Instruction Manual

HI 9142

**Portable Waterproof
Dissolved Oxygen Meter**
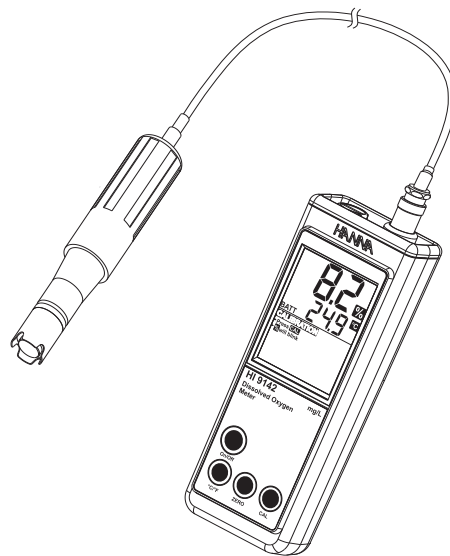
HANNA®
instruments

www.hannainst.com

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 76407/4** DO probe with 4 m cable
- 2 spare membranes with O-rings
- **HI 7041S** electrolyte solution (30 mL)
- Calibration screwdriver
- Batteries (3 x 1.5V AAA)
- Instruction manual
- Rugged carrying case

Note: Save all packing material until you are sure that the instrument functions correctly. All defective items must be returned to us in the original packaging with the supplied accessories.
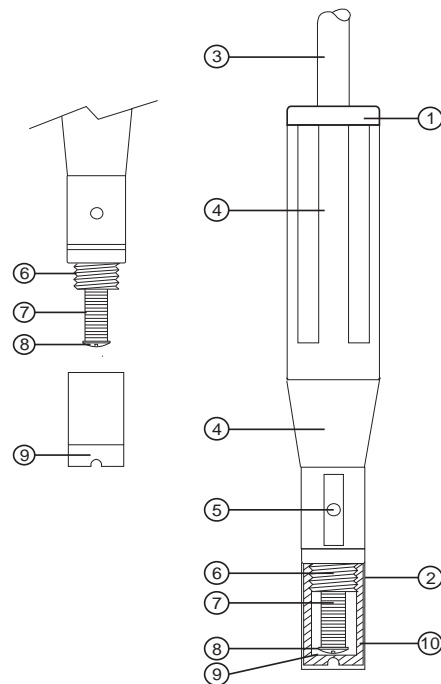
GENERAL DESCRIPTION

HI 9142 is a rugged, waterproof meter that solves the common problems of field use, such as cold, rain, snow and dust, that can damage a meter, rapidly deteriorating its performance and life. It is very simple to use: calibration is performed with **HI 7040** zero oxygen solution, while 100% calibration is done in air.

The polarographic probe (**HI 76407/4**) is provided with a membrane covering the sensors 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 has passed through the membrane reacts causing current to flow, allowing the determination of oxygen.
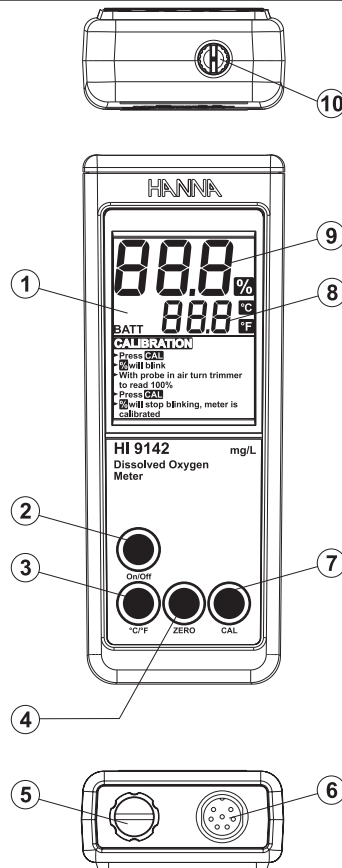
The probe included with the meter is supplied with a 4 m (13') cable that allows measurements to be taken even in even hard to reach places. For applications that require longer probe cables, the **HI 76407/10** and **HI 76407/20** probes with a 10 m (33') or 20 m (67') cable are available.

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تهران ، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)

روبـروی پالایشگاه نفت پارس، پلاک ۱۲

PROBE FUNCTIONAL DESCRIPTION

1. D.O. probe
2. Protective cap
3. Shielded cable
4. Polypropylene probe body
5. Temperature sensor
6. O-Ring seal
7. Silver chloride (AgCl) anode
8. Platinum cathode (sensor)
9. Oxygen permeable membrane
10. Membrane cap

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METER FUNCTIONAL DESCRIPTION

1. Liquid Crystal Display (LCD)
2. **On/Off** button
3. **°C/°F** Celsius or Fahrenheit selection button
4. Zero oxygen calibration button
5. Battery compartment cap
6. Probe connector (DIN7)
7. Calibration button
8. Secondary LCD line
9. Primary LCD line
10. Slope calibration trimmer

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SPECIFICATIONS

Range	0.0 to 19.9 mg/L (ppm) -5.0 to 50.0 °C (23.0 to 122.0 °F)
Resolution	0.1 mg/L 0.1 °C (1 °F)
Accuracy	±1.5% FS ±0.2 °C (±1 °F) excluding probe error
Calibration	Manual in 100% DO Automatic in 0% DO
Temperature Compensation	Automatic, 0 to 50 °C (32 to 122 °F)
Probe	**HI 76407/4**, polarographic, with 4 m (13') cable (included)
Battery Type	3 x 1.5V AAA
Battery Life	Approx. 1000 hours of use
Auto-off	After approx. 30 minutes
Environment	0 to 50 °C (32 to 122 °F); RH max 100%
Dimensions	185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight	300 g (10.6 oz.)

PROBE INITIAL PREPARATION

Probe Preparation

All D.O. probes from Hanna Instrument are shipped dry. To hydrate the probe and prepare it for use, connect it to the meter and proceed as follows.

1. Remove the red & black plastic cap. This cap is used for shipping purposes only and can be thrown away.

   Shipping cap

   black

   red

2. Wet the sensor by soaking the bottom (2.5 cm/1") of the probe in **HI 7041S** electrolyte solution for 5 minutes.

3. Rinse the membrane (**HI 76407A** supplied with the meter) with some electrolyte while shaking it gently. Refill with clean electrolyte.

4. Gently tap the sides of the membrane with your finger to ensure that no air bubbles remain trapped inside.

   FILL FIRST

   THEN TAP

   THEN SCREW BACK ON

   To avoid damaging the membrane, do not tap the membrane directly on the bottom.
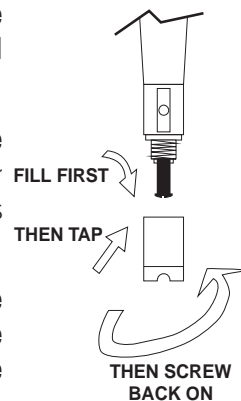
5. Place the rubber O-Ring properly inside the membrane cap.

6. With the sensor facing down, screw the cap clockwise. Some electrolyte will overflow.
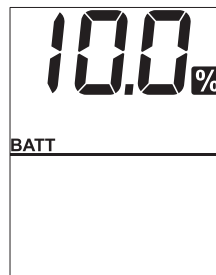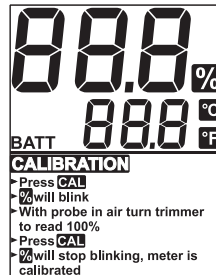
When not in use and during polarization, protect the membrane with the supplied cap.
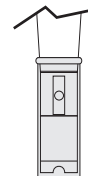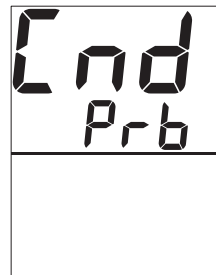
Connect the probe to the instrument. Turn the instrument ON by pressing **On/Off**.

At start-up the display will show all the used segments for a few seconds followed by the percentage indication of the remaining battery life.

- After a few seconds "**Cnd Prb**" message appears, to inform the user that the probe is in auto-conditioning mode (automatic polarization, about 1 minute).

Note: Press any key (except **On/Off**) to skip conditioning time.

- When the conditioning message disappears, the probe is polarized and the instrument can be calibrated.

- The meter is now ready to operate.

If the probe is not connected, the display shows "---" on both LCD lines.

The auto-off feature turns the instrument off after about 30 minutes, if no key is pressed.

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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 in 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 revealed are both that of the tested solution as well of the electrolyte solution. This reading is incorrect.

CALIBRATION PROCEDURE

The calibration is very simple and fast.

• Make sure the probe is ready for measurements (see initial preparation at page 7), i.e. the membrane is filled with electrolyte and the probe is connected to the meter.

• Switch the meter on by pressing the **On/Off** key.

• For an accurate calibration, it is recommended that you wait at least 15 minutes to ensure precise conditioning of the probe.

• Remove the protective cap from the D.O. probe.
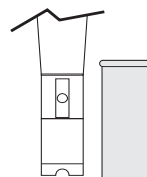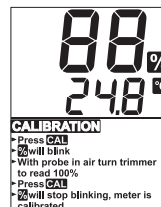
SLOPE CALIBRATION

It is suggested to perform the slope calibration in saturated air (100% DO).

- Rinse the probe in a large amount of clean water to remove any residual zero oxygen solution.

  Dry the probe tip and allow a few minutes for the LCD readout to stabilize.

- Press the **CAL** key and follow the indication on the display.

- Adjust the slope trimmer on the bottom of the meter to read "**100%**" on the LCD.

Note:

- The slope calibration screw is located on the bottom of the case.

- Press the **CAL** key and the LCD will display the value in mg/L of oxygen.

A **zero calibration** is also possible.

ZERO CALIBRATION

- Dip the probe into **HI 7040** zero oxygen solution and stir gently for 2-3 minutes.

- Press and hold down **CAL** key then press **ZERO** key.

- % tag will blink until the reading stabilize.

- When the reading is stable, the message "Press **CAL**, ..., meter is calibrated" will be displayed.

- Press **CAL** to exit zero calibration.

The **zero calibration** of the **HI 9142** is very stable, therefore this procedure needs only to be performed **whenever the probe is replaced**.

However, because the **slope calibration** is more critical, **it is recommended to perform this procedure every week**.

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TAKING MEASUREMENTS

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.

Make sure the temperature sensor is also immersed.

For accurate dissolved oxygen measurements a water movement of 0.3 m/sec is required at a minimum. This is to ensure that the oxygen-depleted membrane surface is constantly replenished. A moving stream will provide adequate circulation. To quickly check if the water speed is sufficient, wait for the reading to stabilize and then move the D.O. probe. If the reading is still stable, the measurement conditions are right, while if the reading increases the water movement is not adequate.
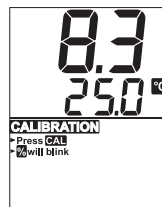
During field measurements, this condition may be met by manually agitating the probe. Accurate readings are not possible while the liquid is at rest.

During laboratory measurements, the use of a magnetic stirrer to ensure a certain velocity in the fluid is recommended. In this way, errors due to the diffusion of the oxygen present in the air in the solution are reduced to a minimum.

At all times, time necessary for thermal equilibrium to occur between the probe and the sample must be allowed (a few minutes for temperature difference of several degrees).

ALTITUDE AND SALINITY COMPENSATION

If the sample contains salts or if you are performing the measurements at a different altitude than sea level, the readout values must be corrected, taking into account the lower degree of oxygen solubility.

ALTITUDE COMPENSATION

All the readouts are referred at sea level, thus the displayed measurements are higher than the actual values. In fact, altitude affects D.O. concentration decreasing its value. The following table reports the oxygen solubility at various temperatures and altitudes, based on sea level barometric pressure of 760 mm Hg.

°C	Altitude, Meters above Sea Level							°F
	0 m	300 m	600 m	900 m	1200 m	1500 m	1800 m	
0	14.6	14.1	13.6	13.2	12.7	12.3	11.8	32.0
2	13.8	13.3	12.9	12.4	12.0	11.6	11.2	35.6
4	13.1	12.7	12.2	11.9	11.4	11.0	10.6	39.2
6	12.4	12.0	11.6	11.2	10.8	10.4	10.1	42.8
8	11.8	11.4	11.0	10.6	10.3	9.9	9.6	46.4
10	11.3	10.9	10.5	10.2	9.8	9.5	9.2	50.0
12	10.8	10.4	10.1	9.7	9.4	9.1	8.8	53.6
14	10.3	9.9	9.6	9.3	9.0	8.7	8.3	57.2
16	9.9	9.7	9.2	8.9	8.6	8.3	8.0	60.8
18	9.5	9.2	8.7	8.6	8.3	8.0	7.7	64.4
20	9.1	8.8	8.5	8.2	7.9	7.7	7.4	68.0
22	8.7	8.4	8.1	7.8	7.7	7.3	7.1	71.6
24	8.4	8.1	7.8	7.5	7.3	7.1	6.8	75.2
26	8.1	7.8	7.5	7.3	7.0	6.8	6.6	78.8
28	7.8	7.5	7.3	7.0	6.8	6.6	6.3	82.4
30	7.5	7.2	7.0	6.8	6.5	6.3	6.1	86.0
32	7.3	7.1	6.8	6.6	6.4	6.1	5.9	89.6
34	7.1	6.9	6.6	6.4	6.2	6.0	5.8	93.2
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5	96.8
38	6.6	6.4	6.2	5.9	5.7	5.6	5.4	100.4
40	6.4	6.2	6.0	5.8	5.6	5.4	5.2	104.4

This gives an idea of the error that can be introduced at different altitudes and allows you to calculate the quantity to be subtracted to correct your reading.

SALINITY COMPENSATION

The table below shows the influence of salt in the measurement of oxygen.

In **HI 9142** all the readouts are referred to 0 g/L of salinity value. In fact, salinity affects D.O. concentration decreasing its value.

For your reference the table below reports the oxygen solubility at various temperatures and salinity. From the table you can calculate the quantity to be subtracted to correct your reading.

°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

PROBE AND MEMBRANE MAINTENANCE

The oxygen probe body is made of reinforced plastic for maximum durability.

A thermistor temperature sensor provides temperature measurement and compensation. When not in use, it is always recommended to protect the probe against damage and dirt using the supplied cap.

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

- Remove the protective cap by gently twisting and pulling it off (see fig. 1).

- Unscrew the membrane by turning it counterclockwise (see fig. 2).

- Wet the sensor by soaking the bottom (2.5 cm) of the probe in **HI 7041S** electrolyte solution for 5 minutes.
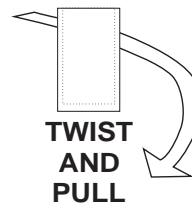
TWIST AND PULL

fig. 1

- Rinse the new membrane (**HI 76407A** supplied with the meter) with some electrolyte while shaking it gently. Refill with clean electrolyte.

- Gently tap the sides of the membrane with your finger to ensure that no air bubbles remain trapped inside. Do no directly tap the bottom as this will damage the membrane.

- 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.
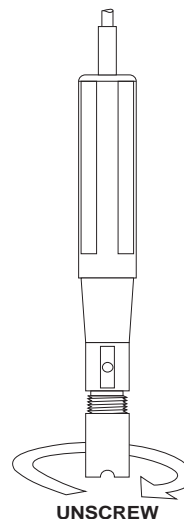
UNSCREW

fig. 2

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The Platinum cathode (#8 in the Functional Description at page 4) 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 should be cleaned. Use a lint-free cardboard or cloth and 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. Afterwards, rinse the probe with deionized or distilled water and install a new membrane cap using fresh electrolyte. 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 semi-permeable membrane isolates the sensor elements from the environment but allows oxygen to enter. If any dirt is observed on the membrane, rinse carefully with distilled or deionized water. If any imperfection still exists, or any damage is evident (such as wrinkles or tears), the membrane should be replaced. Make sure that the O-Ring is properly seated in the membrane cap.
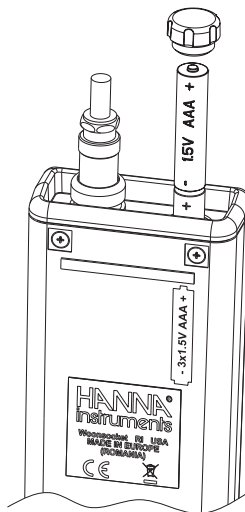
BATTERY REPLACEMENT

When the battery level is low, "**BATT**" tag is displayed blinking on the LCD to advise the user that approx. 1 hour of working time is left.

