



**Standard Operating Procedures for Manual Field Measurement of  
Turbidity, pH, Dissolved Oxygen, and Conductivity**

**Final Reports**

**2012**

**CTSW-RT-11-255.11.02/03/04/05-F**

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Storm Water Liaison, Caltrans Division of Environmental Analysis, MS 27, P.O. Box 942874, Sacramento, CA 94274-0001. (916) 653-8896 Voice, or dial 711 to use a relay service.



# **Standard Operating Procedures for Manual Field Measurement of Turbidity**

DOCUMENT NO. CTSW-RT-11-255.11.02-F

**January 2012**

**California Department of Transportation  
Division of Environmental Analysis  
Storm Water Program MS 27  
1120 N Street, Sacramento, California 95814  
<http://www.dot.ca.gov/hq/env/stormwater/index.htm>**



## Caltrans Technical Report Documentation Page

|  |                             |  |
|--|-----------------------------|--|
| 1. Report No.<br>CTSW-RT-11-255.11.02-F  | 2. Type of Report<br>Report | 3. Report Phase and Edition<br>Final                               |
| 4. Title and Subtitle<br>Standard Operating Procedures for Manual Field Measurement of Turbidity   |                             | 5. Report Date<br>January 2012                                     |
| 6. Editor:<br>Hamid Hakim, Ph.D., P.E, Caltrans<br>Authors:<br>Armand Ruby; Cory LaNeave, P.E.   |                             | 7. Caltrans Project Coordinator<br>Hamid Hakim, Ph.D., P.E.        |
| 8. Performing Organization Names and Addresses<br>CALIFORNIA DEPARTMENT OF TRANSPORTATION<br>Division of Environmental Analysis- MS-27<br>1120 N Street<br>P.O. Box 942874<br>Sacramento CA 94274-0001<br>www.dot.ca.gov/hq/env/stormwater   |                             | 9. Task Order No.<br>11<br>Amendment No.<br>3                      |
|  |                             | 10. Contract No.<br>43A0255  |
| 11. Sponsoring Agency Name and Address<br>California Department of Transportation<br>Sacramento, CA 95814  |                             | 12. Caltrans Functional Reviewers:<br><br>Hamid Hakim, Ph.D., P.E. |
| 13. Supplementary Notes  |                             | 13. External Reviewers   |
| 15. Abstract<br>These Standard Operating Procedures (SOPs) for Manual Field Measurement of Turbidity are a companion document to the <i>Construction Site Monitoring Program Guidance Document</i> . This set of SOPs presents meter calibration, sampling, and measurement methods. The document defers to the User Guide for procedures for troubleshooting. |                             |  |
| 16. Key Words:<br>Storm water, calibration, turbidity meter  | 17. Distribution Statement  | 18. Number of pages:<br>60   |



## **Standard Operating Procedures for Manual Field Measurement of Turbidity**

### **Final Report**

**January 2012**

**CTSW-RT-11-255.11.02-F**

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Storm Water Liaison, Caltrans Division of Environmental Analysis, MS 27, P.O. Box 942874, Sacramento, CA 94274-0001. (916) 653-8896 Voice, or dial 711 to use a relay service.



## Introduction

The California Construction General Stormwater NPDES Permit (CGP) includes requirements for field measurement of turbidity in discharges from construction sites. This Standard Operating Procedures (SOPs) document provides direction on how to perform turbidity measurements at California Department of Transportation (Caltrans) construction sites.

## Responsible Personnel

The following personnel are responsible for various aspects associated with turbidity measurements of stormwater at Caltrans construction sites to comply with the CGP. The brief descriptions provided below serve to clarify the roles that these individuals have in this process.

- *Caltrans District Construction Stormwater Coordinator* is responsible for authorizing all work, and ensures that SOP implementation and documentation responsibilities are clearly communicated to the project personnel.
- *Resident Engineer* is responsible for ensuring that the SOP is implemented and documented on the required schedule and that the Water Pollution Control Manager is performing these requirements in a timely manner.
- *Water Pollution Control (WPC) Manager* is responsible for providing the direction to field crew to perform the analysis for pH according to the required project frequency.
- *Field Crew* are responsible for performing SOPs, clearly documenting data, and relaying data and observations collected from stormwater monitoring activities.

## Frequency of SOP

Meter calibration and measurement procedures described in this SOP must be followed each day that field measurements are performed.

## References to Existing Source Documents

This SOP references the *Hach 2100Q Portable Turbidimeter and 2100Qis Portable Turbidimeter User Manual*, DOC022.53.80041, 01/2010, Edition 1, attached as Attachment 1.

This SOP is also adapted from information provided in the following sources:

(1) *Standard Operating Procedures (SOPs) for Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program (SWAMP)*, version 1.0, released October 15, 2007 (SWAMP, 2007); available for download at: <http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/standard-operating-procedures>

(2) United States Geological Survey, variously dated, National field manual for the collection of water-quality data: *U.S. Geological Survey Techniques of Water-Resources Investigations*,



Book 9, Chapters. A1 through A9; available online at: <http://pubs.water.usgs.gov/twri9A> or <http://water.usgs.gov/owq/FieldManual/index.html>

Turbidity is covered under Chapter A6 Field Measurements, Section 6.7, Turbidity.

Relevant quality assurance/quality control (QA/QC) protocols are referenced in the associated *Caltrans Construction Site Monitoring Program Guidance Manual*.

### **Special Cautions and Considerations; Health and Safety**

Proper gloves must be worn to both prevent alteration of the field measurements, and to protect sampling personnel from environmental hazards. The user should wear at least one layer of gloves, but two layers help protect against leaks. All gloves must be powder-free. Disposable polyethylene, nitrile, or non-talc latex gloves are acceptable for field measurements.

### **CAUTIONS**

When performing measurements in areas of unknown water quality, especially in waters that are suspected to contain hazardous substances or human pathogens, at least one layer of gloves shall be of the “long-cuff” variety to cover the wrist and forearm to limit skin contact with the source water.



## Methods/Procedures

This SOP pertains to manual measurement of turbidity in the field only. Field measurement of dissolved oxygen (DO), temperature, electrical conductivity (EC), and pH are covered in a separate SOP.

### *Equipment*

For field measurement of turbidity at Caltrans construction sites, the specified equipment is the Hach Portable Turbidimeter, Model 2100Q, which is equipped with a complete kit ready for turbidity measurement in the field. Other equipment items also are required for personal safety, sample collection, field data recording, and QC purposes.

A complete list of required equipment for field measurement of turbidity is provided in the checklist below.

### **Standard Equipment and Supplies Checklist**

- Hardhat
- Safety vest
- Box of powder-free gloves
- Long-cuff gloves as necessary
- Scientific Calculator
- "Write-In-The-Rain" Notebook
- Field Meter Calibration Record Form
- Field Measurement Data Form
- Pencil(s) & Pen(s)
- Digital Camera
- Flashlight
- Extra batteries
- Deionized water for rinsing and cleaning
- Turbidity Standards (20 NTU, 100 NTU, and 800 NTU)
- Manufacturer-provided cloth or lint-free tissues
- Manufacturer-provided oiling tissue
- Manufacturer-provided silicon oil cleaning solution (refractive index should match that of the sample cells)
- Sample Collection Containers
- Sample Collection Extension Arm (as required)
- Hach 2100Q Portable Turbidimeter

### *Field Meter Calibration*

All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day for each day of instrument use. Calibration shall be performed prior to the first measurements of the day. Refer to pages 9 and 10 of the *Hach 2100Q Portable Turbidimeter User Manual* (Attachment 1) for specific calibration instructions.



The Hach 2100Q turbidity meter calibration is accomplished with three standards provided in the meter kit by the manufacturer. Start the calibration process by pushing the “Calibration” key to enter the calibration mode. Follow the instructions on the display. The calibration is performed using the 20 NTU, 100 NTU, and 800 NTU standards (in that order). To ensure that the standard solutions are well-mixed, gently invert each standard before inserting into the meter.

For best accuracy, use the same sample cell or four matched sample cells for all readings during calibration. Insert the sample cell in the instrument cell compartment so that the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment.

Record the results of the field meter calibration on the CEM-2056 Stormwater Turbidity Meter Calibration Record form (see Attachment 2).

### ***Sample Collection***

The Hach 2100Q turbidity meter requires collection of a sample for subsequent turbidity measurement within the confines of the meter. The sample may be collected using any clean container. A wide-mouth sample bottle provided by the laboratory is preferred for this purpose, as those bottles are shipped pre-cleaned.

Samples for field measurement purposes are collected by direct submersion of the sample container into the flow whenever possible. Samples always should be collected upstream of sampling personnel and equipment, and with the sample container pointed upstream when the container is opened for sample collection. Care must be taken not to sample water downstream of areas where sediments have been disturbed in any manner by field personnel.

Samples are collected from a location where the sample stream visually appears to be completely mixed. Ideally this is at the centroid of the flow cross-section, but site conditions do not always allow centroid collection. (“Centroid” is defined as the midpoint of that portion of the stream width, which contains 50 percent of the total flow area.) The location should preferably be accessible by direct reach, or in the case of a receiving water body, via wading.

If the centroid of the flow cannot be sampled by direct reach or by wading into the flow, a sampling pole or other sampling device can be used to reach the sampling location. Such devices typically involve a means to extend the reach of the sampler, with the sample bottle attached to the end of the device for filling at the desired location. These methods do not allow opening of the sample container under water; therefore, there is potential for contamination when the container is opened prior to lowering the sample container into the stream. Caution is required when wading, as flowing water provides more force than visually anticipated. Only experienced personnel should perform this collection technique.

When sampling from a stream bank where direct reach is not possible, the sample container is secured by a hardware device, which, in turn, is attached to the end of an extendable sampling pole. Sites accessed by bridge also can be sampled with a sample container secured to a device, lowered into the stream at the end of a rope. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge.



### *Sample Collection Depth:*

- **Sub-Surface Sample:** Grab samples for field measurements are typically collected at 4 inches below the water surface.
- **Surface Sample:** Grab samples for field measurements are collected at the surface when water depth is 4 inches. Because there can be differences in water quality on the surface, compared to subsurface, surface samples should be noted on the field data sheet as collected at 0 inch.

After the sample is collected, it must be transferred as soon as possible to the “sample cell” (small glass container) provided in the Hach 2100Q kit. The sample cell then is placed into the meter for turbidity measurement. During this process care must be taken to avoid settling of any material that is suspended in the sample. Settling can be prevented by swirling the sample.

### *Field Measurement Methods*

When using the Hach 2100Q turbidity meter for measurement of turbidity, samples must be collected using a clean container, and the instructions presented on pages 9 through 11 of the *Hach 2100Q Portable Turbidimeter User Manual* (Attachment 1) must be followed for sample preparation and analysis.

The Hach 2100Q turbidity meter measures turbidity as nephelometric turbidity units (NTU).

The following general instructions must be observed:

#### *During Use:*

- Place the meter on a level, stationary surface during measurement. *Note: Do not hold the meter in the hand during measurement.*
- Avoid contamination of sample from construction site dust or any other source.
- Avoid dilution of sample from rain water.
- Avoid operation in direct sunlight; shade the meter during operation.
- Measure samples immediately to prevent temperature changes and settling. Before taking a measurement, always ensure that the sample is homogeneous throughout.
- Always close the sample compartment lid during measurement, calibration, and storage to prevent the entry of dust and dirt.
- Always cap the sample cell to prevent spillage of the sample into the instrument.
- Always use clean sample cells in good condition. Dirty, scratched, or damaged cells can cause inaccurate readings.



- Make sure that cold samples do not “fog” the sample cell.

*After Use:*

- Store sample cells filled with laboratory-provided distilled or deionized (DI) water and cap tightly.
- Remove sample cell and batteries from the instrument if the instrument is stored for an extended time period (longer than a month).

To perform measurement:

1. Collect a representative sample in a clean container. Fill a sample cell to the line (about 15 milliliter). Take care to handle the sample cell by the top. Cap the cell.
2. Wipe the cell with a soft, lint-free cloth to remove water spots and fingerprints.
3. Apply a thin film of silicone oil (provided in meter kit). Wipe with soft cloth (provided in meter kit) to obtain an even film over the entire surface.
4. Push the “Power” key to turn on the meter. Place the instrument on a flat, sturdy surface.  
*Note: Do not hold the instrument during measurement.*
5. Gently invert the sample cell to ensure mixing, and then insert the sample cell in the instrument cell compartment so the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment. Close the lid.
6. Push the “Read” key. The display shows “Stabilizing” then displays the turbidity in NTU (FNU). The result is stored in the meter automatically.

After measurement, complete the CEM-2052 Stormwater Sample Field Test Report form (see Attachment 3).

Repeat sample collection and measurement process as needed per the *Caltrans Construction Site Monitoring Program Guidance Manual*.

After use, rinse the sample cells with DI water. Store the sample cells with caps on to prevent cells from drying. Do not air dry the sample cells after use.

To properly store the sample cells:

1. Fill the sample cells with DI water.
2. Cap and store the sample cells.
3. Wipe the outside of the sample cells dry with a soft cloth.

Before leaving the sampling site, field personnel should review datasheets to ensure that they are complete and legible, and that all sampling-related materials and equipment have been collected.



## **Maintenance**

The meter is designed to be maintenance-free and does not require regular cleaning for normal operation. Exterior surfaces of the meter may be cleaned as necessary. Clean the meter with a dust- and lint-free dry or slightly damp cloth. A mild soap solution can also be used for liposoluble (greasy/oily) contamination. *Note: Do not clean the meter with solvents to avoid damaging the material.*

Replace the four AA batteries and the meter lamp as needed; see pages 19 through 21 of the *Hach 2100Q Portable Turbidimeter User Manual* (Attachment 1).

## **Quality Assurance/Quality Control**

Perform all required QA/QC measures as specified in the *Caltrans Construction Site Monitoring Program Guidance Manual*.

Adherence to the sample collection and measurement procedures described above, along with adherence to QA/QC measures required per the *Caltrans Construction Site Monitoring Program Guidance Manual*, will ensure that field measurements are representative of environmental conditions, and conform to CGP requirements.

## **Troubleshooting**

Refer to manufacturer-provided literature for troubleshooting suggestions or call manufacturer's representative for specific questions.



**Attachment 1 – Hach Portable Turbidimeter 2100Q User Manual**

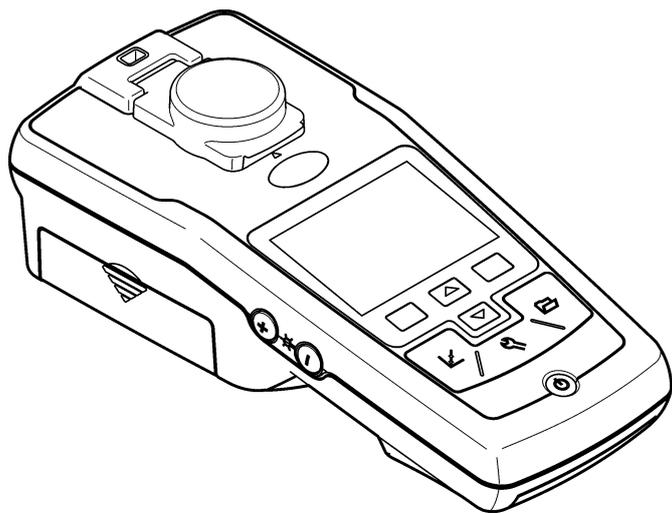


DOC022.53.80041

# 2100Q and 2100Q*is*

01/2010, Edition 1

**User Manual**



---

|   |    |
|---|----|
| <b>Specifications</b> .....                               | 3  |
| <b>General Information</b> .....                          | 3  |
| Safety information .....                                  | 4  |
| Use of hazard information .....                           | 4  |
| Precautionary labels .....                                | 4  |
| Certification .....                                       | 4  |
| Product overview .....                                    | 5  |
| Product components .....                                  | 5  |
| <b>Installation</b> .....                                 | 6  |
| Install the battery .....                                 | 6  |
| <b>User interface and navigation</b> .....                | 7  |
| User interface .....                                      | 7  |
| Display description .....                                 | 8  |
| Navigation .....  | 8  |
| <b>Start-up</b> .....                                     | 8  |
| Turn the meter on and off .....                           | 8  |
| Change the language .....                                 | 8  |
| Change the date and time .....                            | 9  |
| <b>Standard operations</b> .....                          | 9  |
| Use a sample ID .....                                     | 9  |
| Use an operator ID .....                                  | 9  |
| Calibrate the turbidimeter with StablCal® Standards ..... | 9  |
| Turbidity measurement .....                               | 10 |
| Measurement notes .....                                   | 10 |
| Turbidity measurement procedure .....                     | 11 |
| <b>Data management</b> .....                              | 11 |
| About stored data .....                                   | 11 |
| View data log .....                                       | 11 |
| Delete data log .....                                     | 12 |

## Table of Contents

---

|  |    |
|--|----|
| Send stored data .....                         | 12 |
| <b>Advanced operations</b> .....               | 12 |
| Display contrast .....                         | 12 |
| Power management .....                         | 12 |
| Set the sound options .....                    | 12 |
| Security options .....                         | 13 |
| Turn security options on .....                 | 13 |
| View meter information .....                   | 13 |
| Calibration .....                              | 13 |
| Calibration options .....                      | 13 |
| Calibration standard overview .....            | 14 |
| StablCal® RapidCal™ calibration .....          | 15 |
| Verification options .....                     | 16 |
| Calibration verification (Verify Cal) .....    | 16 |
| Reading modes .....                            | 16 |
| Apply silicone oil to a sample cell .....      | 17 |
| Indexing a single cell .....                   | 17 |
| <b>Maintenance</b> .....                       | 19 |
| Clean the meter .....                          | 19 |
| Store the sample cells .....                   | 19 |
| Replace the battery .....                      | 19 |
| Replace the lamp .....                         | 19 |
| <b>Troubleshooting</b> .....                   | 22 |
| <b>Replacement parts and accessories</b> ..... | 23 |
| Replacement parts .....                        | 23 |
| Accessories .....                              | 23 |
| <b>Index</b> .....                             | 25 |

## Specifications

Specifications are subject to change without notice.

| Specification       | Details   |
|---------------------|---|
| Measurement method  | Ratio turbidimetric determination using a primary nephelometric light scatter signal (90°) to the transmitted light scatter signal.                                 |
| Regulatory          | <b>2100Q:</b> Meets EPA Method 180.1<br><b>2100Qis:</b> Meets ISO 7027  |
| Lamp source         | <b>2100Q:</b> Tungsten filament lamp<br><b>2100Qis:</b> Light-emitting diode (LED) at 860 nm  |
| Range               | 0–1000 NTU (FNU)  |
| Accuracy            | ±2% of reading plus stray light from 0–1000 NTU (FNU)   |
| Repeatability       | ±1% of reading or 0.01 NTU (FNU), whichever is greater  |
| Resolution          | 0.01 NTU on lowest range  |
| Stray light         | ≤ 0.02 NTU (FNU)  |
| Signal averaging    | Selectable on or off  |
| Detector            | Silicon Photodiode  |
| Reading modes       | Normal (Push to Read), Signal Averaging or Rapidly Settling Turbidity™  |
| Calibration options | Single step RapidCal™ for Low-Level Regulatory Reporting from 0–40 NTU (FNU)<br>Full range calibration from 0–1000 NTU (FNU)<br>Calibration to degrees of turbidity |
| Calibration logger  | Records the last 25 successful calibrations   |
| Verification logger | Logs the last 250 successful verifications  |
| Data logger         | 500 records   |

| Specification          | Details  |
|------------------------|--|
| Power requirement      | AC 100–240 V , 50/60 Hz (with power or USB/power module)<br>4 AA alkaline batteries<br>Rechargeable NiMH (for use with USB/power module) |
| Operating conditions   | Temperature: 0 to 50 °C (32 to 122 °F)<br>Relative Humidity: 0–90% at 30 °C, 0–80% at 40 °C, 0–70% at 50 °C, noncondensing               |
| Storage conditions     | –40 to 60 °C (–40 to 140 °F), instrument only  |
| Interface              | Optional USB   |
| Sample required        | 15 mL (0.5 oz.)  |
| Sample cells           | Round cells 60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw caps   |
| Dimensions             | 22.9 x 10.7 x 7.7 cm (9.0 x 4.2 x 3.0 in.)   |
| Weight                 | 530 g (1.17 lb) without batteries<br>620 g (1.37 lb) with four AA alkaline batteries   |
| Meter enclosure rating | IP67 (closed lid, battery and module compartment excluded)   |
| Protection class       | Power supply: Class II   |
| Certification          | CE certified   |
| Warranty               | 1 year (EU: 2 years)   |

## General Information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

## Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

## Use of hazard information

|  |
|--|
| <b>⚠ DANGER</b>  |
| Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury. |

|   |
|---|
| <b>⚠ WARNING</b>  |
| Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury. |

|  |
|--|
| <b>⚠ CAUTION</b>   |
| Indicates a potentially hazardous situation that may result in minor or moderate injury. |

|  |
|--|
| <b>NOTICE</b>  |
| Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis. |

## Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

|   |  |
|---|--|
|   | This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.  |
|  | This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.  |
|  | Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.<br><i>Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</i> |

## Certification

### Canadian Radio Interference-Causing Equipment Regulation, IECs-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

### FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate

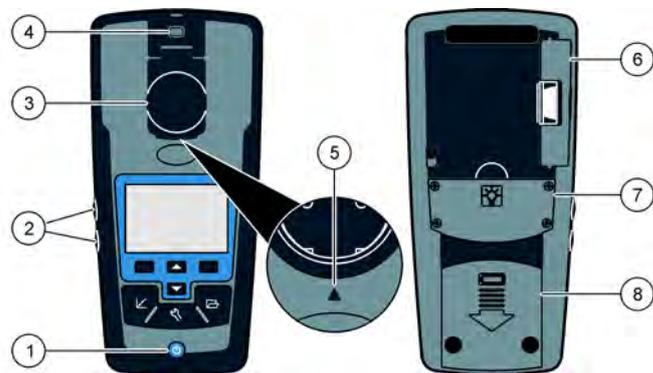
the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

### Product overview

The 2100Q and 2100Q/s portable turbidimeters measure turbidity from 0 to 1000 NTU (FNU). Primarily for field use, the portable meter operates on four AA batteries. Data can be stored and transferred to a printer, computer or USB storage device.

**Figure 1 Product overview**

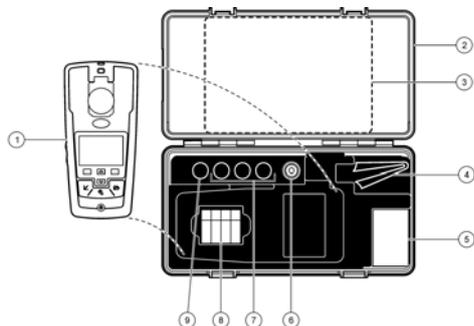


|                               |                       |
|-------------------------------|-----------------------|
| 1 Power on or off             | 5 Alignment arrow     |
| 2 Backlight keys (+ and -)    | 6 Module              |
| 3 Sample cell holder with lid | 7 Lamp compartment    |
| 4 Attachment for lanyard      | 8 Battery compartment |

### Product components

Refer to [Figure 2](#) to make sure that all components have been received. If any of these items are missing or damaged, contact the manufacturer or a sales representative immediately.

**Figure 2 2100Q and 2100Q<sub>i</sub>s components**



|   |  |
|---|--|
| 1 2100Q or 2100Q <sub>i</sub> s turbidimeter    | 6 Silicone oil                                       |
| 2 Carrying case                                 | 7 20, 100 and 800 NTU StablCal calibration standards |
| 3 User manual, Quick reference guide and CD-ROM | 8 AA alkaline batteries (pk/4)                       |
| 4 Oiling cloth                                  | 9 StablCal 10 NTU verification standard              |
| 5 1" sample cell (10 mL) with cap (pk/6)        |  |

## Installation

### ▲ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Install the battery

### ▲ WARNING

Potential fire hazard. Use only alkaline or nickel metal hydride batteries (NiMH) in the meter. Other battery types or incorrect installation can cause a fire. Never mix battery types in the meter.

### NOTICE

The battery compartment is not waterproof. If the battery compartment becomes wet, remove and dry the batteries and thoroughly dry the interior of the compartment. Check the battery contacts for corrosion and clean them if necessary.

### NOTICE

When using nickel metal hydride (NiMH) batteries, the battery icon will not indicate a full charge after freshly charged batteries have been inserted (NiMH batteries are 1.2 V versus 1.5 V for alkaline batteries). Even though the icon does not indicate complete charge, 2300 mAh NiMH batteries will achieve 90% of instrument operation lifetime (before recharge) versus new alkaline batteries.

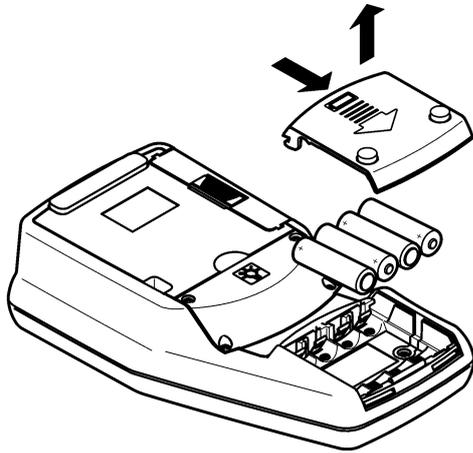
The meter can be powered with AA alkaline or rechargeable NiMH batteries. To conserve battery life, the meter will power off after 10 minutes of inactivity, the backlight powers off after 30 seconds. This time can be changed in the Power Management menu.

**Note:** Rechargeable batteries will only be recharged with the USB/power module. Refer to the module documentation for further information.

For battery installation refer to [Figure 3](#).

1. Remove the battery cover.
2. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct orientation.
3. Replace the battery cover.

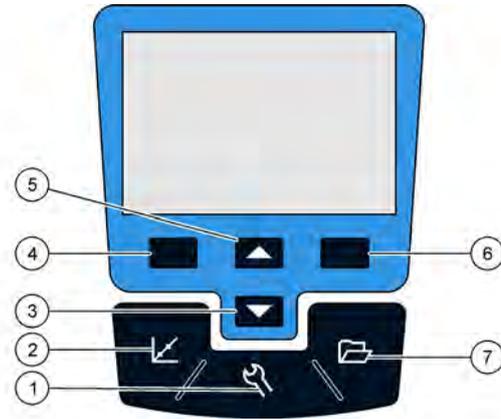
Figure 3 Battery installation



## User interface and navigation

### User interface

Figure 4 Keypad description

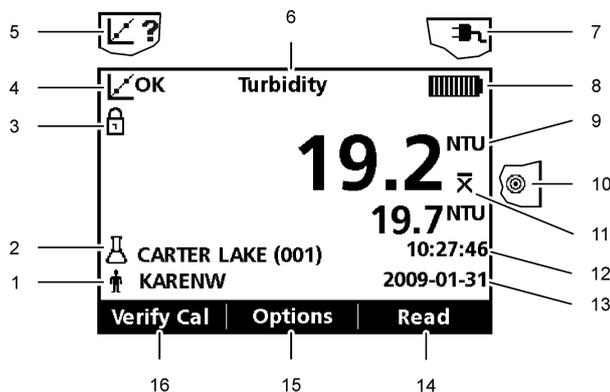


|   |   |
|---|---|
| 1 <b>SETTINGS</b> key: select menu options for setting up the meter   | 5 <b>UP</b> key: scroll through menus, enter numbers and letters  |
| 2 <b>CALIBRATION</b> key: shows calibration screen, start calibration, select cal options   | 6 <b>RIGHT</b> key (contextual): read turbidity sample, selects or confirms options, opens/jumps to sub-menus |
| 3 <b>DOWN</b> key: scroll through menus, enter numbers and letters  | 7 <b>DATA MANAGEMENT</b> key: view, delete or transfer stored data  |
| 4 <b>LEFT</b> key (contextual): access for calibration verification, cancels or exits the current menu screen to the previous menu screen |   |

## Display description

The measurement screen shows the turbidity, unit, calibration status, date and time, operator ID (if setup) and sample ID (if setup). Refer to [Figure 5](#).

**Figure 5** Single screen display



|  |   |
|--|---|
| 1 Operator identification                            | 9 NTU (Nephelometric Turbidity Unit) or FNU (Formazin Turbidity Unit) |
| 2 Sample identification                              | 10 Reading mode: Rapidly Settling Turbidity (Target icon)             |
| 3 Stability or display lock indicator                | 11 Reading mode: Signal Average (X-bar icon)                          |
| 4 Calibration status indicator (Calibration OK=pass) | 12 Time   |
| 5 Calibration status indicator (Calibration ?=fail)  | 13 Date   |
| 6 Parameter title                                    | 14 Read (contextual: OK, Select)                                      |
| 7 AC power icon                                      | 15 Options (contextual)   |
| 8 Battery icon                                       | 16 Verification calibration   |

## Navigation

The meter contains a Settings menu, Reading Options menu, Calibration Options menu and Calibration Verification Options menu to change various options. Use the **UP** and **DOWN** keys to highlight different options. Push the **RIGHT** key to select an option. There are two ways to change options:

1. Select an option from a list: Use the **UP** and **DOWN** keys to select an option. If check boxes are shown, more than one option can be selected. Push the **LEFT** key under Select.
 

*Note: To deselect check boxes, push the **LEFT** key under Deselect.*
2. Enter an option value using the arrow keys: Push the **UP** and **DOWN** keys to enter or change a value.
3. Push the **RIGHT** key to advance to the next space.
4. Push the **RIGHT** key under **OK** to accept the value.

## Start-up

### Turn the meter on and off

 Push the **ON/OFF** key to turn on or turn off the meter. If the meter does not turn on, make sure that the batteries, or the module, are properly installed or that the AC power supply is properly connected to an electrical outlet.

*Note: The Auto-Shutoff option can also be used to turn off the meter. Refer to [Power management](#) on page 12.*

### Change the language

There are three options to set the language:

- The display language is selected when the meter is powered on for the first time.
- The display language is selected when the power key is pushed and held.
- The language can be changed from the Settings menu.

1. Select a language from the list. Confirm with **OK**.
2. Push **Done** when the update is complete.

## Change the date and time

The date and time can be changed from the Date & Time menu.

1. Push the **SETTINGS** key and select Date & Time.
2. Update the time and date information:

| Option        | Description  |
|---------------|--|
| <b>Format</b> | Select one of the formats for the date and time:<br>yyyy-mm-dd 24h<br>yyyy-mm-dd 12h<br>dd-mm-yyyy 24h<br>dd-mm-yyyy 12h<br>mm/dd/yyyy 24h<br>mm/dd/yyyy 12h |
| <b>Date</b>   | Enter the current date   |
| <b>Time</b>   | Enter the current time   |

The current date and time will be shown on the display.

After the date and time setup, the meter is ready to take a reading.

## Standard operations

### Use a sample ID

The sample ID tag is used to associate readings with a particular sample location. If assigned, stored data will include this ID.

1. Select **Sample ID** in the Settings menu.
2. Select, create or delete a sample ID:

| Option                        | Description  |
|-------------------------------|--|
| <b>Current ID</b>             | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Sample ID</b> | Enter a name for a new sample ID.  |
| <b>Delete Sample ID</b>       | Delete an existing sample ID.  |

### Use an operator ID

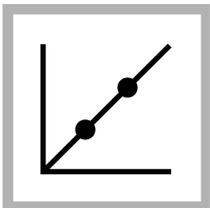
The operator ID tag associates readings with an individual operator. All stored data will include this ID.

1. Select **Operator ID** in the Settings menu.
2. Select, create or delete an operator ID:

| Option                          | Description  |
|---------------------------------|--|
| <b>Current ID</b>               | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Operator ID</b> | Enter a name for a new operator ID (maximum 10 names can be entered).  |
| <b>Delete Operator ID</b>       | Delete an existing operator ID.  |

### Calibrate the turbidimeter with StabiCal® Standards

*Note: For best accuracy use the same sample cell or four matched sample cells for all readings during calibration. Insert the sample cell in the instrument cell compartment so the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment.*

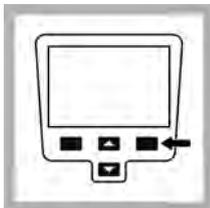


1. Push the **CALIBRATION** key to enter the Calibration mode. Follow the instructions on the display.

**Note:** Gently invert each standard before inserting the standard.



2. Insert the 20 NTU StablCal Standard and close the lid.  
**Note:** The standard to be inserted is bordered.

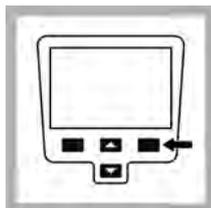


3. Push **Read**. The display shows Stabilizing and then shows the result.

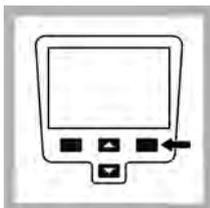


4. Repeat Step 2 and 3 with the 100 NTU and 800 NTU StablCal Standard.

**Note:** Push **Done** to complete a 2 point calibration.



5. Push **Done** to review the calibration details.



6. Push **Store** to save the results. After a calibration is complete, the meter automatically goes into the Verify Cal mode. Refer to [Calibration verification \(Verify Cal\)](#) on page 16.

## Turbidity measurement

### ⚠ WARNING

Potential explosion and fire hazard. This turbidimeter is designed for water based samples. Do not measure solvent or combustible based samples.

Readings can be taken with the Normal reading mode, Signal Average mode or in the Rapidly Settling Turbidity mode. Refer to [Reading modes](#) on page 16 for more information. For accurate turbidity readings use clean sample cells and remove air bubbles (degassing).

### Measurement notes

Proper measurement techniques are important in minimizing the effects of instrument variation, stray light and air bubbles. Use the following measurement notes for proper measurements.

### Instrument

- Make sure that the meter is placed on a level, stationary surface during the measurement.  
**Note:** Do not hold the meter in the hand during measurement.
- Always close the sample compartment lid during measurement, calibration and storage.
- Remove sample cell and batteries from the instrument if the instrument is stored for an extended time period (more than a month).
- Keep the sample compartment lid closed to prevent the entry of dust and dirt.

### Sample cells

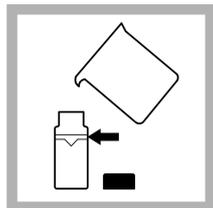
- Always cap the sample cell to prevent spillage of the sample into the instrument.
- Always use clean sample cells in good condition. Dirty, scratched or damaged cells can cause inaccurate readings.
- Make sure that cold samples do not "fog" the sample cell.
- Store sample cells filled with distilled or deionized water and cap tightly.

### Measurement

- Measure samples immediately to prevent temperature changes and settling. Before a measurement is taken, always make sure that the sample is homogeneous throughout.
- Avoid sample dilution when possible.
- Avoid operation in direct sunlight.

## Turbidity measurement procedure

**Note:** Before a measurement is taken, always make sure that the sample is homogeneous throughout.



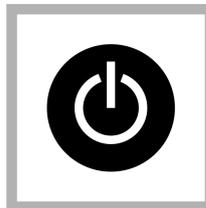
1. Collect a representative sample in a clean container. Fill a sample cell to the line (about 15 mL). Take care to handle the sample cell by the top. Cap the cell.



2. Wipe the cell with a soft, lint-free cloth to remove water spots and fingerprints.

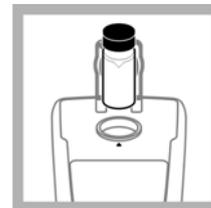


3. Apply a thin film of silicone oil. Wipe with a soft cloth to obtain an even film over the entire surface ([Apply silicone oil to a sample cell](#) on page 17).

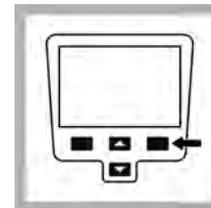


4. Push the **Power** key to turn the meter on. Place the instrument on a flat, sturdy surface.

**Note:** Do not hold the instrument while making measurements.



5. Gently invert and then insert the sample cell in the instrument cell compartment so the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment. Close the lid.



6. Push **Read**. The display shows Stabilizing then the turbidity in NTU (FNU). The result is shown and stored automatically ([Refer to Data management](#) on page 11)

## Data management

### About stored data

The following types of data are stored in the data log:

- Reading Log: stores automatically each time a sample reading is taken (500 records).
- Calibration Log: stores only when **Store** is selected at the end of a calibration (25 records).
- Verify Cal Log: stores only after **Done** is selected at the end of a verification calibration (250 records).

When the data log becomes full, the oldest data point is deleted when more data is added to the log.

### View data log

The data log contains Reading Log, Calibration Log and Verify Cal log. All logs can be sorted by date.

1. Push the **DATA MANAGEMENT** key.
2. Select View Data Log to view the stored data.
3. Push **Select** to view additional information.

| Option                  | Description  |
|-------------------------|--|
| <b>Reading Log</b>      | Reading Log—shows the date, time and reading mode and associated calibration data.   |
| <b>Calibration Log</b>  | Calibration Log—shows the date and time of calibration data and additional information about the calibration.  |
| <b>Verify Cal Log</b>   | Verify Cal Log—shows the calibration verification date and time and additional information about the verification.   |
| <b>All Logs by Date</b> | The most recent data and additional information is shown. The icons show whether the data is from a reading, calibration or calibration verification and identifies the reading mode, if applicable. |

## Delete data log

There are two possibilities to delete stored readings in the Data Management menu:

1. Push the **DATA MANAGEMENT** key and select Delete Data Log.

| Option                     | Description  |
|----------------------------|--|
| <b>Delete Last Reading</b> | Only the last reading stored can be deleted until a new reading is taken and stored. |
| <b>Delete All Logs</b>     | The entire Reading Log can be deleted at once.                                       |

## Send stored data

Data can be stored and transferred to a printer, computer or USB storage device. The data will be formatted as an XML file. Install the USB/power module to the meter and to AC power. Refer to the module documentation for more information.

## Advanced operations

### Display contrast

1. Push the **SETTINGS** key and select Display Contrast.
2. Use the **UP** and **DOWN** key to adjust the contrast of the display and push OK.

### Power management

Use power management to change the backlight option and the battery saving auto-shutoff option.

**Note:** *Power management is not active when the meter is connected to AC power.*

1. Push the **SETTINGS** key and select Power Management.
2. Select which display option to change.

| Option              | Description   |
|---------------------|---|
| <b>Backlight</b>    | The display is illuminated. To maximize battery life, select a time period after which the backlight will automatically power off if no key is pushed: 10 s, 20 s, 30 s, 1 min, 2 min, 5 min<br><b>Note:</b> <i>The Backlight keys (Figure 1 on page 5) will turn the backlight on and off.</i> |
| <b>Auto-Shutoff</b> | To maximize battery life, set a time period after which the meter will automatically power off if no key is pushed: 1 min, 2 min, 5 min, 10 min, 30 min, 1 h  |

### Set the sound options

The meter can make an audible sound when a key is pushed, when a reading is complete or when the calibration reminder is due.

1. Push **SETTINGS** and select Sounds.
2. Select which events will produce an audible sound. Multiple items can be selected.

| Option                  | Description   |
|-------------------------|---|
| <b>Key Press</b>        | The meter will make an audible sound whenever a key is pushed.        |
| <b>Reading complete</b> | The meter will make an audible sound whenever a reading is completed. |
| <b>Reminders</b>        | The meter will make an audible sound when a calibration is due.       |

## Security options

The Security Options menu is used to protect the meter setup.

The Setup Date and Time, Delete Data Log, Restoring Factory Defaults and Restore Factory Cal screens are not accessible without a password.

Store the password in a safe and accessible place. If the specified password is forgotten and Security Options is turned on, the operator is locked out of the restricted menus. Contact technical support if the password is lost.

### Turn security options on

The security options and the set password options are used together to prevent access to restricted menus.

1. Push the **SETTINGS** key and select Security Options.
2. Select Edit Password and use the **UP** and **DOWN** keys to set a password.
3. Select Security On to enable the password setting. The requirement for the password entry is controlled by setting Security Options on or off.

*Note: Set the Security to Off to disable the password setting.*

4. Push the **ON/OFF** key to turn off and on the meter to activate the password settings.

### View meter information

The instrument information menu shows specific information such as the meter name, model number, software version, serial number and available

Operator and Sample IDs. 10 Operator IDs and 100 Sample IDs are available.

1. Push the **SETTINGS** key and select Meter Information.

## Calibration

The portable turbidimeter is calibrated with Formazin Primary Standards at the factory. The meter should be calibrated upon receipt for best results. The manufacturer recommends calibration with a primary standard such as StablCal® Stabilized Standards or with formazin standards every three months.

*Note: Set Cal Reminder Repeat in the Calibration Options menu for periodical calibration. Verify the calibration once a week.*

### Calibration options

The calibration options contain Calibration History, Calibration Curves, Cal Reminder Repeat and Restore Factory Calibration.

1. Push the **CALIBRATION** key and then the **UP** and **DOWN** key.

| Option                     | Description   |
|----------------------------|---|
| <b>Calibration History</b> | The calibration history shows a list of the times when the meter was calibrated. Select a date and time to view a summary of the calibration data.  |
| <b>Cal.Curve</b>           | Select one of the calibration curves for calibration:<br>StablCal® RapidCal™ (0–40 NTU)<br>StablCal® (0–1000 NTU)<br>Formazin RapidCal™ (0–40 NTU)<br>Formazin (0–1000 NTU)<br>Degrees (0–100 mg/L)<br>SDVB (0–1000 NTU)<br>Custom (0–1000 NTU) |
| <b>Cal Reminder Repeat</b> | The meter will make an audible sound when calibration is due. Select one of the following options for time interval and push OK: Off, 1 d, 7 d, 30 d, 60 d, 90 d  |

| Option                             | Description  |
|------------------------------------|--|
| <b>Restore Factory Calibration</b> | All user calibrations will be deleted. The original factory calibration is restored. |

## Calibration standard overview

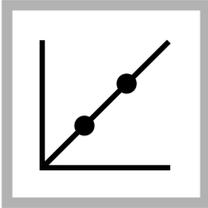
Refer to [Table 1](#) for the calibration standard overview.

**Table 1 Calibration overview**

| Type of calibration            | Required standards                                  |               |         |         |
|--------------------------------|---|---------------|---------|---------|
| StablCal® RapidCal™ (0–40 NTU) | –   | 20 NTU        | –       | –       |
| StablCal® (0–1000 NTU)         | –   | 20 NTU        | 100 NTU | 800 NTU |
| Formazin RapidCal™ (0–40 NTU)  | Typically deionized or distilled water <sup>1</sup> | 20 NTU        | –       | –       |
| Formazin (0–1000 NTU)          | Typically deionized or distilled water <sup>1</sup> | 20 NTU        | 100 NTU | 800 NTU |
| Degrees (0–100 mg/L)           | Typically deionized or distilled water <sup>1</sup> | 20 NTU        | 100 NTU | –       |
| SDVB (0–1000 NTU)              | Typically deionized or distilled water <sup>1</sup> | 20 NTU        | 100 NTU | 800 NTU |
| Custom (0–1000 NTU)            | Typically deionized or distilled water <sup>1</sup> | Select values |         |         |

<sup>1</sup> The water must have a turbidity <0.5 NTU to prepare the calibration standards.

## StabiCal® RapidCal™ calibration

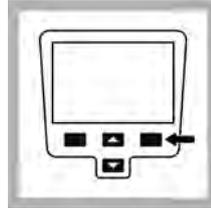


1. Push the **CALIBRATION** key to enter the Calibration mode. Follow the instructions on the display.

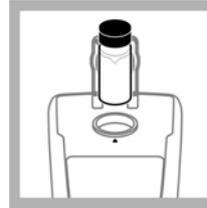
**Note:** Gently invert each standard before inserting the standard.



2. Push the **UP** and **DOWN** key to access Cal Options and then select Cal.Curve.

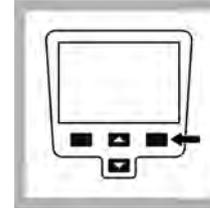


3. Select StabiCal® RapidCal™ from the list and push **OK**.

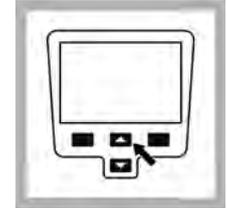


4. Insert the 20 NTU StabiCal Standard and close the lid.

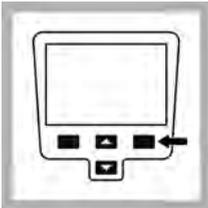
**Note:** The standard to be inserted is bordered.



5. Push **Read**. The display shows Stabilizing and then shows the result.



6. Push **Done** to review the calibration details.



7. Push **Store** to save the results.

After a calibration is complete, the meter automatically goes into the Verify Cal mode, refer to [Calibration verification \(Verify Cal\)](#) on page 16.

## Verification options

The Verification Options contain: Set Verification Standard, Set Acceptance Criteria and Verification Reminder.

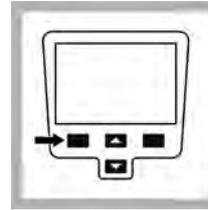
1. Push the **Left** key (Verify Cal) and then the **UP** and **DOWN** keys.

| Option                           | Description  |
|----------------------------------|--|
| <b>Set Verification Standard</b> | To change the verification standard use the <b>UP</b> and <b>DOWN</b> keys to enter a new standard value.<br>Range 0.50–20.0 NTU (Default setting: 10.00 NTU)<br>Range 0–20 NTU for RapidCal™ (0–40 NTU)<br>0–800 NTU for calibration curves with a range from 0–1000 NTU  |
| <b>Set Acceptance Criteria</b>   | Enter the Acceptance Criteria for comparison against the initial calibration verification reading to determine passing or failing. Range 1–50% (Default setting: 10%)  |
| <b>Verification Reminder</b>     | Verification Reminder—The meter will make an audible sound when verification is due. Select one of the following options for time interval and push <b>OK</b> : Off, 30 min (Default setting), 2 h, 4 h, 8 h, 24 h<br>Allow Defer—Push <b>Allow Defer</b> and select Yes or No to postpone the verification due time |

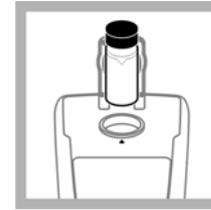
## Calibration verification (Verify Cal)

The manufacturer recommends a calibration verification once a week. After a calibration is complete, the meter automatically goes into the Verify Cal mode.

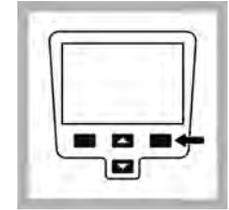
Make sure that the sample cell is clean. Oil the sample cell with silicone oil, refer to [Apply silicone oil to a sample cell](#) on page 17. Check the standard solution. Prepare a formazin standard at the same value and read the value.



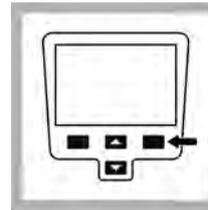
1. Push **Verify Cal** to enter the Verify menu.



2. Gently invert the standard. Insert the 10.0 NTU (or other defined value) Verification Standard and close the lid.



3. Push **Read**. The display shows Stabilizing and then shows the result and tolerance range.



4. Push **Done** to return to the reading display. Repeat the calibration verification if the verification failed.

## Reading modes

1. Push the **UP** or **DOWN** key to enter the Reading Options menu.
2. Select Reading Mode to select one of the following options:

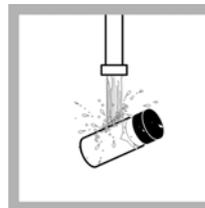
| Option                          | Description   |
|---------------------------------|---|
| <b>Normal (Default setting)</b> | The normal mode reads and averages three readings. The result is shown after the reading. |

| Option  | Description  |
|---|--|
| <b>Signal Average</b><br>                    | <p>The Signal Average mode compensates for reading fluctuations caused by drifting of sample particles through the light path.</p> <p>The X-bar icon is shown on the display when signal averaging is on.</p> <p>The Signal Average mode measures 12 times and starts to show the average after three readings. The final result is the average of all 12 readings.</p>  |
| <b>Rapidly Settling Turbidity™ (RST)</b><br> | <p>The Rapidly Settling Turbidity (RST) mode calculates and continuously updates the turbidity reading of the sample to a confidence of 95%, based on the accumulated trend of the real time measured values.</p> <p>The RST mode is best used on samples that settle rapidly and continuously change in value. The reading is based on a correctly prepared sample that is homogeneous at the beginning of the reading. It is best applied to samples that are greater than 20 NTU. The sample must be mixed thoroughly by inversion immediately before inserting it into the meter.</p> <p>The target icon is shown on the display when the Rapidly Settling Turbidity is on.</p> <p>The Rapidly Settling Turbidity reads and calculates five readings while showing intermediate results.</p> |

## Apply silicone oil to a sample cell

Sample cells and caps must be extremely clean and free from significant scratches. Apply a thin coating of silicone oil on the outside of the sample cells to mask minor imperfections and scratches that may contribute to light scattering.

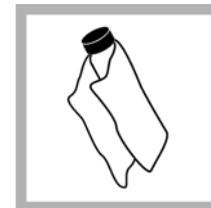
**Note:** Use only the provided silicone oil. This silicone oil has the same refractive index as the sample cell glass.



1. Clean the inside and outside of the cells and caps by washing with a laboratory glass cleaning detergent. Follow with multiple rinses with distilled or demineralized water.



2. Apply a small bead of silicone oil from the top to the bottom of the cell.

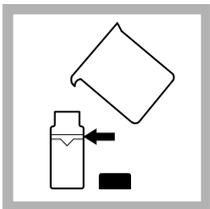


3. Use the provided oiling cloth to spread the oil uniformly. Wipe off the excess so that only a thin coat of oil is left. Make sure that the sample cell is almost dry with little or no visible oil.  
**Note:** Store the oiling cloth in a plastic storage bag to keep the cloth clean.

## Indexing a single cell

Precise measurements for very low turbidity samples require the use of a single cell for all measurements or optically matching the cells. Use one cell to provide the best precision and repeatability. When one cell is used, an index or orientation mark (other than the factory-placed diamond) can be placed on the cell so it is inserted into the instrument with the same orientation each time.

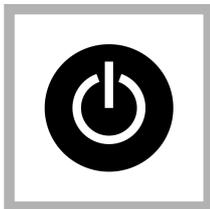
When using a single cell, make an index or orientation mark on the cell as follows:



1. Fill the clean sample cell to the line with high quality water (< 0.5 NTU) and cap immediately. Let the sample cell degas for at least five minutes.



2. Wipe with lint-free cloth. Apply a thin film of silicone oil ([Apply silicone oil to a sample cell](#) on page 17).



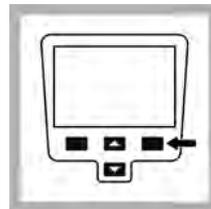
3. Push the **POWER** key to turn the meter on. Place the instrument on a flat, sturdy surface. **Note:** *Do not hold the instrument while making measurements.*



4. Insert the sample cell in the instrument cell compartment so the diamond or orientation mark always aligns with the raised orientation mark in front of the cell compartment. Close the lid.



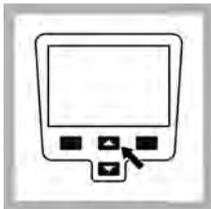
5. Push the **UP** and **DOWN** key to access the Reading Options and then select Indexing Sample Cell. **Note:** *The instruments always stays in the last selected reading mode.*



6. Push **Read**. The display shows Stabilizing then the turbidity in NTU. Record the cell position in the cell compartment and the reading result.



7. Remove the cell, rotate it slightly approximately of a turn and insert it again into the cell compartment. Close the lid.



8. Push **Read**. Record the cell position in the cell compartment and the reading result.



9. Repeat step 6 until the lowest reading is shown. Place an orientation mark on the cell marking band near the top of the cell so the cell can be consistently inserted in the position that yields the lowest reading.

## Maintenance

### ▲ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Clean the meter

The meter is designed to be maintenance-free and does not require regular cleaning for normal operation. Exterior surfaces of the meter may be cleaned as necessary.

**Note:** Do not clean the meter with solvents to avoid damaging the material.

1. Clean the meter with a dust- and lint-free dry or slightly damp cloth. A mild soap solution can also be used for liposoluble contamination.

### Store the sample cells

### NOTICE

Do not air dry the sample cells.

**Note:** Always store the sample cells with caps on to prevent the cells from drying.

1. Fill the sample cells with distilled or demineralized water.
2. Cap and store the sample cells.

3. Wipe the outside of the sample cells dry with the a soft cloth.

### Replace the battery

### ▲ WARNING

Potential fire hazard. Use only alkaline or nickel metal hydride batteries (NiMH) in the meter. Other battery types or incorrect installation can cause a fire. Never mix battery types in the meter.

