Work Instruction (WI)

DIRECTIVE NO.	250-WI-8500.5.9A	**APPROVED BY Signature:**	*Original Signed By*
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EXPIRATION DATE:	05/29/2024	**TITLE:**	Chief, Medical and Environmental Management Division

COMPLIANCE IS MANDATORY

Responsible Office: 250 / Medical and Environmental Management Division

Title: Calibration, Use, and Storage of Water Sampling Equipment

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Preface

P.1 PURPOSE

This Work Instruction (WI) defines the procedures for calibration, use, and storage of the Turbidimeter, Hach Pocket Colorimeter II, and the Hanna (HI 98183 or HI 98191) pH and Temperature Meter. These instruments are used in water quality sampling/monitoring in support of environmental permits.

P.2 APPLICABILITY

a. This WI is applicable to all Medical and Environmental Management Division (MEMD) civil service and contract employees at Greenbelt only.

b. In this WI, all document citations are assumed to be the latest version unless otherwise noted.

c. In this WI, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms "may" or "can" denote discretionary privilege or permission; "should" denotes a good practice and is recommended but not required; "will" denotes expected outcome; and "are/is" denotes descriptive material.

P.3 APPLICABLE DOCUMENTS AND FORMS

a. GPR 8500.5 Water Management
b. LaMotte 2020we/wi Turbidimeter manual.
c. Environmental Protection Agency Method 180.1.
d. HI 98191, HI 98183, HI 98184, and HI 98185 pH/mV/ISE/Temperature Meter manual.
e. Environmental Protection Agency Method 150.1.
f. HACH Pocket Colorimeter™ II Analysis Systems Instruction Manual, 2014, 1st edition.

P.4 CANCELLATION

250-WI-8500.5.9

P.5 TOOLS, EQUIPMENT, AND MATERIALS

Tools, equipment, and materials are stored at building 27B. Required tools for each piece of equipment are identified in the appendices.

P.6 SAFETY PRECAUTIONS AND WARNINGS

Calibration and usage of these pieces of equipment does not generally pose a risk to health and safety. Eye protection and gloves should be worn when handling chemicals, buffers or taking water samples.

P.7 TRAINING

None.

P.8 RECORDS

Record Title	Record Custodian	Retention
Logbooks	MEMD	*NRRS 8/23.5 A1 Cut off annually. Destroy 10 years after cutoff or when no longer needed, whichever is later. See Note 3.
Instrument QC	MEMD	*NRRS 8/23.5A3a Destroy 3 years after superseded or when no longer needed, whichever is later.

** NRRS 1441.1 – NASA Records Retention Schedule*

P.9 MEASUREMENT/VERIFICATION

Specific calibration and measurement requirements are identified in the appendices for each piece of equipment.

Instructions

1. The 2020we Turbidimeter is used to measure water clarity. It is necessary to calibrate the Turbidimeter to ensure that the instrument is operating properly prior to use. See Appendix C for directions on calibration, use and storage.

2. The Hach Pocket Colorimeter II is used to measure chlorine. It is necessary to calibrate the Hach Pocket Colorimeter II to ensure that the instrument is operating properly prior to use. See Appendix D for directions on calibration, use and storage.

3. The Hanna (HI 98183 and HI 98191) pH and temperature meter is used to measure pH and temperature. It is necessary to calibrate the meter to ensure the instrument is operating properly before use. See Appendix E for directions on calibration, use and storage.

Appendix A – Definitions

A.1 Accuracy: The nearness of a measurement to the accepted or true value. The accuracy can be expressed as a range, about the true value, in which a measurement occurs (i.e., ± 0.5 ppm). It can also be expressed as the % recovery of a known amount of analyte in a determination of the analyte (e.g., 103.5%).

A.2 Detection Limit: The minimum value or concentration that can be determined by the meter, which is greater than zero, independent of matrix, glassware, and other sample handling sources of error. It is the detection limit for the optical system of the meter.

A.3 DPD Method: Chlorine can be present in water as free chlorine and as combined chlorine. Both forms can coexist in the same solution and can be determined together as total chlorine. Free chlorine is present as hypochlorous acid or hypochlorite ion. Combined chlorine represents a combination of chlorine-containing compounds including but not limited to monochloramine, dichloramine, nitrogen trichloride, and other chloro derivatives. The combined chlorine oxidizes triiodide ion (I3–) to iodine (I2). The iodine and free chlorine reacts with DPD (N,N-diethyl-p-phenylenediamine) to form a red solution. The color intensity is proportional to the total chlorine concentration. To determine the concentration of combined chlorine, run a free chlorine test and a total chlorine test. Subtract the results of the free chlorine test from the total chlorine test to obtain the combined chlorine concentration.

The range of analysis using the DPD method for chlorine can be extended by adding more indicator in proportion to sample volume. For example, two powder pillows of DPD Chlorine Reagent are added to a 5-mL sample portion to extend the range of analysis.

A.4 Formazin: A polymer suspension used as the standard for turbidity.

A.5 Method Detection Limit: The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

A.6 Precision: The indicator of how well a method or instrument gives the same result when a single sample is tested repeatedly; measures the random error of method, or the scatter in the data.

