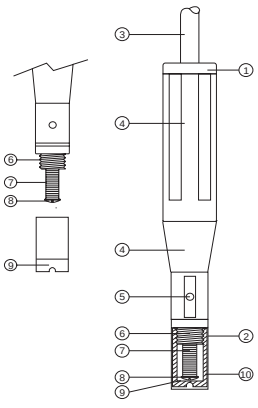
Four 1.5V AA alkaline batteries provide power and make the instrument completely portable. **HI 9146** is also designed to be used with a battery recharger or a 12VDC power supply. A 12VDC input jack is incorporated into the housing.

A microprocessor ensures an accurate and rapid calibration and measurement. The case rugged and water-resistant for maximum protection in the field as well as in the laboratory.

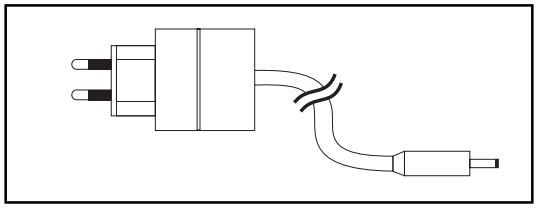
The dissolved oxygen probe has a membrane covering the polarographic sensor elements and a built-in thermistor for temperature measurement and compensation. The thin permeable membrane isolates the sensor elements from the testing solution, but allows oxygen to enter. When a voltage is applied across the sensor, oxygen that passes through the membrane causes a current to flow from which the oxygen concentration is determined.

FUNCTIONAL DESCRIPTION - PROBE

1. D.O. Probe
2. Protective Cap
3. Watertight Shielded Cable
4. Polypropylene Probe Body
5. Temperature Sensor
6. O-Ring Seal
7. AgCl Anode (sensor element)
8. Platinum Cathode (sensor element)
9. Oxygen Permeable Teflon Membrane
10. Protective Cap



ers. In this case, check the correct polarity of your adapter before connecting it to the meter.



ACCESSORIES

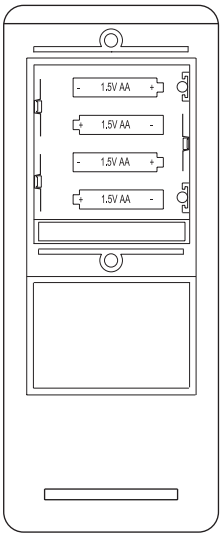
HI 740027	1.5V AA battery (4 pieces)
HI 7041S	Refilling Electrolyte Solution, 30 ml
HI 76407/4F	D.O. probe with 4 m cable and cap
HI 76407/10F	D.O. probe with 10 m cable and cap
HI 76407A/P	D.O. membrane (5 pcs)
HI 710005	115 VAC to 12 VDC, US plug

BATTERY REPLACEMENT

When the batteries are run down "LOBAT" is displayed on the Liquid Crystal Display. This is to inform the user that the display will be shut-off after about 4 hours of use to prevent erroneous measurements due to low voltage.

Battery replacement must only take place in a non-hazardous area using alkaline batteries.

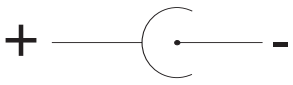
In order to replace run down batteries, simply remove the two screws on the rear cover of the instrument (#1 in the Functional Description on page 3) and replace the four 1.5V AA batteries with new ones, paying attention to the correct polarity.



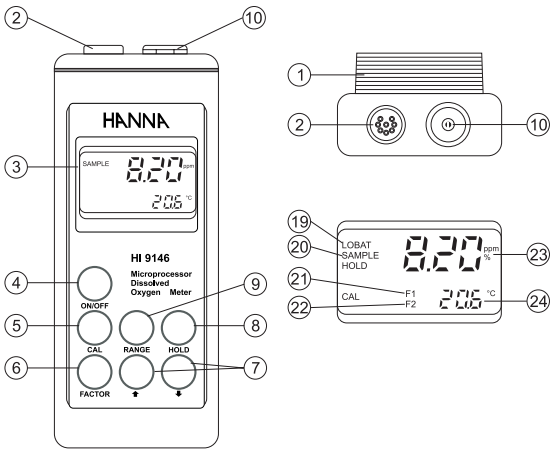
A 12VDC power source can also be used to power the unit (see accessories). Simply unscrew the protective cap on the top of the instrument (#10 page 3) and plug the power supply into the socket.

Note: The instrument uses the following configuration.