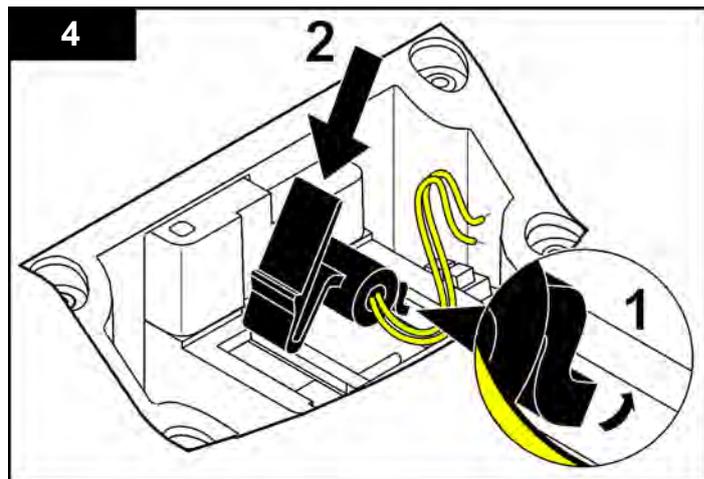
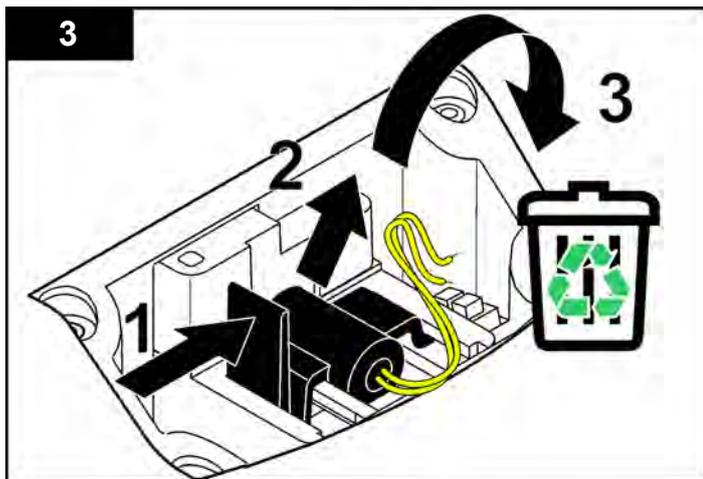
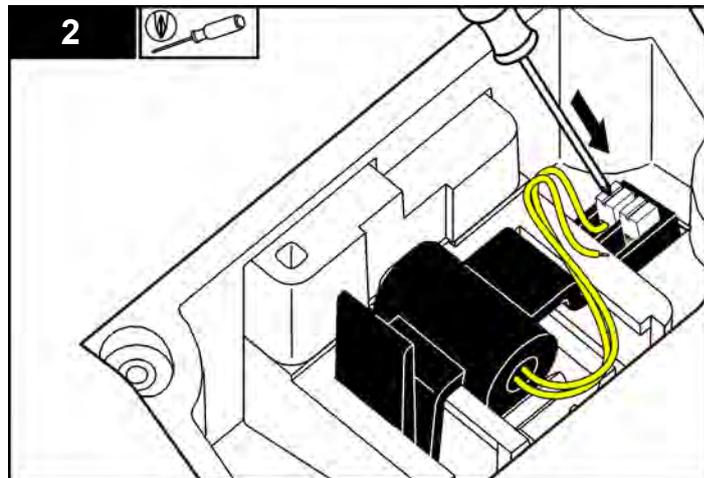
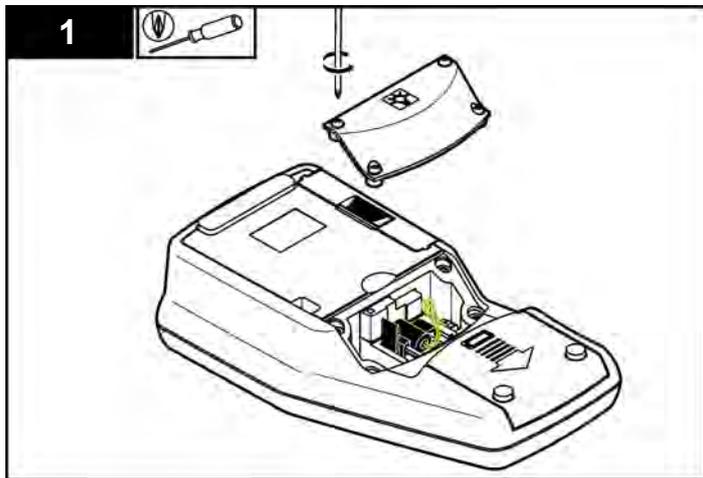
For battery replacement refer to [Figure 3](#) on page 7.

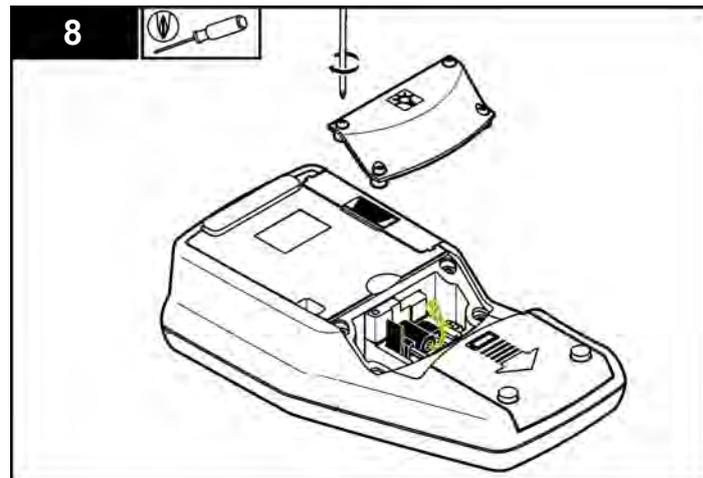
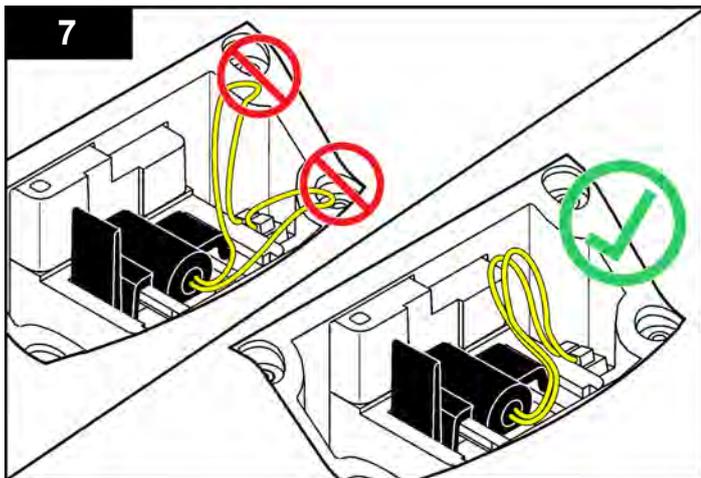
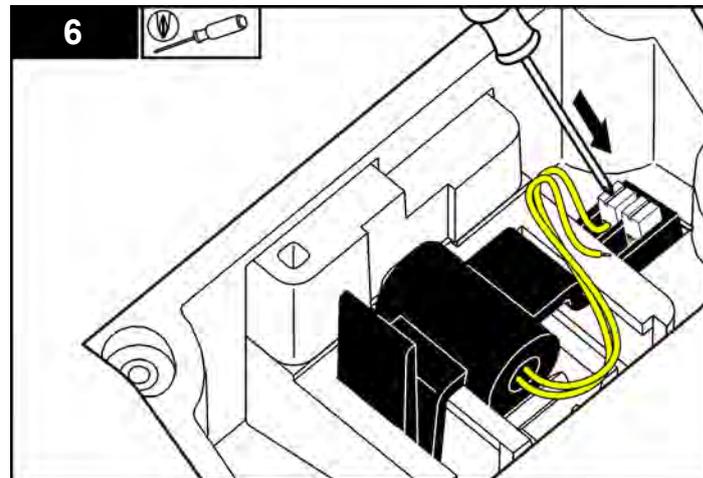
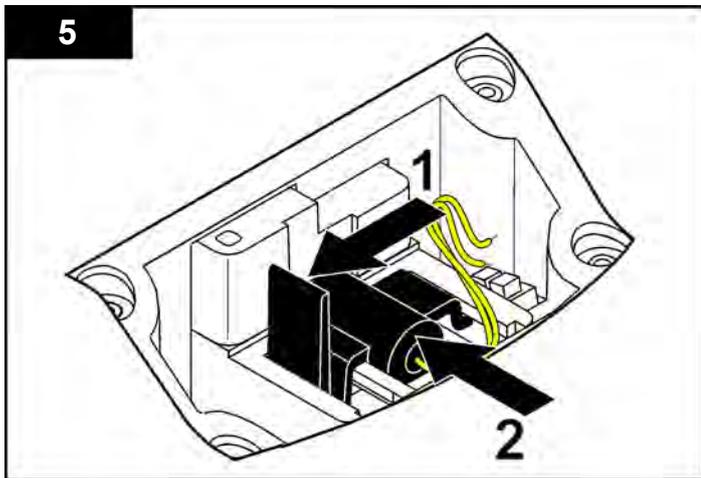
1. Remove the battery cover.
2. Remove the batteries.
3. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct orientation.
4. Replace the battery cover.

### Replace the lamp

### ▲ CAUTION

Burn Hazard. Wait until lamp cools down. Contact with the hot lamp can cause burns.





## Troubleshooting

Refer to the following table for common problem messages or symptoms, possible causes and corrective actions.

| Error/Warning                                       | Description   | Solution  |
|---|---|---|
| <b>Close lid and push Read.</b>                     | The lid is open or lid detection failed.                                | Make sure that the lid is closed during reading and re-read.  |
| <b>Low Battery!</b>                                 | Battery is low.   | <ul style="list-style-type: none"> <li>• Insert new batteries</li> <li>• Connect USB/power module if rechargeable batteries are used</li> </ul>                       |
| <b>ADC Failure!</b>                                 | Hardware error causing reading to fail.                                 | Repeat the reading.   |
| <b>Detector signal too low!</b>                     | Insufficient light on the 180° detector.                                | <ul style="list-style-type: none"> <li>• Check for obstructed light path.</li> <li>• Check the lamp.</li> </ul>   |
| <b>Overrange!</b>                                   | Turbidity too high- caused probably by calibrating with RapidCal™ only. | <ul style="list-style-type: none"> <li>• Calibrate the upper range.</li> <li>• Dilute the sample.</li> </ul>  |
| <b>Underrange!</b>                                  | The measured absorbance is below the calibration range.                 | Repeat calibration  |
| <b>Please check the lamp!</b>                       | Signals are too low on the 90° and 180° detector.                       | <p><b>2100Q:</b> The lamp is defective. Change the lamp (refer to <a href="#">Replace the lamp</a> on page 19).</p> <p><b>2100Qis:</b> Contact technical support.</p> |
| <b>Temperature too high! Switch off instrument.</b> | Temperature has exceeded the meter limits (>60 °C or >140 °F).          | Turn off the meter and let it cool down.  |

| Error/Warning  | Description   | Solution   |
|--|---|--|
| <b>RST: Average value!</b>   | Solids are settling too slowly. The reading mode is not suitable for this sample.             | Select Normal or Signal Average reading mode.  |
| <b>Confidence level is &lt; 95%</b>                                    | The reading mode Rapidly Settling Turbidity did not meet the range of $\geq 95\%$ confidence. | <ul style="list-style-type: none"> <li>• Invert the sample several times so that the solids allocate. Repeat the reading again.</li> <li>• Switch to the Normal reading mode if the sample is stable and does not have settable solids.</li> </ul> |
| <b>Standard value out of range. Insert standard and push Read</b>      | Used incorrect standard value for the reading.  | Insert the appropriate standard and read again.  |
| <b>ID already in use. Enter new ID</b>                                 | The Operator or Sample ID is unavailable as it is already assigned.                           | Create a new ID.   |
| <b>Error - Security Please set password before activating security</b> | No password is created.   | Create a new password.   |
| <b>Please enter at least one character.</b>                            | Password must contain minimum of one character.   | Create a password of at least one character.   |
| <b>Password incorrect. Please retry.</b>                               | Incorrect password was entered.   | Enter the appropriate password.  |
| <b>Please disconnect the USB cable from your computer.</b>             | Data storage does not respond while connected to the meter and the computer.                  | Disconnect the USB cable from the meter and try sending data again.  |

| Error/Warning   | Description                | Solution  |
|---|----------------------------|---|
| <b>USB module memory full. Delete data and try again.</b> | Data storage is full.      | <ol style="list-style-type: none"> <li>1. Connect USB/power module to the computer.</li> <li>2. Download the stored data to the computer.</li> <li>3. Delete Data Log on the module.</li> </ol> |
| <b>Delete Last Reading Failed!</b>                        | Error in the data storage. | Turn the meter off and on. If the error message still occurs, contact technical support.  |
| <b>Delete Data Log failed!</b>                            |                            |   |
| <b>Can't read data set!</b>                               |                            |   |
| <b>Can't store data!</b>                                  |                            |   |
| <b>Can't store to the Reading Log!</b>                    |                            |   |
| <b>Can't store to the Verify Cal Log!</b>                 |                            |   |
| <b>Error storing data!</b>                                |                            |   |
| <b>Error reading data!</b>                                |                            |   |

## Replacement parts and accessories

*Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

### Replacement parts

| Description                     | Quantity | Item no. |
|---------------------------------|----------|----------|
| StabiCal ampule calibration kit | 1        | 2971205  |
| 10 NTU verification standard    | 100 mL   | 2961701  |
| Silicone Oil                    | 15 mL    | 126936   |

### Replacement parts (continued)

| Description                                | Quantity | Item no. |
|--|----------|----------|
| Insert, molded bottom                      | 1        | 2971507  |
| Sample cell oiling cloth                   | 1        | 4707600  |
| 1" glass sample cell (10 ml ) w/cap (Turb) | pkg/6    | 2434706  |
| Carrying case (includes insert)            | 1        | 2971500  |
| Battery set, AA alkaline batteries         | pkg/4    | 1938004  |
| Lamp assy                                  | 1        | 4653900  |
| Blank module                               | 1        | LZV797   |
| Rubber foot set                            | 1        | LZV821   |
| Lamp cover (includes screws)               | 1        | LZV822   |
| Battery cover (includes 2 feet)            | 1        | LZV823   |
| Module cover                               | 1        | LZV824   |
| Connector cover for USB/power module       | 1        | LZV825   |
| Connector cover for power module           | 1        | LZV826   |
| Lid (includes magnet)                      | 1        | LZV827   |

### Accessories

| Description   | Quantity | Item no. |
|---|----------|----------|
| USB/power module (includes: universal power supply, USB cable, instruction sheet) | 1        | LZV813   |
| Power module (includes: universal power supply, instruction sheet)                | 1        | LZV804   |
| StabiCal 0.1 NTU Standard   | 100 mL   | 2723342  |
| StabiCal 0.3 NTU Standard   | 100 mL   | 2697943  |
| StabiCal 0.5 NTU Standard   | 100 mL   | 2698042  |

## Accessories (continued)

| Description                         | Quantity   | Item no. |
|-------------------------------------|------------|----------|
| StablCal calibration kit            | 100 mL     | 2971210  |
| StablCal calibration kit            | 500 mL     | 2971200  |
| Gelex secondary standards set       | 1          | 2464105  |
| Deionized water                     | 4 vials    | 27217    |
| Filter                              | 0.2 micron | 2323810  |
| Formazin                            | 500 ml     | 246149   |
| Formazin                            | 1000 ml    | 246142   |
| Sample degassing kit                | 1          | 4397500  |
| Sample degassing and filtration kit | 1          | 4397510  |
| Battery, NiMH AA                    | pk/4       | 2971304  |

**A**

auto-shutoff ..... 12

**B**

backlight ..... 12  
 battery installation ..... 6, 19

**C**

calibration ..... 13  
 contrast, display ..... 12

**D**

data, calibration log ..... 11  
 data, data log ..... 11  
 data, reading log ..... 11  
 data, stored data ..... 11  
 data, verification log ..... 11  
 date and time ..... 9  
 display ..... 8

**I**

Indexing a sample cell ..... 17

**K**

keypad ..... 7

**L**

language ..... 8

**M**

menu navigation ..... 8  
 meter components ..... 5  
 meter specifications ..... 3  
 meters  
     troubleshooting ..... 22

**N**

normal reading ..... 16

**O**

operator ID ..... 9  
 orientation mark ..... 17

**P**

parts list .....  
 power  
     battery installation ..... 6, 19

**R**

rapidly settling turbidity (RST) ..... 17  
 reading mode ..... 16, 17

**S**

sample ID ..... 9  
 security options ..... 13  
 signal average reading ..... 17

## Index

---

|                         |    |
|-------------------------|----|
| silicone oil .....      | 17 |
| sound options .....     | 12 |
| stored data, send ..... | 12 |

## V

|                    |    |
|--------------------|----|
| verification ..... | 16 |
|--------------------|----|

[www.hach.com](http://www.hach.com)





**Attachment 2 – CEM-2056 Stormwater Turbidity Meter Calibration Record Form**

# STORMWATER TURBIDITY METER CALIBRATION RECORD

CEM-2056 (NEW 4/2011)

|   |  |
|---|--|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |
|   | PROJECT IDENTIFIER NUMBER  |
|   | WDID NUMBER  |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |
| SUBMITTED BY CONTRACTOR (PRINT AND SIGN NAME) |  |
|   | DATE   |

### Turbidity Meter

|   |                       |                     |
|---|-----------------------|---------------------|
| Meter manufacturer  | Meter model number    | Meter serial number |
| <b>Standard Solution (NTU)<br/>(Nephelometric Turbidity Unit)</b> | <b>Control Number</b> | <b>Date</b>         |
| 0.02  |                       |                     |
| 10.0  |                       |                     |
| 1000  |                       |                     |

### Turbidity Calibration Date \_\_\_\_\_

| Standard Solution (NTU) | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes | Initials |
|-------------------------|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|-------|----------|
|                         |                                       | Time:               |      | Time:          |      | Time:       |                        |       |          |
|                         |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable performance |       |          |
| 0.02                    |                                       |                     |      |                |      |             |                        |       |          |
| 10.0                    |                                       |                     |      |                |      |             |                        |       |          |
| 1,000                   |                                       |                     |      |                |      |             |                        |       |          |

### Turbidity Calibration Date \_\_\_\_\_

| Standard Solution (NTU) | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes | Initials |
|-------------------------|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|-------|----------|
|                         |                                       | Time:               |      | Time:          |      | Time:       |                        |       |          |
|                         |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable performance |       |          |
| 0.02                    |                                       |                     |      |                |      |             |                        |       |          |
| 10.0                    |                                       |                     |      |                |      |             |                        |       |          |
| 1,000                   |                                       |                     |      |                |      |             |                        |       |          |







**Attachment 3 – CEM-2052 Stormwater Sample Field Test Report Form**

|   |  |      |
|---|--|------|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |      |
|   | PROJECT IDENTIFIER NUMBER  |      |
|   | WDID NUMBER  |      |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |      |
| Submitted by contractor (print name and sign) |  | Date |

**Stormwater Samples Field Analysis**

|                                       |  |
|---------------------------------------|--|
| Location                              | Date of Sampling   |
| Sample Location Identification Number | Date of Analysis   |
| Sample Analyzed By Signature          |  |
| Sample Analyzed By Print Name         |  |
| Analyzer Phone Number                 | Samples Analyzed For Parameter(s)<br><input type="checkbox"/> Turbidity<br><input type="checkbox"/> pH<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Other _____ |
| Company                               |  |

| Sample Identification                               | Turbidity Analysis (NTU) | pH Analysis (pH) | Analysis (____) | Analysis (____) | Comments                 |
|---|--------------------------|------------------|-----------------|-----------------|--------------------------|
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
| Qualifying Rain Event Daily Average Analysis Result |                          |                  |                 |                 | <input type="checkbox"/> |

|  |   |   |                  |
|--|---|---|------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS  |   | CONTRACT NUMBER/CO/RTE/PM   |                  |
|  |   | PROJECT IDENTIFIER NUMBER   |                  |
|  |   | WDID Number   |                  |
| <b>Turbidity Analysis Information</b>  |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>pH Analysis Information</b>   |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>Analysis Information</b>  |   |   |                  |
| Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| Note: Meter calibration information available in the Storm Water Pollution Prevention Plan (SWPPP) files.<br>Comments  |   |   |                  |
| <b>Review and Record Keeping</b>   |   |   |                  |
| Test results entered into sampling and testing activity log?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No  | Numeric action level exceedance?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No | Numeric effluent limitation violation?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No |                  |
| I have reviewed this document and based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true accurate, and complete. |   |   |                  |
| Water pollution control manager name   |   | Date  |                  |
| Water pollution control manager signature  |   |   |                  |
| Accepted by resident engineer (name)   |   | Date  |                  |
| Resident engineer signature  |   |   |                  |

## Instructions

### GENERAL INFORMATION

- This form is required for compliance with provisions in Section I of Attachments C, D, and E of the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ, NPDES No. CAS000002.
- The *Construction Site Monitoring Program Guidance Manual*, dated July 2010, contains sampling guidance.
- Sampling and sample preservation must be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association).
- Collect, maintain, and ship samples according to the Surface Ambient Monitoring Program's (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).
- Complete a separate stormwater sample field analysis report daily for each sampling location.
- Include a copy of the completed form in the project SWPPP files.

### FORM

#### Project Identifier Number

Starting July 1, 2010, Caltrans projects will have a project identifier number. For projects without a PID, write N/A in the field.

#### Contract Number/Co/Rte/PM

For local agency encroachment permit projects, write the encroachment permit number in the contract number field.

Analysis Result Analytical results less than the method detection limit must be reported as "less than the method detection limit."

#### Qualifying Rain Event Daily Average Analysis Result

A minimum of three daily samples are required to calculate the daily average for a qualifying rain event.

#### Numeric Action Level Exceedance

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Action Level (NAL), complete form CEM-XXXX "Numeric Action Level Exceedance Report," and submit all storm event sampling results to the State Water Board no later than ten days after the conclusion of the storm event.

#### Numeric Effluent Limitation Violation

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Effluent Limitation, complete form CEM-6062, "Numeric Effluent Limitation Violation Report," and submit CEM-2063, "Numeric Effluent Limitation Violation Report," to the State Water Board within 24 hours after the numeric effluent limitation violation was identified. Submit all storm event sampling results to the State Water Board no later than five days after the conclusion of the storm event.



# **Standard Operating Procedures for Manual Field Measurement of pH**

DOCUMENT NO. CTSW-RT-11-255.11.03-F

**January 2012**

**California Department of Transportation  
Division of Environmental Analysis  
Storm Water Program MS 27  
1120 N Street, Sacramento, California 95814  
<http://www.dot.ca.gov/hq/env/stormwater/index.htm>**



## Caltrans Technical Report Documentation Page

|   |                             |  |
|---|-----------------------------|--|
| 1. Report No.<br>CTSW-RT-11-255.11.03-F   | 2. Type of Report<br>Report | 3. Report Phase and Edition<br>Final                               |
| 4. Title and Subtitle<br>Standard Operating Procedures for Manual Field Measurement of pH   |                             | 5. Report Date<br>January 2012                                     |
| 6. Editor:<br>Hamid Hakim, Ph.D., P.E, Caltrans<br>Authors:<br>Armand Ruby; Cory LaNeave, P.E.  |                             | 7. Caltrans Project Coordinator<br>Hamid Hakim, Ph.D., P.E.        |
| 8. Performing Organization Names and Addresses<br>CALIFORNIA DEPARTMENT OF TRANSPORTATION<br>Division of Environmental Analysis- MS-27<br>1120 N Street<br>P.O. Box 942874<br>Sacramento CA 94274-0001<br>www.dot.ca.gov/hq/env/stormwater  |                             | 9. Task Order No.<br>11<br>Amendment No.<br>3                      |
|   |                             | 10. Contract No.<br>43A0255  |
| 11. Sponsoring Agency Name and Address<br>California Department of Transportation<br>Sacramento, CA 95814   |                             | 12. Caltrans Functional Reviewers:<br><br>Hamid Hakim, Ph.D., P.E. |
| 13. Supplementary Notes   |                             | 13. External Reviewers   |
| 15. Abstract<br>These Standard Operating Procedures (SOPs) for Manual Field Measurement of pH are a companion document to the <i>Construction Site Monitoring Program Guidance Document</i> . This set of SOPs presents meter calibration, sampling, and measurement methods. The document defers to the User Guide for procedures for troubleshooting. |                             |  |
| 16. Key Words:<br>Storm water, calibration, pH meter  | 17. Distribution Statement  | 18. Number of pages:<br>86   |



## **Standard Operating Procedures for Manual Field Measurement of pH**

### **Final Report**

**January 2012**

**CTSW-RT-11-255.11.03-F**

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Storm Water Liaison, Caltrans Division of Environmental Analysis, MS 27, P.O. Box 942874, Sacramento, CA 94274-0001. (916) 653-8896 Voice, or dial 711 to use a relay service.



## Introduction

The California Construction General Stormwater NPDES Permit (CGP) includes requirements for routine field measurement of pH in discharges from construction sites. This Standard Operating Procedures (SOPs) document provides direction on how to perform measurements of pH at California Department of Transportation (Caltrans) construction sites.

## Responsible Personnel

The following personnel are responsible for various aspects associated with turbidity measurements of stormwater at Caltrans construction sites to comply with the CGP. The brief descriptions provided below serve to clarify the roles that these individuals have in this process.

- *Caltrans District Construction Stormwater Coordinator* is responsible for authorizing all work, and ensures that SOP implementation and documentation responsibilities are clearly communicated to the project personnel.
- *Resident Engineer* is responsible for ensuring that the SOP is implemented and documented on the required schedule and that the Water Pollution Control Manager is performing these requirements in a timely manner.
- *Water Pollution Control (WPC) Manager* is responsible for providing the direction to field crew to perform the analysis for pH according to the required project frequency.
- *Field Crew* are responsible for performing SOPs, clearly documenting data, and relaying data and observations collected from stormwater monitoring activities.

Meter calibration and measurement procedures described in this SOP must be followed each day that field measurements are performed.

## References to Existing Source Documents

This SOP references the *Hach Multi-Parameter Portable Meter Model HQ40d User Manual* (Attachment 1A) and (the associated pH probe) *Hach Model PHC301 pH Probe User Manual* (Attachment 1B).

This SOP is also adapted from information provided in the following sources:

(1) *Standard Operating Procedures (SOPs) for Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program (SWAMP)*, version 1.0, released October 15, 2007 (SWAMP, 2007); available for download at: <http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/standard-operating-procedures>

(2) United States Geological Survey, variously dated, National field manual for the collection of water-quality data: *U.S. Geological Survey Techniques of Water-Resources Investigations*,



Book 9, Chapters. A1 through A9; available online at: <http://pubs.water.usgs.gov/twri9A> or <http://water.usgs.gov/owq/FieldManual/index.html>

Field measurement of pH is covered under Chapter A6 Field Measurements, in Sections 6.4, pH, and 6.8, Use of Multi-Parameter Instruments for Routine Field Measurements.

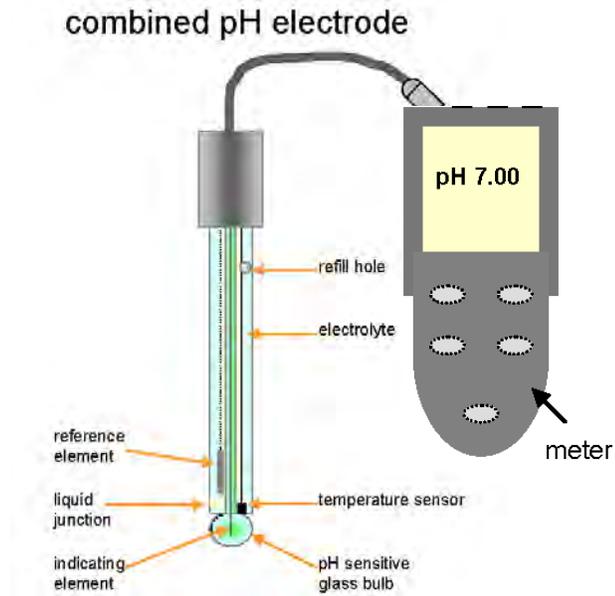
Relevant quality assurance/quality control (QA/QC) protocols are referenced in the associated *Caltrans Construction Site Monitoring Program Guidance Manual*.

### **Special Cautions and Considerations; Health and Safety**

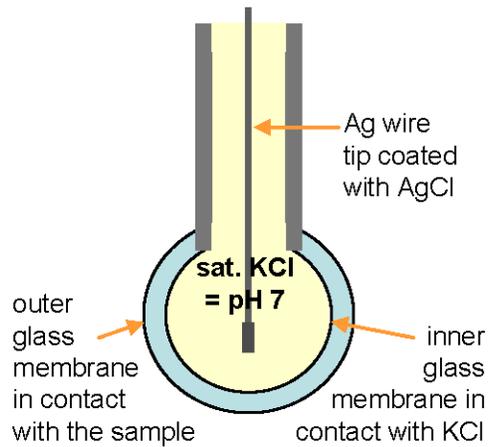
Proper gloves must be worn to both prevent alteration of the field measurements, and to protect sampling personnel from environmental hazards. The user should wear at least one layer of gloves, but two layers help protect against leaks. All gloves must be powder-free. Disposable polyethylene, nitrile, or non-talc latex gloves are acceptable for field measurements.

### **CAUTIONS**

When performing measurements in areas of unknown water quality, especially in waters that are suspected to contain hazardous substances or human pathogens, at least one layer of gloves shall be of the “long-cuff” variety to cover the wrist and forearm, to limit skin contact with the source water.



**Figure 1. Combined pH glass electrode**



**Figure 2. Working principle of a pH glass membrane**



## Methods/Procedures

This SOP pertains to manual measurement of pH in the field only. Field measurement of turbidity, temperature, dissolved oxygen (DO), and electrical conductivity (EC) are covered in separate SOPs.

### *Equipment*

For field measurement of pH at Caltrans construction sites, the specified equipment is the Hach multi-parameter portable meter, model HQ40d, and the associated pH probe, Hach model PHC301. The probe is a glass, digital combination probe with refillable double junction reference and built-in temperature sensor.

A list of required equipment for field measurement of pH is provided in the checklist below.

### Standard Equipment and Supplies Checklist

- Hardhat
- Gloves
- Safety vest
- Box of powder-free gloves
- Long-cuff gloves as necessary
- Scientific Calculator
- "Write-In-The-Rain" Notebook
- Field Meter Calibration Record Form
- Field Measurement Data Form
- Pencil(s) & Pen(s)
- Digital Camera
- Flashlight
- Extra batteries
- Deionized water for rinsing and cleaning
- pH Standards (4.01, 7.00, and 10.01)
- Electrode storage solution
- Sample Collection Containers
- Sample Collection Extension Arm (as required)
- Hach HQ40d Multi-Parameter Portable Meter
- Hach PHC301 pH probe

### *Preparing the pH Probe for Use*

To prepare the probe for use before calibration or sample measurement:

1. Remove the protective tape from the filling hole before initial use. Dispose of the protective tape.
2. Turn the probe soaker bottle cap counter-clockwise to loosen the cap.
3. Remove the soaker bottle from the end of the probe.



4. Rinse the reference junctions and glass bulb with deionized (DI) water thoroughly to remove the viscous storage/filling solution completely from the outside of the probe. Blot dry with a lint-free cloth.
5. Add electrolyte filling solution to the probe as necessary (see instructions under Maintenance, below). The probe electrolyte level must be higher than the buffer solution or sample level during measurement.
6. Make sure that the filling hole is open during measurement for the proper flow of the filling solution.

Note: For the best stabilization time, condition the probe for several minutes in the sample before use.

### *Use of pH Buffer Solutions*

Buffer solutions (buffers) are ionic solutions that are used to calibrate the pH instrument system. Buffers maintain constant pH values because of their ability to resist changes to the specific pH value for which they are produced. Measurements of pH are only as accurate as the buffers used to calibrate the electrode.

Observe the following precautions and protocols with buffer solutions to help ensure the accuracy of the pH measurement:

- Use only buffers that have been certified traceable to a National Institute of Standards and Technology (NIST) standard reference material.
- Select the buffers that are appropriate for the ionic strength and expected pH range of the water to be measured. Two buffers should be used, bracketing the range above and below the expected pH range of the sample stream. For Caltrans construction sites, pH buffers 7.0 and 10.0 are typically used.
- Label pH buffer containers with the acquisition date and the expiration date. Copy the expiration date and the buffer lot number onto any reagent containers into which the buffer is transferred. Copy the temperature-correction information onto the respective buffer container or keep a copy of this information with the buffers being transported to the field.
- Discard each pH buffer on its expiration date. The pH of a buffer can be altered substantially because of temperature fluctuation, carbon dioxide (CO<sub>2</sub>) absorption from the atmosphere, mold growth, or evaporation.
- Cap buffer bottles firmly after use to prevent evaporation or contamination from atmospheric CO<sub>2</sub>.
- Never pour used buffer back into a bottle containing the stock buffer solution.



- Do not insert an electrode or other material into a bottle containing stock buffer solution; always pour the buffer into a separate container and discard the solution after use.
- Take care not to contaminate the buffer with another buffer or with other fluids. Thoroughly rinse the pH probe with DI water in between each buffer.
- Do not let the buffer become diluted (this can happen, for example, if DI water used to clean the electrode drips into the buffer, or if rainfall drips into the buffer).
- Protect buffers against wide temperature variations, whether in transit, during use, or in storage. Never expose buffers to extreme heat or freezing temperatures. If buffers experience these conditions, their pH values can no longer be assumed valid. Discard buffer solutions and any other reagents that have been so exposed.
- Before using buffers in the calibration sequence, bring them to the temperature of the sample solution as much as possible. Because buffer composition differs among manufacturers; check the temperature-correction factors provided by the manufacturer in order to assign the correct pH value to the buffer for the temperature of the buffer at the time of calibration.

### ***Field Meter Calibration***

All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day for each day of instrument use. Calibration shall be performed on a daily basis, prior to the first measurements of the day. Calibration of the HachHQ40d multi-parameter meter is accomplished according to specific procedures for each probe. Refer to pages 3 and 4 of the *Hach PHC301 pH Probe User Manual* (Attachment 1B) for specific pH calibration instructions.

A two-point calibration should be performed, using two buffers: one with a pH above and one with a pH below the expected sample pH.

To calibrate the pH probe:

1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.
2. Push the “Calibrate” key. The display shows the buffers that are necessary for calibration.
3. Prepare fresh buffers by pouring from buffer stock bottles into clean separate beakers or other appropriate containers.
4. Rinse the probe with DI water. Blot dry with a lint-free cloth.
5. Put the probe into the pH buffer solution and stir gently. Make sure that the reference junctions are completely submerged. Shake the probe from side to side in the standard solution to refresh the reference junction.
6. Push the “Read” key. Stir the buffer gently with the probe. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the standard. The display shows



the buffer that has just been read and shows the temperature-corrected pH value when the reading is stable.

7. Repeat steps 4 through 6 until the minimum number of calibration points specified in the current method have been collected.
8. Push the “Done” key to view the calibration summary. The display will not show “Done” until the minimum number of calibration points have been collected.
9. Push the “Store” key to accept the calibration and go back to measurement mode.

Note: Air bubbles under the sensor tip, when submerged, can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.

Record the results of the field meter calibration on the CEM-2057 Stormwater pH Meter Calibration Record form (see Attachment 2).

### ***Sample Collection***

When conditions permit, pH measurement can be made by placing the probe directly into the source water. When flow is turbulent or shallow, or when direct immersion would risk damaging the probe, a sample should be collected for pH measurement.

Samples for field measurements are collected simply by direct submersion of the sample container into the flow whenever possible. The sample may be collected using any clean container. A wide-mouth sample bottle provided by the laboratory is preferred for this purpose, as those bottles are shipped pre-cleaned. Samples always should be collected upstream of sampling personnel and equipment, and with the sample container pointed upstream when the container is opened for sample collection. Care must be taken not to sample water downstream of areas where sediments have been disturbed in any manner by field personnel.

Direct field measurements are made or samples for field measurement purposes are collected from a location where the sample stream visually appears to be completely mixed. Ideally this is at the centroid of the flow cross-section, but site conditions do not always allow centroid collection. (“Centroid” is defined as the midpoint of that portion of the stream width, which contains 50 percent of the total flow area.) The location should preferably be accessible by direct reach, or in the case of a receiving water body, via wading.

If the centroid of the flow cannot be tested or sampled by direct reach or by wading into the flow, a sampling pole or other sampling device can be used to reach the sampling location. Such devices typically involve a means to extend the reach of the sampler, with the sample bottle attached to the end of the device for filling at the desired location. These methods do not allow opening of the sample container under water; therefore, there is potential for contamination when the container is opened prior to lowering the sample container into the stream. Caution is required when wading, as flowing water provides more force than visually anticipated. Only experienced personnel should perform this collection technique.



When sampling from a stream bank where direct reach is not possible, the sample container is secured by a hardware device, which, in turn, is attached to the end of an extendable sampling pole. Sites accessed by bridge also can be sampled with a sample container secured to a device, lowered into the stream at the end of a rope. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge.

*Testing/Sample Collection Depth:*

- **Sub-Surface Test/Sample:** Grab samples for field measurements are typically collected at 4 inches below the water surface. When the field probe is inserted directly into the stream, a measurement depth of 8 inches should be used to ensure that the probe is appropriately submerged.
- **Surface Sample:** Grab samples for field measurements are collected at the surface when water depth is less than 4 inches. Because there can be differences in water quality on the surface, compared to subsurface, surface samples should be noted on the field data sheet as collected at 0 inch.

*Field Measurement Methods*

Field pH measurements may be made either by direct submersion of the instrument probe into the sample stream, or by collection of a grab sample and immediate analysis of the grab sample in the field. In either case, the measurement is made with the pH probe attached to the Hach HQ40d portable meter.

The Hach HQ40d meter measures pH directly in pH units. pH is the negative logarithm of the hydrogen ion concentration of a sample.

Collect a sample for pH measurement (rather than direct immersion of the probe into the sample stream) when flow is turbulent or shallow, or when direct immersion of the probe would risk damaging the probe.

Carefully prepare the probe for use and perform daily calibration prior to field measurement as described above.

To perform pH measurement:

1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.
2. For the best stabilization time, condition the probe in the sample for at least 10 minutes before the initial sample measurement.
3. Rinse the probe with DI water and then with the sample water. Blot dry with a lint-free cloth.



4. Put the probe in the sample and stir gently. Make sure that the reference junctions are completely submerged. Do not put the probe on the bottom or sides of the container. Shake the probe from side to side in the sample to refresh the reference junction.
5. Push the "Read" key. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes.
6. Repeat steps 2 through 4 for additional measurements.
7. When measurements are completed, store the probe (refer to Storage, page 10).

After measurement, complete the CEM-2052 Stormwater Sample Field Test Report form (see Attachment 3).

Repeat sample collection and measurement process as needed per the *Caltrans Construction Site Monitoring Program Guidance Manual*.

Before leaving the sampling site, field personnel should review datasheets to ensure that they are complete and legible, and that all sampling-related materials and equipment have been collected.

## **Maintenance**

Perform all required maintenance as specified in the *Hach PHC301 pH Probe User Manual* (Attachment 1B).

The pH probe is a refillable combination electrode; the essential maintenance involves proper storage of the probe with the soaker bottle/cap affixed, cleaning of the glass probe, and replacement of the electrolyte on a routine basis.

### ***Storing the pH Probe***

For the best performance, do not let the reference junction inside the probe dry out.

Between uses, store the pH probe as follows:

1. Put the filling-hole cap in the filling hole (refer to Figure 1 on page 2 of the *Hach PHC301 pH Probe User Manual*; see Attachment 1B).
2. Rinse the probe with DI water. Dry the probe with a lint-free cloth.
3. Fill the probe soaker bottle half full with Hach electrode storage solution or 3M potassium chloride (KCl) solution.
4. Loosen the soaker bottle cap and put the soaker bottle on the probe.
5. Turn the soaker bottle cap clockwise to tighten the soaker bottle cap.
6. Make sure that the solution in the soaker bottle completely covers the glass bulb and reference junction holes.

If the glass bulb on the end of the pH probe becomes dry:



1. Soak the probe tip in the 4.01, 7.00 and 10.01 buffers each for 5 minutes.
2. Rinse the probe with DI water. Blot dry with a lint-free cloth.
3. Calibrate the probe.

### ***Cleaning the pH Probe***

Clean the probe when:

- Drifting/inaccurate readings occur as a result of contamination on the glass sensor or the probe being left dry for extended periods of time.
- Slow stabilization time occurs as a result of contamination on the glass sensor.
- A calibration error occurs as a result of contamination on the glass sensor.

*To clean the probe after exposure to general contaminants:*

1. Rinse the probe with DI water and blot dry with a lint-free cloth.
2. Soak the glass bulb for 12 to 16 hours in Hach electrode cleaning solution.
3. Rinse or soak the probe for 1 minute in DI water.
4. Soak the probe in pH 4 buffer for up to 20 minutes, then rinse with DI water.
5. Blot dry with a lint-free cloth.

*To clean the probe after exposure to fats, grease, and oils:*

1. Soak the glass bulb in a warm detergent solution for up to 2 hours.
2. Rinse or soak the probe for 1 minute in DI water.
3. Soak the probe in pH 4 buffer for up to 20 minutes, then rinse with DI water.
4. Blot dry with a lint-free cloth.

### ***Refilling the Electrolyte***

To add electrolyte filling solution to the probe:

1. If the filling hole is closed, remove the filling-hole cap from the filling hole (refer to Figure 1 on page 2 of the *Hach PHC301 pH Probe User Manual*; see Attachment 1B).
2. Remove the cap from the tip of the filling solution bottle.
3. Hold the bottle so that the tip is down. Put the tip of the bottle in the filling hole.
4. Slowly squeeze the bottle and *fill the probe completely*.
5. If the probe will not be used immediately, store the probe (see storage instructions, above).



6. Keep the filling solution bottle and cap for later use. Note: If the dispensing tip becomes clogged, remove the dispensing tip and soak the tip in warm water. Dry tip thoroughly and re-attach to filling solution bottle.

### **Quality Assurance/Quality Control**

Perform all required QA/QC measures as specified in the *Caltrans Construction Site Monitoring Program Guidance Manual*.

Adherence to the sample collection and measurement procedures described above, along with adherence to QA/QC measures required per the *Caltrans Construction Site Monitoring Program Guidance Manual*, will ensure that field measurements are representative of environmental conditions, and conform to CGP requirements.

### **Troubleshooting**

Refer to manufacturer provided literature for troubleshooting suggestions or call manufacturer's representative for specific questions.



**Attachment 1A – Hach Portable Meter HQ40d User Manual**

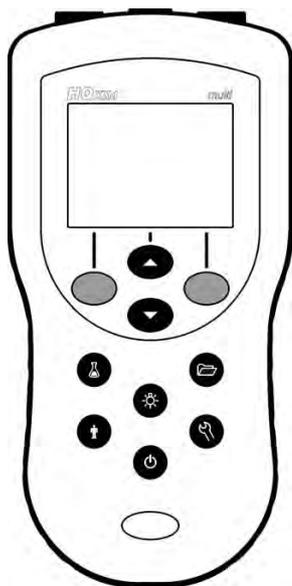


DOC022.53.80017

# HQ40d, HQ30d HQ14d, HQ11d

01/2011, Edition 3

**User Manual**



|                                      |    |
|--------------------------------------|----|
| <b>Specifications</b>                | 5  |
| <b>General information</b>           | 5  |
| Safety information                   | 5  |
| Use of hazard information            | 5  |
| Precautionary labels                 | 6  |
| Product overview                     | 6  |
| Product components                   | 6  |
| <b>Installation</b>                  | 7  |
| Install the batteries                | 7  |
| Connect to AC power                  | 8  |
| <b>User interface and navigation</b> | 9  |
| User interface                       | 9  |
| Display description                  | 9  |
| Navigation                           | 11 |
| <b>Start-up</b>                      | 11 |
| Turn the meter on and off            | 11 |
| Change the language                  | 11 |
| Change the date and time             | 11 |
| Connect a probe                      | 12 |
| <b>Standard operations</b>           | 12 |
| About calibration                    | 12 |
| About sample measurements            | 13 |
| About check standards                | 13 |
| Use a sample ID                      | 13 |
| Use an operator ID                   | 13 |
| <b>Data management</b>               | 13 |
| About stored data                    | 13 |
| View stored data                     | 14 |
| View stored probe data               | 14 |

## **Table of Contents**

---

|   |           |
|---|-----------|
| Print stored data .....                                       | 14        |
| Change the report options .....                               | 15        |
| Send data to a USB storage device .....                       | 15        |
| Open data files on a PC .....                                 | 16        |
| Data file description .....                                   | 16        |
| Remove column headers .....                                   | 18        |
| Send data directly to a computer .....                        | 18        |
| <b>Advanced operations</b> .....                              | <b>18</b> |
| Security options .....  | 18        |
| Turn Security Options on .....                                | 18        |
| Full access options menu .....                                | 19        |
| Restricted operator access options menu .....                 | 19        |
| Set the display options .....                                 | 20        |
| Set the sound options .....                                   | 20        |
| Set the probe calibration reminder .....                      | 20        |
| Change the temperature units .....                            | 21        |
| Set the measurement mode .....                                | 21        |
| Set auto measurement intervals .....                          | 21        |
| Start interval measurements .....                             | 21        |
| Prevent data log overflow in interval mode .....              | 22        |
| View instrument information .....                             | 22        |
| Update the meter software .....                               | 22        |
| Download software updates .....                               | 23        |
| Transfer method settings .....                                | 23        |
| Bi-directional Communication between the meter and a PC ..... | 23        |
| About meter control .....                                     | 23        |
| About meter configuration .....                               | 24        |
| <b>Maintenance</b> .....                                      | <b>24</b> |
| Clean the meter .....   | 24        |
| Replace the batteries .....                                   | 24        |
| <b>Troubleshooting</b> .....                                  | <b>25</b> |

**Replacement parts and accessories** .....26

**Examples of printed reports** .....28

**Index** .....33



## Specifications

Specifications are subject to change without notice.

| Specification                 | Details   |
|-------------------------------|---|
| Dimensions                    | 19.7 x 9.5 cm (7.75 x 3.75 in.)   |
| Weight                        | 335 g (0.75 lb) without batteries; 430 g (0.95 lb) with four AA alkaline batteries  |
| Meter enclosure               | IP67, waterproof to 1 meter for 30 minutes  |
| Battery enclosure             | Water resistant to 0.6 m (2 ft) for 15 seconds  |
| Power requirements (internal) | AA Alkaline or rechargeable Nickel Metal Hydride (NiMH) batteries (4); battery life: up to 200 hours                                    |
| Power requirements (external) | Class II, external power adapter: 100–240 VAC, 50/60 Hz input; 4.5 to 7.5 VDC (7 VA) output   |
| Meter protection class        | Class I   |
| Storage temperature           | –20 to +60 °C (–4 to +140 °F)   |
| Operating temperature         | 0 to +60 °C (32 to 140 °F)  |
| Operating humidity            | 90% (non-condensing)  |
| 5-pin input connector         | M12 connector for IntelliCAL™ probes  |
| 8-pin input connector         | The 8-pin connector enables USB and external AC power connectivity  |
| USB/DC adapter                | Peripheral and host   |
| Data memory (internal)        | 500 results   |
| Data storage                  | Automatic in Press to Read mode and Interval Mode. Manual in Continuous Read Mode.  |
| Data export                   | USB connection to PC or USB storage device (limited to the storage device capacity). Transfer entire data log or as readings are taken. |
| Connections                   | Integrated USB type A (for USB flash memory device, printer, keyboard) and Integrated USB type B (for PC)                               |

| Specification            | Details  |
|--------------------------|--|
| Temperature correction   | Off, automatic and manual (parameter dependent)  |
| Measurement display lock | Continuous measurement, Interval or Press to Read mode. Averaging function for LDO probes. |
| Keyboard                 | External PC keyboard connector via USB/DC adapter  |

## General information

Revised editions are found on the manufacturer's website.

## Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

## Use of hazard information

### **▲ DANGER**

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

### **▲ WARNING**

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

### **▲ CAUTION**

Indicates a potentially hazardous situation that may result in minor or moderate injury.

## NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

### Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

|  |  |
|--|--|
|  | This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.  |
|  | This symbol indicates that the marked item can be hot and should not be touched without care.  |
|  | Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.<br><i>Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</i> |

### Product overview

The HQd series portable meters are used with digital IntelliCAL™ probes to measure various parameters in water. The meter automatically recognizes the type of probe that is connected to the meter. Measurement data can be stored and transferred to a printer, PC or USB storage device.

The HQd series meters are available in 4 models:

- HQ11d—pH/mV/ORP
- HQ14d—conductivity, salinity, total dissolved solids (TDS), resistivity
- HQ30d—all IntelliCAL probes, 1 probe connector

- HQ40d—all IntelliCAL probes, 2 probe connectors

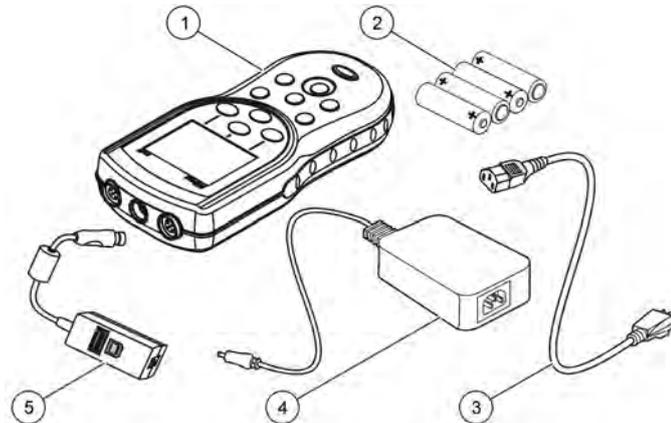
Features common to all models:

- Automatic probe and parameter recognition
- Instrument guided calibration procedures
- Calibration data stored in the probe
- Probe specific method settings for regulatory compliance and Good Laboratory Practice (GLP)
- Security Options
- Real-time data logging via USB connection
- USB connectivity to PC/printer/USB storage device/keyboard
- Bi-directional communication with PC-based systems via a virtual serial port connection
- Sample ID and Operator ID for data traceability
- Adjustable automatic shut-off

### Product components

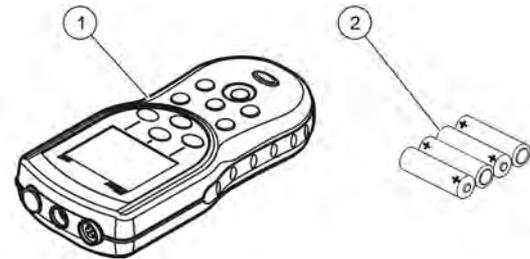
Refer to [Figure 1](#) and [Figure 2](#) to make sure that all components have been received. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

**Figure 1 Meter components (HQ40d model)**



|                       |  |
|-----------------------|--|
| 1 Meter               | 4 AC-DC power supply   |
| 2 AA batteries (pk/4) | 5 USB/DC adapter   |
| 3 AC power cord       | 6 Not shown: Basic user manual, Quick Start Guide and HQd/ IntelliCAL Documentation CD |

**Figure 2 Meter components (HQ11d, HQ14d and HQ30d models)**



|                       |  |
|-----------------------|--|
| 1 Meter               | 3 Not shown: Basic user manual, Quick Start Guide and HQd/ IntelliCAL Documentation CD |
| 2 AA batteries (pk/4) |  |

## Installation

### ⚠ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Install the batteries

### ⚠ WARNING

Explosion Hazard. Improper battery installation can cause release of explosive gases. Insert batteries in proper orientation only. Use only new batteries from the same manufacturer and lot.

### NOTICE

The battery compartment is not waterproof. If the battery compartment becomes wet, remove and dry the batteries and dry the interior of the compartment. Check the battery contacts for corrosion and clean them if necessary.

## NOTICE

When using nickel metal hydride (NiMH) batteries, the battery icon will not indicate a full charge after freshly charged batteries have been inserted (NiMH batteries are 1.2 V versus 1.5 V for alkaline batteries). Even though the icon does not indicate complete charge, 2300 mAh NiMH batteries will achieve 90% of instrument operation lifetime (before recharge) versus new alkaline batteries.

## NOTICE

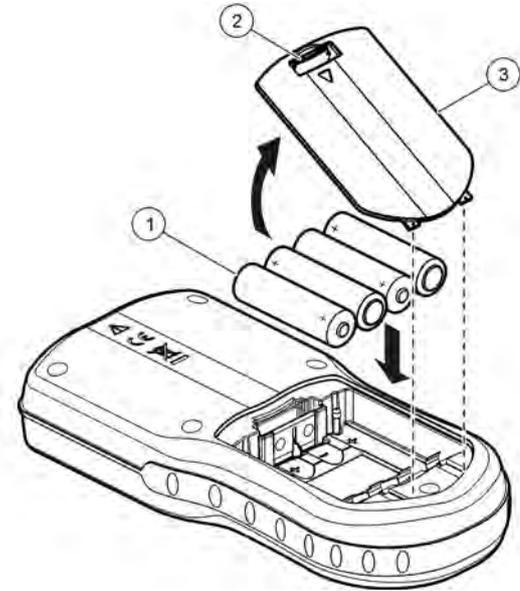
To avoid potential damage to the meter from battery leakage, remove the meter batteries prior to extended periods of non-use.

The meter can be powered with AA alkaline or rechargeable NiMH batteries. To conserve battery life, the meter will power off after 5 minutes of inactivity. This time can be changed in the Display Options menu.

For battery installation refer to [Figure 3](#).

1. Pull the release tab on the battery cover and the remove the cover.
2. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct polarity.
3. Replace the battery cover.

Figure 3 Battery installation



1 Batteries

2 Release tab

3 Battery cover

## Connect to AC power

### ⚠ DANGER

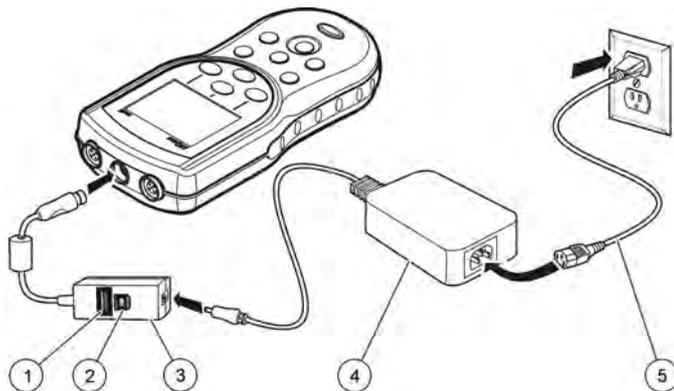


Electrocution Hazard. AC power outlets in wet or potentially wet locations MUST ALWAYS be provided with a Ground Fault Circuit Interrupting (GFCI/GFI) circuit breaker. The AC-DC power adapter for this product is not sealed and must not be used on wet benches or in wet locations without GFCI protection.

The meter can be powered by AC power with an AC power adapter kit. The kit includes an AC-DC power supply, USB/DC adapter and AC power cord.

1. Turn the meter off.
2. Plug the AC power cord into the AC-DC power supply (Figure 4).
3. Connect the AC-DC power supply to the USB/DC adapter.
4. Connect the USB/DC adapter to the meter.
5. Plug the AC power cord into an AC receptacle.
6. Turn the meter on.

**Figure 4 AC power connection**

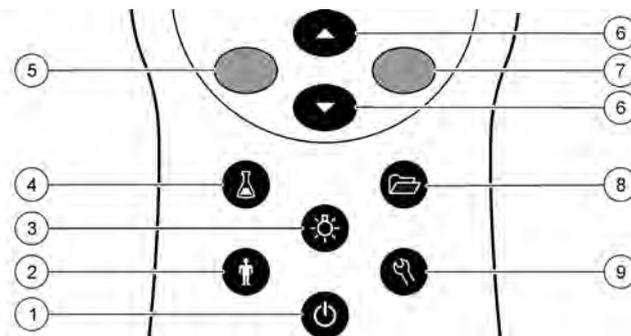


|  |                      |
|--|----------------------|
| 1 USB storage device/printer/Qterty keyboard connection (USB peripheral) | 4 AC-DC power supply |
| 2 Personal computer connection (USB host)                                | 5 AC power cord      |
| 3 USB/DC adapter   |                      |

## User interface and navigation

### User interface

**Figure 5 Keypad description**



|  |  |
|--|--|
| 1 ON/OFF: turn on or turn off the meter                        | 6 UP and DOWN key: scroll through menus, enter numbers and letters or change the reading screen view |
| 2 OPERATOR ID: associate data with an individual               | 7 GREEN/RIGHT key: reads, selects, confirms or stores data   |
| 3 BACKLIGHT: illuminate the display screen                     | 8 DATA LOG: recall or transfer stored data   |
| 4 SAMPLE ID: associate data with a sample location             | 9 METER OPTIONS: change settings, run check standards, view meter information                        |
| 5 BLUE/LEFT key: calibrates, cancels or exits the current menu |  |

### Display description

#### Measurement screen

The meter display shows the concentration, units, temperature, calibration status, operator ID, sample ID, date and time (Figure 6).