It is recommended to change the batteries as soon as the battery indicator blinks.

To replace the batteries, follow the next steps:

• Turn OFF the instrument.

• Open the battery compartment cap (located on the top of the instrument).

• Remove old batteries.

• Insert three new 1.5V AAA batteries in the battery compartment, following the instructions on the rear of the instrument.

• Reattach the battery compartment cap.

The instrument is provided with the BEPS (Battery Error Prevention System) feature, which automatically turns the instrument off when the batteries level is too low to ensure reliable readings.

At start up the display will show "**0 % BATT**" message for a few seconds, then the instrument automatically turns off.

ACCESSORIES

HI 7040L	Zero oxygen solution, 500 mL
HI 7041S	Refilling electrolyte solution, 30 mL
HI 7041M	Refilling electrolyte solution, 230 mL
HI 7041L	Refilling electrolyte solution, 500 mL
HI 76407/4	D.O. probe with 4 m (13') cable
HI 76407/10	D.O. probe with 10 m (33') cable
HI 76407/20	D.O. probe with 20 m (66') cable
HI 76407A/P	D.O. membrane (5 pcs.)

WARRANTY

HI 9142 is guaranteed for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. Electrodes and probes are guaranteed for six months. This warranty is limited to repair or replacement free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance is 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 problem. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization number from the Technical Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packed for complete protection.

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Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

Operation of this instrument in residential area could cause unacceptable interferences 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 this instrument when voltages at the measurement surface exceed 24 Vac or 60 Vdc.

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

In particular cases the meter could turn off. In these cases it can be turned on by pressing the ON/OFF key.

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edge®
DO

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instruments®

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any damage, please contact your local Hanna Instruments Office.

Each instrument edge® DO (HI2004) is supplied with:
Bench cradle
Wall cradle
Electrode holder
USB cable
5 VDC Power Adapter
Instruction Manual
Quality Certificate

HI764080: Digital polarographic dissolved oxygen probe with integrated temperature sensor
HI7041S: Electrolyte for DO probe
2 DO membrane caps for HI764080 DO probe
2 replacement O-Rings for membrane caps
Electrode protective cap

Note: Save all packing material until you are sure that the instrument works correctly. Any defective item must be returned in its original packing.

Before using this product, make sure that it is entirely suitable for your specific application and for the environment in which it is used.

Operation of this instrument may cause interference to other electronic equipment, requiring the operator to take steps to correct interference. Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

To avoid damages or burns, do not put the instrument in microwave ovens. For your and the instrument's safety, do not use or store the instrument in hazardous environments.

edge® ᴰᴼ enables the user to make fast, accurate measurements of dissolved oxygen using one of the Hanna Instruments edge® ᴰᴼ digital sensors for Dissolved Oxygen. Each digital sensors has a unique serial number that is automatically identified by the meter. Once connected to the meter, the sensor is ready to measure dissolved oxygen along with temperature.
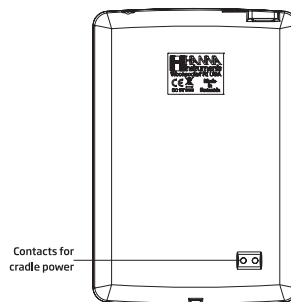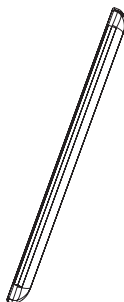
The user interface permits you to adapt edge® ᴰᴼ to your exact measurement requirements. The intuitive design simplifies configuration, calibration, measurement, data logging and transfer of data to a USB thumb drive or computer. (Every feature and measurement detail is designed to give you an edge in measurement technology.)
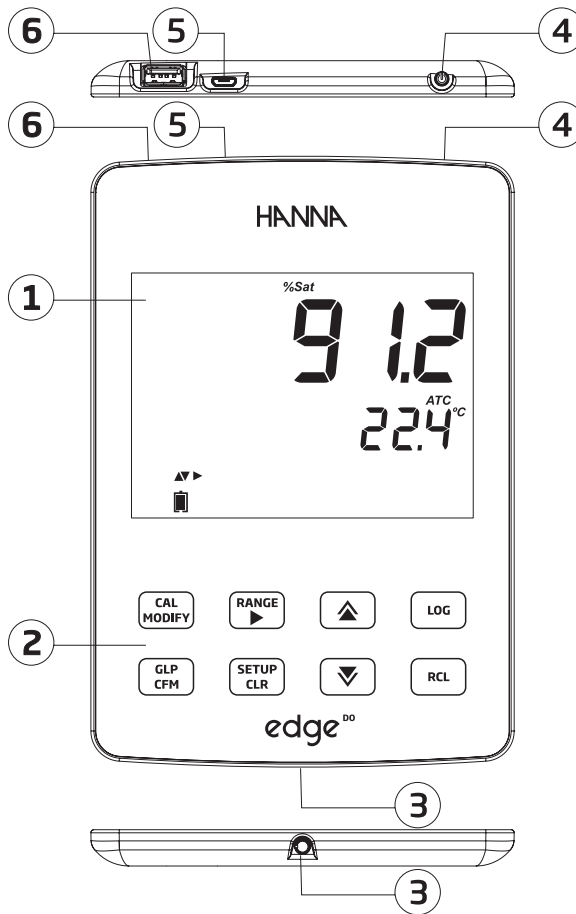
edge® ᴰᴼ is versatile in many ways. The slim meter and probe can be used as a portable device (using its rechargeable battery) or used in its bench or wall cradles (that also power the meter) as a line-powered laboratory instrument.

PRODUCT DIAGRAM

- Sleek, clean, intuitive design
- Internal clock and date
- Auto parameter recognition
- Dedicated GLP key
- GLP data included with logged data
- Simplified data transfer to a PC
- Up to 8 hour battery life when used as a portable device

Side & Back view

Contacts for cradle power

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تهران ، کیلومتر ۲۱ بزرگراه لشگری (جاده مخصوص کرج)

روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

1. Liquid Crystal Display (LCD)
2. Capacitive Touch Keypad
3. 3 mm jack input for edge® DO digital probes
4. Top mounted ON/OFF button
5. Micro USB device connection for power or PC interface
6. Standard USB host connection for data transfer to a USB thumb-drive

PROBE DIAGRAM
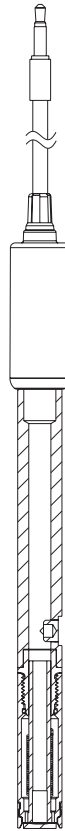
DO Electrode

- Probes process signal directly for noise free measurements
- Auto sensor recognition
- Store calibration specific data from the last calibration
- Are built with materials suitable for use in chemical analysis
- Have integrated temperature measurement
- Incorporate a 3 mm jack termination
- Unique serial ID in every probe for traceability

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)

روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

KEYPAD FUNCTION
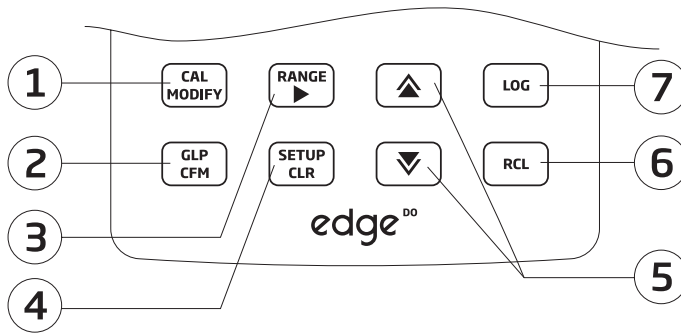
1. CAL/MODIFY - Used to enter and exit calibration mode. In SETUP, used to initiate changes of a configuration setting.
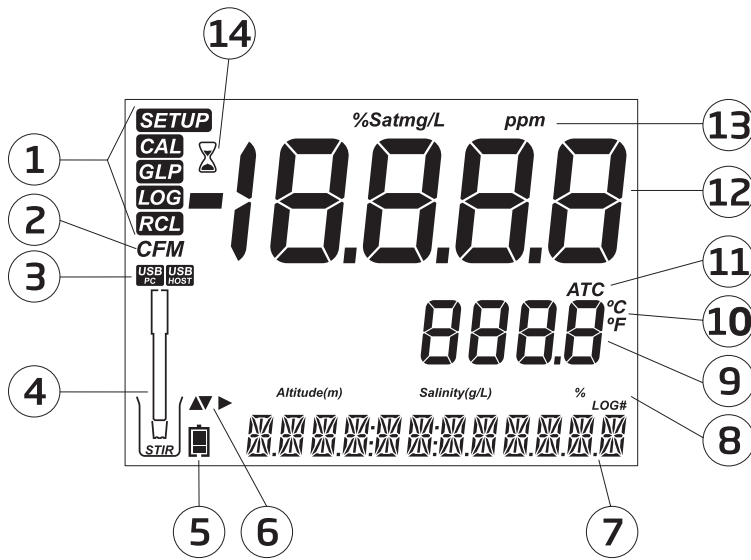
2. GLP/CFM - Used to display GLP calibration information. In SETUP, used to confirm change made. In calibration, used to accept calibration points.

3. RANGE/▶ - Used to select measurement range. In SETUP, used to move to right in pick list. In log RCL, used to view GLP data for a data point.

4. SETUP/CLR - Used to enter/exit SETUP mode. During calibration, used to clear previous calibration data. In log RCL, used to clear log records.

5. ⩔/⩓ - Used to scroll through SETUP menu. Used to change selection when modifying a parameter in SETUP.

6. RCL (Recall) - Used to view logged records or view % log memory used.

7. LOG - Used to log data by manual log on demand or manual log on stability or to start/stop interval logging.

Sliding Area

Note: You can increase/decrease the speed to change the value of a parameter. Proceed as follows:
Press and hold down the ⩓ or ⩔ key, then slide the finger toward the double apex to increase the speed that a value changes.

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GUIDE TO INDICATORS

1. Mode tags
2. Confirm tag
3. USB connection status
4. Probes symbol
5. Battery symbol
6. Arrow tags, displayed when they are available
7. Third LCD line, message area

8. Labels
9. Second LCD line, temperature measurement
10. Temperature units
11. Temp. Compensation status
12. Measurement line
13. Measurement units
14. Stability Indicator

The third line of the LCD (7) is a dedicated message line. During measurement the user may use the ⬆⬇ keys to select desired message. Options include date, time, calibration data, battery charge or no message. If a measurement error or log status change occurs during measurement, the third line will display a pertinent message.

SETTING UP edge® DO

The main operating modes of edge® DO are setup, calibration, measurement, data logging, and data export. Follow this general outline of steps to get you started. The following topics are expanded upon in the sections that follow in this manual.
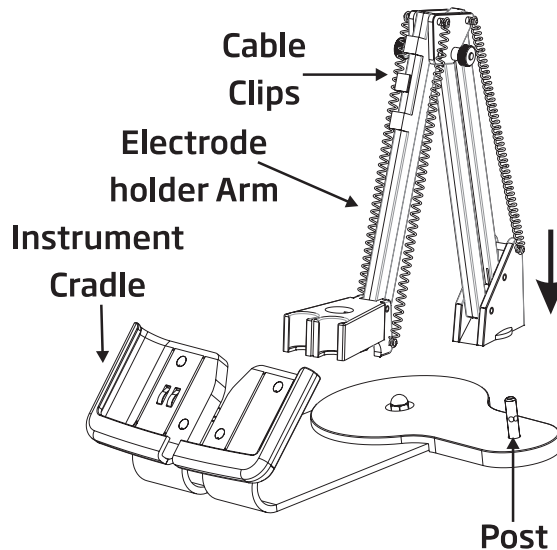
1. Familiarize yourself with the design features of this unique meter.
2. Decide how the meter will be used and set up the wall or bench cradle in a clean area near line power.
3. Turn edge® DO on using the ON/OFF button located on the top of the meter.
4. Plug in the probe required for measurement.
5. SETUP the measurement parameters required for the measurement you will be making.
6. Calibrate the sensor/probe.

You are now ready for measurements.

Bench Cradle Setup

Insert electrode holder arm into the post on the pivoting base.
Connect the probe connector to the socket located at the bottom of the instrument.

Cable
Clips

Electrode
holder Arm

Instrument
Cradle

Post

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Slide edge® ᴰᴼ into the cradle while positioning the probe cable behind the cradle.
Put the probe/sensor into the electrode holder and secure cable in clips.
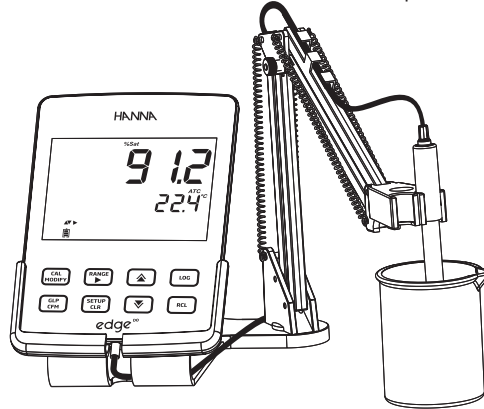
Connect the power adapter cable to the rear socket of the bench cradle. Connect the other end to the power adapter and plug into line power. Verify the battery icon indicates charging.
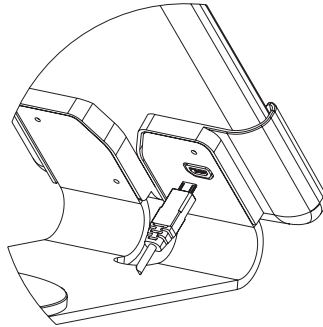
Wall Cradle Setup
Choose suitable wall location. (Use 2.5 mm or US #3 bit). Fasten the wall cradle using the provided screws. Snap cover over screw heads.

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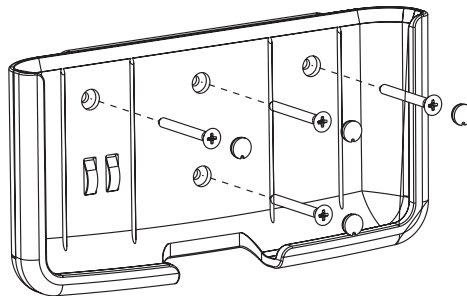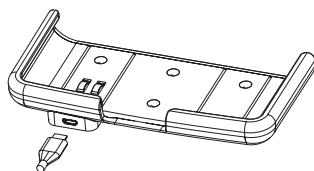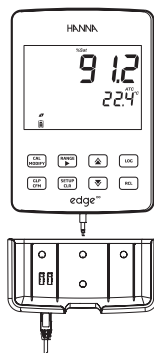Connect the power adapter cable to the bottom socket of the wall cradle. Connect the other end to the power adapter and plug into line power.

Connect the 3 mm probe jack to the socket located at the bottom of edge® DO.
Slide edge® DO into the wall cradle. Verify the battery icon indicates charging.

Power Connection
Alternatively to using the cradle for power, edge® DO can be powered by micro USB socket at the top. Plug the 5 VDC adapter into the power supply socket or by connecting directly to a PC.

Note: edge® DO is supplied with a rechargeable battery inside, which provides about 8 hours of continuous use. Whenever edge® DO is connected to the power adapter or to a PC, the battery is charging.

