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6

Dissolved Oxygen Meters

Professional Instruments for a Variety of Applications

Dissolved Oxygen

introduction

6.2

Dissolved Oxygen Theory and Measurement

Dissolved oxygen (DO) is a measure of how much oxygen is dissolved in a system. Measurements are usually taken in water using a DO probe and meter. Henry's Law states that the concentration of gas in a solution is directly proportional to the partial pressure of that gas above the solution. Henry's Law constant is a factor of proportionality, and so is specific to the gas in the solvent being measured.

The partial pressure of oxygen is in fact a measurement of the thermodynamic activity of its molecules. The rate at which oxygen dissolves, diffuses, and reacts is not determined by its concentration, but by its partial pressure. The Earth's atmosphere is composed of 20.9% oxygen, and at sea level the atmosphere is 100% saturated with oxygen.

Percent saturation is the amount of DO present per amount of DO possible at a given temperature and pressure. Percent saturation is a common unit for DO measurement since it is based upon the partial pressure of a gas; thus it is correct for determination in any solvent.

Concentration measurements of DO can also use the units of parts per million (ppm) or milligrams per liter (mg/L). In meters that report DO concentration in ppm or mg/L, the solvent is always assumed to be water. In other solvents such as oils or acids, the Henry's Law constant would be different. In those cases, percent saturation should be used as it is incorrect to use ppm or mg/L.

Effects of Temperature and Pressure

As the temperature of a solution increases, the particle movement within that solution increases. With greater particle motion, dissolved gases escape more readily from solution. In warm water, oxygen is less soluble while in cold water, oxygen is more soluble. DO concentration in air saturated waters decreases with increasing temperature.

Atmospheric pressure decreases as altitude increases. Since there is lower partial pressure, oxygen is less soluble at higher altitudes. DO concentration in air saturated waters decreases with increasing elevations.

Applications

Water quality measurements are vital to environmental monitoring. In quiescent lakes and rivers, the decay of organic matter can cause bacteria levels to increase. The aerobic bacteria consume oxygen, triggering a deficiency that can cause a water body "to die," killing aquatic plants and animals.

Aquaculture is the breeding, rearing, and harvesting of plants and animals in all types of water environments. Dissolved oxygen is needed by fish, zooplankton, and plants to survive and reproduce. DO measurements are used to monitor and control the environment required for success.

Wastewater treatment plants rely on bacteria to break down the organic compounds found in water. If the amount of dissolved oxygen in the wastewater is too low, these bacteria will die and septic conditions will occur. The amount of DO must be consistently monitored to ensure proper waste treatment.

Wine and beer are both affected by oxygen at various stages during production and storage. DO is an important parameter to monitor for those who wish to produce consistent, high quality products.

Laboratory Monitoring of BOD, OUR and SOUR

BOD (Biochemical Oxygen Demand) is a measurement that indicates the concentration of biodegradable organic matter present in a water sample. It can be used to determine the general quality of water and its degree of pollution. BOD measures the rate of oxygen uptake by microorganisms in a water sample at a fixed temperature over a given period of time. To ensure that all other conditions are equal, a very small amount of microorganism seed is added to each sample being tested. The samples are kept at 20°C in the dark for five days. The loss of dissolved oxygen during incubation is called the BOD5. BOD is an empirical test that determines the relative oxygen requirements of wastewater, effluent, and polluted waters.

OUR (Oxygen Uptake Rate) is used to determine the biological activity of a system in terms of oxygen consumption or respiration rate. It is defined as the milligrams per liter of oxygen consumed per hour. This measurement indicates the rate of metabolic processes in sludge treatment, helping operators determine the stability of solids after digestion.

SOUR (Specific Oxygen Uptake Rate) also determines the oxygen consumption of a system, but is defined as the milligrams of oxygen consumed per gram of volatile suspended solids (VSS) per hour. This quick measurement has many advantages: rapid measure of influent organic load and biodegradability, indication of the presence of toxic or inhibitory wastes, degree of stability and condition of a sample, and calculation of oxygen demand rates at various points in the aeration basin.

Types of Dissolved Oxygen Probes

Hanna's dissolved oxygen meters utilize one of two common types of sensing probes: polarographic sensors and galvanic sensors.

Polarographic DO probes consist of a working electrode (cathode) and a counter electrode (anode). A polarizing voltage is applied to these electrodes that is specific for the reduction of oxygen. A thin, gas permeable membrane isolates the sensor elements from the water sample but allows oxygen to pass through. The oxygen that passes through the membrane is reduced at the cathode, causing a current from which the oxygen concentration is determined. Two-electrode polarographic probes use the anode as a reference electrode.

Galvanic DO probes consist of a working electrode (cathode) and a counter electrode (anode) that act as a battery to produce a voltage specific for the reduction of oxygen. A thin, gas permeable membrane isolates the sensor elements from the water sample but allows oxygen to pass through. The oxygen that passes through the membrane is reduced at the cathode, causing a current from which the oxygen concentration is determined.


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Product Spotlights

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Dissolved Oxygen

product spotlights/comparison guide



edge®DO

edge DO is thin and lightweight, measuring just 1/2" thick and weighing less than 9 ounces. edge DO has an incredibly wide viewing angle, 5.5" LCD and a sensitive capacitive touch keypad.

edge DO measures dissolved oxygen through its unique digital conductivity electrodes that connect to with an easy to plug-in 3.5mm connector. edge DO's versatile design is equally at home in your hand, on a lab bench or mounted on a wall. edge DO simplifies measurement, configuration, calibration, diagnostics, logging and transferring data to a computer or a USB drive.

See page 6.4



HI5421

Research Grade Dissolved Oxygen and BOD Meter

Hanna's research grade bench meter line expands to include HI5421. The fully customizable HI5421 features DO, BOD, OUR and SOUR measurement modes in a compact versatile instrument. The color graphic LCD is capable of displaying graphs, soft key menus, help screens and calibration reminders. HI5421 also incorporates an intuitive menu system to help streamline your workflow process and provide accurate measurements quickly and efficiently. The large log memory offers 100 lots with 10,000 records per lot. Measurements can be transferred to a PC via USB or RS 232 with Hanna software.