Figure 6 Single screen display



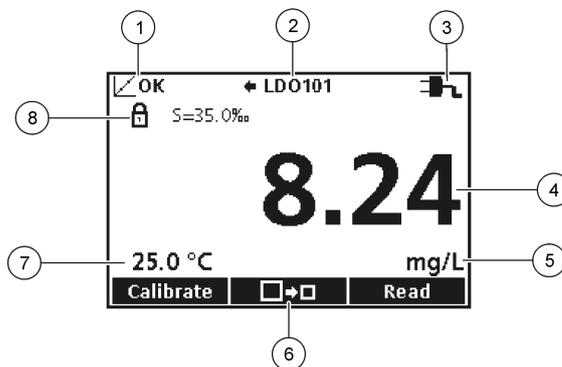
|  |  |
|--|--|
| 1 Calibration status indicator             | 9 Time                                 |
| 2 Main measurement value and unit          | 10 Date                                |
| 3 IntelliCAL probe type and port indicator | 11 Read (OK, Select)                   |
| 4 Battery status                           | 12 Display size icon                   |
| 5 Power source                             | 13 Calibrate (Cancel, Exit)            |
| 6 Sample temperature (°C or °F)            | 14 Sample and operator identification  |
| 7 Secondary measurement unit               | 15 Stability or display lock indicator |
| 8 Tertiary units (for some probes)         |  |

### Big-screen mode

The font size of the sample reading can be increased or decreased with the  $\triangle$  key (Figure 7).

**Note:** When two probes are connected, push and hold the  $\triangle$  key to select the big-screen mode. The big-screen mode can also be selected in the Display Options menu (Refer to [Set the display options](#) on page 20).

Figure 7 Single-screen display—big-screen mode



|  |                                       |
|--|---------------------------------------|
| 1 Calibration status indicator             | 5 Main measurement unit               |
| 2 IntelliCAL probe type and port indicator | 6 Display size icon                   |
| 3 Power source or battery status           | 7 Sample temperature (°C or °F)       |
| 4 Main measurement value                   | 8 Stability or display lock indicator |

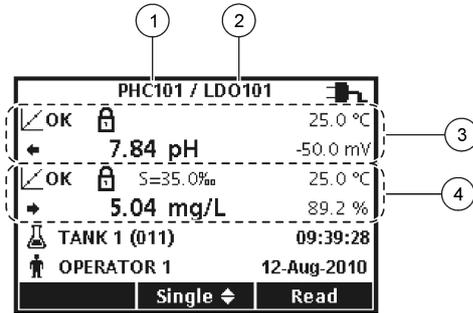
### Dual-screen mode (HQ40d model only)

When two probes are connected to the HQ40d meter, the display can show the reading from both probes simultaneously or show just one probe (Figure 8).

**Note:** For probe calibration, change the screen mode to the single screen mode.

To change the screen mode to single or dual screen, use the  $\triangle$  and  $\nabla$  keys. In dual screen mode, the  $\triangle$  key will select the probe on the left and the  $\nabla$  key will select the probe on the right.

Figure 8 Dual-screen display



|  |  |
|--|--|
| 1 Probe that is connected to port on left  | 3 Measurement information for probe on left  |
| 2 Probe that is connected to port on right | 4 Measurement information for probe on right |

## Navigation

The meter contains menus to change various options. Use the  $\triangle$  and  $\nabla$  keys to highlight different options. Push the GREEN/RIGHT key to select an option. There are two ways to change options:

1. Select an option from a list: Use the  $\triangle$  and  $\nabla$  keys to select an option. If check boxes are shown, more than one option can be selected. Push the BLUE/LEFT key under Select.  
*Note: To deselect check boxes, push the BLUE/LEFT key under Deselect.*
2. Enter an option value using the arrow keys:  
Push the  $\triangle$  and  $\nabla$  keys to enter or change a value.
3. Push the GREEN/RIGHT key to advance to the next space.
4. Push the GREEN/RIGHT key under OK to accept the value.

## Start-up

### Turn the meter on and off

Push the  $\odot$  key to turn on or turn off the meter. If the meter does not turn on, make sure that the batteries are properly installed or that the AC power supply is properly connected to an electrical outlet.

### Change the language

The display language is selected when the meter is powered on for the first time. The language can also be changed from the Meter Options menu.

Access to the language menu can be restricted with the Security Options. Refer to [Security options](#) on page 18.

1. Push the  $\odot$  key and select Language.
2. Select a language from the list.

*Note: While turning the meter on, the language can also be changed when the power key is pushed and held.*

### Change the date and time

The date and time can be changed from the Date & Time menu.

1. Push the  $\odot$  key and select Date & Time.

## 2. Update the time and date information:

| Option | Description |
|--------|-------------|
|--------|-------------|

**Format** Select one of the formats below for the date and time. Use the  $\triangle$  and  $\nabla$  keys to select from the format options.

dd-mm-yyyy 24h

dd-mm-yyyy 12h

mm/dd/yyyy 24h

mm/dd/yyyy 12h

dd-mmm-yyyy 24h

dd-mmm-yyyy 12h

yyyy-mm-dd 24h

yyyy-mm-dd 12h

**Date** Use the  $\triangle$  and  $\nabla$  keys to enter the current date.

**Time** Use the  $\triangle$  and  $\nabla$  keys to enter the current time.

The current date and time will be shown on the display.

Connect a probe after the date and time setup, so that the meter is ready to take a measurement.

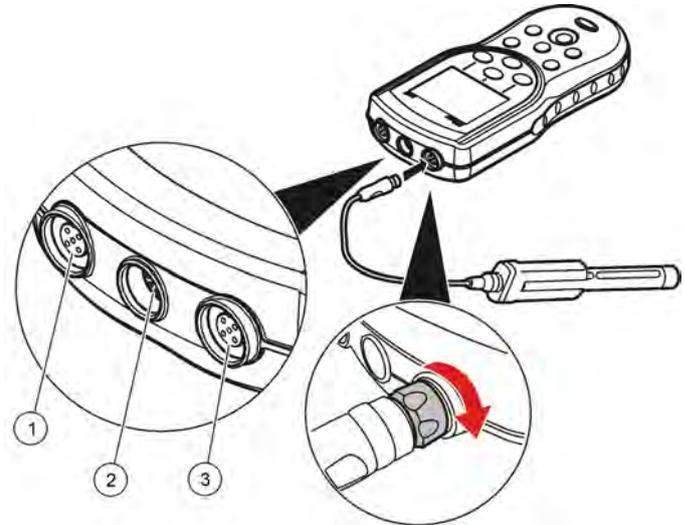
## Connect a probe

1. Make sure the display shows the current time and date. Refer to [Change the date and time](#) on page 11.

**Note:** The time stamp for a probe is set when the probe is first connected to the meter. This time stamp makes it possible to record the probe history and record the time when measurements are made.

2. Plug the probe into the meter ([Figure 9](#)).
3. Push and turn the locking nut to tighten.

**Figure 9** Probe connection



|                                      |                       |                         |
|--------------------------------------|-----------------------|-------------------------|
| 1 Probe connection port (HQ40d only) | 2 USB/DC adapter port | 3 Probe connection port |
|--------------------------------------|-----------------------|-------------------------|

## Standard operations

### About calibration

Each probe uses a different type of calibration solution. Make sure to calibrate the probes frequently to maintain the highest level of accuracy.

**Note:** For step-by-step instructions, refer to the documents that are included with each probe.

The calibration icon  $\angle ?$  can indicate that:

- the calibration timer has expired

- the LDO sensor cap should be replaced
- the calibration is out of range
- the calibration results are outside acceptance criteria settings

## About sample measurements

Each probe has specific preparation steps and procedures for taking sample measurements. For step-by-step instructions, refer to the documents that are included with the probe.

## About check standards

Run Check Standards verifies equipment accuracy by measuring a solution of a known value. The meter will indicate if the Check Standard passed or failed. If the Check Standard fails, the calibration icon  is shown until the probe is calibrated.

The meter can be set to automatically show a reminder for check standard measurement at a specified interval with a specified acceptance criteria. The reminder, value of the check standard, and acceptance criteria can be changed. For step-by-step instructions, refer to the documents that are included with the probe.

## Use a sample ID

The sample ID tag is used to associate measurements with a particular sample location. If assigned, stored data will include the sample ID.

1. Push the  key.
2. Select, create or delete a sample ID:

| Option                        | Description  |
|-------------------------------|--|
| <b>Current ID</b>             | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Sample ID</b> | Enter a name for a new sample ID.  |
| <b>Delete Sample ID</b>       | Delete an existing sample ID.  |

## Use an operator ID

The operator ID tag associates measurements with an individual operator. All stored data will include the operator ID.

1. Push the  key.
2. Select, create or delete an operator ID:

| Option                          | Description  |
|---------------------------------|--|
| <b>Current ID</b>               | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Operator ID</b> | Enter a name for a new operator ID (maximum 10 names can be entered).  |
| <b>Delete Operator ID</b>       | Delete an existing operator ID.  |

## Data management

### About stored data

The following types of data are stored in the data log:

- Sample measurements: stored automatically each time a sample is measured in the Press to Read or Interval Mode. When the continuous measurement mode is used, data is stored only when Store is selected.
- Calibrations: stored only when Store is selected at the end of a calibration. Calibration data is also stored in the IntelliCAL (R) probe.
- Check standard measurements: stored automatically each time a check standard is measured (in the Press to Read or Interval Mode).

When the data log becomes full (500 data points), the oldest data point is deleted when a new data point is added. The entire data log can be deleted to remove data that has already been sent to a printer or PC ( key > Delete Data Log). To prevent deletion of the data log by a user, use the Security Options menu.

## View stored data

The data log contains sample, calibration and check standard data. The most recent data point in the data log is tagged as Data Point 001.

1. Push the  key.
2. Select View Data Log to view the stored data. The most recent data point is shown. The top of the screen shows whether the data is from a sample reading, a calibration or a check standard. Push the  key to view the next most recent data point.

| Option                    | Description   |
|---------------------------|---|
| <b>Reading Log</b>        | Reading Log—shows sample measurements including the time, date, operator and sample ID. Select Details to view the associated calibration data. |
| <b>Calibration Log</b>    | Calibration Log—shows calibration data. Select Details to view additional information about the calibration.                                    |
| <b>Check Standard Log</b> | Check Standard Log—shows check standard measurements. Select Details to view the calibration data that was associated with the measurement.     |

## View stored probe data

Make sure that a probe is connected to the meter. If two probes are connected, select the appropriate probe when prompted.

1. To view the calibration data that is stored in a probe, push the  key and select View Probe Data. The current calibration and calibration history for the probe can be viewed.

| Option                          | Description   |
|---------------------------------|---|
| <b>View Current Calibration</b> | The current calibration information shows the calibration details for the most recent calibration. If the probe has not been calibrated by the user, the factory calibration data is shown. |
| <b>View Calibration History</b> | The calibration history shows a list of the times when the probe was calibrated. Select a date and time to view a summary of the calibration data.  |

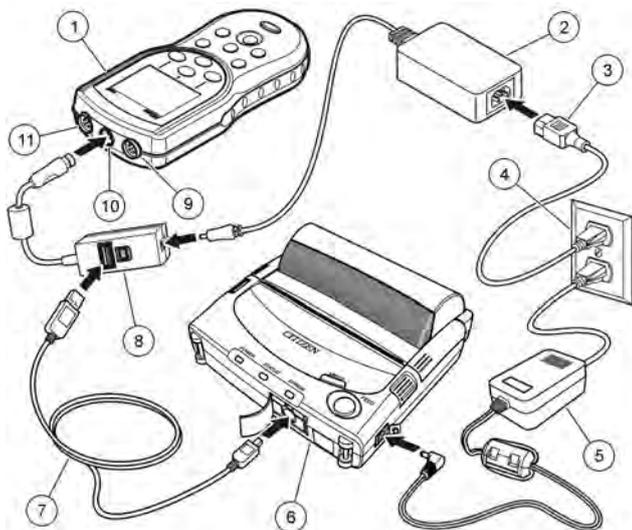
## Print stored data

The meter must connect to AC power to start the USB connection. Make sure that the connection to AC power is made before the meter is powered on.

All data can be sent to a printer. The PD-24 Citizen Printer is compatible with the HQd meters and is FCC Part 15B, Class B compliant with the HQ meters. Other printers may not be compatible. Compatible printers should support a minimum of 72 columns of data, be capable of printing up to 500 continuous data-stream events in 1, 2 and 3 lines of text and fully support code page 437 and code page 850.

1. Turn off the meter. Make sure that the meter is connected to AC power. Refer to [Connect to AC power](#) on page 8.
2. Connect the printer to the meter with a USB cable type A. Refer to [Figure 10](#).
3. Turn on the meter.
4. Push the  key.
5. Select Send Data Log. Wait for the display to show “Transfer Complete” and wait for the printer to stop printing. Disconnect the printer.

**Figure 10 Connection to the printer**



|  |                              |
|--|------------------------------|
| 1 Meter  | 7 USB cable                  |
| 2 AC-DC power supply                               | 8 USB/DC adapter             |
| 3 AC power cord                                    | 9 Port for probe connection  |
| 4 AC power outlet                                  | 10 Port for USB/DC adapter   |
| 5 Power supply for printer (optional)              | 11 Port for probe connection |
| 6 Citizen Printer, FCC Part 15B, Class B compliant |                              |

### Change the report options

Printed reports for sample data can contain 1, 2 or 3 lines of information. Refer to [Examples of printed reports](#) on page 28 for further information.

1. Push the  key. Select Report Options.
2. Select Report Type and select one of the options.

| Option                 | Description  |
|------------------------|--|
| <b>Basic report</b>    | One line of data.  |
| <b>Advanced report</b> | Two lines of data. The first line contains the same information as in the basic report.          |
| <b>Total report</b>    | Three lines of data. The first two lines contain the same information as in the advanced report. |

### Send data to a USB storage device

#### NOTICE

The transfer of a large number of data points will take some time. DO NOT disconnect the USB storage device until the transfer is complete.

Data can be transferred to a USB storage device for storage or transfer to a computer.

1. Turn off the meter. Make sure that the meter is connected to AC power.
2. Plug the USB storage device into the meter before the meter is powered on.
3. Turn on the meter.
4. Push the  key.
5. Select Send Data Log. Wait for the display to show "Transfer Complete" and for any lights on the USB storage device to stop flashing. Then remove the USB device.

**Note:** If the data transfer is slow, reformat the USB storage device to use the file allocation table (FAT) format for the next use.

## Open data files on a PC

Data that has been downloaded to a USB storage device can be transferred to a computer. The data is sent in a text (.txt) file format.

1. Plug the USB storage device into the computer.
2. Find the data file. The file will have the following format: "Meter Serial Number-Data File Type-Date Time". Example: 9999NN000000-SENDDATA-0603131624.TXT
3. Save the data file to a location on the computer.
4. Open a spreadsheet program such as Microsoft® Excel® spreadsheet software.
5. Open the data file from the spreadsheet program. Select the delimited option with comma as the delimiter.

The data will be shown in the spreadsheet program.

**Note:** If an application is used that is not compatible with column headings, the headings can be omitted. Refer to [Remove column headers](#) on page 18.

## Data file description

Data that is saved to a USB storage device and then opened in a spreadsheet application will have multiple columns of data. A description for each of the columns is shown in [Table 1](#).

**Table 1 Spreadsheet column descriptions**

| Column header name | Data description and example values   |
|--------------------|---|
| Type               | Type of data: RD = Reading; CL = Calibration; CK = Check Standard; CH = Calibration History; IC = Current Calibration |
| Parameter          | Type Parameter: LDO, pH, CD (conductivity), ORP, ISE  |
| Date               | Date of reading: stored in user-defined date format   |
| Time               | Time of reading: stored in user-defined format  |
| Operator ID        | Operator ID that was used when the data was recorded. Shows "- -" if no operator ID is used.                          |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name  | Data description and example values   |
|---|---|
| Probe Model   | Model number of probe, for example pHC101, CDC401, LDO101   |
| Probe SN  | Probe serial number<br>If two probes are connected to the HQ40d meter, the serial number shows "<" or ">" to identify the port (left or right) the probe was connected to during the reading. |
| Method name   | User-defined name of the probe settings that were used for the reading.   |
| Sample ID   | Sample ID that was used when the data was recorded. Shows "Sample ID" if the default sample ID is used.   |
| Primary Reading Value   | Measured value. Shows "—" if the value was out of range.  |
| Primary Reading Units   | Measurement units, for example pH or $\mu\text{S}/\text{cm}$  |
| Supp Reading 1  | First supplemental reading (example: temperature), if applicable  |
| Supp Units 1  | Units for first supplemental reading, if applicable.  |
| Supp Reading 2  | Second supplemental reading (example: "mV" for pH), if applicable   |
| Supp Units 2  | Units for second supplemental reading, if applicable  |
| Supp Reading 3  | Third supplemental reading, if applicable   |
| Supp Units 3  | Units for third supplemental reading, if applicable.  |
| Reading Setting 1–4   | Any settings that affect the reading, for example "NaCl/Non-Linear"   |
| Any settings that affect the reading, for example "NaCl/Non-Linear" | Reading Message 1–4 Any message that was shown during the measurement, for example "Out of limits".   |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name | Data description and example values  |
|--------------------|--|
| Check Std Value    | Value of the check standard that was used to verify accuracy, for example: 7.00 pH–25 °C (pH, temp-compensated); 7.01 pH (pH, custom)          |
| Check Std Units    | Check standard units, for example $\mu\text{S}/\text{cm}$ .<br><b>Note:</b> pH is not displayed here as it is included in the previous column. |
| Check Std Graph    | Bar-graph showing the measurement in relation to the acceptance limits. Example: "6.901 <— —> 7.101".  |
| Check Std Status   | Status of the check standard reading. Example: "Reading within limits", "Reading outside limits"   |
| Calibration Status | Status of the calibration that is in use. $\checkmark\text{OK}$ = current calibration is valid; $\checkmark?$ = calibration has expired.       |
| Cal Date           | Date of calibration reading: stored in user-defined date format  |
| Cal Time           | Time of calibration reading: stored in user-defined time format  |
| Cal Operator ID    | The operator ID specified when the probe was calibrated. Shows "--" if undefined.  |
| Cal Slope Name     | Slope (pH or LDO) or cell constant (conductivity)  |
| Cal Slope          | The slope value for the calibration  |
| Cal Slope Aux      | Used by pH to give the percent of nominal slope  |
| Cal Slope Units    | Units of the calibration slope. Example: "mV/pH" for pH  |
| Cal Offset         | Calibration offset value   |
| Cal Offset Units   | Calibration offset units. Example: "mV" for pH.  |
| Cal $r^2$          | Calibration correlation coefficient without a unit (may be blank)  |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name        | Data description and example values   |
|---------------------------|---|
| Cal Number of Std's       | Number of standards used during calibration, for example 5. May be blank depending on record type, parameter type, and method settings. |
| Cal Std 1                 | Known value of the first calibration standard   |
| Cal Std 1 Units           | Units of the first calibration standard   |
| Cal Std 1 Primary Value   | Measured value of the first calibration standard  |
| Cal Std 1 Primary Units   | Associated units for the calibration measurement  |
| Cal Std 1 Supp Value      | Value of supplemental measurement, for example temperature  |
| Cal Std 2–7               | Known value of additional calibration standards, if used  |
| Cal Std 2–7 Units         | Units of additional calibration standards, if used  |
| Cal Std 2–7 Primary Value | Measured values of additional calibration standards, if used  |
| Cal Std 2–7 Primary Units | Associated units for additional calibration measurements, if used   |
| Cal Std 2–7 Supp Value    | Value of supplemental measurement, for example temperature  |
| Cal Std Supp Units        | Units applicable to all secondary calibration readings. Example: "°C" or "°F" for temperature   |
| Cal Message 1–4           | Any messages about the calibration  |
| Date/Time POSIX           | Date and time of reading stored in POSIX format (number of seconds from January 1, 1970) Example: 1149234913                            |
| Cal Date/Time POSIX       | Date and time of calibration stored in POSIX format (number of seconds from January 1, 1970). Example: 1111320348                       |
| Meter SN                  | Meter serial number used to take the measurement  |

## Remove column headers

When transferred data is viewed in a spreadsheet program, the first row of data contains headings to identify the type of data in each column. If an application or post-processing method is used that is incompatible with the headers, the column headers can be omitted.

1. Push the  key.
2. Select Column Headers.
3. Set the column headers to off.

## Send data directly to a computer

Data can be transferred from any HQd series meter directly to a computer when the HQ40d PC Application is installed. The data can be sent in real time during data collection, or the entire data log can be transferred.

**Note:** The HQ40d PC Application is included on the HQd/IntelliCAL™ Documentation and Advanced Operations CD. The application is also available on <http://www.hach.com/SoftwareDownloads>.

1. Install the HQ40d PC Application on the computer.
2. Turn off the meter. Make sure that the meter is connected to AC power.
3. Connect the PC to the meter with a USB type B cable.
4. Turn on the meter.
5. Open the HQ40d PC Application on the computer. Click on the green triangle in the menu bar to start a connection.
6. Collect the data in real time or transfer the data from the data log:
  - Real time—when a data point is stored in the meter, the result is sent simultaneously to the PC Application (refer to [Set the measurement mode](#) on page 21).
  - Data log—push the  key and select Send Data Log. Wait for the display to show “Transfer Complete.” The data is sent as a comma separated values (.csv) file.

The data is shown in the HQ40d PC Application window.

## Advanced operations

### Security options

The Security Options menu is used to protect the meter setup and method settings from unwanted changes. This menu is available in the Full Access Options menu.

The Setup Measurement Mode, Date and Time, Temperature Units, Language, Probe settings, Delete data log and Security Options screens are disabled in the Operator Access Options menu. All menu options are enabled in the Full Access Options menu.

**Note:** The Full Access Options menu is shown when the  key is pushed when Security Options is OFF, whether or not a password has been set.

When the meter is powered on for the first time and Security Options is selected, the display prompts the user to set a password. Until the meter is shut off, pushing the  key will still display the Full Access Options menu, even after Security Options is turned on and a password has been set. After the meter is shut off and powered on again with Security Options on, the Operator Access Options menu is displayed until a valid password is entered.

Store the password in a safe and accessible place. If the specified password is forgotten and Security Options is turned on, the operator is locked out of the restricted menus. Contact technical support if the password is lost.

### Turn Security Options on

The Security Options and the Set Password options are used together to prevent access to restricted menus.

1. Push the  key and select Security Options.

2. Change the settings as needed to allow or prevent menu access.

| Option                  | Description  |
|-------------------------|--|
| <b>Security Options</b> | When Security Options is on, and a password has been specified, the password is required to enable the Full Access Options menu. If the meter is turned off while Security Options is on, the password is required to enable the Full Access Options menu again when the meter is turned on. |
| <b>Set Password</b>     | Set a password that must be entered to enable the Full Access Options menu. The requirement for password entry is controlled by setting Security Options on or off.  |

### Full access options menu

The Full Access Options menu is displayed when Security Options is OFF or when Security Options is ON and a valid password is entered (Table 2). These options do not need to be changed if the factory default settings are used.

**Table 2 Full Access Options**

| Option                 | Description   |
|------------------------|---|
| (Probe model) settings | Settings such as measurement options, calibration options, check standard options, units and resolution. Refer to the probe documentation for more information.<br><i>Note: A probe must be connected to the meter.</i> |
| Run check standard     | Measure standard solution (available for pH, conductivity, ORP and ISE probes)  |
| Measurement mode       | Press to Read   |
|                        | Interval: Duration and Interval   |
|                        | Continuous  |
| Instrument information | Probe information   |
|                        | Meter information   |
| Security options       | ON or OFF   |
|                        | Set password  |

**Table 2 Full Access Options (continued)**

| Option            | Description           |
|-------------------|-----------------------|
| Display options   | Contrast              |
|                   | Auto shutoff          |
|                   | Backlight             |
|                   | Mode                  |
| Sounds            | Key press             |
|                   | Stability alert       |
|                   | Calibration reminder  |
| Date and time     | Format                |
|                   | Date                  |
|                   | Time                  |
| Temperature units | Set temperature units |
| Language          | Select language       |

### Restricted operator access options menu

The Operator Access Options menu is shown at meter startup when Security Options is ON (Table 3). When a valid password is entered, the menu changes to Full Access Options.

**Table 3 Operator access options**

| Option                 | Description  |
|------------------------|--|
| (Probe model) settings | Only methods (if methods exist) can be selected. Refer to the probe documentation.<br><i>Note: A probe must be connected to the meter.</i>   |
| Run check standard     | Measure standard solution (available for pH, conductivity, ORP and ISE probes)<br><i>Note: A probe must be connected to use this option.</i> |

**Table 3 Operator access options (continued)**

| Option                 | Description          |
|------------------------|----------------------|
| Instrument information | Probe information    |
|                        | Meter information    |
| Access password        | Enter password       |
| Display options        | Contrast             |
|                        | Auto shutoff         |
|                        | Backlight            |
|                        | Mode                 |
| Sounds                 | Key press            |
|                        | Stability alert      |
|                        | Calibration reminder |

### Set the display options

Use Display Options to change the display contrast, battery saving auto-shutoff options, the backlight option or the detailed or big reading screen mode.

1. Push the  key and select Display Options.
2. Select which display option to change.

| Option              | Description  |
|---------------------|--|
| <b>Contrast</b>     | Adjust the contrast of the display. The lightest setting is 0 and the darkest setting is 9.  |
| <b>Auto-shutoff</b> | To maximize battery life, set a time period after which the meter will automatically power off if no key is pushed (1, 2, 5, 10, 30 min, 1 h, 2 h or never). Auto-shutoff is not active when the meter is connected to AC power or in the Interval Reading Mode. |

| Option           | Description  |
|------------------|--|
| <b>Backlight</b> | The display backlight is turned off when the  key is pushed. Is it possible to set a time period after which the backlight will automatically power off if no key is pushed.  |
| <b>Mode</b>      | Select Detailed or Big screen size. Detailed will show more information with smaller numbers and text. Big will show less information with larger numbers and text.<br><b>Note:</b> The screen size can also be selected from the measure mode (refer to <a href="#">Display description</a> on page 9). |

### Set the sound options

The meter can make an audible sound when a key is pushed, when stability is reached or when the calibration reminder is due. The meter also makes an audible sound when it begins transferring data to a USB storage device and again when the data transfer is complete.

1. Push the  key and select Sound.
2. Choose which events will produce an audible sound. Multiple items can be selected.

| Option                 | Description  |
|------------------------|--|
| <b>Key Press</b>       | The meter will make an audible sound whenever a key is pushed.   |
| <b>Stability Alert</b> | The meter will make an audible sound whenever measurement stability is reached.  |
| <b>Cal reminder</b>    | The meter will make an audible sound when calibration is due.<br><b>Note:</b> Refer to <a href="#">Set the probe calibration reminder</a> on page 20 to set the calibration reminder to on or off. |

### Set the probe calibration reminder

Make sure that a probe is connected to the meter.

1. Push the  key and select the probe settings.
2. Select Modify Current Settings.
3. Select Calibration Options.

#### 4. Select Calibration Reminder.

| Option                      | Description   |
|-----------------------------|---|
| <b>Calibration reminder</b> | Reminder repeat: Off, 2 h, 4 h, 8 h, 2 d, 5 d, 7d<br>Expires: Immediately, Reminder + 30 min, Reminder + 1 hr, Reminder + 2 hr, Continue Reading<br><br>The meter can be set to make an audible sound when calibration is due. Calibration expires after a specified time set by the user.<br><b>Note:</b> <i>The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.</i> |

### Change the temperature units

To select degrees Celsius or Fahrenheit:

1. Push the  key and select Temperature Units.
2. Select the Celsius or Fahrenheit option.

### Set the measurement mode

One of three modes can be used to specify when measurements are taken and how the data is stored. When a data point is stored, the result is sent simultaneously to any device (PC/printer/ USB storage device) that is connected to the meter.

1. Push the  key and select Measurement Mode.
2. Select Mode.
3. Select one of the measurement modes.

| Option               | Description  |
|----------------------|--|
| <b>Press to Read</b> | The sample is measured only when the GREEN/RIGHT key under Read is pushed. Data is stored in the data log automatically when the stability criteria are met. |

| Option            | Description  |
|-------------------|--|
| <b>Interval</b>   | The sample is measured at regular intervals for a specified duration (refer to <a href="#">Set auto measurement intervals</a> on page 21). Data is stored in the data log automatically. |
| <b>Continuous</b> | The sample is measured continuously. Data is stored in the data log only when the GREEN/RIGHT key under Store is pushed.   |

### Set auto measurement intervals

When the measurement mode is set to Interval, the time intervals and duration must be specified. Measurements are stored at the user-defined intervals whether or not stability criteria are met.

**Note:** *Use of an external USB storage device or direct printer connection while in Interval Measurement mode prevents data from being over-written in the data log. Data points are over-written on a First In/First Out basis. Refer to [Prevent data log overflow in interval mode](#) on page 22.*

1. Push the  key and select Measurement Mode.
2. Select Mode.
3. Select Interval as the Measurement Mode.
4. Select Duration and select the total time that measurements will be taken for (15 min, 30 min, 1 h, 4 h, 8 h, 24 h, 48 h or no limit).
5. Select Interval and select how often measurements will be taken (every 10 s, 30 s, 1 min, 5 min, 15 min or 30 min).

### Start interval measurements

During interval measurements, the meter goes into a standby state between readings to conserve power. The auto-shutoff option is disabled. Measurements stop when the selected interval duration has passed. The auto-shutoff option then becomes active.

Interval measurements are suspended for calibrations, check standard measurements or when the  key is pushed. Interval measurements resume when returning to the measurement screen.

1. From the Main Measurement screen, select Start to begin interval measurements. The screen will show "Recording" and the remaining

time of the duration. The sample number automatically advances when each reading is taken.

2. To stop interval measurements, select Stop.
3. To repeat the interval measurement after it has been stopped or completed, select Start.

### Prevent data log overflow in interval mode

When measurements are taken at specified intervals (Table 4), each result is automatically stored. The meter can store up to 500 data records. When 500 records have been stored, data is replaced on a first-in, first-out basis. To prevent loss of data, connect the meter to a PC/printer/USB storage device.

**Note:** Stop interval measurements before changes are made to a method or to meter settings.

**Table 4 Recommended interval/duration pairs**

| Interval   | Duration |
|------------|----------|
| 10 seconds | 1 hour   |
| 30 seconds | 4 hours  |
| 1 minute   | 8 hours  |
| 5 minutes  | 24 hours |

**Note:** When 2 probes are connected to the meter, use the next lowest recommended duration time. For example, for a 30-second interval, set the duration to 1 hour to prevent data log overload with 2 probes.

### View instrument information

The instrument information menu shows specific information such as the serial number for the meter or IntelliCAL (R) probe(s).

1. Push the  key and select Instrument Information.

2. Select (Probe model) Information or Meter Information.

| Option                   | Description   |
|--------------------------|---|
| <b>Probe information</b> | The Probe Information screen shows the probe model number, serial number, software version and date of first use. For LDO and LBOD probes, the lot code for the sensor cap and the remaining time before sensor cap replacement is shown.<br><b>Note:</b> A probe must be connected to the meter. |
| <b>Meter information</b> | The Meter Information screen shows the meter model number, serial number, software version and memory information. The amount of memory used and the number of available user method settings, operator IDs and sample IDs is shown.  |

### Update the meter software

A USB storage device that contains software update files is used to update the meter software.

**Note:** The meter must be turned off and then on again before the software update will begin. The software update initiates upon meter startup after the USB device is correctly inserted.

#### NOTICE

Do not remove the USB device until the “Update complete” message is shown. The meter can become damaged if the USB device is removed before the update process is complete.

1. Save stored data from the data log to a USB storage device or to a PC. Refer to [Send data to a USB storage device](#) on page 15 and [Send data directly to a computer](#) on page 18.
2. Turn off the meter.
3. Connect the USB/DC adapter, AC-DC power supply and cord ([Figure 4](#) on page 9).
4. Insert the USB storage device that contains the software update files into the USB/DC adapter.
5. Turn on the meter.  
The update process starts. The display will show “Updating meter to <firmware version>”. After an interval, the display changes to

“Updating files, please wait...” In addition, the display will show a rotating flask and emit a periodic audio signal during the update process.

*Note: A large capacity USB storage device increases the time required for completion of the update process, even if most of the device memory is empty.*

6. Wait for the meter to finish the software update. When the update process is complete, the message “Update complete. Remove USB device” is shown. The meter will turn off after the USB device has been removed.
7. Repeat steps 1 through 6 to update the software in other HQd meters as necessary.

### Download software updates

The latest software version can be obtained online:

1. Go to [www.hach.com/SoftwareDownloads](http://www.hach.com/SoftwareDownloads).
2. Click on Lab System Software/Software Update Downloads.
3. Click on HQd Series Meter Software Update and open or save the update files.
4. Open the ReadMeFirst.txt file and follow the instructions to transfer the update files to a USB storage device.
5. Follow the instructions in [Update the meter software](#) on page 22 to update the software in the meter.

### Transfer method settings

Probe settings that have been changed by the user for measurements, calibrations or check standards (Meter Options > (Probe Model) Settings > Modify Current Settings) can be copied to a USB storage device. The USB device can then be used to transfer the method settings to other HQd meters that accept the same probes.

#### NOTICE

Make sure the USB storage device does not contain HQd meter software update files to prevent unintentional updates.

1. Turn off the meter.
2. Connect the meter to AC power ([Figure 4](#) on page 9).

3. Plug the USB storage device into the USB/DC adapter before the meter is powered on.
4. Turn on the meter.
5. Push the  key and select Transfer Methods. If the USB device already contains a method settings file, an option to export or import methods is shown. Select Export Methods.
6. In the Select Methods to Export screen, select one or more methods to copy to the USB device. A check mark is shown next to each selected method.
7. Select OK. The settings are copied to the USB storage device. When complete, the Transfer Summary screen is shown.
8. Connect the AC power and USB device to a meter that will receive the method settings. Turn the meter on.
9. Push the  key and select Transfer Methods. If the USB device already contains a method settings file, an option to export or import methods is shown. Select Import Methods.
10. In the Select Methods to Import screen, select one or more methods to transfer to the meter. A check mark is shown next to each selected method.
11. Select OK. The user method settings are transferred from the USB storage device to the meter. When complete, the Transfer Summary screen is shown. Select details to view additional information about the transfer.
12. Disconnect the USB storage device from the meter.

### Bi-directional Communication between the meter and a PC

For measurement automation the meter can be used to implement a command set for meter remote control or automated data transfer. The command set can be used to perform minimal configuration and to control the meter. To set up the meter for communication and control, refer to [About meter configuration](#) on page 24. For additional information and the command set contact Technical Support.

#### About meter control

The virtual serial connection can be used to control meter functions from a PC. For example, the functions include starting a measurement cycle,

turning off the meter and sending the entire measurement (including calibrations) to the PC or other information management system.

### About meter configuration

To use the meter communication and control from the PC, an INF file must be installed.

1. If the meter software is not numbered version 2.0.0.710 or higher, download the latest software from <http://www.hach.com/SoftwareDownloads>.
2. Open the Zip file.
3. Copy the INF file from the software upgrade package to a convenient location on the PC.  
**Note:** The INF file must be installed to use the meter manual control from a PC.
4. Turn on the meter.
5. Push the  key and select Instrument Information.
6. Select USB Device Type and then select Virtual Serial to use the virtual serial port on the meter.
7. Push OK. The meter will automatically restart to complete the setting change.
8. Connect the meter with the USB cable to the PC and turn on the meter. Windows XP starts the "Found New Hardware Wizard".
9. Select "No, not at this time" to the query "Can Windows connect to Windows Update to search for software?"
10. Click Next. The next wizard screen will prompt.
11. Select "Install from a list or specific location (Advanced)" to the query "What do you want the wizard to do?"
12. Click Next. The next wizard screen will prompt.
13. Select the option "Search for the best driver in these locations."
14. Uncheck the "Search removable media (floppy, CD-ROM)" option and select the "Include this location in the search:" and click the "Browse" button.
15. Select the INF folder or location and click OK.
16. Click Next. The new software will be installed.

17. Click Finish to complete the Found New Hardware Wizard for: HQd Meter - Virtual Serial Port.
18. To make sure that the installation succeeded, go to Computer Management>Device Manager>Ports. The new installed port is listed as HQd Meter - Virtual Serial Port (COM#).
19. The meter is now ready for communication with PC-based systems using the Virtual Serial port. A program interface must be developed by the user for the command set used to control the meter functions from the PC. Contact Technical Support for more information and command set documentation.

## Maintenance

### ⚠ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Clean the meter

The meter is designed to be maintenance-free and does not require regular cleaning for normal operation. Exterior surfaces of the meter may be cleaned as necessary.

1. Wipe the surface of the meter with a damp cloth.
2. Use a cotton-tipped applicator to clean or dry the connectors.

### Replace the batteries

### ⚠ WARNING

Explosion Hazard. Improper battery installation can cause release of explosive gases. Insert batteries in proper orientation only. Use only new batteries from the same manufacturer and lot.

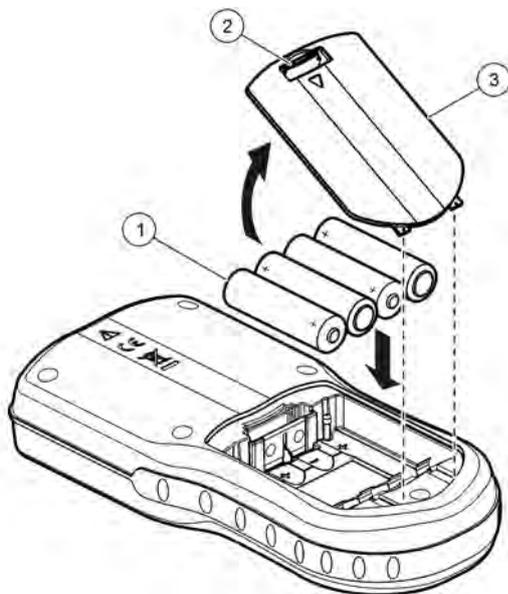
### NOTICE

Make sure that all meter connectors stay dry. Use a dry towel to remove liquid from the connectors.

For battery replacement refer to [Figure 11](#).

1. Pull the release tab on the battery cover and the remove the cover.
2. Remove the batteries.
3. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct polarity.
4. Replace the battery cover.

**Figure 11 Battery replacement**



|             |               |                 |
|-------------|---------------|-----------------|
| 1 Batteries | 2 Release tab | 3 Battery cover |
|-------------|---------------|-----------------|

## Troubleshooting

Refer to the following table for common problem messages or symptoms, possible causes and corrective actions.

| Error/Warning                     | Description                                   | Solution   |
|-----------------------------------|---|--|
| <b>Connect a Probe</b>            | Probe disconnected or connected improperly    | Tighten the locking nut on the probe connector.<br><br>Disconnect the probe and then connect the probe again                                 |
|                                   | Software not updated to most current version  | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |
|                                   | Problem with probe                            | Connect a different IntelliCAL probe to verify if problem is with probe or meter   |
| <b>Probe Not Supported</b>        | Probe disconnected or connected improperly    | Tighten the locking nut on the probe connector.<br><br>Disconnect the probe and then connect the probe again.                                |
|                                   | Software not updated to most current version  | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |
|                                   | Problem with probe                            | Connect a different IntelliCAL probe to the meter to verify if problem is with the meter or the probe.                                       |
|                                   | HQd meter does not support IntelliCAL probe   | Contact Technical Support.   |
| <b>Bootloader X.X.XX.XX error</b> | Software not updated to most current version. | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |

| Error/Warning   | Description   | Solution  |
|---|---|---|
| <b>0 days remaining message (For LDO and LBOD only)</b> | LDO or LBOD sensor cap used for 365 days                      | Replace the LDO or LBOD sensor cap and iButton®.  |
|   | There are 0 days remaining in the life of the LDO sensor cap. | Replace the LDO sensor cap. Calibration will be allowed. However, the calibration icon and question mark will appear on the measurement screen even if the calibration has passed.  |
|   | Meter set to incorrect date and time                          | <ol style="list-style-type: none"> <li>1. Disconnect the probe from the meter.</li> <li>2. Remove the meter batteries.</li> <li>3. Install the meter batteries properly. Follow the polarity markings.</li> <li>4. Set correct date and time in the meter.</li> <li>5. Connect the probe and verify that message has been removed.</li> </ol> |
|   | Software not updated to most current version                  | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads  |
| <b>Meter not configured</b>                             | Software error(s)   | If the meter starts up correctly, back up the Data Log and Method files. Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads   |

| Error/Warning  | Description                                  | Solution   |
|--|--|--|
| <b>Meter will not power on or powers on intermittently</b>     | Batteries are not installed correctly        | Examine battery orientation to make sure the batteries follow the polarity markings. Test again. |
|  |  | Clean the battery terminals, then install new batteries.   |
|  |  | Connect AC power adapter and test again.   |
|  | Software not updated to most current version | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads     |
|  | Damaged meter                                | Contact Technical Support.   |
| <b>Unable to access Full Access Options screen</b>             | Correct password has not been entered        | Contact Technical Support.   |
| <b>Unable to access Full or Operator Access Options screen</b> | Software not updated to most current version | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads     |

## Replacement parts and accessories

**Note:** Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.

### Replacement parts

| Description                       | Item no. |
|-----------------------------------|----------|
| AC Power/USB Adapter Kit, 115 VAC | 5826300  |
| AC Power/USB Adapter Kit, 230 VAC | 5834100  |
| Batteries, Alkaline AA            | 1938004  |
| Battery cover                     | 9245500  |

## Replacement parts and accessories (continued)

| Description  | Item no.                                 |
|--|--|
| Battery Contact, dual fixed  | 5188400                                  |
| Battery Contact, dual spring   | 5188800                                  |
| Cable, USB 6 ft (1.8 m), Type A male, Type B male  | 5924000                                  |
| Field Kit (includes Protective Glove Kit for meter and five 120-mL sample cups)  | 5825800                                  |
| Field Case for 2 probes with up to 5 m cables (10 m total). Includes empty case, insert for meter and probe storage, 4 containers for sample collection. | 8505500                                  |
| Field Case for 3 probes with up to 5 m cables (15 m total). Includes empty case, insert for meter and probe storage, 4 containers for sample collection. | 8505501                                  |
| Field Case for 2 probes with greater than 5 m cables (30 m total). Includes empty case, insert for meter with protective glove.                          | 8505600                                  |
| Keyboard (QWERTY), USB type  | LZV582                                   |
| Printer, Citizen PD-24 USB printer, 120–220 VAC  | <b>US:</b> 2960100<br><b>EU:</b> 5835900 |
| Printer Paper for Citizen PD-24, thermal, 5/pk   | 5836000                                  |
| Probe Clips, color coded (5 colors, 2 clips of each color), 10/pk  | 5818400                                  |
| Probe Depth Marker (rugged cables)   | 5828610                                  |
| Probe Holder, standard (fits on protective glove)  | 5829400                                  |
| Protective Glove Kit for meter   | 5828700                                  |
| Universal Probe Stand for standard IntelliCAL Probes   | 8508850                                  |
| Meter Stand for Portable HQd meters  | 4754900                                  |

## Examples of printed reports

Printed reports contain a report header and all stored data for samples, check standards and calibrations.

### Report header

The first line of a report shows the report header (Figure 12).

Figure 12 Report header

9999RV123456-SENDDATA-0512131618.TXT  
RD LDO 16:14:32 12-08-10 6.59 mg/L NORTH TANK -05 JOSEPH L

|                                    |                                    |
|------------------------------------|------------------------------------|
| 1 Meter serial number <sup>1</sup> | 3 Date and time, 24 h (YYMMDDhhmm) |
| 2 Report label                     | 4 File type extension              |

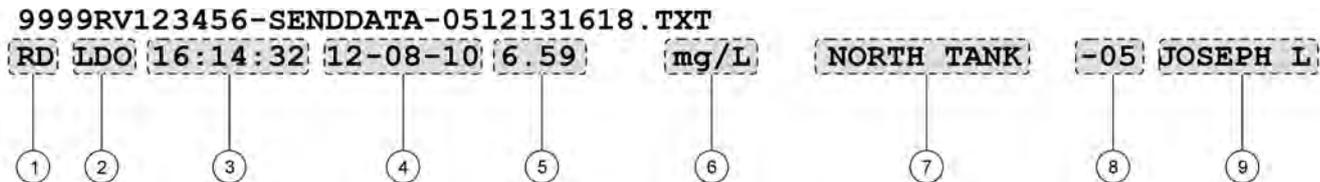
### Data reports

Sample data can be printed in a basic, advanced or total report format.

- Total report—refer to [Figure 13](#).
- Advanced report—refer to [Figure 14](#).
- Basic report—refer to [Figure 15](#).

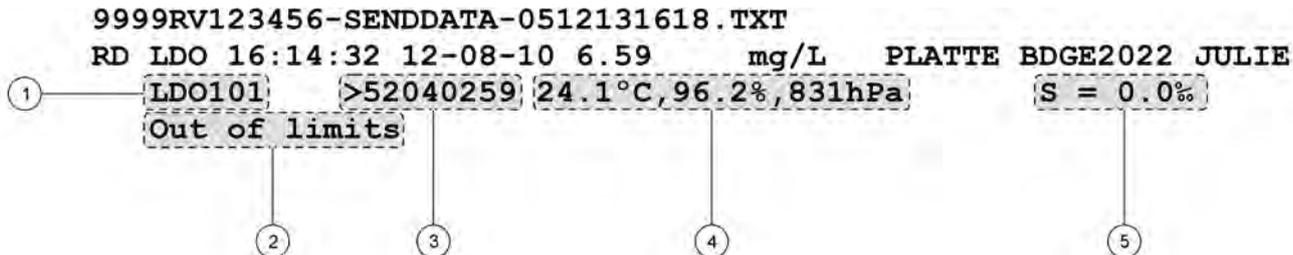
<sup>1</sup> The probe serial number is shown on calibration history and current calibration reports.

Figure 13 Basic report for sample data—1 line



|  |   |
|--|---|
| 1 Data type (RD=reading)                         | 6 Units   |
| 2 Parameter (pH, LDO, etc.)                      | 7 Sample ID: user-defined; shows "SAMPLE ID" if undefined |
| 3 Time (hh:mm:ss in 24 h or user-defined format) | 8 Sample ID counter                                       |
| 4 Date (DD-MM-YY or user-defined format)         | 9 Operator ID: user-defined; shows "- -" if undefined     |
| 5 Measured value                                 |   |

Figure 14 Advanced report for sample data—2 lines



|  |  |
|--|--|
| 1 Probe model  | 4 Additional units: shows all additional units associated with the reading.      |
| 2 Error message (if applicable)  | 5 Probe settings: shows the highest-priority setting associated with the reading |
| 3 Probe serial number (a "<" or ">" on the HQ40d meter indicates the probe position) |  |

Figure 15 Total report for sample data—3 lines

```

9999RV123456-SENDDATA-0512131618.TXT
RD pH 07:52:47 12-08-10 3.95 pH PLATTE BDGE2046 JULIE
pHC301 <06047527 21.8°C,167.0mV
Default CAL12:52 12-08-10 58.36mV/pH -9.3mV MICHAEL
  
```

|  |  |
|--|--|
| 1 Method name for probe settings   | 4 Calibration slope/ratio/constant   |
| 2 Time of calibration, prefaced by “CAL” and displayed as hh:mm in 24 h (or user-defined) format | 5 Offset—contents vary depending on type of parameter and user settings. May be blank. |
| 3 Date of calibration (DD-MM-YY or user-defined format)  | 6 Operator ID: user-defined; shows “- -” if undefined                                  |

**Check standard reports**

Check standard data is printed with 1 line of information (Figure 16)

Figure 16 Check standard report

```

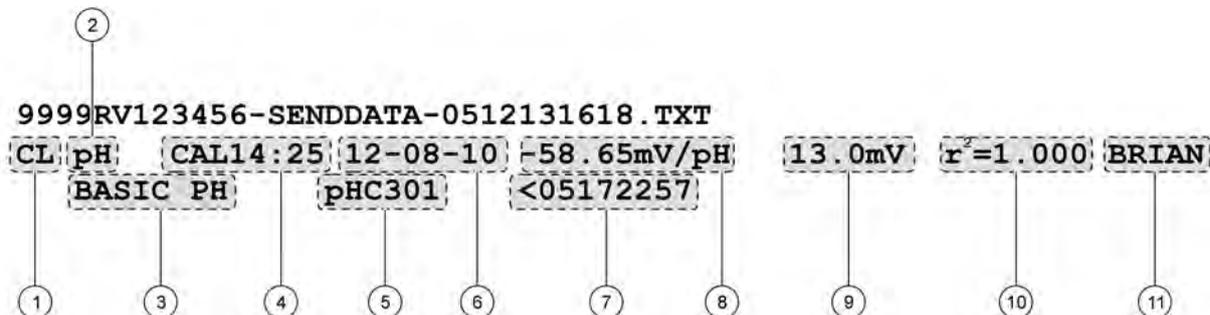
9999RV123456-SENDDATA-0512131618.TXT
ST pH 15:24:07 12-08-10 5.71 pH Fail GEORGE
  
```

|  |   |
|--|---|
| 1 Report type (ST = check standard)              | 5 Measured value  |
| 2 Report type (ST = check standard)              | 6 Units   |
| 3 Time (hh:mm:ss in 24 h or user-defined format) | 7 Check standard status: Pass/Fail based on the acceptance criteria |
| 4 Date (DD-MM-YY or user-defined format)         | 8 Operator ID: user-defined; shows “- -” if undefined               |

## Calibration reports

Calibration data is printed when the data log is sent to the printer or when probe data is sent to the printer. Calibration data is printed with 2 lines of information (Figure 17).

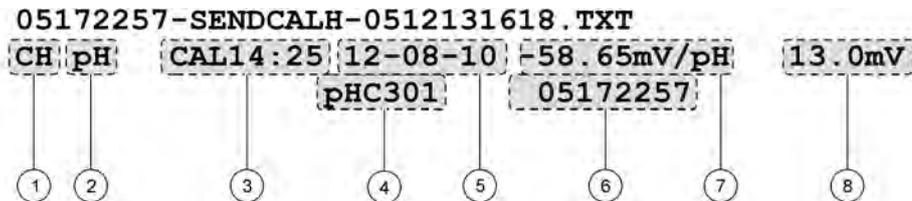
Figure 17 Calibration report



|  |   |
|--|---|
| 1 Report type (CL = calibration, IC = current calibration)                                       | 7 Probe serial number (a "<" or ">" on the HQ440d meter indicates the probe position)   |
| 2 Parameter (pH, LDO, etc.)  | 8 Calibration slope/ratio/constant  |
| 3 Method name for probe settings   | 9 Offset—contents vary depending on type of parameter and user settings. May be blank.  |
| 4 Time of calibration, prefaced by "CAL" and displayed as hh:mm in 24 h (or user-defined) format | 10 r <sup>2</sup> : contents vary depending on type of parameter being read, configuration of specific method and number of calibration standards used. May be blank. |
| 5 Probe model  | 11 Operator ID: user-defined; shows "- -" if undefined  |
| 6 Date of calibration (DD-MM-YY or user-defined format)  |   |

The calibration history can be printed from the probe data menu. Refer to Figure 18.

**Figure 18 Calibration history report**



|  |  |
|--|--|
| 1 Report type (CH=calibration history)   | 5 Date of calibration (DD-MM-YY or user-defined format)                                |
| 2 Parameter (pH, LDO, etc.)  | 6 Probe serial number (a "<" or ">" on the HQ40d meter indicates the probe position).  |
| 3 Time of calibration, prefaced by "CAL" and displayed as hh:mm in 24 h (or user-defined) format | 7 Calibration slope/ratio/constant   |
| 4 Probe model  | 8 Offset—contents vary depending on type of parameter and user settings. May be blank. |

**A**

AC power connection ..... 8  
 auto-shutoff ..... 20

**B**

backlight ..... 20  
 Bi-directional Communication ..... 23  
 big screen mode ..... 10, 20

**C**

calibration ..... 12  
     dual-screen mode ..... 10  
     probe reminder ..... 20  
     reminder ..... 20  
 check standards ..... 13  
 contrast, display ..... 20

**D**

data file descriptions ..... 16  
 data log ..... 23  
     prevent data loss ..... 22  
     printing ..... 14  
     transfer data to PC ..... 18, 24  
 data log, stored data ..... 14  
 date and time  
     changing ..... 11  
 detailed screen mode ..... 20  
 display description ..... 20  
 dual-screen mode  
     calibration ..... 10

**I**

interval measurements ..... 21

**M**

measurement modes ..... 21  
 menu navigation ..... 11  
 modes  
     screen ..... 20

**O**

operator ID ..... 13

**P**

power ..... 8  
 printing ..... 14  
 probes  
     connecting ..... 12  
     stored data ..... 14

**S**

sample ID ..... 13  
 screen modes ..... 9  
 security options ..... 18  
     restrict menu access ..... 19  
 software  
     install PC Application software ..... 18  
     update meter software ..... 22  
 sounds, turn on or off ..... 20  
 stored data ..... 13, 14  
     file descriptions ..... 16  
     probe ..... 14

## Index

---

### T

|                             |        |
|-----------------------------|--------|
| transfer data               |        |
| to PC .....                 | 16, 18 |
| to USB storage device ..... | 15     |
| transfer data to USB device |        |
| data log .....              | 23     |
| troubleshooting .....       | 25     |

### U

|                         |    |
|-------------------------|----|
| USB storage device      |    |
| file descriptions ..... | 16 |
| transfer data to .....  | 15 |

**HACH COMPANY World Headquarters**

P.O. Box 389, Loveland, CO 80539-0389 U.S.A.  
Tel. (970) 669-3050  
(800) 227-4224 (U.S.A. only)  
Fax (970) 669-2932  
orders@hach.com  
www.hach.com

**HACH LANGE GMBH**

Willstätterstraße 11  
D-40549 Düsseldorf  
Tel. +49 (0) 2 11 52 88-320  
Fax +49 (0) 2 11 52 88-210  
info@hach-lange.de  
www.hach-lange.de

**HACH LANGE Sàrl**

6, route de Compois  
1222 Vézenaz  
SWITZERLAND  
Tel. +41 22 594 6400  
Fax +41 22 594 6499





**Attachment 1B – Hach PHC301 pH Probe User Manual**

# User Manual

## Refillable pH Probe: Model PHC30101 or PHC30103

### Safety information

#### Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

|   |   |
|---|---|
|  | <p>Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.</p> <p><b>Note:</b> For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxillary items for proper disposal.</p> |
|---|---|

### Specifications

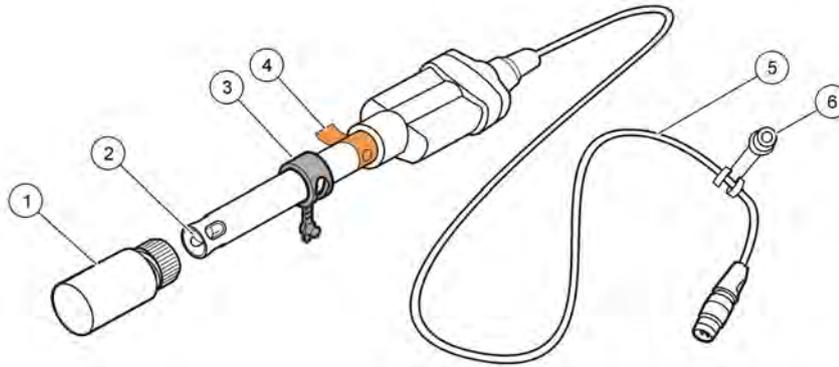
*Note: Specifications are subject to change without notice.*

| Specifications              | Details   |
|-----------------------------|---|
| Probe type                  | Digital combination probe with refillable double junction reference and built-in temperature sensor                                   |
| pH range                    | pH 0 to 14  |
| pH resolution               | User-selectable stabilization time and resolution—Fast: 0.1, Fast: 0.01, Medium: 0.01, Slow: 0.01 or Slow: 0.001                      |
| Sodium (alkalinity) error   | -0.6 pH at pH 12.6 in 1 M NaOH  |
| Slope                       | -59 mV/pH (90 to 110% at 25 °C per Nernstian theoretical value)   |
| Temperature accuracy        | ±0.3 °C (±0.54 °F)  |
| Operating temperature range | 0 to 50 °C (32 to 122 °F)   |
| Storage temperature range   | 5 to 40 °C (41 to 104 °F)   |
| Junction                    | Ceramic   |
| Reference type              | Ag/AgCl   |
| Minimum sample depth        | 15 mm (0.59 in.)  |
| Dimensions                  | Diameter: 12 mm (0.47 in.)<br>Length: 103 mm (4.1 in.)<br>Total length: 200 mm (7.87 in.)<br>Cable length: 1 or 3 m (3.28 or 9.84 ft) |
| Cable connection            | M12 digital output and connector compatible with HQd meters   |

### Product overview

The PHC301 series probe is a pH refillable combination probe with a built-in temperature sensor (Figure 1). The PHC30101 or PHC30103 probe is available with a 1 or 3 m (3.28 or 9.84 ft) cable and is intended for laboratory use. The pH refillable combination probe measures pH in wastewater, drinking water and general aqueous applications. The probe is not suitable for use with organic solvents. A 28-mL bottle of reference electrolyte filling solution (3 M KCl solution saturated with AgCl) is included with the probe.