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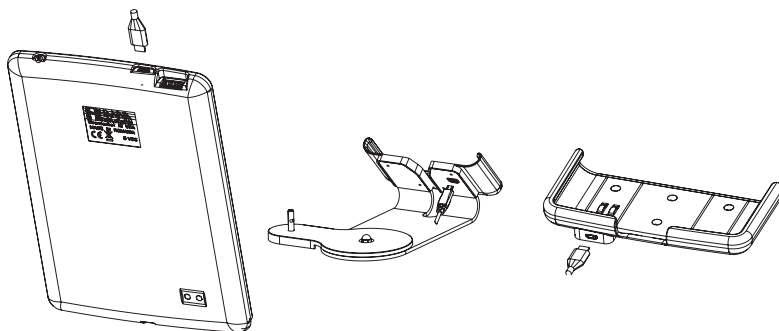
ELECTRODE & PROBE CONNECTIONS

Connect the 3 mm probe jack to the probe input located on the bottom of edge® DO. Make sure the probe is completely connected. If the probe is recognized, "CONNECTING" message is displayed along with sensor model.

```
- - - -
🔋 CONNECTING
```
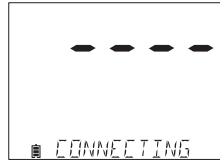
If the probe is not connected or not recognized, "NO PROBE" message is displayed.

```
- - - -
🔋 NO PROBE
```

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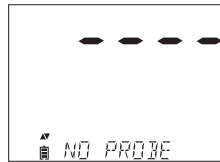
GENERAL SETUP

The following General Setup options are displayed regardless of the sensor being used. These settings remain when switching to another probe type or when no probe is attached. Options are tabulated in the table below with choices and default values. Options are accessed by pressing **SETUP/CLR** key. Loop through the options by using the ⌃⌄ keys. To modify a setting, press **CAL/MODIFY** key. The option may be modified by using **RANGE/▶**, ⌃ and ⌄ keys. Press **GLP/CFM** key to confirm the change. To exit SETUP press **SETUP/CLR** key.

Option	Description	Choices	Default
*Only seen when cable connection between micro USB and PC is made.	Select if PC is being used for charging battery (and meter will be used for logging) or if Data will be exported to the PC.	LOG ON EDGE or EXPORT TO PC	LOG ON EDGE
Log	Select log type to be used from 3 types of logging: Manual log on demand Manual log on stability (3 types of stability criteria available) Timed interval lot logging	Manual Log Stability Log: Fast, Medium, Accurate; Interval Log: Seconds: 5,10, 30; Interval Log Minutes: 1, 2, 5, 15, 30, 60, 120, 180.	Interval (5 Sec)
Set Calibration Expiration Warning	Meter will indicate "CAL DUE" when set time in this parameter has been exceeded.	1, 2, 3, 4, 5, 6, 7 days or OFF	7 days
Probe Specific	Parameters that are specific to a measurement type are inserted here in the SETUP list.		
Set Date	Press **CAL/MODIFY** key to Set current date, displayed in ISO format. Press **GLP/CFM** key to save changes.	YYYY/MM/DD Date	Set date
Set Time	Press **CAL/MODIFY** key to Set current time, displayed in ISO format. Press **GLP/CFM** key to save changes.	24hr:MM:SS Time	Set time

Option	Description	Choices	Default
Set Auto Off	Used to save battery life by automatically turning off when no key press is detected for time set and meter is not in active logging or calibration mode.	5, 10, 30, 60 Min or Off	10 MIN
Sound	If enabled, a short audible tone is produced for key stroke or calibration confirmation and a longer tone for wrong key.	On or Off	On
Temperature Unit	Select degree Celsius or Fahrenheit scale for displayed and logged temperatures.	ºC or ºF	ºC
LCD Contrast	Permits modification of the display contrast for various lighting conditions.	1 to 8	3
Flash Format* Only seen when log errors are present.	Permits formatting the flash drive.	On or Off	OFF
Message Transition	User may choose how messages are displayed on third LCD line of display.	Word scroll messages or letter scroll messages	Letter scroll messages
Reset Config To Default	Press the **CAL/MODIFY** key and **GLP/CFM** key (when prompted) to reset parameters.		
Instrument Firmware/ Probe Firmware	Displays firmware version of meter. Using the **RANGE/▶** key switches to Probe firmware (if connected) and diagnostic made for troubleshooting.	View only	Current firmware version.
Meter ID/ Meter SN/ Probe SN	User ID and Serial Number of meter and probe (if connected). Use **RANGE/▶** key to change between the three parameters.	Meter ID is user selectable	0000/ Serial Number

Note: Options that are seen under special conditions only.

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LOGGING FUNCTION

Note: If powering edge® DO through the micro USB connector to a PC, a SETUP option will require the choice "LOG ON EDGE" or "EXPORT TO PC".
1000 log records can be stored into edge® DO memory. This memory is shared between and all logging types (Manual, Manual Stability, Interval logs).
The maximum number of records for an Interval lot is 600 records (provided log space is available).
A record is a stored reading and a lot is a group of records.

Types of Logging
Interval logging: A continuous log recorded using a user-selected timed period. (This is not available in Basic mode).

Manual log on demand: Readings are logged each time **LOG** key is pressed. All of the records are stored in a single Manual lot for the measurement type. New records made on different days are stored in the same Manual lot.

Manual Stability log on demand: A log on demand that is made each time **LOG** key is pressed and the stability criteria is reached. Stability criteria may be set to Fast, Medium or Accurate settings.

In Setup mode, choose log parameter, press **CAL/MODIFY** key then use the **RANGE/▶** key to select between Interval, Manual, or Stability. When Interval is displayed, use the ⬙ and ⬙ keys to select the setting for the timed interval. When Stability is displayed, use the ⬙ and ⬙ to select the measurement stability setting.

A complete set of GLP information including date, time, range selection, temperature reading, calibration information and probe serial number is stored with each log made.

Interval Logging
Select Interval and sampling period in the SETUP menu. To start Interval logging, press the **LOG** key while the instrument is in measurement mode.

A "PLEASE WAIT" message will be displayed followed by the number of free spaces. During active interval logging, lot information is displayed 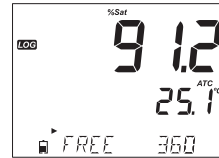on the third LCD line. The line indicates in which lot the data will be placed and keeps track of the number of logged records taken. The "LOG" tag is continuously on during active logging.
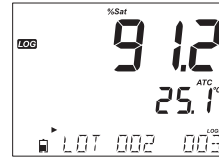
Pressing **RANGE/▶** key during an interval log will display the number of logs available.

Pressing the **LOG** key again will stop the Interval logging session. The "LOG STOPPED" message will be displayed for a few seconds.
If a sensor failure occurs during interval logging, the message "OUT OF SPEC." will alternate with logging information.
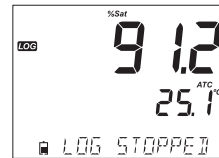
Manual Logging
Select Manual in the SETUP menu. To initiate a Manual log, press the **LOG** key while the instrument is in measurement mode. The "PLEASE WAIT" screen will be displayed briefly followed by a screen indicating the measurement has been saved and then a screen indicating the log record number.
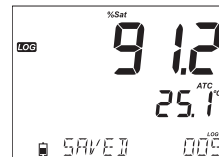
The "LOG" tag will be displayed on all 3 screens.
"PLEASE WAIT"
"SAVED" with the log record number
"FREE" with the number of free spaces available

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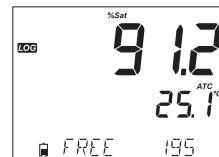
Stability Logging

Select Stability and choose measurement stability criteria in the SETUP menu. To initiate the Stability log, press the **LOG** key while the instrument is in measurement.

The "PLEASE WAIT" screen will be displayed briefly followed by a screen showing the stability tag, "LOG" tag and a "WAITING" message. The log can be stopped while the "WAITING" message is displayed by pressing **LOG** key again.
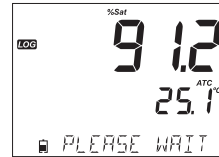
When the stability selected criteria has been met, a "SAVED" message will be displayed followed by a screen indicating how much log space is available. The "LOG" tag will be displayed on all 4 screens.
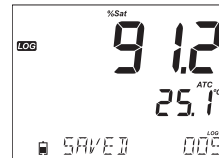
"PLEASE WAIT"
"WAITING"
"SAVED" with the log record number
"FREE" with the number of free spaces available

VIEWING LOGGED DATA

All log records stored on edge® DO may be viewed on the meter by pressing the **RCL** key.

Use the ⬆ ⬇ keys to chose the type of logging records to view.
Choices are:
•   Manual log on demand lot,
•   Manual log on stability lot,
•   Individual Interval logging lots.

If no data was logged for the selected measurement range, the instrument displays the following messages:

- "NO MANUAL LOGS"
- "NO STABILITY LOGS"

Press **GLP/CFM** key to enter inside lot information to view recorded data. Use the ⬆⬇ keys to toggle between different records.

Use **RANGE/▶** to display GLP data including calibration information, date, time, etc.

Press **SETUP/CLR** key then **GLP/CFM** key when deleting records or lots.

Press **RCL** key to exit the logging type.

Press **RCL** key to return to the measurement screen.

Delete Logging Type/Lot

Press **RCL** followed by **GLP/CFM** key.

Use the ⬆⬇ keys to select the Manual/Stability records or Interval lots to delete.

Press **SETUP/CLR** key. The instrument will display "CLEAR MANUAL" for Manual Records, "CLEAR STAB" for Stability Records.

For Interval lots, the message "CLEAR", followed by the selected lot will be displayed with "CFM" tag blinking.

Press the ⬆⬇ keys to select a different lot. Press **GLP/CFM** key. The instrument will display "PLEASE WAIT".
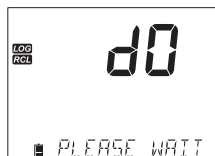
"CLEAR DONE" is displayed for a few seconds after the selected Interval lot is deleted.
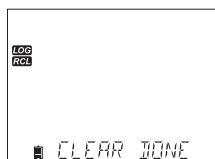
Delete Records (Manual and Stability log on demand)

To delete individual records (Manual and Stability logs only), enter Manual (Stability) log by pressing **GLP/CFM** key when Manual (Stability) is displayed.

Use the ⬆⬇ keys to select the record to be deleted and then press **SETUP/CLR** key.

The instrument will display "CLEAR REC." and record number along with "CFM" tag blinking. Use the ⬆⬇ keys to select another record if necessary.

Press **GLP/CFM** key. The instrument will display "PLEASE WAIT" and then "CLEAR DONE" message. When individual logs are deleted within saved MANUAL or STABILITY logs, the logs will renumber, filling in the deleted data but staying in chronological order.

To delete all records of the MANUAL (STABILITY) log, proceed as described on page 19 for LOTS.

Select the Manual (Stability) lot and press **SETUP/CLR** key. The "CLEAR" message will be displayed along with "MANUAL" or "STABILITY" and CFM tag blinking on the LCD. Press the **GLP/CFM** key to confirm the deleting of the selected lot (MANUAL or STABILITY) or all records. Press **SETUP/CLR** key to exit without deleting.

The lot number is used to identify particular sets of data. The lot numbers are allocated successively until 100, even if some lots were deleted. The total number of lots that can be saved is 100. If some are deleted (for example 1-50), fifty additional logs may be stored. These will be numbered 101-150. The lots are allocated successively (provided available memory space) until 999 is reached. After this, it is necessary to delete all the LOT logs to start over the numbering.

Delete All

All logs, may be deleted in a single clear. This function will delete all MANUAL, STABILITY and INTERVAL logs.

Press the **RCL** key. The DO type will be blinking. Use **RANGE/▶** key to select desired measurement parameter log data to delete.
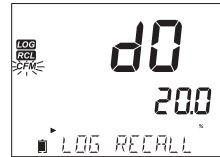
While the measurement type is blinking and message states "LOG RECALL", press **SETUP/CLR** key.
"CLEAR ALL" and measurement type will be displayed with "CFM" tag blinking. Press **GLP/CFM** key.
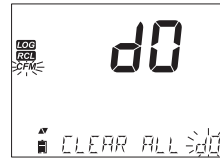
"PLEASE WAIT" and the percent cleared will be displayed until completed. The procedure can be repeated for the other measurement modes.

Note: If SETUP/CLR key is pressed in error, press SETUP/CLR key again to exit without deleting.
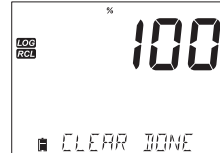
PC & STORAGE INTERFACE

Logged data on edge® DO can be transferred from the meter to a USB flash drive by using the log recall function. The minimum requirement for the drive is USB 2.0. Select the DO record you wish to export and follow the simple steps below.

Connect USB flash drive to the USB port, located on the top of the meter. Press the **RCL** key. Select Manual, Stability, or interval lots by using the ⬆⬇ keys. Press the **LOG** key (not **GLP/CFM**). The "USB HOST" tag should come on.

"PLEASE WAIT" message appears followed by "EXPORT".
Press **GLP/CFM** key to export the selected record or lot. If **GLP/CFM** key is not pressed in 10 seconds, the USB host will become inactive.

The meter will display the percentage of export.
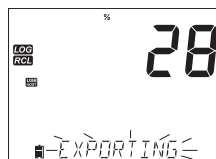
The export percentage should go to 100%. Remove USB flash drive.
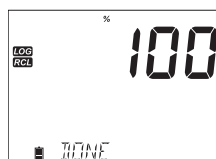
If the selected file is already saved on the flash drive, edge® DO will ask for confirmation of overwriting the existing file. The message "OVERWRITE' and "CFM" tag will blink. Press **GLP/CFM** key for overwriting the existing file or **CAL/MODIFY** key to exit without exporting.

After exporting the display will return to the selected file. Press the **RCL** key twice to return to measurements.

> Note: Do not remove USB flash drive during an active export transfer.

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Logged data on the edge® DO can be transferred from the meter to a PC by following these simple directions. Suitable operating systems include Windows (XP minimum), OS X or Linux.

1.   Connect edge® DO to the PC using the supplied micro USB cable.
2.   Turn on edge® DO.
3.   Press **SETUP/CLR** key and select "LOG ON EDGE".
4.   Press **CAL/MODIFY** key then use ⬆⬇ keys to change to "EXPORT TO USB".
5.   Press **GLP/CFM** key and the USB/PC Tag is displayed.
6.   Press **SETUP/CLR** key to exit.

The PC should detect the USB as a removable drive. Open the drive to view the stored files. Log files are formatted as Comma separated values (*.CSV) and can be opened with any text editor or spreadsheet program.

Note: Western Europe (ISO-88859-1) character set and English language are suggested settings. Other files may be visible depending upon computer settings. All files stored will appear in this folder.
Adjust Font or column width appropriately.

Interval logs are designated as DO Lots. ie. DOLOT001, DOLOT002, DOLOT003.
The Manual Lots are DOLOTMAN.
The Stability Lots are DOLOTSTAB. All stability logs, regardless of stability setting, are located in the same stability file for that measurement.

Click on the desired log to view data.

Note:If "℃ !" appeared in log data, the electrode/probe was used beyond it's operation specifications and the data is not considered reliable.If "°C !!" appeared in log data, the temperature sensor within the probe or electrode is broken and the device should be replaced. Logged data should not be considered reliable.

DISSOLVED OXYGEN SETUP

Steps To Optimize

1. Determine if Concentration or % Saturated measurements will be made.
2. Prepare the Dissolved Oxygen (DO) probe for measurement.
3. Connect the probe to the meter and configure the SETUP parameters.
4. Calibrate the DO sensor.
5. Take measurements using the DO sensor.

Measurements Available

Concentration measurements in water and % oxygen-saturated measurements are available using edge® DO together with HI764080 DO probe. Algorithms used for concentration measurements (units of ppm or mg/L) are based upon the oxygen solubility in air-saturated fresh water. Compensation for salinity and altitude are made by configuring SETUP options. Percent saturation measurements are based upon the partial pressure of oxygen and are suitable for measurement in samples other than air-saturated fresh water. It is advised to check material compatibility of the probe with the sample.

DO Probe Preparation

CAUTION: Use care during servicing and use. The HI764080 contains a glass insulator. Do not drop or handle carelessly.
Probes from Hanna Instruments are shipped dry.

