STANDARD OPERATING PROCEDURE

Instructions for the Calibration and Use of the HI98195 Multiparameter Meter for Groundwater Sampling

KEY WORDS

Probe, sensor, pH, temperature, total dissolved solids, calibration, purging, stabilization

APPROVALS

Original signed by [1/17/2023]
APPROVED BY: _____ DATE: _____
Joy Dias
Environmental Monitoring Branch, Environmental Program Manager

Original signed by [1/11/2023]
APPROVED BY: _____ DATE: _____
Vaneet Aggarwal
Environmental Monitoring Branch, Sr. Environmental Scientist (QA Officer)

Original signed by [1/11/2023]
APPROVED BY: _____ DATE: _____
Tiffany Kocis
Environmental Monitoring Branch, Sr. Environmental Scientist (Specialist)

Original signed by [1/11/2023]
PREPARED BY: _____ DATE: _____
Andrew Hawkins
Environmental Monitoring Branch, Environmental Scientist

Environmental Monitoring Branch organization and personnel, such as management, senior scientist, quality assurance officer, project leader, etc., are defined and discussed in Standard Operating Procedure (SOP) ADMN002.

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1.0 INTRODUCTION

1.1 Purpose

Obtaining quality groundwater samples requires purging of standing water within well systems before sample collection. For the Groundwater Protection Program (GWPP), adequate purging ensures groundwater sampled is freshly recharged and representative of the underlying aquifer. Proper purging is confirmed by chemical parameter stabilization. Samples can be collected once the parameters are stabilized (Kocis, 2022). Measurements of pH, total dissolved solids (TDS), and temperature are routinely collected during the groundwater sampling process as they provide insight into groundwater quality.

Additionally, geochemical and physical properties of groundwater, including pH, TDS, and temperature, influence the efficacy, transformation rate, and persistence of pesticides in the environment (Barbash, 2007). Temperature affects thermal reaction rates, and measurements of pH and TDS can indicate relative concentrations of reactants (such as H3O+ and OH-), which affect pesticide transformation rates directly and indirectly (Barbash & Resek, 1996).

The Hanna Instruments HI98195 Multiparameter Meter measures, displays, and logs data in real-time for these three water quality parameters. Quality measurements with this device requires proper calibration, validation, and sampling procedures as outlined in this Standard Operating Procedure (SOP).

1.2 Scope

This SOP provides proper methods for calibration, basic maintenance, storage, and use of the HI98195 Multiparameter Meter during groundwater sampling.

GWPP staff should calibrate the HI98195 multiparameter meter once per month or before extended sampling trips. Using HI9828-0 calibration solution provides quick single-point calibration for pH and electrical conductivity (EC) and can be performed in the field if necessary. For additional groundwater sampling procedures, refer to SOP FSWA001 Obtaining Well Water Samples (Kocis, 2022).

2.0 MATERIALS

2.1 HI98195 multiparameter meter

2.2 HI7698195 probe with built in temperature sensor, removable pH sensor

(HI7698194-0), removable EC sensor (HI7698194-3), and cable

2.3 Carrying case
2.4 5-gallon bucket
2.5 Plastic trash bag
2.6 Tubing and adapters as needed per SOP FSWA001 (Kocis, 2022)
2.7 Instruction manual for HI98195 multiparameter meter
2.8 HI9828-(27) Quick Calibration solution (check expiration date)
2.9 HI70300L Long-term pH sensor storage solution
2.10 HI7698290 Calibration Beaker
2.11 Deionized (DI) water
2.12 Laboratory wipes
2.13 Nitrile gloves
2.14 Micro-USB cable
2.15 Maintenance kit with brush, lubricant, replacement O-rings
2.16 Replacement AA batteries
2.17 Phillips head screwdriver

Figure 1. *Carrying case with multiparameter meter, probe, calibration beaker, quick-calibration solution, maintenance kit, PC connector cable (micro-USB), and instruction manual.*

