Instruction Manual

HI2400

Dissolved Oxygen
Bench Meter
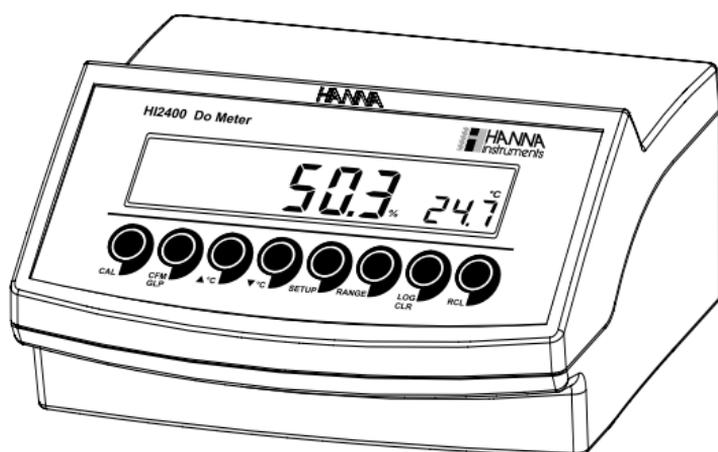
HANNA®
instruments

www.hannainst.com

Dear Customer,

Thank you for choosing a Hanna Instruments product.

Please read this instruction manual carefully before using these instruments.

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

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.

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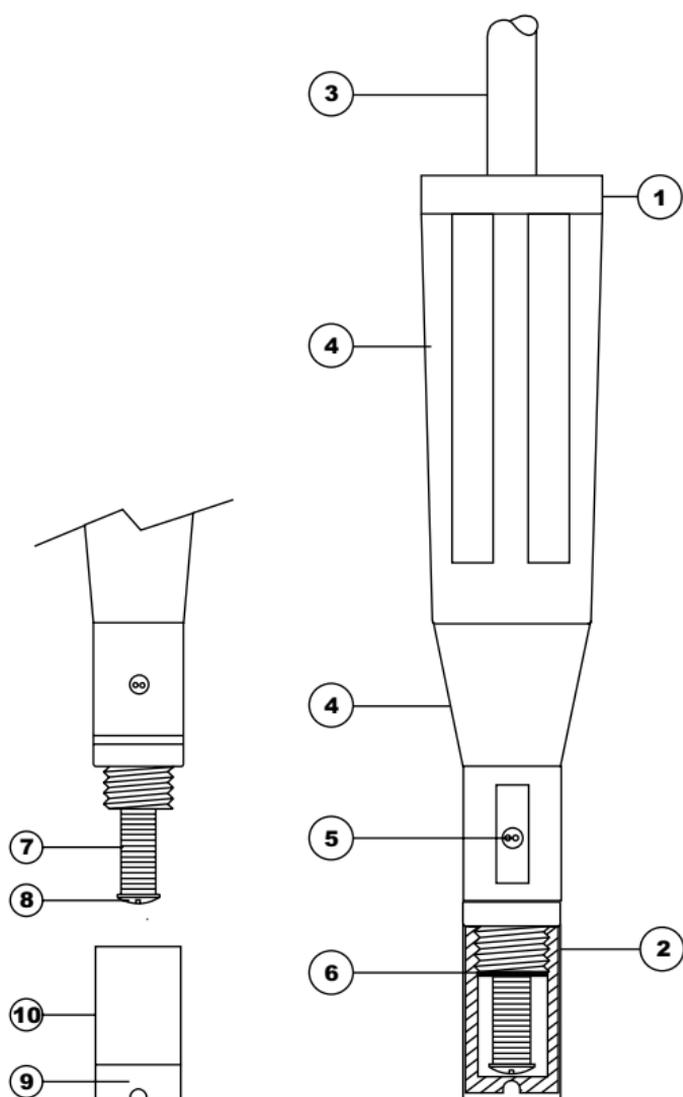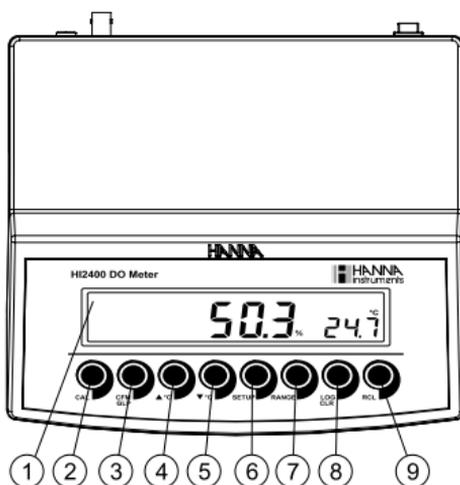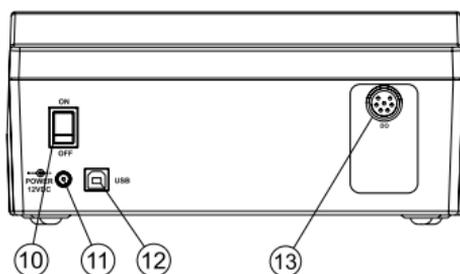
1. DO Probe
2. Protective Cap
3. Watertight Shielded Cable
4. Polypropylene Probe Body
5. Temperature Sensor
6. O-Ring Seal
7. Silver Chloride Anode
8. Platinum Cathode (sensor)
9. Oxygen Permeable PTFE Membrane
10. Membrane Cap