Use only the Hanna voltage adapter (such as HI 710005) with proper polarity configuration. The meter can however also run on other adapt



FUNCTIONAL DESCRIPTION - METER



1) Battery Compartment
2) Probe Connector
3) Liquid Crystal Display
4) ON/OFF key
5) CAL key (to enter/exit calibration mode)
6) FACTOR key (to select altitude F1 and salinity F2)
7) UP and DOWN arrow keys (to select F1 and F2 levels)
8) HOLD key (to freeze displayed value)
9) RANGE key (to select ppm or % of saturation)
10) Power socket for 12VDC adapter
19) LOW BAT indicator
20) SAMPLE indicator (to indicate measurement mode)
21) F1 indicator (altitude factor)
22) F2 indicator (salinity factor)
23) % or ppm mode indicator
24) Temperature and factor display

SPECIFICATIONS

Range	0.00 to 45.00 mg/l O_2 0.0 to 300 %O_2 0.0 to 50.0 °C
Resolution	0.01 mg/l O_2 0.1 %O_2 0.1 °C
Accuracy **(@25°C/77°F)**	±1.5% Full Scale mg/l O_2 ±1.5% Full Scale %O_2 ±0.5 °C
Typical EMC Deviation	±0.3 mg/l O_2 / ±3.5 %O_2 ±0.5 °C
Calibration	Automatic in saturated air
Temperature Compensation	Automatic from 0 to 50°C (32 to 122°F)
Altitude Compensation	0 to 4000 m 100 m resolution
Salinity Compensation	0 to 80 g/l 1 g/l resolution
Environment	0 to 50°C (32 to 122°F) RH 100%
Power supply	• 4x1.5V AA batteries; 200 hours of continuous use; auto-off after 4 hours. • 12 VDC adapter
Dimensions	196 x 80 x 60 mm (7.7 x 3.1 x 2.4")
Weight	meter: 425 g (15 oz) kit: 1.4 kg (3.1 lb)

- Make sure that the rubber O-ring is seated properly inside the membrane cap.
- With the sensor facing down, screw the membrane cap clockwise. Some electrolyte will overflow.

The Platinum cathode sensor (#8 in the Functional Description on page 2) should always be bright and untarnished. If it is tarnished or stained, which could be due to contact with certain gases or extended use with a loose or damaged membrane, the cathode sensor should be cleaned. Use a clean, lint-free cardboard or cloth. Rub the cathode very gently side to side 4-5 times. This will be enough to polish and remove any stains without damaging the platinum tip. Then, rinse the probe with deionized or distilled water. Install a new membrane and fill it with fresh electrolyte following the instructions above. Recalibrate the instrument.

Important: In order to have accurate and stable measurements, it is important that the surface of the membrane is in perfect condition. This permeable membrane isolates the sensor elements from the environment but allows oxygen to enter. If any dirt is deposited on the membrane, rinse it carefully with distilled or deionized water. If any imperfections are observed, or any damage is evident (such as wrinkles, tears or holes), the membrane should be replaced. Make sure that the O-Ring is properly seated in the membrane cap.

PROBE & MEMBRANE MAINTENANCE

The oxygen probe body is made of reinforced polypropylene for maximum durability.
A thermistor sensor measures temperature of the sample. It is recommended that the protective cap be always kept on the probe when the probe is not in use.

To replace the membrane or refill it with electrolyte, proceed as follows:

- Remove the protective cap by gently twisting and pulling it off the probe (see fig. 1).
- Unscrew the membrane by turning it counterclockwise (see fig.2)
- Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (**HI 7041S**) for 5 minutes.
- Rinse a new membrane (**HI 76407A**) with electrolyte while shaking it gently. Refill with clean electrolyte.
- Gently tap the sides of the membrane with your finger tip to ensure that no air bubbles remain trapped. Do not directly tap the bottom as this may cause irreparable damage to the membrane.

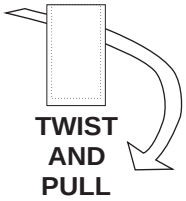


fig. 1

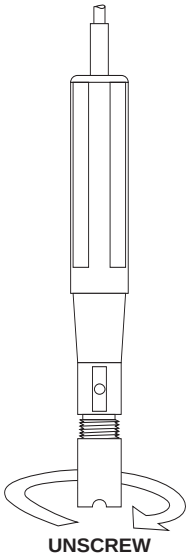


fig. 2

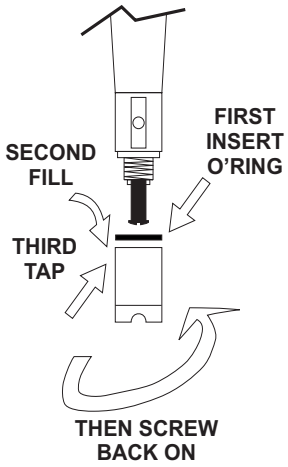
PROBE PREPARATION

All probes are shipped dry by Hanna Instruments. To hydrate the probe and prepare it for use, connect it to the meter and proceed as follows.