See page 6.8

Comparison Guide

	Dissolved Oxygen Range	Barometric Pressure	% Saturation O ₂	Salinity Compensation	Altitude Compensation	Temperature Range(s)	DO Calibration Points	Barometric Pressure Calibration Points	ATC	Hold Feature	BEP's	PC Connectivity	Logging	Alarm	GLP	Capacitive Touch Buttons	Benchtop, Portable & Wall-Mount	Page
Bench Meters																		
edge®DO	•			•	•	•	2		•			•	•			•	•	6.4
HI5421	•	•	•	•		°C/°F/K	2	1	•	•		•	•	•		•		6.8
HI2400	•		•	•	•	°C	2		•			•	•			•		6.10
Portable Meters																		
HI98193	•	•	•	•		°C/°F	2	1	•	•	•	•	•			•		6.12
HI9147	•		•	•	•	°C/°F	1		•		•							6.15
HI9146	•		•	•	•	°C	2		•		•					•		6.16
HI9142	•					°C/°F	2		•		•							6.18

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edge® DO

Dissolved Oxygen

edge®DO



edge®DO–Innovation in a Single Parameter

edge®DO's groundbreaking design is the culmination of Hanna's vision, design capabilities, integrated production and world class R&D. edge®DO is a single meter that can measure pH and ORP and is incredibly easy to use.

Additional feature information

- Clark type digital polarographic probe with easy-to-replace membrane cap
- Covers all ranges from 0.00 to 45.00 mg/L (ppm); 0.0 to 300% saturation
- Accuracy $\pm 1.5\%$ full scale
- One or two-point calibration (HI7040), 0% (solution) and 100% (air)
- Data logging
 - Manual log-on-demand
 - Manual log-on-stability
 - Interval logging
- Automatic Temperature Compensation from 0 to 50 °C
- GLP data
 - Records date, time, calibration standards, altitude value and salinity value
- Altitude compensation from -500 to 4000 meters (-1640 to 13,123')
- Salinity compensation from 0 to 40g/L


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edge®DO technical features



- Two USB ports
 - edge®DO includes one standard USB for exporting data to a flash drive. edge®DO also includes one micro USB port for exporting files to your computer as well as charging edge®DO when the cradle is not available.



- Clear, full text readout
 - edge®DO features clear, full text guides displayed on the bottom of the screen. There is no need to decipher scrambled abbreviations or symbols; these helpful messages guide you through every process quickly and easily.



- Data logging
 - edge®DO allows you to store up to 1000 log records of data. Logging data sets include readings, GLP data, date and time.



- GLP
 - Data from the last calibration you perform is stored in the sensor including the date, time and standards. When the sensor is connected to edge DO, GLP data is automatically transferred.

edge®DO design features



- Capacitive touch keypad
 - edge®DO features a capacitive touch keypad that gives a distinctive, modern look. Since the keypad is part of the screen, your buttons can never get clogged with sample residue.



- Easy to read LCD
 - edge®DO features a 5.5" (14 cm) LCD display that you can clearly view from over 5 m (16.4'). The large display, with its wide 150° viewing angle, provides one of the easiest to read LCDs in the industry.



- Zero footprint
 - Using the wall mount cradle (included), edge®DO can be placed on a wall, leaving zero footprint on the benchtop space. The cradle has a built-in connector to power edge®pH and charge its batteries.

- 3.5 mm probe input
 - Plugging an electrode in has never been simpler; no alignments or broken pins, simply connect the 3.5 mm plug and begin. Digital electrodes are automatically recognized.



- Sleek design
 - Incredibly thin and lightweight, edge DO measures just 1/2" (12 mm) thick and weighs just 8.8 ounces (250 g).

0

footprint

0.5

inch thick
(12.7 mm)

8.8

oz. weight
(250 g)

8

hours battery
life

5.5

inch display
(14 cm)

2

USB ports

6

Dissolved Oxygen

edge®DO

A hybrid meter that can be used in portable, wall-mount and bench-top configurations

The versatile design of edge®DO enables it to be used as a portable, wall-mount or benchtop meter. edge DO simplifies measurement, configuration, calibration, diagnostics, logging and transferring data directly to a computer or USB drive.



- Portable field unit
 - edge DO is ideal for field use due to its light weight, large screen and thin design. It can be easily slipped into a backpack or messenger bag. Up to 8 hours of battery life when used as a portable device



- Wall mount cradle
 - The included wall mount cradle makes it easy to conserve space on the benchtop and can charge edge DO with the AC adapter. Ideal for continuous monitoring applications



- Electrode holder with built-in cradle
 - The included electrode holder features a swivel, adjustable arm with a built-in cradle to hold edge DO securely in place at the optimum viewing angle

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Digital electrodes



edge®DO performs measurements through its unique digital electrodes. These digital electrodes are auto-recognized, providing sensor type, calibration data and a serial number when connected to edge®DO by an easy to plug-in 3.5 mm connector.

- Simply connect each probe via the 3.5 mm jack; digital Smart electrodes are automatically recognized

Dissolved oxygen electrode



HI764080 (included)
Dissolved oxygen electrode with temperature sensor
Recommended for general purpose

Specifications		edge DO
DO	Range	0.00 to 45.00 ppm (mg/L); 0.0 to 300.0 % saturation
	Resolution	0.01 ppm (mg/L); 0.1 % saturation
	Accuracy	± 1.5% of reading ±1 digit
	Calibration	one or two-point at 0% (HI7040 solution) and 100% (in air)
	Temperature Compensation	ATC (0 to 50°C; 32.0 to 122.0°F)*
	Salinity Compensation	0 to 40 g/L (with 1 g/L resolution)
	Altitude Compensation	-500 to 4000 m (-1640 to 13120') (with 100 m (328') resolution)
Temperature	Range*	-20.0 to 120.0°C; -4.0 to 248.0°F
	Resolution	0.1°C; 0.1°F
	Accuracy	±0.5°C; ±0.9°F
Additional Specifications	Probe	HI764080 digital dissolved oxygen electrode with 3.5 mm (1/8") connector and 1 m (3.3') cable (included)
	Logging	up to 1000 records organized in: manual log-on-demand (max. 200 logs), manual log-on-stability (max. 200 logs), interval logging (max. 600 samples; 100 lots)
	Connectivity	1 USB port for storage; 1 micro USB port for charging and PC connectivity
	Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
	Power Supply	5 VDC adapter (included)
	Dimensions	202 x 140 x 12 mm (7.9" x 5.5" x 0.5")
	Weight	250 g (8.82 oz.)
Ordering Information	HI2004-01 (115V) and HI2004-02 (230V) edge®DO includes: HI764080 dissolved oxygen electrode, HI7041S refill electrolyte solution, DO membrane caps (2), o-rings (2), benchtop docking station with electrode holder, wall-mount cradle, USB cable, 5 VDC power adapter, quality certificates and instruction manual.	