3.0 GENERAL INFORMATION

The Hanna Instruments HI98195 multiparameter meter is comprised of two components: a handheld meter with LCD screen and a probe attached to a cord. Connect the probe to the meter by aligning the plug at the end of the cord with the pins of the instrument input on the meter and inserting. Meters and probes are paired with matching labels ("Meter 1" & "Probe 1"). **As with all expensive instruments, handle the meter properly and with care.**

3.1 Probe

3.1.1 The probe has three sensors to measure temperature, pH, and electrical conductivity (EC). The sensors are protected by a probe shield (Figure 2).

3.1.2 The EC sensor has a blue ring matching the socket with two blue triangles. The pH sensor has a red ring matching the socket with one red triangle. Both are replaceable.

3.1.3 The pH sensor has an additional protective storage cup (flexible and translucent) that must be used to keep the sensor moist when not in use. The protective cup for the pH sensor should be filled with groundwater to keep the sensor moist between sites (in the field) and with tap water for short-term storage (one to two days) in the lab. Use long-term pH electrode storage solution (HI70300) if storing for longer than two days. **Note: Never use DI water in the protective storage cup.**

3.1.4 The probe must be calibrated before sampling trips or after long-term storage. Calibration data is stored on the probe. Record each date of calibration, and any issues or maintenance performed on probes in the probe Calibration Log. Calibration is described in section 4.1.

3.1.5 It is good practice to check the condition of the sensors when calibrating. The holes in the EC sensor should be clear of debris. **It is normal for the pH sensor to have salt build-up on it**. This build up can be rinsed with DI or tap water.

3.1.6 If sensors need to be cleaned or replaced, refer to sensor maintenance in sections 4.8-4.11. The maintenance kit includes a brush to clean the EC sensor as well as replacement grease and O-rings.

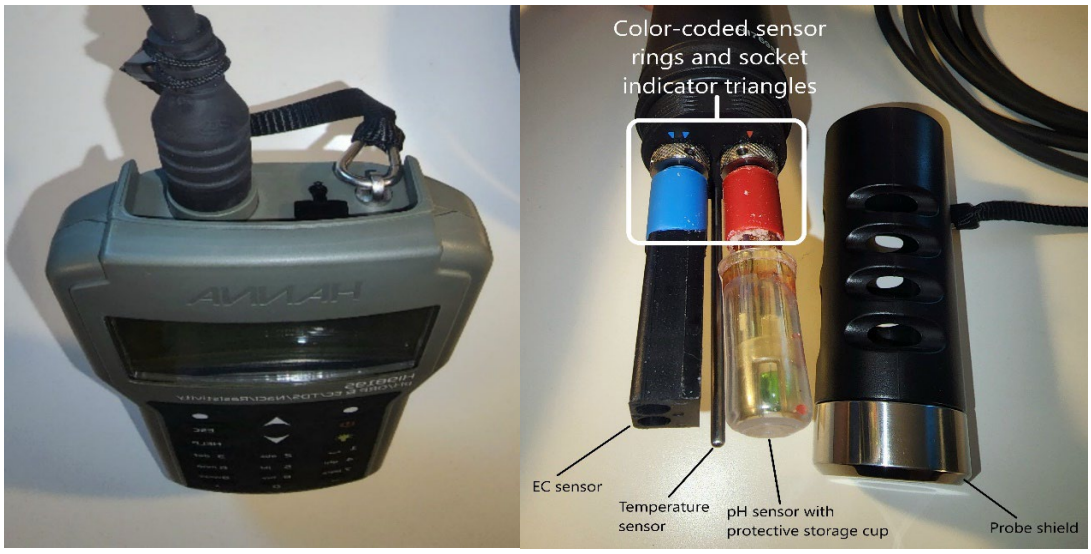

Figure 2. *Left: Handheld meter with probe plug inserted into the device input socket. Right: Probe with probe shield removed exposing color-coded sensors and pH sensor protective storage cup.*

3.2 Handheld meter

3.2.1 The handheld meter is powered by four-AA batteries. A battery indicator in the lower left corner of the display indicates how much battery life is left (Figure 3). The manual describes battery life under various operating conditions.