A.7 Repeatability: The within-run precision. A run is a single data set, from set up to clean up. Generally, one run occurs on one day. For meter calibrations, a single calibration is considered a single run or date set, even though it may take 2 or 3 days.

A.8 Reproducibility: The between-run precision.

A.9 Resolution: The smallest discernible difference between any two measurements that can be made. For meters, this is usually how many decimal places are displayed (e.g., 0.01). Note that the resolution may change with concentration or range. Resolution has very little relationship to accuracy or precision. The resolution will always be smaller than the accuracy or precision.

A.10 Turbidity: A measure of water clarity related to the amount of material suspended in water that decreases the passage of light through the water. Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances. These materials are typically in the size range of 0.004 mm (clay) to 1.0 mm (sand). Turbidity can affect the color of the water.

Appendix B – Acronyms

AU	Attenuation Units
DI	Deionized Water
DL	Detection Limit
GSFC	Goddard Space Flight Center
LR	Low Range
MDL	Method Detection Limit
MEMD	Medical and Environmental Management Division
mg/L	Milligrams per Liter
NASA	National Aeronautics and Space Administration
NTU	Nephelometric Turbidity Units
QC	Quality Control
WI	Work Instruction

Appendix C – Turbidimeter

1.0 Tools, Equipment, and Materials

Tools, equipment, and materials are stored at building 27B.

- 2020we Turbidimeter;
- AMCO© or formazin primary turbidity standards of 0.0, 1.0, and 10.0 Nephelometric Turbidity Units (NTU);
- Latex or Nitrile Gloves;
- Eye protection;
- Four glass 10 mL tubes (0209);
- Water sample bottle;
- Paper towels;
- Graduated pipets;
- Deionized (DI) water (in a spray or wash bottle); and
- Bound Logbook.

2.0 Measurement/Verification

None.

3.0 Calibration

Instruments shall be calibrated prior to each use or as necessary throughout daily use. Calibrations are completed using AMCO© or formazin standards. The concentration of the calibration standard should be similar to the expected concentration of sample that will be tested. The following calibration procedures are used:

1. Don protective gloves and eye protection.
2. Press and briefly hold ⏻ to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the **Main Menu** will appear.
3. Press ENTER to select **Measure**.
4. Press ∨ to scroll to **Turbidity – With Blank**.
5. Press ENTER to select **Turbidity – With Blank**.
6. Rinse a clean tube (part code 0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (<0.1 NTU) water. Tap water and DI water are not acceptable. For the most accurate results, use the same tube for the blank and the sample.

7. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.
8. Wipe the tube thoroughly with a towel or a lint-free cloth.
9. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.
10. Press ENTER to scan the blank. The screen will display **Blank Done** for about 1 second and then return to the **Turbidity – With Blank Menu**.
11. Rinse a clean tube (0290), or the same tube three times with the standard.
12. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube in a manner to avoid creating bubbles. Cap the tube.
13. Wipe the tube thoroughly with a lint-free cloth or towel.
14. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.
15. Press ENTER to scan the standard. The screen will display **Reading** for about 1 second. The result will appear on the screen.
16. Press ▼ to scroll to **Calibrate**.
17. Press ENTER to select **Calibrate**. A reverse font (dark background with light characters) will appear to indicate that the reading can be adjusted.
18. Press ▲ or ▼ to scroll to the concentration of the standard, 1.00 in the example. Note: The allowable adjustment is ± 10%.
19. Press ENTER to select **Calibrate**. Two menu choices will be offered, **Set Calibration** and **Factory Setting**.
20. Press ENTER to select **Set Calibration** and save the calibration. Press ▲ or ▼ to scroll and select **Factory Setting** to revert to the factory calibration. The meter will momentarily display **Storing** and return to the **Turbidity-Without Blank** menu. The calibration has now been saved and the meter can be used for testing.

    NOTE: For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00.

4.0 Use

After calibration is complete and criteria met, the following usage procedures shall be followed for taking Turbidity Water Samples:

1. Clean plastic or glass containers may be used for turbidity samples. Ideally, samples should be tested immediately (within 15 minutes) after collection and before the temperature has a chance to fluctuate.
2. Press ⏻ to turn meter **on**. (Meter should have been calibrated with 1.0 NTU Standard.)
3. Select **Measure**.

4. Select **Turbidity – With Blank**.
5. **Rinse** a tube three times with **0 NTU Standard** or turbidity-free water. **Fill** the tube to the line with 0 NTU Standard or turbidity-free water. **Cap** the tube. This is the BLANK.
6. **Wipe** the tube thoroughly with a lint-free cloth or paper towel.
7. Insert the tube into the chamber. Close lid. **Scan Blank**. Remove the tube.
8. **Empty** the tube. **Rinse** the same tube three times with the **Sample**. **Fill** the tube to the line with the Sample. Cap the tube.
9. **Wipe** the tube thoroughly with a lint-free cloth or towel.
10. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid. **Scan Sample**.
11. **Record** the result in logbook.

5.0 Storage

The following storage procedures shall be followed:

1. Store the unit in its plastic case when not in use.
2. Store in a cool, dry place. The turbidimeter (and related supplies) is stored in building 27B.
3. Use USB wall adapter to charge the turbidimeter. Charge life is approximately 380 tests with backlight on to 1000 tests with backlight off. The battery life is approximately 500 charges.