1. Carefully remove the cardboard shipping tube used to protect the probe during shipping. Save the tube, should the probe be stored dry again.
2. Open membrane package and remove one O-Ring and one membrane cap.
3. Rinse the membrane cap with a small amount of HI7041 electrolyte and discard.
4. Position O-Ring in cap as indicated. Refill membrane cap $^3/_4$ full with electrolyte solution, ensure to cover the O-Ring.
5. Holding the membrane cap by the top, tap the side walls of the membrane cap to dislodge gas bubbles and force them to rise to the surface. Do not tap on the membrane directly as it may damage it.
6. With the probe facing down, slowly screw the cap counterclockwise until completely tightened. Electrolyte will overflow.
7. Rinse outer body of the probe and inspect membrane for entrapped gas bubbles. The cathode area should be free of bubbles.
8. Connect the DO probe to edge® DO meter and turn meter on.
9. Allow probe conditioning (polarizing) function to occur.
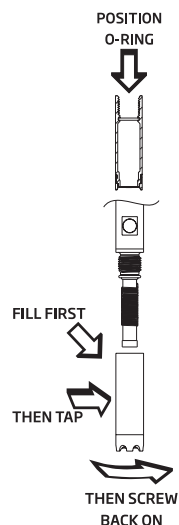
During this process, the following message will be displayed on the LCD, "DISSOLVED OXYGEN PROBE CONDITIONING".

The conditioning message will be displayed for about 60 seconds while the DO probe is conditioned. If the probe was conditioned and a new conditioning is not necessary, press any key to enter measurement mode.

The probe is polarized with a fixed voltage of approximately 800 mV between the cathode and anode. Probe polarization is essential for stable measurements. With the probe properly polarized, oxygen is continually consumed as it passes through gas permeable PTFE membrane.

If polarization 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 measurement will be drifty and inaccurate. The measurement will jump when the probe is moved.

> *Note: When not in use and during polarization, use the protective transparent cap.*

DISSOLVED OXYGEN PROBE DIAGRAM

1. Strain Relief
2. Probe Cap
3. PEI Probe Body
4. Temperature Sensor
5. Threads for Membrane Cap
6. Ag/AgCl Anode and Reference
7. Glass Insulator
8. Platinum Cathode
9. O-Ring
10. Disposable Membrane Cap
11. Oxygen Permeable PTFE Membrane
12. Shipping Tube

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)

روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

DISSOLVED OXYGEN METER CONFIGURATION

DO (Dissolved Oxygen) meter operation is configured using the SETUP key with a DO probe connected to the meter. The parameter-specific options will be seen inserted into the menu.

Parameter	Description	Choices	Default
Altitude (m)	Concentration measurements of dissolved oxygen change depending on atmospheric pressure. A convenient way to estimate atmospheric pressure effects is by the related parameter of elevation (m) above or below sea level. Enter altitude in meters closest to the actual altitude to ensure the most accurate calibration and concentration measurement.	-500, -400, -300, -200, -100, 0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 2600, 2700, 2800, 2900, 3000, 3100, 3200, 3300, 3400, 3500, 3600, 3700, 3800, 3900, 4000 m	0
Salinity (g/L)	Dissolved oxygen solubility decreases if water contains salts. Selecting this factor as to be close to your known salt level, will improve the accuracy of DO concentration calibration and measurement.	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37,38, 39, 40 g/L	0
DO Units	Select preferred measurement units for DO concentration.	mg/L or ppm	ppm

Salinity and Altitude Compensation

Temperature, altitude and salinity compensation are used for DO concentration measurements (ppm or mg/L). When the water is colder, it can hold more dissolved oxygen, when it is warmer it holds less oxygen. Compensation for temperature-related solubility is done automatically using the built-in temperature sensor within the DO probe and algorithms in edge® DO. When water is measured at an altitude below sea level, oxygen solubility increases, but above sea level the oxygen solubility decreases. To compensate for this during calibration and measurement, the user must provide the approximate altitude (in meters) in the SETUP menu. The settings are in 100 m increments; select the value closest to the actual altitude. Some examples of altitudes around the world follow:

Location	Meter	Feet
Sebkha paki Tah, Morocco	-55	-180
Lake Frome, Australia	-6	-20
Netherlands, coastal providence	-1 to -7	-3 to -23
Lake Michigan, USA	176	577
Lake Geneva; France, Switzerland	372	1220
Denver, CO USA	1609	5279
Mount Everest	8848	29029

The solubility of oxygen in water is also influenced by the amount of salt the water contains. Seawater typically has a salinity of 35 g/L and the oxygen solubility is 18 % less compared to fresh water at 25 °C. By entering the approximate salinity value, the calibration and subsequent concentration measurement will be compensated to display the correct oxygen concentration. A 18 % error would result if the salinity value is not entered.

Note: Salinity and Altitude have no effect on % oxygen solubility range.

When water is fresh (no sea water), the concentration of oxygen will be at a maximum. The solubility of the oxygen dissolved in water is decreased when water is brackish or seawater. The solubility of oxygen in water is decreased when measurements are made at elevations above sea level.

DISSOLVED OXYGEN CALIBRATION

Before proceeding with the calibration, make sure the probe is ready for measurements (see page 23), i.e. the membrane cap is filled with electrolyte, the probe is connected to the meter and properly polarized. For an accurate calibration, it is recommended to wait at least 15 minutes to ensure conditioning of the probe. Keep the protective cap on during polarization time and remove it for calibration and measurements. Follow the calibration procedure.

Calibrate the probe frequently, especially if high accuracy is required. The probe can be calibrated at 2 points: 100.0 % (slope calibration) and 0.0 % (zero calibration).

Initial Preparation
Prepare a fresh bottle of HI7040 by following package directions. Use solution within one month of preparation. Pour small quantities of HI7040 Zero Oxygen solution into a beaker. If used, remove the protective cap from the DO probe.

100% Saturated Calibration
It is suggested to perform the slope calibration in water-saturated air.
Pour water into a small beaker.
Rinse the polarized probe with clean water.
Dry the probe tip and allow a few seconds for the LCD reading to stabilize (probe in air).
Suspend probe with membrane just over the beaker of water. Press **CAL/MODIFY** key.

The "⧗" tag will be displayed along with "WAIT" blinking on the LCD until the reading is stable.
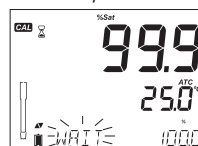
When the reading is stable and is within the limits, "CFM" tag starts blinking. Press **GLP/CFM** key to confirm the 100.0 % DO calibration.
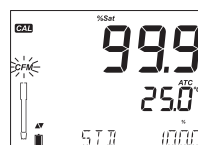
Press **CAL/MODIFY** key to leave calibration after the first point. The instrument will display "SAVING" message and it will return to measurement mode memorizing the slope calibration data.

Zero Calibration
Press **CAL/MODIFY** key or continue with calibration after confirming the first point. The meter will display "WAIT" and "0.0 %" will be displayed in lower right corner. Submerse the probe membrane and temperature sensor into the beaker containing HI7040 Zero Oxygen solution and stir gently for 2-3 minutes, the reading will go down.

When the reading is stable and stops decreasing, "CFM" tag starts blinking. Press **GLP/CFM** key to confirm the 0.0 % DO calibration.

The instrument will display "SAVING" message and it will return to measurement mode. Rinse probe tip off in water before taking measurements in samples.

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تهران ، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲
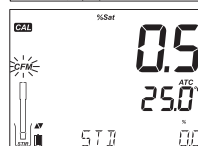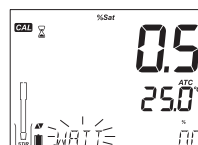
DISSOLVED OXYGEN CALIBRATION MESSAGES

If the reading is outside limits, "WRONG STANDARD" message will be displayed.
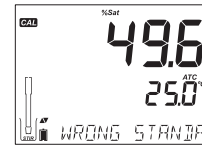
If the temperature is out of range (0.0 - 50.0 ºC) during calibration, then the message "WRONG STANDARD TEMPERATURE" will be displayed and temperature value will blink.
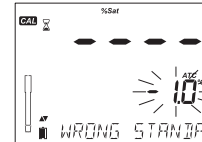
DISSOLVED OXYGEN GLP INFORMATION

GLP refers to a quality control function used to ensure uniformity of probe calibrations and measurements. The dedicated **GLP/CFM** key opens a file of the latest calibration information. Use the ⬆⬇ keys to scroll the stored information. This includes the standards used, temperature of the standard, Altitude and Salinity factors, time and date of the last calibration, the expired calibration information and the probe serial number. This information is also included with all logged data.

Last DO Calibration Data

The last DO calibration data is stored automatically after a successful calibration. To view the DO calibration data, press **GLP/CFM** key when the instrument is in measurement mode.
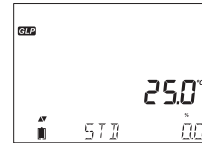
The instrument will display:
The calibration standard and the calibration temperature:

0.0 % will be displayed if the instrument was calibrated at this point.
100.0 % calibration point, if instrument was calibrated in water-saturated air.

The altitude and salinity setting at the moment of calibration together with the current reading.

The time of day that the calibration was performed together with the current reading.

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The date of the calibration together with the current reading.

Calibration Expiration status together with the current reading: If disabled, "EXPIRATION WARNING DISABLED" is displayed.
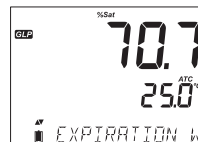
If enabled, the number of days until the calibration alarm "CAL DUE" will be displayed. (i.e. "CAL EXPIRES IN 2 DAYS")
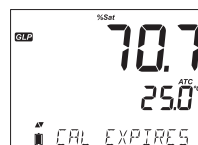
If enabled, the number of days the calibration has expired (i.e. "CAL EXPIRED 2 DAYS AGO").

The probe serial number together with the current reading.
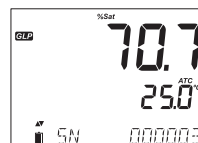
DISSOLVED OXYGEN MEASUREMENTS

Make sure that the probe is polarized, calibrated and the protective cap has been removed.
Rinse probe.
Submerse the probe in the sample to be tested, make sure the temperature probe is also immersed.
Allow time for the reading to stabilize.

Note: The sample should be stirred when taking a reading.

The Dissolved Oxygen value (in %) is displayed on the first LCD line and the temperature on the secondary LCD line.

Press **RANGE/▶** key to change the reading from % to ppm (mg/L) and vice versa.

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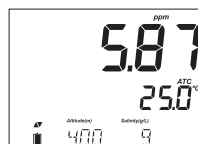
Oxygen is consumed during the measurement. For accurate DO measurements, water movement of 0.3 m/s is suggested. This is to ensure that the oxygen-depleted membrane surface is constantly measuring a representative sample. Is recommended to use magnetic stirrers. The probe has a built-in temperature sensor. Make sure it is also immersed in sample. The measured temperature is indicated on the second LCD line as shown on page 27. Allow time for the probe to reach a thermal equilibrium before taking any measurement. This can take several minutes. If the difference between the temperature at which the probe was stored and the sample's temperature is greater, the time will be longer.

If the DO temperature exceeds the limits of the probe, the message "PROBE OUT OF SPEC" will scroll on the third LCD line and LCD will display dashes. If the temperature exceeds the probe specification 50 ºC, then "50 ºC" will blink on the display. If interval logging, the message "OUT OF SPEC." will alternate with the Log specific messages in both of these cases. The Log file will indicate "ºC!" next to the data.

If the temperature sensor is damaged, "BROKEN TEMPERATURE SENSOR" will be displayed and the temperature will display "----" along with the unit tag blinking on the second LCD line. The Log file will indicate "ºC!!" next to the data.
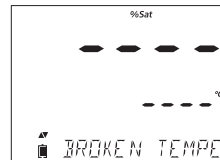
DISSOLVED OXYGEN PROBE MAINTENANCE

The DO probe body is made of PEI.
Use the protective cap when the probe is not in use. To replace the membrane or refill with electrolyte, proceed as follows:

For a new probe, remove the protective shipping tube by gently twisting and pulling it off the body of the probe (see fig. 1).

If the membrane was previously installed, unscrew the membrane cap by turning it clockwise (see fig. 2).

The new membrane cap should be rinsed with electrolyte solution. Refill with clean electrolyte solution.

Gently tap the sides of the membrane cap to ensure that no air bubbles remain trapped. Do not tap the bottom directly with your finger, as this will damage the membrane.

Make sure that the rubber O-Ring sits properly inside the membrane cap. With the sensor facing down, slowly screw the membrane cap counterclockwise. Some electrolyte will overflow.

The platinum cathode (DO Probe Diagram, page 24) should always be bright and untarnished. If it is tarnished or stained, the cathode should be cleaned. You can 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. Afterwards, rinse the probe with deionized or distilled water and install a new membrane cap using fresh electrolyte and follow DO Probe Preparation page 31.

Important

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

TWIST AND PULL
fig. 1

UNSCREW
fig. 2
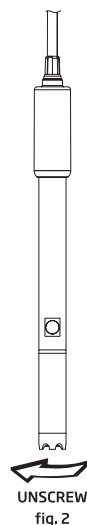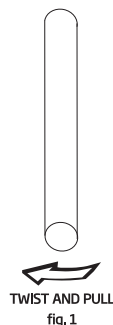
TROUBLESHOOTING GUIDE

Symptoms	Problems	Solution
Readings fluctuate up and down (noise).	DO: DO probe electrolyte contains entrapped gas.	Remove cap. Refill, tap and reinstall.
The display shows DO reading blinking.	Out of range in DO scale.	Verify area of cathode is free of bubbles inside cap. Verify solution movement past membrane. Remove cap, inspect and clean if necessary. Install new cap, fresh electrolyte with no bubbles, permit longer polarization. Stir or increase flow rate.
The meter does not measure temperature. "----" is displayed on second LCD line.	Broken temperature sensor.	Replace the probe.
At startup the meter displays all LCD tags permanently.	One of the keys is stuck.	Check the keyboard or contact your local Hanna Instruments Office.
CAL "Prod" message at startup.	Instrument was not factory calibrated or lost factory calibration.	Contact your local Hanna Instruments Office for help.

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تهران ، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

Dissolved Oxygen Specifications		
DO	Range	0.00 to 45.00 ppm (mg/L); 0.0 to 300.0%;
	Resolution	0.01 ppm (mg/L); 0.1%;
	Accuracy @ 25 °C / 77 °F	±1.5% of reading ±1 digit;
	Calibration	One or two points at 0% (HI7040) and 100% (water saturated air)
	Temperature Compensation	0.0 to 50.0 ºC; (32.0 to 122 ºF)
	Salinity Compensation	0 to 40 g/L; (with 1 g/L resolution)
	Altitude Compensation	-500 to 4,000 m (-1640 to 13120'); (with 100 m (328') resolution)
	Probe	HI764080
	Log Feature	Up to 1000 records organized in: Manual Log on Demand (Max. 200 logs) Manual Log on Stability (Max. 200 logs) Interval Logging (100 lots, Max. 600 logs/lot)
Temperature	Range	-20.0 to 120.0 ºC ; -4.0 to 248.0 °F
	Resolution	0.1 ºC; 0.1 ºF
	Accuracy	±0.5 ºC; ±0.9 ºF
Additional Specifications	PC Interface	Micro USB
	Storage Interface	USB
	Power Supply	5 VDC Adapter (included)
	Environment	0-50 ºC (32-122 ºF) Max 95% RH non-condensing
	Dimensions	202 x 140 x 12 mm (7.9 x 5.5 z 0.5")
	Weight	250 g (8.82 oz)

DO

HI7040L	Zero Oxygen Solution
HI7041S	Refilling Electrolyte Solution, 30 mL
HI764080	Spare DO probe
HI764080A/P	5 spare membranes

Other Accessories

HI75110/220U	Voltage adapter from 115 VAC to 5 VDC (USA plug)
HI75110/220E	Voltage adapter from 230 VAC to 5 VDC (European plug)
HI76404W	Electrode holder
HI2000WCW	Wall cradle
HI2000BCW	Bench cradle
HI920015	Micro USB cable

MANEDGEDO   10/16

Warranty | The edge® DO is warranted for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. Electrodes and probes are warranted for six months. This warranty is limited to repair or replacement free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered.

If service is required, contact your local Hanna Instruments Office. If under warranty, report the model number, date of purchase, serial number and the nature of the problem. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization (RGA) number from the Technical Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packed for complete protection.

Hanna Instruments reserves the right to modify the design, construction or appearance of its products without advance notice.