**Figure 1 Probe overview**



|   |   |   |                                      |
|---|---|---|--------------------------------------|
| 1 | Probe soaker bottle                                   | 4 | Protective tape and filling-hole     |
| 2 | Glass bulb, reference junction and temperature sensor | 5 | 1 or 3 meter (3.28 or 9.84 ft) cable |
| 3 | Filling-hole cap                                      | 6 | Probe soaker bottle holder           |

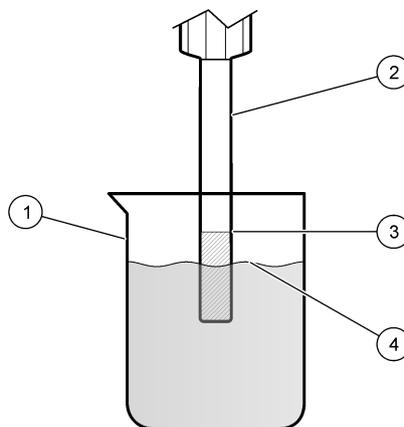
## Preparation for use

Prepare the probe for use before calibration or sample measurement.

1. Turn the probe soaker bottle cap counter-clockwise to loosen the cap.
2. Remove the soaker bottle from the probe.
3. Rinse the reference junctions and glass bulb with deionized water thoroughly to remove the viscous storage/filling solution completely. Blot dry with a lint-free cloth.
4. Remove the protective tape from the filling hole before initial use (refer to [Figure 1](#) on page 2). Dispose of the protective tape.
5. Add filling solution to the probe as necessary (refer to [Fill the probe](#) on page 10). The filling solution must be above the standard solution or sample level during measurement ([Figure 2](#)).
6. Make sure that the filling hole is open during measurement for the proper flow of the filling solution.

**Note:** For the best stabilization time, condition the probe for several minutes in the sample before use.

**Figure 2 Measurement method**



|   |            |   |                                   |
|---|------------|---|-----------------------------------|
| 1 | Container  | 3 | Filling solution level            |
| 2 | Probe body | 4 | Standard solution or sample level |

# Calibration

## Before calibration:

The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.

It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured to use the same calibration options.

To view the current calibration, push , select View Probe Data, then select View Current Calibration.

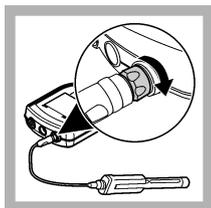
If any two probes are connected, push the **UP** or **DOWN** arrow to change to the single display mode in order to show the Calibrate option.

Prepare the probe for use (refer to [Preparation for use](#) on page 2).

## Calibration notes:

- pH buffers can be used in any order. Use buffers that are two pH units apart.
- Additional standard sets along with the minimum number of calibration points can be selected in the Calibration Options. For a two point calibration, it is recommended that two buffers be selected: one with a pH above and one with a pH below the expected sample pH. For a one point calibration, select the buffer nearest to the expected sample pH.
- The calibration is recorded in the probe and the data log. The calibration is also sent to a PC, printer or flash memory stick if connected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a calibration error occurs, refer to [Troubleshooting](#) on page 10.

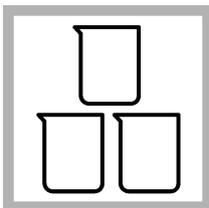
## Calibration procedure:



1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.



2. Push **Calibrate**. The display shows the buffers that are necessary for calibration.



3. Prepare the fresh buffers in separate beakers or appropriate containers.



4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.



5. Put the probe in the pH buffer solution and stir gently. Make sure that the reference junctions are completely submerged. Shake the probe from side to side in the standard solution to refresh the reference junction.



**6. Push Read.** Stir gently. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the standard. The display shows the buffer that has just been read and shows the temperature corrected pH value when the reading is stable.

**7. Repeat steps 4 - 6** until the minimum number of calibration points specified in the current method have been collected.

**8. Push Done** to view the calibration summary. The display will not show Done until the minimum number of calibration points have been collected.

**9. Push Store** to accept the calibration and go back to measurement mode.

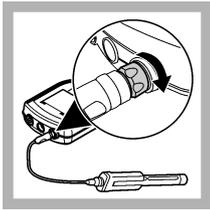
## Sample measurement

|  |
|--|
| <b>Before measurement:</b>   |
| The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.                        |
| If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the HQd meter manual for more information. |
| Regular calibration is required for the best measurement accuracy (refer to <a href="#">Calibration</a> on page 3).                              |
| Prepare the probe for use (refer to <a href="#">Preparation for use</a> on page 2).  |

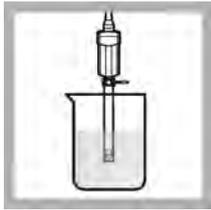
### Measurement notes:

- Data is automatically stored in the data log when **Press to Read** or **Interval** is selected in the Measurement Mode. When **Continuous** is selected, data will only be stored when **Store** is selected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a measurement error occurs, refer to [Troubleshooting](#) on page 10.

### Measurement procedure:



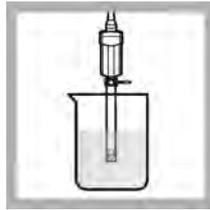
1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn the meter on.



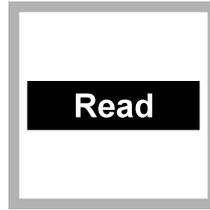
2. For the best stabilization time, condition the probe in the sample for at least 10 minutes before the initial sample measurement.



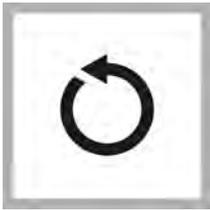
3. Rinse the probe with deionized water and then with the sample. Blot dry with a lint-free cloth.



4. Put the probe in the sample and stir gently. Make sure that the reference junctions are completely submerged. Do not put the probe on the bottom or sides of the container. Shake the probe from side to side in the sample to refresh the reference junction.



5. Push **Read**. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes.



6. Repeat steps 2-4 for additional measurements.



7. When measurements are done, store the probe (refer to [Storage](#) on page 10).

## Run a check standard

The run check standard feature validates instrument performance between sample measurements. Use the run check standard feature for periodic or user-defined interval measurements of a traceable standard solution. Set the criteria for check standards from the PHC301 Settings menu.

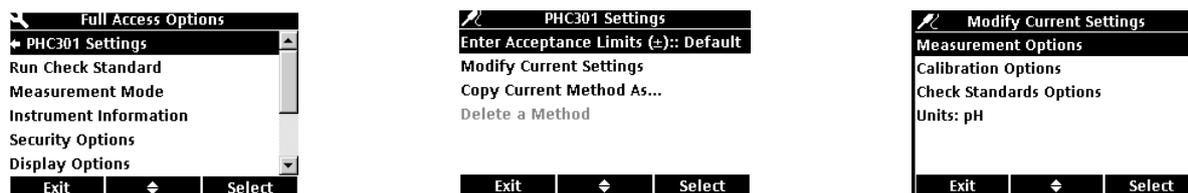
**Note:** Access control must be off or a valid password must be entered before any of the check standard method options can be changed.

1. Push . The Full Access Options menu is shown.
2. Select Run Check Standard.  
**Note:** Select the correct probe if two probes are connected to the meter.
3. Get the standard solution shown on the display.
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
5. Put the probe in the standard solution until the temperature sensor is completely submerged. Move the probe up or down or gently tap on the beaker to remove air bubbles from the probe.
6. Push **Read**. The display will show "Stabilizing" and a progress bar as the reading stabilizes. The display shows the value of the check standard and either Check Standard Passed or Check Standard Failed.
7. If the display shows **Check Standard Passed**, the check standard measurement is within the accepted limits set by the administrative user. Select **Done** to continue with the sample measurement.

8. If the display shows **Check Standard Failed**, the measurement is outside of accepted limits set by the administrative user and a recalibration is recommended. If the acceptance criteria is set to Cal Expires on Failure: Yes, the display shows the calibration icon and a question mark until the probe is recalibrated. To correct the probe calibration and status indicator, calibrate the probe (refer to [Calibration](#) on page 3).

## Advanced operation

Parameter-specific settings can be changed through the Full Access Options menu. Details about menu navigation, available options and how to change them are given in the screens, tables and procedures throughout this section.



The settings that can be changed are shown in [Table 1](#).

**Table 1 Parameter-specific settings**

| Setting                | Options  |
|------------------------|--|
| Measurement Options    | <ul style="list-style-type: none"> <li>• Resolution</li> <li>• Upper and lower range limits</li> </ul>   |
| Calibration Options    | <ul style="list-style-type: none"> <li>• Buffer set</li> <li>• Buffer set values (if Custom Buffer Set selected)</li> <li>• Reminder</li> <li>• Minimum Cal points</li> <li>• Slope limit</li> </ul>                                 |
| Check Standard Options | <ul style="list-style-type: none"> <li>• Standard (temperature compensated buffer or custom at 25 °C)</li> <li>• Reminder</li> <li>• Acceptance criteria</li> <li>• Standard value at 25 °C (if custom standard selected)</li> </ul> |
| Units                  | <ul style="list-style-type: none"> <li>• pH</li> <li>• mV</li> </ul>   |

## Change measurement options

Methods are groups of default or user-defined settings relevant to specific applications. If the meter is set to the default method and the Modify Current Settings option is chosen, a prompt for a new name is shown after the changes are entered. The settings are saved with this name to distinguish them from the default method settings, which cannot be changed. A saved method can be used instead of multiple adjustments to the individual settings. Changes made to a user-defined method are automatically saved with the existing name. Multiple methods can be saved for the same probe on each meter.

1. Make sure a probe is connected to the meter.
2. Push and select PHC301 Settings.
3. Select Modify Current Settings.
4. Select Units. Select pH (default) or mV.  
**Note:** The mV option can be used to find the probe offset in a pH 7 buffer or to measure the slope. Both units are shown when the detail display mode is selected.

5. Select Measurement Options and update the settings:

| Option                    | Description   |
|---------------------------|---|
| <b>Resolution</b>         | <p>Sets the resolution:</p> <ul style="list-style-type: none"> <li>• 0.1pH—Fast</li> <li>• 0.01pH—Fast (default)</li> <li>• 0.01pH—Medium</li> <li>• 0.01pH—Slow, or</li> <li>• 0.001pH—Slow</li> </ul> <p>The resolution affects the number of decimal places and the stabilization time. Higher resolution measurements take more time to stabilize. Slower stabilization times provide higher accuracy measurements.</p> |
| <b>Measurement Limits</b> | <p>Set the measurement limits—Lower limit (default: 0.00 pH) or Upper limit (default: 14.00 pH).</p> <p>The measurement limits can be set to match the acceptable values for the sample. When the measurement is above the upper limit setting or below the lower limit setting, the meter shows an "Out of limits" message. This message is an alert to a potential problem with the process conditions.</p>               |

6. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
7. Push **EXIT** until the meter returns to the measurement mode.

## Change calibration options

1. Make sure a probe is connected to the meter.
2. Push  and select PHC301 Settings.
3. Select Modify Current Settings.
4. Select Calibration Options and update the settings:

| Option                    | Description   |
|---------------------------|---|
| <b>Buffer Set</b>         | <p>Sets the temperature compensated buffer set used for calibration—</p> <ul style="list-style-type: none"> <li>• Color Coded—4.01, 7.00, 10.01 (default)</li> <li>• IUPAC—4.01, 7.00, 10.01, 12.45</li> <li>• DIN—4.65, 9.23</li> <li>• IUPAC—4.01, 6.86, 10.01, 12.45</li> <li>• IUPAC—4.01, 6.86, 9.18, 12.45</li> <li>• IUPAC—4.01, 7.00, 9.18, 12.45</li> <li>• Custom Buffer Set (refer to <a href="#">Table 2</a>)</li> </ul> <p>Custom buffer sets are characterized at 25 °C (77 °F).<br/>Buffer set values are shown on the Calibration Options screen.</p> <p><b>Note:</b> Only the minimum calibration points must be measured for <b>DONE</b> to be shown on the calibration screen.</p> |
| <b>Buffer Set Values</b>  | <p>If the Buffer Set is set to Customer Buffer Set, sets the custom buffer set (refer to <a href="#">Table 2</a>).</p>  |
| <b>Minimum Cal Points</b> | <p>Sets the minimum number of calibration points necessary before a calibration can be completed—1 (default), 2 or 3.</p>   |
| <b>Slope Limit</b>        | <p>Sets the slope limit—1% to 10% (acceptable slope criteria, default = 5%).<br/>The slope must fall within set limits for successful calibration.</p>  |

- Select Calibration Reminder and update the settings:

| Option                 | Description   |
|------------------------|---|
| <b>Reminder Repeat</b> | Meter will make an audible sound when a calibration is due and repeat the sound at the selected interval—Off (default), 2 h, 4 h, 8 h, 2 d, 5 d or 7 d.   |
| <b>Expires</b>         | Calibration expires after the selected time—Immediately, Reminder + 30 min, Reminder + 1 h, Reminder + 2 h or Continue Reading.<br><br><i>Note: The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.</i> |

- If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
- Push **EXIT** until the meter returns to the measurement mode.

**Table 2 Custom buffer set**

| Buffer set values | Option        | Description  |   |
|-------------------|---------------|--|---|
| Std1              | 1.09pH—25 °C  | <b>Note:</b> Selected standards must differ by a minimum of 2 pH units. For example, if 1.09 pH is chosen for the first standard, the second standard must differ by at least 2 pH. Standards that do not meet this minimum will appear gray on the screen and will not be selectable. |   |
| Std2              | 1.68pH—25 °C  |  |   |
| Std3              | 4.01pH—25 °C  |  |   |
| Std4              | 4.65pH—25 °C  |  |   |
| Std5              | 6.86pH—25 °C  |  |   |
|                   | 7.00pH—25 °C  |  |   |
|                   | 9.18pH—25 °C  |  |   |
|                   | 9.23pH—25 °C  |  |   |
|                   | 10.01pH—25 °C |  |   |
|                   | 12.45pH—25 °C |  |   |
|                   | Custom Buffer |  | Custom buffer value.<br>Range = 2.000 pH to 14.000 pH.<br>Custom buffer values are not temperature compensated. Custom buffers should be read at 25 °C. |
|                   | No Buffer     |  | Standard is undefined when this option is selected.   |

### Change check standard options

- Make sure a probe is connected to the meter.
- Push  and select PHC301 Settings.
- Select Modify Current Settings.

4. Select Check Standards Options and update the settings:

| Option                | Description   |
|-----------------------|---|
| <b>Standard</b>       | Sets the temperature compensated buffer value for check standard— <ul style="list-style-type: none"><li>• 4.01pH—25 °C</li><li>• 4.65pH—25 °C</li><li>• 6.86pH—25 °C</li><li>• 7.00pH—25 °C</li><li>• 9.18pH—25 °C</li><li>• 9.23pH—25 °C</li><li>• 10.01pH—25 °C</li><li>• 12.45pH—25 °C</li><li>• Custom</li></ul> <p>The standard value is shown on the Check Standard Options screen.<br/>No temperature compensation for custom buffers.</p> |
| <b>Standard Value</b> | When Standard is set to Custom, enter the standard value using the up/down arrow keys.  |

5. Select Check Standard Reminder and update the settings:

| Option                 | Description  |
|------------------------|--|
| <b>Reminder Repeat</b> | Sets the time interval for the check standard reminder—Off, 30 minutes, 2 h, 4 h, 8 h, 12 h or 24 h. |
| <b>Allow Defer</b>     | Allows the postponement of check standard reminders—Yes or No.                                       |

6. Select Acceptance Criteria and update the settings:

| Option                        | Description  |
|-------------------------------|--|
| <b>Acceptance Limits</b>      | Sets the tolerance limits for check standard—0.005pH (default) to 1.000pH. |
| <b>Cal Expires on Failure</b> | Recalibration required if check standard fails—Yes or No.                  |

7. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.

8. Push **EXIT** until the meter returns to the measurement mode.

## Maintenance

### Clean the probe

Clean the probe when:

- Drifting/inaccurate readings occur as a result of contamination on the glass sensor or the probe being left dry for extended periods of time.
- Slow stabilization time occurs as a result of contamination on the glass sensor.
- A calibration error occurs as a result of contamination on the glass sensor.

#### For general contaminants:

1. Rinse the probe with deionized water and blot dry with a lint-free cloth.
2. Soak the glass bulb for 12 to 16 hours in Hach Electrode Cleaning Solution.
3. Rinse or soak the probe for 1 minute in deionized water.
4. Soak the probe in pH 4 buffer for up to 20 minutes, then rinse with deionized water.
5. Blot dry with a lint-free cloth.

#### For fats, grease and oils:

1. Soak the glass bulb in a warm detergent solution for up to 2 hours.

2. Rinse or soak the probe for 1 minute in deionized water.
3. Soak the probe in pH 4 buffer for up to 20 minutes, then rinse with deionized water.
4. Blot dry with a lint-free cloth.

## Fill the probe

To add filling solution to the probe:

1. If the filling hole is closed, remove the filling-hole cap from the filling hole (refer to [Figure 1](#) on page 2).
2. Remove the cap from the tip of the filling solution bottle.
3. Hold the bottle so that the tip is down. Put the tip of the bottle in the filling hole.
4. Slowly squeeze the bottle and fill the probe completely.  
*Note: Fill the probe completely for the best performance.*
5. If the probe will not be used immediately, store the probe (refer to [Storage](#) on page 10).
6. Keep the filling solution bottle and cap for later use.  
*Note: If the dispensing tip becomes clogged, remove the dispensing tip and soak the tip in warm water. Dry thoroughly and assemble.*

## Storage

For the best probe performance, do not let the reference junction dry out.

### Short-term and long-term storage

*Note: The probe can be stored in a sample for up to 2 hours if the sample pH is not high.*

1. Put the filling-hole cap in the filling hole (refer to [Figure 1](#) on page 2).
2. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.
3. Fill the probe soaker bottle half full with Hach Electrode Storage Solution or 3 M potassium chloride (KCl) solution.
4. Loosen the soaker bottle cap and put the soaker bottle on the probe.
5. Turn the soaker bottle cap clockwise to tighten the soaker bottle cap.
6. Make sure that the solution in the soaker bottle completely covers the glass bulb and reference junction holes.

If the glass bulb becomes dry:

1. Soak the probe tip in the 4.01, 7.00 and 10.01 buffers each for 5 minutes.
2. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
3. Calibrate the probe.

## Troubleshooting

| Message or symptom  | Possible cause   | Action  |
|---------------------|--|---|
| Probe not supported | Software not updated                                     | Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">http://www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual for specific instructions for the meter model. |
|                     | HQd meter does not support IntelliCAL <sup>®</sup> probe | Contact a Technical Support Representative.   |

| Message or symptom                                     | Possible cause   | Action   |
|--|--|--|
| Connect a probe or probe requires service              | Probe not connected properly   | Disconnect, then connect the probe. Tighten the locking nut.   |
|  | Software not updated   | Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">http://www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual.  |
|  | Large number of methods stored on probe  | Continue to let the probe connect. Do not disconnect the probe.  |
|  | Damaged probe  | Make sure there is connectivity with another probe or meter to confirm isolated issue with probe. Contact a Technical Support Representative.  |
| pH reading and/or mV reading is same for all solutions | Soaker bottle not removed  | Remove the soaker bottle.  |
|  | Electrical issue   | Contact a Technical Support Representative.  |
| Standard not recognized error                          | Soaker bottle not removed  | Remove the soaker bottle.  |
|  | Incorrect or contaminated buffer solution  | Use fresh buffer solution as specified in the method.  |
|  | Contaminated filling solution  | Drain and replace the filling solution with fresh solution.  |
| Slow stabilization time                                | Tape not removed from the filling-hole   | Remove the tape that is over the filling hole.   |
|  | Contaminated glass sensor  | Clean the probe (refer to <a href="#">Clean the probe</a> on page 9).  |
|  | Contaminated filling solution  | Drain and replace the filling solution with fresh solution.  |
|  | Filling hole closed  | Open the filling hole while in use by removing the filling-hole cap from the filling hole.   |
|  | Poor contact between reference junction and solution                                   | Shake the probe in the solution from side to side to refresh the reference junction.   |
|  | Probe not prepared for LIS sample  | For the best stabilization time, soak the probe in the sample for 10 to 15 minutes before the initial measurement.   |
|  | Low sample temperature or temperature difference between samples                       | Check the sample temperature. The lower the temperature or the greater the difference of temperatures between samples, the longer the stabilization time will be.  |
|  | Air bubbles around inner reference electrode   | Gently tap the probe with hand or shake the probe downward to remove any air bubbles.  |
| Calibration errors                                     | Calibration not done correctly   | Recalibrate using freshly prepared pH buffers.   |
|  | Contaminated glass sensor  | Clean the probe (refer to <a href="#">Clean the probe</a> on page 9).  |
|  | Slope exceeds the criteria for % of theoretical (as defined in the method slope limit) | <ol style="list-style-type: none"> <li>1. Widen the slope limits by changing the PHC301 calibration settings and method.</li> <li>2. Recalibrate the probe.</li> <li>3. Run a check standard to check the performance of the probe.</li> </ol> |

| Message or symptom           | Possible cause  | Action   |
|------------------------------|---|--|
| Drifting/Inaccurate readings | Contaminated glass bulb   | Clean the probe (refer to <a href="#">Clean the probe</a> on page 9).  |
|                              | CO <sub>2</sub> absorption (for low ionic strength or high purity sample)   | Use the LIS chamber for LIS/high purity samples to prevent sample contamination.   |
|                              | Clogged reference   | Rinse the reference junction holes with deionized water and then gently tap the probe with hand or shake the probe to remove any air bubbles.  |
|                              | Improper storage conditions/<br>Dehydrated glass bulb   | Clean or condition the probe and do recalibration. The probe may not operate correctly if the probe has been left dry for a long time. Condition the glass sensor and reference junctions again: <ol style="list-style-type: none"> <li>1. Soak the probe tip in the 4.01, 7.00 and 10.01 buffers each for 5 minutes.</li> <li>2. Rinse with deionized water. Blot dry with a lint-free cloth.</li> <li>3. Calibrate the probe.</li> </ol> |
|                              | Electromagnetic Forces (EMF) such as voltaic cells, thermoelectric devices, electrical generators, resistors and transformers | Do not test in areas where EMF is present. For testing in process units (spot checking), make sure that the equipment is grounded.   |
|                              | Colloidal and/or particulates in the filling solution.  | Replace the filling solution, calibrate and test again.  |
|                              | Air bubbles around inner reference electrode  | Gently tap the probe with hand or shake the probe downward to remove any air bubbles.  |
| Out of range                 | Measurement value is outside of range   | Make sure that the sample is within the range of the probe.  |
| Out of limits                | Check standard value is outside of limits set in the current method   | Make sure that the standard is within the limits of the current method.  |
|                              |   | Create another method that expands the acceptable limits.  |
|                              | Measurement value is outside of measurement limits set in the current method.   | Make sure that the sample is within the limits of the current method.  |
|                              |   | Create a new method with an expanded range.  |
| Temperature out of range     | Temperature value is outside of range   | Make sure that the sample temperature is within the range of the probe.  |
|                              |   | Make sure that the temperature sensor is working correctly.  |
|                              | Measured temperature is outside the range of the probe  | Make sure that the standard temperature is within the range of the probe.  |
|                              |   | Make sure that the temperature sensor is working correctly.  |
|                              | Check standard temperature value is outside of range  | Make sure that the check standard temperature is within the range of the probe.  |

**HACH COMPANY World Headquarters**

P.O. Box 389, Loveland, CO 80539-0389 U.S.A  
Tel. (970) 669-3050  
(800) 227-4224 (U.S.A. only)  
Fax (970) 669-2932  
orders@hach.com  
www.hach.com

**HACH LANGE GMBH**

Willstätterstraße 11  
D-40549 Düsseldorf  
Tel. +49 (0) 2 11 52 88-320  
Fax +49 (0) 2 11 52 88-210  
info@hach-lange.de  
www.hach-lange.de

**HACH LANGE Sàrl**

6, route de Compois  
1222 Vézenaz  
SWITZERLAND  
Tel. +41 22 594 6400  
Fax +41 22 594 6499





**Attachment 2 – CEM-2057 Stormwater pH Meter Calibration Record Form**



|   |                           |
|---|---------------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS | CONTRACT NUMBER/CO/RTE/PM |
|   | PROJECT IDENTIFIER NUMBER |
|   | WDID NUMBER               |

**pH Meter Calibration Record Continued**

| Date | Electrode Number | Temperature at Calibration | Slope (%) | Buffers Used for Calibration |                          |                          | Re-check pH 7.0          | Notes                    | Initials |
|------|------------------|----------------------------|-----------|------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------|
|      |                  |                            |           | pH 4.0                       | pH 7.0                   | pH 10.0                  |                          |                          |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |
|      |                  |                            |           | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |          |

| Date | Calibration Notes |
|------|-------------------|
|      |                   |
|      |                   |
|      |                   |
|      |                   |
|      |                   |
|      |                   |

**Review**

I have reviewed this document and, based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete.

|   |      |
|---|------|
| Water pollution control manager           | Date |
| Water pollution control manager signature |      |

## Instructions

### GENERAL INFORMATION

- Projects with Construction Site Monitoring Program require the information on this form as part of the Stormwater Pollution Prevention Plan for stormwater analysis meter calibration.
- Completed forms must be filed in project file category 20.55, Field Testing Equipment Maintenance and Calibration Records

### FORM

#### Contract Number/Co/Rte/PM

For local agency encroachment permit projects write the encroachment permit number in the Contract Number field.

#### Project Identifier Number

Caltrans projects starting July 1, 2010, will have a Project Identifier Number. For projects without a PID, write "N/A" in the field.

### ELECTRODE MAINTENANCE

- To pass calibration, the pH meter must display a slope between 95 percent and 105 percent. If the pH meter does not display such a slope, take the following corrective action:
  1. Change the standard pH and buffers and recalibrate.
  2. Change the 3M KCl fill in the electrode, or bring up the volume and recalibrate.
  3. Clean the electrode with the pH Electrode Cleaning Solution (follow manufacturer's instructions), and recalibrate.
  4. If the meter does not recalibrate using the three steps above, consult the manufacturer's technical manual, and discontinue use of the meter until it functions properly.
- Corrective actions to calibrate the pH meter must be recorded in the calibration notes section on form CEM-2056, "Stormwater pH Meter Calibration Record."
- Any pH meter maintenance activities must be recorded under the calibration notes section on form CEM-2056, "Stormwater pH Meter Calibration Record."



**Attachment 3 – CEM-2052 Stormwater Sample Field Test Report Form**

|   |  |      |
|---|--|------|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |      |
|   | PROJECT IDENTIFIER NUMBER  |      |
|   | WDID NUMBER  |      |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |      |
| Submitted by contractor (print name and sign) |  | Date |

**Stormwater Samples Field Analysis**

|                                       |  |
|---------------------------------------|--|
| Location                              | Date of Sampling   |
| Sample Location Identification Number | Date of Analysis   |
| Sample Analyzed By Signature          |  |
| Sample Analyzed By Print Name         |  |
| Analyzer Phone Number                 | Samples Analyzed For Parameter(s)<br><input type="checkbox"/> Turbidity<br><input type="checkbox"/> pH<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Other _____ |
| Company                               |  |

| Sample Identification                               | Turbidity Analysis (NTU) | pH Analysis (pH) | Analysis ( ) | Analysis ( ) | Comments                 |
|---|--------------------------|------------------|--------------|--------------|--------------------------|
|   |                          |                  |              |              | <input type="checkbox"/> |
|   |                          |                  |              |              | <input type="checkbox"/> |
|   |                          |                  |              |              | <input type="checkbox"/> |
|   |                          |                  |              |              | <input type="checkbox"/> |
|   |                          |                  |              |              | <input type="checkbox"/> |
| Qualifying Rain Event Daily Average Analysis Result |                          |                  |              |              | <input type="checkbox"/> |

|  |   |   |                  |
|--|---|---|------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS  |   | CONTRACT NUMBER/CO/RTE/PM   |                  |
|  |   | PROJECT IDENTIFIER NUMBER   |                  |
|  |   | WDID Number   |                  |
| <b>Turbidity Analysis Information</b>  |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>pH Analysis Information</b>   |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>Analysis Information</b>  |   |   |                  |
| Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| Note: Meter calibration information available in the Storm Water Pollution Prevention Plan (SWPPP) files.<br>Comments  |   |   |                  |
| <b>Review and Record Keeping</b>   |   |   |                  |
| Test results entered into sampling and testing activity log?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No  | Numeric action level exceedance?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No | Numeric effluent limitation violation?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No |                  |
| I have reviewed this document and based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true accurate, and complete. |   |   |                  |
| Water pollution control manager name   |   | Date  |                  |
| Water pollution control manager signature  |   |   |                  |
| Accepted by resident engineer (name)   |   | Date  |                  |
| Resident engineer signature  |   |   |                  |

## Instructions

### GENERAL INFORMATION

- This form is required for compliance with provisions in Section I of Attachments C, D, and E of the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ, NPDES No. CAS000002.
- The *Construction Site Monitoring Program Guidance Manual*, dated July 2010, contains sampling guidance.
- Sampling and sample preservation must be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association).
- Collect, maintain, and ship samples according to the Surface Ambient Monitoring Program's (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).
- Complete a separate stormwater sample field analysis report daily for each sampling location.
- Include a copy of the completed form in the project SWPPP files.

### FORM

#### Project Identifier Number

Starting July 1, 2010, Caltrans projects will have a project identifier number. For projects without a PID, write N/A in the field.

#### Contract Number/Co/Rte/PM

For local agency encroachment permit projects, write the encroachment permit number in the contract number field.

Analysis Result Analytical results less than the method detection limit must be reported as "less than the method detection limit."

#### Qualifying Rain Event Daily Average Analysis Result

A minimum of three daily samples are required to calculate the daily average for a qualifying rain event.

#### Numeric Action Level Exceedance

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Action Level (NAL), complete form CEM-XXXX "Numeric Action Level Exceedance Report," and submit all storm event sampling results to the State Water Board no later than ten days after the conclusion of the storm event.

#### Numeric Effluent Limitation Violation

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Effluent Limitation, complete form CEM-6062, "Numeric Effluent Limitation Violation Report," and submit CEM-2063, "Numeric Effluent Limitation Violation Report," to the State Water Board within 24 hours after the numeric effluent limitation violation was identified. Submit all storm event sampling results to the State Water Board no later than five days after the conclusion of the storm event.



# **Standard Operating Procedures for Manual Field Measurement of Dissolved Oxygen**

DOCUMENT NO. CTSW-RT-11-255.11.04-F

**January 2012**

**California Department of Transportation  
Division of Environmental Analysis  
Storm Water Program MS 27  
1120 N Street, Sacramento, California 95814  
<http://www.dot.ca.gov/hq/env/stormwater/index.htm>**



## Caltrans Technical Report Documentation Page

|   |                             |  |
|---|-----------------------------|--|
| 1. Report No.<br>CTSW-RT-11-255.11.04-F   | 2. Type of Report<br>Report | 3. Report Phase and Edition<br>Final                               |
| 4. Title and Subtitle<br>Standard Operating Procedures for Manual Field Measurement of Dissolved Oxygen   |                             | 5. Report Date<br>January 2012                                     |
| 6. Editor:<br>Hamid Hakim, Ph.D., P.E, Caltrans<br>Authors:<br>Armand Ruby; Cory LaNeave, P.E. Corinne Marks, PE  |                             | 7. Caltrans Project Coordinator<br>Hamid Hakim, Ph.D., P.E.        |
| 8. Performing Organization Names and Addresses<br>CALIFORNIA DEPARTMENT OF TRANSPORTATION<br>Division of Environmental Analysis- MS-27<br>1120 N Street<br>P.O. Box 942874<br>Sacramento CA 94274-0001<br>www.dot.ca.gov/hq/env/stormwater  |                             | 9. Task Order No.<br>11<br>Amendment No.<br>3                      |
|   |                             | 10. Contract No.<br>43A0255  |
| 11. Sponsoring Agency Name and Address<br>California Department of Transportation<br>Sacramento, CA 95814   |                             | 12. Caltrans Functional Reviewers:<br><br>Hamid Hakim, Ph.D., P.E. |
| 13. Supplementary Notes   |                             | 13. External Reviewers   |
| 15. Abstract<br>These Standard Operating Procedures (SOPs) for Manual Field Measurement of Dissolved Oxygen are a companion document to the <i>Construction Site Monitoring Program Guidance Document</i> . This set of SOPs presents meter calibration, sampling, and measurement methods. The document defers to the User Guide for procedures for troubleshooting. |                             |  |
| 16. Key Words:<br>Stormwater, calibration, dissolved oxygen meter   | 17. Distribution Statement  | 18. Number of pages:<br>80   |



# **Standard Operating Procedures for Manual Field Measurement of Dissolved Oxygen**

## **Final Report**

**January 2012**

**CTSW-RT-11-255.11.04-F**

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Storm Water Liaison, Caltrans Division of Environmental Analysis, MS 27, P.O. Box 942874, Sacramento, CA 94274-0001. (916) 653-8896 Voice, or dial 711 to use a relay service.



## Introduction

The California Construction General Stormwater National Pollutant Discharge Elimination System Permit (CGP) includes requirements for routine field measurement of dissolved oxygen in discharges from construction sites. This Standard Operating Procedures (SOPs) document provides direction on how to perform measurements of dissolved oxygen at California Department of Transportation (Caltrans) construction sites.

## Responsible Personnel

The following personnel are responsible for various aspects of CGP compliance associated with dissolved oxygen measurements at Caltrans construction sites. The brief descriptions below serve to clarify the roles that these individuals have in this process:

- The Caltrans District Construction Stormwater Coordinator is responsible for authorizing all work, and ensures that SOP implementation and documentation responsibilities are clearly communicated to the project personnel.
- The Resident Engineer is responsible for ensuring that the SOP is implemented and documented on the required schedule and that the Water Pollution Control Manager (WPC) is performing these requirements in a timely manner.
- The WPC Manager is responsible for providing the direction to field crews to perform dissolved oxygen measurements according to the required project frequency.
- The Field Crew is responsible for performing SOPs, clearly documenting data, and relaying data and observations collected from stormwater monitoring activities.

Meter calibration and measurement procedures described in this SOP must be followed each day that field measurements are performed.

## References to Existing Source Documents

This SOP references the *Hach Multi-Parameter Portable Meter Model HQ40d User Manual* (Attachment 1A) and (the associated dissolved oxygen probe) *Hach Model LDO101 dissolved oxygen Probe User Manual* (Attachment 1B).

This SOP is also adapted from information provided in the following sources:

- (1) *Standard Operating Procedures (SOPs) for Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program (SWAMP)*, version 1.0, released October 15, 2007 (SWAMP, 2007); available for download at:

<http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/standard-operating-procedures>



(2) United States Geological Survey, variously dated, National field manual for the collection of water-quality data: *U.S. Geological Survey Techniques of Water-Resources Investigations*, Book 9, Chapters. A1 through A9; available online at:

<http://pubs.water.usgs.gov/twri9A> or <http://water.usgs.gov/owq/FieldManual/index.html>

Field measurement of dissolved oxygen is covered under Chapter A6 Field Measurements, in Sections 6.2, Dissolved Oxygen, and 6.8, *Use of Multi-Parameter Instruments for Routine Field Measurements*.

Relevant quality assurance/quality control (QA/QC) protocols are referenced in the associated *Caltrans Construction Site Monitoring Program Guidance Manual*.

### **Special Cautions and Considerations; Health and Safety**

Proper gloves must be worn to both prevent alteration of the field measurements, and to protect sampling personnel from environmental hazards. The user should wear at least one layer of gloves, but two layers help protect against leaks. All gloves must be powder-free. Disposable polyethylene, nitrile, or non-talc latex gloves are acceptable for field measurements.

### **CAUTIONS**

When performing measurements in areas of unknown water quality, especially in waters that are suspected to contain hazardous substances or human pathogens, at least one layer of gloves shall be of the “long-cuff” variety to cover the wrist and forearm, to limit skin contact with the source water.



## Methods/Procedures

This SOP pertains to manual measurement of dissolved oxygen in the field only. Field measurement of turbidity, pH, temperature, and electrical conductivity (EC) are covered in separate SOPs.

### *Equipment*

For field measurement of dissolved oxygen at Caltrans construction sites, the specified equipment is the Hach multi-parameter portable meter, model HQ40d, and the associated dissolved oxygen probe, Hach model LDO101. The probe is a luminescent dissolved oxygen (LDO) probe with a dissolved oxygen range of 0.1 to 20.0 mg/L (parts per million), up to 200 percent saturation, and accuracy of  $\pm 0.1$  mg/L for 0 to 8 mg/L,  $\pm 0.2$  mg/L for greater than 8 mg/L.

Below is a checklist of required equipment for field measurement of dissolved oxygen.

### **Standard Equipment and Supplies Checklist**

- Hardhat
- Gloves
- Safety vest
- Box of powder-free gloves
- Long-cuff gloves as necessary
- Scientific calculator
- "Write-In-The-Rain" notebook
- Field meter calibration record form
- Field measurement data form
- Pencil(s) and pen(s)
- Digital camera
- Flashlight
- Extra batteries
- Deionized water for rinsing and cleaning
- Reagent water for calibration
- Dissolved oxygen sample collection containers
- Sample collection extension arm (as required)
- Hach HQ40d multi-parameter portable meter
- HachLDO101 dissolved oxygen probe

### *Preparing the dissolved oxygen Probe for Use*

**Note:** Do not touch the probe cap with a hand, fingers, or any surface that can scratch the cap.

Before calibration or sample measurement, it is necessary to properly prepare the probe.

To prepare the probe for use before calibration or sample measurement:



1. Ensure that the probe cap and iButton are installed correctly. The iButton label should be up.
2. Ensure that the probe cap and iButton have the same lot code.
3. If using a rugged probe, ensure that the shroud is installed before field use. Refer to page 9 of the *Hach LDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B). Note: Damage to the sensing elements can occur if the shroud is not installed during field use. Damage under these conditions is not covered by the product warranty.
4. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.
5. If dissolved oxygen monitoring periods are longer than 6 hours, condition the probe cap for 72 hours. Calibrate the probe once every 8 hours. Note: After 72 hours, the probe cap will reach a fully hydrated state.

### ***Field Meter Calibration***

All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day for each day of instrument use. Calibration shall be performed on a daily basis, prior to the first measurements of the day. Calibration of the HachHQ40d multi-parameter meter is accomplished according to specific procedures for each probe. Refer to pages 3 and 4 of the *HachLDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B) for specific dissolved oxygen calibration instructions.

#### *Before calibration:*

- The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.
- It is not necessary to recalibrate when moving a calibrated probe from one Hach HQd portable meter to another if the additional meter is configured to use the same calibration options.
- To view the current calibration, push the open folder symbol, select “View Probe Data,” then select “View Current Calibration.”
- If any two probes are connected, push the “UP” or “DOWN” arrow to change to the single display mode in order to show the Calibrate option.
- Prepare the probe for use (refer to “Preparing the Probe for Use,” above).
- If using a rugged probe, remove the shroud from the probe.

#### *Calibration notes:*



- Percent saturation or mg/L calibration methods are available in the “Modify Current Settings” menu.
- The slope value is the comparison between the latest calibration and the factory calibration shown as a percentage.
- An additional zero point calibration can be added to the calibration routine. Refer to “Change Calibration Options” on page 7 of the *Hach LDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B).
- The calibration is recorded in the probe and the data log. The calibration is also sent to a computer, printer, or flash memory stick, if connected.
- Air bubbles under the sensor tip, when submerged, can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a calibration error occurs, refer to “Troubleshooting” on page 10 of the *Hach LDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B)

*Calibrating the dissolved oxygen probe:*

1. Connect the probe to the meter. Ensure that the cable locking nut is securely connected to the meter. Turn on the meter.
2. Push “Calibrate.”
3. Push “Methods.” Select “User Cal - 100%.” Push “OK.”
4. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.
5. Add approximately ¼ inch (6.4 mm) of reagent water to a narrow-neck glass bottle, such as a biological oxygen demand bottle.
6. Put a stopper in the bottle and shake the bottle vigorously for approximately 30 seconds to saturate the entrapped air with water. Allow up to 30 minutes for contents to equilibrate to room temperature.
7. Remove the stopper. Carefully dry the probe cap with a nonabrasive cloth. Put the probe in the bottle.
8. Push “Read.” The display shows “Stabilizing” and a progress bar as the probe stabilizes. The display shows the standard value when the reading is stable.
9. Push “Done” to view the calibration summary.
10. Push “Store” to accept the calibration and return to the measurement mode. If a rugged probe, install the shroud on the probe.



Record the results of the field meter calibration on the CEM-2058 Stormwater Meter Calibration Record form (Attachment 2).

### ***Sample Collection***

When conditions permit, dissolved oxygen measurement can be made by placing the probe directly into the source water. When flow is turbulent or shallow, or when direct immersion would risk damaging the probe, a sample should be collected for dissolved oxygen measurement.

Samples for field measurements are collected simply by direct submersion of the sample container into the flow whenever possible. The sample may be collected using any clean container. A wide-mouth sample bottle provided by the laboratory is preferred for this purpose, as those bottles are shipped pre-cleaned. Samples always should be collected upstream of sampling personnel and equipment, and with the sample container pointed upstream when the container is opened for sample collection. Care must be taken not to sample water downstream of areas where sediments have been disturbed in any manner by field personnel.

Direct field measurements are made or samples for field measurement purposes are collected from a location where the sample stream visually appears to be completely mixed. Ideally, this area is at the centroid of the flow cross-section, but site conditions do not always allow centroid collection. ("Centroid" is defined as the midpoint of that portion of the stream width, which contains 50 percent of the total flow area.) Preferably, the location should be accessible by direct reach, or in the case of a receiving water body, via wading.

If the centroid of the flow cannot be tested or sampled by direct reach or by wading into the flow, a sampling pole or other sampling device can be used to reach the sampling location. Such devices typically involve a means to extend the reach of the sampler, with the sample bottle attached to the end of the device for filling at the desired location. These methods do not allow opening of the sample container under water; therefore, there is potential for contamination when the container is opened prior to lowering the sample container into the stream. Caution is required when wading, as flowing water provides more force than visually anticipated. Only experienced personnel should perform this collection technique.

When sampling from a stream bank where direct reach is not possible, the sample container is secured by a hardware device, which, in turn, is attached to the end of an extendable sampling pole. Sites accessed by bridge also can be sampled with a sample container secured to a device, lowered into the stream at the end of a rope. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge.

### ***Testing/Sample Collection Depth:***

- **Subsurface Test/Sample:** Grab samples for field measurements are typically collected at 4 inches below the water surface. When the field probe is inserted directly into the stream, a measurement depth of 8 inches should be used to ensure that the probe is appropriately submerged.



- **Surface Sample:** Grab samples for field measurements are collected at the water surface when water depth is less than 4 inches. Because water quality varies on the water surface, compared to subsurface, surface samples should be noted on the field data sheet as collected at 0 inch.

### ***Field Measurement Methods***

Field dissolved oxygen measurements may be made either by direct submersion of the instrument probe into the sample stream, or by collection of a grab sample and immediate analysis of the grab sample in the field. In either case, the measurement is made with the dissolved oxygen probe attached to the Hach HQ40d portable meter.

The Hach HQ40d meter measures dissolved oxygen in units of milligrams per liter (mg/L).

Collect a sample for dissolved oxygen measurement (rather than direct immersion of the probe into the sample stream) when flow is turbulent or shallow, or when direct immersion of the probe would risk damaging the probe.

Carefully prepare the probe for use and perform daily calibration prior to field measurement as described above.

#### ***Before measurement:***

- The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.
- If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the *Hach Multi-Parameter Portable Meter Model HQ40d User Manual* (Attachment 1A) for more information.
- Regular calibration is required for the best measurement accuracy (refer to “Calibrating the Dissolved Oxygen Probe,” above).
- Prepare the probe for use (refer to “Preparing the Probe for Use,” above).
- To deploy a rugged probe at a distance, toss the probe body with a gentle underhand throw. Do not swing the probe by the cable as this may cause injury to the user, will cause severe strain on the cable and will shorten the service life of the cell. Damage under these conditions is not covered by the product warranty.

#### ***Measurement notes:***

- Stabilization times with smaller concentration changes generally will be longer and can be minimized by correct stirring and conditioning. Experiment to determine the correct stir rate if necessary.



- Note regarding the “Resolution” setting: Do not reset the Resolution to either of the “Fast” settings.
- Salinity affects the concentration of dissolved oxygen in the sample. To correct for salinity effects (when saltwater is present, causing the sample stream to be saline), refer to “Advanced Operation” on page 6 of the *Hach Multi-Parameter Portable Meter Model HQ40d User Manual* (Attachment 1A), or do the “Auto Salinity Correction” described on page 5 of the manual.
- Data are automatically stored in the data log when “Press to Read” or “Interval” is selected in the “Measurement Mode.” When “Continuous” is selected, data will only be stored when “Store” is selected.
- Air bubbles under the sensor tip, when submerged, can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a measurement error occurs, refer to “Troubleshooting” on page 10 of the *Hach LDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B).

*Performing dissolved oxygen measurement:*

1. Connect the probe to the meter. Ensure that the cable locking nut is securely connected to the meter. Turn on the meter.
2. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.
3. Put the probe in the sample and stir gently or add a stir bar. Do not put the probe on the bottom or sides of the container. Stir the sample at a moderate rate or put the probe in flowing conditions.
4. Put the probe in the sample at least 25 millimeters (1 inch) deep. Push “Read”. The display will show “Stabilizing” and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes.
5. Repeat steps 2 through 4 for additional measurements. When measurements are complete, store the probe.

After measurement, complete the CEM-2052 Stormwater Sample Field Test Report form (Attachment 3).

Before leaving the sampling site, field personnel should review datasheets to ensure that they are complete and legible, and that all sampling-related materials and equipment have been collected.

**Maintenance**



Perform all required maintenance as specified in the *Hach LDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B). This includes periodically cleaning the probe, and replacing the probe cap (requires purchase of the Hach LDO probe cap replacement kit).

### *Cleaning the Probe*

Keep the probe cap free of deposits for the best measurements.

Note: Do not touch the black colored substrate of the probe cap. Do not use alcohol or other organic solvents to clean the black-colored substrate of the probe cap. These solvents cause damage to the probe cap.

To clean the probe:

1. If using a rugged probe, remove the shroud (see below).
2. Gently clean the probe cap with a mild detergent, water, and a soft cloth or cotton swab. Do not remove the black-colored substrate from the probe cap. Do not scrub the probe cap or lens.
3. If water is present between the probe cap and lens:
  - a. Remove the probe cap.
  - b. Blot dry the probe cap and lens with a soft dry cloth.
  - c. Install the probe cap.
4. If using a rugged probe, install the shroud (see below).

### *Replacing the Probe Cap*

The probe cap must be replaced annually or more often if the cap becomes damaged or fouled. The meter will show a reminder message when 30 days of probe service life remains on the probe cap. For LDO probe cap replacement instructions, refer to the instructions provided with the LDO probe cap replacement kit.

### *Removing the shroud*

1. Loosen and remove the locking ring.
2. Slide the shroud and locking ring off the probe.

### *Installing the shroud*

1. Put the locking ring on the probe with the threads toward the probe.
2. Slide the shroud on the probe until it is against the locking groove.



3. Hand-tighten the locking ring on the shroud.

### **Quality Assurance/Quality Control**

Per the manufacturer, electrode sensitivity is +/- 0.1 mg/L for dissolved oxygen measurements in the 0 to 8 mg/L range, and +/-0.2 mg/L for dissolved oxygen measurements greater than 8 mg/L.

Perform all required QA/QC measures as specified in the *Caltrans Construction Site Monitoring Program Guidance Manual*.

Adherence to the sample collection and measurement procedures described above, along with adherence to QA/QC measures required per the *Caltrans Construction Site Monitoring Program Guidance Manual*, will ensure that field measurements are representative of environmental conditions, and conform to CGP requirements.

### **Troubleshooting**

Refer to the *Hach LDO101 Dissolved Oxygen Probe User Manual* (Attachment 1B) for troubleshooting suggestions or call manufacturer's representative for specific questions.



**Attachment 1A – Hach Multi-Parameter Portable Meter HQ40d User Manual**

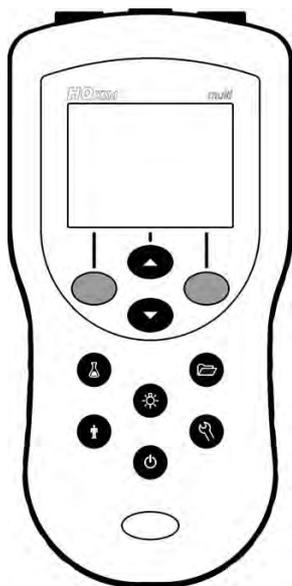


DOC022.53.80017

# HQ40d, HQ30d HQ14d, HQ11d

01/2011, Edition 3

**User Manual**



|                                      |    |
|--------------------------------------|----|
| <b>Specifications</b>                | 5  |
| <b>General information</b>           | 5  |
| Safety information                   | 5  |
| Use of hazard information            | 5  |
| Precautionary labels                 | 6  |
| Product overview                     | 6  |
| Product components                   | 6  |
| <b>Installation</b>                  | 7  |
| Install the batteries                | 7  |
| Connect to AC power                  | 8  |
| <b>User interface and navigation</b> | 9  |
| User interface                       | 9  |
| Display description                  | 9  |
| Navigation                           | 11 |
| <b>Start-up</b>                      | 11 |
| Turn the meter on and off            | 11 |
| Change the language                  | 11 |
| Change the date and time             | 11 |
| Connect a probe                      | 12 |
| <b>Standard operations</b>           | 12 |
| About calibration                    | 12 |
| About sample measurements            | 13 |
| About check standards                | 13 |
| Use a sample ID                      | 13 |
| Use an operator ID                   | 13 |
| <b>Data management</b>               | 13 |
| About stored data                    | 13 |
| View stored data                     | 14 |
| View stored probe data               | 14 |

## **Table of Contents**

---

|   |           |
|---|-----------|
| Print stored data .....                                       | 14        |
| Change the report options .....                               | 15        |
| Send data to a USB storage device .....                       | 15        |
| Open data files on a PC .....                                 | 16        |
| Data file description .....                                   | 16        |
| Remove column headers .....                                   | 18        |
| Send data directly to a computer .....                        | 18        |
| <b>Advanced operations</b> .....                              | <b>18</b> |
| Security options .....  | 18        |
| Turn Security Options on .....                                | 18        |
| Full access options menu .....                                | 19        |
| Restricted operator access options menu .....                 | 19        |
| Set the display options .....                                 | 20        |
| Set the sound options .....                                   | 20        |
| Set the probe calibration reminder .....                      | 20        |
| Change the temperature units .....                            | 21        |
| Set the measurement mode .....                                | 21        |
| Set auto measurement intervals .....                          | 21        |
| Start interval measurements .....                             | 21        |
| Prevent data log overflow in interval mode .....              | 22        |
| View instrument information .....                             | 22        |
| Update the meter software .....                               | 22        |
| Download software updates .....                               | 23        |
| Transfer method settings .....                                | 23        |
| Bi-directional Communication between the meter and a PC ..... | 23        |
| About meter control .....                                     | 23        |
| About meter configuration .....                               | 24        |
| <b>Maintenance</b> .....                                      | <b>24</b> |
| Clean the meter .....   | 24        |
| Replace the batteries .....                                   | 24        |
| <b>Troubleshooting</b> .....                                  | <b>25</b> |

**Replacement parts and accessories** .....26

**Examples of printed reports** .....28

**Index** .....33



## Specifications

Specifications are subject to change without notice.

| Specification                 | Details   |
|-------------------------------|---|
| Dimensions                    | 19.7 x 9.5 cm (7.75 x 3.75 in.)   |
| Weight                        | 335 g (0.75 lb) without batteries; 430 g (0.95 lb) with four AA alkaline batteries  |
| Meter enclosure               | IP67, waterproof to 1 meter for 30 minutes  |
| Battery enclosure             | Water resistant to 0.6 m (2 ft) for 15 seconds  |
| Power requirements (internal) | AA Alkaline or rechargeable Nickel Metal Hydride (NiMH) batteries (4); battery life: up to 200 hours                                    |
| Power requirements (external) | Class II, external power adapter: 100–240 VAC, 50/60 Hz input; 4.5 to 7.5 VDC (7 VA) output   |
| Meter protection class        | Class I   |
| Storage temperature           | –20 to +60 °C (–4 to +140 °F)   |
| Operating temperature         | 0 to +60 °C (32 to 140 °F)  |
| Operating humidity            | 90% (non-condensing)  |
| 5-pin input connector         | M12 connector for IntelliCAL™ probes  |
| 8-pin input connector         | The 8-pin connector enables USB and external AC power connectivity  |
| USB/DC adapter                | Peripheral and host   |
| Data memory (internal)        | 500 results   |
| Data storage                  | Automatic in Press to Read mode and Interval Mode. Manual in Continuous Read Mode.  |
| Data export                   | USB connection to PC or USB storage device (limited to the storage device capacity). Transfer entire data log or as readings are taken. |
| Connections                   | Integrated USB type A (for USB flash memory device, printer, keyboard) and Integrated USB type B (for PC)                               |

| Specification            | Details  |
|--------------------------|--|
| Temperature correction   | Off, automatic and manual (parameter dependent)  |
| Measurement display lock | Continuous measurement, Interval or Press to Read mode. Averaging function for LDO probes. |
| Keyboard                 | External PC keyboard connector via USB/DC adapter  |

## General information

Revised editions are found on the manufacturer's website.

## Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

## Use of hazard information

### **▲ DANGER**

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

### **▲ WARNING**

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

### **▲ CAUTION**

Indicates a potentially hazardous situation that may result in minor or moderate injury.

## NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

### Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

|  |  |
|--|--|
|  | This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.  |
|  | This symbol indicates that the marked item can be hot and should not be touched without care.  |
|  | Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.<br><i>Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</i> |

### Product overview

The HQd series portable meters are used with digital IntelliCAL™ probes to measure various parameters in water. The meter automatically recognizes the type of probe that is connected to the meter. Measurement data can be stored and transferred to a printer, PC or USB storage device.

The HQd series meters are available in 4 models:

- HQ11d—pH/mV/ORP
- HQ14d—conductivity, salinity, total dissolved solids (TDS), resistivity
- HQ30d—all IntelliCAL probes, 1 probe connector

- HQ40d—all IntelliCAL probes, 2 probe connectors

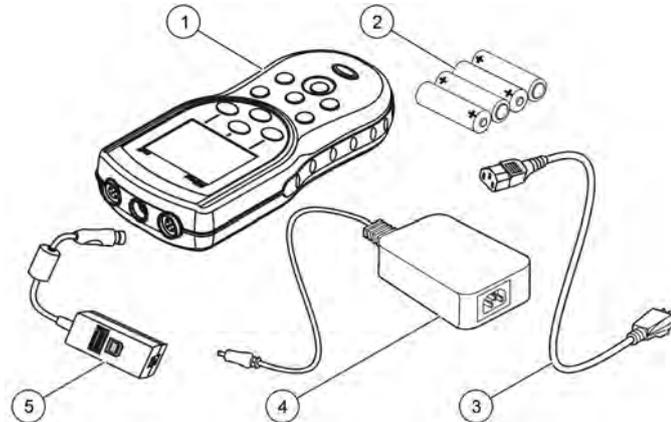
Features common to all models:

- Automatic probe and parameter recognition
- Instrument guided calibration procedures
- Calibration data stored in the probe
- Probe specific method settings for regulatory compliance and Good Laboratory Practice (GLP)
- Security Options
- Real-time data logging via USB connection
- USB connectivity to PC/printer/USB storage device/keyboard
- Bi-directional communication with PC-based systems via a virtual serial port connection
- Sample ID and Operator ID for data traceability
- Adjustable automatic shut-off

### Product components

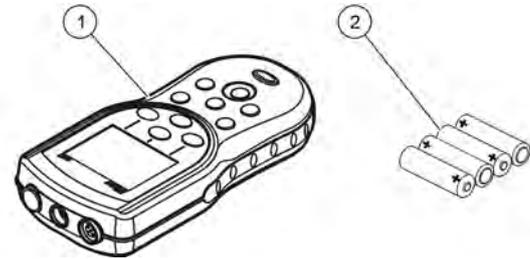
Refer to [Figure 1](#) and [Figure 2](#) to make sure that all components have been received. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

**Figure 1 Meter components (HQ40d model)**



|                       |  |
|-----------------------|--|
| 1 Meter               | 4 AC-DC power supply   |
| 2 AA batteries (pk/4) | 5 USB/DC adapter   |
| 3 AC power cord       | 6 Not shown: Basic user manual, Quick Start Guide and HQd/ IntelliCAL Documentation CD |

**Figure 2 Meter components (HQ11d, HQ14d and HQ30d models)**



|                       |  |
|-----------------------|--|
| 1 Meter               | 3 Not shown: Basic user manual, Quick Start Guide and HQd/ IntelliCAL Documentation CD |
| 2 AA batteries (pk/4) |  |

## Installation

### ⚠ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Install the batteries

### ⚠ WARNING

Explosion Hazard. Improper battery installation can cause release of explosive gases. Insert batteries in proper orientation only. Use only new batteries from the same manufacturer and lot.

### NOTICE

The battery compartment is not waterproof. If the battery compartment becomes wet, remove and dry the batteries and dry the interior of the compartment. Check the battery contacts for corrosion and clean them if necessary.

## NOTICE

When using nickel metal hydride (NiMH) batteries, the battery icon will not indicate a full charge after freshly charged batteries have been inserted (NiMH batteries are 1.2 V versus 1.5 V for alkaline batteries). Even though the icon does not indicate complete charge, 2300 mAh NiMH batteries will achieve 90% of instrument operation lifetime (before recharge) versus new alkaline batteries.

## NOTICE

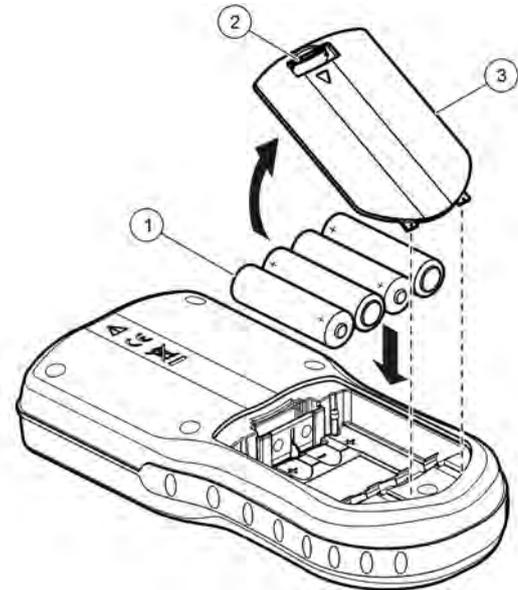
To avoid potential damage to the meter from battery leakage, remove the meter batteries prior to extended periods of non-use.

The meter can be powered with AA alkaline or rechargeable NiMH batteries. To conserve battery life, the meter will power off after 5 minutes of inactivity. This time can be changed in the Display Options menu.

For battery installation refer to [Figure 3](#).

1. Pull the release tab on the battery cover and the remove the cover.
2. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct polarity.
3. Replace the battery cover.

Figure 3 Battery installation



1 Batteries

2 Release tab

3 Battery cover

## Connect to AC power

### ⚠ DANGER

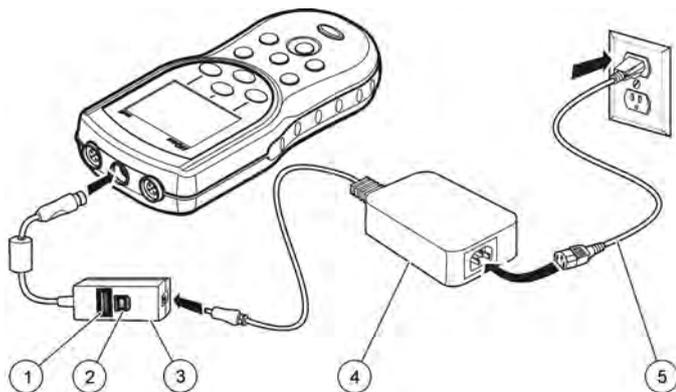


Electrocution Hazard. AC power outlets in wet or potentially wet locations MUST ALWAYS be provided with a Ground Fault Circuit Interrupting (GFCI/GFI) circuit breaker. The AC-DC power adapter for this product is not sealed and must not be used on wet benches or in wet locations without GFCI protection.

The meter can be powered by AC power with an AC power adapter kit. The kit includes an AC-DC power supply, USB/DC adapter and AC power cord.

1. Turn the meter off.
2. Plug the AC power cord into the AC-DC power supply (Figure 4).
3. Connect the AC-DC power supply to the USB/DC adapter.
4. Connect the USB/DC adapter to the meter.
5. Plug the AC power cord into an AC receptacle.
6. Turn the meter on.

**Figure 4 AC power connection**

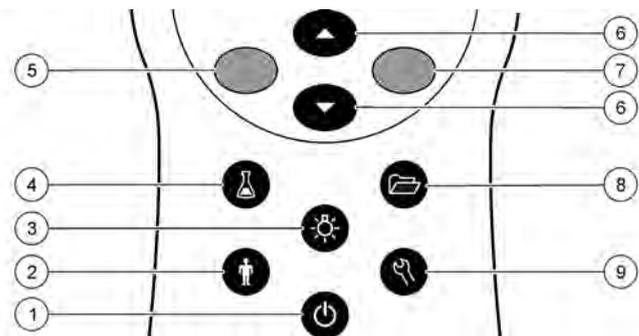


|  |                      |
|--|----------------------|
| 1 USB storage device/printer/Qterty keyboard connection (USB peripheral) | 4 AC-DC power supply |
| 2 Personal computer connection (USB host)                                | 5 AC power cord      |
| 3 USB/DC adapter   |                      |

## User interface and navigation

### User interface

**Figure 5 Keypad description**



|  |  |
|--|--|
| 1 ON/OFF: turn on or turn off the meter                        | 6 UP and DOWN key: scroll through menus, enter numbers and letters or change the reading screen view |
| 2 OPERATOR ID: associate data with an individual               | 7 GREEN/RIGHT key: reads, selects, confirms or stores data   |
| 3 BACKLIGHT: illuminate the display screen                     | 8 DATA LOG: recall or transfer stored data   |
| 4 SAMPLE ID: associate data with a sample location             | 9 METER OPTIONS: change settings, run check standards, view meter information                        |
| 5 BLUE/LEFT key: calibrates, cancels or exits the current menu |  |

### Display description

#### Measurement screen

The meter display shows the concentration, units, temperature, calibration status, operator ID, sample ID, date and time (Figure 6).

Figure 6 Single screen display



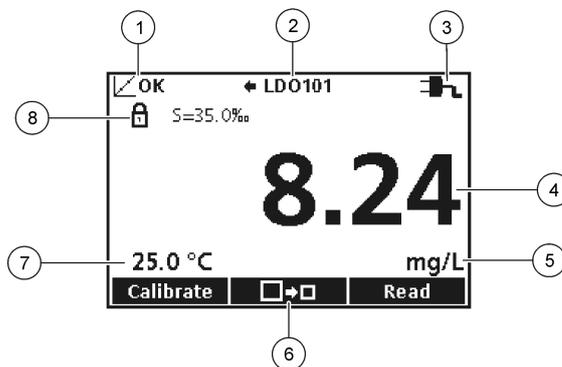
|  |  |
|--|--|
| 1 Calibration status indicator             | 9 Time                                 |
| 2 Main measurement value and unit          | 10 Date                                |
| 3 IntelliCAL probe type and port indicator | 11 Read (OK, Select)                   |
| 4 Battery status                           | 12 Display size icon                   |
| 5 Power source                             | 13 Calibrate (Cancel, Exit)            |
| 6 Sample temperature (°C or °F)            | 14 Sample and operator identification  |
| 7 Secondary measurement unit               | 15 Stability or display lock indicator |
| 8 Tertiary units (for some probes)         |  |

### Big-screen mode

The font size of the sample reading can be increased or decreased with the  $\triangle$  key (Figure 7).

**Note:** When two probes are connected, push and hold the  $\triangle$  key to select the big-screen mode. The big-screen mode can also be selected in the Display Options menu (Refer to [Set the display options](#) on page 20).

Figure 7 Single-screen display—big-screen mode



|  |                                       |
|--|---------------------------------------|
| 1 Calibration status indicator             | 5 Main measurement unit               |
| 2 IntelliCAL probe type and port indicator | 6 Display size icon                   |
| 3 Power source or battery status           | 7 Sample temperature (°C or °F)       |
| 4 Main measurement value                   | 8 Stability or display lock indicator |

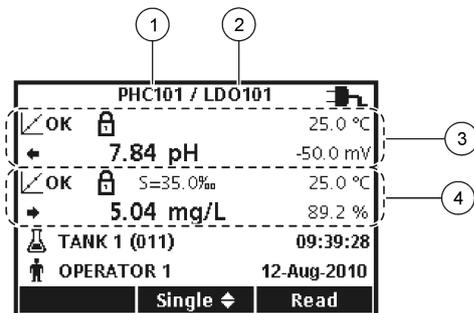
### Dual-screen mode (HQ40d model only)

When two probes are connected to the HQ40d meter, the display can show the reading from both probes simultaneously or show just one probe (Figure 8).

**Note:** For probe calibration, change the screen mode to the single screen mode.

To change the screen mode to single or dual screen, use the  $\triangle$  and  $\nabla$  keys. In dual screen mode, the  $\triangle$  key will select the probe on the left and the  $\nabla$  key will select the probe on the right.

Figure 8 Dual-screen display



|  |  |
|--|--|
| 1 Probe that is connected to port on left  | 3 Measurement information for probe on left  |
| 2 Probe that is connected to port on right | 4 Measurement information for probe on right |

## Navigation

The meter contains menus to change various options. Use the  $\triangle$  and  $\nabla$  keys to highlight different options. Push the GREEN/RIGHT key to select an option. There are two ways to change options:

1. Select an option from a list: Use the  $\triangle$  and  $\nabla$  keys to select an option. If check boxes are shown, more than one option can be selected. Push the BLUE/LEFT key under Select.  
*Note: To deselect check boxes, push the BLUE/LEFT key under Deselect.*
2. Enter an option value using the arrow keys:  
Push the  $\triangle$  and  $\nabla$  keys to enter or change a value.
3. Push the GREEN/RIGHT key to advance to the next space.
4. Push the GREEN/RIGHT key under OK to accept the value.

## Start-up

### Turn the meter on and off

Push the  $\odot$  key to turn on or turn off the meter. If the meter does not turn on, make sure that the batteries are properly installed or that the AC power supply is properly connected to an electrical outlet.

### Change the language

The display language is selected when the meter is powered on for the first time. The language can also be changed from the Meter Options menu.

Access to the language menu can be restricted with the Security Options. Refer to [Security options](#) on page 18.

1. Push the  $\odot$  key and select Language.
2. Select a language from the list.

*Note: While turning the meter on, the language can also be changed when the power key is pushed and held.*

### Change the date and time

The date and time can be changed from the Date & Time menu.

1. Push the  $\odot$  key and select Date & Time.

## 2. Update the time and date information:

| Option | Description |
|--------|-------------|
|--------|-------------|

**Format** Select one of the formats below for the date and time. Use the  $\triangle$  and  $\nabla$  keys to select from the format options.

dd-mm-yyyy 24h

dd-mm-yyyy 12h

mm/dd/yyyy 24h

mm/dd/yyyy 12h

dd-mmm-yyyy 24h

dd-mmm-yyyy 12h

yyyy-mm-dd 24h

yyyy-mm-dd 12h

**Date** Use the  $\triangle$  and  $\nabla$  keys to enter the current date.

**Time** Use the  $\triangle$  and  $\nabla$  keys to enter the current time.

The current date and time will be shown on the display.

Connect a probe after the date and time setup, so that the meter is ready to take a measurement.

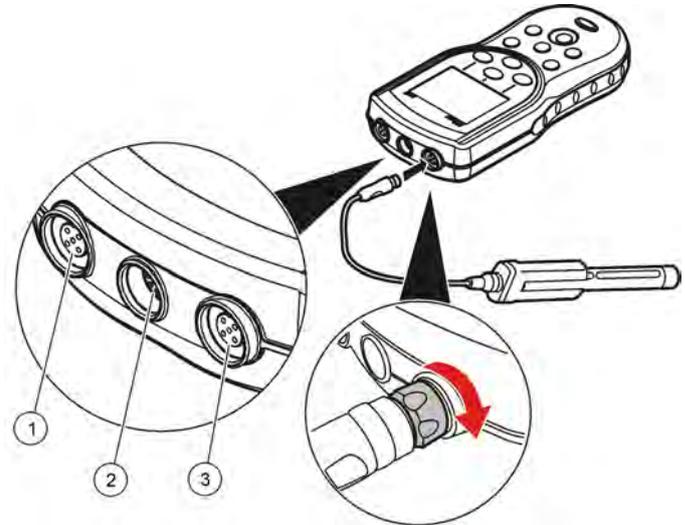
## Connect a probe

1. Make sure the display shows the current time and date. Refer to [Change the date and time](#) on page 11.

**Note:** The time stamp for a probe is set when the probe is first connected to the meter. This time stamp makes it possible to record the probe history and record the time when measurements are made.

2. Plug the probe into the meter ([Figure 9](#)).
3. Push and turn the locking nut to tighten.

**Figure 9** Probe connection



|                                      |                       |                         |
|--------------------------------------|-----------------------|-------------------------|
| 1 Probe connection port (HQ40d only) | 2 USB/DC adapter port | 3 Probe connection port |
|--------------------------------------|-----------------------|-------------------------|

## Standard operations

### About calibration

Each probe uses a different type of calibration solution. Make sure to calibrate the probes frequently to maintain the highest level of accuracy.

**Note:** For step-by-step instructions, refer to the documents that are included with each probe.

The calibration icon  $\angle ?$  can indicate that:

- the calibration timer has expired

- the LDO sensor cap should be replaced
- the calibration is out of range
- the calibration results are outside acceptance criteria settings

## About sample measurements

Each probe has specific preparation steps and procedures for taking sample measurements. For step-by-step instructions, refer to the documents that are included with the probe.

## About check standards

Run Check Standards verifies equipment accuracy by measuring a solution of a known value. The meter will indicate if the Check Standard passed or failed. If the Check Standard fails, the calibration icon  is shown until the probe is calibrated.

The meter can be set to automatically show a reminder for check standard measurement at a specified interval with a specified acceptance criteria. The reminder, value of the check standard, and acceptance criteria can be changed. For step-by-step instructions, refer to the documents that are included with the probe.

## Use a sample ID

The sample ID tag is used to associate measurements with a particular sample location. If assigned, stored data will include the sample ID.

1. Push the  key.
2. Select, create or delete a sample ID:

| Option                        | Description  |
|-------------------------------|--|
| <b>Current ID</b>             | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Sample ID</b> | Enter a name for a new sample ID.  |
| <b>Delete Sample ID</b>       | Delete an existing sample ID.  |

## Use an operator ID

The operator ID tag associates measurements with an individual operator. All stored data will include the operator ID.

1. Push the  key.
2. Select, create or delete an operator ID:

| Option                          | Description  |
|---------------------------------|--|
| <b>Current ID</b>               | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Operator ID</b> | Enter a name for a new operator ID (maximum 10 names can be entered).  |
| <b>Delete Operator ID</b>       | Delete an existing operator ID.  |

## Data management

### About stored data

The following types of data are stored in the data log:

- Sample measurements: stored automatically each time a sample is measured in the Press to Read or Interval Mode. When the continuous measurement mode is used, data is stored only when Store is selected.
- Calibrations: stored only when Store is selected at the end of a calibration. Calibration data is also stored in the IntelliCAL (R) probe.
- Check standard measurements: stored automatically each time a check standard is measured (in the Press to Read or Interval Mode).

When the data log becomes full (500 data points), the oldest data point is deleted when a new data point is added. The entire data log can be deleted to remove data that has already been sent to a printer or PC ( key > Delete Data Log). To prevent deletion of the data log by a user, use the Security Options menu.

## View stored data

The data log contains sample, calibration and check standard data. The most recent data point in the data log is tagged as Data Point 001.

1. Push the  key.
2. Select View Data Log to view the stored data. The most recent data point is shown. The top of the screen shows whether the data is from a sample reading, a calibration or a check standard. Push the  key to view the next most recent data point.

| Option                    | Description   |
|---------------------------|---|
| <b>Reading Log</b>        | Reading Log—shows sample measurements including the time, date, operator and sample ID. Select Details to view the associated calibration data. |
| <b>Calibration Log</b>    | Calibration Log—shows calibration data. Select Details to view additional information about the calibration.                                    |
| <b>Check Standard Log</b> | Check Standard Log—shows check standard measurements. Select Details to view the calibration data that was associated with the measurement.     |

## View stored probe data

Make sure that a probe is connected to the meter. If two probes are connected, select the appropriate probe when prompted.

1. To view the calibration data that is stored in a probe, push the  key and select View Probe Data. The current calibration and calibration history for the probe can be viewed.

| Option                          | Description   |
|---------------------------------|---|
| <b>View Current Calibration</b> | The current calibration information shows the calibration details for the most recent calibration. If the probe has not been calibrated by the user, the factory calibration data is shown. |
| <b>View Calibration History</b> | The calibration history shows a list of the times when the probe was calibrated. Select a date and time to view a summary of the calibration data.  |

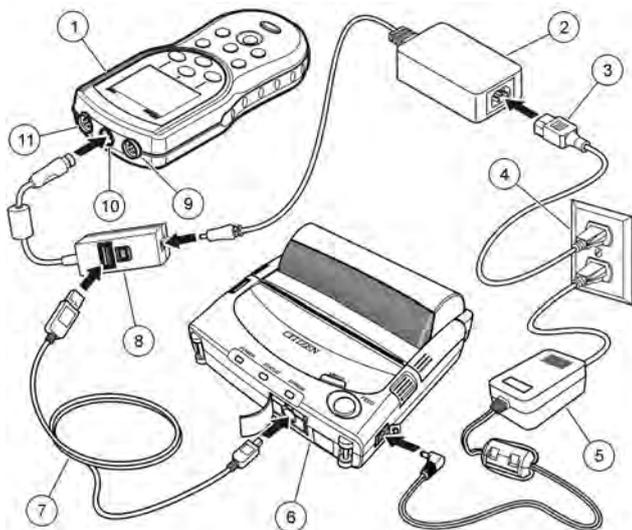
## Print stored data

The meter must connect to AC power to start the USB connection. Make sure that the connection to AC power is made before the meter is powered on.

All data can be sent to a printer. The PD-24 Citizen Printer is compatible with the HQd meters and is FCC Part 15B, Class B compliant with the HQ meters. Other printers may not be compatible. Compatible printers should support a minimum of 72 columns of data, be capable of printing up to 500 continuous data-stream events in 1, 2 and 3 lines of text and fully support code page 437 and code page 850.

1. Turn off the meter. Make sure that the meter is connected to AC power. Refer to [Connect to AC power](#) on page 8.
2. Connect the printer to the meter with a USB cable type A. Refer to [Figure 10](#).
3. Turn on the meter.
4. Push the  key.
5. Select Send Data Log. Wait for the display to show “Transfer Complete” and wait for the printer to stop printing. Disconnect the printer.

**Figure 10 Connection to the printer**



|  |                              |
|--|------------------------------|
| 1 Meter  | 7 USB cable                  |
| 2 AC-DC power supply                               | 8 USB/DC adapter             |
| 3 AC power cord                                    | 9 Port for probe connection  |
| 4 AC power outlet                                  | 10 Port for USB/DC adapter   |
| 5 Power supply for printer (optional)              | 11 Port for probe connection |
| 6 Citizen Printer, FCC Part 15B, Class B compliant |                              |

### Change the report options

Printed reports for sample data can contain 1, 2 or 3 lines of information. Refer to [Examples of printed reports](#) on page 28 for further information.

1. Push the  key. Select Report Options.
2. Select Report Type and select one of the options.

| Option                 | Description  |
|------------------------|--|
| <b>Basic report</b>    | One line of data.  |
| <b>Advanced report</b> | Two lines of data. The first line contains the same information as in the basic report.          |
| <b>Total report</b>    | Three lines of data. The first two lines contain the same information as in the advanced report. |

### Send data to a USB storage device

#### NOTICE

The transfer of a large number of data points will take some time. DO NOT disconnect the USB storage device until the transfer is complete.

Data can be transferred to a USB storage device for storage or transfer to a computer.

1. Turn off the meter. Make sure that the meter is connected to AC power.
2. Plug the USB storage device into the meter before the meter is powered on.
3. Turn on the meter.
4. Push the  key.
5. Select Send Data Log. Wait for the display to show "Transfer Complete" and for any lights on the USB storage device to stop flashing. Then remove the USB device.

**Note:** If the data transfer is slow, reformat the USB storage device to use the file allocation table (FAT) format for the next use.

## Open data files on a PC

Data that has been downloaded to a USB storage device can be transferred to a computer. The data is sent in a text (.txt) file format.

1. Plug the USB storage device into the computer.
2. Find the data file. The file will have the following format: "Meter Serial Number-Data File Type-Date Time". Example: 9999NN000000-SENDDATA-0603131624.TXT
3. Save the data file to a location on the computer.
4. Open a spreadsheet program such as Microsoft® Excel® spreadsheet software.
5. Open the data file from the spreadsheet program. Select the delimited option with comma as the delimiter.

The data will be shown in the spreadsheet program.

**Note:** If an application is used that is not compatible with column headings, the headings can be omitted. Refer to [Remove column headers](#) on page 18.

## Data file description

Data that is saved to a USB storage device and then opened in a spreadsheet application will have multiple columns of data. A description for each of the columns is shown in [Table 1](#).

**Table 1 Spreadsheet column descriptions**

| Column header name | Data description and example values   |
|--------------------|---|
| Type               | Type of data: RD = Reading; CL = Calibration; CK = Check Standard; CH = Calibration History; IC = Current Calibration |
| Parameter          | Type Parameter: LDO, pH, CD (conductivity), ORP, ISE  |
| Date               | Date of reading: stored in user-defined date format   |
| Time               | Time of reading: stored in user-defined format  |
| Operator ID        | Operator ID that was used when the data was recorded. Shows "- -" if no operator ID is used.                          |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name  | Data description and example values   |
|---|---|
| Probe Model   | Model number of probe, for example pH101, CDC401, LDO101  |
| Probe SN  | Probe serial number<br>If two probes are connected to the HQ40d meter, the serial number shows "<" or ">" to identify the port (left or right) the probe was connected to during the reading. |
| Method name   | User-defined name of the probe settings that were used for the reading.   |
| Sample ID   | Sample ID that was used when the data was recorded. Shows "Sample ID" if the default sample ID is used.   |
| Primary Reading Value   | Measured value. Shows "—" if the value was out of range.  |
| Primary Reading Units   | Measurement units, for example pH or $\mu\text{S}/\text{cm}$  |
| Supp Reading 1  | First supplemental reading (example: temperature), if applicable  |
| Supp Units 1  | Units for first supplemental reading, if applicable.  |
| Supp Reading 2  | Second supplemental reading (example: "mV" for pH), if applicable   |
| Supp Units 2  | Units for second supplemental reading, if applicable  |
| Supp Reading 3  | Third supplemental reading, if applicable   |
| Supp Units 3  | Units for third supplemental reading, if applicable.  |
| Reading Setting 1–4   | Any settings that affect the reading, for example "NaCl/Non-Linear"   |
| Any settings that affect the reading, for example "NaCl/Non-Linear" | Reading Message 1–4 Any message that was shown during the measurement, for example "Out of limits".   |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name | Data description and example values  |
|--------------------|--|
| Check Std Value    | Value of the check standard that was used to verify accuracy, for example: 7.00 pH–25 °C (pH, temp-compensated); 7.01 pH (pH, custom)          |
| Check Std Units    | Check standard units, for example $\mu\text{S}/\text{cm}$ .<br><b>Note:</b> pH is not displayed here as it is included in the previous column. |
| Check Std Graph    | Bar-graph showing the measurement in relation to the acceptance limits. Example: "6.901 <— —> 7.101".  |
| Check Std Status   | Status of the check standard reading. Example: "Reading within limits", "Reading outside limits"   |
| Calibration Status | Status of the calibration that is in use. $\checkmark\text{OK}$ = current calibration is valid; $\checkmark?$ = calibration has expired.       |
| Cal Date           | Date of calibration reading: stored in user-defined date format  |
| Cal Time           | Time of calibration reading: stored in user-defined time format  |
| Cal Operator ID    | The operator ID specified when the probe was calibrated. Shows "--" if undefined.  |
| Cal Slope Name     | Slope (pH or LDO) or cell constant (conductivity)  |
| Cal Slope          | The slope value for the calibration  |
| Cal Slope Aux      | Used by pH to give the percent of nominal slope  |
| Cal Slope Units    | Units of the calibration slope. Example: "mV/pH" for pH  |
| Cal Offset         | Calibration offset value   |
| Cal Offset Units   | Calibration offset units. Example: "mV" for pH.  |
| Cal $r^2$          | Calibration correlation coefficient without a unit (may be blank)  |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name        | Data description and example values   |
|---------------------------|---|
| Cal Number of Std's       | Number of standards used during calibration, for example 5. May be blank depending on record type, parameter type, and method settings. |
| Cal Std 1                 | Known value of the first calibration standard   |
| Cal Std 1 Units           | Units of the first calibration standard   |
| Cal Std 1 Primary Value   | Measured value of the first calibration standard  |
| Cal Std 1 Primary Units   | Associated units for the calibration measurement  |
| Cal Std 1 Supp Value      | Value of supplemental measurement, for example temperature  |
| Cal Std 2–7               | Known value of additional calibration standards, if used  |
| Cal Std 2–7 Units         | Units of additional calibration standards, if used  |
| Cal Std 2–7 Primary Value | Measured values of additional calibration standards, if used  |
| Cal Std 2–7 Primary Units | Associated units for additional calibration measurements, if used   |
| Cal Std 2–7 Supp Value    | Value of supplemental measurement, for example temperature  |
| Cal Std Supp Units        | Units applicable to all secondary calibration readings. Example: "°C" or "°F" for temperature   |
| Cal Message 1–4           | Any messages about the calibration  |
| Date/Time POSIX           | Date and time of reading stored in POSIX format (number of seconds from January 1, 1970) Example: 1149234913                            |
| Cal Date/Time POSIX       | Date and time of calibration stored in POSIX format (number of seconds from January 1, 1970). Example: 1111320348                       |
| Meter SN                  | Meter serial number used to take the measurement  |

## Remove column headers

When transferred data is viewed in a spreadsheet program, the first row of data contains headings to identify the type of data in each column. If an application or post-processing method is used that is incompatible with the headers, the column headers can be omitted.

1. Push the  key.
2. Select Column Headers.
3. Set the column headers to off.

## Send data directly to a computer

Data can be transferred from any HQd series meter directly to a computer when the HQ40d PC Application is installed. The data can be sent in real time during data collection, or the entire data log can be transferred.

**Note:** The HQ40d PC Application is included on the HQd/IntelliCAL™ Documentation and Advanced Operations CD. The application is also available on <http://www.hach.com/SoftwareDownloads>.

1. Install the HQ40d PC Application on the computer.
2. Turn off the meter. Make sure that the meter is connected to AC power.
3. Connect the PC to the meter with a USB type B cable.
4. Turn on the meter.
5. Open the HQ40d PC Application on the computer. Click on the green triangle in the menu bar to start a connection.
6. Collect the data in real time or transfer the data from the data log:
  - Real time—when a data point is stored in the meter, the result is sent simultaneously to the PC Application (refer to [Set the measurement mode](#) on page 21).
  - Data log—push the  key and select Send Data Log. Wait for the display to show “Transfer Complete.” The data is sent as a comma separated values (.csv) file.

The data is shown in the HQ40d PC Application window.

## Advanced operations

### Security options

The Security Options menu is used to protect the meter setup and method settings from unwanted changes. This menu is available in the Full Access Options menu.

The Setup Measurement Mode, Date and Time, Temperature Units, Language, Probe settings, Delete data log and Security Options screens are disabled in the Operator Access Options menu. All menu options are enabled in the Full Access Options menu.

**Note:** The Full Access Options menu is shown when the  key is pushed when Security Options is OFF, whether or not a password has been set.

When the meter is powered on for the first time and Security Options is selected, the display prompts the user to set a password. Until the meter is shut off, pushing the  key will still display the Full Access Options menu, even after Security Options is turned on and a password has been set. After the meter is shut off and powered on again with Security Options on, the Operator Access Options menu is displayed until a valid password is entered.

Store the password in a safe and accessible place. If the specified password is forgotten and Security Options is turned on, the operator is locked out of the restricted menus. Contact technical support if the password is lost.

### Turn Security Options on

The Security Options and the Set Password options are used together to prevent access to restricted menus.

1. Push the  key and select Security Options.

2. Change the settings as needed to allow or prevent menu access.

| Option                  | Description  |
|-------------------------|--|
| <b>Security Options</b> | When Security Options is on, and a password has been specified, the password is required to enable the Full Access Options menu. If the meter is turned off while Security Options is on, the password is required to enable the Full Access Options menu again when the meter is turned on. |
| <b>Set Password</b>     | Set a password that must be entered to enable the Full Access Options menu. The requirement for password entry is controlled by setting Security Options on or off.  |

### Full access options menu

The Full Access Options menu is displayed when Security Options is OFF or when Security Options is ON and a valid password is entered (Table 2). These options do not need to be changed if the factory default settings are used.

**Table 2 Full Access Options**

| Option                 | Description   |
|------------------------|---|
| (Probe model) settings | Settings such as measurement options, calibration options, check standard options, units and resolution. Refer to the probe documentation for more information.<br><i>Note: A probe must be connected to the meter.</i> |
| Run check standard     | Measure standard solution (available for pH, conductivity, ORP and ISE probes)  |
| Measurement mode       | Press to Read   |
|                        | Interval: Duration and Interval   |
|                        | Continuous  |
| Instrument information | Probe information   |
|                        | Meter information   |
| Security options       | ON or OFF   |
|                        | Set password  |

**Table 2 Full Access Options (continued)**

| Option            | Description           |
|-------------------|-----------------------|
| Display options   | Contrast              |
|                   | Auto shutoff          |
|                   | Backlight             |
|                   | Mode                  |
| Sounds            | Key press             |
|                   | Stability alert       |
|                   | Calibration reminder  |
| Date and time     | Format                |
|                   | Date                  |
|                   | Time                  |
| Temperature units | Set temperature units |
| Language          | Select language       |

### Restricted operator access options menu

The Operator Access Options menu is shown at meter startup when Security Options is ON (Table 3). When a valid password is entered, the menu changes to Full Access Options.

**Table 3 Operator access options**

| Option                 | Description  |
|------------------------|--|
| (Probe model) settings | Only methods (if methods exist) can be selected. Refer to the probe documentation.<br><i>Note: A probe must be connected to the meter.</i>   |
| Run check standard     | Measure standard solution (available for pH, conductivity, ORP and ISE probes)<br><i>Note: A probe must be connected to use this option.</i> |

**Table 3 Operator access options (continued)**

| Option                 | Description          |
|------------------------|----------------------|
| Instrument information | Probe information    |
|                        | Meter information    |
| Access password        | Enter password       |
| Display options        | Contrast             |
|                        | Auto shutoff         |
|                        | Backlight            |
|                        | Mode                 |
| Sounds                 | Key press            |
|                        | Stability alert      |
|                        | Calibration reminder |

### Set the display options

Use Display Options to change the display contrast, battery saving auto-shutoff options, the backlight option or the detailed or big reading screen mode.

1. Push the  key and select Display Options.
2. Select which display option to change.

| Option              | Description  |
|---------------------|--|
| <b>Contrast</b>     | Adjust the contrast of the display. The lightest setting is 0 and the darkest setting is 9.  |
| <b>Auto-shutoff</b> | To maximize battery life, set a time period after which the meter will automatically power off if no key is pushed (1, 2, 5, 10, 30 min, 1 h, 2 h or never). Auto-shutoff is not active when the meter is connected to AC power or in the Interval Reading Mode. |

| Option           | Description  |
|------------------|--|
| <b>Backlight</b> | The display backlight is turned off when the  key is pushed. Is it possible to set a time period after which the backlight will automatically power off if no key is pushed.  |
| <b>Mode</b>      | Select Detailed or Big screen size. Detailed will show more information with smaller numbers and text. Big will show less information with larger numbers and text.<br><b>Note:</b> The screen size can also be selected from the measure mode (refer to <a href="#">Display description</a> on page 9). |

### Set the sound options

The meter can make an audible sound when a key is pushed, when stability is reached or when the calibration reminder is due. The meter also makes an audible sound when it begins transferring data to a USB storage device and again when the data transfer is complete.

1. Push the  key and select Sound.
2. Choose which events will produce an audible sound. Multiple items can be selected.

| Option                 | Description  |
|------------------------|--|
| <b>Key Press</b>       | The meter will make an audible sound whenever a key is pushed.   |
| <b>Stability Alert</b> | The meter will make an audible sound whenever measurement stability is reached.  |
| <b>Cal reminder</b>    | The meter will make an audible sound when calibration is due.<br><b>Note:</b> Refer to <a href="#">Set the probe calibration reminder</a> on page 20 to set the calibration reminder to on or off. |

### Set the probe calibration reminder

Make sure that a probe is connected to the meter.

1. Push the  key and select the probe settings.
2. Select Modify Current Settings.
3. Select Calibration Options.

#### 4. Select Calibration Reminder.

| Option                      | Description   |
|-----------------------------|---|
| <b>Calibration reminder</b> | Reminder repeat: Off, 2 h, 4 h, 8 h, 2 d, 5 d, 7d<br>Expires: Immediately, Reminder + 30 min, Reminder + 1 hr, Reminder + 2 hr, Continue Reading<br><br>The meter can be set to make an audible sound when calibration is due. Calibration expires after a specified time set by the user.<br><b>Note:</b> <i>The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.</i> |

### Change the temperature units

To select degrees Celsius or Fahrenheit:

1. Push the  key and select Temperature Units.
2. Select the Celsius or Fahrenheit option.

### Set the measurement mode

One of three modes can be used to specify when measurements are taken and how the data is stored. When a data point is stored, the result is sent simultaneously to any device (PC/printer/ USB storage device) that is connected to the meter.

1. Push the  key and select Measurement Mode.
2. Select Mode.
3. Select one of the measurement modes.

| Option               | Description  |
|----------------------|--|
| <b>Press to Read</b> | The sample is measured only when the GREEN/RIGHT key under Read is pushed. Data is stored in the data log automatically when the stability criteria are met. |

| Option            | Description  |
|-------------------|--|
| <b>Interval</b>   | The sample is measured at regular intervals for a specified duration (refer to <a href="#">Set auto measurement intervals</a> on page 21). Data is stored in the data log automatically. |
| <b>Continuous</b> | The sample is measured continuously. Data is stored in the data log only when the GREEN/RIGHT key under Store is pushed.   |

### Set auto measurement intervals

When the measurement mode is set to Interval, the time intervals and duration must be specified. Measurements are stored at the user-defined intervals whether or not stability criteria are met.

**Note:** *Use of an external USB storage device or direct printer connection while in Interval Measurement mode prevents data from being over-written in the data log. Data points are over-written on a First In/First Out basis. Refer to [Prevent data log overflow in interval mode](#) on page 22.*

1. Push the  key and select Measurement Mode.
2. Select Mode.
3. Select Interval as the Measurement Mode.
4. Select Duration and select the total time that measurements will be taken for (15 min, 30 min, 1 h, 4 h, 8 h, 24 h, 48 h or no limit).
5. Select Interval and select how often measurements will be taken (every 10 s, 30 s, 1 min, 5 min, 15 min or 30 min).

### Start interval measurements

During interval measurements, the meter goes into a standby state between readings to conserve power. The auto-shutoff option is disabled. Measurements stop when the selected interval duration has passed. The auto-shutoff option then becomes active.

Interval measurements are suspended for calibrations, check standard measurements or when the  key is pushed. Interval measurements resume when returning to the measurement screen.

1. From the Main Measurement screen, select Start to begin interval measurements. The screen will show "Recording" and the remaining

time of the duration. The sample number automatically advances when each reading is taken.

2. To stop interval measurements, select Stop.
3. To repeat the interval measurement after it has been stopped or completed, select Start.

### Prevent data log overflow in interval mode

When measurements are taken at specified intervals (Table 4), each result is automatically stored. The meter can store up to 500 data records. When 500 records have been stored, data is replaced on a first-in, first-out basis. To prevent loss of data, connect the meter to a PC/printer/USB storage device.

**Note:** Stop interval measurements before changes are made to a method or to meter settings.

**Table 4 Recommended interval/duration pairs**

| Interval   | Duration |
|------------|----------|
| 10 seconds | 1 hour   |
| 30 seconds | 4 hours  |
| 1 minute   | 8 hours  |
| 5 minutes  | 24 hours |

**Note:** When 2 probes are connected to the meter, use the next lowest recommended duration time. For example, for a 30-second interval, set the duration to 1 hour to prevent data log overload with 2 probes.

### View instrument information

The instrument information menu shows specific information such as the serial number for the meter or IntelliCAL (R) probe(s).

1. Push the  key and select Instrument Information.

2. Select (Probe model) Information or Meter Information.

| Option                   | Description   |
|--------------------------|---|
| <b>Probe information</b> | The Probe Information screen shows the probe model number, serial number, software version and date of first use. For LDO and LBOD probes, the lot code for the sensor cap and the remaining time before sensor cap replacement is shown.<br><b>Note:</b> A probe must be connected to the meter. |
| <b>Meter information</b> | The Meter Information screen shows the meter model number, serial number, software version and memory information. The amount of memory used and the number of available user method settings, operator IDs and sample IDs is shown.  |

### Update the meter software

A USB storage device that contains software update files is used to update the meter software.

**Note:** The meter must be turned off and then on again before the software update will begin. The software update initiates upon meter startup after the USB device is correctly inserted.

#### NOTICE

Do not remove the USB device until the “Update complete” message is shown. The meter can become damaged if the USB device is removed before the update process is complete.

1. Save stored data from the data log to a USB storage device or to a PC. Refer to [Send data to a USB storage device](#) on page 15 and [Send data directly to a computer](#) on page 18.
2. Turn off the meter.
3. Connect the USB/DC adapter, AC-DC power supply and cord ([Figure 4](#) on page 9).
4. Insert the USB storage device that contains the software update files into the USB/DC adapter.
5. Turn on the meter.  
The update process starts. The display will show “Updating meter to <firmware version>”. After an interval, the display changes to

“Updating files, please wait...” In addition, the display will show a rotating flask and emit a periodic audio signal during the update process.

*Note: A large capacity USB storage device increases the time required for completion of the update process, even if most of the device memory is empty.*

6. Wait for the meter to finish the software update. When the update process is complete, the message “Update complete. Remove USB device” is shown. The meter will turn off after the USB device has been removed.
7. Repeat steps 1 through 6 to update the software in other HQd meters as necessary.

### Download software updates

The latest software version can be obtained online:

1. Go to [www.hach.com/SoftwareDownloads](http://www.hach.com/SoftwareDownloads).
2. Click on Lab System Software/Software Update Downloads.
3. Click on HQd Series Meter Software Update and open or save the update files.
4. Open the ReadMeFirst.txt file and follow the instructions to transfer the update files to a USB storage device.
5. Follow the instructions in [Update the meter software](#) on page 22 to update the software in the meter.

### Transfer method settings

Probe settings that have been changed by the user for measurements, calibrations or check standards (Meter Options > (Probe Model) Settings > Modify Current Settings) can be copied to a USB storage device. The USB device can then be used to transfer the method settings to other HQd meters that accept the same probes.

#### NOTICE

Make sure the USB storage device does not contain HQd meter software update files to prevent unintentional updates.

1. Turn off the meter.
2. Connect the meter to AC power ([Figure 4](#) on page 9).

3. Plug the USB storage device into the USB/DC adapter before the meter is powered on.
4. Turn on the meter.
5. Push the  key and select Transfer Methods. If the USB device already contains a method settings file, an option to export or import methods is shown. Select Export Methods.
6. In the Select Methods to Export screen, select one or more methods to copy to the USB device. A check mark is shown next to each selected method.
7. Select OK. The settings are copied to the USB storage device. When complete, the Transfer Summary screen is shown.
8. Connect the AC power and USB device to a meter that will receive the method settings. Turn the meter on.
9. Push the  key and select Transfer Methods. If the USB device already contains a method settings file, an option to export or import methods is shown. Select Import Methods.
10. In the Select Methods to Import screen, select one or more methods to transfer to the meter. A check mark is shown next to each selected method.
11. Select OK. The user method settings are transferred from the USB storage device to the meter. When complete, the Transfer Summary screen is shown. Select details to view additional information about the transfer.
12. Disconnect the USB storage device from the meter.

### Bi-directional Communication between the meter and a PC

For measurement automation the meter can be used to implement a command set for meter remote control or automated data transfer. The command set can be used to perform minimal configuration and to control the meter. To set up the meter for communication and control, refer to [About meter configuration](#) on page 24. For additional information and the command set contact Technical Support.

#### About meter control

The virtual serial connection can be used to control meter functions from a PC. For example, the functions include starting a measurement cycle,

turning off the meter and sending the entire measurement (including calibrations) to the PC or other information management system.

### About meter configuration

To use the meter communication and control from the PC, an INF file must be installed.

1. If the meter software is not numbered version 2.0.0.710 or higher, download the latest software from <http://www.hach.com/SoftwareDownloads>.
2. Open the Zip file.
3. Copy the INF file from the software upgrade package to a convenient location on the PC.  
**Note:** *The INF file must be installed to use the meter manual control from a PC.*
4. Turn on the meter.
5. Push the  key and select Instrument Information.
6. Select USB Device Type and then select Virtual Serial to use the virtual serial port on the meter.
7. Push OK. The meter will automatically restart to complete the setting change.
8. Connect the meter with the USB cable to the PC and turn on the meter. Windows XP starts the "Found New Hardware Wizard".
9. Select "No, not at this time" to the query "Can Windows connect to Windows Update to search for software?"
10. Click Next. The next wizard screen will prompt.
11. Select "Install from a list or specific location (Advanced)" to the query "What do you want the wizard to do?"
12. Click Next. The next wizard screen will prompt.
13. Select the option "Search for the best driver in these locations."
14. Uncheck the "Search removable media (floppy, CD-ROM)" option and select the "Include this location in the search:" and click the "Browse" button.
15. Select the INF folder or location and click OK.
16. Click Next. The new software will be installed.

17. Click Finish to complete the Found New Hardware Wizard for: HQd Meter - Virtual Serial Port.
18. To make sure that the installation succeeded, go to Computer Management>Device Manager>Ports. The new installed port is listed as HQd Meter - Virtual Serial Port (COM#).
19. The meter is now ready for communication with PC-based systems using the Virtual Serial port. A program interface must be developed by the user for the command set used to control the meter functions from the PC. Contact Technical Support for more information and command set documentation.

## Maintenance

### ⚠ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Clean the meter

The meter is designed to be maintenance-free and does not require regular cleaning for normal operation. Exterior surfaces of the meter may be cleaned as necessary.

1. Wipe the surface of the meter with a damp cloth.
2. Use a cotton-tipped applicator to clean or dry the connectors.

### Replace the batteries

### ⚠ WARNING

Explosion Hazard. Improper battery installation can cause release of explosive gases. Insert batteries in proper orientation only. Use only new batteries from the same manufacturer and lot.

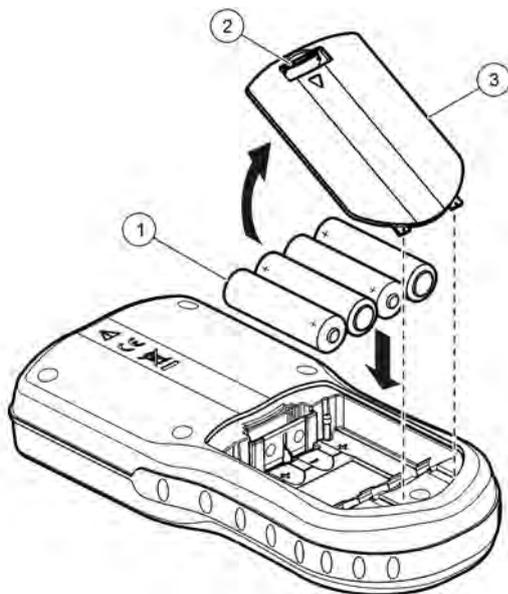
### NOTICE

Make sure that all meter connectors stay dry. Use a dry towel to remove liquid from the connectors.

For battery replacement refer to [Figure 11](#).

1. Pull the release tab on the battery cover and the remove the cover.
2. Remove the batteries.
3. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct polarity.
4. Replace the battery cover.

**Figure 11 Battery replacement**



|             |               |                 |
|-------------|---------------|-----------------|
| 1 Batteries | 2 Release tab | 3 Battery cover |
|-------------|---------------|-----------------|

## Troubleshooting

Refer to the following table for common problem messages or symptoms, possible causes and corrective actions.

| Error/Warning                     | Description                                   | Solution   |
|-----------------------------------|---|--|
| <b>Connect a Probe</b>            | Probe disconnected or connected improperly    | Tighten the locking nut on the probe connector.<br><br>Disconnect the probe and then connect the probe again                                 |
|                                   | Software not updated to most current version  | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |
|                                   | Problem with probe                            | Connect a different IntelliCAL probe to verify if problem is with probe or meter   |
| <b>Probe Not Supported</b>        | Probe disconnected or connected improperly    | Tighten the locking nut on the probe connector.<br><br>Disconnect the probe and then connect the probe again.                                |
|                                   | Software not updated to most current version  | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |
|                                   | Problem with probe                            | Connect a different IntelliCAL probe to the meter to verify if problem is with the meter or the probe.                                       |
|                                   | HQd meter does not support IntelliCAL probe   | Contact Technical Support.   |
| <b>Bootloader X.X.XX.XX error</b> | Software not updated to most current version. | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |

| Error/Warning   | Description   | Solution  |
|---|---|---|
| <b>0 days remaining message (For LDO and LBOD only)</b> | LDO or LBOD sensor cap used for 365 days                      | Replace the LDO or LBOD sensor cap and iButton®.  |
|   | There are 0 days remaining in the life of the LDO sensor cap. | Replace the LDO sensor cap. Calibration will be allowed. However, the calibration icon and question mark will appear on the measurement screen even if the calibration has passed.  |
|   | Meter set to incorrect date and time                          | <ol style="list-style-type: none"> <li>1. Disconnect the probe from the meter.</li> <li>2. Remove the meter batteries.</li> <li>3. Install the meter batteries properly. Follow the polarity markings.</li> <li>4. Set correct date and time in the meter.</li> <li>5. Connect the probe and verify that message has been removed.</li> </ol> |
|   | Software not updated to most current version                  | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads  |
| <b>Meter not configured</b>                             | Software error(s)   | If the meter starts up correctly, back up the Data Log and Method files. Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads   |

| Error/Warning  | Description                                  | Solution   |
|--|--|--|
| <b>Meter will not power on or powers on intermittently</b>     | Batteries are not installed correctly        | Examine battery orientation to make sure the batteries follow the polarity markings. Test again. |
|  |  | Clean the battery terminals, then install new batteries.   |
|  |  | Connect AC power adapter and test again.   |
|  | Software not updated to most current version | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads     |
|  | Damaged meter                                | Contact Technical Support.   |
| <b>Unable to access Full Access Options screen</b>             | Correct password has not been entered        | Contact Technical Support.   |
| <b>Unable to access Full or Operator Access Options screen</b> | Software not updated to most current version | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads     |

## Replacement parts and accessories

**Note:** Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.

### Replacement parts

| Description                       | Item no. |
|-----------------------------------|----------|
| AC Power/USB Adapter Kit, 115 VAC | 5826300  |
| AC Power/USB Adapter Kit, 230 VAC | 5834100  |
| Batteries, Alkaline AA            | 1938004  |
| Battery cover                     | 9245500  |

## Replacement parts and accessories (continued)

| Description  | Item no.                                 |
|--|--|
| Battery Contact, dual fixed  | 5188400                                  |
| Battery Contact, dual spring   | 5188800                                  |
| Cable, USB 6 ft (1.8 m), Type A male, Type B male  | 5924000                                  |
| Field Kit (includes Protective Glove Kit for meter and five 120-mL sample cups)  | 5825800                                  |
| Field Case for 2 probes with up to 5 m cables (10 m total). Includes empty case, insert for meter and probe storage, 4 containers for sample collection. | 8505500                                  |
| Field Case for 3 probes with up to 5 m cables (15 m total). Includes empty case, insert for meter and probe storage, 4 containers for sample collection. | 8505501                                  |
| Field Case for 2 probes with greater than 5 m cables (30 m total). Includes empty case, insert for meter with protective glove.                          | 8505600                                  |
| Keyboard (QWERTY), USB type  | LZV582                                   |
| Printer, Citizen PD-24 USB printer, 120–220 VAC  | <b>US:</b> 2960100<br><b>EU:</b> 5835900 |
| Printer Paper for Citizen PD-24, thermal, 5/pk   | 5836000                                  |
| Probe Clips, color coded (5 colors, 2 clips of each color), 10/pk  | 5818400                                  |
| Probe Depth Marker (rugged cables)   | 5828610                                  |
| Probe Holder, standard (fits on protective glove)  | 5829400                                  |
| Protective Glove Kit for meter   | 5828700                                  |
| Universal Probe Stand for standard IntelliCAL Probes   | 8508850                                  |
| Meter Stand for Portable HQd meters  | 4754900                                  |

## Examples of printed reports

Printed reports contain a report header and all stored data for samples, check standards and calibrations.

### Report header

The first line of a report shows the report header (Figure 12).

Figure 12 Report header

9999RV123456-SENDDATA-0512131618.TXT  
RD LDO 16:14:32 12-08-10 6.59 mg/L NORTH TANK -05 JOSEPH L

|                                    |                                    |
|------------------------------------|------------------------------------|
| 1 Meter serial number <sup>1</sup> | 3 Date and time, 24 h (YYMMDDhhmm) |
| 2 Report label                     | 4 File type extension              |

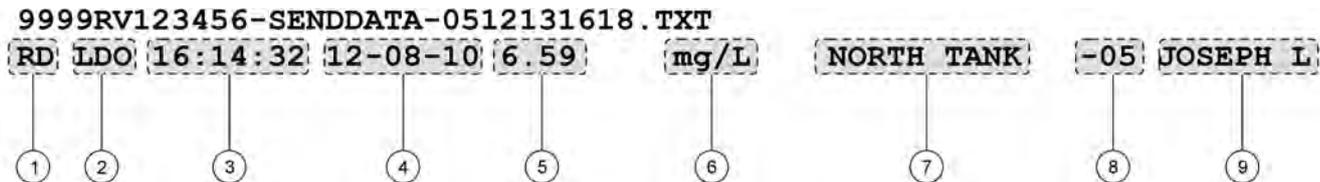
### Data reports

Sample data can be printed in a basic, advanced or total report format.