6.0 Troubleshooting

Problem	Reason	Solution
"Blank?"	Sample is reading lower than the blank	With samples of very low concentration reblank or record as zero. On samples of higher concentration reblank and read again.
Battery Flashing	Low battery. Readings are reliable.	Charge battery or use USB wall/computer charger.
"Low Battery"	Battery voltage is very low. Readings are not reliable.	Charge battery or use USB wall/computer charger.
"Shut Down Low Batt" Shut Down	Battery is too low to operate the unit.	Charge battery or use USB wall/computer charger.
"Over range"	Sample is outside of acceptable range.	Dilute sample and test again.
"Error1"	High readings with 90° and 180° detectors.	Dilute sample by at least 50% and retest.
Lost in meter menus	Reset to factory default settings.	Follow Procedures on page 9 or 26 of the User's Manual.

Problem	Reason	Solution
Unusually large negative or positive readings when performing calibration	Incorrect standard used to calibrate meter.	Use fresh 0.0 standard in clean tube. Reset meter to factory default settings. Recalibrate meter.

Appendix D – Hach Pocket Colorimeter II

1.0 Tools, Equipment, and Materials

Tools, equipment, and materials are normally stored in Building 27B. For catalogue numbers for replacements materials, see the manual referenced in P.3.

- Hach Pocket Colorimeter II;
- Instruction manual for Hach Pocket Colorimeter II (copy stored on the Environmental drive at EM-7 Property\Equipment User Manuals and Info\Hach Colorimeter;
- Hach Secondary Standard Kit for Chlorine (includes 1 blank and 3 standards);
- Glass fiber filter;
- Syringe;
- Two 10-mL sample cells;
- DPD Total Chlorine Reagent or DPD Free Chlorine Reagent;
- Latex or Nitrile gloves;
- Eye protection;
- Deionized water (DI);
- Paper towel;
- Glass jar (sample must be collected in glass);
- Stopwatch or a clock with a seconds counter;
- Logbook

2.0 Measurement/Verification

Colorimeters have a life expectancy of three years. An internal standard curve is stored in each instrument. The curve is verified by performing Quality Control (QC) checks. The QC for this instrument is checked routinely using secondary standards. The results of secondary standard calibrations are recorded in the logbook for the associated activity (e.g., Special Studies Logbook). In addition, a primary standard calibration is performed twice per year. The results of primary standard calibrations are stored electronically at \Public\Environment\E-6 Clean Water\Instrument QC\Hach Colorimeter.

3.0 Calibration

A certificate of analysis from the manufacturer with precise and accurate ranges is included with the secondary standards. Each set of standards has a different certificate of analysis and the concentrations often vary from one lot to the next. Verify the concentrations for the lot of standards before use.

The chlorine colorimeter shall be calibrated prior to each NPDES sampling event using one blank and a set of three reference standards within the range of 0.00 to 2.00 mg/L. The chlorine colorimeter functions by passing a beam of light through the sample. Even something as simple as a fingerprint or smudge on the colorimeter sample container can cause significant errors. Similarly, variations in the amount of suspended matter in the sample can cause erroneous results. Follow the following procedures for calibration:

1. Record in the Logbook the following items: date, time, Pocket Colorimeter model number, LOT number and expiration dates for the calibration standards, and any identification features of the equipment.
2. Remove colorimeter from case.
3. Remove plastic covering from the colorimeter.
4. Turn colorimeter on by pressing the Power key.
5. The colorimeter should be on Low Range (LR) setting, indicated by a black arrow pointing to LR. If the colorimeter is not on LR, follow these steps:
   - Press the menu key (black button with 4 white lines).
   - Press the Read/Enter (√) key until the arrow is under the LR.
   - Press the menu key again.
6. Use a paper towel to ensure the vials are clean and free of smudges, fingerprints, etc.
7. Place the Blank standard in the cell holder, and place plastic covering back on (in a vertical position).
8. Press the Zero (0) key.
9. Record the reading in the Logbook.
10. Repeat the above three steps for the remaining three standards (STD 1, 2, and 3) by pressing the Read/Enter (√) key instead of the Zero (0) key. Note: The calibration readings shall be within the range for the standards. If the readings are not within range, recalibrate the colorimeter. The instrument may not be used to read samples until all calibration readings are within range.

In addition to routine secondary standard calibration, a primary calibration test shall be performed twice per year. Check the Equipment Management and Tracking Database (or PM.accdb) for a schedule of primary calibration standards. This database is saved in the electronic files for Public\Environment\EM-7 Property. Procedures for the primary calibration test are available in Section 5.0.

4.0 Use

The following usage procedures should be followed for typical samples. Deviations may be necessary when dictated by the sample matrix (see notes below):

1. Don gloves and eye protection.
2. Collect water sample using a glass jar.
3. If the sample is a surface water or effluent waste wastewater sample it must be filtered through a glass fiber filter, using a syringe, before analysis to avoid false positive results; filtration is not necessary for drinking water samples. Using the syringe, withdraw 10 mL of sample from the glass

container. Screw the filter onto the bottom of the syringe. Dispense the filtered surface water sample into a clean sample cell. Repeat the process for the second sample cell. Filtering is necessary to remove sediment particles that cause interference. A glass fiber filter is used since the membrane cannot be nylon or nylon-based.