1 Remove the red and black plastic cap which is for shipping purposes and can be discarded.

2 Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (**HI 7041S**) for 5 minutes.

3 Take a membrane (**HI 76407A** supplied with the meter) and Make sure that the rubber O-ring sits properly inside the membrane cap.

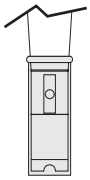


4 Rinse the membrane with electrolyte while shaking it gently. Refill with clean electrolyte.

5 Gently tap the sides of the membrane cap with your finger tip to ensure that no air bubbles remain trapped. To avoid damaging to the membrane, do not tap the membrane directly on the bottom.

6 With the sensor facing down, screw the cap clockwise. Some electrolyte will overflow.

When not in use, protect the membrane by placing the protective cap on it.



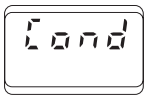
CALIBRATION

PROBE POLARIZATION

The probe is under polarization with a fixed voltage of approximately 800 mV.
Probe polarization is essential for stable measurements with the same recurring degree of accuracy.
With the probe properly polarized, oxygen is continually "consumed" by passing through the sensitive diaphragm and dissolving in the electrolyte solution contained inside the probe. If this operation is interrupted, the electrolyte solution continues to be enriched with oxygen until it reaches an equilibrium with the surrounding solution. Whenever measurements are taken with a non-polarized probe, the oxygen level indicated is that of the test solution as well as any oxygen present in the electrolyte solution. This reading is obviously incorrect. The Hanna oxygen meter shown here automatically polarize the probe when they are switched on.

Calibration is simple and is recommended every time the meter is switched on.

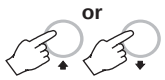
- Make sure the probe is ready for measurement (see page 5), i.e. the membrane is filled with electrolyte and probe is connected to the meter and properly polarized.
- Switch the meter on.
- "COND" appears on the display to inform you that the probe is in auto-conditioning (automatic polarization) mode.



- Once "COND" disappears the probe is polarized and instrument can be calibrated.

SALINITY COMPENSATION

Press FACTOR twice and “F2” will be displayed. Press UP and DOWN to set the salinity between 0 and 80 g/l. Press FACTOR again to display the temperature.

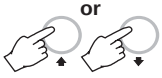


°C	Salinity (g/l) at Sea Level					°F
	0 g/l	10 g/l	20 g/l	30 g/l	35 g/l	
10	11.3	10.6	9.9	9.3	9.0	50.0
12	10.8	10.1	9.5	8.9	8.6	53.6
14	10.3	9.7	9.1	8.6	8.3	57.2
16	9.9	9.3	8.7	8.2	8.0	60.8
18	9.5	8.9	8.4	7.9	7.6	64.4
20	9.1	8.5	8.0	7.6	7.4	68.0
22	8.7	8.2	7.8	7.3	7.1	71.6
24	8.4	7.9	7.5	7.1	6.9	75.2
26	8.1	7.6	7.2	6.8	6.6	78.8
28	7.8	7.4	7.0	6.6	6.4	82.4

ALTITUDE COMPENSATION

Press FACTOR and "F1" will be displayed.

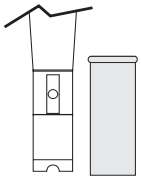
Use the UP and the DOWN keys to set the altitude from 0 and 4000 m, in steps of 100 m.



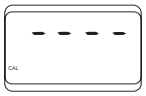
The table provides an idea of the error that can be introduced at different altitudes and the quantity to be subtracted to correct the reading.