3.2.2 To turn on the backlight, press the lamp key found under the on/off button. **The backlight should be kept off to conserve battery life.**

3.2.3 The “Help” button provides information about the displayed screen.

3.2.4 There are two softkeys used to select options available at the bottom left or right of the display.

3.3 Powering on

3.3.1 To turn on the meter press the on/off button. On startup, meter will display the probe status screen with information about the installed sensors and two options available: “Measure” and “Param.” (Figure 3).

3.3.2 Press the left softkey labeled “Measure” to enter measurement mode. Press the right softkey labeled “Param.” to select which parameters are enabled. To access the logging mode or main menu, you must first select measurement mode.

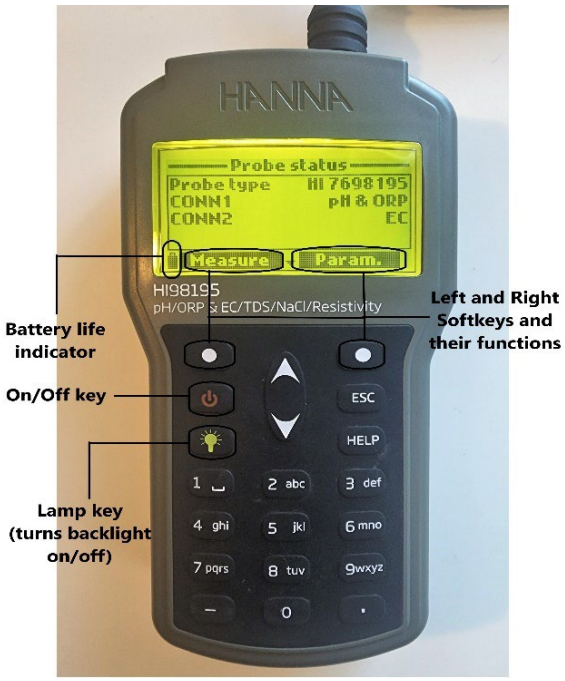

Figure 3. *Handheld meter displaying probe status screen on startup.*

3.4 Measurement mode

3.4.1 Measurement mode is the main operating mode of the meter. The meter simultaneously measures and displays data for all enabled parameters. Use the keypad numbers to select the number of parameters to display (up to 12) and the display will automatically adjust.

3.4.2 In measurement mode, there are two options available: “Log” and “Menu”. Press the left softkey labeled “Log” on the display to enter the logging mode. Press the right softkey labeled “Menu” to enter the main setup menu to select parameters, calibrate sensors, change system settings, and view meter or probe status.

3.5 Logging mode

3.5.1 In logging mode, you can select to enter one sample or start a continuous meter log. Continuous meter logs are used to ensure adequate purging as part of standard well sampling procedures. Select “New” to start a new log and a field will appear to name the lot. A lot is a collection of logged data. It is useful to name lots the same as sampling site location codes.

3.5.2 The logging interval for the continuous meter log should already be set to one minute. If the logging interval needs to be changed, highlight “Start meter log”, and press the left softkey labeled “Options”. Press the softkey labeled “Modify” to change the interval, press “Accept” to confirm. To stop the log, enter the log menu and select “Stop meter log”.

3.5.3 Recorded logs can be accessed by selecting “Meter log recall” in the log menu. Select “Lots” to view or delete individual lots.

3.5.4 When the meter’s memory is full, the message “Log space full” will be displayed and lots will need to be deleted before additional data can be logged. Lots can be downloaded to a computer (see section 4.5).