4. Carefully clean the outside of the sample cells making sure there is no lint, smudges or water remaining.
5. Add one packet of the appropriate Chlorine Powder Pillow or dispense one aliquot of the reagent from the SwifTest dispenser into one sample cell.
6. Cap and shake the cell (with chlorine powder) for 20 seconds. Place out of direct sunlight.
7. Take the cell WITHOUT added chlorine powder and place it in the cell holder.
8. Replace colorimeter cap in vertical position.
9. Press the Zero (0) key (reading should be 0.00 mg/L).
10. Remove the cell and insert the cell with the chlorine reagent into the cell holder.
11. Replace colorimeter cap in vertical position.
12. For **Free Available Chlorine,** measure the sample within 1 minute of adding chlorine reagent. For **Total Chlorine,** wait 3 to 6 minutes before reading sample.
13. Press the Read/Enter (√) key.
14. Record reading in the Logbook. This is the chlorine reading in mg/L for the sample.
15. Rinse sample cells three times with deionized water after each use.

Notes:

1. *If you get an error message, refer to the Hach Instruction Manual section 2-9 for troubleshooting information. Flashing "0.00" generally means that the sample is under the range, meaning that there is no chlorine in the sample and the meter is not reading anything. If you continue to receive error messages after troubleshooting, stop and call the manufacturer for advice (800-227-4224 select tech support when prompted).*
2. *If the sample result is 0.1 mg/l or greater, clean all of the equipment including the container used to obtain the sample with DI water. Resample and record the sample result. If the two samples have a difference greater than 0.02 mg/l, clean the equipment again and resample. Continue this process until two consecutive results are within 0.02 mg/l of each other. Note in the logbook that only the final two results are valid and the prior results are invalid due to calibration/sampling error.*
3. *The Colorimeter should not be used for surface water samples during hazy days or days with significant ground level ozone (ozone is an interference). During the warmer months, use the Colorimeter during the early morning or later evening to avoid peak sunlight and when threat of ground level ozone is reduced.*

5.0 Storage

The following storage procedures should be followed:

1. Store colorimeter in its case at all times when not in use.

2. Store in a cool, dry location. The colorimeter and related supplies are stored in building 27B.
3. Replace batteries (uses four AAA) as necessary. A battery symbol will flash when the batteries are low.
4. Replace calibration standards when they expire.

6.0 Troubleshooting

Error	Description	Solution
E-0	No zero	In user calibration mode, a standard solution was measured before the instrument zero was set. Measure a blank solution to set the instrument to zero.
E-1	Ambient light error[1]	There is ambient light in the cell holder. Make sure that the instrument cap is fully installed over the cell holder.
E-2	LED error[1]	The LED (light source) is out of regulation. Replace the batteries. Make sure that the LED in the cell holder comes on when (√) or (0) is pushed.
E-3	Standard adjust error	• The measured value of the standard solution is more than the adjustment limits. Prepare a fresh standard. • The standard solution is not within the concentrated range that can be used for standard calibration adjust. Prepare a standard with a value at or near the recommended concentrations given in the procedure.
E-6	Abs error	The absorbance value is not correct or the user-entered calibration curve has fewer than two points. Enter or measure the absorbance value again.
E-7	Standard value error	The standard solution concentration is equal to another standard solution concentration that is already entered in the user-entered calibration curve. Enter the correct standard concentration.
E-9	Flash error	The instrument is not able to save data.
Reading flashes	The reading is more or less than the instrument range[2]	• If the reading is less than the instrument range, make sure that the instrument cap is fully installed over the cell holder. Measure a blank. If the blank reading is not zero, set the instrument to zero again. • If the reading is more than the instrument range, identify if there is a light blockage in the cell holder. Dilute the sample. Do the test again. • For the factory-calibrated programs, the maximum and minimum values always equal the factory-calibrated values and cannot be changed.

[1] When an E-1 or E-2 error occurs on a measurement, the display shows "_.__". The decimal place depends on the chemistry. If the E-1 or E-2 error occurs while the instrument is set to zero, set the instrument to zero again.

[2] The flashing value will be 10% over the upper test range limit.

Materials

- All working Hach Colorimeters
- At least **2** Colorimeter sample cells
- 10mL TenSette® pipet
- **One** 10mL TenSette® pipet tip
- 1mL TenSette® pipet
- **One** 1mL TenSette® pipet tip
- Chlorine Standard Ampule
- **6** aliquots of DPD free chlorine reagent
- 200mL Volumetric Flask
- Glass Jar with lid
- DI water
- Paper towels
- Accuracy check Datasheet

TenSette Pipet

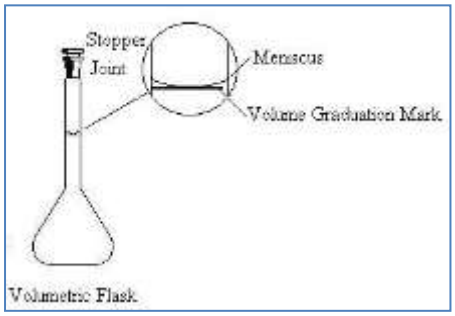
7.0 Primary Standard Calibration Test

A. Prepare Worksheet
   1. Record date, time, and location on the Accuracy Check Datasheet.
   2. Record DPD reagent lot number and expiration date on the Accuracy Check Datasheet.
   3. Record lot number, expiration date, and concentration of the chlorine standard being used on the Accuracy Check Datasheet.