FUNCTIONAL DESCRIPTION

Front Panel

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.

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)	±1.5% of full scale or ±1 digit, whichever is greater
	±0.2 ºC (excluding probe error)
Typical EMC Deviation	±1.5% of full scale
	±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

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.

Shipping cap

black

red

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.

FILL FIRST

THEN TAP

THEN SCREW BACK ON

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.
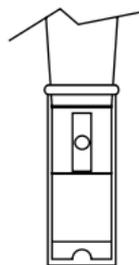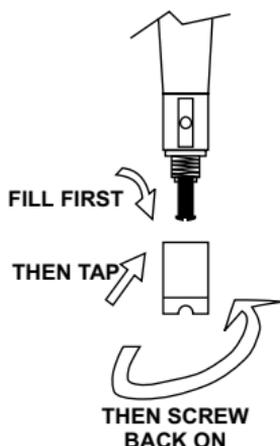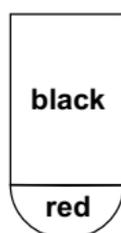
INSTRUMENT START-UP

- 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 "ৠ" blinking until initialization is complete.

```
CAL DUE  ppm              RCL Date Time
CFM  ৠ
WRONG    g/L                        Log# Intv.    °F°C
LOG  🔋 NaCl                                  %  8.8:8.8
SETUP    m
```

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

```
ৠ      Cond
```

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

```
● ● ● ● - - -
                          °C
```
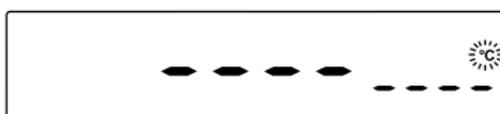
PROBE POLARIZATION

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).

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.

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

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.
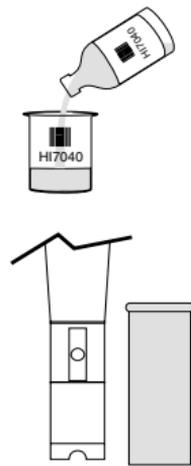
DO CALIBRATION

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.
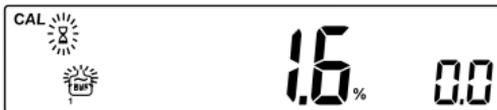
- When the reading is stable, "**CFM**" starts blinking. Press **CFM** to confirm the "**0.0%**" DO calibration.
- If the reading is within the limits ($\pm$15% f.s.), the meter stores the value (and adjusts the slope point).

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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.

$$\boxed{\begin{array}{c} \text{CAL} \ \text{☒} \\ \text{BUF} \ \text{2} \end{array} \quad \mathbf{100.7}_\%\ \mathit{100.0}}$$

- If the reading is within the limits (±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.

$$\boxed{\begin{array}{c} \text{CAL} \\ \text{WRONG} \\ \text{BUF} \ \text{2} \end{array} \quad \mathbf{163.7}_\%\ \mathit{100.0}}$$

• If the temperature goes out of range during calibration the "**WRONG**", temperature unit tag and both measurements will blink.

$$\boxed{\begin{array}{c} \text{CAL} \\ \text{WRONG} \\ \text{BUF} \ \text{1} \end{array} \quad \text{----} \quad \mathit{50.0}°\text{C}}$$

• **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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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.

Pressing the ▲ key:

• The date of the calibration.

• The calibration standards.

• Press **SETUP** to view the temperature of the calibration.

• The altitude value.

• The salinity value.

• The instrument ID.

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.
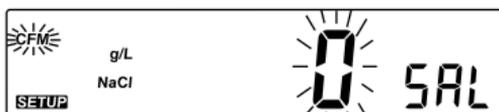
Press **ARROW** keys to change the salinity factor value.

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.

°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:

$$\text{Salinity (g/l)} = 1.80655 \ \text{Chlorinity (g/l)}$$

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.
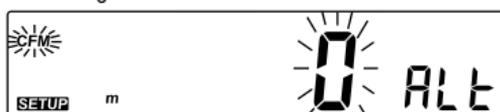
Press the **ARROW** keys to change the altitude factor value.