* temperature limits will be reduced to actual probe limits
** with temperature compensation function disabled
† standard mode only

See page 6.23 for DO solutions and accessories

6

HI5421

Research Grade Bench Meter

Dissolved Oxygen and BOD

Dissolved Oxygen

benchtop

6.8


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The HI5421 is an advanced research grade benchtop Dissolved Oxygen and BOD meter that is completely customizable with a large color LCD, capacitive touch keys, and USB port for computer connectivity. The HI5421 is rich in features including data logging, alarm limits, comprehensive GLP, and many more while retaining simplicity in use with both dedicated keys for routine operation and virtual keys that guide the user through setup options.

Customizable User Interface

The user interface of the HI5421 allows the user to show measurements in various modes: basic measurement with or without GLP information, real-time graphing, and logging data. Calibration stability criteria can be adjusted from fast, moderate, and accurate. Programmable alarm limits can be set to inside or outside allowable limits.

Color Graphic LCD

The HI5421 features a color graphic LCD with on-screen help, graphic, and custom color configurations. The display allows for real-time graphing and the use of virtual keys provide for an intuitive user interface.

Capacitive Touch

The HI5421 features sensitive capacitive touch buttons for accurate keystrokes when navigating menus and screens. There are four dedicated keys that are used for routine operations including calibration and switching measurement modes and four virtual keys that change based upon use. The capacitive touch technology ensures the buttons never get clogged with sample residue.

Built in Barometer

Readings are compensated for barometric pressure by a built in pressure transducer located in the meter. Calibration of the barometric pressure is single point with manual entry of current value obtained from local weather service or other device. Barometric pressure is displayed in a multiple choice of units including mmHg, mbar, kPa, mHg, psi, and atm.

Choice of Calibration

Automatic standard recognition is available for two points at 0% and 100% saturation or 0 mg/L and 8.26 mg/L. A user standard option is available for a user defined value.

BOD, OUR and Sour Measurement Modes

An additional three measurement modes are available to measure Biological Oxygen Demand (BOD), Oxygen Uptake Rate (OUR) and Specific Oxygen Uptake Rate (SOUR). Simply enter values and take readings at appropriate times and the meter will automatically calculate the values.

Automatic Salinity Compensation

The HI5421 allows for automatic salinity compensation with a selectable salinity range of 0 to 45 g/L.

GLP Data

View calibration data and calibration expiration information by selecting the Good Laboratory Practice (GLP) display option. Calibration data include date, time, and calibration points.

Data Transfer

Data can be transferred to a PC with USB cable and HI92000 software (both sold separately).

Data Logging

Three selectable logging modes are available on the HI5421: automatic, manual, and AutoHold logging. Automatic and manual logs up to 100 lots with 50,000 records max/lot, with up to 100,000 total data points. Automatic logging features the option to save data according to sampling period and interval.

Contextual Help

Contextual help is always available through a dedicated "HELP" key. Clear tutorial messages and directions are available on-screen to quickly and easily guide users through setup and calibration. The help information displayed is relative to the setting/option being viewed.

DO probe included

The HI5421 is supplied with the HI76483 Clark-Type Polarographic probe. This probe is only 12 mm in diameter and has a built in thermistor temperature sensor that compensates for temperature variations from 0 to 50°C.



Specifications	HI5421
DO	Range0.00 to 90.00 ppm (mg/L); 0.0 to 600.0 % saturation
	Resolution0.01 ppm; 0.1% saturation
	Accuracy±1.5% of reading ±1 digit
	Calibrationautomatic using single or two-point calibration; user calibration single point
Barometric Pressure	Range450 to 850 mmHg; 600 to 1133 mBar; 60 to 133 KPa; 17 to 33 inHg; 8.7 to 16.40 psi; 592 to 1.118 atm
	Resolution1 mm Hg
	Accuracy±3 mm Hg + 1 least significant digit
Temperature	Range-20.0 to 120°C; -4.0 to 248.0°F; 253.15 to 393.15K
	Resolution0.1°C; 0.1°F; 0.1K
	Accuracy±0.2°C; ±0.4°F; ±0.2K (without probe)
Additional Specifications	Measurement Modesdirect DO; BOD (biochemical oxygen demand); OUR (oxygen uptake rate); SOUR (specific oxygen uptake rate)
	Temperature Compensation0.0 to 50.0°C; 32.0 to 122.0°F; 237.1 to 323.1 K
	Salinity Compensation0 to 45 ppt
	Barometric Pressure Calibrationsingle point calibration
	ProbeHI76483 thin body, polarographic dissolved oxygen probe with internal temperature sensor and 1 m (3.3') cable (included)
	Record Samples Logging100,000 records storage, 100 lots each for automatic and manual logs; maximum 50,000 records/log for automatic logging
	Interval Loggingfourteen presets selectable between 1 second and max log time of 180 minutes
	Logging Typemanual AutoHOLD, automatic
	Alarm (DO, BOD, OUR, SOUR)inside and outside limits
	PC Connectionopto-isolated USB
	Displaygraphic color LCD with 240x340 pixels
	Power Supply12 VDC adapter (included)
	Dimensions160 x 231 x 94 mm (6.3 x 9.1 x 3.7")
	Weight1.2 kg (2.6 lbs.)
Ordering Information	HI5421-01 (115V) and HI5421-02 (230V) is supplied with HI764083 DO probe, HI70415 electrolyte solution (30 mL), DO membrane caps (2), O-rings for DO membrane cap, HI76404W electrode holder, 12 VDC adapter, quality certificates, quick start guide and instruction manual.

See page 6.24 for DO solutions and accessories

On-screen Features



BOD (Biological Oxygen Demand)



OUR (Oxygen Uptake Rate)



SOUR (Specific Oxygen Uptake Rate)

6

HI2400

Dissolved Oxygen Meter

Dissolved Oxygen and Temperature

Dissolved Oxygen

benchtop



- Automatic temperature compensation (ATC)
- Calibration
 - One or two-point calibration at 0% or 100%
- GLP Features
 - Meets Good Laboratory Practices
- Connectivity
 - PC compatible via USB
- Interval logging
- Data logging and storage up to 8000 samples

Accurate, Repeatable Measurements

The HI2400 is a dissolved oxygen benchtop meter with automatic calibration and % or mg/L (ppm) measurement range. The measurement is automatically compensated for altitude and salinity based on the user settings for altitude up to 4000 m and salinity up to 40 g/L.

Measurements are automatically temperature compensated by using the polarographic DO probe with built-in temperature sensor. This probe features screw cap membranes for easy replacement.

Calibration is performed at one or two points at 0% using Hanna's HI7040 solution or 100% in air.

Data Logging

With a built-in logging function, measurements are stored in non-volatile memory, and can be transferred to a PC through the USB

port using the optional HI92000 software and HI920013 USB cable. The software is provided with an exclusive online guide of all the commands available and allows data printing, plotting and exporting.