3.6 Calibration mode

3.6.1 The calibration mode is accessed from the main menu. There are two types of calibration available: quick calibration and single parameter calibration.

3.6.2 The “Quick calibration” is a single-point calibration of pH and conductivity. GWPP uses this type of calibration for efficient use in the field to determine adequate purging of wells. Single parameter calibration allows each parameter to be calibrated individually and is another available option.

4.0 PROCEDURES

4.1 Quick calibration of the HI98195

4.1.1 Calibration should be performed before leaving for field work, and at least once per month. **Record the date of calibration, calibration data, and any other action taken** in the Calibration Log associated with the meter and probe pair (Meter 1 & Probe 1, etc.). This is a good time to check battery life, inspect sensors for damage or corrosion, O-ring failure, and other potential issues.

4.1.2 Put on fresh gloves and check the expiration date of the HI9828-0 Quick Calibration Solution before performing calibration.

4.1.3 Connect the probe to the meter: insert the plug at the end of the cord attached to the probe into the DIN socket on the meter. The probe can be secured to the meter by attaching the carabiner.

4.1.4 Pour enough quick calibration solution into the calibration beaker to fill 2/3. Set aside.

4.1.5 Carefully remove the probe shield by holding the probe and turning the shield counterclockwise to unscrew.

4.1.6 Remove the pH sensor protective storage cup.

4.1.7 Next, attach the calibration beaker, filled with calibration solution, to the probe. Hold the filled beaker upright in one hand. With the other hand, submerge the probe into the beaker. Slowly screw the beaker onto the probe. **Be careful to not overtighten.**

4.1.8 Press the on/off (⏻) button to turn on the meter.

4.1.9 Use the right softkey to select “Menu” and open the main menu. Scroll down using the down arrow key until “Calibration” is highlighted. Press right softkey again to confirm the selection. Select “Quick calibration” to begin the quick calibration (Figure 4). *A single parameter or two-point calibration of pH can be performed by selecting single parameter calibration*.

4.1.10 A list will appear with two parameters: pH and conductivity. pH will blink and display a “Not ready” message. Once the pH signal stabilizes the message on the display will change to “Ready”. Press the right softkey to confirm the calibration and store the calibration data. The pH box should now be checked, indicating a successful calibration.

4.1.11 Conductivity will start blinking. When the EC measurement is stable, “Ready” will be displayed. Press the right softkey to confirm and store the calibration data. After successful calibration, the screen will display “Calibration Completed.” *If calibration is unsuccessful, the meter will display an error message; sensors may need to be cleaned or replaced.*

4.1.12 Recall calibration data as outlined in section 4.2. Record the calibration date, pH offset (mV), and conductivity cell (µS/cm) in the Calibration Log for the paired meter and probe being calibrated (Meter 1 & Probe 1, etc.).

4.1.13 Remove the calibration beaker and empty the used quick calibration solution into the sink. Rinse the calibration beaker with DI water three times.

4.1.14 Rinse the sensors with DI water three times.

4.1.15 Fill the pH sensor cap with tap water if storing for one to two days. For more than two days, use long-term pH electrode storage solution. **Never use DI water for storage**. Replace the probe shield back on the probe, taking care to **not overtighten**.

4.1.16 Place the calibration beaker back into the probe case. If packing to do field work, place the meter and probe in the case. If storing long-term, set the probe on the storage rack, on the shelf in the lab.

Figure 4. *Left: Meter, calibration beaker, and quick-calibration solution. Middle: Probe with attached calibration beaker filled with quick-calibration solution. Right: Meter displaying quick calibration selected from the menu.*

4.2 Recording calibration data

4.2.1 Documenting calibration history provides quality assurance for data collected during groundwater studies. Calibration data for the last five calibrations are stored on the probe. When readings begin to change, sensors may need to be cleaned or replaced.