B. Prepare Standard Solution
   1. Add approximately 100mL of DI water in the volumetric flask.
   2. Snap off the tip of the chlorine standard ampule.
   3. Add 0.4mL of the chlorine to the volumetric flask:
      a. Attach a clean tip to the 1mL TenSette® pipet.
      b. Turn the volume setting ring to align the 0.4mL volume to the mark on the housing assembly.
      c. Press down on the turret cap with thumb until turret reaches the stop.
      d. Immerse the tip into the chlorine standard.
      e. While maintaining a constant pressure, allow the turret to return to the extended position. Do not let the turret snap into place as this will allow air to enter the pipet tip and offset the volume accuracy.
      f. With the turret up, withdraw the tip from the chlorine standard and move it to the volumetric flask.

g. Use thumb and forefinger to twist the volume ring to the next highest setting to assure full blowout.
h. With the tip in contact with the side of the container, smoothly press down on the cap until the turret reaches the stop and is completely discharged.

4. Fill the volumetric flask with DI water to the 200mL mark.



5. Invert the volumetric flask several times to mix solution.
6. Transfer the solution from the volumetric flask to the glass jar and cap. Be sure to keep all samples cold and in an airtight container. Use this "standard solution" to complete the remaining portion of the accuracy check.

C. Measure Chlorine Concentration

1. Transfer 10mL of the standard solution into the "Blank" Sample Cell.
   a. With the 10mL TenSette® pipet press down on the turret cap with thumb until turret reaches the stop.
   b. Immerse the tip into the container with the prepared standard solution.
   c. While maintaining a constant pressure, allow the turret to return to the extended position. Do not let the turret snap into place as this will allow air to enter the pipet tip and offset the volume accuracy.
   d. With the turret up, withdraw the tip from the solution and recap the sample solution.
   e. Use thumb and forefinger to twist the volume ring to the next highest setting (F) to assure full blowout.
   f. With the tip in contact with the side of the sample cell, smoothly press down on the cap until the turret reaches the stop and is completely discharged.
2. Zero the colorimeter:
   a. Wipe off excess liquid and fingerprints off sample cell with a paper towel.
   b. Place the "Blank" sample cell into the cell holder, with the diamond mark facing the keypad.
   c. Cover with the instrument cap.
   d. Press the ZERO/SCROLL button. (The display will show "-----"then "0.00").
   e. Retain this "Blank" sample cell for further use.
3. Transfer 10mL of standard solution into a clean dry sample cell (see step 1).

Note: Prior to adding DPD reagent be sure to have all materials ready to complete this portion of the accuracy check, you have only one minute to analyze the sample.

4. Analyze the sample:
   a. Add contents of one DPD reagent to the sample cell; recap and shake for 20 seconds.
   b. Wipe off excess liquid and fingerprints off sample cells with a paper towel.
   c. Place the sample cell into the cell holder, with the diamond mark facing the keypad.
   d. Cover with the instrument cap.
   e. Press the READ/ENTER button. (The display will show "-----" then the results).
   f. Record the results in the proper column on the datasheet.
   g. Zero the colorimeter (see step 2).
5. Transfer 10mL of the standard solution to a clean, dry sample cell (see step 1).
6. Spike this sample with 0.1mL of concentrated chlorine standard from the ampule.
   a. Attach a clean tip to the 1mL TenSette® pipet *(omit this step when repeating).*
   b. Turn the volume setting ring to align the appropriate volume to the mark on the housing assembly.
   c. Press down on the turret cap with thumb until turret reaches the stop.
   d. Immerse the tip into the standard.
   e. While maintaining a constant pressure, allow the turret to return to the extended position. Do not let the turret snap into place as this will allow air to enter the pipet tip and offset the volume accuracy.
   f. With the turret up, withdraw the tip from the standard and move it to the experimental sample cell.
   g. Use thumb and forefinger to twist the volume ring to the next highest setting to assure full blowout.
   h. Uncap the sample cell.
   i. With the tip in contact with the side of the sample cell, smoothly press down on the cap until the turret reaches the stop and is completely discharged.
7. Analyze the spiked sample (see step 4).
8. Repeat steps 5 thru 7 with spike volumes of:
   a. 0.2mL;
   b. 0.3mL;
   c. 0.4mL; and
   d. 0.5mL.
9. Record name and end time on Accuracy Check Datasheet.
10. Repeat this procedure for all working colorimeters in equipment inventory.