- Total report—refer to [Figure 13](#).
- Advanced report—refer to [Figure 14](#).
- Basic report—refer to [Figure 15](#).

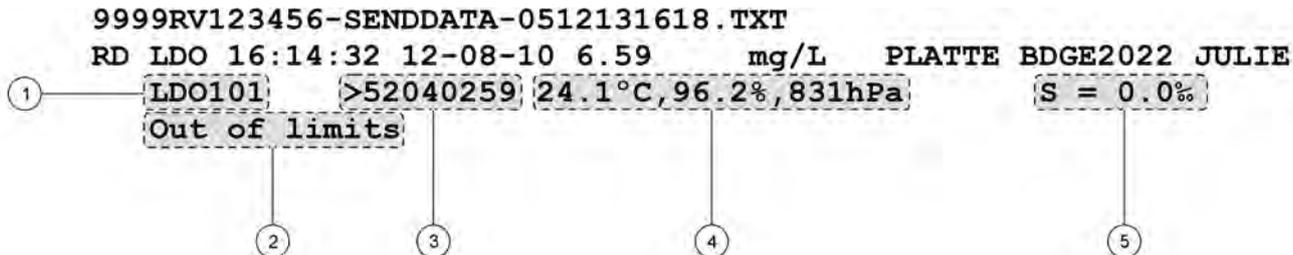
<sup>1</sup> The probe serial number is shown on calibration history and current calibration reports.

Figure 13 Basic report for sample data—1 line



|  |   |
|--|---|
| 1 Data type (RD=reading)                         | 6 Units   |
| 2 Parameter (pH, LDO, etc.)                      | 7 Sample ID: user-defined; shows "SAMPLE ID" if undefined |
| 3 Time (hh:mm:ss in 24 h or user-defined format) | 8 Sample ID counter                                       |
| 4 Date (DD-MM-YY or user-defined format)         | 9 Operator ID: user-defined; shows "- -" if undefined     |
| 5 Measured value                                 |   |

Figure 14 Advanced report for sample data—2 lines



|  |  |
|--|--|
| 1 Probe model  | 4 Additional units: shows all additional units associated with the reading.      |
| 2 Error message (if applicable)  | 5 Probe settings: shows the highest-priority setting associated with the reading |
| 3 Probe serial number (a "<" or ">" on the HQ40d meter indicates the probe position) |  |

Figure 15 Total report for sample data—3 lines

```

9999RV123456-SENDDATA-0512131618.TXT
RD pH 07:52:47 12-08-10 3.95 pH PLATTE BDGE2046 JULIE
pHC301 <06047527 21.8°C,167.0mV
Default CAL12:52 12-08-10 58.36mV/pH -9.3mV MICHAEL

```

|  |  |
|--|--|
| 1 Method name for probe settings   | 4 Calibration slope/ratio/constant   |
| 2 Time of calibration, prefaced by “CAL” and displayed as hh:mm in 24 h (or user-defined) format | 5 Offset—contents vary depending on type of parameter and user settings. May be blank. |
| 3 Date of calibration (DD-MM-YY or user-defined format)  | 6 Operator ID: user-defined; shows “- -” if undefined                                  |

**Check standard reports**

Check standard data is printed with 1 line of information (Figure 16)

Figure 16 Check standard report

```

9999RV123456-SENDDATA-0512131618.TXT
ST pH 15:24:07 12-08-10 5.71 pH Fail GEORGE

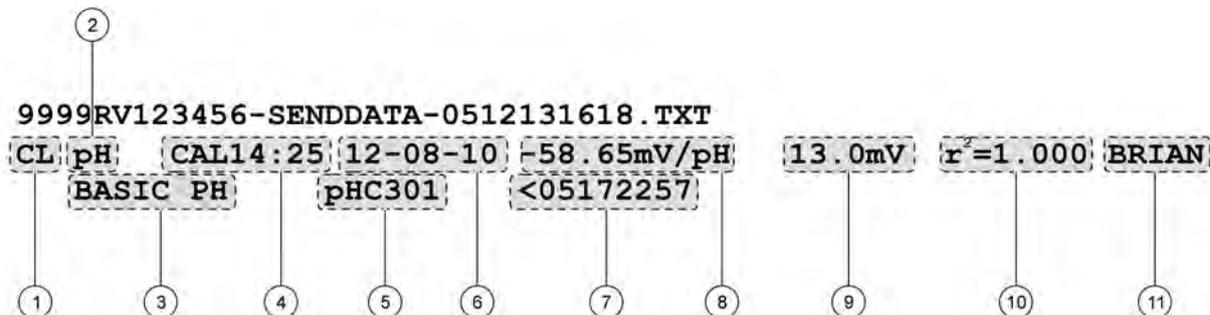
```

|  |   |
|--|---|
| 1 Report type (ST = check standard)              | 5 Measured value  |
| 2 Report type (ST = check standard)              | 6 Units   |
| 3 Time (hh:mm:ss in 24 h or user-defined format) | 7 Check standard status: Pass/Fail based on the acceptance criteria |
| 4 Date (DD-MM-YY or user-defined format)         | 8 Operator ID: user-defined; shows “- -” if undefined               |

## Calibration reports

Calibration data is printed when the data log is sent to the printer or when probe data is sent to the printer. Calibration data is printed with 2 lines of information (Figure 17).

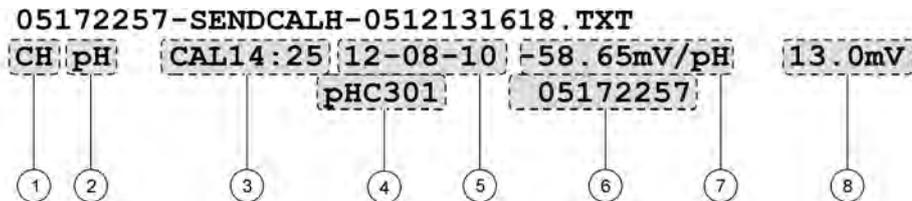
Figure 17 Calibration report



|  |   |
|--|---|
| 1 Report type (CL = calibration, IC = current calibration)                                       | 7 Probe serial number (a "<" or ">" on the HQ440d meter indicates the probe position)   |
| 2 Parameter (pH, LDO, etc.)  | 8 Calibration slope/ratio/constant  |
| 3 Method name for probe settings   | 9 Offset—contents vary depending on type of parameter and user settings. May be blank.  |
| 4 Time of calibration, prefaced by "CAL" and displayed as hh:mm in 24 h (or user-defined) format | 10 r <sup>2</sup> : contents vary depending on type of parameter being read, configuration of specific method and number of calibration standards used. May be blank. |
| 5 Probe model  | 11 Operator ID: user-defined; shows "- -" if undefined  |
| 6 Date of calibration (DD-MM-YY or user-defined format)  |   |

The calibration history can be printed from the probe data menu. Refer to Figure 18.

**Figure 18 Calibration history report**



|  |  |
|--|--|
| 1 Report type (CH=calibration history)   | 5 Date of calibration (DD-MM-YY or user-defined format)                                |
| 2 Parameter (pH, LDO, etc.)  | 6 Probe serial number (a "<" or ">" on the HQ40d meter indicates the probe position).  |
| 3 Time of calibration, prefaced by "CAL" and displayed as hh:mm in 24 h (or user-defined) format | 7 Calibration slope/ratio/constant   |
| 4 Probe model  | 8 Offset—contents vary depending on type of parameter and user settings. May be blank. |

**A**

AC power connection ..... 8  
 auto-shutoff ..... 20

**B**

backlight ..... 20  
 Bi-directional Communication ..... 23  
 big screen mode ..... 10, 20

**C**

calibration ..... 12  
     dual-screen mode ..... 10  
     probe reminder ..... 20  
     reminder ..... 20  
 check standards ..... 13  
 contrast, display ..... 20

**D**

data file descriptions ..... 16  
 data log ..... 23  
     prevent data loss ..... 22  
     printing ..... 14  
     transfer data to PC ..... 18, 24  
 data log, stored data ..... 14  
 date and time  
     changing ..... 11  
 detailed screen mode ..... 20  
 display description ..... 20  
 dual-screen mode  
     calibration ..... 10

**I**

interval measurements ..... 21

**M**

measurement modes ..... 21  
 menu navigation ..... 11  
 modes  
     screen ..... 20

**O**

operator ID ..... 13

**P**

power ..... 8  
 printing ..... 14  
 probes  
     connecting ..... 12  
     stored data ..... 14

**S**

sample ID ..... 13  
 screen modes ..... 9  
 security options ..... 18  
     restrict menu access ..... 19  
 software  
     install PC Application software ..... 18  
     update meter software ..... 22  
 sounds, turn on or off ..... 20  
 stored data ..... 13, 14  
     file descriptions ..... 16  
     probe ..... 14

## Index

---

### T

|                             |        |
|-----------------------------|--------|
| transfer data               |        |
| to PC .....                 | 16, 18 |
| to USB storage device ..... | 15     |
| transfer data to USB device |        |
| data log .....              | 23     |
| troubleshooting .....       | 25     |

### U

|                         |    |
|-------------------------|----|
| USB storage device      |    |
| file descriptions ..... | 16 |
| transfer data to .....  | 15 |

**HACH COMPANY World Headquarters**

P.O. Box 389, Loveland, CO 80539-0389 U.S.A.  
Tel. (970) 669-3050  
(800) 227-4224 (U.S.A. only)  
Fax (970) 669-2932  
orders@hach.com  
www.hach.com

**HACH LANGE GMBH**

Willstätterstraße 11  
D-40549 Düsseldorf  
Tel. +49 (0) 2 11 52 88-320  
Fax +49 (0) 2 11 52 88-210  
info@hach-lange.de  
www.hach-lange.de

**HACH LANGE Sàrl**

6, route de Compois  
1222 Vérenaz  
SWITZERLAND  
Tel. +41 22 594 6400  
Fax +41 22 594 6499





**Attachment 1B – Hach LDO101 Dissolved Oxygen Probe User Manual**

# User Manual

## Luminescent Dissolved Oxygen Probe: Model LDO10101, LDO10103, LDO10105, LDO10110, LDO10115 or LDO10130

### Safety information

#### Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

|   |   |
|---|---|
|  | <p>Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.</p> <p><b>Note:</b> For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</p> |
|---|---|

### Specifications

*Note: Specifications are subject to change without notice.*

| Specifications              | Details   |
|-----------------------------|---|
| Probe type                  | Luminescent dissolved oxygen (LDO) probe  |
| Dissolved oxygen range      | 0.1 to 20.0 mg/L (ppm) 1 to 200% saturation   |
| Dissolved oxygen accuracy   | ±0.1 mg/L for 0 to 8 mg/L<br>±0.2 mg/L for greater than 8 mg/L  |
| % saturation resolution     | 0.1%  |
| Stabilization time          | T90% at 10 seconds (when stirred)   |
| Temperature resolution      | 0.1 °C (0.18 °F)  |
| Temperature accuracy        | ±0.3 °C (±0.54 °F)  |
| Pressure resolution         | 1 hPa   |
| Pressure accuracy           | ±0.8%   |
| Operating temperature range | 0 to 50 °C (32 to 122 °F)   |
| Storage temperature range   | 0 to 40 °C (32 to 104 °F)   |
| Minimum sample depth        | 25 mm (0.984 in.)   |
| Dimensions (standard)       | Diameter: 15 mm (0.59 in.)<br>Length: 103 mm (4.1 in.)<br>Total length: 200 mm (7.9 in.)<br>Cable length: 1 or 3 m (3.28 or 9.84 ft)                              |
| Dimensions (rugged)         | Diameter: 15 mm (0.59 in.)<br>Length: 16 mm (0.63 in.)<br>Total length: 220 mm (8.7 in.)<br>Cable length: 5, 10, 15 or 30 meter (16.40, 32.81, 49.21 or 98.42 ft) |
| Cable connection            | M12 digital output and connector compatible with HQd meters   |

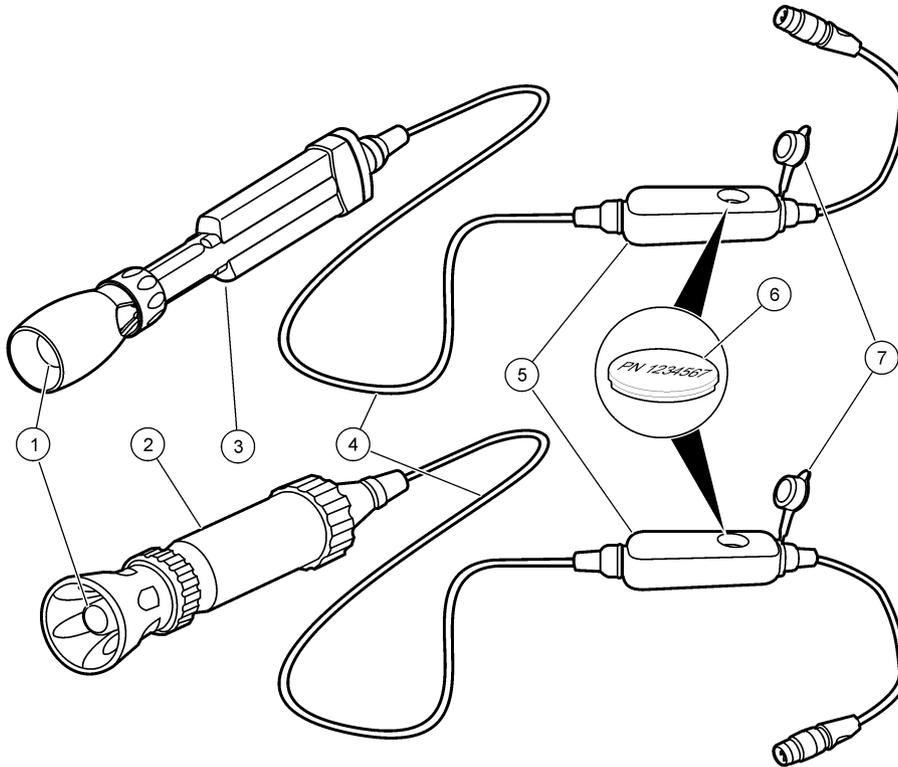
### Product overview

The LDO101 series probe is a luminescent dissolved oxygen probe (Figure 1). The LDO10105, LDO10110, LDO10115 or LDO10130 rugged probe is available with a 5, 10, 15

or 30 m (16.40, 32.81, 49.21 or 98.42 ft) cable. The LDO10101 or LDO10103 standard probe is available with a 1 or 3 m (3.28 or 9.84 ft) cable and is intended for laboratory use. The probe measures the dissolved oxygen concentration in wastewater, drinking water and general applications.

**Note:** For BOD applications, use the LBOD10101 probe which has LDO technology and a stirrer.

**Figure 1 Probe overview**



|   |  |   |                                   |
|---|--|---|-----------------------------------|
| 1 | LDO probe cap                              | 5 | Pressure sensor module            |
| 2 | Rugged probe (5, 10, 15 or 30 meter cable) | 6 | iButton® compartment <sup>1</sup> |
| 3 | Standard probe (1 or 3 meter cable)        | 7 | Pressure sensor module cap        |
| 4 | Probe cable                                |   |                                   |

## Preparation for use

**Note:** Do not touch the probe cap with a hand, fingers or any surface that can scratch the cap. Prepare the probe for use before calibration or sample measurement.

1. Make sure that the probe cap and iButton are installed correctly. The iButton label should be up.
2. Make sure that the probe cap and iButton have the same lot code.
3. If a rugged probe, make sure that the shroud is installed before field use (refer to [Install the shroud](#) on page 9).

**Note:** Damage to the sensing elements can occur if the shroud is not installed during field use. Damage under these conditions is not covered by the product warranty.

4. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.
5. If dissolved oxygen monitoring periods are longer than 6 hours, condition the probe cap for 72 hours. Calibrate the probe once every 8 hours.

**Note:** After 72 hours, the probe cap will reach a fully hydrated state.

<sup>1</sup> iButton is a registered trademark of Maxim Integrated Products, Inc.

# Calibration

## Before calibration:

The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.

It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured to use the same calibration options.

To view the current calibration, push , select View Probe Data, then select View Current Calibration.

If any two probes are connected, push the **UP** or **DOWN** arrow to change to the single display mode in order to show the Calibrate option.

Prepare the probe for use (refer to [Preparation for use](#) on page 2).

If a rugged probe, remove the shroud from the probe (refer to [Remove the shroud](#) on page 9).

## Calibration notes:

- % saturation or mg/L calibration methods are available in the Modify Current Settings menu.
- The slope value is the comparison between the latest calibration and the factory calibration shown as a percentage.
- An additional zero point calibration can be added to the calibration routine. Refer to [Change calibration options](#) on page 7.
- The calibration is recorded in the probe and the data log. The calibration is also sent to a PC, printer or flash memory stick if connected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a calibration error occurs, refer to [Troubleshooting](#) on page 10.

## Water-saturated air (100%) calibration procedure:



1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.



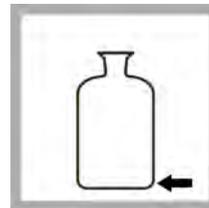
2. Push **Calibrate**.



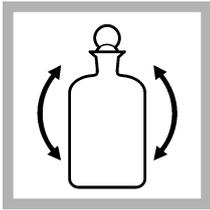
3. Push **Methods**. Select User Cal - 100%. Push **OK**.



4. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.



5. Add approximately  $\frac{1}{4}$  inch (6.4 mm) of reagent water to a narrow-neck bottle, such as a BOD bottle.



6. Put a stopper in the bottle and shake the bottle vigorously for approximately 30 seconds to saturate the entrapped air with water. Allow up to 30 minutes for contents to equilibrate to room temperature.



7. Remove the stopper. Carefully dry the probe cap with a non-abrasive cloth. Put the probe in the bottle.



8. Push **Read**. The display shows "Stabilizing" and a progress bar as the probe stabilizes. The display shows the standard value when the reading is stable.



9. Push **Done** to view the calibration summary.



10. Push **Store** to accept the calibration and return to the measurement mode. If a rugged probe, install the shroud on the probe (refer to [Install the shroud](#) on page 9).

## Sample measurement

### Before measurement:

The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.

If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the HQd meter manual for more information.

Regular calibration is required for the best measurement accuracy (refer to [Calibration](#) on page 3). Calibrate the probe if accuracy better than  $\pm 0.50$  mg/L is necessary for the application

Prepare the probe for use (refer to [Preparation for use](#) on page 2).

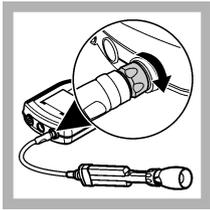
To deploy a rugged probe at a distance, toss the probe body with a gentle underhand throw. Do not swing the probe by the cable as this may cause injury to the user, will cause severe strain on the cable and will shorten the service life of the cell. Damage under these conditions is not covered by the product warranty.

### Measurement notes:

- Stabilization times with smaller concentration changes generally will be longer and can be minimized by correct stirring and conditioning. Experiment to determine the correct stir rate if necessary.
- Salinity affects the concentration of dissolved oxygen in the sample. To correct for salinity effects, refer to [Advanced operation](#) on page 6 or do the [Auto salinity correction](#) on page 5.
- Data is automatically stored in the data log when **Press to Read** or **Interval** is selected in the Measurement Mode. When **Continuous** is selected, data will only be stored when **Store** is selected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a measurement error occurs, refer to [Troubleshooting](#) on page 10.

### Measurement procedure:

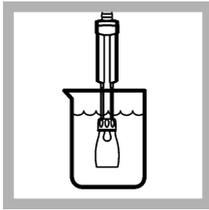
**Note:** Procedures also apply for rugged model probes.



1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.



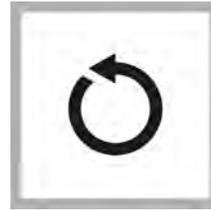
2. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.



3. Put the probe in the sample and stir gently or add a stir bar. Do not put the probe on the bottom or sides of the container. Stir the sample at a moderate rate or put the probe in flowing conditions.



4. Put the probe in the sample at least 25 mm (0.984 in.) deep. Push **Read**. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes.



5. Repeat steps 2-4 for additional measurements. When measurements are done, store the probe [Storage](#) on page 9.

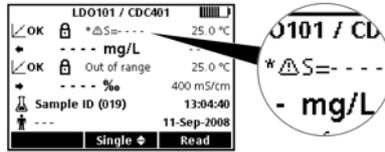
## Auto salinity correction

Dissolved substances affect the amount of oxygen water can hold. Manually enter salinity settings for the most accurate dissolved oxygen measurements or use the optional Auto Salinity Correction feature.

The manufacturer recommends using the Auto Salinity Correction feature when measuring dissolved oxygen in samples where salinity varies. Auto salinity correction measures dissolved oxygen through the connection of one LDO101 probe and one CDC401 conductivity cell (set to Salinity parameter). The value obtained by the CDC401 conductivity cell automatically adjusts the salinity value for the LDO101 series probe. Salinity units are represented as parts per thousand (ppt) or (‰).

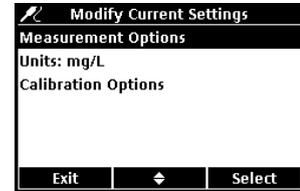
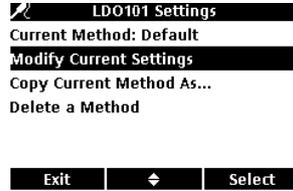
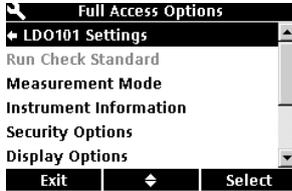
1. Connect the LDO101 probe and CDC401 conductivity cell to the HQd meter. Turn the meter on.  
**Note:** Security options must be turned off to use auto salinity correction.
2. Push  and select the CDC401 Settings.
3. Select Current Method, Hach Salinity. Push **OK**.  
**Note:** To change more measurement options, choose Modify Current Settings, change the parameter to Salinity and any other desired settings.
4. Push **EXIT** until the Full Access Options menu is shown.
5. Select LDO101 Settings, Modify Current Settings, Measurement Options, Salinity Correction: Off. Then select Sal Correction Mode: Off. Push the **DOWN** arrow to select Auto (\*) - Use CDC401. Push **OK**.
6. Push **EXIT** until the meter returns to the measurement mode. The HQ40d meter is now set up to automatically use the salinity values obtained by the CDC401 with the LDO101 probe. If the salinity value is out of range, the display will show \*S= ---- above the dissolved oxygen reading as shown in [Figure 2](#).  
**Note:** The asterisk (\*) indicates that salinity is automatically correcting the dissolved oxygen value. No asterisk indicates that salinity is being manually corrected. Warning messages will override the asterisk (\*) priority.

**Figure 2 Salinity value out of range**



## Advanced operation

Parameter-specific settings can be changed through the Full Access Options menu. Details about menu navigation, available options and how to change them are given in the screens, tables and procedures throughout this section.



The settings that can be changed are shown in [Table 1](#).

**Table 1 Parameter-specific settings**

| Setting             | Options              | Description   |
|---------------------|----------------------|---|
| Measurement Options | Resolution           | Defines measurement resolution  |
|                     | Measurement Limits   | Upper and lower measurement limits  |
|                     | Salinity Correction  | Value for salinity correction   |
|                     | Pressure Units       | Atmospheric pressure units  |
|                     | Averaging Interval   | How often the meter calculates an average readings  |
| Units               | mg/L<br>%            | Primary unit of measurement   |
| Calibration Options | Calibration          | <ul style="list-style-type: none"> <li>User 100%</li> <li>User 100% with 0</li> <li>User mg/L</li> <li>User mg/L with 0</li> <li>Factory</li> </ul> |
|                     | Calibration Reminder | Reminder Repeat—Off, 8 h, 12 h, 1 d, 2 d, 5 d or 7 d<br>Expires—Immediately, Reminder + 30 m, Reminder + 1 h, Reminder + 2 h or Continue Reading    |

## Change measurement options

Methods are groups of default or user-defined settings relevant to specific applications. If the meter is set to the default method and the Modify Current Settings option is chosen, a prompt for a new name is shown after the changes are entered. The settings are saved with this name to distinguish them from the default method settings, which cannot be changed. A saved method can be used instead of multiple adjustments to the individual settings. Changes made to a user defined method are automatically saved with the existing name. Multiple methods can be saved for the same probe on each meter.

There are three default methods available for the LDO101 probe:

- Factory Cal (Calibration with default LDO calibration)

- User Calibration—100% (allows user calibration)
  - Default
1. Make sure a probe is connected to the meter.
  2. Push  and select LDO101 Settings.
  3. Select Modify Current Settings.
  4. Select Units. Select mg/L (default) or %.
  5. Select Measurement Options and update the settings:

| Option                     | Description   |
|----------------------------|---|
| <b>Resolution</b>          | <p>Sets the resolution:</p> <ul style="list-style-type: none"> <li>• 0.1—Fast (0.35 mg/L)/min</li> <li>• 0.01—Fast (0.35 mg/L)/min</li> <li>• 0.01—Medium (0.15 mg/L)/min (default), or</li> <li>• 0.01—Slow (0.05 mg/L)/min</li> </ul> <p>The resolution affects the number of decimal places and the stabilization time. Higher resolution measurements take more time to stabilize.</p>  |
| <b>Measurement Limits</b>  | <p>Set the measurement limits—Lower limit (default: 0.0 mg/L; 0%) or Upper limit (default: 20.0 mg/L; 200%).</p> <p>The measurement limits can be set to match the acceptable values for the sample. When the measurement is above the upper limit setting or below the lower limit setting, the meter shows an "Out of limits" message. This message is an alert to a potential problem with the process conditions.</p>   |
| <b>Salinity Correction</b> | <p>Sets the salinity correction—Off (default), Manual or Auto (connect conductivity probe).</p> <p>Salinity lowers the solubility of dissolved oxygen in water. To correct for salinity in the sample, set salinity correction to manual and then enter the salinity value.</p> <p><b>Note:</b> When the HQ40d meter is used, a conductivity probe can also be connected for automatic salinity measurement and correction. The parameter setting for the conductivity probe must show salinity.</p>  |
| <b>Salinity Value</b>      | <p>Sets the salinity value—‰ (default: 35.0 ‰).</p> <p>When salinity correction is set to manual, sets the salinity value of the sample. Salinity can be measured with a conductivity probe.</p>  |
| <b>Pressure Units</b>      | <p>Sets the pressure units—hPa, mBar, inHg or mmHg.</p> <p>The meter shows the atmospheric pressure at the current elevation, which is necessary for accurate measurements.</p> <p><b>Note:</b> This pressure reading will not agree with readings from sources such as weather stations, which report atmospheric pressure at sea level.</p>   |
| <b>Averaging Interval</b>  | <p>Sets the averaging interval—Off, 30, 60, 90 seconds, 3, 5 minutes.</p> <p>The averaging interval is useful for samples that contain a lot of air bubbles, for example in an aeration basin. The air bubbles cause the dissolved oxygen readings to vary greatly from one reading to the next. To make the readings more consistent, increase the averaging interval. The meter will take measurements at the same frequency but show only the average over a longer interval.</p> <p><b>Note:</b> Labels and options may vary depending on the units selected.</p> |

6. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
7. Push **EXIT** until the meter returns to the measurement mode.

## Change calibration options

1. Make sure that a probe is connected to the meter.
2. Push  and select LDO101 Settings.

3. Select Modify Current Settings.
4. Select Calibration Options and update the settings:

| Option                | Description   |
|-----------------------|---|
| <b>Calibration</b>    | <ul style="list-style-type: none"> <li>• User—100% (water-saturated air (100%) calibration)</li> <li>• User—100% with 0 (water-saturated air (100%) calibration with 0 point)</li> <li>• User—mg/L (calibration with a specified dissolved oxygen concentration (mg/L) solution)</li> <li>• User—mg/L with 0 (calibration with a specified dissolved oxygen concentration (mg/L) solution with 0 point )</li> <li>• Factory (calibration with the default LDO calibration)</li> </ul> |
| <b>Standard Value</b> | When Calibration is set to mg/L or mg/L with 0, sets the concentration of the solution that will be used for calibration—2.00 to 20.00 mg/L (default=7.00 mg/L)   |

5. Select Calibration Reminder and update the settings:

| Option                 | Description   |
|------------------------|---|
| <b>Reminder Repeat</b> | Meter will make an audible sound when calibration is due and repeat the sound at selected interval—Off, 8 h, 12 h, 1 d, 2 d, 5 d or 7 d.  |
| <b>Expires</b>         | Calibration expires after the selected time—Immediately, Reminder + 30 min, Reminder + 1 h, Reminder + 2 h or Continue Reading.<br><i>Note: The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.</i> |

6. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
7. Push **EXIT** until the meter goes back to the measurement mode.

## Maintenance

### Clean the probe

Keep the probe cap free of deposits for the best measurements.

*Note: Do not touch the black colored substrate of the probe cap. Do not use alcohol or other organic solvents to clean the black colored substrate of the probe cap. These solvents cause damage to the probe cap.*

1. Remove the shroud (refer to [Remove the shroud](#) on page 9).
2. Gently clean the probe cap with a mild detergent, water and a soft cloth or cotton swab. Do not remove the black colored substrate from the probe cap. Do not scrub the probe cap or lens.
3. If water is present between the probe cap and lens:
  - a. Remove the probe cap.
  - b. Blot dry the probe cap and lens with a soft dry cloth.
  - c. Install the probe cap.
4. Install the shroud (refer to [Install the shroud](#) on page 9).

### Replace probe cap

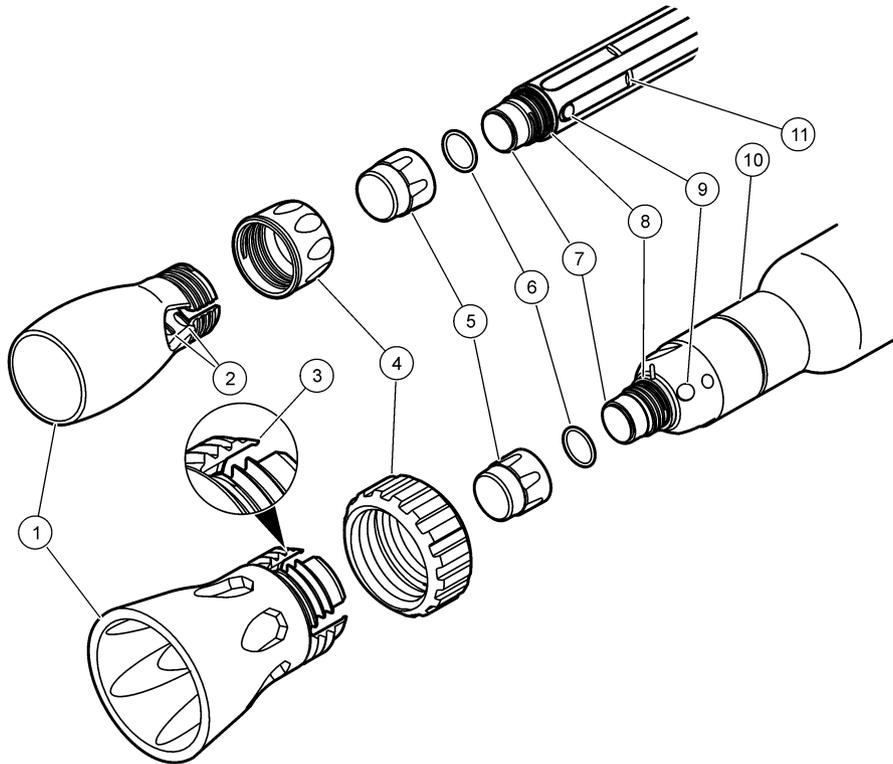
The probe cap must be replaced every 365 days or more often if the cap becomes damaged or fouled. The meter will show a reminder message when 30 days of probe service life remains on the probe cap.

For LDO probe cap replacement instructions, refer to the instructions provided with the LDO probe cap replacement kit.

## Remove the shroud

1. Loosen and remove the locking ring (Figure 3).
2. Slide the shroud and locking ring off the probe.

Figure 3 Probe exploded view



|   |                     |    |                    |
|---|---------------------|----|--------------------|
| 1 | Shroud              | 7  | Probe lens         |
| 2 | Locking ridges (8x) | 8  | Cap seal           |
| 3 | Locking rib         | 9  | Temperature sensor |
| 4 | Locking ring        | 10 | Locking groove     |
| 5 | Probe cap           | 11 | Locking ribs (4x)  |
| 6 | O-ring              |    |                    |

## Install the shroud

1. Put the locking ring on the probe with the threads toward the probe cap (Figure 3 on page 9).
2. Slide the shroud on the probe until it is against the locking groove (rugged) or ribs (standard). Slide the standard probe shroud on the standard probe until the inside locking ridges align halfway between the ribs on the probe. Turn the shroud slightly until it is seated.
3. Hand-tighten the locking ring on the shroud.

## Storage

- Dry storage—the manufacturer recommends that the probe is stored dry when the probe is used for measurements of short duration (less than 6 hours).
- Wet storage—the probe must be stored wet when the probe is used for monitoring periods longer than 6 hours.

## Dry storage

**Note:** Rugged probes may be stored dry with the shroud installed if the storage container is sufficiently large.

1. Rinse the probe with deionized water. Blot dry with a lint-free cloth.  
**Note:** The probe must be conditioned again in tap water for at least 30 minutes prior to use.
2. If a rugged probe, remove the shroud (optional). Refer to [Remove the shroud](#) on page 9.

## Wet storage

**Note:** The need for recalibration is minimized if the probe cap is kept wet.

1. Put the probe in tap water.
2. During the initial 72 hours in tap water, calibrate the probe once every 8 hours.  
**Note:** After 72 hours of storage in tap water, the probe cap will reach a fully hydrated state.

## Troubleshooting

| Message or symptom                        | Possible cause   | Action  |
|---|--|---|
| Probe not supported                       | Software not updated                                     | Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">http://www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual for specific instructions for the meter model. |
|   | HQd meter does not support IntelliCAL <sup>®</sup> probe | Contact a Technical Support Representative.   |
| Connect a probe or probe requires service | Probe not connected correctly                            | Disconnect, then connect the probe. Tighten the locking nut.  |
|   | Software not updated                                     | Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">http://www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual.   |
|   | Large number of methods stored on the probe              | Continue to let the probe connect. Do not disconnect the probe.   |
|   | Damaged probe  | Make sure there is connectivity with another probe or meter to confirm isolated issue with probe. Contact a Technical Support Representative.   |
| Out of range                              | Probe cap loose, scratched or damaged                    | Reposition or replace the probe cap.  |
|   | Temperature and/or pressure sensor error                 | Make sure that the temperature and pressure sensors are both reading correctly. <sup>2</sup>  |
|   | Damaged probe  | Make sure that the blue and red LEDs are both illuminated on the probe. If not, replace the probe or contact a Technical Support Representative.  |
|   | Sample outside of specifications                         | Make sure that the sample concentration, temperature and pressure are within the range of the probe.  |
|   | iButton number does not match probe cap lot number       | Replace the iButton or probe cap or do a user calibration.  |
|   | Bubbles trapped under probe tip                          | Gently shake the probe until bubbles are removed.   |

<sup>2</sup> The pressure as measured by the probe is what is referred to as atmospheric pressure and is not corrected to sea level. Weather station pressures are reported at sea level and commonly referred to as mean sea level pressure. As a result the probe will not read the same as most household or professional barometers or weather station reports (which are compensated) unless reported at sea level. In order to compare the pressure results obtained from the probe barometer and these compensated barometers, it is necessary to first compensate the pressure reported by the probes mathematically.

| Message or symptom   | Possible cause   | Action   |
|--|--|--|
| Out of range   | Probe cap exposed to direct sunlight                               | Install the protective shroud.   |
| Slope out of range   | Probe not prepared for sample                                      | Let the probe reach equilibrium in a water-saturated air environment and do the calibration again.   |
|  | Calibration method settings  | Make sure that the calibration standards in the method are correct.  |
|  | Probe cap loose, scratched or damaged                              | Locate and install the iButton that matches the probe cap and replace the probe cap.   |
|  | Temperature and pressure errors                                    | Make sure that the temperature and pressure sensors are both reading accurately. Contact a Technical Support Representative. <sup>2</sup>                                      |
|  | LED lights do not function   | Contact a Technical Support Representative.  |
|  | Bubbles trapped under probe tip                                    | Gently shake the probe until bubbles are removed.  |
| LDO—calibration not supported (factory calibration)  | LDO method calibration option is set to Factory.                   | If user calibration is necessary, change the settings in Calibration Options. Refer to <a href="#">Change calibration options</a> on page 7.                                   |
| O2 Sensor 0 days remaining   | There are 0 days remaining in the life of the probe cap            | Replace the probe cap. Calibration will be allowed, however the calibration icon and question mark will be shown on the measurement screen even if the calibration has passed. |
|  | Meter set to incorrect date and time                               | Disconnect the probe from the meter. Set the correct date and time in the Meter Options menu. Connect the probe and make sure that the message has been removed.               |
|  | Software not updated   | Update the HQd software to the latest version and test again.  |
| O2 Sensor ## of days remaining   | There are 30 days or fewer remaining in the life of the probe cap. | Replace the probe cap soon.  |
| Calibration failed: outside of acceptance criteria/<br>Temperature out of range/<br>Offset out of limits | Water Saturated air equilibration not reached                      | Allow longer equilibration time.   |
|  | Probe cap loose, scratched, or damaged                             | Change the location of the probe cap or replace the probe cap.   |
|  | Temperature and/or pressure sensor error                           | Make sure that the temperature and pressure sensors are both reading correctly and within range. <sup>2</sup>  |
|  | Damaged probe  | Make sure that the blue and red LEDs are both illuminated on the probe. If not, replace the probe or contact a Technical Support Representative.                               |

**HACH COMPANY World Headquarters**

P.O. Box 389, Loveland, CO 80539-0389 U.S.A  
Tel. (970) 669-3050  
(800) 227-4224 (U.S.A. only)  
Fax (970) 669-2932  
orders@hach.com  
www.hach.com

**HACH LANGE GMBH**

Willstätterstraße 11  
D-40549 Düsseldorf  
Tel. +49 (0) 2 11 52 88-320  
Fax +49 (0) 2 11 52 88-210  
info@hach-lange.de  
www.hach-lange.de

**HACH LANGE Sàrl**

6, route de Compois  
1222 Vézenaz  
SWITZERLAND  
Tel. +41 22 594 6400  
Fax +41 22 594 6499





**Attachment 2 – CEM-2058 Stormwater Meter Calibration Record Form**

|   |  |      |
|---|--|------|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |      |
|   | PROJECT IDENTIFIER NUMBER  |      |
|   | WDID NUMBER  |      |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |      |
| SUBMITTED BY CONTRACTOR (PRINT AND SIGN NAME) |  | DATE |

| Meter              |                    |                     |
|--------------------|--------------------|---------------------|
| Meter manufacturer | Meter model number | Meter serial number |

| Conductivity Meter Calibration Date _____ |                                       |                     |      |                |      |             |                        |                          |          |
|---|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
| Standard Solution (uS/cm)                 | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|   |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|   |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
| 447                                       |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| 1413                                      |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| 8974                                      |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| 15,000                                    |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

| Dissolved Oxygen Meter Calibration Date _____ |                                       |                     |      |                |      |             |                        |                          |          |
|---|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
| Standard                                      | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|   |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|   |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
| Open Air (mg/L)                               |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| Zero Oxygen Standard (MG/L)                   |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| Barometer (mm Hg)                             |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION  
**STORMWATER METER CALIBRATION RECORD**  
 CEM-2058 (NEW 12/2010)

|   |                           |
|---|---------------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS | CONTRACT NUMBER/CO/RTE/PM |
|   | PROJECT IDENTIFIER NUMBER |
|   | WDID NUMBER               |

\_\_\_\_\_ Meter Calibration Date \_\_\_\_\_

| Standard | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|----------|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
|          |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|          |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

\_\_\_\_\_ Meter Calibration Date \_\_\_\_\_

| Standard | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|----------|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
|          |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|          |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

| Date | Notes |
|------|-------|
|      |       |
|      |       |

**Review**

I have reviewed this document and, based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete.

|                                 |                                 |
|---------------------------------|---------------------------------|
| Water pollution control manager | Water pollution control manager |
|---------------------------------|---------------------------------|

Water pollution control manager signature

### Instructions

**GENERAL INFORMATION**

- Projects with Construction Site Monitoring Program require the information on this form as part of the Stormwater Pollution Prevention Plan for stormwater analysis meter calibration.
- Completed forms shall be filed in project file category 20.55, Field Testing Equipment Maintenance and Calibration Records.

**FORM****Contract Number/Co/Rte/PM**

For local agency encroachment permit projects write the encroachment permit number in the Contract Number field.

**Project Identifier Number**

Caltrans projects starting July 1, 2010, will have a Project Identifier Number. For projects without a PID, write "N/A" in the field.

Acceptable performance for conductivity drift is  $\pm 10$  percent, and acceptable performance for dissolved oxygen is  $\pm 10$  percent.

### Instructions

#### GENERAL INFORMATION

- Projects with Construction Site Monitoring Program require the information on this form as part of the Stormwater Pollution Prevention Plan for stormwater analysis meter calibration.
- Completed forms shall be filed in project file category 20.55, Field Testing Equipment Maintenance and Calibration Records.

#### FORM

##### **Contract Number/Co/Rte/PM**

For local agency encroachment permit projects write the encroachment permit number in the Contract Number field.

##### **Project Identifier Number**

Caltrans projects starting July 1, 2010, will have a Project Identifier Number. For projects without a PID, write "N/A" in the field.

Acceptable performance for conductivity drift is  $\pm 10$  percent, and acceptable performance for dissolved oxygen is  $\pm 10$  percent.



**Attachment 3 – CEM-2052 Stormwater Sample Field Test Report Form**

|   |  |      |
|---|--|------|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |      |
|   | PROJECT IDENTIFIER NUMBER  |      |
|   | WDID NUMBER  |      |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |      |
| Submitted by contractor (print name and sign) |  | Date |

**Stormwater Samples Field Analysis**

|                                       |  |
|---------------------------------------|--|
| Location                              | Date of Sampling   |
| Sample Location Identification Number | Date of Analysis   |
| Sample Analyzed By Signature          |  |
| Sample Analyzed By Print Name         |  |
| Analyzer Phone Number                 | Samples Analyzed For Parameter(s)<br><input type="checkbox"/> Turbidity<br><input type="checkbox"/> pH<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Other _____ |
| Company                               |  |

| Sample Identification                               | Turbidity Analysis (NTU) | pH Analysis (pH) | Analysis (____) | Analysis (____) | Comments                 |
|---|--------------------------|------------------|-----------------|-----------------|--------------------------|
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
| Qualifying Rain Event Daily Average Analysis Result |                          |                  |                 |                 | <input type="checkbox"/> |

|  |   |   |                  |
|--|---|---|------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS  |   | CONTRACT NUMBER/CO/RTE/PM   |                  |
|  |   | PROJECT IDENTIFIER NUMBER   |                  |
|  |   | WDID Number   |                  |
| <b>Turbidity Analysis Information</b>  |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>pH Analysis Information</b>   |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>Analysis Information</b>  |   |   |                  |
| Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| Note: Meter calibration information available in the Storm Water Pollution Prevention Plan (SWPPP) files.<br>Comments  |   |   |                  |
| <b>Review and Record Keeping</b>   |   |   |                  |
| Test results entered into sampling and testing activity log?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No  | Numeric action level exceedance?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No | Numeric effluent limitation violation?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No |                  |
| I have reviewed this document and based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true accurate, and complete. |   |   |                  |
| Water pollution control manager name   |   | Date  |                  |
| Water pollution control manager signature  |   |   |                  |
| Accepted by resident engineer (name)   |   | Date  |                  |
| Resident engineer signature  |   |   |                  |

## Instructions

### GENERAL INFORMATION

- This form is required for compliance with provisions in Section I of Attachments C, D, and E of the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ, NPDES No. CAS000002.
- The *Construction Site Monitoring Program Guidance Manual*, dated July 2010, contains sampling guidance.
- Sampling and sample preservation must be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association).
- Collect, maintain, and ship samples according to the Surface Ambient Monitoring Program's (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).
- Complete a separate stormwater sample field analysis report daily for each sampling location.
- Include a copy of the completed form in the project SWPPP files.

### FORM

#### Project Identifier Number

Starting July 1, 2010, Caltrans projects will have a project identifier number. For projects without a PID, write N/A in the field.

#### Contract Number/Co/Rte/PM

For local agency encroachment permit projects, write the encroachment permit number in the contract number field.

Analysis Result Analytical results less than the method detection limit must be reported as "less than the method detection limit."

#### Qualifying Rain Event Daily Average Analysis Result

A minimum of three daily samples are required to calculate the daily average for a qualifying rain event.

#### Numeric Action Level Exceedance

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Action Level (NAL), complete form CEM-XXXX "Numeric Action Level Exceedance Report," and submit all storm event sampling results to the State Water Board no later than ten days after the conclusion of the storm event.

#### Numeric Effluent Limitation Violation

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Effluent Limitation, complete form CEM-6062, "Numeric Effluent Limitation Violation Report," and submit CEM-2063, "Numeric Effluent Limitation Violation Report," to the State Water Board within 24 hours after the numeric effluent limitation violation was identified. Submit all storm event sampling results to the State Water Board no later than five days after the conclusion of the storm event.



# **Standard Operating Procedures for Manual Field Measurement of Conductivity**

DOCUMENT NO. CTSW-RT-11-255.11.05-F

**January 2012**

**California Department of Transportation  
Division of Environmental Analysis  
Storm Water Program MS 27  
1120 N Street, Sacramento, California 95814  
<http://www.dot.ca.gov/hq/env/stormwater/index.htm>**



## Caltrans Technical Report Documentation Page

|   |                             |  |
|---|-----------------------------|--|
| 1. Report No.<br>CTSW-RT-11-255.11.05-F   | 2. Type of Report<br>Report | 3. Report Phase and Edition<br>Final                               |
| 4. Title and Subtitle<br>Standard Operating Procedures for Manual Field Measurement of Conductivity   |                             | 5. Report Date<br>January 2012                                     |
| 6. Editor:<br>Hamid Hakim, Ph.D., P.E, Caltrans<br>Authors:<br>Armand Ruby; Cory LaNeave, P.E., Corinne Marks, PE   |                             | 7. Caltrans Project Coordinator<br>Hamid Hakim, Ph.D., P.E.        |
| 8. Performing Organization Names and Addresses<br>CALIFORNIA DEPARTMENT OF TRANSPORTATION<br>Division of Environmental Analysis- MS-27<br>1120 N Street<br>P.O. Box 942874<br>Sacramento CA 94274-0001<br>www.dot.ca.gov/hq/env/stormwater  |                             | 9. Task Order No.<br>11<br>Amendment No.<br>3                      |
|   |                             | 10. Contract No.<br>43A0255  |
| 11. Sponsoring Agency Name and Address<br>California Department of Transportation<br>Sacramento, CA 95814   |                             | 12. Caltrans Functional Reviewers:<br><br>Hamid Hakim, Ph.D., P.E. |
| 13. Supplementary Notes   |                             | 13. External Reviewers   |
| 15. Abstract<br>These Standard Operating Procedures (SOPs) for Manual Field Measurement of Conductivity are a companion document to the <i>Construction Site Monitoring Program Guidance Document</i> . This set of SOPs presents meter calibration, sampling, and measurement methods. The document defers to the User Guide for procedures for troubleshooting. |                             |  |
| 16. Key Words:<br>Stormwater, calibration, conductivity meter   | 17. Distribution Statement  | 18. Number of pages:<br>82   |



# **Standard Operating Procedures for Manual Field Measurement of Conductivity**

## **Final Report**

**January 2012**

**CTSW-RT-11-255.11.05-F**

For individuals with sensory disabilities, this document is available in alternate formats upon request. Please call or write to Storm Water Liaison, Caltrans Division of Environmental Analysis, MS 27, P.O. Box 942874, Sacramento, CA 94274-0001. (916) 653-8896 Voice, or dial 711 to use a relay service.



## Introduction

The California Construction General Stormwater National Pollutant Discharge Elimination System Permit (CGP) includes requirements for routine field measurement of conductivity in discharges from construction sites. This Standard Operating Procedures (SOPs) document provides direction on how to perform measurements of conductivity at California Department of Transportation (Caltrans) construction sites.

## Responsible Personnel

The following personnel are responsible for various aspects of CGP compliance associated with conductivity measurements of stormwater at Caltrans construction sites. The brief descriptions below serve to clarify the roles that these individuals have in this process.

- The Caltrans District Construction Stormwater Coordinator is responsible for authorizing all work, and ensures that SOP implementation and documentation responsibilities are clearly communicated to the project personnel.
- The Resident Engineer is responsible for ensuring that the SOP is implemented and documented on the required schedule and that the Water Pollution Control (WPC) Manager is performing these requirements in a timely manner.
- The WPC Manager is responsible for providing the direction to field crew to perform the analysis for conductivity according to the required project frequency.
- The Field Crew are responsible for performing SOPs, clearly documenting data, and relaying data and observations collected from stormwater monitoring activities.

Meter calibration and measurement procedures described in this SOP must be followed each day that field measurements are performed.

## References to Existing Source Documents

This SOP references the *Hach Multi-Parameter Portable Meter Model HQ40d User Manual* (Attachment 1A) and (the associated conductivity probe) *Hach Model CDC401 Conductivity Probe User Manual* (Attachment 1B).

This SOP is also adapted from information provided in the following sources:

(1) *Standard Operating Procedures (SOPs) for Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program (SWAMP)*, version 1.0, released October 15, 2007 (SWAMP, 2007); available for download at:

<http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/standard-operating-procedures>



(2) United States Geological Survey, variously dated, National field manual for the collection of water-quality data: *U.S. Geological Survey Techniques of Water-Resources Investigations*, Book 9, Chapters. A1 through A9; available online at:

<http://pubs.water.usgs.gov/twri9A> or <http://water.usgs.gov/owq/FieldManual/index.html>

Field measurement of conductivity is covered under Chapter A6 Field Measurements, in Sections 6.3, Specific Electrical Conductance, and 6.8, *Use of Multi-Parameter Instruments for Routine Field Measurements*.

Relevant quality assurance/quality control (QA/QC) protocols are referenced in the associated *Caltrans Construction Site Monitoring Program Guidance Manual*.

### **Special Cautions and Considerations; Health and Safety**

Proper gloves must be worn to both prevent alteration of the field measurements, and to protect sampling personnel from environmental hazards. The user should wear at least one layer of gloves, but two layers help protect against leaks. All gloves must be powder-free. Disposable polyethylene, nitrile, or non-talc latex gloves are acceptable for field measurements.

### **CAUTIONS**

When performing measurements in areas of unknown water quality, especially in waters that are suspected to contain hazardous substances or human pathogens, at least one layer of gloves shall be of the “long-cuff” variety to cover the wrist and forearm, to limit skin contact with the source water.



## Methods/Procedures

This SOP pertains to manual measurement of conductivity in the field only. Field measurement of turbidity, pH, temperature, and electrical conductivity (EC) are covered in separate SOPs.

### *Equipment*

For field measurement of conductivity at Caltrans construction sites, the specified equipment is the Hach multi-parameter portable meter, model HQ40d, and the associated conductivity probe, Hach model CDC401. The probe is a graphite, 4-pole conductivity probe with a conductivity measurement range of 0.01 microSiemens per centimeter ( $\mu\text{S}/\text{cm}$ ) to 200.0 milliSiemens per centimeter ( $\text{mS}/\text{cm}$ ), and accuracy of +/- 0.5 percent.

Below is a checklist of required equipment for field measurement of conductivity.

### **Standard Equipment and Supplies Checklist**

- Hardhat
- Gloves
- Safety vest
- Box of powder-free gloves
- Long-cuff gloves as necessary
- Scientific calculator
- "Write-In-The-Rain" notebook
- Field meter calibration record form
- Field measurement data form
- Pencil(s) and pen(s)
- Digital camera
- Flashlight
- Extra batteries
- Deionized water for rinsing and cleaning
- Sample collection containers
- Sample collection extension arm (as required)
- Hach HQ40d multi-parameter portable meter
- Hach CDC401 conductivity probe
- Hach conductivity calibration standards

### *Field Meter Calibration*

All field meters must be calibrated prior to use. Calibration shall be performed at a minimum of once per day for each day of instrument use. Calibration shall be performed on a daily basis, prior to the first measurements of the day. Calibration of the HachHQ40d multi-parameter meter is accomplished according to specific procedures for each probe. Refer to pages 3 and 4 of the *Hach CDC401 Conductivity Probe User Manual* (Attachment 1B) for specific conductivity calibration instructions.

*Before calibration:*

- The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.
- It is not necessary to recalibrate when moving a calibrated probe from one Hach HQD portable meter to another if the additional meter is configured to use the same calibration options.
- To view the current calibration, push the open folder symbol, select “View Probe Data,” then select “View Current Calibration.”
- If any two probes are connected, push the UP or DOWN arrow to change to the single display mode in order to show the Calibrate option.
- If using a rugged probe, remove the shroud from the probe (refer to “Remove the Shroud” on page 8 of the *Hach CDC401 Conductivity Probe User Manual* [Attachment 1B]).

*Calibration notes:*

- Do not touch the tip of the probe.
- Additional conductivity standards can be selected in the “Calibration Options” menu.
- The cell constant is derived from the calibration standard.
- Do not dilute conductivity standards and samples.
- The meter will automatically correct the calibration measurement to the selected reference temperature (20 or 25 degrees Celsius [°C]) using the default NaCl-based, non-linear temperature coefficient. Settings can be changed in the CDC401 “Calibration Options” menu.
- The calibration is recorded in the probe and the data log. The calibration is also sent to a computer, printer, or flash memory stick, if connected.
- Air bubbles under the sensor tip, when submerged, can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a calibration error occurs, refer to “Troubleshooting” on page 9 of *Hach CDC401 Conductivity Probe User Manual* (Attachment 1B).

*Calibrating the conductivity probe:*

1. Connect the probe to the meter. Ensure that the cable locking nut is securely connected to the meter. Turn on the meter.