The 8000 record logging interval allows the possibility of process and experimental monitoring of DO. The logging interval is automatic with user-selectable intervals from 5 seconds to 180 minutes.

GLP Capabilities

The HI2400 also provides users with GLP (Good Laboratory Practice) capabilities. GLP is a set of functions that allow the storage and retrieval of data regarding calibration. The GLP feature provides data consistency and a calibration reminder which can be set to alert the user that too much time has elapsed since the last calibration and a new one should be performed.

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HI76407
Standard DO Probe

The HI76407 dissolved oxygen probe is extremely rugged, making it ideal for both laboratory and field applications. Calibration is fast and simple, while all DO measurements are temperature compensated. The pre-tensioned, ready-made PTFE membrane can be changed in a matter of seconds without the need to stretch and cut replacements.

Several cable lengths are available.

HI76408
Thinner DO Probe for Laboratories

The HI76408 DO probe is rugged and perfect for both laboratory and field applications. Calibration is fast and simple, and measurements are temperature compensated. The sensitive PTFE membrane can be changed in a few seconds.

Available in 1 m (3.3') cable length..

HI76407A/P
Easy, Screw Cap DO Membranes

Carry Extras for Assurance

Pretensioned PTFE membranes are easily replaced using these screw on cap replacements. Should a pin hole or stretching occur, have replacements on hand.

Specifications		HI2400
Dissolved Oxygen	Range	0.00 to 45.00 mg/L (ppm); 0.0 to 300.0% saturation
	Resolution	0.01 mg/L (ppm); 0.1% saturation
	Accuracy	±1.5% FS
	Calibration	one or two points at 0% (HI7040 solution) and 100% (in air)
Temperature	Range	0.0 to 50.0°C
	Resolution	0.1°C
	Accuracy	±0.2°C (excluding probe error)
	Altitude Compensation	0 to 4000 m (with 100 m resolution)
	Salinity Compensation	0 to 40 g/L (ppt) (with 1 g/L resolution)
	Temperature Compensation	automatic from 0.0 to 50.0°C (32.0 to 122°F)
	Probe	HI76407/2 polarographic DO probe with internal temperature sensor, DIN connector and 2 m (6.6') cable (included)
	Logging Interval	5, 10, 30 seconds or 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes
	PC Connection	opto-isolated USB
	Power Supply	12 VDC adapter
Ordering Information	Environment	0 to 50°C; RH max 95%
	Dimensions	235 x 222 x 109 mm (9.2 x 8.7 x 4.3")
	Weight	1.3 kg (2.9 lbs.)
		HI2400-01 (115V) and HI2400-02 (230V) are supplied with HI76407/2 dissolved oxygen probe, HI76407A membrane caps (2), HI7041S electrolyte solution (30 mL), 12 VDC adapter and instructions.

See page 6.19 and 6.21 for DO solutions and accessories

6

Dissolved Oxygen

portable

HI98193

Professional
Waterproof Meters

Dissolved Oxygen and BOD

- **Waterproof**
 - IP67 rated waterproof, rugged enclosure
- **Choice of units**
 - Display units in % saturation or mg/L (ppm)
- **Salinity compensation**
 - Salinity compensation allows for direct determination of dissolved oxygen in saline waters.
 - Users can set the salinity value
- **Built-in temperature sensor**
 - Automatic temperature compensation with one or two point temperature calibration
 - Displays temperature in °C or °F
- **Built-in barometer**
 - Automatic barometric pressure compensation with 1 point calibration
 - Displays pressure in user-selectable units (mmHg, inHg, atm, psi, kPa, mbar)
- **Built-in calculations**
 - Determination of Biochemical Oxygen Demand (BOD), Oxygen Uptake Rate (OUR) and Specific Oxygen Uptake Rate (SOUR)
- **Polarization**
 - Automatic polarization of probe at startup
- **Membrane caps**
 - Ready-to-use PTFE preformed membrane caps
- **200 hour battery life**
 - Approximately 200 hours of continuous use
- **Clear display**
 - Dot matrix display with multifunction virtual keys
- **AutoHold**
 - Automatically holds the first stable reading on the display
- **Calibration timeout**
 - Alerts when calibration is due at a specified interval
- **Connectivity**
 - PC connectivity via opto-isolated micro-USB with HI92000 software
- **Log-on-demand**
 - Store measurement data at the press of a button
- **GLP**
 - GLP data provides calibration data including date, time, pressure, calibrated value, temperature and salinity value of the last calibration



For Universal Applications

The HI98193 is a portable DO meter with extended ranges of up to 50 ppm and 600% saturation. HI98193 features compensations for pressure, temperature and salinity, which are essential for an accurate dissolved oxygen reading. HI98193 is supplied with the HI764073 polarographic dissolved oxygen probe that utilizes field replaceable PTFE membrane caps.

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Backlit Graphic LCD Display

The HI98193 features a backlit graphic LCD with on-screen help. The graphic display allows for the use of virtual keys to provide for an intuitive user interface.

Waterproof Protection

The meter is enclosed in an IP67 rated waterproof casing and can withstand immersion in water at a depth of 1 m for up to 30 minutes. The probe features an IP68 rating for continuous immersion in water.



Quick connect probe

The HI764073 DO probe features a quick connect DIN connector to make attaching and removing the probe simple and easy.

The HI764073's built-in temperature sensor allows for automatic temperature compensation. The temperature sensor can be calibrated to one or two points. Manual entry of salinity values allows for the salinity compensation of dissolved oxygen readings in saline waters.



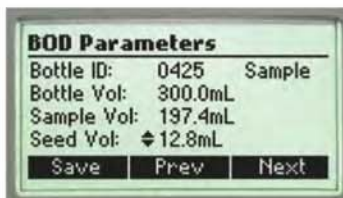
Measurement

The HI98193 has extended ranges of up to 50 ppm and 600% saturation. When measuring dissolved oxygen, compensations for salinity, temperature and pressure are essential to improve the accuracy and precision of readings.

BOD, OUR and SOUR



- BOD results
 - BOD is calculated in mg per liter from the difference between the initial and final dissolved oxygen



- BOD parameters and records
 - All necessary parameters for BOD testing can be set and displayed at once.
 - A list of all saved BOD data can be easily retrieved and shown on the LCD display.



- OUR results
 - Measured in mg of oxygen consumed per L per hour.



- SOUR results
 - Measured in mg of oxygen consumed per g of volatile suspended solids per hour.

AutoHold

Pressing AutoHold during measurement will automatically hold the first stable reading on the display.