Colorimeter Accuracy Check Datasheet

Date	Start Time	Location

Reagent Specifications	
Reagent Type	
Lot #	
Expiration Date	

Chlorine Standard Specifications	
Concentration	± mg/L
Lot #	
Expiration Date	

Part B: Sample Solution Preparation	
Volume DI Water	**200 mL**
Volume Standard	**0.40 mL**

Part C: Measure Chlorine Concentration		
Hach Colorimeter II #3		Hach Colorimeter II #1
Concentration **(mg/L)**		Concentration **(mg/L)**
	Sample Solution	
	Spike Volume 1 (0.1mL)	
	Spike Volume 2 (0.2mL)	
	Spike Volume 3 (0.3mL)	
	Spike Volume 4 (0.4mL)	
	Spike Volume 5 (0.5mL)	

Notes:

Completed By:	End Time

Data should be recorded to:
\\gsfc-filesrvc\250Data\Public\Environment\E-6 Clean Water\Instrument QC\Hach Colorimeter\Colorimeter Accuracy Check.xlsx

Recorded by: _____ Date: ____/____/____

Appendix E – Hanna pH and Temperature Meter

1.0 Tools, Equipment, and Materials

Tools, equipment, and materials are stored at building 27B (or alternatively building 27A).

- HI 98191 or HI 98183 pH and temperature meter;
- HI 72911B Titanium Body pH Electrode;
- Buffer solutions (for calibration and pH checks);
- Latex or Nitrile Gloves;
- Eye protection;
- Container (to hold sample);
- Containers, glass jars, or beakers (for buffer solutions) for calibration and pH checks;
- Paper towels;
- Hand warmers;
- Storage Solution (HI 70300 or HI 80300) or Filling Solution (HI 7071 or HI 8071);
- Cleaning Solution (HI 7061);
- Deionized (DI) water (in a spray or wash bottle);
- Logbook; and
- Indelible ink pen.

2.0 Measurement/Verification

The pH check readings shall be within +/- 0.05 pH units of the actual value for buffers used in calibration. For example, if calibration is performed using pH buffer 7.00, the readings during pH checks for this buffer should be between 6.95 and 7.05. If pH checks are performed using buffers not used to calibrate, the pH check readings must be within 0.10 pH units. If the meter fails to meet these performance criteria, see troubleshooting in section 5.0 for solutions. If recommended solutions do not correct the problem, the meter may need to be retired from service.

3.0 Calibration

Instruments shall be calibrated prior to each use or as necessary throughout daily use. Calibrations are completed using a choice of seven memorized buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, and 12.45 pH). The meter allows the user to set up to five custom buffers. The most common buffers used for 3-point calibration for the field are 4.01, 7.01, and 10.01 pH. It may improve instrument performance to start with a neutral pH for calibration before moving on to the other selected buffers. The buffer solutions used to perform calibrations and pH checks must meet National Institute of Standards and Technology requirements for traceability. Only buffers solutions that are accurate to 0.02 pH units at 25 degrees Celsius should be purchased. Fresh buffer solution should be used to calibrate the pH probe for

each sampling event. This prevents contamination of buffer solution and ensures the accuracy of pH calibrations, ultimately improving the reliability of the pH readings. If all measures have been taken to prevent cross contamination, the buffer can be reused; however, the buffer solutions shall be refreshed at least weekly and the frequency of replacement must be tracked and recorded either on the jar or in a log or logbook.

The pH buffers are temperature sensitive and should be stored at room temperature. The following calibration procedures should be used:

1. Don protective gloves and eye protection.
2. Pour small quantities of selected buffer solutions into clean containers or beakers.
3. Remove the protective cap and rinse the electrode with DI water.
4. Turn the instrument ON by pressing **ON/OFF** key.
5. Immerse the pH electrode approximately 4 cm into the first buffer solution of your choice (it is best to start with a neutral pH) and stir gently.
6. Press **CAL**. The instrument will display the measured pH, the LCD first expected buffer, and the temperature reading.
7. If necessary, press the **ARROW** keys to select a different buffer value.
8. The icon will blink on the LCD until the reading is stable.
9. When the reading is stable and close to the selected buffer, **CFM** functional key is displayed.
10. Press **CFM** to confirm first point. (Please note that the **CFM** functional key is only displayed for a few seconds. If you do not press **CFM** quickly you may have to start the calibration over.)
11. The calibrated value and the second expected buffer value are then displayed on the LCD.
12. After the first calibration point is confirmed, rinse the pH electrode with DI water and immerse the pH electrode approximately 4 cm into the second buffer solution and stir gently.
13. If necessary, press the **ARROW** keys to select a different buffer value.
14. The icon will blink on the LCD until the reading is stable.
15. When the reading is stable and close to the selected buffer, the **CFM** functional key is displayed.
16. Press **CFM** to confirm calibration.
17. The calibrated value and the third expected buffer value will be displayed.
18. After the second calibration point is confirmed, rinse the pH electrode with DI water and immerse the pH electrode approximately 4 cm into the third buffer solution and stir gently.
19. If necessary, press the **ARROW** keys to select a different buffer value.
20. The icon will blink on the LCD until the reading is stable.
21. When the reading is stable and close to the selected buffer, the **CFM** functional key is displayed.
22. Press **CFM** to confirm calibration.
23. Press the ESC key to end calibration.
24. This shows the process for a 3-point calibration which is the most commonly used. The instrument is capable of performing up to a 5-point calibration.

4.0 pH Checks

After completing calibration, follow these steps to verify accurate readings (pH checks) of all buffer solutions.