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هایپـرصنعت

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HANNA®
instruments

MANEDGEDO   Printed in ROMANIA

HI 9146

Dissolved Oxygen Meter

- On-screen tutorial messages
- Two point calibration
- Auto endpoint
- DO range up to 300%, temperature compensated
- Altitude compensation up to 4000 m
- Salinity compensation up to 80 g/L
- Automatic calibration in air
- GLP features
- Low battery indicator

HI 9146 is a water-resistant, dissolved oxygen meter that measures up to 300% saturation or 45 ppm (mg/L) with temperature compensation and automatic calibration. It has been developed for DO and temperature measurement in water, wastewater, and applications such as fish farming.

This instrument also allows altitude compensation up to 4000 m and the ppm and % saturation are both compensated for changes in solubility of oxygen in water and for permeability of the membrane as well as the temperature effect.

The included polarographic probe features built-in temperature compensation and removable protective membrane cover.

ORDERING INFORMATION

HI 9146-04 is supplied complete with HI 76407/4F probe with 4 m (13.1') cable, HI 76407A membranes (2), HI 7041S electrolyte solution (30 mL), batteries, instructions and rugged carrying case.
HI 9146-10 is supplied complete with HI 76407/10F probe with 10 m (32.8') cable, HI 76407A membranes (2), HI 7041S electrolyte solution (30 mL), batteries, instructions and rugged carrying case.

PROBES

| HI 76407/4F | Polarographic DO probe with protective sleeve, internal temperature sensor, DIN connector and 4 m (13') cable |
| HI 76407/10F | Polarographic DO probe with protective sleeve, internal temperature sensor, DIN connector and 10 m (33') cable |

SOLUTIONS

HI 7040M	Zero oxygen solution, 230 mL
HI 7040L	Zero oxygen solution, 500 mL
HI 7041S	Electrolyte solution, 30 mL
HI 7041M	Refilling electrolyte solution (230mL)
HI 7041L	Refilling electrolyte solution (500 mL)

ACCESSORIES

| HI 76407A/P | Replacement membranes (5) |

SPECIFICATIONS

		HI 9146
Range	O$_2$	0.00 to 45.00 mg/L (ppm)
	% Saturation O$_2$	0.0 to 300.0%
	Temperature	0.0 to 50.0°C
Resolution	O$_2$	0.01 mg/L (ppm)
	% Saturation O$_2$	0.1%
	Temperature	0.1°C
Accuracy (@ 20°C/68°F)	O$_2$	±1.5% F.S.
	% Saturation O$_2$	±1.5% F.S.
	Temperature	±0.2°C (excluding probe error)
Dissolved Oxygen Calibration		one or two points at 0% (HI 7040 solution) and 100% (in air)
Temperature Compensation		automatic, 0 to 50°C (32 to 122°F)
Altitude Compensation		0 to 4000 m (resolution 100 m)
Salinity Compensation		0 to 40 g/L (ppt) (resolution 1 g/L)
Probe		HI 76407/4F polarographic DO probe, internal temperature sensor, DIN connector and 2 m (6.6') cable (included)
Battery Type / Life		1.5V AAA (3)/approximately 200 hours of continuous use without backlight (50 hours with backlight on)
Environment		0 to 50°C (32 to 122°F); RH max 95%
Dimensions		185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight		300 g (10.6 oz.)

For a complete list of Solutions, Probes and Accessories, see the end of this section.

With Great Products, Come Great Results™

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تهران ، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

HI764113 Rugged Optical Dissolved Oxygen Probe for Fresh and Saltwater Applications

- Fast and stable readings
- Not affected by sunlight
- Factory calibrated "Smart Cap"
- Smart Caps last one year
- Minimal maintenance

- Digital, weighted probe
- No membranes
- No electrolytes
- No oxygen consumption
- No flow dependence or minimum flow rate

Alignment key

HI764113 optical DO probe
The IP68 rated waterproof ABS probe contains circuit, photodetector, and excitation and reference LEDs.

Smart Cap

Stainless steel, weighted protective guard

Smart Cap

RFID tag

Smart Cap with RFID communication stores factory calibration coefficients.

The domed surface helps repel surface bubbles and provides increased luminophore surface area for better

HI764113 Specifications

Probe Body	ABS
Smart Cap	polypropylene
Cable Jacket	PVC
Probe Guard	316 stainless steel, weighted
Temperature	thermistor
Probe Dimensions (with Guard)	174 X 25 mm (6.8 X 1")

OPdo

Optical Dissolved Oxygen Meter

Professional dissolved oxygen measurement
with digital optical probe

Design Features

- Digital optical probe with Quick Connect
- IP67 rated waterproof, rugged enclosure
- Clear, dot matrix display with multifunction virtual keys
- Dedicated HELP key

Technical Features

- Percent saturation or concentration measurements (mg/L)
- Automatic temperature compensation with one-point temperature calibration
- Salinity compensation
  - Salinity compensation allows for direct determination of dissolved oxygen in saline waters.
  - Users can set the salinity value
- Calibration timeout
  - Flags when calibration is due at a specified interval
- Built-in calculations
  - Biochemical Oxygen Demand (BOD), Oxygen Uptake Rate (OUR) and Specific Oxygen Uptake Rate (SOUR) modes
- Built-in barometer
  - Automatic barometric pressure compensation with 1 point calibration
  - Displays pressure in user-selectable units (mmHg, inHg, atm, psi, kPa, mbar)
- Data logging capability
  - Continuous data logging (with selectable intervals), log on demand, or stability
- GLP
  - GLP data provides calibration data including date, time, pressure, calibrated value, temperature and salinity value of the last five calibrations
- PC connectivity via opto-isolated USB Type-C
- Displays temperature in °C or °F
- Approximately 200 hours of continuous use using 4 AA batteries

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تهران ، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)

روبـروی پالایشگاه نفت پارس ، پلاک ۱۲

Features in Detail

Backlit graphic LCD display

The HI98198 features a backlit graphic LCD with on-screen help and battery life indicator. Dissolved oxygen, barometric pressure, and temperature readings can be displayed in user preferred units. The graphic display allows the use of virtual keys to enhance the intuitive user interface. The meter also displays a text reminder when a scheduled calibration is due.

Waterproof protection

The meter is enclosed in an IP67 rated waterproof casing and can withstand immersion in water at a depth of 1m for up to 30 minutes.

Quick connections to probes

The HI98198 meter is compatible with the HI764113 Optical dissolved oxygen probe. Connections are facilitated by the Quick Connect 7-pin DIN connector which makes attaching and removing the probe quick and easy. The meter automatically detects the connected probe.
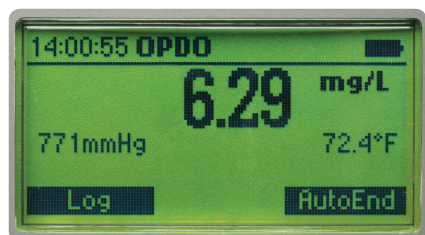
Measurement

The HI98198 automatically compensates dissolved oxygen concentrations. Temperature and atmospheric pressure compensations are automatically made. Salinity compensation can be manually entered.
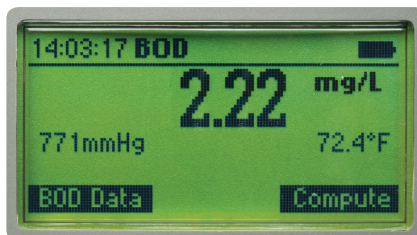
BOD, OUR and SOUR

Dedicated measurement programs are available by using the Mode selection key.

Built-in barometer

With the internal barometer, the HI98198 is able to compensate for changes in barometric pressure so there is no need for charts, altitude information or external barometric pressure information.

Pressure compensation with the meter's built-in barometer can be validated against a reference barometer, and if needed, can be recalibrated in user-selectable units (mmHg, inHg, atm, psi, kPa, mbar).

Data logging

Log on demand or stability (400 samples); interval logging (selectable 1s to 1 hour) with storage of up to 10,000 records in up to 100 files with 1,000 data points each.
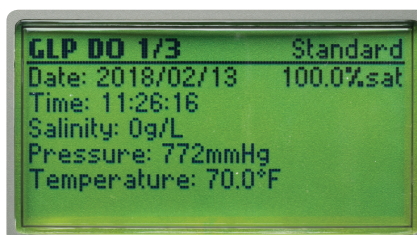
GLP

The last five sets of Calibration data are available by pressing the dedicated GLP key. Calibration values with time and date stamp are captured as well as pressure, salinity and temperature values at the time of calibration. GLP data is available on logged data.

Data transfer

USB Type-C port for easy data transfer to memory stick, PC, or other compatible devices.

Intuitive keypad

The fitted rubber keypad has dedicated keys for power, backlight, up/down arrows and help. The meter also features two virtual soft keys that navigate the user through the configuration, meter setup, and logging of data. The interface is intuitive for any user's level of experience.

Dedicated help key

Access help at any time via the Help button and view content specific information based on the screen that is currently being viewed.

AutoEnd

Press AutoEnd during measurement to hold the first stable reading on the display automatically.

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The Hanna HI764113 optical DO sensing probe is based on the principle of fluorescence quenching. The sensing method features an immobilized Pt based luminophore that is excited by the light of a blue LED and emits a red light. Dissolved oxygen quenches this excitation. As oxygen interacts with the luminophore it reduces the intensity and lifetime of the luminescence. The lifetime of the luminescence is measured by a photodetector, and is used to calculate the dissolved oxygen concentration.

The major components of the probe include a blue LED for excitation, a red LED used as a reference light, and a photodetector. The Smart Cap is locked in place on the optical probe and includes the immobilized O_2 sensitive luminophore and a rugged insoluble black oxygen permeable protective layer.

A. 0% O_2 saturation
B. 100% O_2 saturation
C. 500% O_2 saturation

intensity

microseconds
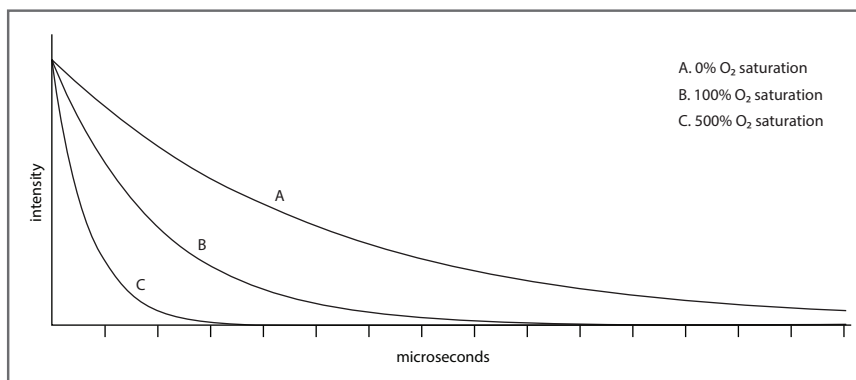
Luminophore emissions of three oxygen measurements after pulsed blue light excitation.
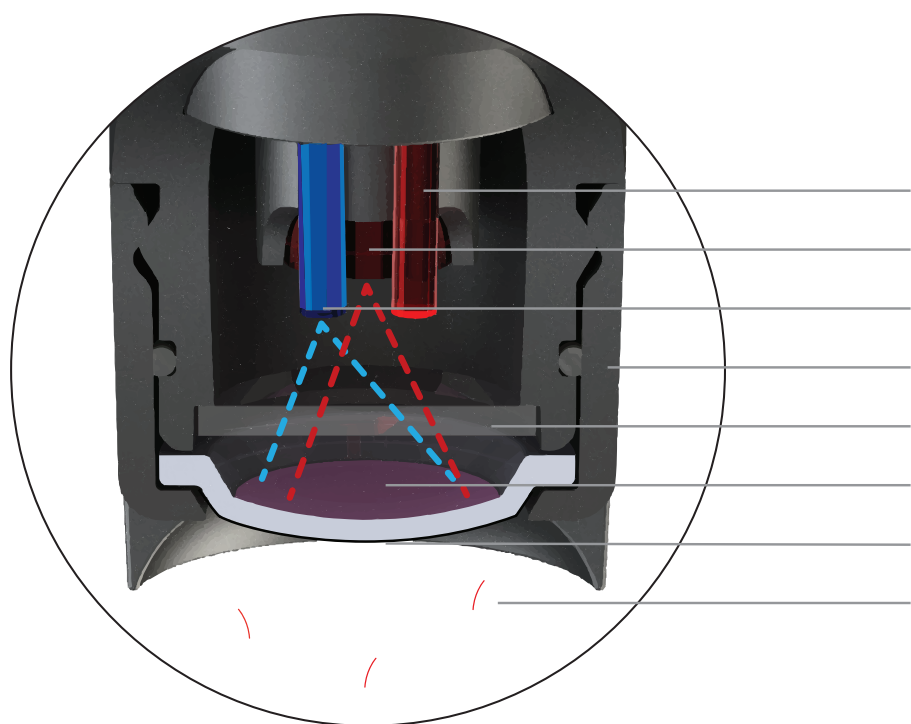
Sensor

Red light: reference source

Photodetector

Blue light: excitation source

Smart cap

Optical window

Fluorescent luminophore

Black protective layer

Oxygen molecules

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Supplied complete in a rugged, custom carrying case.

opdo Optical Dissolved Oxygen Meter

Specifications

Dissolved Oxygen	Range	0.00 to 50 mg/L (ppm); 0.0 to 500.0% saturation
	Resolution	0.01 mg/L (ppm); 0.1% saturation
	Accuracy (@25°C/77°F)	±1% of reading ±1 digit (0-20 mg/L); ±5% of reading (>20 mg/L)
	Calibration	automatic one or two point at 100 % (8.26 mg/L) and 0 % (0 mg/L); manual one point using a value entered by the user in % saturation or mg/L
Atmospheric Pressure	Range	420 to 850 mmHg
	Resolution	1 mmHg
	Accuracy (@25°C/77°F)	±3 mmHg within ±15% from the calibration point
	Calibration	one-point at any in range pressure value
Temperature	Range	-5.0 to 50.0°C; -4.0 to 248.0°F
	Resolution	0.1°C; 0.1°F
	Accuracy (@25°C/77°F)	±0.3°C; ±0.4°F (probe + meter)
	Calibration	one-point at any in range temperature value
Additional Specifications	Measurement Modes	direct DO; BOD (biochemical oxygen demand); OUR (oxygen uptake rate); SOUR (specific oxygen uptake rate)
	Barometric Compensation	automatic from 420 to 850 mmHg
	Salinity Compensation	automatic from 0 to 70 PSU
	Temperature Compensation	automatic from -5.0 to 50.0 °C (23.0 to 122.0 °F)
	Probe	HI764113 optical DO probe with stainless steel, weighted protective sleeve, internal temperature sensor, 7-pin DIN connector and 4m (13') cable (included)
	Logging	interval logging selectable in 1 second to 1 hour intervals, 10,000 records max; log-on-demand up to 400 samples
	PC Connectivity	opto-isolated USB Type-C
	Battery Type / Life	1.5V (4) AA batteries / approximately 200 hours of continuous use without backlight (50 hours with backlight)
	Auto-off	user-selectable: 5, 10, 30, 60 min or disabled
	Environment	0 to 50°C (32 to 122°F); RH 100% IP67
	Dimensions	185 x 93 x 35.2 mm (7.3 x 3.6 x 1.4")
	Weight	400 g (14.2 oz.)
Ordering Information		**HI98198** is supplied with HI764113 optical DO probe with protective sleeve, HI7040 bi-component zero oxygen solution (230 mL + 30 mL), 100 mL plastic beaker (2), 1.8 m USB Type-C cable, 1.5V AA batteries (4), quality certificate, and instruction manual in a rugged carrying case with custom insert.

HANNA® instruments

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HI9147
Portable, Water-resistant Dissolved Oxygen Meter with Galvanic Probe

Dear Customer,
Thank you for choosing a Hanna Instruments product.
Please read carefully this instruction manual before using the meter. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com or view our worldwide contact list at www.hannainst.com.