2. Push “Calibrate.” The display shows the conductivity standard solution that is necessary for calibration.
3. Add fresh conductivity standard solution to a beaker or an appropriate container.
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
5. Put the probe in the standard solution and stir gently. Ensure that the temperature sensor is completely submerged.
6. Push Read. Stir gently. The display will show “Stabilizing” and a progress bar as the probe stabilizes in the standard. The display shows the standard solution value that has just been read and shows the temperature-corrected value when the reading is stable.
7. Push “Done” to view the calibration summary.
8. Push “Store” to accept the calibration and return to the measurement mode. If a rugged probe, install the shroud on the probe (refer to “Install the Shroud” on page 9 of the *Hach CDC401 Conductivity Probe User Manual* [Attachment 1B]).

Record the results of the field meter calibration on the CEM-2058StormwaterMeter Calibration Record form (Attachment 2).

### ***Sample Collection***

When conditions permit, conductivity measurement can be made by placing the probe directly into the source water. When flow is turbulent or shallow, or when direct immersion would risk damaging the probe, a sample should be collected for conductivity measurement.

Samples for field measurements are collected by direct submersion of the sample container into the flow whenever possible. The sample may be collected using any clean container. A wide-mouth sample bottle provided by the laboratory is preferred for this purpose, as those bottles are shipped pre-cleaned. Samples always should be collected upstream of sampling personnel and equipment, and with the sample container pointed upstream when the container is opened for sample collection. Care must be taken not to sample water downstream of areas where sediments have been disturbed in any manner by field personnel.

Direct field measurements are made or samples for field measurement purposes are collected from a location where the sample stream visually appears to be completely mixed. Ideally, this area is at the centroid of the flow cross-section, but site conditions do not always allow centroid collection. (“Centroid” is defined as the midpoint of that portion of the stream width, which contains 50 percent of the total flow area.) Preferably, the location should be accessible by direct reach, or in the case of a receiving water body, via wading.

If the centroid of the flow cannot be tested or sampled by direct reach or by wading into the flow, a sampling pole or other sampling device can be used to reach the sampling location. Such devices typically involve a means to extend the reach of the sampler, with the sample bottle



attached to the end of the device for filling at the desired location. These methods do not allow opening of the sample container under water; therefore, there is potential for contamination when the container is opened prior to lowering the sample container into the stream. Caution is required when wading, as flowing water provides more force than visually anticipated. Only experienced personnel should perform this collection technique.

When sampling from a stream bank where direct reach is not possible, the sample container is secured by a hardware device, which, in turn, is attached to the end of an extendable sampling pole. Sites accessed by bridge also can be sampled with a sample container secured to a device, lowered into the stream at the end of a rope. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge.

#### *Testing/Sample Collection Depth:*

- **Subsurface Test/Sample:** Grab samples for field measurements are typically collected at 4 inches below the water surface. When the field probe is inserted directly into the stream, a measurement depth of 8 inches should be used to ensure that the probe is appropriately submerged.
- **Surface Sample:** Grab samples for field measurements are collected at the water surface when water depth is less than 4 inches. Because water quality varies on the water surface, compared to subsurface, surface samples should be noted on the field data sheet as collected at 0 inch.

#### *Field Measurement Methods*

Field conductivity measurements may be made either by direct submersion of the instrument probe into the sample stream, or by collection of a grab sample and immediate analysis of the grab sample in the field. In either case, the measurement is made with the conductivity probe attached to the Hach HQ40d portable meter.

The Hach HQ40d meter measures conductivity in units of  $\mu\text{S}/\text{cm}$  or  $\text{mS}/\text{cm}$ . These units are equivalent to  $\mu\text{mho}/\text{cm}$  and  $\text{mmho}/\text{cm}$ , respectively.

Collect a sample for conductivity measurement (rather than direct immersion of the probe into the sample stream) when flow is turbulent or shallow, or when direct immersion of the probe would risk damaging the probe. Carefully prepare the probe for use and perform daily calibration prior to field measurement as described above. Regular calibration is required for the best measurement accuracy.

#### *Before measurement:*

- The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.



- If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the *Hach Multi-Parameter Portable Meter Model HQ40d User Manual* (Attachment 1A) for more information.
- If using a rugged probe, ensure that the shroud is installed. Damage to the sensing elements can occur if the shroud is not installed during field use. Damage under these conditions is not covered by the product warranty.
- To deploy a rugged probe at a distance, toss the probe body with a gentle underhand throw. Do not swing the probe by the cable as this may cause injury to the user, will cause severe strain on the cable, and will shorten the service life of the probe. Damage under these conditions is not covered by the product warranty.

*Measurement notes:*

- Do not touch the tip of the probe.
- Stabilization times with smaller concentration changes generally will be longer and can be minimized by correct stirring and conditioning. Experiment to determine the correct stir rate if necessary.
- Data is automatically stored in the data log when “Press to Read” or “Interval” is selected in the Measurement Mode. When “Continuous” is selected, data will only be stored when “Store” is selected.
- Air bubbles under the sensor tip, when submerged, can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a measurement error occurs, refer to “Troubleshooting” on page 9 of the *Hach CDC401 Conductivity Probe User Manual* (Attachment 1B).

*Performing conductivity measurement:*

1. Connect the probe to the meter. Ensure that the cable locking nut is securely connected to the meter. Turn on the meter.
2. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
3. Put the probe into the sample so that the temperature sensor is completely submerged. Do not put the probe on the bottom or sides of the container.
4. Push “Read.” The display will show “Stabilizing” and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes. The measurement is automatically corrected to the selected reference temperature (20 or 25 °C).
5. Repeat steps 2 through 4 above for additional measurements.



6. When measurements are complete, store the probe (refer to “Storage” on page 9 of the *Hach CDC401 Conductivity Probe User Manual* (Attachment 1B)).

After measurement, complete the CEM-2052 Stormwater Sample Field Test Report form (Attachment 3).

Before leaving the sampling site, field personnel should review datasheets to ensure that they are complete and legible, and that all sampling-related materials and equipment have been collected.

### **Maintenance**

Perform all required maintenance as specified in the *Hach CDC401 Conductivity Probe User Manual* (Attachment 1B), including periodically cleaning the probe.

Clean the probe when:

- Drifting/inaccurate readings or slow stabilization time occurs as a result of mineral or sample buildup on the electrodes.
- The slope is out of range as a result of mineral or sample buildup on the electrodes.

#### *Cleaning the Probe*

Before a rugged probe can be cleaned, the shroud must be removed (see below). Install the shroud after the probe is clean (see below).

For general contaminants: Rinse the probe with deionized water and blot dry with a lint-free cloth.

For greases and oils:

1. Soak the glass bulb in a warm detergent solution for up to two hours.
2. Rinse or soak the probe for one minute in deionized water.
3. Blot dry with a lint-free cloth.

For mineral buildup:

1. Soak the probe in a dilute 10 percent hydrochloric acid solution for no more than five minutes.
2. Rinse or soak the probe for one minute in deionized water.
3. Blot dry with a lint-free cloth.

#### *Removing the shroud*

1. Loosen and remove the locking ring.



2. Slide the shroud and locking ring off the probe.

#### *Installing the shroud*

1. Put the locking ring on the probe with the threads toward the probe.
2. Slide the shroud on the probe until it is against the locking groove.
3. Hand-tighten the locking ring on the shroud.

#### *Storage*

Between uses, ensure the probe is dry and store it in ambient conditions. Rugged probes may be stored with the shroud installed if the storage container is sufficiently large.

#### **Quality Assurance/Quality Control**

Graphite electrodes used in the Hach CDC401 are quoted to have an accuracy of +/- 0.5 percent of reading and a precision varying with measurement range such that:

| <b>Resolution</b>            | <b>Measurement Range</b>              |
|------------------------------|---------------------------------------|
| 0.01 $\mu\text{S}/\text{cm}$ | 0.0 to 19.99 $\mu\text{S}/\text{cm}$  |
| 0.1 $\mu\text{S}/\text{cm}$  | 20.0 to 199.9 $\mu\text{S}/\text{cm}$ |
| 1 $\mu\text{S}/\text{cm}$    | 200 to 1999 $\mu\text{S}/\text{cm}$   |
| 0.01 $\text{mS}/\text{cm}$   | 2.00 to 19.99 $\text{mS}/\text{cm}$   |
| 0.1 $\text{mS}/\text{cm}$    | 20.0 to 200.0 $\text{mS}/\text{cm}$   |

Perform all required QA/QC measures as specified in the *Caltrans Construction Site Monitoring Program Guidance Manual*.

#### ***Running a Check Standard***

The run check standard feature validates instrument performance between sample measurements. Use the run check standard feature for periodic or user-defined interval measurements of a traceable standard solution. Set the criteria for check standards from the CDC401 “Settings” menu.

Note: Access control must be off or a valid password must be entered before any of the check standard method options can be changed.

1. Push the wrench icon. The “Full Access Options” menu is shown.



2. Select “Run Check Standard.” Note: Select the correct probe if two probes are connected to the meter.
3. Get the standard solution shown on the display.
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
5. Put the probe in the standard solution until the temperature sensor is completely submerged. Move the probe up or down or gently tap on the beaker to remove air bubbles from the probe.
6. Push Read. The display will show “Stabilizing” and a progress bar as the reading stabilizes. The display shows the value of the check standard and either “Check Standard Passed” or “Check Standard Failed.”
7. If the display shows “Check Standard Passed,” the check standard measurement is within the accepted limits set by the administrative user. Select “Done” to continue with the sample measurement.
8. If the display shows “Check Standard Failed,” the measurement is outside of accepted limits set by the administrative user and a recalibration is recommended. If the acceptance criterion is set to “Cal Expires on Failure: Yes,” the display shows the calibration icon and a question mark until the probe is recalibrated. To correct the probe calibration and status indicator, calibrate the probe as detailed above.

Adherence to the sample collection and measurement procedures described above, along with adherence to QA/QC measures required per the *Caltrans Construction Site Monitoring Program Guidance Manual*, will ensure that field measurements are representative of environmental conditions, and conform to CGP requirements.

### **Troubleshooting**

Refer to the *Hach CDC401 Conductivity Probe User Manual* (Attachment 1B) for troubleshooting suggestions or call manufacturer’s representative for specific questions.



**Attachment 1A – Hach Multi-Parameter Portable Meter HQ40d User Manual**

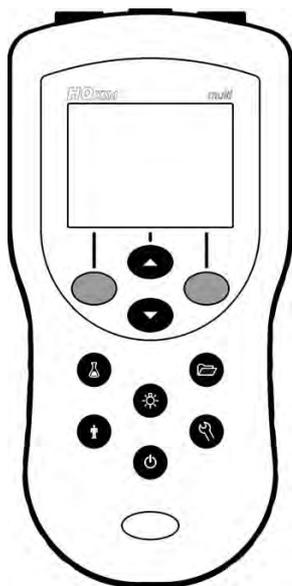


DOC022.53.80017

# HQ40d, HQ30d HQ14d, HQ11d

01/2011, Edition 3

**User Manual**



|                                      |    |
|--------------------------------------|----|
| <b>Specifications</b>                | 5  |
| <b>General information</b>           | 5  |
| Safety information                   | 5  |
| Use of hazard information            | 5  |
| Precautionary labels                 | 6  |
| Product overview                     | 6  |
| Product components                   | 6  |
| <b>Installation</b>                  | 7  |
| Install the batteries                | 7  |
| Connect to AC power                  | 8  |
| <b>User interface and navigation</b> | 9  |
| User interface                       | 9  |
| Display description                  | 9  |
| Navigation                           | 11 |
| <b>Start-up</b>                      | 11 |
| Turn the meter on and off            | 11 |
| Change the language                  | 11 |
| Change the date and time             | 11 |
| Connect a probe                      | 12 |
| <b>Standard operations</b>           | 12 |
| About calibration                    | 12 |
| About sample measurements            | 13 |
| About check standards                | 13 |
| Use a sample ID                      | 13 |
| Use an operator ID                   | 13 |
| <b>Data management</b>               | 13 |
| About stored data                    | 13 |
| View stored data                     | 14 |
| View stored probe data               | 14 |

## **Table of Contents**

---

|   |           |
|---|-----------|
| Print stored data .....                                       | 14        |
| Change the report options .....                               | 15        |
| Send data to a USB storage device .....                       | 15        |
| Open data files on a PC .....                                 | 16        |
| Data file description .....                                   | 16        |
| Remove column headers .....                                   | 18        |
| Send data directly to a computer .....                        | 18        |
| <b>Advanced operations</b> .....                              | <b>18</b> |
| Security options .....  | 18        |
| Turn Security Options on .....                                | 18        |
| Full access options menu .....                                | 19        |
| Restricted operator access options menu .....                 | 19        |
| Set the display options .....                                 | 20        |
| Set the sound options .....                                   | 20        |
| Set the probe calibration reminder .....                      | 20        |
| Change the temperature units .....                            | 21        |
| Set the measurement mode .....                                | 21        |
| Set auto measurement intervals .....                          | 21        |
| Start interval measurements .....                             | 21        |
| Prevent data log overflow in interval mode .....              | 22        |
| View instrument information .....                             | 22        |
| Update the meter software .....                               | 22        |
| Download software updates .....                               | 23        |
| Transfer method settings .....                                | 23        |
| Bi-directional Communication between the meter and a PC ..... | 23        |
| About meter control .....                                     | 23        |
| About meter configuration .....                               | 24        |
| <b>Maintenance</b> .....                                      | <b>24</b> |
| Clean the meter .....   | 24        |
| Replace the batteries .....                                   | 24        |
| <b>Troubleshooting</b> .....                                  | <b>25</b> |

**Replacement parts and accessories** .....26

**Examples of printed reports** .....28

**Index** .....33



## Specifications

Specifications are subject to change without notice.

| Specification                 | Details   |
|-------------------------------|---|
| Dimensions                    | 19.7 x 9.5 cm (7.75 x 3.75 in.)   |
| Weight                        | 335 g (0.75 lb) without batteries; 430 g (0.95 lb) with four AA alkaline batteries  |
| Meter enclosure               | IP67, waterproof to 1 meter for 30 minutes  |
| Battery enclosure             | Water resistant to 0.6 m (2 ft) for 15 seconds  |
| Power requirements (internal) | AA Alkaline or rechargeable Nickel Metal Hydride (NiMH) batteries (4); battery life: up to 200 hours                                    |
| Power requirements (external) | Class II, external power adapter: 100–240 VAC, 50/60 Hz input; 4.5 to 7.5 VDC (7 VA) output   |
| Meter protection class        | Class I   |
| Storage temperature           | –20 to +60 °C (–4 to +140 °F)   |
| Operating temperature         | 0 to +60 °C (32 to 140 °F)  |
| Operating humidity            | 90% (non-condensing)  |
| 5-pin input connector         | M12 connector for IntelliCAL™ probes  |
| 8-pin input connector         | The 8-pin connector enables USB and external AC power connectivity  |
| USB/DC adapter                | Peripheral and host   |
| Data memory (internal)        | 500 results   |
| Data storage                  | Automatic in Press to Read mode and Interval Mode. Manual in Continuous Read Mode.  |
| Data export                   | USB connection to PC or USB storage device (limited to the storage device capacity). Transfer entire data log or as readings are taken. |
| Connections                   | Integrated USB type A (for USB flash memory device, printer, keyboard) and Integrated USB type B (for PC)                               |

| Specification            | Details  |
|--------------------------|--|
| Temperature correction   | Off, automatic and manual (parameter dependent)  |
| Measurement display lock | Continuous measurement, Interval or Press to Read mode. Averaging function for LDO probes. |
| Keyboard                 | External PC keyboard connector via USB/DC adapter  |

## General information

Revised editions are found on the manufacturer's website.

## Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

## Use of hazard information

### DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

### WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

### CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

## NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

### Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

|  |  |
|--|--|
|  | This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.  |
|  | This symbol indicates that the marked item can be hot and should not be touched without care.  |
|  | Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.<br><i>Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</i> |

### Product overview

The HQd series portable meters are used with digital IntelliCAL™ probes to measure various parameters in water. The meter automatically recognizes the type of probe that is connected to the meter. Measurement data can be stored and transferred to a printer, PC or USB storage device.

The HQd series meters are available in 4 models:

- HQ11d—pH/mV/ORP
- HQ14d—conductivity, salinity, total dissolved solids (TDS), resistivity
- HQ30d—all IntelliCAL probes, 1 probe connector

- HQ40d—all IntelliCAL probes, 2 probe connectors

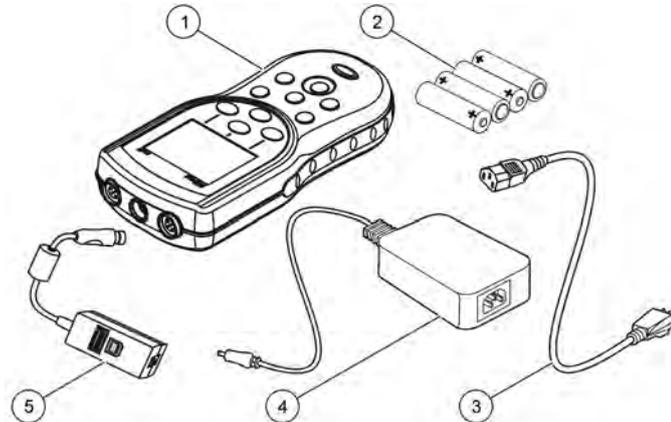
Features common to all models:

- Automatic probe and parameter recognition
- Instrument guided calibration procedures
- Calibration data stored in the probe
- Probe specific method settings for regulatory compliance and Good Laboratory Practice (GLP)
- Security Options
- Real-time data logging via USB connection
- USB connectivity to PC/printer/USB storage device/keyboard
- Bi-directional communication with PC-based systems via a virtual serial port connection
- Sample ID and Operator ID for data traceability
- Adjustable automatic shut-off

### Product components

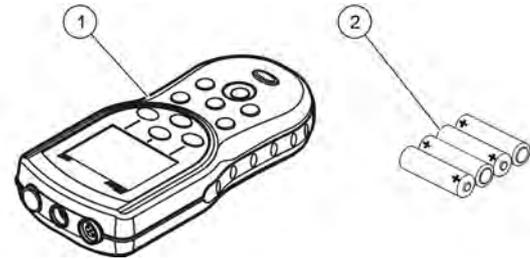
Refer to [Figure 1](#) and [Figure 2](#) to make sure that all components have been received. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

**Figure 1 Meter components (HQ40d model)**



|                       |  |
|-----------------------|--|
| 1 Meter               | 4 AC-DC power supply   |
| 2 AA batteries (pk/4) | 5 USB/DC adapter   |
| 3 AC power cord       | 6 Not shown: Basic user manual, Quick Start Guide and HQd/ IntelliCAL Documentation CD |

**Figure 2 Meter components (HQ11d, HQ14d and HQ30d models)**



|                       |  |
|-----------------------|--|
| 1 Meter               | 3 Not shown: Basic user manual, Quick Start Guide and HQd/ IntelliCAL Documentation CD |
| 2 AA batteries (pk/4) |  |

## Installation

### ⚠ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Install the batteries

### ⚠ WARNING

Explosion Hazard. Improper battery installation can cause release of explosive gases. Insert batteries in proper orientation only. Use only new batteries from the same manufacturer and lot.

### NOTICE

The battery compartment is not waterproof. If the battery compartment becomes wet, remove and dry the batteries and dry the interior of the compartment. Check the battery contacts for corrosion and clean them if necessary.

## NOTICE

When using nickel metal hydride (NiMH) batteries, the battery icon will not indicate a full charge after freshly charged batteries have been inserted (NiMH batteries are 1.2 V versus 1.5 V for alkaline batteries). Even though the icon does not indicate complete charge, 2300 mAh NiMH batteries will achieve 90% of instrument operation lifetime (before recharge) versus new alkaline batteries.

## NOTICE

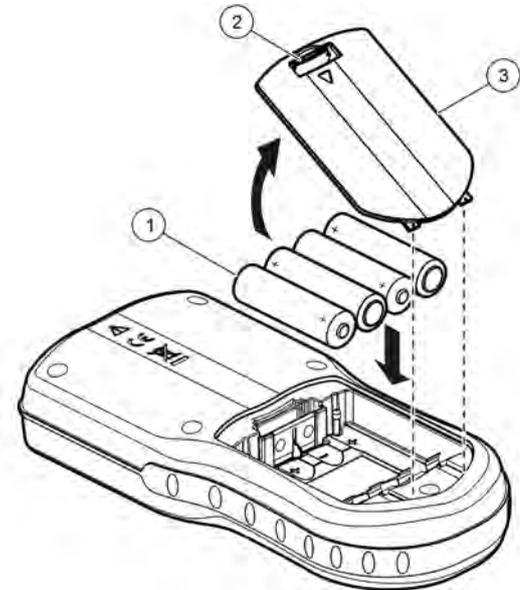
To avoid potential damage to the meter from battery leakage, remove the meter batteries prior to extended periods of non-use.

The meter can be powered with AA alkaline or rechargeable NiMH batteries. To conserve battery life, the meter will power off after 5 minutes of inactivity. This time can be changed in the Display Options menu.

For battery installation refer to [Figure 3](#).

1. Pull the release tab on the battery cover and the remove the cover.
2. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct polarity.
3. Replace the battery cover.

Figure 3 Battery installation



1 Batteries

2 Release tab

3 Battery cover

## Connect to AC power

### ⚠ DANGER

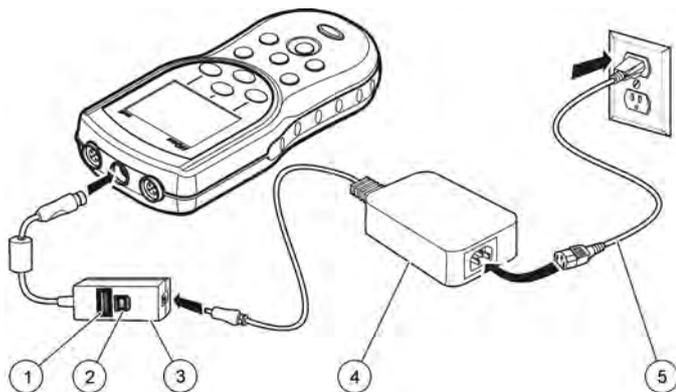


Electrocution Hazard. AC power outlets in wet or potentially wet locations MUST ALWAYS be provided with a Ground Fault Circuit Interrupting (GFCI/GFI) circuit breaker. The AC-DC power adapter for this product is not sealed and must not be used on wet benches or in wet locations without GFCI protection.

The meter can be powered by AC power with an AC power adapter kit. The kit includes an AC-DC power supply, USB/DC adapter and AC power cord.

1. Turn the meter off.
2. Plug the AC power cord into the AC-DC power supply (Figure 4).
3. Connect the AC-DC power supply to the USB/DC adapter.
4. Connect the USB/DC adapter to the meter.
5. Plug the AC power cord into an AC receptacle.
6. Turn the meter on.

**Figure 4 AC power connection**

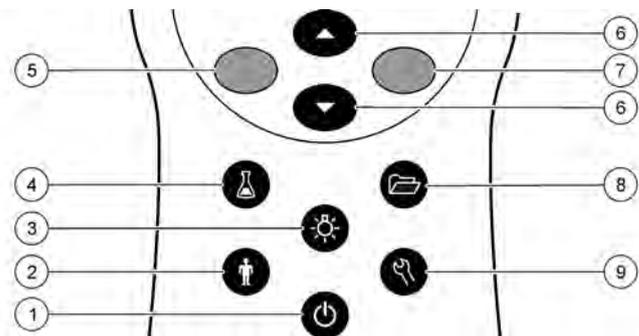


|  |                      |
|--|----------------------|
| 1 USB storage device/printer/Qterty keyboard connection (USB peripheral) | 4 AC-DC power supply |
| 2 Personal computer connection (USB host)                                | 5 AC power cord      |
| 3 USB/DC adapter   |                      |

## User interface and navigation

### User interface

**Figure 5 Keypad description**



|  |  |
|--|--|
| 1 ON/OFF: turn on or turn off the meter                        | 6 UP and DOWN key: scroll through menus, enter numbers and letters or change the reading screen view |
| 2 OPERATOR ID: associate data with an individual               | 7 GREEN/RIGHT key: reads, selects, confirms or stores data   |
| 3 BACKLIGHT: illuminate the display screen                     | 8 DATA LOG: recall or transfer stored data   |
| 4 SAMPLE ID: associate data with a sample location             | 9 METER OPTIONS: change settings, run check standards, view meter information                        |
| 5 BLUE/LEFT key: calibrates, cancels or exits the current menu |  |

### Display description

#### Measurement screen

The meter display shows the concentration, units, temperature, calibration status, operator ID, sample ID, date and time (Figure 6).

Figure 6 Single screen display



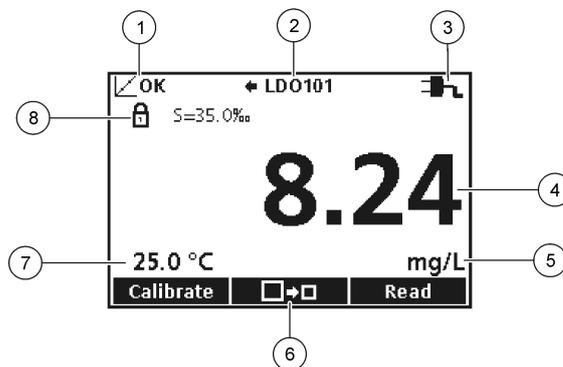
|  |  |
|--|--|
| 1 Calibration status indicator             | 9 Time                                 |
| 2 Main measurement value and unit          | 10 Date                                |
| 3 IntelliCAL probe type and port indicator | 11 Read (OK, Select)                   |
| 4 Battery status                           | 12 Display size icon                   |
| 5 Power source                             | 13 Calibrate (Cancel, Exit)            |
| 6 Sample temperature (°C or °F)            | 14 Sample and operator identification  |
| 7 Secondary measurement unit               | 15 Stability or display lock indicator |
| 8 Tertiary units (for some probes)         |  |

### Big-screen mode

The font size of the sample reading can be increased or decreased with the  $\triangle$  key (Figure 7).

**Note:** When two probes are connected, push and hold the  $\triangle$  key to select the big-screen mode. The big-screen mode can also be selected in the Display Options menu (Refer to [Set the display options](#) on page 20).

Figure 7 Single-screen display—big-screen mode



|  |                                       |
|--|---------------------------------------|
| 1 Calibration status indicator             | 5 Main measurement unit               |
| 2 IntelliCAL probe type and port indicator | 6 Display size icon                   |
| 3 Power source or battery status           | 7 Sample temperature (°C or °F)       |
| 4 Main measurement value                   | 8 Stability or display lock indicator |

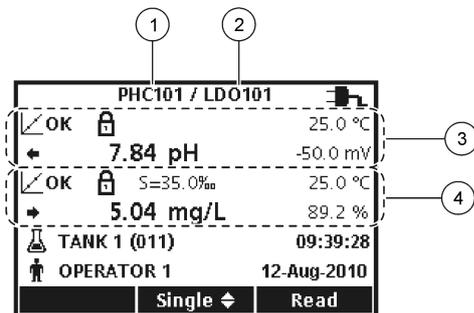
### Dual-screen mode (HQ40d model only)

When two probes are connected to the HQ40d meter, the display can show the reading from both probes simultaneously or show just one probe (Figure 8).

**Note:** For probe calibration, change the screen mode to the single screen mode.

To change the screen mode to single or dual screen, use the  $\triangle$  and  $\nabla$  keys. In dual screen mode, the  $\triangle$  key will select the probe on the left and the  $\nabla$  key will select the probe on the right.

Figure 8 Dual-screen display



|  |  |
|--|--|
| 1 Probe that is connected to port on left  | 3 Measurement information for probe on left  |
| 2 Probe that is connected to port on right | 4 Measurement information for probe on right |

## Navigation

The meter contains menus to change various options. Use the  $\triangle$  and  $\nabla$  keys to highlight different options. Push the GREEN/RIGHT key to select an option. There are two ways to change options:

1. Select an option from a list: Use the  $\triangle$  and  $\nabla$  keys to select an option. If check boxes are shown, more than one option can be selected. Push the BLUE/LEFT key under Select.  
*Note: To deselect check boxes, push the BLUE/LEFT key under Deselect.*
2. Enter an option value using the arrow keys:  
Push the  $\triangle$  and  $\nabla$  keys to enter or change a value.
3. Push the GREEN/RIGHT key to advance to the next space.
4. Push the GREEN/RIGHT key under OK to accept the value.

## Start-up

### Turn the meter on and off

Push the  $\odot$  key to turn on or turn off the meter. If the meter does not turn on, make sure that the batteries are properly installed or that the AC power supply is properly connected to an electrical outlet.

### Change the language

The display language is selected when the meter is powered on for the first time. The language can also be changed from the Meter Options menu.

Access to the language menu can be restricted with the Security Options. Refer to [Security options](#) on page 18.

1. Push the  $\odot$  key and select Language.
2. Select a language from the list.

*Note: While turning the meter on, the language can also be changed when the power key is pushed and held.*

### Change the date and time

The date and time can be changed from the Date & Time menu.

1. Push the  $\odot$  key and select Date & Time.

## 2. Update the time and date information:

| Option | Description |
|--------|-------------|
|--------|-------------|

**Format** Select one of the formats below for the date and time. Use the  $\triangle$  and  $\nabla$  keys to select from the format options.

dd-mm-yyyy 24h

dd-mm-yyyy 12h

mm/dd/yyyy 24h

mm/dd/yyyy 12h

dd-mmm-yyyy 24h

dd-mmm-yyyy 12h

yyyy-mm-dd 24h

yyyy-mm-dd 12h

**Date** Use the  $\triangle$  and  $\nabla$  keys to enter the current date.

**Time** Use the  $\triangle$  and  $\nabla$  keys to enter the current time.

The current date and time will be shown on the display.

Connect a probe after the date and time setup, so that the meter is ready to take a measurement.

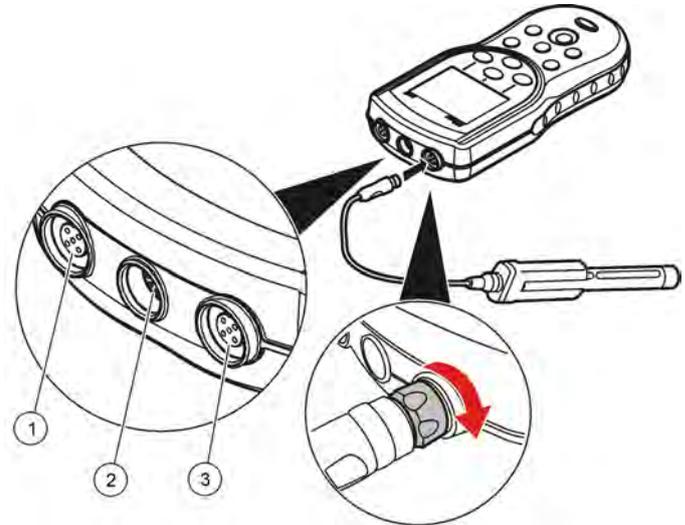
## Connect a probe

1. Make sure the display shows the current time and date. Refer to [Change the date and time](#) on page 11.

**Note:** The time stamp for a probe is set when the probe is first connected to the meter. This time stamp makes it possible to record the probe history and record the time when measurements are made.

2. Plug the probe into the meter ([Figure 9](#)).
3. Push and turn the locking nut to tighten.

**Figure 9** Probe connection



|                                      |                       |                         |
|--------------------------------------|-----------------------|-------------------------|
| 1 Probe connection port (HQ40d only) | 2 USB/DC adapter port | 3 Probe connection port |
|--------------------------------------|-----------------------|-------------------------|

## Standard operations

### About calibration

Each probe uses a different type of calibration solution. Make sure to calibrate the probes frequently to maintain the highest level of accuracy.

**Note:** For step-by-step instructions, refer to the documents that are included with each probe.

The calibration icon  $\angle ?$  can indicate that:

- the calibration timer has expired

- the LDO sensor cap should be replaced
- the calibration is out of range
- the calibration results are outside acceptance criteria settings

## About sample measurements

Each probe has specific preparation steps and procedures for taking sample measurements. For step-by-step instructions, refer to the documents that are included with the probe.

## About check standards

Run Check Standards verifies equipment accuracy by measuring a solution of a known value. The meter will indicate if the Check Standard passed or failed. If the Check Standard fails, the calibration icon  is shown until the probe is calibrated.

The meter can be set to automatically show a reminder for check standard measurement at a specified interval with a specified acceptance criteria. The reminder, value of the check standard, and acceptance criteria can be changed. For step-by-step instructions, refer to the documents that are included with the probe.

## Use a sample ID

The sample ID tag is used to associate measurements with a particular sample location. If assigned, stored data will include the sample ID.

1. Push the  key.
2. Select, create or delete a sample ID:

| Option                        | Description  |
|-------------------------------|--|
| <b>Current ID</b>             | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Sample ID</b> | Enter a name for a new sample ID.  |
| <b>Delete Sample ID</b>       | Delete an existing sample ID.  |

## Use an operator ID

The operator ID tag associates measurements with an individual operator. All stored data will include the operator ID.

1. Push the  key.
2. Select, create or delete an operator ID:

| Option                          | Description  |
|---------------------------------|--|
| <b>Current ID</b>               | Select an ID from a list. The current ID will be associated with sample data until a different ID is selected. |
| <b>Create a New Operator ID</b> | Enter a name for a new operator ID (maximum 10 names can be entered).  |
| <b>Delete Operator ID</b>       | Delete an existing operator ID.  |

## Data management

### About stored data

The following types of data are stored in the data log:

- Sample measurements: stored automatically each time a sample is measured in the Press to Read or Interval Mode. When the continuous measurement mode is used, data is stored only when Store is selected.
- Calibrations: stored only when Store is selected at the end of a calibration. Calibration data is also stored in the IntelliCAL (R) probe.
- Check standard measurements: stored automatically each time a check standard is measured (in the Press to Read or Interval Mode).

When the data log becomes full (500 data points), the oldest data point is deleted when a new data point is added. The entire data log can be deleted to remove data that has already been sent to a printer or PC ( key > Delete Data Log). To prevent deletion of the data log by a user, use the Security Options menu.

## View stored data

The data log contains sample, calibration and check standard data. The most recent data point in the data log is tagged as Data Point 001.

1. Push the  key.
2. Select View Data Log to view the stored data. The most recent data point is shown. The top of the screen shows whether the data is from a sample reading, a calibration or a check standard. Push the  key to view the next most recent data point.

| Option                    | Description   |
|---------------------------|---|
| <b>Reading Log</b>        | Reading Log—shows sample measurements including the time, date, operator and sample ID. Select Details to view the associated calibration data. |
| <b>Calibration Log</b>    | Calibration Log—shows calibration data. Select Details to view additional information about the calibration.                                    |
| <b>Check Standard Log</b> | Check Standard Log—shows check standard measurements. Select Details to view the calibration data that was associated with the measurement.     |

## View stored probe data

Make sure that a probe is connected to the meter. If two probes are connected, select the appropriate probe when prompted.

1. To view the calibration data that is stored in a probe, push the  key and select View Probe Data. The current calibration and calibration history for the probe can be viewed.

| Option                          | Description   |
|---------------------------------|---|
| <b>View Current Calibration</b> | The current calibration information shows the calibration details for the most recent calibration. If the probe has not been calibrated by the user, the factory calibration data is shown. |
| <b>View Calibration History</b> | The calibration history shows a list of the times when the probe was calibrated. Select a date and time to view a summary of the calibration data.  |

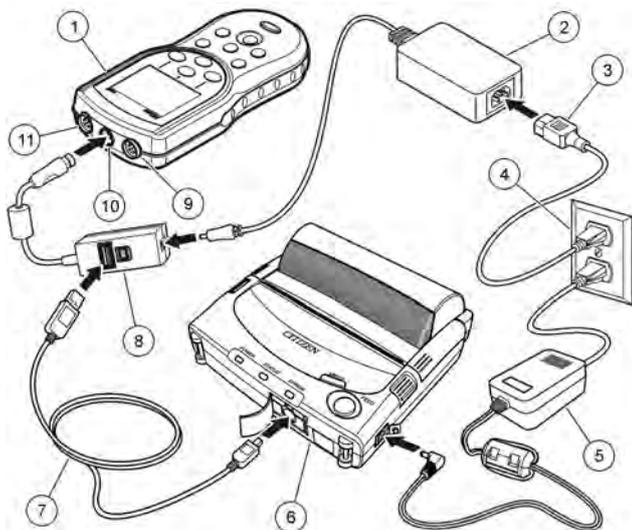
## Print stored data

The meter must connect to AC power to start the USB connection. Make sure that the connection to AC power is made before the meter is powered on.

All data can be sent to a printer. The PD-24 Citizen Printer is compatible with the HQd meters and is FCC Part 15B, Class B compliant with the HQ meters. Other printers may not be compatible. Compatible printers should support a minimum of 72 columns of data, be capable of printing up to 500 continuous data-stream events in 1, 2 and 3 lines of text and fully support code page 437 and code page 850.

1. Turn off the meter. Make sure that the meter is connected to AC power. Refer to [Connect to AC power](#) on page 8.
2. Connect the printer to the meter with a USB cable type A. Refer to [Figure 10](#).
3. Turn on the meter.
4. Push the  key.
5. Select Send Data Log. Wait for the display to show “Transfer Complete” and wait for the printer to stop printing. Disconnect the printer.

**Figure 10 Connection to the printer**



|  |                              |
|--|------------------------------|
| 1 Meter  | 7 USB cable                  |
| 2 AC-DC power supply                               | 8 USB/DC adapter             |
| 3 AC power cord                                    | 9 Port for probe connection  |
| 4 AC power outlet                                  | 10 Port for USB/DC adapter   |
| 5 Power supply for printer (optional)              | 11 Port for probe connection |
| 6 Citizen Printer, FCC Part 15B, Class B compliant |                              |

### Change the report options

Printed reports for sample data can contain 1, 2 or 3 lines of information. Refer to [Examples of printed reports](#) on page 28 for further information.

1. Push the  key. Select Report Options.
2. Select Report Type and select one of the options.

| Option                 | Description  |
|------------------------|--|
| <b>Basic report</b>    | One line of data.  |
| <b>Advanced report</b> | Two lines of data. The first line contains the same information as in the basic report.          |
| <b>Total report</b>    | Three lines of data. The first two lines contain the same information as in the advanced report. |

### Send data to a USB storage device

#### NOTICE

The transfer of a large number of data points will take some time. DO NOT disconnect the USB storage device until the transfer is complete.

Data can be transferred to a USB storage device for storage or transfer to a computer.

1. Turn off the meter. Make sure that the meter is connected to AC power.
2. Plug the USB storage device into the meter before the meter is powered on.
3. Turn on the meter.
4. Push the  key.
5. Select Send Data Log. Wait for the display to show "Transfer Complete" and for any lights on the USB storage device to stop flashing. Then remove the USB device.

**Note:** If the data transfer is slow, reformat the USB storage device to use the file allocation table (FAT) format for the next use.

## Open data files on a PC

Data that has been downloaded to a USB storage device can be transferred to a computer. The data is sent in a text (.txt) file format.

1. Plug the USB storage device into the computer.
2. Find the data file. The file will have the following format: "Meter Serial Number-Data File Type-Date Time". Example: 9999NN000000-SENDDATA-0603131624.TXT
3. Save the data file to a location on the computer.
4. Open a spreadsheet program such as Microsoft® Excel® spreadsheet software.
5. Open the data file from the spreadsheet program. Select the delimited option with comma as the delimiter.

The data will be shown in the spreadsheet program.

**Note:** If an application is used that is not compatible with column headings, the headings can be omitted. Refer to [Remove column headers](#) on page 18.

## Data file description

Data that is saved to a USB storage device and then opened in a spreadsheet application will have multiple columns of data. A description for each of the columns is shown in [Table 1](#).

**Table 1 Spreadsheet column descriptions**

| Column header name | Data description and example values   |
|--------------------|---|
| Type               | Type of data: RD = Reading; CL = Calibration; CK = Check Standard; CH = Calibration History; IC = Current Calibration |
| Parameter          | Type Parameter: LDO, pH, CD (conductivity), ORP, ISE  |
| Date               | Date of reading: stored in user-defined date format   |
| Time               | Time of reading: stored in user-defined format  |
| Operator ID        | Operator ID that was used when the data was recorded. Shows "- -" if no operator ID is used.                          |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name  | Data description and example values   |
|---|---|
| Probe Model   | Model number of probe, for example pH101, CDC401, LDO101  |
| Probe SN  | Probe serial number<br>If two probes are connected to the HQ40d meter, the serial number shows "<" or ">" to identify the port (left or right) the probe was connected to during the reading. |
| Method name   | User-defined name of the probe settings that were used for the reading.   |
| Sample ID   | Sample ID that was used when the data was recorded. Shows "Sample ID" if the default sample ID is used.   |
| Primary Reading Value   | Measured value. Shows "—" if the value was out of range.  |
| Primary Reading Units   | Measurement units, for example pH or $\mu\text{S}/\text{cm}$  |
| Supp Reading 1  | First supplemental reading (example: temperature), if applicable  |
| Supp Units 1  | Units for first supplemental reading, if applicable.  |
| Supp Reading 2  | Second supplemental reading (example: "mV" for pH), if applicable   |
| Supp Units 2  | Units for second supplemental reading, if applicable  |
| Supp Reading 3  | Third supplemental reading, if applicable   |
| Supp Units 3  | Units for third supplemental reading, if applicable.  |
| Reading Setting 1–4   | Any settings that affect the reading, for example "NaCl/Non-Linear"   |
| Any settings that affect the reading, for example "NaCl/Non-Linear" | Reading Message 1–4 Any message that was shown during the measurement, for example "Out of limits".   |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name | Data description and example values  |
|--------------------|--|
| Check Std Value    | Value of the check standard that was used to verify accuracy, for example: 7.00 pH–25 °C (pH, temp-compensated); 7.01 pH (pH, custom)          |
| Check Std Units    | Check standard units, for example $\mu\text{S}/\text{cm}$ .<br><b>Note:</b> pH is not displayed here as it is included in the previous column. |
| Check Std Graph    | Bar-graph showing the measurement in relation to the acceptance limits. Example: "6.901 <— —> 7.101".  |
| Check Std Status   | Status of the check standard reading. Example: "Reading within limits", "Reading outside limits"   |
| Calibration Status | Status of the calibration that is in use. $\checkmark\text{OK}$ = current calibration is valid; $\checkmark?$ = calibration has expired.       |
| Cal Date           | Date of calibration reading: stored in user-defined date format  |
| Cal Time           | Time of calibration reading: stored in user-defined time format  |
| Cal Operator ID    | The operator ID specified when the probe was calibrated. Shows "- -" if undefined.   |
| Cal Slope Name     | Slope (pH or LDO) or cell constant (conductivity)  |
| Cal Slope          | The slope value for the calibration  |
| Cal Slope Aux      | Used by pH to give the percent of nominal slope  |
| Cal Slope Units    | Units of the calibration slope. Example: "mV/pH" for pH  |
| Cal Offset         | Calibration offset value   |
| Cal Offset Units   | Calibration offset units. Example: "mV" for pH.  |
| Cal $r^2$          | Calibration correlation coefficient without a unit (may be blank)  |

**Table 1 Spreadsheet column descriptions (continued)**

| Column header name        | Data description and example values   |
|---------------------------|---|
| Cal Number of Std's       | Number of standards used during calibration, for example 5. May be blank depending on record type, parameter type, and method settings. |
| Cal Std 1                 | Known value of the first calibration standard   |
| Cal Std 1 Units           | Units of the first calibration standard   |
| Cal Std 1 Primary Value   | Measured value of the first calibration standard  |
| Cal Std 1 Primary Units   | Associated units for the calibration measurement  |
| Cal Std 1 Supp Value      | Value of supplemental measurement, for example temperature  |
| Cal Std 2–7               | Known value of additional calibration standards, if used  |
| Cal Std 2–7 Units         | Units of additional calibration standards, if used  |
| Cal Std 2–7 Primary Value | Measured values of additional calibration standards, if used  |
| Cal Std 2–7 Primary Units | Associated units for additional calibration measurements, if used   |
| Cal Std 2–7 Supp Value    | Value of supplemental measurement, for example temperature  |
| Cal Std Supp Units        | Units applicable to all secondary calibration readings. Example: "°C" or "°F" for temperature   |
| Cal Message 1–4           | Any messages about the calibration  |
| Date/Time POSIX           | Date and time of reading stored in POSIX format (number of seconds from January 1, 1970) Example: 1149234913                            |
| Cal Date/Time POSIX       | Date and time of calibration stored in POSIX format (number of seconds from January 1, 1970). Example: 1111320348                       |
| Meter SN                  | Meter serial number used to take the measurement  |

## Remove column headers

When transferred data is viewed in a spreadsheet program, the first row of data contains headings to identify the type of data in each column. If an application or post-processing method is used that is incompatible with the headers, the column headers can be omitted.

1. Push the  key.
2. Select Column Headers.
3. Set the column headers to off.

## Send data directly to a computer

Data can be transferred from any HQd series meter directly to a computer when the HQ40d PC Application is installed. The data can be sent in real time during data collection, or the entire data log can be transferred.

**Note:** The HQ40d PC Application is included on the HQd/IntelliCAL™ Documentation and Advanced Operations CD. The application is also available on <http://www.hach.com/SoftwareDownloads>.

1. Install the HQ40d PC Application on the computer.
2. Turn off the meter. Make sure that the meter is connected to AC power.
3. Connect the PC to the meter with a USB type B cable.
4. Turn on the meter.
5. Open the HQ40d PC Application on the computer. Click on the green triangle in the menu bar to start a connection.
6. Collect the data in real time or transfer the data from the data log:
  - Real time—when a data point is stored in the meter, the result is sent simultaneously to the PC Application (refer to [Set the measurement mode](#) on page 21).
  - Data log—push the  key and select Send Data Log. Wait for the display to show “Transfer Complete.” The data is sent as a comma separated values (.csv) file.

The data is shown in the HQ40d PC Application window.

## Advanced operations

### Security options

The Security Options menu is used to protect the meter setup and method settings from unwanted changes. This menu is available in the Full Access Options menu.

The Setup Measurement Mode, Date and Time, Temperature Units, Language, Probe settings, Delete data log and Security Options screens are disabled in the Operator Access Options menu. All menu options are enabled in the Full Access Options menu.

**Note:** The Full Access Options menu is shown when the  key is pushed when Security Options is OFF, whether or not a password has been set.

When the meter is powered on for the first time and Security Options is selected, the display prompts the user to set a password. Until the meter is shut off, pushing the  key will still display the Full Access Options menu, even after Security Options is turned on and a password has been set. After the meter is shut off and powered on again with Security Options on, the Operator Access Options menu is displayed until a valid password is entered.

Store the password in a safe and accessible place. If the specified password is forgotten and Security Options is turned on, the operator is locked out of the restricted menus. Contact technical support if the password is lost.

### Turn Security Options on

The Security Options and the Set Password options are used together to prevent access to restricted menus.

1. Push the  key and select Security Options.

2. Change the settings as needed to allow or prevent menu access.

| Option                  | Description  |
|-------------------------|--|
| <b>Security Options</b> | When Security Options is on, and a password has been specified, the password is required to enable the Full Access Options menu. If the meter is turned off while Security Options is on, the password is required to enable the Full Access Options menu again when the meter is turned on. |
| <b>Set Password</b>     | Set a password that must be entered to enable the Full Access Options menu. The requirement for password entry is controlled by setting Security Options on or off.  |

### Full access options menu

The Full Access Options menu is displayed when Security Options is OFF or when Security Options is ON and a valid password is entered (Table 2). These options do not need to be changed if the factory default settings are used.

**Table 2 Full Access Options**

| Option                 | Description   |
|------------------------|---|
| (Probe model) settings | Settings such as measurement options, calibration options, check standard options, units and resolution. Refer to the probe documentation for more information.<br><i>Note: A probe must be connected to the meter.</i> |
| Run check standard     | Measure standard solution (available for pH, conductivity, ORP and ISE probes)  |
| Measurement mode       | Press to Read   |
|                        | Interval: Duration and Interval   |
|                        | Continuous  |
| Instrument information | Probe information   |
|                        | Meter information   |
| Security options       | ON or OFF   |
|                        | Set password  |

**Table 2 Full Access Options (continued)**

| Option            | Description           |
|-------------------|-----------------------|
| Display options   | Contrast              |
|                   | Auto shutoff          |
|                   | Backlight             |
|                   | Mode                  |
| Sounds            | Key press             |
|                   | Stability alert       |
|                   | Calibration reminder  |
| Date and time     | Format                |
|                   | Date                  |
|                   | Time                  |
| Temperature units | Set temperature units |
| Language          | Select language       |

### Restricted operator access options menu

The Operator Access Options menu is shown at meter startup when Security Options is ON (Table 3). When a valid password is entered, the menu changes to Full Access Options.

**Table 3 Operator access options**

| Option                 | Description  |
|------------------------|--|
| (Probe model) settings | Only methods (if methods exist) can be selected. Refer to the probe documentation.<br><i>Note: A probe must be connected to the meter.</i>   |
| Run check standard     | Measure standard solution (available for pH, conductivity, ORP and ISE probes)<br><i>Note: A probe must be connected to use this option.</i> |

**Table 3 Operator access options (continued)**

| Option                 | Description          |
|------------------------|----------------------|
| Instrument information | Probe information    |
|                        | Meter information    |
| Access password        | Enter password       |
| Display options        | Contrast             |
|                        | Auto shutoff         |
|                        | Backlight            |
|                        | Mode                 |
| Sounds                 | Key press            |
|                        | Stability alert      |
|                        | Calibration reminder |

### Set the display options

Use Display Options to change the display contrast, battery saving auto-shutoff options, the backlight option or the detailed or big reading screen mode.

1. Push the  key and select Display Options.
2. Select which display option to change.

| Option              | Description  |
|---------------------|--|
| <b>Contrast</b>     | Adjust the contrast of the display. The lightest setting is 0 and the darkest setting is 9.  |
| <b>Auto-shutoff</b> | To maximize battery life, set a time period after which the meter will automatically power off if no key is pushed (1, 2, 5, 10, 30 min, 1 h, 2 h or never). Auto-shutoff is not active when the meter is connected to AC power or in the Interval Reading Mode. |

| Option           | Description  |
|------------------|--|
| <b>Backlight</b> | The display backlight is turned off when the  key is pushed. Is it possible to set a time period after which the backlight will automatically power off if no key is pushed.  |
| <b>Mode</b>      | Select Detailed or Big screen size. Detailed will show more information with smaller numbers and text. Big will show less information with larger numbers and text.<br><b>Note:</b> The screen size can also be selected from the measure mode (refer to <a href="#">Display description</a> on page 9). |

### Set the sound options

The meter can make an audible sound when a key is pushed, when stability is reached or when the calibration reminder is due. The meter also makes an audible sound when it begins transferring data to a USB storage device and again when the data transfer is complete.

1. Push the  key and select Sound.
2. Choose which events will produce an audible sound. Multiple items can be selected.

| Option                 | Description  |
|------------------------|--|
| <b>Key Press</b>       | The meter will make an audible sound whenever a key is pushed.   |
| <b>Stability Alert</b> | The meter will make an audible sound whenever measurement stability is reached.  |
| <b>Cal reminder</b>    | The meter will make an audible sound when calibration is due.<br><b>Note:</b> Refer to <a href="#">Set the probe calibration reminder</a> on page 20 to set the calibration reminder to on or off. |

### Set the probe calibration reminder

Make sure that a probe is connected to the meter.

1. Push the  key and select the probe settings.
2. Select Modify Current Settings.
3. Select Calibration Options.

#### 4. Select Calibration Reminder.

| Option                      | Description   |
|-----------------------------|---|
| <b>Calibration reminder</b> | Reminder repeat: Off, 2 h, 4 h, 8 h, 2 d, 5 d, 7d<br>Expires: Immediately, Reminder + 30 min, Reminder + 1 hr, Reminder + 2 hr, Continue Reading<br><br>The meter can be set to make an audible sound when calibration is due. Calibration expires after a specified time set by the user.<br><b>Note:</b> <i>The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.</i> |

### Change the temperature units

To select degrees Celsius or Fahrenheit:

1. Push the  key and select Temperature Units.
2. Select the Celsius or Fahrenheit option.

### Set the measurement mode

One of three modes can be used to specify when measurements are taken and how the data is stored. When a data point is stored, the result is sent simultaneously to any device (PC/printer/ USB storage device) that is connected to the meter.

1. Push the  key and select Measurement Mode.
2. Select Mode.
3. Select one of the measurement modes.

| Option               | Description  |
|----------------------|--|
| <b>Press to Read</b> | The sample is measured only when the GREEN/RIGHT key under Read is pushed. Data is stored in the data log automatically when the stability criteria are met. |

| Option            | Description  |
|-------------------|--|
| <b>Interval</b>   | The sample is measured at regular intervals for a specified duration (refer to <a href="#">Set auto measurement intervals</a> on page 21). Data is stored in the data log automatically. |
| <b>Continuous</b> | The sample is measured continuously. Data is stored in the data log only when the GREEN/RIGHT key under Store is pushed.   |

### Set auto measurement intervals

When the measurement mode is set to Interval, the time intervals and duration must be specified. Measurements are stored at the user-defined intervals whether or not stability criteria are met.

**Note:** *Use of an external USB storage device or direct printer connection while in Interval Measurement mode prevents data from being over-written in the data log. Data points are over-written on a First In/First Out basis. Refer to [Prevent data log overflow in interval mode](#) on page 22.*

1. Push the  key and select Measurement Mode.
2. Select Mode.
3. Select Interval as the Measurement Mode.
4. Select Duration and select the total time that measurements will be taken for (15 min, 30 min, 1 h, 4 h, 8 h, 24 h, 48 h or no limit).
5. Select Interval and select how often measurements will be taken (every 10 s, 30 s, 1 min, 5 min, 15 min or 30 min).

### Start interval measurements

During interval measurements, the meter goes into a standby state between readings to conserve power. The auto-shutoff option is disabled. Measurements stop when the selected interval duration has passed. The auto-shutoff option then becomes active.

Interval measurements are suspended for calibrations, check standard measurements or when the  key is pushed. Interval measurements resume when returning to the measurement screen.

1. From the Main Measurement screen, select Start to begin interval measurements. The screen will show "Recording" and the remaining

time of the duration. The sample number automatically advances when each reading is taken.

2. To stop interval measurements, select Stop.
3. To repeat the interval measurement after it has been stopped or completed, select Start.

### Prevent data log overflow in interval mode

When measurements are taken at specified intervals (Table 4), each result is automatically stored. The meter can store up to 500 data records. When 500 records have been stored, data is replaced on a first-in, first-out basis. To prevent loss of data, connect the meter to a PC/printer/USB storage device.

**Note:** Stop interval measurements before changes are made to a method or to meter settings.

**Table 4 Recommended interval/duration pairs**

| Interval   | Duration |
|------------|----------|
| 10 seconds | 1 hour   |
| 30 seconds | 4 hours  |
| 1 minute   | 8 hours  |
| 5 minutes  | 24 hours |

**Note:** When 2 probes are connected to the meter, use the next lowest recommended duration time. For example, for a 30-second interval, set the duration to 1 hour to prevent data log overload with 2 probes.