Built-in Barometer

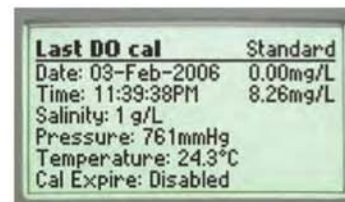
With the internal barometer, the HI98193 is able to compensate for changes in barometric pressure so there is no need for charts, altitude information or external barometric pressure information.

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

The HI98193's log on-demand feature allows users to store up to 400 readings. This data can then be transferred to a PC with the HI920015 USB cable and HI92000 software.



GLP

Comprehensive GLP functions are directly accessible by pressing the GLP key. This data includes date, time, pressure, calibrated value, temperature and salinity value of the last calibration.

Intuitive Keypad

The fitted rubber keypad has dedicated keys for power, backlight, up/down arrows, help and alphanumeric characters. The meter also features two virtual soft keys that navigate the user through the configuration of each parameter, 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 at the press of a dedicated button and view content specific information based on the screen that is currently being viewed.



Setup screen

Our extensive setup screen features a host of configurable options such as time, date, temperature units and language for help screens and guides

PC Connectivity

Logged data can be transferred to a Windows compatible PC with the included HI920015 micro USB cable and HI92000 software.

Long Battery Life

The display of the meter has a battery icon indicator to show the remaining power. The meter uses four 1.5V AA batteries that provide up to 200 hours of battery life.



Rugged custom carrying case

The HI98193 meter, probe, and all accessories are supplied in the HI720193 rugged carrying case designed to provide years of use. The inside compartment of the carrying case is thermoformed to securely hold and protect all of the components.



HI98193		
DO	Range	0.00 to 50.00 mg/L (ppm); 0.0 to 600.0% saturation
	Resolution	0.01 mg/L (ppm); 0.1% saturation
	Accuracy (@25°C/77°F)	±1.5% of reading ±1 digit
	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	450 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	-20.0 to 120.0°C; -4.0 to 248.0°F
	Resolution	0.1°C; 0.1°F
	Accuracy (@25°C/77°F)	±0.2°C; ±0.4°F (excluding probe error)
	Calibration	one or two 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 450 to 850 mmHg
	Salinity Compensation	automatic from 0 to 70 g/L
	Temperature Compensation	automatic from 0.0 to 50.0 °C (32.0 to 122.0 °F)
	Probe	HI764073 polarographic DO probe with protective sleeve, internal temperature sensor, DIN connector and 4m (13') cable (included)
	Logging	log-on-demand up to 400 samples
	PC Connectivity	opto-isolated USB (with HI92000 software)
	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 can be 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		HI98193 is supplied with HI764073 polarographic DO probe with protective sleeve, HI7040 bi-component zero oxygen solution (230 mL + 30 mL), HI7041S electrolyte solution (30 mL), preformed PTFE membrane caps (2), DO protective cap, O-rings (2), 100 mL plastic beaker (2), HI92000 PC software, HI920015 micro USB cable, 1.5V AA batteries (4), quick start guide, quality certificate and instruction manual in an HI720193 rugged carrying case with custom insert.

HI9147

Dissolved Oxygen Meter for Aquaculture

- Automatic Temperature Compensation (ATC)
- Waterproof
- Backlit LCD

The HI9147 is designed for aquaculture applications. This unit is unique among our family of DO meters as it is supplied with a galvanic probe.

Unlike polarographic probes, galvanic DO probes require no conditioning time. When you need to measure multiple samples in a given period of time, simply turn the meter on and start taking measurements.

The HI9147 is a must have for DO sensitive organisms or high bio-load environments.

DO Levels at 100% Saturation

	Salinity (ppt)				
Temperature	0	10	20	30	40
10°C / 50°F	13.0	12.2	11.4	10.6	9.8
15°C / 59°F	10.3	9.7	9.2	8.6	8.1
20°C / 68°F	9.4	8.8	8.4	7.9	7.4
25°C / 77°F	8.5	8.0	7.6	7.2	6.7
30°C / 86°F	7.8	7.4	7.0	6.6	6.2



Specifications		HI9147
DO	Range	0.0 to 50.0 mg/L (ppm); 0 to 600% saturation
	Resolution	0.1 mg/L (ppm); 1% saturation
	Accuracy (@ 20°C/68°F)	±1% of reading
Temperature	Range	0.0 to 50.0°C; 32.0 to 122.0°F
	Resolution	0.1°C; 1°F
	Accuracy (@ 20°C/68°F)	±0.2°C; ±1°F (excluding probe error)
Additional Specifications	Calibration	manual, in saturated air
	Temperature Compensation	automatic, 0° to 50°C (32°F to 122°F)
	Altitude Compensation	0 to 4000 m (resolution 100 m)
	Salinity Compensation	0 to 51 g/L (ppt) (1 g/L resolution)
	Probe	HI76409/4 galvanic DO probe (fixed) with internal temperature sensor, DIN connector and 4 m (13') cable (HI9147-04), 10 m (33') cable (HI9147-10), 15 m (49') cable (HI9147-15) or 20 m (66') cable (HI9147-20) (included)
	Battery Type / Life	1.5V AAA (3) / approx. 1000 hours of continuous use without backlight
	Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing
	Dimensions / Weight	185 x 72 x 36 mm (7.3 x 2.8 x 1.4") / 450 g (15.9 oz.)
Ordering Information	HI9147-04 is supplied with HI76409/4 probe with 4 m (13') cable, spare membranes (5), electrolyte solution (30 mL), batteries, screwdriver and instructions. HI9147-10 is supplied with HI76409/10 probe with 10 m (32.8') cable, spare membranes (5), electrolyte solution (30 mL), batteries, screwdriver and instructions. HI9147-15 is supplied with HI76409/15 probe with 15 m (49.2') cable, spare membranes (5), electrolyte solution (30 mL), batteries, screwdriver and instructions. HI9147-20 is supplied with HI76409/20 probe with 20 m (65.6') cable, spare membranes (5), electrolyte solution (30 mL), batteries, screwdriver and instructions.	

See page 6.22 for DO solutions and accessories

6

Dissolved Oxygen

portable

HI9146

Dissolved Oxygen Meter

Dissolved oxygen is a commonly measured parameter in aquaculture, wastewater treatment, environmental studies, and wine analysis. The HI9146 is a rugged, portable dissolved oxygen (DO) meter designed to provide high accuracy measurements whether in the field or in the lab. The meter features automatic calibration performed at one or two points in saturated air and/or zero oxygen solution. All readings are automatically compensated for temperature variations and can be frozen on the display upon stability using the auto-end feature. Salinity and altitude compensation are user adjustable based on the environmental conditions that are present. The HI9146 features a Battery Error Prevention System (BEPS) that detects when the batteries become too weak to ensure reliable measurements. The HI9146 is supplied complete and ready to use.