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipment. If there is any damage, please contact your local Hanna Instruments Office.
The meter is supplied complete with:

- D.O. probe, fixed:
  HI76409/4 with 4 m cable for HI9147-04
  HI76409/10 with 10 m cable for HI9147-10
- Spare membranes (HI76409A/P) with O-rings, 5 pcs.
- HI7042S electrolyte solution (30 ml bottle)
- Batteries (3 x 1.5V AAA)
- Screwdriver and instructions.
- Quality Certificate

Note: Conserve all packing material until the instrument has been observed to function correctly. Any defective item must be returned in its original packing.

GENERAL DESCRIPTION

HI9147 is a water-resistant Dissolved Oxygen meter with manual calibration, automatic temperature compensation (ATC), salinity compensation and direct probe.
Dissolved Oxygen is indicated in mg/L or in % of saturation.
The temperature can be measured in the range from -5 to 50 °C.
The Dissolved Oxygen readings are automatically compensated for the temperature effects on the oxygen solubility and membrane permeability. Moreover, the salinity compensation feature allows determination of Dissolved Oxygen even in salty waters.
The meter is housed in a rugged water-resistant case for maximum protection in the field as well as in the laboratory.
The D.O. probe is provided with a membrane covering the galvanic sensors 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. Oxygen that passes through the membrane causes a current flow, from which the oxygen concentration is determined.
Two models are available:
- HI9147-04 with HI76409/4 probe (4 m cable)
- HI9147-10 with HI76409/10 probe (10 m cable)
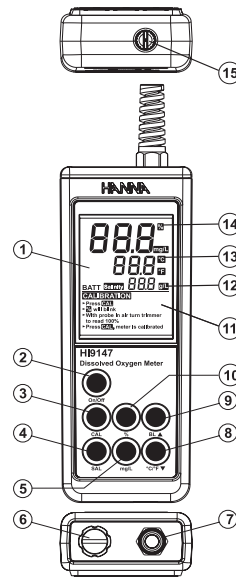
FUNCTIONAL DESCRIPTION

1) Liquid Crystal Display
2) **On/Off** key, turn the instrument ON/OFF
3) **CAL** key, to enter %DO calibration
4) **SAL** key, display setting menu of salinity factor. Use **ARROW** keys to set salinity factor. Press **SAL** to exit
5) **mg/L** key, display O_2 measurement in mg/L
6) Battery holder cap
7) **HI76409/4** or **HI76409/10** galvanic D.O. probe (fixed)
8) **°C/°F** or ▼ key, to select temperature unit or to decrease salinity, during salinity setup
9) **BL** or ▲ key, turn the backlight ON or OFF. Increase salinity coefficient during salinity setup.
10) **%** key, display O_2 measurement in % of saturation
11) DO Calibration Help screen
12) Salinity display LCD line
13) Temperature display LCD line
14) DO display LCD line
15) % trimmer, for calibration adjustment

Hanna Instruments reserves the right to modify the design, construction or appearance of its products without advance notice.

SPECIFICATIONS

Range	0.0 to 50.0 mg/L O_2
	0 to 600 % O_2
	-5.0 to 50.0 °C (23 to 122 °F)
Resolution	0.1 mg/L or 1% (O_2) / 0.1 °C (1 °F)
Accuracy	±1% of reading (O_2) / ±0.2°C (1°F) (excluding probe error)
Calibration	Manual, in saturated air
Temperature Compensation	Automatic, from 0 to 50 °C (32 to 122 °F)
Salinity	0 to 51 g/L (resolution 1 g/L) Compenstion
Probe (fixed)	HI76409/4 with 4 m cable or
	HI76409/10 with 10 m cable
Battery Type	3 x 1.5V AAA
Battery Life	1000 hours of use (BL off)
Auto-off	After approx. 8 minutes
Environment	0 to 50 °C (32 to 122 °F); max 95% RH non-condensing
Dimensions	185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight (with HI76409/4 probe)	450 g (15.9 oz.)

PROBE PREPARATION

All Hanna Instruments D.O. probes are shipped dry. To hydrate the probe and prepare it for use proceed as follows:

1. Remove the black & red plastic cap. This cap is used for shipping purposes only and can be thrown away.

2. Insert the supplied O-ring in the membrane (see figure).

3. Rinse the supplied membrane (**HI76409A**) with electrolyte while shaking it gently. Refill with clean electrolyte. Gently tap the membrane over a surface to ensure that no air bubbles remain trapped. To avoid damaging the membrane, do not touch it with your fingers.

4. With the sensor facing down screw the cap clockwise to the end of the threads. Some electrolyte will overflow.
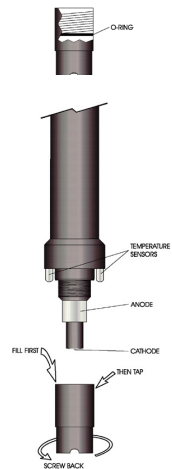
CALIBRATION

Calibration is a very simple 1-point procedure, performed in air. Ensure the probe is ready for measurements, i.e. the membrane is filled with electrolyte (see "Probe Preparation" section for details). Switch the meter on, select the % mode and turn the % trimmer to display 100%.

If the environmental relative humidity is lower than 30%, pour some deionized water (approx. 3 mm) in the white cap supplied with the membrane. Insert the probe in the cap and calibrate.

Keep the probe in vertical position to avoid any contact of the membrane with the water.

Note: For best accuracy, calibration should be performed on the measurement site, and the probe should be at the same temperature as the air.

After replacing the membrane or the electrolyte solution, wait a few minutes for the reading to stabilize.

TAKING MEASUREMENTS

Ensure the meter has been calibrated. Ensure the temperature sensors are immersed in the sample to be tested.

The D.O. reading can be displayed in % air saturation or in mg/L; press the corresponding key to enter the desired mode. The instrument also measures the temperature. Press the °C/°F button to display the temperature value in the desired unit.

The salinity coefficient is also displayed on the LCD. Press **SAL** key to enter/exit salinity setup menu. Use **ARROW** keys to modify salinity coefficient.

For accurate dissolved oxygen measurements a water movement of at least 5-7 cm/sec is required. In this way a constant replenishment of the oxygen-depleted membrane surface is ensured.

During field measurements, this condition may be achieved by manually agitating the probe into the solution being measured. Accurate readings are not possible in still water.

During laboratory operations, the use of a magnetic stirrer is recommended.

Note: For some particular applications, such as fish farming, the membrane can be sterilized with stabilized iodine (20 to 50 ppm), typically used for this purpose.

For use in harsh environments, it is recommended to protect the membrane with the optional HI76409-0 sleeve. The response time will slightly slow down.

SALINITY COMPENSATION

Oxygen measurements can be compensated for salinity factor and the correction value can be set by the user.

Press **SAL** to enter/exit salinity coefficient menu, with the help of the **ARROW** keys adjust to the desired coefficient value (within the 0 to 51 g/L range).

ALTITUDE COMPENSATION

When salinity compensation is not required (i.e. not salty water), the SAL indicator can be used to set the altitude correction value. Press the **SAL** button. Use **ARROW** keys to set desired altitude. See below table for reference:

ALTITUDE	g/L	ALTITUDE	g/L
250 m	6	1250 m	26
500 m	11	1500 m	31
750 m	17	1750 m	36
1000 m	22	2000 m	40

Press **SAL** key to exit.

PROBE & MEMBRANE MAINTENANCE

For a top performance probe, it is recommended to replace the membrane every 2 months and the electrolyte once a month. Proceed as follows:

- Unscrew the membrane by turning it counterclockwise.
- Rinse the supplied spare membrane (**HI76409A**) with some electrolyte solution while shaking it gently. Refill with clean electrolyte.
- Gently tap the membrane over a surface to ensure that no air bubbles remain trapped.
- Whit the sensor facing down screw the cap clockwise to the end of the threads. Some electrolyte will overflow.

If any deposit scales the sensors, gently brush the sensor surface with the supplied scouring pad, while paying attention to not damage the plastic body.

BATTERY REPLACEMENT

When the battery level is low, "**BATT**" tag is displayed blinking on the LCD to advise the user that approx. 1 hour of working time is left. It is recommended to change the batteries as soon as the battery indicator blinks.

To replace the batteries, follow the next steps:
- Turn OFF the instrument.
- Open the battery compartment cap (located on the top of the instrument).
- Remove old batteries.
- Insert three new 1.5V AAA batteries in the battery compartment, following the instructions on the rear of the instrument.
- Reattach the battery compartment cap.

The instrument is provided with the BEPS (Battery Error Prevention System) feature, which automatically turns the instrument off when the battery level is too low to ensure reliable readings. At start up the display will show "**0 % BATT**" message for a few seconds, then the instrument automatically turns off.

ACCESSORIES

HI76409/4*	Galvanic D.O. probe with built-in temperature sensor and 4 m cable
HI76409/10*	Galvanic D.O. probe with built-in temperature sensor and 10 m cable
HI76409-0	Protective sleeve for **HI76409** probes series
HI76409A/P	Membrane for **HI76409** probes series, 5 pcs.
HI7040L	Zero Oxygen Solution, 500 ml bottle
HI7042S	Electrolyte solution, 30 ml bottle
HI731326	Calibration screwdriver (20 pcs.)

* To be substituted by authorized technical personnel only

RECOMMENDATIONS FOR USERS

Before using this product, make sure it is entirely suitable for your specific application and for the environment in which it is used. Any variation introduced by the user to the supplied equipment may degrade the meters' performance. For yours and the meter's safety do not use or store the meter in hazardous environments.

WARRANTY

HI9147 meter is guaranteed for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. **The probes are guaranteed for one year.**

This warranty is limited to repair or replacement free of charge. Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered.

If service is required, contact your local Hanna Instruments Office. If under warranty, report the model number, date of purchase, serial number and the nature of the problem.

If the repair is not covered by the warranty, you will be notified of the charges incurred.

If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization Number from the Technical Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packed for complete protection.

IST9147 09/18

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روبـروی پالایشگاه نفت پارس، پلاک ۱۲

Instruction Manual

HI2400

Dissolved Oxygen
Bench Meter
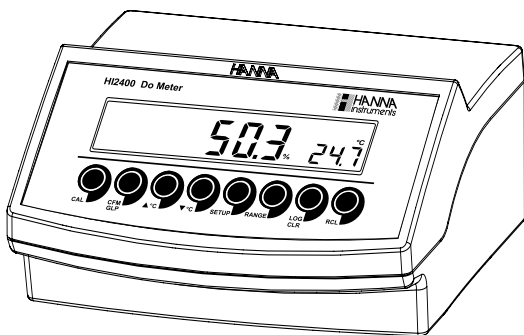
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PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occured during shipping. If there is any damage, please contact your local Hanna Instruments Office.

Each instrument is supplied with:

- **HI76407/2** DO probe with 2 m (6.7') cable
- **HI76407A** membrane cap (2 pcs)
- **HI7041S** electrolyte solution (30 ml)
- 12 VDC power adapter
- Instruction Manual

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

GENERAL DESCRIPTION

HI2400 is a logging microprocessor-based DO/Temperature bench meter.

It can store up to 100 lots in memory, with up to 8000 readings.

These readings can be transferred to a computer for further analysis or permanent storage.

Dissolved Oxygen is indicated in ppm (parts per million) or in %.

All measurements are automatically compensated for temperature. Salinity compensation in water allows direct determination of Dissolved Oxygen in saline waters and altitude compensation readjusts for the altitude variance.

The Dissolved Oxygen probe has a membrane covering the polarographic sensors and a built-in thermistor for temperature measurements and compensation.

This permeable PTFE membrane isolates the sensor elements from the testing solution, but allows Oxygen to pass through. When a voltage is applied across the sensor, oxygen that has passed through the membrane reacts causing a current flow, and hence determining a reading.

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PROBE FUNCTIONAL DESCRIPTION
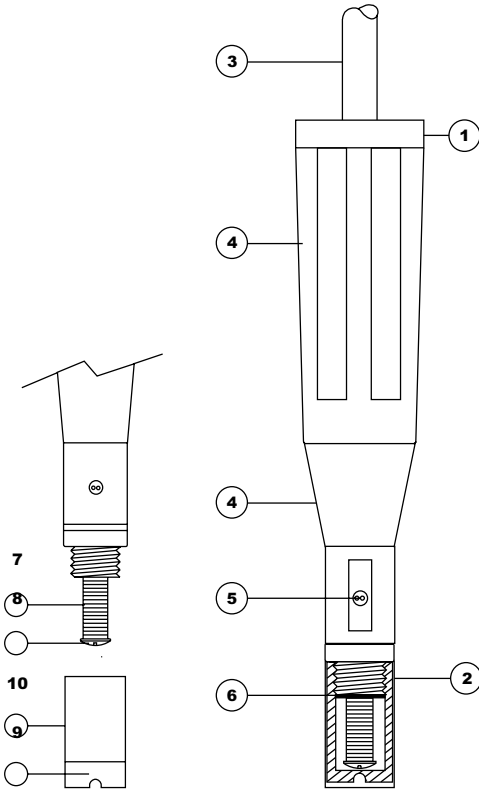
1. DO Probe
2. Protective Cap
3. Watertight Shielded Cable
4. Polypropylene Probe Body
5. Temperature Sensor
6. O-Ring Seal
7. Silver Chloride Anode
8. Platinum Cathode (sensor)
9. Oxygen Permeable PTFE Membrane
10. Membrane Cap

FUNCTIONAL DESCRIPTION
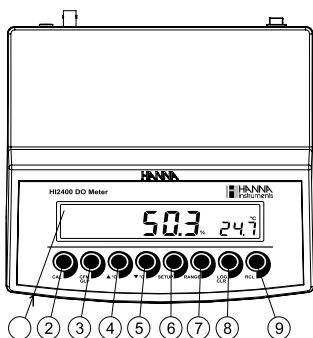
Rear Panel
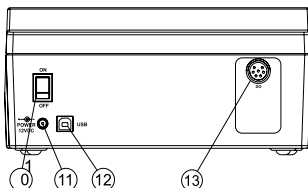
1) Liquid Crystal Display (LCD).
2) **CAL** key, to enter and exit calibration mode.
3) **CFM/GLP** key, to confirm calibration selection, different setup values or to display Good Laboratory Practice information.
4) **▲°C** key, to manually increase temperature value or other parameters.
5) **▼°C** key, to manually decrease temperature value or other parameters.
6) **SETUP** key, to enter/exit SETUP mode.
7) **RANGE** key, to select measurement range (% or ppm), switch to focused data in SETUP or toggle between standard value and temperature during calibration.
8) **LOG/CLR** key, to store a value into memory, or to select to delete log records.
9) **RCL** key, to enter and exit view memory mode.
10) **ON/OFF** switch.
11) Power supply socket.
12) USB connector.
13) DO probe connector.

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

SPECIFICATIONS

RANGE	0.00 to 45.00 ppm
	0.0 to 300.0%
	0.0 to 50.0 ºC (32.0 to 122°F)
RESOLUTION	0.01 ppm
	0.1%
	0.1 °C
ACCURACY (@20 °C / 68 °F)	$\pm$1.5% of full scale or $\pm$1 digit, whichever is greater
	$\pm$0.2 ºC (excluding probe error)
Typical EMC Deviation	$\pm$1.5% of full scale
	$\pm$0.5 ºC
DO Calibration	Single or double point at 0% (HI7040) and 100% (in air)
Altitude Compensation Resolution	0 to 4,000 m (13,120') 100 m (328')
Salinity Compensation Resolution	0 to 40 g/l 1 g/l
Temperature Compensation	0.0 to 50.0 ºC (32.0 to 122 ºF)
Probe	HI76407/2 with 2 m (6.6') cable
Logging interval	5, 10, 30 seconds or 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes
PC communication	Optoisolated USB
Power supply	12 VDC adapter
Dimensions	235 x 222 x 109 mm (9.2 x 8.7 x 4.3")
Weight	1.3 Kg (2.9 lb) kit with holder 2.1 Kg (4.6 lb)
Environment	0 – 50 ºC (32 - 122 ºF) max. 95% RH non condensing
Warranty	2 years

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OPERATIONAL GUIDE

POWER CONNECTION

Plug the 12 VDC adapter into the power supply socket.