1. Rinse the probe with DI water and place in container with first buffer solution.
2. Stir gently and wait for the pH and temperature to stabilize (it is normal for pH to continue to fluctuate even after stabilization). The icon will blink on the LCD until the reading is stable.
3. Record the pH when the hourglass indicates that the reading has stabilized.
4. Repeat the process using the second and third buffer solutions.
5. The pH check readings shall be within +/- 0.05 pH units of the actual value for buffers used in calibration. For example, if calibration is performed using pH buffers 7.00, the readings during pH checks for this buffer should be between 6.95 and 7.05. If pH checks are performed on buffers not used to calibrate, the pH check readings must be within 0.10 pH units. If any of the pH checks fail to meet this standard, the meter should be recalibrated or another meter should be used.

5.0 Use

After calibration criteria have been met, the following usage procedures shall be followed for taking pH and temperature readings for samples:

1. Clean plastic or glass containers may be used for pH and temperature samples. Ideally, samples should be tested soon after collection and at the same temperature as when collected.
2. Turn instrument on by pressing **ON/OFF**.
3. Remove protective cap and rinse pH electrode with DI water.
4. Once probe is in the plastic or glass container with the water sample that will be tested for pH, wait a couple seconds until the hourglass symbol turns off which indicates the pH reading has stabilized, then record the pH and temperature readings displayed on screen.
5. The pH reading is directly affected by temperature. For accurate pH measurements, temperature must be taken into consideration. If the sample temperature is different from the temperature at which the pH electrode was kept, allow a few minutes for the electrode to reach thermal equilibrium. If thermal equilibrium takes more than one minute, a separate discreet sample should be collected after the probe has stabilized to confirm the reading. The instrument is equipped with *Automatic Temperature Compensation*. Allowing additional time for temperature stabilization should not affect the accuracy, but a re-sample should confirm this. If the difference is significant, the confirmatory sample should be considered the more reliable result.
6. Ensure the instrument is in pH mode as indicated at the top row of the LCD display. If necessary, press **RANGE** until the display changes to the pH mode.
7. To store the current reading into memory, press **LOG** while in measurement mode.
8. Press **RCL** to retrieve the information stored while in measurement mode for the specific range.
9. To ensure proper operation and improved performance always store the equipment as described in section 4.0 of this WI.

6.0 Storage

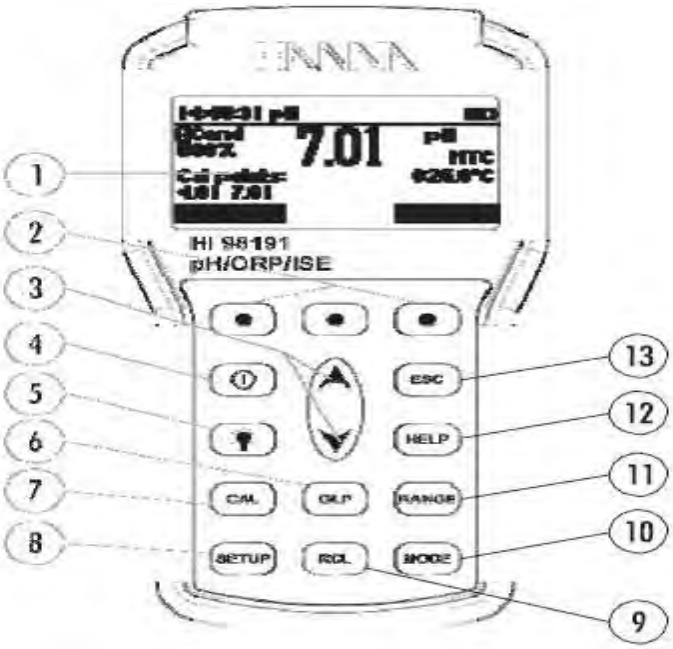
The following storage procedures should be followed:

1. The pH electrode must be kept moist and not allowed to dry out. Replace the solution in the protective cap with a few drops of HI 70300 or HI 80300 Storage Solution or, in its absence, pH 7 buffer solution.
2. Store the unit in its plastic case or on the charging dock when not in use.
3. Store in a cool, dry place. The Hanna pH/temperature probe and buffers (and related supplies) are stored in building 27B (or alternately in 27A).