6.16

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Polarographic Measuring System

The meter and probe use polarographic sensor technology based on the Ross and Clark polarographic measurement method. The probe is comprised of a platinum cathode and silver anode in an electrolyte solution held in place over the surfaces of the electrodes by a polymer membrane. An external voltage applied across the system establishes a current proportional to the concentration of dissolved oxygen.

Replaceable Membrane Caps

The pretensioned thin polytetrafluoroethylene (PTFE) membranes employ a screw cap design that can be changed quickly by simply filling with the HI7041 electrolyte fill solution and screw on the DO probe.

Automatic Calibration

Calibration can be performed at one or two points to 100% and/or 0% saturation. The 100% saturation is done in air while the 0% is done with the HI7040 bicomponent zero oxygen solution.

Good Laboratory Practice (GLP)

The Good Laboratory Practice feature allows the user to recall calibration information including date, time and calibrations points.

Automatic Temperature Compensation

All readings are automatically compensated for temperature variations with a high accuracy, built in linearized thermistor temperature sensor behind a stainless steel cover.

Altitude Compensation

The HI9146 allows for altitude compensation for up to 4000 meters with a 100 meter resolution.

Salinity Compensation

Salinity compensation is adjustable from 0 to 80 g/L (ppt) with a 1 g/L resolution for the measurement of DO in brackish and seawater.

Auto End Point

The HI9146 features an auto endpoint mode in which when selected the reading will frozen on the display once a stable measurement is obtained. The auto-end feature allows for consistency among various users by ensuring that stability has been achieved before recording a measurement.

Backlit LCD

The HI9146 has a display with a backlight for easy viewing of readings in poor lighting conditions.

Battery Error Prevention System (BEPS)

The Battery Error Prevention System detects when the batteries become too weak to ensure reliable measurements. The backlight feature is automatically disabled when batteries are getting low and a clear indication is displayed to warn the user of this condition.

Specifications		HI9146
DO	Range	0.00 to 45.00 mg/L (ppm); 0.0 to 300.0% saturation
	Resolution	0.01 mg/L (ppm); 0.1% saturation
	Accuracy (@ 25°C/77°F)	±1.5% F.S. or ±1 digit, whichever is grater
Temperature	Range	0.0 to 50.0°C; 32.0 to 122.0°F
	Resolution	0.1°C; 0.1°F
	Accuracy (@ 25°C/77°F)	±0.2°C; ±0.4°F (excluding probe error)
Additional Specifications	Dissolved Oxygen Calibration	one or two points at 0% (HI7040 solution) and 100% (in air)
	Temperature Compensation	automatic from 0 to 50°C (32 to 122°F)
	Altitude Compensation	0 to 4000 m (resolution 100 m)
	Salinity Compensation	0 to 80 g/L (ppt) (resolution 1 g/L)
	Probe	HI76407/4F 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.)
Ordering Information	HI9146-04 is supplied complete with HI76407/4F probe with 4 m (13.1') cable, HI76407A membranes (2), HI7041S electrolyte solution (30 mL), batteries, instructions and rugged carrying case.	
	HI9146-10 is supplied complete with HI76407/10F probe with 10 m (32.8') cable, HI76407A membranes (2), HI7041S electrolyte solution (30 mL), batteries, instructions and rugged carrying case.	

See page 6.20 for DO solutions and accessories



HI9142

Manual Calibration Dissolved Oxygen Meter

- Automatic Temperature Compensation (ATC)
- One or two-point calibration
- Waterproof

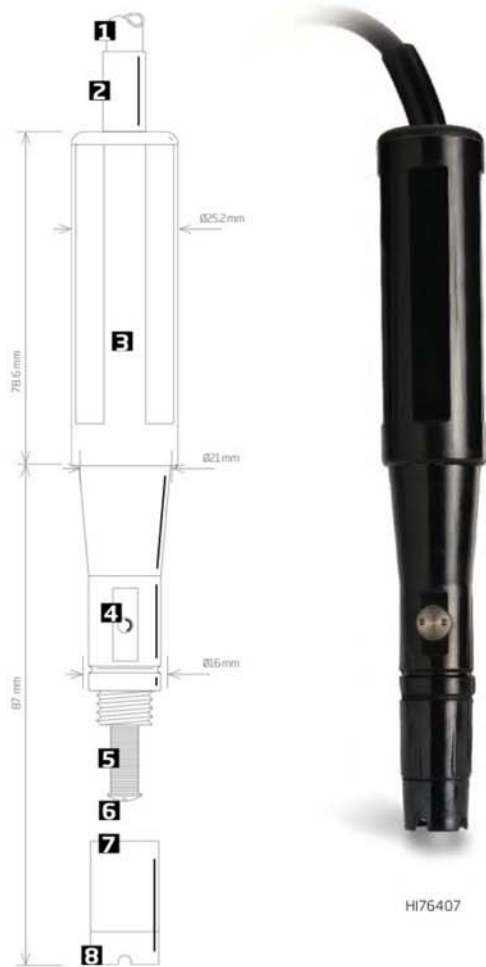
The ever increasing demand for instant on-site analysis results has created a need for innovative, rugged, portable and waterproof meters.

Field work can subject instrumentation to the inclemency of weather. Cold, rain, snow, dust and humidity can cause condensation to breach the housing. Once the housing has been compromised, the meter is susceptible to diminishing performance and life span. The rugged, waterproof housing of the HI9142 solves many of the problems of field use.

Calibration is performed with HI7040 zero oxygen solution, while 100% calibration is done in air.

The polarographic probe (HI76407/4) is accurate to 0.3 ppm and is supplied with a 4 m (13') cable that allows measurements to be taken even in hard to reach places.

Specifications	HI9142	
Dissolved Oxygen	Range	0.0 to 19.9 mg/L (ppm)
	Resolution	0.1 mg/L (ppm)
	Accuracy (@ 25°C/77°F)	±1.5% F.S.
Temperature	Range	-5.0 to 50.0°C (23.0 to 122.0°F)
	Resolution	0.1°C (1°F)
	Accuracy (@ 25°C/77°F)	±0.2°C (±1°F) (excluding probe error)
Additional Specifications	Calibration	manual, at one or two points (zero and slope)
	Temperature Compensation	automatic, 0 to 50°C (32 to 122°F)
	Probe	HI76407/4 polarographic DO probe with internal temperature sensor, DIN connector and 4 m (13') cable
	Battery Type / Life	1.5V AAA (3) / approximately 1,000 hours of continuous use
	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.)
Ordering Information	HI9142 is supplied with HI 76407/4 probe with 4 m (13') cable, 2 spare membranes, HI7041S electrolyte solution (30 mL), calibration screwdriver, batteries, instructions and rugged carrying case.	



