Standard Operating Procedure

Conductivity using Multi-Parameter Water Quality Meters: Measurement, Meter Calibration, and Meter Maintenance

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1.0 INTRODUCTION

1.1 Purpose

To provide standardized procedures for the use and maintenance of *in situ* Conductivity probes housed within multi-parameter water quality meters.

1.2 Scope of Work

These procedures are applicable for ambient surface water samples from lakes, streams, and tidal waters, and for wastewater samples.

2.0 MATERIALS

2.1 Equipment

The procedures described herein are applicable for use with the following multi-parameter water quality meters:

DRBC Name	Meter Make & Model	Cond. Probe
1. Coastal YSI	YSI 650 MDS + 6920 sonde	YSI 6560
2. Tristate #1	YSI 556 MPS	YSI 5560
3. Tristate #2	YSI 556 MPS	YSI 5560
4. EPA YSI	YSI 556 MPS	YSI 5560
5. Quanta	HydroLab Quanta	Quanta Conductivity
6. YSI 30 - #1	YSI 30	YSI 30
7. YSI 30 - #2	YSI 30	YSI 30

All of these multi-parameter meters provide temperature compensation of conductivity readings for the measurement of Specific Conductance (i.e., conductivity @ 25°C).

2.2 Reagents & Chemicals

- 10,000 µS/cm conductivity standard
- 2000 µS/cm conductivity standard
- 1000 µS/cm conductivity standard
- 500 µS/cm conductivity standard
- 200 µS/cm conductivity standard

The above NIST-traceable conductivity standards will be routinely used for probe calibration and verification. Upon arrival at the lab, each standard will be marked with the date received and, upon first opening and breaking the seal, the date first opened. Fresh standards (i.e., unused standards directly from the manufacturer's container) will be used for all calibrations and verifications. Upon use, the aliquots of standards for calibration and verification will be discarded. In addition, conductivity standards will be discarded upon expiration.

3.0 PROCEDURES

3.1 Cleaning & Maintenance

Prior to calibration and use each day, examine the conductivity cell for oil, grease, or other fouling material. Should any material be found on the sensor or if the sensor responds erratically during calibration or use, gently clean the sensor with a cotton swab (e.g., Q-tip) or soft-bristle brush. Sufficient cleaning may be obtained simply by using distilled water or clean tap water. However, if the sensor continues to perform poorly, more thorough cleaning can be conducted using alcohol or a mild detergent solution. If significant problems with calibration and measurement persist, see Section 3.5 below on possible probe replacement. Following any cleaning, rinse thoroughly with plenty of tap water or distilled water.

3.2 Calibration

Calibrations are to be conducted every day prior to use of the conductivity probe. In addition, each conductivity probe needs a 5-point calibration curve developed prior to its initial use by DRBC (see Section 3.6 below). Daily calibrations for conductivity involve a minimum 1-point calibration at the upper range of values expected to be sampled that day; additional calibration or validation points lower than the initial calibration may also be valuable for quality assurance. See each meter's users manual for specific instructions on accessing the calibration menus for that meter. The following provides step-by-step instructions for completing the calibration:

1. Rinse the conductivity probe and the calibration cup thoroughly with tap water, ensuring that water is flushed through the conductivity sensor openings.
2. Select the appropriate conductivity standard for the anticipated environmental condition that will be encountered in the field that day. For instance, if tidal waters across the salt front will be sampled, select a 10,000 µS/cm (or higher) standard for calibration. For

sampling dilute headwaters in the Poconos or Catskills, select either a 500 µS/cm or 200 µS/cm standard [***note: some manufacturers recommend calibrating only with standards of 1000 µS/sm or higher because of the weak buffering capacity of lower standards and possible contamination; if calibrations are conducted using 500 µS/cm or 200 µS/cm standards, extra care must be taken to prevent any dilution with tap water or spikes from other calibration standards***].