### View instrument information

The instrument information menu shows specific information such as the serial number for the meter or IntelliCAL (R) probe(s).

1. Push the  key and select Instrument Information.

2. Select (Probe model) Information or Meter Information.

| Option                   | Description   |
|--------------------------|---|
| <b>Probe information</b> | The Probe Information screen shows the probe model number, serial number, software version and date of first use. For LDO and LBOD probes, the lot code for the sensor cap and the remaining time before sensor cap replacement is shown.<br><b>Note:</b> A probe must be connected to the meter. |
| <b>Meter information</b> | The Meter Information screen shows the meter model number, serial number, software version and memory information. The amount of memory used and the number of available user method settings, operator IDs and sample IDs is shown.  |

### Update the meter software

A USB storage device that contains software update files is used to update the meter software.

**Note:** The meter must be turned off and then on again before the software update will begin. The software update initiates upon meter startup after the USB device is correctly inserted.

#### NOTICE

Do not remove the USB device until the “Update complete” message is shown. The meter can become damaged if the USB device is removed before the update process is complete.

1. Save stored data from the data log to a USB storage device or to a PC. Refer to [Send data to a USB storage device](#) on page 15 and [Send data directly to a computer](#) on page 18.
2. Turn off the meter.
3. Connect the USB/DC adapter, AC-DC power supply and cord ([Figure 4](#) on page 9).
4. Insert the USB storage device that contains the software update files into the USB/DC adapter.
5. Turn on the meter.  
The update process starts. The display will show “Updating meter to <firmware version>”. After an interval, the display changes to

“Updating files, please wait...” In addition, the display will show a rotating flask and emit a periodic audio signal during the update process.

*Note: A large capacity USB storage device increases the time required for completion of the update process, even if most of the device memory is empty.*

6. Wait for the meter to finish the software update. When the update process is complete, the message “Update complete. Remove USB device” is shown. The meter will turn off after the USB device has been removed.
7. Repeat steps 1 through 6 to update the software in other HQd meters as necessary.

### Download software updates

The latest software version can be obtained online:

1. Go to [www.hach.com/SoftwareDownloads](http://www.hach.com/SoftwareDownloads).
2. Click on Lab System Software/Software Update Downloads.
3. Click on HQd Series Meter Software Update and open or save the update files.
4. Open the ReadMeFirst.txt file and follow the instructions to transfer the update files to a USB storage device.
5. Follow the instructions in [Update the meter software](#) on page 22 to update the software in the meter.

### Transfer method settings

Probe settings that have been changed by the user for measurements, calibrations or check standards (Meter Options > (Probe Model) Settings > Modify Current Settings) can be copied to a USB storage device. The USB device can then be used to transfer the method settings to other HQd meters that accept the same probes.

#### NOTICE

Make sure the USB storage device does not contain HQd meter software update files to prevent unintentional updates.

1. Turn off the meter.
2. Connect the meter to AC power ([Figure 4](#) on page 9).

3. Plug the USB storage device into the USB/DC adapter before the meter is powered on.
4. Turn on the meter.
5. Push the  key and select Transfer Methods. If the USB device already contains a method settings file, an option to export or import methods is shown. Select Export Methods.
6. In the Select Methods to Export screen, select one or more methods to copy to the USB device. A check mark is shown next to each selected method.
7. Select OK. The settings are copied to the USB storage device. When complete, the Transfer Summary screen is shown.
8. Connect the AC power and USB device to a meter that will receive the method settings. Turn the meter on.
9. Push the  key and select Transfer Methods. If the USB device already contains a method settings file, an option to export or import methods is shown. Select Import Methods.
10. In the Select Methods to Import screen, select one or more methods to transfer to the meter. A check mark is shown next to each selected method.
11. Select OK. The user method settings are transferred from the USB storage device to the meter. When complete, the Transfer Summary screen is shown. Select details to view additional information about the transfer.
12. Disconnect the USB storage device from the meter.

### Bi-directional Communication between the meter and a PC

For measurement automation the meter can be used to implement a command set for meter remote control or automated data transfer. The command set can be used to perform minimal configuration and to control the meter. To set up the meter for communication and control, refer to [About meter configuration](#) on page 24. For additional information and the command set contact Technical Support.

#### About meter control

The virtual serial connection can be used to control meter functions from a PC. For example, the functions include starting a measurement cycle,

turning off the meter and sending the entire measurement (including calibrations) to the PC or other information management system.

### About meter configuration

To use the meter communication and control from the PC, an INF file must be installed.

1. If the meter software is not numbered version 2.0.0.710 or higher, download the latest software from <http://www.hach.com/SoftwareDownloads>.
2. Open the Zip file.
3. Copy the INF file from the software upgrade package to a convenient location on the PC.  
**Note:** *The INF file must be installed to use the meter manual control from a PC.*
4. Turn on the meter.
5. Push the  key and select Instrument Information.
6. Select USB Device Type and then select Virtual Serial to use the virtual serial port on the meter.
7. Push OK. The meter will automatically restart to complete the setting change.
8. Connect the meter with the USB cable to the PC and turn on the meter. Windows XP starts the "Found New Hardware Wizard".
9. Select "No, not at this time" to the query "Can Windows connect to Windows Update to search for software?"
10. Click Next. The next wizard screen will prompt.
11. Select "Install from a list or specific location (Advanced)" to the query "What do you want the wizard to do?"
12. Click Next. The next wizard screen will prompt.
13. Select the option "Search for the best driver in these locations."
14. Uncheck the "Search removable media (floppy, CD-ROM)" option and select the "Include this location in the search:" and click the "Browse" button.
15. Select the INF folder or location and click OK.
16. Click Next. The new software will be installed.

17. Click Finish to complete the Found New Hardware Wizard for: HQd Meter - Virtual Serial Port.
18. To make sure that the installation succeeded, go to Computer Management>Device Manager>Ports. The new installed port is listed as HQd Meter - Virtual Serial Port (COM#).
19. The meter is now ready for communication with PC-based systems using the Virtual Serial port. A program interface must be developed by the user for the command set used to control the meter functions from the PC. Contact Technical Support for more information and command set documentation.

## Maintenance

### ⚠ CAUTION

Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

### Clean the meter

The meter is designed to be maintenance-free and does not require regular cleaning for normal operation. Exterior surfaces of the meter may be cleaned as necessary.

1. Wipe the surface of the meter with a damp cloth.
2. Use a cotton-tipped applicator to clean or dry the connectors.

### Replace the batteries

### ⚠ WARNING

Explosion Hazard. Improper battery installation can cause release of explosive gases. Insert batteries in proper orientation only. Use only new batteries from the same manufacturer and lot.

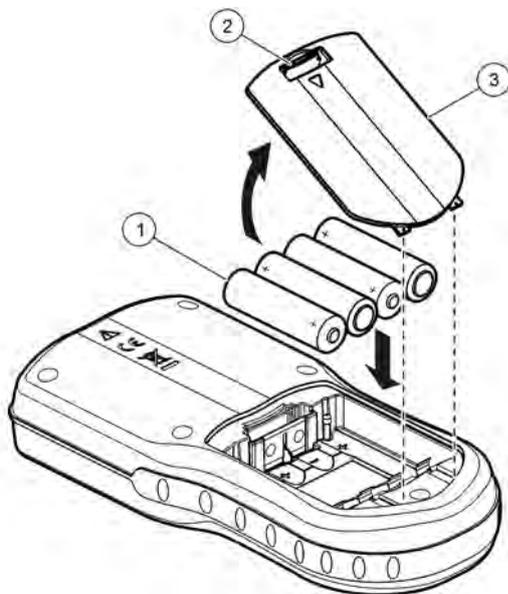
### NOTICE

Make sure that all meter connectors stay dry. Use a dry towel to remove liquid from the connectors.

For battery replacement refer to [Figure 11](#).

1. Pull the release tab on the battery cover and the remove the cover.
2. Remove the batteries.
3. Install 4 AA alkaline or 4 AA nickel metal hydride (NiMH) batteries. Make sure that the batteries are installed in the correct polarity.
4. Replace the battery cover.

**Figure 11 Battery replacement**



|             |               |                 |
|-------------|---------------|-----------------|
| 1 Batteries | 2 Release tab | 3 Battery cover |
|-------------|---------------|-----------------|

## Troubleshooting

Refer to the following table for common problem messages or symptoms, possible causes and corrective actions.

| Error/Warning                     | Description                                   | Solution   |
|-----------------------------------|---|--|
| <b>Connect a Probe</b>            | Probe disconnected or connected improperly    | Tighten the locking nut on the probe connector.<br><br>Disconnect the probe and then connect the probe again                                 |
|                                   | Software not updated to most current version  | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |
|                                   | Problem with probe                            | Connect a different IntelliCAL probe to verify if problem is with probe or meter   |
| <b>Probe Not Supported</b>        | Probe disconnected or connected improperly    | Tighten the locking nut on the probe connector.<br><br>Disconnect the probe and then connect the probe again.                                |
|                                   | Software not updated to most current version  | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |
|                                   | Problem with probe                            | Connect a different IntelliCAL probe to the meter to verify if problem is with the meter or the probe.                                       |
|                                   | HQd meter does not support IntelliCAL probe   | Contact Technical Support.   |
| <b>Bootloader X.X.XX.XX error</b> | Software not updated to most current version. | Update the meter software to the most current version:<br><a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> |

| Error/Warning   | Description   | Solution  |
|---|---|---|
| <b>0 days remaining message (For LDO and LBOD only)</b> | LDO or LBOD sensor cap used for 365 days                      | Replace the LDO or LBOD sensor cap and iButton®.  |
|   | There are 0 days remaining in the life of the LDO sensor cap. | Replace the LDO sensor cap. Calibration will be allowed. However, the calibration icon and question mark will appear on the measurement screen even if the calibration has passed.  |
|   | Meter set to incorrect date and time                          | <ol style="list-style-type: none"> <li>1. Disconnect the probe from the meter.</li> <li>2. Remove the meter batteries.</li> <li>3. Install the meter batteries properly. Follow the polarity markings.</li> <li>4. Set correct date and time in the meter.</li> <li>5. Connect the probe and verify that message has been removed.</li> </ol> |
|   | Software not updated to most current version                  | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads  |
| <b>Meter not configured</b>                             | Software error(s)   | If the meter starts up correctly, back up the Data Log and Method files. Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads   |

| Error/Warning  | Description                                  | Solution   |
|--|--|--|
| <b>Meter will not power on or powers on intermittently</b>     | Batteries are not installed correctly        | Examine battery orientation to make sure the batteries follow the polarity markings. Test again. |
|  |  | Clean the battery terminals, then install new batteries.   |
|  |  | Connect AC power adapter and test again.   |
|  | Software not updated to most current version | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads     |
|  | Damaged meter                                | Contact Technical Support.   |
| <b>Unable to access Full Access Options screen</b>             | Correct password has not been entered        | Contact Technical Support.   |
| <b>Unable to access Full or Operator Access Options screen</b> | Software not updated to most current version | Update the meter software to the most current version:<br>www.hach.com/<br>SoftwareDownloads     |

## Replacement parts and accessories

**Note:** Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.

### Replacement parts

| Description                       | Item no. |
|-----------------------------------|----------|
| AC Power/USB Adapter Kit, 115 VAC | 5826300  |
| AC Power/USB Adapter Kit, 230 VAC | 5834100  |
| Batteries, Alkaline AA            | 1938004  |
| Battery cover                     | 9245500  |

## Replacement parts and accessories (continued)

| Description  | Item no.                                 |
|--|--|
| Battery Contact, dual fixed  | 5188400                                  |
| Battery Contact, dual spring   | 5188800                                  |
| Cable, USB 6 ft (1.8 m), Type A male, Type B male  | 5924000                                  |
| Field Kit (includes Protective Glove Kit for meter and five 120-mL sample cups)  | 5825800                                  |
| Field Case for 2 probes with up to 5 m cables (10 m total). Includes empty case, insert for meter and probe storage, 4 containers for sample collection. | 8505500                                  |
| Field Case for 3 probes with up to 5 m cables (15 m total). Includes empty case, insert for meter and probe storage, 4 containers for sample collection. | 8505501                                  |
| Field Case for 2 probes with greater than 5 m cables (30 m total). Includes empty case, insert for meter with protective glove.                          | 8505600                                  |
| Keyboard (QWERTY), USB type  | LZV582                                   |
| Printer, Citizen PD-24 USB printer, 120–220 VAC  | <b>US:</b> 2960100<br><b>EU:</b> 5835900 |
| Printer Paper for Citizen PD-24, thermal, 5/pk   | 5836000                                  |
| Probe Clips, color coded (5 colors, 2 clips of each color), 10/pk  | 5818400                                  |
| Probe Depth Marker (rugged cables)   | 5828610                                  |
| Probe Holder, standard (fits on protective glove)  | 5829400                                  |
| Protective Glove Kit for meter   | 5828700                                  |
| Universal Probe Stand for standard IntelliCAL Probes   | 8508850                                  |
| Meter Stand for Portable HQd meters  | 4754900                                  |

## Examples of printed reports

Printed reports contain a report header and all stored data for samples, check standards and calibrations.

### Report header

The first line of a report shows the report header (Figure 12).

Figure 12 Report header

9999RV123456-SENDDATA-0512131618.TXT  
RD LDO 16:14:32 12-08-10 6.59 mg/L NORTH TANK -05 JOSEPH L

|                                    |                                    |
|------------------------------------|------------------------------------|
| 1 Meter serial number <sup>1</sup> | 3 Date and time, 24 h (YYMMDDhhmm) |
| 2 Report label                     | 4 File type extension              |

### Data reports

Sample data can be printed in a basic, advanced or total report format.

- Total report—refer to [Figure 13](#).
- Advanced report—refer to [Figure 14](#).
- Basic report—refer to [Figure 15](#).

<sup>1</sup> The probe serial number is shown on calibration history and current calibration reports.

Figure 13 Basic report for sample data—1 line

9999RV123456-SENDDATA-0512131618.TXT

RD LDO 16:14:32 12-08-10 6.59 mg/L NORTH TANK -05 JOSEPH L

|  |   |
|--|---|
| 1 Data type (RD=reading)                         | 6 Units   |
| 2 Parameter (pH, LDO, etc.)                      | 7 Sample ID: user-defined; shows "SAMPLE ID" if undefined |
| 3 Time (hh:mm:ss in 24 h or user-defined format) | 8 Sample ID counter                                       |
| 4 Date (DD-MM-YY or user-defined format)         | 9 Operator ID: user-defined; shows "- -" if undefined     |
| 5 Measured value                                 |   |

Figure 14 Advanced report for sample data—2 lines

9999RV123456-SENDDATA-0512131618.TXT

RD LDO 16:14:32 12-08-10 6.59 mg/L PLATTE BDGE2022 JULIE

LDO101 >52040259 24.1°C, 96.2%, 831hPa S = 0.0%

Out of limits

|  |  |
|--|--|
| 1 Probe model  | 4 Additional units: shows all additional units associated with the reading.      |
| 2 Error message (if applicable)  | 5 Probe settings: shows the highest-priority setting associated with the reading |
| 3 Probe serial number (a "<" or ">" on the HQ40d meter indicates the probe position) |  |

Figure 15 Total report for sample data—3 lines

```

9999RV123456-SENDDATA-0512131618.TXT
RD pH 07:52:47 12-08-10 3.95 pH PLATTE BDGE2046 JULIE
pHC301 <06047527 21.8°C,167.0mV
Default CAL12:52 12-08-10 58.36mV/pH -9.3mV MICHAEL

```

|  |  |
|--|--|
| 1 Method name for probe settings   | 4 Calibration slope/ratio/constant   |
| 2 Time of calibration, prefaced by “CAL” and displayed as hh:mm in 24 h (or user-defined) format | 5 Offset—contents vary depending on type of parameter and user settings. May be blank. |
| 3 Date of calibration (DD-MM-YY or user-defined format)  | 6 Operator ID: user-defined; shows “- -” if undefined                                  |

**Check standard reports**

Check standard data is printed with 1 line of information (Figure 16)

Figure 16 Check standard report

```

9999RV123456-SENDDATA-0512131618.TXT
ST pH 15:24:07 12-08-10 5.71 pH Fail GEORGE

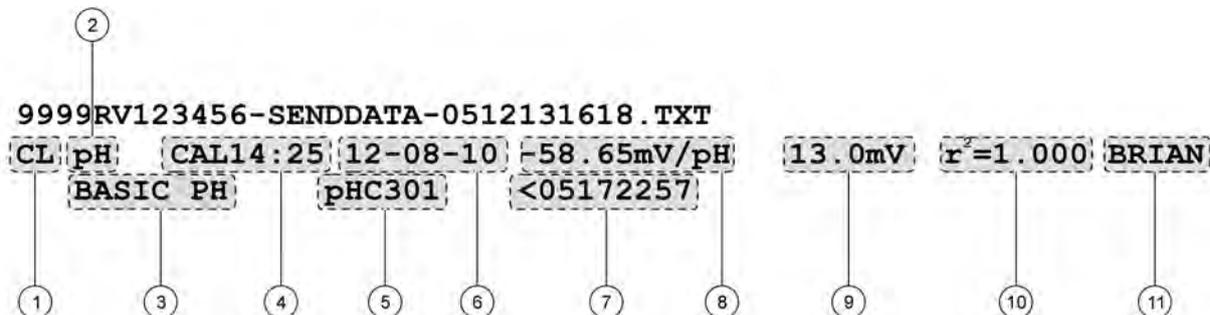
```

|  |   |
|--|---|
| 1 Report type (ST = check standard)              | 5 Measured value  |
| 2 Report type (ST = check standard)              | 6 Units   |
| 3 Time (hh:mm:ss in 24 h or user-defined format) | 7 Check standard status: Pass/Fail based on the acceptance criteria |
| 4 Date (DD-MM-YY or user-defined format)         | 8 Operator ID: user-defined; shows “- -” if undefined               |

## Calibration reports

Calibration data is printed when the data log is sent to the printer or when probe data is sent to the printer. Calibration data is printed with 2 lines of information (Figure 17).

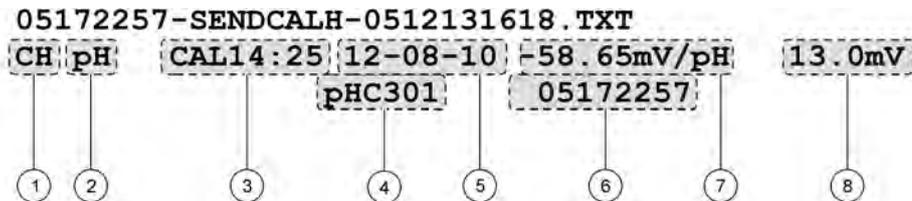
Figure 17 Calibration report



|  |   |
|--|---|
| 1 Report type (CL = calibration, IC = current calibration)                                       | 7 Probe serial number (a "<" or ">" on the HQ440d meter indicates the probe position)   |
| 2 Parameter (pH, LDO, etc.)  | 8 Calibration slope/ratio/constant  |
| 3 Method name for probe settings   | 9 Offset—contents vary depending on type of parameter and user settings. May be blank.  |
| 4 Time of calibration, prefaced by "CAL" and displayed as hh:mm in 24 h (or user-defined) format | 10 r <sup>2</sup> : contents vary depending on type of parameter being read, configuration of specific method and number of calibration standards used. May be blank. |
| 5 Probe model  | 11 Operator ID: user-defined; shows "- -" if undefined  |
| 6 Date of calibration (DD-MM-YY or user-defined format)  |   |

The calibration history can be printed from the probe data menu. Refer to Figure 18.

**Figure 18 Calibration history report**



|  |  |
|--|--|
| 1 Report type (CH=calibration history)   | 5 Date of calibration (DD-MM-YY or user-defined format)                                |
| 2 Parameter (pH, LDO, etc.)  | 6 Probe serial number (a "<" or ">" on the HQ40d meter indicates the probe position).  |
| 3 Time of calibration, prefaced by "CAL" and displayed as hh:mm in 24 h (or user-defined) format | 7 Calibration slope/ratio/constant   |
| 4 Probe model  | 8 Offset—contents vary depending on type of parameter and user settings. May be blank. |

**A**

AC power connection ..... 8  
 auto-shutoff ..... 20

**B**

backlight ..... 20  
 Bi-directional Communication ..... 23  
 big screen mode ..... 10, 20

**C**

calibration ..... 12  
     dual-screen mode ..... 10  
     probe reminder ..... 20  
     reminder ..... 20  
 check standards ..... 13  
 contrast, display ..... 20

**D**

data file descriptions ..... 16  
 data log ..... 23  
     prevent data loss ..... 22  
     printing ..... 14  
     transfer data to PC ..... 18, 24  
 data log, stored data ..... 14  
 date and time  
     changing ..... 11  
 detailed screen mode ..... 20  
 display description ..... 20  
 dual-screen mode  
     calibration ..... 10

**I**

interval measurements ..... 21

**M**

measurement modes ..... 21  
 menu navigation ..... 11  
 modes  
     screen ..... 20

**O**

operator ID ..... 13

**P**

power ..... 8  
 printing ..... 14  
 probes  
     connecting ..... 12  
     stored data ..... 14

**S**

sample ID ..... 13  
 screen modes ..... 9  
 security options ..... 18  
     restrict menu access ..... 19  
 software  
     install PC Application software ..... 18  
     update meter software ..... 22  
 sounds, turn on or off ..... 20  
 stored data ..... 13, 14  
     file descriptions ..... 16  
     probe ..... 14

## Index

---

### T

|                             |        |
|-----------------------------|--------|
| transfer data               |        |
| to PC .....                 | 16, 18 |
| to USB storage device ..... | 15     |
| transfer data to USB device |        |
| data log .....              | 23     |
| troubleshooting .....       | 25     |

### U

|                         |    |
|-------------------------|----|
| USB storage device      |    |
| file descriptions ..... | 16 |
| transfer data to .....  | 15 |

**HACH COMPANY World Headquarters**

P.O. Box 389, Loveland, CO 80539-0389 U.S.A.  
Tel. (970) 669-3050  
(800) 227-4224 (U.S.A. only)  
Fax (970) 669-2932  
orders@hach.com  
www.hach.com

**HACH LANGE GMBH**

Willstätterstraße 11  
D-40549 Düsseldorf  
Tel. +49 (0) 2 11 52 88-320  
Fax +49 (0) 2 11 52 88-210  
info@hach-lange.de  
www.hach-lange.de

**HACH LANGE Sàrl**

6, route de Compois  
1222 Vézenaz  
SWITZERLAND  
Tel. +41 22 594 6400  
Fax +41 22 594 6499





**Attachment 1B – Hach CDC401 Conductivity Probe User Manual**

# User Manual

## Conductivity Probe: Model CDC40101, CDC40103, CDC40105, CDC40110, CDC40115 or CDC40130

### Safety information

#### Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

|   |   |
|---|---|
|  | <p>Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/98/EC), European electrical equipment users must now return old or end-of-life equipment to the Producer for disposal at no charge to the user.</p> <p><b>Note:</b> For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</p> |
|---|---|

### Specifications

**Note:** Specifications are subject to change without notice.

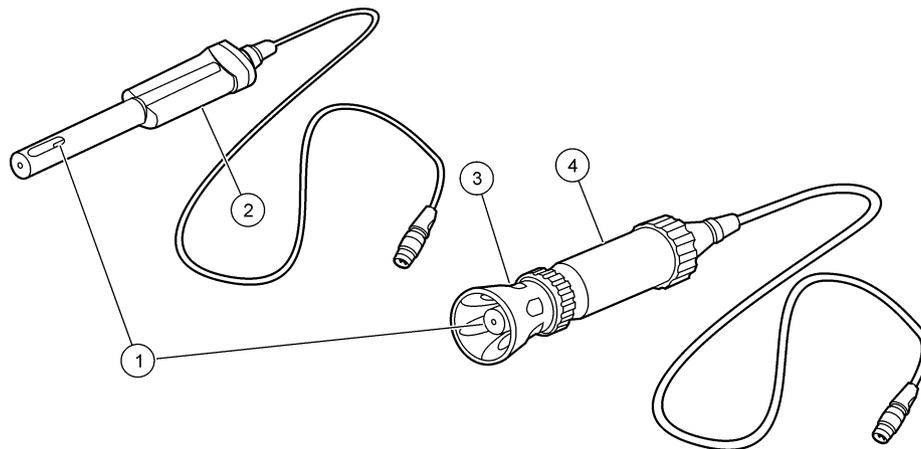
| Specifications                     | Details  |
|------------------------------------|--|
| Probe type                         | Graphite, 4-pole conductivity probe  |
| Conductivity range                 | 0.01 $\mu\text{S}/\text{cm}$ to 200.0 $\text{mS}/\text{cm}$  |
| Cell constant                      | 0.40 $\text{cm}^{-1} \pm 10\%$   |
| Conductivity resolution            | 0.0 to 19.99 $\mu\text{S}/\text{cm}$ : 0.01 $\mu\text{S}/\text{cm}$<br>20.0 to 199.9 $\mu\text{S}/\text{cm}$ : 0.1 $\mu\text{S}/\text{cm}$<br>200 to 1999 $\mu\text{S}/\text{cm}$ : 1 $\mu\text{S}/\text{cm}$<br>2.00 to 19.99 $\text{mS}/\text{cm}$ : 0.01 $\text{mS}/\text{cm}$<br>20.0 to 200.0 $\text{mS}/\text{cm}$ : 0.1 $\text{mS}/\text{cm}$ |
| Conductivity accuracy              | $\pm 0.5\%$ of reading   |
| TDS (total dissolved solids) range | 0 to 50,000 $\text{mg}/\text{L}$ as NaCl   |
| TDS resolution                     | 0.0 to 19.99 $\text{mg}/\text{L}$ : 0.01 $\text{mg}/\text{L}$<br>200 to 1999 $\text{mg}/\text{L}$ : 1 $\text{mg}/\text{L}$<br>2.00 to 19.99 $\text{g}/\text{L}$ : 0.01 $\text{g}/\text{L}$<br>20.0 to 50.0 $\text{g}/\text{L}$ : 0.1 $\text{g}/\text{L}$   |
| TDS accuracy                       | $\pm 0.5\%$ of reading   |
| Sample salinity range              | 0 to 42 (ppt) ( $\text{‰}$ )   |
| Salinity resolution                | 0.01 parts per thousand (ppt) ( $\text{‰}$ )   |
| Salinity accuracy                  | $\pm 1$ parts per thousand (ppt) ( $\text{‰}$ )  |
| Temperature accuracy               | $\pm 0.3$ $^{\circ}\text{C}$ ( $\pm 0.54$ $^{\circ}\text{F}$ )   |
| Operating temperature range        | -10 to 110 $^{\circ}\text{C}$ (14 to 230 $^{\circ}\text{F}$ )  |
| Storage temperature range          | 5 to 40 $^{\circ}\text{C}$ (41 to 104 $^{\circ}\text{F}$ )   |
| Minimum sample depth               | 45 mm (1.77 in.)   |

| Specifications   | Details   |
|------------------|---|
| Dimensions       | Diameter: 14 mm (0.55 in.)<br>Length: 103 mm (4.06 in.)<br>Total length: 220 mm (8.66 in.)<br>Cable length (standard): 1 or 3 m (3.28 or 9.84 ft)<br>Cable length (rugged): 5, 10, 15 or 30 m (16.40, 32.81, 49.21 or 98.42 ft) |
| Cable connection | M12 digital output and connector compatible with HQd meters   |

## Product overview

The CDC401 series probe is a graphite, 4-pole conductivity probe (Figure 1). The CDC40101 or CDC40103 standard conductivity probe is available with a 1 or 3 m (3.28 or 9.84 ft) cable and is intended for laboratory use. The CDC40105, CDC40110, CDC40115 or CDC40130 rugged conductivity probe is available with a 5, 10, 15 or 30 m (16.40, 32.81, 49.21 or 98.42 ft) cable. The probe measures electrical conductivity, salinity, resistivity or total dissolved solids (TDS) in wastewater, drinking water and general applications.

**Figure 1 Probe overview**



|   |   |   |   |
|---|---|---|---|
| 1 | Temperature sensor and 4-pole graphite design conductivity cell | 3 | Shroud (rugged model)                       |
| 2 | Standard probe (1 or 3 meter cable)                             | 4 | Rugged probe (5, 10, 15, or 30 meter cable) |

## Calibration

### Before calibration:

The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.

It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured to use the same calibration options.

To view the current calibration, push , select View Probe Data, then select View Current Calibration.

If any two probes are connected, push the **UP** or **DOWN** arrow to change to the single display mode in order to show the Calibrate option.

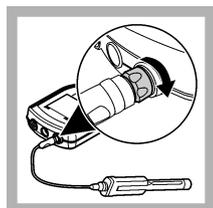
If a rugged probe, remove the shroud from the probe (refer to [Remove the shroud](#) on page 8).

### Calibration notes:

- Do not touch the tip of the probe.
- Additional conductivity standards can be selected in the Calibration Options menu.
- The cell constant is derived from the calibration standard.

- Do not dilute conductivity standards and samples.
- The meter will automatically correct the calibration measurement to the selected reference temperature (20 or 25 °C) using the default NaCl-based, non-linear temperature coefficient. Settings can be changed in the CDC401 Calibration Options menu.
- The calibration is recorded in the probe and the data log. The calibration is also sent to a PC, printer or flash memory stick if connected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a calibration error occurs, refer to [Troubleshooting](#) on page 9.

#### Calibration procedure:



1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.



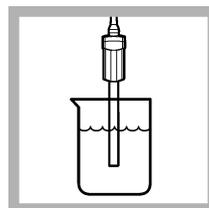
2. Push **Calibrate**. The display shows the conductivity standard solution that is necessary for calibration.



3. Add fresh conductivity standard solution to a beaker or an appropriate container.



4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.



5. Put the probe in the standard solution and stir gently. Make sure that the temperature sensor is completely submerged.



6. Push **Read**. Stir gently. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the standard. The display shows the standard solution value that has just been read and shows the temperature corrected value when the reading is stable.



7. Push **Done** to view the calibration summary.



8. Push **Store** to accept the calibration and return to the measurement mode. If a rugged probe, install the shroud on the probe (refer to [Install the shroud](#) on page 9).

## Sample measurement

### Before measurement:

The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.

If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the HQd meter manual for more information.

To display other parameters (TDS, salinity or resistivity), push , select CDC401 Settings and then Current Method.

When using the CDC401 probe with the LDO101 probe to do auto salinity correction, set the CDC401 probe to measure salinity. Refer to [Change measurement options](#) on page 6.

Regular calibration is required for the best measurement accuracy (refer to [Calibration](#) on page 2).

If a rugged probe, make sure that the shroud is installed. Damage to the sensing elements can occur if the shroud is not installed during field use. Damage under these conditions is not covered by the product warranty.

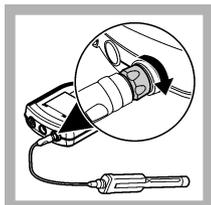
To deploy a rugged probe at a distance, toss the probe body with a gentle underhand throw. Do not swing the probe by the cable as this may cause injury to the user, will cause severe strain on the cable and will shorten the service life of the probe.

### Measurement notes:

- Do not touch the tip of the probe.
- Stabilization times with smaller concentration changes generally will be longer and can be minimized by correct stirring and conditioning. Experiment to determine the correct stir rate if necessary.
- Data is automatically stored in the data log when **Press to Read** or **Interval** is selected in the Measurement Mode. When **Continuous** is selected, data will only be stored when **Store** is selected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a measurement error occurs, refer to [Troubleshooting](#) on page 9.

### Measurement procedure:

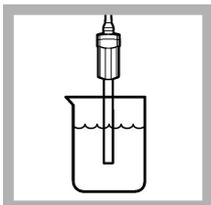
*Note: Procedure also applies for rugged model probes.*



**1.** Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.



**2.** Rinse the probe with deionized water. Blot dry with a lint-free cloth.



**3.** Put the probe into the sample so that the temperature sensor is completely submerged. Do not put the probe on the bottom or sides of the container.



**4.** Push **Read**. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes. The measurement is automatically corrected to the selected reference temperature (20 or 25 °C).



**5.** Repeat steps 2 - 4 for additional measurements. When measurements are done, store the probe (refer to [Storage](#) on page 9).

## Run a check standard

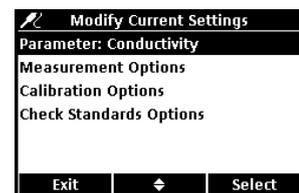
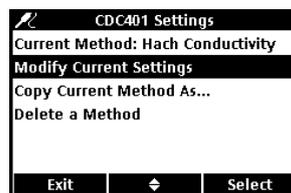
The run check standard feature validates instrument performance between sample measurements. Use the run check standard feature for periodic or user-defined interval measurements of a traceable standard solution. Set the criteria for check standards from the CDC401 Settings menu.

**Note:** Access control must be off or a valid password must be entered before any of the check standard method options can be changed.

1. Push . The Full Access Options menu is shown.
2. Select Run Check Standard.  
**Note:** Select the correct probe if two probes are connected to the meter.
3. Get the standard solution shown on the display.
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
5. Put the probe in the standard solution until the temperature sensor is completely submerged. Move the probe up or down or gently tap on the beaker to remove air bubbles from the probe.
6. Push **Read**. The display will show "Stabilizing" and a progress bar as the reading stabilizes. The display shows the value of the check standard and either Check Standard Passed or Check Standard Failed.
7. If the display shows **Check Standard Passed**, the check standard measurement is within the accepted limits set by the administrative user. Select **Done** to continue with the sample measurement.
8. If the display shows **Check Standard Failed**, the measurement is outside of accepted limits set by the administrative user and a recalibration is recommended. If the acceptance criteria is set to Cal Expires on Failure: Yes, the display shows the calibration icon and a question mark until the probe is recalibrated. To correct the probe calibration and status indicator, calibrate the probe (refer to [Calibration](#) on page 2).

## Advanced operation

Parameter-specific settings can be changed through the Full Access Options menu. Details about menu navigation, available options and how to change them are given in the screens, tables and procedures throughout this section.



The settings that can be changed are shown in [Table 1](#).

**Table 1 Parameter-specific settings**

| Setting             | Options  |
|---------------------|--|
| Parameter           | <ul style="list-style-type: none"> <li>• Conductivity</li> <li>• Salinity</li> <li>• TDS</li> <li>• Resistivity</li> </ul>   |
| Measurement Options | <ul style="list-style-type: none"> <li>• Units</li> <li>• Measurement limits</li> <li>• Temperature correction</li> <li>• Correction factor (if linear temperature correction is selected)</li> <li>• Reference temperature (if a temperature correction is selected)</li> </ul> |

**Table 1 Parameter-specific settings (continued)**

| Setting                 | Options   |
|-------------------------|---|
| Calibration Options     | <ul style="list-style-type: none"> <li>• Standard</li> <li>• Calibration reminder</li> <li>• Standard units (if Custom option is selected)</li> <li>• Standard value (if Custom option is selected)</li> <li>• Reference temperature (if Custom option is selected)</li> <li>• Temperature correction (if Custom option is selected)</li> </ul> |
| Check Standards Options | <ul style="list-style-type: none"> <li>• Standard solution for calibration verification</li> <li>• Reminder</li> <li>• Acceptance criteria</li> </ul>   |

## Change measurement options

Methods are groups of default or user-defined settings relevant to specific applications. If the meter is set to the default method and the Modify Current Settings option is chosen, a prompt for a new name is shown after the changes are entered. The settings are saved with this name to distinguish them from the default method settings, which cannot be changed. A saved method can be used instead of multiple adjustments to the individual settings. Changes made to a user defined method are automatically saved with the existing name. Multiple methods can be saved for the same probe on each meter.

[Table 2](#) lists the five default methods available for the CDC401 conductivity cell.

**Table 2 Default methods**

| Options           | Description  |
|-------------------|--|
| Hach Conductivity | Default method with conductivity measurement values. Conductivity is typically used for natural water samples.   |
| Hach TDS          | Default method with TDS measurement values. TDS is typically used to estimate the amount of total dissolved solids in the sample. The conductivity value is also shown in the Detailed Reading screen.         |
| Hach Salinity     | Default method with salinity measurement values. Salinity is typically used for samples with a high salt content, such as sea water. The conductivity value will also be shown in the Detailed Reading screen. |
| Hach Resistivity  | Default method with resistivity measurement values. Resistivity is typically used for ultra pure water applications.   |
| Default           | —  |

1. Make sure a probe is connected to the meter.
2. Push  and select CDC401 Settings.
3. Select Modify Current Settings.
4. Select Parameter to change the parameter that is shown in the display.
5. Select Measurement Options and update the settings:

| Option                    | Description   |
|---------------------------|---|
| <b>Units—Conductivity</b> | Sets the units for conductivity—Auto (default), $\mu\text{S}/\text{cm}$ or $\text{mS}/\text{cm}$ .<br>When Auto is selected, the units will automatically change to $\text{mS}/\text{cm}$ when the sample conductivity is high and $\mu\text{S}/\text{cm}$ when the conductivity is low. Select $\mu\text{S}/\text{cm}$ or $\text{mS}/\text{cm}$ to always show the same units. |
| <b>Units—Salinity</b>     | Sets the units for salinity—‰ (default), $\text{g}/\text{kg}$ , <unitless> or ppt (parts per thousand).   |

| Option                        | Description   |
|-------------------------------|---|
| <b>Measurement Limits</b>     | <p>Sets the measurement limits—Lower limit (default: 0.01 <math>\mu\text{S}/\text{cm}</math>; 0 ‰) or Upper limit (default: 400000.00 <math>\mu\text{S}/\text{cm}</math>; 42 ‰).</p> <p>The measurement limits can be set to match the acceptable values for the sample. When the measurement is above the upper limit setting or below the lower limit setting, the meter shows an "Out of limits" message. This message is an alert to a potential problem with the process conditions.</p> |
| <b>Temperature Correction</b> | <p>Sets the temperature correction—None, Linear, NaCl non-linear (default) or Natural Water.</p> <p>The conductivity of a sample changes when the temperature changes. Temperature correction shows the conductivity at the user-selected reference temperature. Temperature correction can be changed or turned off when the parameter is set to conductivity, TDS or resistivity.</p>   |
| <b>Correction Factor</b>      | <p>When the temperature correction is set to linear, this sets a correction factor based on the sample type—% per <math>^{\circ}\text{C}</math> (default: 1.90% per <math>^{\circ}\text{C}</math>).</p> <p>The correction factor may need to be identified experimentally. For example, the factor for ultrapure water is 4.55% per <math>^{\circ}\text{C}</math> and the factor for NaCl salt solution 2.125% per <math>^{\circ}\text{C}</math>.</p>   |
| <b>Reference Temperature</b>  | <p>When the parameter is set to conductivity, TDS or resistivity, sets the reference temperature for temperature correction—20 <math>^{\circ}\text{C}</math> or 25 <math>^{\circ}\text{C}</math> (default).</p>   |
| <b>TDS Form</b>               | <p>When the parameter is set to TDS, sets the conversion factor from conductivity to total dissolved solids—NaCl (default, factor 0.5) or Custom. To change the factor, select Custom and enter the conversion factor and temperature correction information.</p>   |

**Note:** Labels and options may vary depending on the units selected.

- If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
- Push **EXIT** until the meter returns to the measurement mode.

## Change calibration options

- Make sure a probe is connected to the meter.
- Push  and select CDC401 Settings.
- Select Modify Current Settings.
- Select Calibration Options and update the settings:

| Option                | Description  |
|-----------------------|--|
| <b>Standard</b>       | <p>Sets the conductivity calibration standard—</p> <ul style="list-style-type: none"> <li>1 D KCl, 111.3 mS/cm, 25 <math>^{\circ}\text{C}</math></li> <li>0.1 D KCl, 12.85 mS/cm, 25 <math>^{\circ}\text{C}</math></li> <li>0.01 D KCl, 1408 <math>\mu\text{S}/\text{cm}</math>, 25 <math>^{\circ}\text{C}</math></li> <li>0.1 M KCl, 12.88 mS/cm, 25 <math>^{\circ}\text{C}</math></li> <li>0.01 M KCl, 1413 <math>\mu\text{S}/\text{cm}</math>, 25 <math>^{\circ}\text{C}</math></li> <li>0.001 M KCl, 146.93 <math>\mu\text{S}/\text{cm}</math>, 25 <math>^{\circ}\text{C}</math></li> <li>NaCl, 18 mS/cm, 25 <math>^{\circ}\text{C}</math></li> <li>NaCl, 1000 <math>\mu\text{S}/\text{cm}</math>, 25 <math>^{\circ}\text{C}</math></li> <li>NaCl, 25 <math>\mu\text{S}/\text{cm}</math>, 25 <math>^{\circ}\text{C}</math></li> <li>NaCl, 0.05%, 1015 <math>\mu\text{S}/\text{cm}</math>, 25 <math>^{\circ}\text{C}</math></li> <li>Seawater (S=35)</li> <li>Custom</li> </ul> |
| <b>Standard Units</b> | <p>When Standard is set to Custom, sets the units for the custom calibration standard.</p>   |

| Option                        | Description  |
|-------------------------------|--|
| <b>Standard Value</b>         | When Standard is set to Custom, sets the values for the custom calibration standard.                 |
| <b>Reference Temperature</b>  | When Standard is set to Custom, sets the reference temperature for the custom calibration standard.  |
| <b>Temperature Correction</b> | When Standard is set to Custom, sets the temperature correction for the custom calibration standard. |

5. Select Calibration Reminder and update the settings:

| Option                 | Description   |
|------------------------|---|
| <b>Reminder Repeat</b> | Meter will make an audible sound when calibration is due and repeat the sound at selected interval—Off, 2 h, 4 h, 8 h, 2 d, 5 d or 7 d.   |
| <b>Expires</b>         | Calibration expires after the selected time—Immediately, Reminder + 30 min, Reminder + 1 h, Reminder + 2 h or Continue Reading.<br><i>Note: The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.</i> |

6. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
7. Push **EXIT** until the meter returns to the measurement mode.

## Maintenance

### Clean the probe

Clean the probe when:

- Drifting/inaccurate readings or slow stabilization time occurs as a result of mineral or sample buildup on the electrodes.
- The slope is out of range as a result of mineral or sample buildup on the electrodes.

Before a rugged probe can be cleaned, the shroud must be removed (refer to [Remove the shroud](#) on page 8). Install the shroud after the probe is clean (refer to [Install the shroud](#) on page 9).

#### For general contaminants:

1. Rinse the probe with deionized water and blot dry with a lint-free cloth.

#### For greases and oils:

1. Soak the glass bulb in a warm detergent solution for up to 2 hours.
2. Rinse or soak the probe for 1 minute in deionized water.
3. Blot dry with a lint-free cloth.

#### For mineral buildup:

1. Soak the probe in a dilute 10% hydrochloric acid (HCl) solution for no more than 5 minutes.
2. Rinse or soak the probe for 1 minute in deionized water.
3. Blot dry with a lint-free cloth.

### Remove the shroud

1. Loosen and remove the locking ring.
2. Slide the shroud and locking ring off the probe.

## Install the shroud

1. Put the locking ring on the probe with the threads toward the probe.
2. Slide the shroud on the probe until it is against the locking groove.
3. Hand-tighten the locking ring on the shroud.

## Storage

Between uses, make sure the probe is dry and store it in ambient conditions. Rugged probes may be stored with the shroud installed if the storage container is sufficiently large.

## Troubleshooting

| Message or symptom                        | Possible cause   | Action  |
|---|--|---|
| Probe not supported                       | Software not updated                                     | Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">http://www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual for specific instructions for the meter model. |
|   | HQd meter does not support IntelliCAL <sup>®</sup> probe | Contact a Technical Support Representative.   |
| Connect a probe or probe requires service | Probe not connected correctly                            | Disconnect, then connect the probe. Tighten the locking nut.  |
|   | Software not updated                                     | Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">http://www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual.   |
|   | Large number of methods stored on the probe              | Continue to let probe connect. Do not disconnect the probe.   |
|   | Damaged probe  | Make sure there is connectivity with another probe or meter to confirm isolated issue with probe. Contact a Technical Support Representative.   |
| Slow stabilization time                   | Mineral or sample buildup on electrodes                  | Clean the probe (refer to <a href="#">Clean the probe</a> on page 8).   |
|   | Bubbles trapped under probe tip                          | Make sure that the sample concentration and temperature are both within the range of the CDC401 probe.  |
| Out of range                              | Temperature and/or pressure sensor error                 | Make sure that the temperature and pressure sensors are both reading correctly.   |
|   | Damaged probe  | Replace the conductivity probe or contact a Technical Support Representative.   |
|   | CO <sub>2</sub> absorption in LIS/high purity samples    | Replace the conductivity probe or contact a Technical Support Representative.   |
|   | Bubbles trapped under probe tip                          | Make sure that the sample concentration and temperature are both within the range of the CDC401 probe.  |
| Drifting/Inaccurate readings              | Incorrect settings                                       | Measurement Options—Make sure that Temp Correction (Correction Factor if not set as NaCl) and reference temperature are both correct.   |
|   |  | Calibration Options—Make sure that Standard Value, Reference Temperature and Temp Correction are all correct.   |
|   | Mineral or sample buildup on cell                        | Clean the probe (refer to <a href="#">Clean the probe</a> on page 8).   |
|   | CO <sub>2</sub> absorption in LIS/high purity samples    | Isolate LIS/high purity samples to prevent sample contamination.  |
|   | Bubbles trapped under probe tip                          | Gently shake the probe until bubbles are removed.   |

| Message or symptom                              | Possible cause     | Action  |
|---|--------------------|---|
| Calibration failed - Out of limits/Out of range | Incorrect settings | Measurement Options—Make sure that Temp Correction (Correction Factor if not set as NaCl) and reference temperature are both correct. |
|   |                    | Calibration Options—Make sure that Standard Value, Reference Temperature and Temp Correction are all correct.                         |

**HACH COMPANY World Headquarters**

P.O. Box 389, Loveland, CO 80539-0389 U.S.A  
Tel. (970) 669-3050  
(800) 227-4224 (U.S.A. only)  
Fax (970) 669-2932  
orders@hach.com  
www.hach.com

**HACH LANGE GMBH**

Willstätterstraße 11  
D-40549 Düsseldorf  
Tel. +49 (0) 2 11 52 88-320  
Fax +49 (0) 2 11 52 88-210  
info@hach-lange.de  
www.hach-lange.de

**HACH LANGE Sàrl**

6, route de Compois  
1222 Vézenaz  
SWITZERLAND  
Tel. +41 22 594 6400  
Fax +41 22 594 6499





**Attachment 2 – CEM-2058 Stormwater Meter Calibration Record Form**

|   |  |      |
|---|--|------|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |      |
|   | PROJECT IDENTIFIER NUMBER  |      |
|   | WDID NUMBER  |      |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |      |
| SUBMITTED BY CONTRACTOR (PRINT AND SIGN NAME) |  | DATE |

| Meter              |                    |                     |
|--------------------|--------------------|---------------------|
| Meter manufacturer | Meter model number | Meter serial number |

| Conductivity Meter Calibration Date _____ |                                       |                     |      |                |      |             |                        |                          |          |
|---|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
| Standard Solution (uS/cm)                 | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|   |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|   |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
| 447                                       |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| 1413                                      |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| 8974                                      |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| 15,000                                    |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

| Dissolved Oxygen Meter Calibration Date _____ |                                       |                     |      |                |      |             |                        |                          |          |
|---|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
| Standard                                      | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|   |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|   |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
| Open Air (mg/L)                               |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| Zero Oxygen Standard (MG/L)                   |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
| Barometer (mm Hg)                             |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION  
**STORMWATER METER CALIBRATION RECORD**  
 CEM-2058 (NEW 12/2010)

|   |                           |
|---|---------------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS | CONTRACT NUMBER/CO/RTE/PM |
|   | PROJECT IDENTIFIER NUMBER |
|   | WDID NUMBER               |

\_\_\_\_\_ Meter Calibration Date \_\_\_\_\_

| Standard | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|----------|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
|          |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|          |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

\_\_\_\_\_ Meter Calibration Date \_\_\_\_\_

| Standard | Cal Standard Solution Expiration Date | Initial Calibration |      | Re-Calibration |      | Drift Check |                        | Notes                    | Initials |
|----------|---------------------------------------|---------------------|------|----------------|------|-------------|------------------------|--------------------------|----------|
|          |                                       | Time                |      | Time           |      | Time        |                        |                          |          |
|          |                                       | Cal                 | Read | Cal            | Read | Read        | Acceptable Performance |                          |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |
|          |                                       |                     |      |                |      |             |                        | <input type="checkbox"/> |          |

| Date | Notes |
|------|-------|
|      |       |
|      |       |

**Review**

I have reviewed this document and, based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete.

|                                 |                                 |
|---------------------------------|---------------------------------|
| Water pollution control manager | Water pollution control manager |
|---------------------------------|---------------------------------|

Water pollution control manager signature

### Instructions

#### GENERAL INFORMATION

- Projects with Construction Site Monitoring Program require the information on this form as part of the Stormwater Pollution Prevention Plan for stormwater analysis meter calibration.
- Completed forms shall be filed in project file category 20.55, Field Testing Equipment Maintenance and Calibration Records.

#### FORM

##### Contract Number/Co/Rte/PM

For local agency encroachment permit projects write the encroachment permit number in the Contract Number field.

##### Project Identifier Number

Caltrans projects starting July 1, 2010, will have a Project Identifier Number. For projects without a PID, write "N/A" in the field.

Acceptable performance for conductivity drift is  $\pm 10$  percent, and acceptable performance for dissolved oxygen is  $\pm 10$  percent.

### Instructions

**GENERAL INFORMATION**

- Projects with Construction Site Monitoring Program require the information on this form as part of the Stormwater Pollution Prevention Plan for stormwater analysis meter calibration.
- Completed forms shall be filed in project file category 20.55, Field Testing Equipment Maintenance and Calibration Records.

**FORM****Contract Number/Co/Rte/PM**

For local agency encroachment permit projects write the encroachment permit number in the Contract Number field.

**Project Identifier Number**

Caltrans projects starting July 1, 2010, will have a Project Identifier Number. For projects without a PID, write "N/A" in the field.

Acceptable performance for conductivity drift is  $\pm 10$  percent, and acceptable performance for dissolved oxygen is  $\pm 10$  percent.



**Attachment 3 – CEM-2052 Stormwater Sample Field Test Report Form**

|   |  |      |
|---|--|------|
| PROJECT INFORMATION NAME AND SITE ADDRESS     | CONTRACT NUMBER/CO/RTE/PM  |      |
|   | PROJECT IDENTIFIER NUMBER  |      |
|   | WDID NUMBER  |      |
| CONTRACTOR NAME AND ADDRESS                   | PROJECT SITE RISK LEVEL<br><input type="checkbox"/> Risk Level 1<br><input type="checkbox"/> Risk Level 2<br><input type="checkbox"/> Risk Level 3 |      |
| Submitted by contractor (print name and sign) |  | Date |

**Stormwater Samples Field Analysis**

|                                       |  |
|---------------------------------------|--|
| Location                              | Date of Sampling   |
| Sample Location Identification Number | Date of Analysis   |
| Sample Analyzed By Signature          |  |
| Sample Analyzed By Print Name         |  |
| Analyzer Phone Number                 | Samples Analyzed For Parameter(s)<br><input type="checkbox"/> Turbidity<br><input type="checkbox"/> pH<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Other _____ |
| Company                               |  |

| Sample Identification                               | Turbidity Analysis (NTU) | pH Analysis (pH) | Analysis (____) | Analysis (____) | Comments                 |
|---|--------------------------|------------------|-----------------|-----------------|--------------------------|
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
|   |                          |                  |                 |                 | <input type="checkbox"/> |
| Qualifying Rain Event Daily Average Analysis Result |                          |                  |                 |                 | <input type="checkbox"/> |

|  |   |   |                  |
|--|---|---|------------------|
| PROJECT INFORMATION NAME AND SITE ADDRESS  |   | CONTRACT NUMBER/CO/RTE/PM   |                  |
|  |   | PROJECT IDENTIFIER NUMBER   |                  |
|  |   | WDID Number   |                  |
| <b>Turbidity Analysis Information</b>  |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>pH Analysis Information</b>   |   |   |                  |
| Turbidity Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| <b>Analysis Information</b>  |   |   |                  |
| Meter Manufacturer   | Model Number  | Serial Number   | Calibration Date |
| Analytical Method  | Method Reporting Unit   | Method Detection Limit  |                  |
| Note: Meter calibration information available in the Storm Water Pollution Prevention Plan (SWPPP) files.<br>Comments  |   |   |                  |
| <b>Review and Record Keeping</b>   |   |   |                  |
| Test results entered into sampling and testing activity log?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No  | Numeric action level exceedance?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No | Numeric effluent limitation violation?<br><br><input type="checkbox"/> Yes<br><input type="checkbox"/> No |                  |
| I have reviewed this document and based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true accurate, and complete. |   |   |                  |
| Water pollution control manager name   |   | Date  |                  |
| Water pollution control manager signature  |   |   |                  |
| Accepted by resident engineer (name)   |   | Date  |                  |
| Resident engineer signature  |   |   |                  |

## Instructions

### GENERAL INFORMATION

- This form is required for compliance with provisions in Section I of Attachments C, D, and E of the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ, NPDES No. CAS000002.
- The *Construction Site Monitoring Program Guidance Manual*, dated July 2010, contains sampling guidance.
- Sampling and sample preservation must be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association).
- Collect, maintain, and ship samples according to the Surface Ambient Monitoring Program's (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).
- Complete a separate stormwater sample field analysis report daily for each sampling location.
- Include a copy of the completed form in the project SWPPP files.

### FORM

#### Project Identifier Number

Starting July 1, 2010, Caltrans projects will have a project identifier number. For projects without a PID, write N/A in the field.

#### Contract Number/Co/Rte/PM

For local agency encroachment permit projects, write the encroachment permit number in the contract number field.

Analysis Result Analytical results less than the method detection limit must be reported as "less than the method detection limit."

#### Qualifying Rain Event Daily Average Analysis Result

A minimum of three daily samples are required to calculate the daily average for a qualifying rain event.

#### Numeric Action Level Exceedance

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Action Level (NAL), complete form CEM-XXXX "Numeric Action Level Exceedance Report," and submit all storm event sampling results to the State Water Board no later than ten days after the conclusion of the storm event.

#### Numeric Effluent Limitation Violation

In the event that any daily average effluent samples analysis results exceeds an applicable Numeric Effluent Limitation, complete form CEM-6062, "Numeric Effluent Limitation Violation Report," and submit CEM-2063, "Numeric Effluent Limitation Violation Report," to the State Water Board within 24 hours after the numeric effluent limitation violation was identified. Submit all storm event sampling results to the State Water Board no later than five days after the conclusion of the storm event.