> *Notes: - This instrument use non volatile memory to retain the calibration parameters and all the other settings even when unplugged.*
> *- Make sure a fuse protects the main line.*

PROBE CONNECTION AND PREPARATION

To take measurements, connect the DO probe to the meter securely by aligning the pins with the socket located on the back of the meter, pushing the plug in and tightening the threaded ring.

Probes shipped from Hanna Instruments are dry. 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. This cap is for shipping purposes and can be thrown away.
2. Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (**HI7041S**) for 5 minutes.
3. Rinse the membrane cap (**HI76407A** supplied in the kit with the meter) with electrolyte solution while shaking it gently. Refill with clean electrolyte solution.
4. Tap gently the sides of the membrane cap with your finger tip to ensure that no air bubbles are trapped. To avoid damaging the membrane, do not tap it directly on the bottom.
5. Make sure that the rubber O-ring sits properly inside the membrane cap.
6. With the sensor facing down, slowly screw the cap clockwise. Some electrolyte will overflow.

When not in use and during polarization (see page 9), use the protective transparent cap supplied in the kit with the meter.

Shipping cap

black

red

FILL FIRST

THEN TAP

THEN SCREW BACK ON
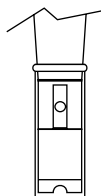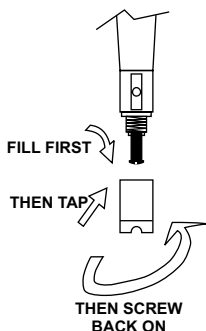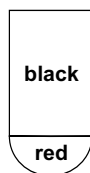
INSTRUMENT START-UP

- Turn the instrument on by pressing the **ON/OFF** switch.
- All LCD tags are displayed and a beep is generated while the instrument performs a self test.
- The instrument will display "⊠" blinking until initialization is complete.

- After a few seconds **"Cond"** message appears on the LCD to inform the user that the probe is in auto-conditioning (automatic polarization) mode.

- When this message disappears, the probe is polarized and the instrument can be calibrated.
- If the probe is disconnected, the meter will display "----".

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 when it passes through the sensitive diaphragm and dissolves in the electrolyte solution contained in the probe. If polarization 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 revealed is both that of the tested solution, as well as that present in the electrolyte solution. This reading is incorrect.

The calibration of this instrument is very simple. Before proceeding with the calibration, make sure the probe is ready for measurements (see page 8), i.e. the membrane cap is filled with electrolyte and the probe is connected to the meter and properly polarized.

For an accurate calibration, it is recommended to wait at least 15 minutes to ensure precise conditioning of the probe. Keep the protective cap on during polarization time and remove it for calibration and measurements. Follow the calibration procedure (see page 11).

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SALINITY AND ALTITUDE COMPENSATION

If the sample contains significant concentration of salinity or if you are performing measurements at an altitude different from sea level, the read out values must be corrected, taking into account the lower degree of oxygen solubility in these situations (see pages 15-16).

Remember to set the altitude and/or the salinity before taking any DO measurements. The meter will automatically compensate for these factors.

DO MEASUREMENTS

Make sure that the instrument has been calibrated and the protective cap has been removed.

• Submerse the tip of the probe in the sample to be tested. Allow approximately one minute for the reading to stabilize.

• The Dissolved Oxygen value (in %) is displayed on the primary LCD and the temperature on the secondary LCD.

$$50.3_\% \quad 24.7^\circ C$$

• Press **RANGE** to change the reading from % to ppm and vice-versa.

$$ppm \quad 3.85 \quad 24.7^\circ C$$
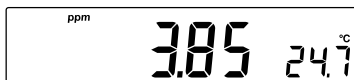
For accurate Dissolved Oxygen measurements, a water movement of 0.3 m/s is required. This is to ensure that the oxygen-depleted membrane surface is constantly replenished. A moving stream will provide adequate circulation.

The use of a magnetic stirrer to ensure a certain fluid velocity is recommended.

TEMPERATURE MEASUREMENTS

The probe has a built-in temperature sensor.

The measured temperature is indicated on the secondary LCD as shown above.

Allow the probe to reach thermal equilibrium before taking any measurement. This can take several minutes. The greater the difference between the temperature at which the probe was stored and the temperature of the sample, the longer the time will be.

Note: If "—" is displayed, the DO probe is not properly connected. This also indicates the possibility of a broken probe cable. If the temperature is displayed blinking, the temperature is out of range.

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DO CALIBRATION

Calibrate the instrument frequently, especially if high accuracy is required. The instrument can be calibrated in maximum 2 points: 0.0% (zero calibration) and 100.0% (slope calibration).

The zero calibration of the **HI2400** is very stable, therefore this procedure needs to be performed only whenever the probe or the membrane is replaced.

However, because the slope calibration is more critical, it is recommended to perform this procedure every week.

INITIAL PREPARATION

- Pour small quantities of **HI7040** Zero Oxygen solution into a beaker. If possible, use a plastic beaker to minimize any EMC interferences.
- Make sure the probe is ready for measurements (see probe preparation on page 8), i.e. the membrane is filled with electrolyte and the probe is connected to the meter.
- Switch the meter on by pressing the **ON/OFF** switch.
- For an accurate calibration, it is recommended to wait for at least 15 minutes to ensure precise conditioning of the probe.
- Remove the protective cap from the DO probe.
- Set the appropriate altitude factor (see page 15). Make sure the salinity factor is set to zero (see page 16).
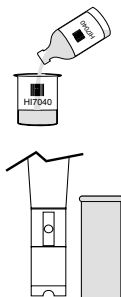
ZERO CALIBRATION

- Submerse the probe into **HI7040** zero oxygen solution and stir gently for 2-3 minutes.
- Press **CAL**. The "~" and "⧈" tags will blink on the LCD until the reading is stable.
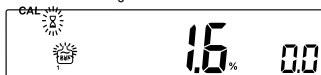
- When the reading is stable, "CFM" starts blinking. Press **CFM** to confirm the "**0.0%**" DO calibration.
- If the reading is within the limits ($\pm15\%$ f.s.), the meter stores the value (and adjusts the slope point).

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- Press **CAL**. The instrument will return to measurement mode and will memorize the zero calibration data. For a two-point calibration do not press **CAL** and follow the procedure below.

SLOPE CALIBRATION

It is suggested to perform the slope calibration in air.

- Rinse the probe in clean water to remove any residual zero oxygen solution.

Note: If you did not perform the zero calibration procedure, press CAL and then the ARROW keys to select the 100% DO calibration point.

 OR

- Dry the probe tip and allow a few seconds for the LCD reading to stabilize. The "~" and "⊠" tags will blink until the reading is stable.
- When the reading is stable, "CFM" tag starts blinking. Press **CFM** to confirm the "100.0%" DO calibration.
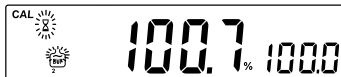
- If the reading is within the limits ($\pm 15\%$ f.s.), the meter stores the value (and adjusts the slope point).
- The instrument stores the slope calibration data and returns to measurement mode.

Notes: • If the reading is not close to the selected value, "**WRONG**" tag will blink.
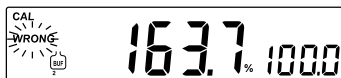
• If the temperature goes out of range during calibration the "**WRONG**", temperature unit tag and both measurements will blink.
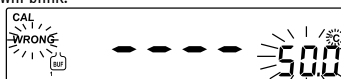
• **HI 2400** has automatic buffer recognition function. If the **ARROW** keys are pressed to select the desired calibration value, the automatic buffer recognition function is disabled.

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![FAMCO هایپرصنعت]

GOOD LABORATORY PRACTICE (GLP)

GLP is a set of functions that allows storage and retrieval of data regarding the maintenance and status of the system.

All data regarding DO calibration is stored for the user to review when necessary.

LAST DO CALIBRATION DATA

The last DO calibration data is stored automatically after a successful calibration. To view the DO calibration data, press **GLP** when the instrument is in measurement mode.

The instrument will display the time (hh:mm) of the last calibration.

Press the **ARROW** keys to view the next calibration parameter.

$$13{:}28 \quad \text{Time}$$

Pressing the ▲ key:

• The date of the calibration.

$$07.24\ 2009 \quad \text{Date}$$

• The calibration standards.

$$0.0_{\%} \quad Std$$

• Press

SETUP to view the temperature of the calibration.

$$0.0_{\%} \quad 24.7 \quad °C$$

• The altitude value.

$$300 \quad ALt \quad m$$

• The salinity value.

$$3 \quad SAL \quad g/L \; NaCl$$

• The instrument ID.

$$9985 \quad In\,Id$$

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SETUP

Setup mode allows viewing and modifying the following parameters:

- Salinity Factor
- Altitude Factor
- Log Interval
- Current Time (hour & minute)
- Current Date (month, day & year)
- Beep Status
- Instrument ID
- Temperature Unit

To enter the Setup mode press **SETUP** while the instrument is in measurement mode. Press **SETUP** again to exit SETUP mode.

Select a parameter with the **ARROW** keys.

Press **CAL** if you want to change a parameter value. The selected parameter will blink.

Press **RANGE** to toggle between displayed paramet+ers.

Press the **ARROW** keys to increase or decrease the displayed value.

Press **CFM** to save the modified value or **CAL** to escape.

Press the **ARROW** keys to select the next/previous parameter.

SALINITY FACTOR

Press **CAL** when the salinity factor is displayed. The salinity factor ("**0**" to "**40**" g/l) and the "**CFM**" tag will start blinking.
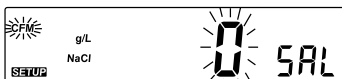
Press **ARROW** keys to change the salinity factor value.

Press **CFM** to save the modified value or press **CAL** to escape without saving.

The salinity affects the DO concentration, decreasing its value. The next table shows the maximum oxygen solubility at various temperatures and salinity levels.

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°C	Salinity (g/l) at Sea Level					°F
	0 g/l	10 g/l	20 g/l	30 g/l	35 g/l	
0	14.60	13.64	12.74	11.90	11.50	32.0
2	13.81	12.91	12.07	11.29	10.91	35.6
4	13.09	12.25	11.47	10.73	10.38	39.2
6	12.44	11.65	10.91	10.22	9.89	42.8
8	11.83	11.09	10.40	9.75	9.44	46.4
10	11.28	10.58	9.93	9.32	9.03	50.0
12	10.77	10.11	9.50	8.92	8.65	53.6
14	10.29	9.68	9.10	8.55	8.30	57.2
16	9.86	9.28	8.73	8.21	7.97	60.8
18	9.45	8.90	8.39	7.90	7.66	64.4
20	9.08	8.56	8.07	7.60	7.38	68.0
22	8.73	8.23	7.77	7.33	7.12	71.6
24	8.40	7.93	7.49	7.07	6.87	75.2
25	8.24	7.79	7.36	6.95	6.75	77.0
26	8.09	7.65	7.23	6.83	6.64	78.8
28	7.81	7.38	6.98	6.61	6.42	82.4
30	7.54	7.14	6.75	6.39	6.22	86.0
32	7.29	6.90	6.54	6.19	6.03	89.6
34	7.05	6.68	6.33	6.01	5.85	93.2
36	6.82	6.47	6.14	5.83	5.68	96.8
38	6.61	6.28	5.96	5.66	5.51	100.4
40	6.41	6.09	5.79	5.50	5.36	104.0
42	6.22	5.93	5.63	5.35	5.22	107.6
44	6.04	5.77	5.48	5.21	5.09	111.2
46	5.87	5.61	5.33	5.07	4.97	114.8
48	5.70	5.47	5.20	4.95	4.85	118.4
50	5.54	5.33	5.07	4.83	4.75	122.0

Note: The relationship between salinity and chlorinity for sea water is given by the equation below:

Salinity (g/l) = 1.80655 Chlorinity (g/l)

ALTITUDE FACTOR

Press **CAL** when the altitude factor is displayed. The altitude factor ("**0**" to "**4000**" m, in steps of 100 m; 1 meter = 3.28 feet) and the "**CFM**" tag will start blinking.

Press the **ARROW** keys to change the altitude factor value.
Press **CFM** to save the modified value or press **CAL** to escape without saving.

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| °C	Altitude, Meters above Sea Level															°F
	0	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4000	
	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	
0	14.6	14.1	13.6	13.1	12.6	12.1	11.7	11.2	10.8	10.4	10.0	9.7	9.3	9.0	8.9	32.0
2	13.8	13.3	12.8	12.4	11.9	11.5	11.0	10.6	10.2	9.9	9.5	9.2	8.8	8.5	8.4	35.6
4	13.1	12.6	12.2	11.7	11.3	10.9	10.5	10.1	9.7	9.3	9.0	8.7	8.4	8.0	7.9	39.2
6	12.4	12.0	11.5	11.1	10.7	10.3	9.9	9.6	9.2	8.9	8.6	8.2	7.9	7.6	7.5	42.8
8	11.8	11.4	11.0	10.6	10.2	9.8	9.5	9.1	8.8	8.4	8.1	7.8	7.5	7.3	7.2	46.4
10	11.3	10.9	10.5	10.1	9.7	9.4	9.0	8.7	8.4	8.1	7.8	7.5	7.2	6.9	6.8	50.0
12	10.8	10.4	10.0	9.6	9.3	8.9	8.6	8.3	8.0	7.7	7.4	7.1	6.9	6.6	6.5	53.6
14	10.3	9.9	9.6	9.2	8.9	8.5	8.2	7.9	7.6	7.4	7.1	6.8	6.6	6.3	6.2	57.2
16	9.9	9.5	9.2	8.8	8.5	8.2	7.9	7.6	7.3	7.0	6.8	6.5	6.3	6.1	6.0	60.8
18	9.5	9.1	8.8	8.5	8.1	7.8	7.6	7.3	7.0	6.8	6.5	6.3	6.0	5.8	5.7	64.4
20	9.1	8.8	8.4	8.1	7.8	7.5	7.3	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.5	68.0
22	8.7	8.4	8.1	7.8	7.5	7.2	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.3	71.6
24	8.4	8.1	7.8	7.5	7.2	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.1	75.2
25	8.3	8.0	7.7	7.4	7.1	6.8	6.6	6.4	6.1	5.9	5.7	5.5	5.3	5.1	5.0	77.0
26	8.1	7.8	7.5	7.2	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.0	4.9	78.8
28	7.8	7.5	7.3	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.7	82.4
30	7.6	7.3	7.0	6.8	6.5	6.3	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.6	86.0
32	7.3	7.0	6.8	6.5	6.3	6.1	5.8	5.6	5.4	5.2	5.0	4.8	4.7	4.5	4.4	89.6
34	7.1	6.8	6.6	6.3	6.1	5.9	5.6	5.4	5.2	5.0	4.9	4.7	4.5	4.3	4.3	93.2
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.1	96.8
38	6.6	6.4	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.1	4.0	100.4
40	6.4	6.2	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.6	4.4	4.2	4.1	3.9	3.9	104.4
42	6.2	6.0	5.8	5.6	5.3	5.2	5.0	4.8	4.6	4.4	4.3	4.1	4.0	3.8	3.8	107.6
44	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.5	4.3	4.1	4.0	3.8	3.7	3.7	111.2
46	5.8	5.6	5.4	5.2	5.0	4.8	4.7	4.5	4.3	4.2	4.0	3.9	3.7	3.6	3.5	114.8
48	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.0	3.9	3.7	3.6	3.5	3.4	118.4
50	5.5	5.3	5.1	4.9	4.7	4.6	4.4	4.2	4.1	3.9	3.8	3.6	3.5	3.4	3.3	122.0

LOG INTERVAL

Press **CAL** when log interval is displayed. The log interval and "**CFM**" tag is displayed blinking.
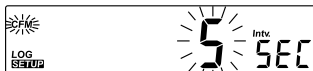
Press the **ARROW** keys to change the custom buffer value.
Press **CFM** to confirm the selection.
Press **CAL** to escape without saving.

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CURRENT TIME

Press **CAL** when the current time is displayed. The hour and "CFM" tag will start blinking.

Press the **ARROW** keys to change the hour.
Press **RANGE**. The minutes will start blinking.

Press the **ARROW** keys to change the minutes.
Press **CFM** to save the modified value.
Press **CAL** to escape without saving.