4.2.2 Open the "Multiparameter Meter Calibration Logs" Excel workbook (internal link). Select the sheet associated with the meter and probe pair (Meter 1 & Probe 1, etc.). An example log is shown in Appendix 1. If the Excel workbook is unavailable, a paper log can be used, and the workbook can be updated later.

4.2.3 Connect the probe to the meter prior to turning on the meter.

4.2.4 Open the main menu and select "Status" to open the status menu.

4.2.5 Select "GLP" from the status menu. A list of available parameters will be displayed.

4.2.6 Select desired parameter. The most recent calibration data will be displayed. Use the up/down arrow keys to scroll through calibration data.

4.2.7 Record date of calibration, pH offset, and conductivity cell for all previous calibrations (up to five) in the Calibration Log, omitting duplicate entries.

4.3 Field measurements

4.3.1 While working in teams, one person operates the meter and reads out the parameter measurements while another person records the data in the purging information table on the well information sheet.

4.3.2 Put on a fresh pair of gloves. Place a five-gallon bucket on the ground near the sample collection port. Purging should be performed using the same port used to collect groundwater samples, if possible. If the sampling port and purging port are not the same, the purging port should be located after (downstream) the sampling port.

4.3.3 Carefully remove the probe shield to access and remove the pH sensor protective storage cup. Replace the probe shield to protect the exposed sensor, taking care not to overtighten. Set the probe in the bucket (Figure 5).

4.3.4 Position the discharge end of the sample collection tubing near the sensors on the end of the probe to ensure freshly purged groundwater is being measured by the meter. Allow purged water to flow from the bucket. When using a bucket with drilled holes for purging, position the bucket with the holes pointed in the best direction to keep water from pooling near the sampling area.

4.3.5 Turn on the meter by pressing the on/off (⏻) button.

4.3.6 Select “Measure” to enter the measurement mode. Press “Log” to enter logging mode. Set up the log interval appropriately as described in section 3.5.2.

4.3.7 Track time using a timer on cell phone, watch, stopwatch, or by watching the log interval counter in the bottom right corner of the display. The counter interval is set to minutes and will show the minutes elapsed.

4.3.8 Record measurements of pH, temperature, and TDS every minute in the purging to stabilization table on the well information sheet. Record measurements until parameters have stabilized per SOP FSWA001 (Kocis, 2022).

4.3.9 Once parameters have stabilized and been recorded, groundwater samples can be collected according to the SOP FSWA001. **Always put on a clean pair of disposable gloves before handling sampling equipment and/or collecting samples**.

4.3.10 Remove the probe from the bucket and make sure the meter is turned off. Disconnect the probe cable from the meter and store the handheld meter in the carrying case.

4.3.11 Before storing the probe, fill the pH sensor protective storage cup with groundwater from the bucket and fit the cup over the pH sensor. The pH sensor must remain moist. **Always cover the pH sensor with the protective cup, filled with groundwater or storage solution, before storing the probe.**

Replace the probe shield to protect the sensors and rinse the outside of the probe with DI water. Store the probe in the case.

4.3.12 Empty the bucket and place back into the plastic trash bag to avoid contamination of the vehicle or other equipment.

Figure 5. *Probe in 5-gallon bucket with garden hose purging a well.*

4.4 Cleaning and storage

4.4.1 After returning from field work, put on gloves and rinse the probe well with tap water followed by a DI water rinse. Remove the probe shield and pH sensor cap. Rinse the sensors with DI water three times.

4.4.2 Add a few drops of long-term storage rinse to the pH sensor cap and place on the pH sensor. Put the probe shield back on.

4.4.3 Store probe on the storage rack, with the cable coiled up. Place the carrying case with meter on the shelf.

4.5 Downloading data to PC

4.5.1 The HI9298194 Windows software can be used to transfer data from the meter to a computer. Data can be imported into Excel or another spreadsheet program to analyze or visualize. Software is available from Hanna Instruments webpage: http://software.hannainst.com/.