HI76407

HI76407

Standard DO Probe

The HI76407 dissolved oxygen probe is extremely rugged, making it perfect for both laboratory and field applications. Calibration is fast, simple and all DO readings are temperature compensated.

The pre-tensioned, ready-made PTFE membrane can be changed in a few seconds without the need to stretch and cut replacements.

The HI76407 is offered with several cable lengths to meet your specific needs.

HI76407

- 1** Shielded, waterproof cable
- 2** Protective sleeve
- 3** PEI probe for best field protection
- 4** Linearized and accurate thermistor temperature sensor protected behind a stainless steel cover
- 5** Silver wire anode element
- 6** Glass encapsulated platinum cathode
- 7** Screw cap membrane that holds potassium chloride electrolyte solution (HI7041S)
- 8** Thin, permeable PTFE membrane isolates the sensor elements from the testing solution, but allows oxygen to enter (HI76407A/P)

Probe	Cable Length	Recommended Meter
HI76407/2	2 m (6.6')	HI2400 HI9142
HI76407/4	4 m (13')	
HI76407/10	10 m (33')	

HI76407A/P

Easy, Screw Cap DO Membranes

When the PTFE (polytetrafluoroethylene) membrane of the protective cap wears, it is always good to have a back-up.

HI76407A/P	contains 5 ready-to-use, replacement membranes
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HI7041

Electrolyte Solution

It is crucial to the performance of your DO probe to keep the sensor active with regular maintenance. For this purpose, Hanna has developed HI7041 electrolyte solution to refill the membrane cap.

HI7041S	refilling electrolyte solution (30 mL)
HI7041	refilling electrolyte solution (6 x 30 mL)
HI7041M	refilling electrolyte solution (230 mL)
HI7041L	refilling electrolyte solution (500 mL)



HI76407 Protected Sleeve Series
DO Probe
with Protective Sleeve

Perfect for laboratory and field applications, The Hanna HI76407F Series DO probes are extremely rugged with a screw-on protective sleeve. Calibration is fast and simple, and measurements are temperature compensated. The sensitive PTFE membrane can be changed in a few seconds.

- 1 Shielded, waterproof cable
- 2 Protective sleeve
- 3 PEI probe for best field protection
- 4 Linearized and accurate thermistor temperature sensor protected behind a stainless steel cover
- 5 Silver wire anode element
- 6 Glass encapsulated platinum cathode
- 7 Screw cap membrane that holds potassium chloride electrolyte solution (HI7041S)
- 8 Thin, permeable PTFE membrane isolates the sensor elements from the testing solution, but allows oxygen to enter (HI76407A/P)
- 9 Hole for solution cycling
- 10 Protective sleeve for field applications

Probe	Cable Length	Recommended Meter
HI76407/4F	4 m (13')	HI9146
HI76407/10F	10 m (33')	HI9142
HI764073	4 m (13')	HI98193

HI76407A/P
Easy,
Screw Cap
DO Membranes

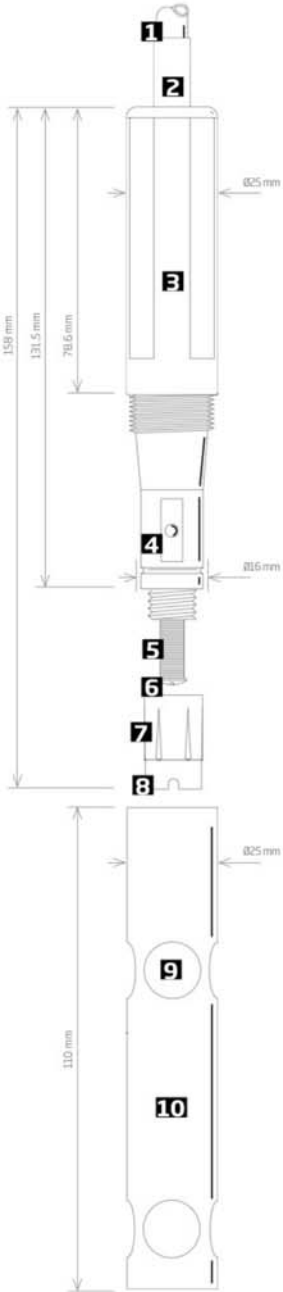
When the PTFE (polytetrafluoroethylene) membrane of the protective cap wears, it is always good to have a back-up.

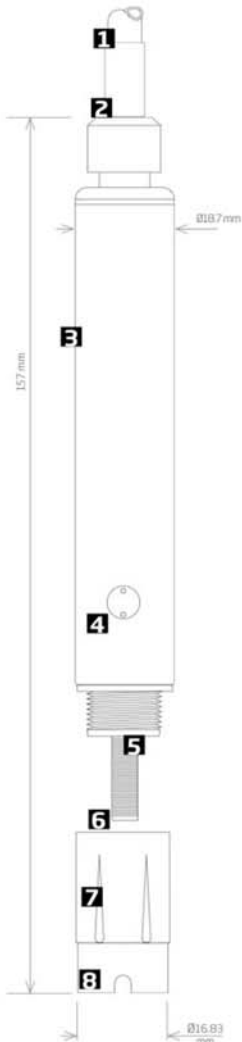
HI76407A/P	contains 5 ready-to-use, replacement membranes.
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HI7040 • HI7041
DO
Solutions

It is crucial to the performance of your DO probe to keep the sensor active with regular maintenance.

HI7040L	zero oxygen solution set, 500 mL + 12g
HI7041S	refilling electrolyte solution (30 mL)
HI7041	refilling electrolyte solution (6 x 30 mL)
HI7041M	refilling electrolyte solution (230 mL)
HI7041L	refilling electrolyte solution (500 mL)





HI76408

HI76408

Thinner, Lighter Probe

for Laboratories

The Hanna HI76408 DO probe is rugged and perfect for both laboratory and field applications. Calibration is fast and simple, and measurements are temperature compensated. The sensitive PTFE membrane can be changed in a few seconds.

- 1 Shielded, waterproof cable
- 2 Protective sleeve
- 3 PEI probe for best field protection
- 4 Linearized and accurate thermistor temperature sensor protected behind a stainless steel cover
- 5 Silver wire anode element
- 6 Glass-encapsulated platinum cathode
- 7 Screw cap membrane that holds potassium chloride electrolyte solution (HI7041S)
- 8 Thin permeable PTFE membrane isolates the sensor elements from the testing solution, but allows oxygen to enter (HI76407A/P)

Probe	Cable Length	Recommended Meter
HI76408	1 m (3.3')	HI2400

HI76407A/P

Easy, Screw Cap DO Membranes

When the PTFE (polytetrafluoroethylene) membrane of the protective cap wears, it is always good to have a back-up.