CURRENT DATE

Press **CAL** when the current date is displayed. The month and "CFM" tag will start blinking.

Press the **ARROW** keys to change the month.
Press **RANGE**. The day and "CFM" tag will start blinking.

Press the **ARROW** keys to change the day.
Press **RANGE**. The year and "CFM" tag will start blinking.

Press the **ARROW** keys to change the year.
Press **CFM** to save the modified value.
Press **CAL** to escape without saving.

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BEEP STATUS

Press **CAL** when the beep status is displayed. The beep status ("ON" or "OFF") and "CFM" tag will start blinking.

Press the **ARROW** keys to change the beep status.

Press **CFM** to save the modified value or press **CAL** to escape without saving.

INSTRUMENT ID

Press **CAL** when "InId" is displayed. The instrument ID ("0000" to "9999") and "CFM" tag will start blinking.

Press the **ARROW** keys to change the instrument ID value.

Press **CFM** to save the modified instrument ID value.

Press **CAL** to escape without saving.

Note: The instrument ID is downloaded to a PC as part of a logged data, set to identify its origin.

TEMPERATURE UNIT

Press **CAL** when "Unit" is displayed. The temperature unit and "CFM" tag will start blinking.

Press the **ARROW** keys to change the option.

Press **CFM** to save the modified temperature unit.

Press **CAL** to escape without saving.

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LOGGING

This function allows the user to log DO (in ppm or %) together with temperature automatically, for long periods of time. All logged data can be stored into a PC through the USB port.

The memory used for storing the logged data is divided in 32 pages. The capacity of each page is 250 samples. The lot number goes from 1 to 100. The maximum capacity of the log memory is 8000 samples. Each time a new lot starts, it automatically starts from a new page. When the samples collected for a single lot reach the limit (8000 samples) or all memory pages are occupied, the meter stops logging automatically. The appropriate logging interval can be set between 5, 10, 30 seconds or 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes (see SETUP section for details).

LOGGING THE CURRENT DATA

To start the Auto LOG mode press LOG while in measurement mode.

When the selected interval is reached the instrument will display the current lot number on the primary LCD line, the record number on the secondary LCD line and the LOG tag (see example below: Lot 15 record 22)

$$\boxed{\text{LOG} \quad L \ 15 \ {}^{\text{Log\#}} \ 22}$$
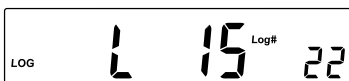
followed by the number of free records on the corresponding memory space.

$$\boxed{\text{LOG} \quad FrEE \ 1228}$$

If there are less than 6 memory locations remaining, the record number and "Lo" message will be displayed to alert the user.

$$\boxed{\text{LOG} \quad Lo \ 5}$$
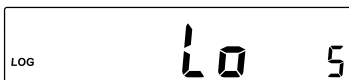
To stop the Auto LOG mode press LOG again. The "LOG" tag will be cleared.

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If the log space is full, the "FULL LOG" message will be displayed and no more data will be saved.

$$FULL \ {}_{LOG}$$

Note: When pressing any key that is not active, while lot logging is running, the following message is displayed for a few seconds.

$$_{LOG} \ Auto \ run$$

VIEW LOGGED DATA

Press the RCL key while in measurement mode to retrieve the stored information.

If no lots are memorized, the next messages will be displayed:

$$no \ rEc$$

Otherwise, the instrument will display "L" and the lot number on the primary LCD and the number of records on the secondary LCD, "RCL" tag and "CFM" blinking.

$$L \ 78 \ 75$$

Press the ARROW keys to select a different lot.

Press CFM to view record information. Then the record information will appear. To view the record number at any time just press the SETUP key.

$$46.8_{\%} \ 24.7_{°C}$$

Use the ARROW keys to scroll through the records.

To view additional information press RANGE:

* The **time** on the primary LCD, along with **"TIME"** tag and the seconds on the secondary LCD.

$$14:02 \ 52'$$

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- The **date** on the primary LCD, along with **"DATE"**, month and day tags.

- The **salinity** on the primary LCD and **"SAL"** message on the secondary LCD.
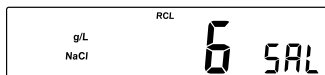
- The **altitude** on the primary LCD and **"ALt"** message on the secondary LCD.

- The interval for lot logging.
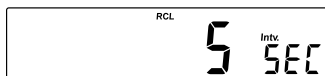
TO DELETE LOTS

To delete a lot, use the **ARROW** keys to select the desired lot. Press **CLR** key.

The "**dEL**" message is displayed on the primary LCD and the selected lot on the secondary LCD, along with "**RCL**" tag.

- The **ARROW** keys can be used to change the lot number.
- Press **SETUP** to select delete all lots feature. The display will show "**dEL**" in the primary LCD and "**ALL**" in the secondary LCD.

- Press **CFM** to confirm delete.
- Press **CAL, CLR** or **RCL** to escape and return to the RCL screen.
- If "**dEL ALL**" option was selected, all the lots are deleted. The "**no rEc**" message will appear.
- Press **RCL** exit record information and enter lot information.
- Press **RCL** again to return to measurement mode.

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TEMPERATURE CALIBRATION
(for technical personnel only)

Each meter has been factory calibrated for temperature with the supplied DO probe and is ready for measurements.

The DO probes are interchangeable and no temperature calibration is needed.

If the temperature measurements are not accurate, temperature recalibration should be performed.

For an accurate recalibration, contact your local Hanna Instruments Office, or follow the procedure below.

• Prepare a vessel containing ice and water and another one containing hot water (at a temperature of around 50 °C). Place insulation material around the vessels to minimize temperature changes.

• Use a calibrated thermometer with a resolution of 0.1 °C as a reference thermometer. Connect the **HI76407/2** DO probe to the appropriate socket.

• With the instrument off, press and hold down **CFM&SETUP**, then power on the instrument. The "**CAL**" tag will appear and the secondary LCD will show "**0.0 °C**".

• Submerse the DO probe in the vessel with ice and water as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.

• Use the **ARROW** keys to set the reading on the secondary LCD to that of ice and water, measured by reference thermometer. When the reading is stable, the "**CFM**" tag starts blinking.

0°C
(32°F)

• Press **CFM** to confirm. The secondary LCD will show "**50.0 °C**".

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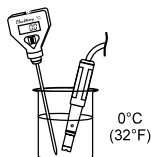
- Submerse the DO probe in the second vessel as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.

- Use the **ARROW** keys to set the reading on the secondary LCD to that of the hot water.

- When the reading is stable, the "**CFM**" tag starts blinking.

- Press **CFM** to confirm. The instrument returns to measurement mode.

50°C
(122°F)
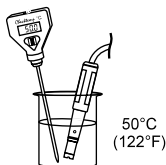
Note: If the reading is not close to the selected calibration point, "WRONG" tag will blink. In this case, check if the value set on the secondary LCD and the temperature measured with reference thermometer are close. Change the DO probe or restart calibration if necessary.

PC INTERFACE

Data transmission from the instrument to the PC can be done with the **HI92000** Windows® compatible software (optional). **HI92000** also offers graphing and an on-line help feature.

Data can be exported to the most popular spreadsheet programs for further analysis.

To connect your instrument to a PC, use a standard USB cable. Make sure that your instrument is switched off and plug one connector to the instrument's USB socket and the other to the USB port of your PC.

To allow our users access to the latest version of Hanna Instruments PC compatible software, we made the products available for download at **http://software.hannainst.com**. Select the product code and click Download Now. After download is complete, use the setup.exe file to install the software.

Note: If you are not using Hanna Instruments HI92000 software, please see the following instructions.

SENDING COMMANDS FROM PC

It is also possible to remotely control the instrument with any terminal program. Use a standard USB cable to connect the instrument to a PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control, baud rate 9600.

COMMAND TYPES

To send a command to the instrument follow the next scheme:

$<$ command prefix $>$ $<$ command $>$ $<$ CR $>$

where: $<$ command prefix $>$ is a selectable ASCII character between 0 and 47 (default 16).

$<$ command $>$ is the command code.

Note: Either small or capital letters can be used.

SIMPLE COMMANDS

RNG	Is equivalent to pressing **RANGE**
CAL	Is equivalent to pressing **CAL**
CFM	Is equivalent to pressing **CFM**
UPC	Is equivalent to pressing the **UP** arrow key
DWC	Is equivalent to pressing the **DOWN** arrow key
LOG	Is equivalent to pressing **LOG**
RCL	Is equivalent to pressing **RCL**
SET	Is equivalent to pressing **SETUP**
CHR xx	Change the instrument's range according to the parameter's value (xx):

- xx $=$ 06 % range
- xx $=$ 07 ppm range

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The instrument will answer for these commands with:

        <STX> <answer> <ETX>

where: <STX> is 02 ASCII code character (start of text)

            <ETX> is 03 ASCII code character (end of text)

            <answer>:

            <ACK> is 06 ASCII code character (recognized command)

            <NAK> is 21 ASCII code character (unrecognized command)

            <CAN> is 24 ASCII code character (corrupted command)

COMMANDS REQUIRING AN ANSWER

The instrument will answer for these commands with:

        <STX> <answer> <checksum> <ETX>

where the checksum is the bytes sum of the answer string sent as 2 ASCII characters.

All the answer messages are with ASCII characters.

RAS   Causes the instrument to send a complete set of readings.

        The answer string contains:

- Meter mode (2 chars):
    - 06 - % range
    - 07 - ppm range
- Meter status (2 chars of status byte): represents an 8 bit hexadecimal encoding.
    - 0x10 - temperature probe is connected
    - 0x01 - new GLP data available
    - 0x02 - new SETUP parameter
- Reading status (1 char): R - in range, O - over range, U - under range.
- The reading (corresponding to the selected range) - 7 ASCII chars, including sign and decimal point.
- Temperature reading - 7 ASCII chars, with sign and two decimal points, always in ºC.

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MDR   Requests the instrument's model name and firmware code (16 ASCII chars).

GLP   Requests the calibration data record.

The answer string contains:

- GLP status (1 char): represents a 4 bit hexadecimal encoding.
  - 0x04 - DO calibration available
- DO calibration data (if available), which contains:
  - the number of calibrated satandards (1 char)
  - the calibration time, **yymmddhhmmss** (12 chars)
  - standards information
  - standard value, with sign and decimal point (7 chars).
  - the standard temperature, with sign and decimal point (7 chars)
    - the salinity value (4 chars)
    - the altitude value (4 chars)

PAR   Requests the setup parameters setting.

The answer string contains:

- Instrument ID (4 chars)
  - SETUP information (2 chars): 8 bit hexadecimal encoding.
    - 0x01 - beep ON (else OFF)
    - 0x04 - degrees Celsius (else degrees Fahrenheit)
  - Log type - 01 to 12 - the coresponding interval for lot log (5 s to 180 min)
  - Salinity value (4 chars)
  - Altitude value (4 chars)

LLsxff: requests information about all lots and it sends the information in frames of 10 lots each (a frame contains information about 10 lots)

Command Parameters:

    x = D - request DO data

        ff - requested frame number - first frame is labeled 01

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GLDxxxfff: Requests the records of the "xxx" lot number. The records
             are sent in frames of 10 records; "fff" is the frame number (01
             first frame). (Example: Lot 13 has 53 records. The records will
             be sent in 6 frames, 5 with10 records and 1 with 3 records.)
             Command Parameters:

   xxx - Lot number (eq: for lot number 1 xxx = 001)
   fff - requested frame number - first frame is labeled 01

Notes: • "Err3" is sent if the Log on demand is empty.

   • "Err4" is sent if the requested set parameter is not available.

   • "Err5" is sent if the command argument is wrong.

   • "Err6" is sent if the requested range is not available.

   • "Err7" is sent if the instrument is logging.

   • "Err8" is sent if the instrument is not in measurement mode.

   • Invalid commands will be ignored.

w w w . f a m c o c o r p . c o m
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PROBE AND MEMBRANE MAINTENANCE

The oxygen probe body is made of reinforced plastic for maximum durability.

A thermistor temperature sensor provides temperature measurements of the sample. Use the protective probe cap when not in use.

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

- Remove the protective cap by gently twisting and pulling it off the body of the probe (see fig. 1).

- Unscrew the membrane cap by turning it counterclockwise (see fig. 2).

- Wet the sensor by soaking the bottom $2\frac{1}{2}$ cm (1") of the probe in electrolyte (**HI7041S**) for 5 minutes.

- Rinse the new membrane cap (**HI76407A**), supplied with the meter with electrolyte solution while shaking it gently. Refill with clean electrolyte solution.

- Gently tap the sides of the membrane cap with your finger tip to ensure that no air bubbles remain trapped. Do not tap directly the bottom with your finger, as this will damage the membrane.

- Make sure that the rubber O-ring sits properly inside the membrane cap.

- With the sensor facing down, slowly screw the membrane cap clockwise. Some electrolyte will overflow.

The Platinum cathode (#8 in the Functional Description page 4) should always be bright and untarnished. If it is tarnished or stained, the cathode should be cleaned. You can use a clean lint-free cardboard or cloth. Rub the cathode very gently side to side 4-5 times.

TWIST AND PULL

fig. 1

UNSCREW

fig. 2

This will be enough to polish and remove any stains without damaging the platinum tip. Afterwards, rinse the probe with deionized or distilled water and install a new membrane cap using fresh electrolyte and follow the steps above. Recalibrate the instrument.
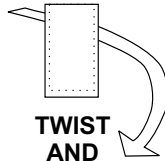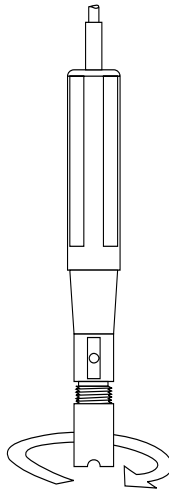
Important

In order to have accurate and stable measurements, it is important that the membrane surface is in perfect condition. This semipermeable membrane isolates the sensor elements from the environment but allows oxygen to enter. If any dirt is observed on the membrane, rinse carefully with distilled or deionized water. If any imperfections still exist, or any damage is evident (such as wrinkles or tears-holes), the membrane should be replaced.

Make sure that the O-Ring sits properly in the membrane cap.

TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Readings fluctuate up and down (noise).	DO probe sleeve wasn't inserted properly.	Insert the sleeve.
The display shows DO reading blinking.	Out of range in DO scale.	Recalibrate the meter. Make sure the solution is in specified range.
The meter does not measure the temperature.	Broken probe.	Replace the probe.
The meter fails to calibrate or gives faulty readings.	Broken probe.	Replace the probe.
At startup the meter displays all LCD tags permanently.	One of the keys is blocked.	Check the keyboard or contact the vendor.
"Err xx" error message displayed.	Internal error.	Power off the meter and then power it on. If the error persists, contact the vendor.
CAL "Prod" message at startup.	Instrument not factory calibrated.	Contact Hanna Technical Support for factory calibration.

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ACCESSORIES

HI7040M	Zero Oxygen Solution, 230 ml
HI7040L	Zero Oxygen Solution, 500 ml
HI7041S	Refilling Electrolyte Solution, 30 ml
HI710005	115VAC to 12VDC converter
HI710006	230VAC to 12VDC converter
HI76407/2	Spare probe with 2 meters (6.7') cable
HI76407/10	Spare probe with 10 meters (33') cable
HI76407/20	Spare probe with 20 meters (67') cable
HI76407A/P	5 spare membranes
HI76404N	Electrode holder
OTHER ACCESSORIES	
HI710005	Voltage adapter from 115 VAC to 12 VDC (USA plug)
HI710006	Voltage adapter from 230 VAC to 12 VDC (European plug)
HI710012	Voltage adapter from 240 VAC to 12 VDC (UK plug)
HI710013	Voltage adapter from 230 VAC to 12 VDC (South African plug)
HI710014	Voltage adapter from 230 VAC to 12 VDC (Australian plug)
ChecktempC	Pocket-size thermometer (range −50.0 to 150.0 ºC)
HI76310	Platinum 4-ring conductivity/TDS probe with temperature sensor and 1 m (3.3') cable
HI92000	Windows® compatible software.

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