3. Fill the calibration cup completely with the selected conductivity standard, immerse the probes into the standard within the cup, and then remove the cup and pour the conductivity standard over and through the conductivity probe and other sonde probes to displace any remaining tap water [*note: a second rinse can be performed when using low-conductivity standards such as 200 µS/cm or 500 µS/cm]*. Carefully shake free any remaining fluid from the calibration cup and the sonde.
4. Fill the calibration cup completely with fresh conductivity standard and insert the probe into the calibration cup so that the entire conductivity probe is immersed in the standard solution.
5. Allow the conductivity readings on the meter to stabilize (minimum of 60 seconds) before calibrating to the conductivity standard. Record on the calibration bench sheet the initial reading immediately prior to calibration, whether the reading was calibrated, and the final reading on the meter. The time of meter calibration is also recorded on the calibration bench sheet along with a signature of the analyst performing the calibration.
6. Rinse the calibration cup and conductivity probe (and other affected probes) thoroughly with tap water.
7. ***(optional)*** Repeat steps 3 through 6 for additional calibrations or validations at lower conductivity values.
8. Rinse the calibration cup and conductivity probe (and other affected probes) thoroughly with tap water, and prepare for either further calibrations or for storage and travel (see 3.4 below)

3.3 Measurement Procedures

3.3.1 Streams & Rivers

Attach the probe guard and deploy the sonde within a representative area of appreciable flow to provide adequate mixing around the probes. Turn the meter on, record the time on the data sheet, and wait an initial 60 seconds before checking conductivity readings. From 60 seconds onward, observe the conductivity readings and record an initial conductivity reading and the time of measurement when conductivity values stabilize (less than 1% change in conductivity readings within 10 seconds [e.g., less than 5 µS/cm change at 500 µS/cm reading]). Record a duplicate reading and the time of the measurement at least 60 seconds following the initial

reading and up to 10 minutes following that reading. Retrieve the sonde, retain a small volume of either tap water or surface water within the travel cup, and finish packing the meter for travel.

3.3.2 Tidal Waters

Attach the probe guard and deploy the sonde within the water column and a minimum of 10 cm above the bottom. Turn the meter on, record the time on the data sheet, and wait an initial 60 seconds before checking conductivity readings. If the probes are situated in adequate flow, no special care is needed. However, if the measurements are taken at slack tide or from a quiescent location, ensure adequate flow around the probes by either gentle movement of the sonde or by utilizing a flow inducing device (e.g., stirrer, pump). Starting 60 seconds following deployment / turning on the electronics, observe the conductivity readings and record an initial conductivity reading and the time of measurement at the point when conductivity values stabilize (less than 1% change in conductivity readings within 10 seconds [e.g., less than 5 µS/cm change at 500 µS/cm reading, etc.]). Record a duplicate reading and the time of the measurement at least 60 seconds following the initial reading and up to 5 minutes following that reading. Retrieve the sonde, retain a small volume of either tap water or surface water within the travel cup, and finish packing the meter for travel [*note: if brackish or saline waters are used for storage in the travel cup, flush the probes and replace with tap water upon return to the lab, office, or motel; see 3.4 below*].

3.3.3 Lakes & Ponds

Attach the probe guard and deploy the sonde within the water column and a minimum of 10 cm above the bottom. Turn the meter on, record the time on the data sheet, and wait an initial 60 seconds before checking conductivity readings. Ensure adequate flow around the probes by either gentle movement of the sonde or by utilizing a flow inducing device (e.g., stirrer, pump). Starting 60 seconds following deployment / turning on the electronics, observe the conductivity readings and record an initial conductivity reading and the time of measurement at the point when conductivity values stabilize (less than 1% change in conductivity readings within 10 seconds [e.g., less than 5 µS/cm change at 500 µS/cm reading, etc.]). Record a duplicate reading and the time of the measurement at least 60 seconds following the initial reading and up to 5 minutes following that reading. Retrieve the sonde, retain a small volume of either tap water or surface water within the travel cup, and finish packing the meter for travel.

3.3.4 Wastewater

Attach the probe guard and deploy the sonde within the water column and a minimum of 10 cm above the bottom of any structure. Turn the meter on, record the time, and wait an initial 60 seconds before checking conductivity readings. If the probes are situated in adequate flow, no special care is needed. However, if the measurements are taken from a quiescent location, ensure adequate flow around the probes by either gentle movement of the sonde or by utilizing a flow inducing device (e.g., stirrer, pump). Starting 60 seconds following deployment / turning on the electronics, observe the conductivity readings and record an initial conductivity reading and the time of measurement at the point when conductivity values stabilize (less than 1% change in conductivity readings within 10 seconds [e.g., less than 5 µS/cm change at 500 µS/cm reading, etc.]). Record a duplicate reading and the time of the measurement at least 60 seconds following the initial reading and up to 5 minutes following that reading. Retrieve the sonde, place a small volume of either tap water or pH buffer within the travel cup (*no not use wastewater!*), and finish packing the meter for travel.