	Altitude above Sea Level (in meters)													
°C	0	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	4000
0	14.6	14.1	13.6	13.2	12.7	12.3	11.8	10.9	10.2	9.4	8.7	8.1	7.6	6.6
2	13.8	13.3	12.9	12.4	12.0	11.6	11.2	10.3	9.6	8.9	8.2	7.7	7.1	6.3
4	13.1	12.7	12.2	11.9	11.4	11.0	10.6	9.8	9.1	8.5	7.8	7.3	6.7	6.0
6	12.4	12.0	11.6	11.2	10.8	10.4	10.1	9.3	8.6	8.0	7.4	6.9	6.4	5.7
8	11.8	11.4	11.0	10.6	10.3	9.9	9.6	8.9	8.2	7.6	7.1	6.5	6.1	5.4
10	11.3	10.9	10.5	10.2	9.8	9.5	9.2	8.5	7.8	7.3	6.8	6.3	5.8	5.1
12	10.8	10.4	10.1	9.7	9.4	9.1	8.8	8.1	7.5	7.0	6.4	6.0	5.6	4.9
14	10.3	9.9	9.6	9.3	9.0	8.7	8.3	7.8	7.2	6.6	6.2	5.7	5.3	4.7
16	9.9	9.7	9.2	8.9	8.6	8.3	8.0	7.5	6.9	6.4	5.9	5.5	5.1	4.5
18	9.5	9.2	8.7	8.6	8.3	8.0	7.7	7.2	6.6	6.1	5.7	5.3	4.9	4.3
20	9.1	8.8	8.5	8.2	7.9	7.7	7.4	6.9	6.3	5.9	5.5	5.1	4.7	4.1
22	8.7	8.4	8.1	7.8	7.7	7.3	7.1	6.6	6.0	5.6	5.3	4.9	4.5	4.0
24	8.4	8.1	7.8	7.5	7.3	7.1	6.8	6.3	5.8	5.5	5.1	4.7	4.4	3.8
26	8.1	7.8	7.5	7.3	7.0	6.8	6.6	6.1	5.7	5.2	4.8	4.5	4.2	3.7
28	7.8	7.5	7.3	7.0	6.8	6.6	6.3	5.9	5.4	5.0	4.7	4.3	4.0	3.6
30	7.5	7.2	7.0	6.8	6.5	6.3	6.1	5.7	5.2	4.9	4.6	4.2	3.9	3.5
32	7.3	7.1	6.8	6.6	6.4	6.1	5.9	5.5	5.1	4.7	4.4	4.1	3.8	3.3
34	7.1	6.9	6.6	6.4	6.2	6.0	5.8	5.4	4.9	4.6	4.2	3.9	3.7	3.2
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.2	4.8	4.5	4.1	3.8	3.5	3.1
38	6.6	6.4	6.2	5.9	5.7	5.6	5.4	5.0	4.6	4.3	4.0	3.7	3.5	3.0
40	6.4	6.2	6.0	5.8	5.6	5.4	5.2	4.8	4.5	4.2	3.9	3.6	3.3	2.9
42	6.3	6.1	5.8	5.6	5.4	5.2	5.0	4.7	4.3	4.0	3.7	3.5	3.2	2.9
44	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.6	4.3	4.0	3.7	3.4	3.1	2.8
46	5.9	5.7	5.5	5.3	5.1	4.9	4.8	4.4	4.1	3.8	3.5	3.3	3.1	2.7
48	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.3	4.0	3.7	3.5	3.2	2.9	2.6
50	5.6	5.4	5.2	5.0	4.9	4.7	4.5	4.2	3.9	3.6	3.4	3.1	2.9	2.6

- For an accurate calibration, it is recommended to wait an additional 5 or 10 minutes to ensure optimum conditioning of the probe.
- Remove the protective cap.



- Press CAL. "----" appears on the larger LCD together with "CAL" to indicate that the instrument is in calibration mode.



- The instrument will automatically standardize itself to the actual saturation value. After approx. 1 minute it will show "100%" on the LCD and a small "SAMPLE" to indicate that the calibration is complete.

- Press FACTOR and ensure F1 and F2 are set to the appropriate altitude and salinity values (pages 10-11).

Notes:
- The instrument must be calibrated whenever the probe, membrane or the electrolyte is changed.
- To exit the calibration mode during calibration, press CAL.
- The display may be switched from readings in % saturation to mg/l without recalibration, by simply pressing RANGE.

MEASUREMENT

Make sure the meter has been calibrated and the protective cap has been removed. Immerse the tip of the probe in the sample to be tested and ensure that the temperature sensor is also immersed.

To display values in % saturation, press RANGE.

For accurate dissolved oxygen measurements, a water movement of at least 30 cm (12")/ second is required. This is to ensure that oxygen depleted on the membrane surface is constantly replenished. A moving stream will provide adequate circulation.

During field measurements, this condition may be obtained by manually stirring the probe. Accurate readings are not possible while the liquid is stationary.

During laboratory measurements, the use of a magnetic stirrer to ensure a certain agitation of the fluid is recommended. This way, any errors due to the presence of air bubbles on the membrane surface are minimized.

For an accurate measurement, allow sufficient time for thermal equilibrium between the probe and the measurement sample (a few minutes if the temperature difference is several degrees).

mg/l READINGS

The mg/l readings make it possible to read the concentration of the dissolved oxygen directly in ppm.

If the sample contains significant salinity or if the measurement is taken at a higher altitude than sea level, the read-out values must be corrected (by taking into account the lower degree of oxygen solubility in such conditions - see below).

Set the altitude and/or the salinity before calibration and taking mg/l measurements. The meter will automatically compensate for these factors.

% O_2 SATURATION READINGS

The % O_2 reading provides the rate of oxygen saturation with reference to 100.0% at sea level.

TEMPERATURE READINGS

The lower part of the display will show the measured temperature in Celsius degrees.

Allow the probe to reach thermal equilibrium with the sample before taking any measurement. The greater the difference between the ambient temperature and the temperature of the sample, the longer it will take the probe to acclimatized itself to the sample.