7.0 Troubleshooting

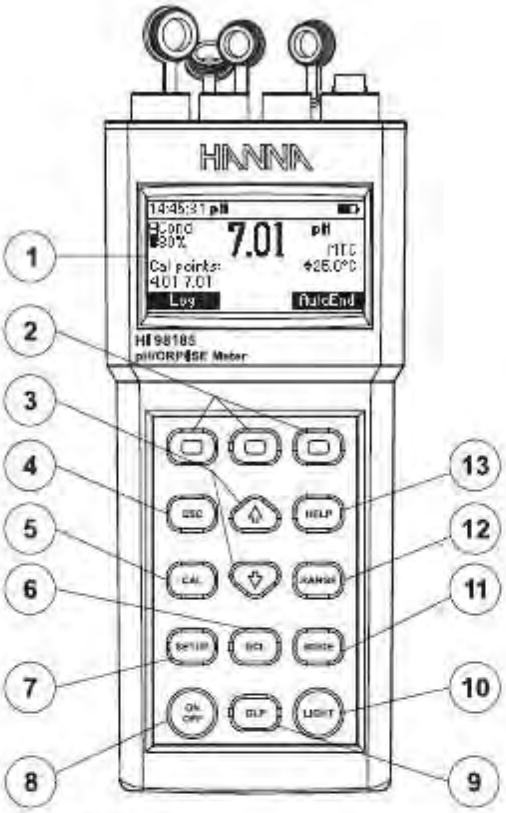
SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI 7061 solution for 30 minutes and then follow the Cleaning Procedure.
Reading fluctuates up and down (noise).	Clogged/dirty junction. Low electrolyte level (refillable electrodes only).	Clean the electrode.
Display shows blinking full scale value.	Reading out of range.	Check that sample is within measurable range; Check electrolyte level and general electrode status.
mV scale out of range.	Dry membrane or dry junction.	Soak electrode in HI 70300 storage solution for at least 30 minutes.
Display shows ♦ symbol in front of temperature reading.	Out of order or missing temperature probe.	Replace temperature probe or check the connection.
Display shows "Clean electrode" blinking.	Difference between new and previous calibration has been detected.	Clean electrode and recalibrate. If the problem remains, check the buffer solutions. While cleaning the electrode, it should only sit in cleaning solution for 30-60 seconds.
Meter is not working with temperature probe.	Broken temperature probe.	Replace temperature probe.
Meter fails to calibrate or gives faulty readings.	Broken pH electrode.	Replace electrode.
Error messages are displayed during pH calibration procedure.	Wrong or contaminated buffer, electrode dirty or broken.	Check that buffer solution is correct and fresh.
Meter shuts off.	Dead accumulators; Auto-off feature is enabled: in this case, meter shuts off after selected period of non-use.	Recharge accumulators or replace batteries; Press ON/OFF.
"Errxx" message at start up.	Internal error.	Contact your dealer or any Hanna Service Center.
The instrument does not start when pressing ON/OFF.	Initialization error.	Press and hold down ON/OFF for about 20 sec. or disconnect and then connect one accumulator.

Hanna HI 98191 pH/Temperature Meter



1) Liquid Crystal Display (LCD).
2) Functional keys.
3) ▲ ▼ keys to manually increase/decrease the parameters or to scroll between the parameter list.
4) ON/OFF (⏻) key, to turn the instrument ON and OFF.
5) LIGHT (☀) key to toggle display backlighting.
6) GLP key, to display Good Laboratory Practice information.
7) CAL key, to enter/exit calibration mode.
8) SETUP key, to enter/exit SETUP mode.
9) RCL key, to enter/exit view logged data mode.
10) MODE key to change pH resolution or to toggle between mV and Rel mV mode.
11) RANGE key, to switch between pH and mV range (HI98190) or pH, mV and ISE range (HI98191).
12) HELP key to enter/exit contextual help.
13) ESC to leave current mode, exit calibration, setup, help. etc.

Hanna HI 98183 pH/Temperature Meter



1) Liquid Crystal Display (LCD).
2) Functional keys.
3) ▲/▼ keys to manually increase/decrease the parameters or to scroll between the parameter list.
4) ESC to escape the current mode, exit calibration, setup, help, etc.
5) CAL key, to enter/exit calibration mode.
6) RCL key, to enter/exit view logged data mode.
7) SETUP key, to enter/exit SETUP mode.
8) ON/OFF key, to turn the instrument ON and OFF.
9) GLP key, to display Good Laboratory Practice information.
10) LIGHT key to toggle between backlighting.
11) MODE key, to change pH resolution or to toggle between mV and Rel mV mode.
12) RANGE key, to switch between pH and mV range (HI 98182/3) or pH, mV and ISE range (HI 98184/5).
13) Help key to enter/exit contextual help.

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	09/06/2017	Initial Release
A	05/29/2019	• P.1 - Added HI 98181 and clarified that the instruments are used for sampling and monitoring. • P.3f - Updated to the current version for the HACH Pocket Colorimeter II manual. • P.6 and P.9 - Minor text clarifications made. • P.8 - Added Instrument QC records and associated retention schedule. • Notes have been italicized throughout the document. • Appendix A - Minor grammatical changes made. • Appendices C, D and E - Added section 2, measurement/verification each and renumbered the successive sections. • Appendix C section 3.0 - Minor text clarification and grammatical correction made. • Appendix D section 1.0 - Updated hyperlink to equipment manual. • Appendix D section 4.0 - Minor text clarifications made. • Appendix D section 4.0 - Deleted note 4 on winter sampling and road salt. Reference to manual section/page in note 5 was removed as it does not exist in current user manual. • Appendix D section 6.0, Troubleshooting added. Renumbered the subsequent section. • Appendix E section 3.0 - Revised the paragraph just prior to the step-by-step instructions, to specify the use of three buffers bracketing the pH of the water for calibration. • Appendix E - Corrected the paragraph numbering in section 5.0, Use, and made minor text clarifications in section 6.0. • Added steps to Appendix D, 4.0: Usage pertaining to filtering of samples.

For Best Practices refer to:
https://gs279gdmsias.gsfc.nasa.gov/GDMSv2/downloadFile.htm?docId=28819