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

°C	0	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3900	4000	°F
	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

Top header spanning: **Altitude, Meters above Sea Level**

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.

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.

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.

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)

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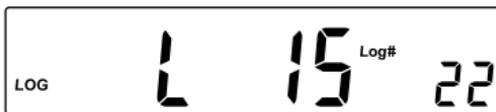
followed by the number of free records on the corresponding memory space.

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

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

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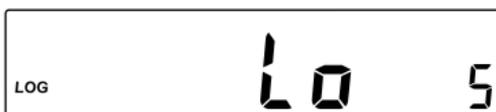
To stop the Auto LOG mode press **LOG** again. The "**LOG**" tag will be cleared.

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

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

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

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

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:

$$no \text{ } rEc$$

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.

$$\text{CFM} \qquad {}^{RCL} \qquad L \text{ } 78 \qquad 75$$

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.

$$\qquad {}^{RCL} \qquad 46.8_{\%} \text{ } 24.7{}^{\circ C}$$

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.

$$\qquad {}^{RCL} \text{ } {}^{Time} \qquad 14:02 \text{ } 52'$$

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


```
    ᴹ  RCL Date ᵈ
    07.23 2009
```

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


```
         RCL
  g/L     6  SAL
  NaCl
```
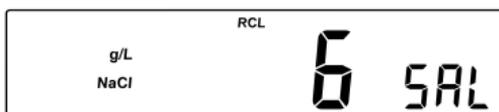
- The **altitude** on the primary LCD and **"ALt"** message on the secondary LCD.


```
         RCL
  ₘ    500  ALt
```

- The interval for lot logging.


```
         RCL
       5  Intv. SEC
```
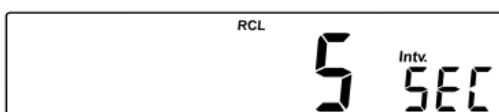
TO DELETE LOTS

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.


```
  ≋CFM≋  RCL
       dEL   10
```

- 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.


```
  ≋CFM≋  RCL
       dEL   ALL
```

- 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.

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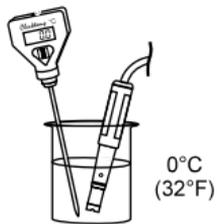
- Submerse the DO probe in the second vessel as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.

50°C
(122°F)

- 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.

CFM
GLP

- Press **CFM** to confirm. The instrument returns to measurement mode.
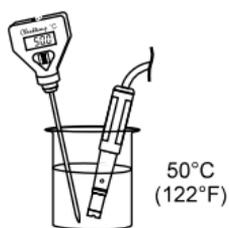
Note: If the reading is not close to the selected calibration point, "WRONG" tag will blink. In this case, check if the value set on the secondary LCD and the temperature measured with reference thermometer are close. Change the DO probe or restart calibration if necessary.

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

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.

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

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.

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 2½ 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.

TWIST AND PULL

fig. 1

- 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.

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.
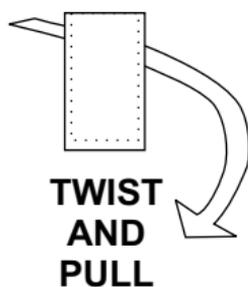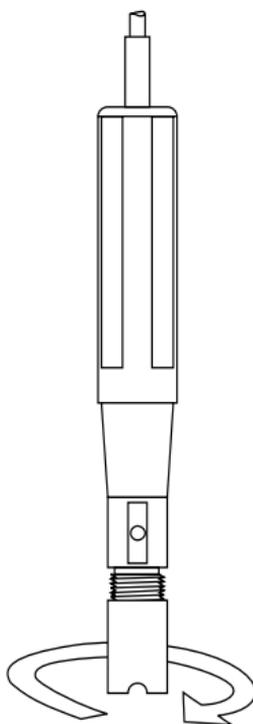
Important

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.

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.

Windows® is registered Trademark of "Microsoft Co."

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.

CERTIFICATION

All Hanna Instruments conform to the **CE European Directives.**

$$C \, \epsilon \quad \text{RoHS compliant}$$

Disposal of Electrical & Electronic Equipment. The product should not be treated as household waste. Instead hand it over to the appropriate collection point for the recycling of electrical and electronic equipment which will conserve natural resources.

Disposal of waste batteries. This product contains batteries, do not dispose of them with other household waste. Hand them over to the appropriate collection point for recycling.

Ensuring proper product and battery disposal prevents potential negative consequences for the environment and human health. For more information, contact your city, your local household waste disposal service, the place of purchase or go to www.hannainst.com.

WARRANTY

HI2400 is guaranteed for two years against defects in workmanship and materials when used for its 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, please 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.

HANNA®
instruments

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