HI76407A/P contains 5 ready-to-use, replacement membranes.



HI7040 • HI7041

DO Solutions

It is crucial to the performance of your DO probe to keep the sensor active with regular maintenance.



HI7040L	zero oxygen solution set, 500 mL + 12g
HI7041S	refilling electrolyte solution (30 mL)
HI7041	refilling electrolyte solution (6 x 30 mL)
HI7041M	refilling electrolyte solution (230 mL)
HI7041L	refilling electrolyte solution (500 mL)

6

Dissolved Oxygen

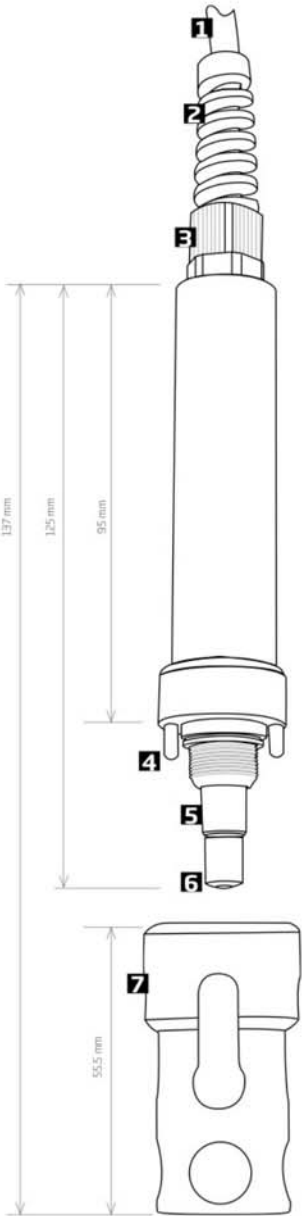
probes and solutions

HI76409
Galvanic DO Probe
with Protective Cap

Unlike polarographic probes, galvanic DO probes require no conditioning time. When you need to measure multiple samples in a given period of time, simply turn on the meter and measure on demand.

- 1 Shielded, waterproof cable
- 2 Flex protect
- 3 Strain relief for cable
- 4 Temperature sensors
- 5 Zinc (Zn) anode
- 6 Ag⁺ cathode (3.5 mm), pure silver
- 7 Protective cap

Probe	Cable Length	Recommended Meter
HI76409/4	4 m (13')	HI9147 (meter specific, fixed probe)
HI76409/10	10 m (33')	



HI76409A/P
Easy,
Screw Cap
DO Membranes

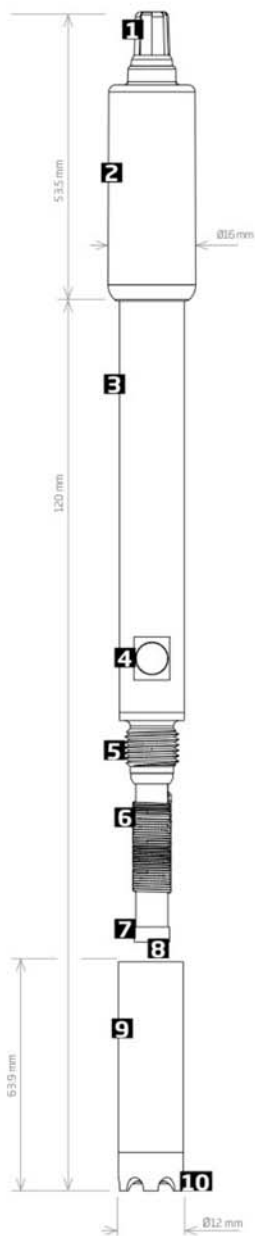
When the HDPE (High Density Polyethylene) membrane of the protective cap wears, it is always good to have a back-up.

HI76409A/P	Contains 5 ready-to-use, replacement membranes
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HI7040 • HI7042
DO
Solutions

It is crucial to the performance of your DO probe to keep the sensor active with regular maintenance.

HI7040L	Zero oxygen solution set, 500 mL + 12g
HI7042S	Refilling electrolyte solution (30 mL)



HI7041
DO
Solutions

It is crucial to the performance of your DO probe to keep the sensor active with regular maintenance.

HI7041S	refilling electrolyte solution (30 mL)
HI7041	refilling electrolyte solution (6 x 30 mL)
HI7041M	refilling electrolyte solution (230 mL)
HI7041L	refilling electrolyte solution (500 mL)

HI764080
edge® Compatible
Digital DO Probe

The electrodes used with edge are nearly as advanced as edge itself. They feature a built-in microchip that stores sensor, serial number, type, ID, and calibration information that is automatically retrieved by edge once the electrode is plugged in.

Dissolved oxygen calibration information includes: standards used for calibration, date, time, altitude and salinity correction.

These digital electrodes also feature an easy to plug in 3.5 mm connector so you never have to worry about the right angle or aligning pins.

- 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 3.5 mm jack termination
- Unique serial ID in every probe for traceability

- 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** Disposable membrane cap
- 10** Oxygen permeable PTFE membrane

Probe	Cable Length	Compatible edge™ meters
HI764080	1m (3.3')	HI2020 HI2030 HI2040 HI2004

6

Dissolved Oxygen

probes and solutions

HI76483
Polarographic DO Probe

This polarographic probe will provide a high degree of accuracy and reproducibility for dissolved oxygen determinations. The probe features a Pt cathode and Ag/AgCl anode assembly, a replaceable membrane cap with reinforced PTFE pre-tensioned membrane, a 12 mm in diameter PEI body and 1 m cable with connector. The polarographic DO probe was designed to cover a wide range of applications and is fits easily into wine and BOD bottles where size is an issue. For use with HI5421.

- Polarographic DO probe with analog signal
- 12 mm design that incorporates integral temperature
- Durable PEI (polyetherimide) body and membrane cap has outstanding chemical resistance
- Incorporated 1 m cable and DIN connector

- 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** Disposable membrane cap
- 10** Oxygen permeable PTFE membrane

Probe	Cable Length	Recommended meters
HI76483	1 m (3.3')	HI5421



HI7041
DO
Solutions

It is crucial to the performance of your DO probe to keep the sensor active with regular maintenance.

HI7041S	refilling electrolyte solution (30 mL)
HI7041	refilling electrolyte solution (6 x 30 mL)
HI7041M	refilling electrolyte solution (230 mL)
HI7041L	refilling electrolyte solution (500 mL)