4.5.2 Use the USB cord in the case to connect the meter to a computer. Turn the meter on and the meter will read “PC connected”.

4.5.3 Run the HI9298194 software on the computer. Press the settings button at the top of the active window to confirm the correct units for the data.

4.5.4 Select “Meter” to access meter data. A window will appear with meter information and a summary of logged data lots stored on the meter.

4.5.5 Select desired lot and press the “Download lot” button to view and save lot data to the computer.

4.5.6 After downloading desired data, turn the meter off before disconnecting the USB cord. Store probe on the storage rack and meter in the case.

4.6 Maintaining probe quality assurance data for field studies

4.6.1 Save the downloaded data for parameter stabilization in a folder within the study folder after downloading data as described in section 4.5.

4.6.2 Save a copy of the Calibration Log referenced in section 4.2 in the study folder.

4.7 Replacing batteries

4.7.1 The meter is powered by 4 AA batteries. To replace the batteries, remove the 4 Phillips (crosshead) screws securing the battery housing on the back of the meter. In the field, find the precision screwdriver in the tool kit and replacement batteries in the office box.

4.7.2 Insert new batteries with correct polar orientation of terminals as indicated (+/-) inside battery housing.

4.7.3 Replace the 4 screws. Lightly tighten each screw first, so that all screws are threaded before fully tightening screws. This improves waterproofing.

4.7.4 Remaining battery life is indicated by a battery symbol on the bottom left corner of the meter display (Figure 3). The battery symbol will blink when the batteries need to be replaced. The meter backlight should be turned off to preserve battery life. Press the lamp key to turn the backlight off.

4.8 General sensor maintenance

4.8.1 Sensors should be calibrated after long-term storage, at least monthly.

4.8.2 Inspect sensor connectors for corrosion.

4.8.3 Inspect O-rings for damage.

4.8.4 Rinse outside of probe with tap and/or DI water after use and dry it.

4.9 pH sensor maintenance

4.9.1 The pH sensor bulb must be kept moist; always store with protective storage cup on. Tap water can be used for no more than two days. Never use distilled or deionized water (DI) to store pH sensors.

4.9.2 Shake down the sensor to eliminate any air bubbles inside the glass bulb (like a thermometer).

4.9.3 If the bulb or junction are dry, soak the electrode in HI70300 storage solution for at least one hour.

4.9.4 Inspect the sensor for damage and replace if scratched or cracked.

4.10 EC sensor maintenance

4.10.1 Rinse the sensor with tap or DI water between measurements.

4.10.2 Clean the sensor with the supplied brush in the maintenance kit if necessary. Ensure the two holes in the sensor are clear of debris.

4.11 Sensor replacement

4.11.1 To replace sensors, use supplies in the maintenance kit (Figure 6).

4.11.2 Remove the syringe plunger. Cut the top of the of the packet of silicone grease and empty the grease into the syringe. Use the syringe to lubricate the O-ring with a thin film of grease. Do not use any other lubricant than the supplied grease from the manufacturer.

4.11.3 Insert the sensor into the color-coded socket opening that matches the sensor. Position the connector key toward the center of the probe. Confirm the connector is seated correctly before tightening the locking threads by hand. The sensor will not move freely.

4.11.4 Use the tool in the maintenance kit to continue tightening the threads until the sensor is tightly secured against the probe body.

4.11.5 Screw the protective shield back onto the probe.

4.11.6 With the meter off, connect the probe to the meter and attach the carabiner.

4.11.7 Turn the meter on. The meter will automatically recognize the installed sensors and identify them on the probe status screen.

4.11.8 Delete previous calibration data by selecting “Restore factory calib.” in the single parameter calibration menu. Immediately perform calibration after replacing sensors and restoring factory calibration.

***Figure 6**. Maintenance kit with brush, O-rings, syringe, and grease lubricant.*

5.0 REFERENCES

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Appendix 1: Multiparameter Meter Calibration Logs