3.4 Storage

Except when no other sanitary water is available, distilled or deionized water should ***not*** be used for storage of conductivity and other water quality probes due to its low ionic strength. Instead, tap water, clean surface fresh water, or pH 4.0 buffer should be used for storage. For short-term storage (a day or less), tap water or clean surface water is preferred [*note: brackish or saline water can be used for short term storage of a day or less, but the probes must be rinsed thoroughly and the storage cup water replaced upon return to the lab, office, or motel*]. For moderate lengths of storage (up to 2 weeks), tap water should be used for storage in the travel cup. For long-term storage (a month or longer), pH 4.0 buffer solution must be used to prevent damage to the probes (pH 4.0 buffer can also be used for shorter-term storage, but greater care with calibration and verifications must be used in such cases). It is important to note that maintaining some fluid in the cup is more important than the source of water. As a result, if the preferred water source is not immediately available, use a small volume of the available water source (e.g., water bottle) for short-term storage but immediately and thoroughly rinse the sensors at the earliest opportunity, and replace the fluid within the travel cup with the recommended water source.

In both short-term and moderate-term storage, fill the travel cup with approximately ½ inch (1 cm) of water and secure the travel cup to prevent evaporation. A small volume of

water is necessary to simultaneously maintain a moist, humid environment within the storage cup while preventing immersion of any probe in the storage fluid. Long-term immersion within any storage fluid can result in sensor drift and/or shorten the sensor lifetime.

Exceptions: The two YSI 30 temperature/conductivity meters provide for dry storage rather than a storage cup. For these two YSI 30 meters, no storage solution is necessary.

3.5 Probe Replacement

Conductivity probes are generally long-lasting, reliable water quality probes that provide many years of service without significant maintenance. However, even these reliable sensors at times fail and need to be replaced. Signs of poor performance (e.g., reading >10µS/cm in air, continuous drift during deployment, inconsistent calibrations) are important indications that the conductivity probe may need replacement; other than cleaning (see 3.1 above), there are no ways to service the probes in-house. Should the probes continue to demonstrate poor performance or erratic behavior, replace the conductivity probe. For some DRBC meters (e.g., YSI 556 meters and YSI 6920 sonde), a replacement part can be ordered from the manufacturer or a supplier (e.g., Fondriest). For other meters, however, the replacement of the conductivity probe must be done at the manufacturer or a manufacturer-authorized service provide. See each meter's users manual for additional details on probe replacement.

3.6 Development of 5-Point Calibration Curve for New Probes

Upon installation of a new conductivity probe on any meter, or upon purchase or receipt of a new multi-parameter water quality meter, an initial 5-point calibration curve needs to be developed for that conductivity probe. Following calibration at a high standard (2000 µS/cm or 10,000 µS/cm) according to Section 3.2 above, the conductivity probe will be sequentially checked at five (5) separate NIST-traceable conductivity standards covering the typical range of monitored conditions. The readings from the probe will be recorded along with the standard value and the standard's lot number. From these paired readings, a calibration curve will be developed for the probe using linear regression through the origin.

A tabular representation of the raw results from the 5-point calibration curve along with a graph demonstrating the paired values and the calibration curve will be compiled into a single-page report. This report will contain the specification on the water quality meter

tested, the date of analysis, the name and signature of the analyst, and summary statistics for the calibration curve. In addition, Certificates of Analysis for each of the conductivity standards used in developing the calibration curve will be obtained from the manufacturer and retained within the files for a minimum of 5 years.

3.7 Quality Control

Original calibration records will be retained within the lab for a period no less than 5 years. These calibration records will clearly indicate the meter and/or probe being calibrated, the date and time of calibration, and the analyst conducting the calibration. Any calibration checks or validations will also be recorded and transferred to the calibration bench sheet.