SOP 52

Standard Operating Procedure

for

Verification and Adjustment of Digital Conductivity Meter and Measuring Water Conductivity

1 Introduction

1.1 Purpose. This specification covers the procedure for testing the conductivity and resistivity of the water stored and used in the laboratory for gravimetric calibrations. This specification also covers the procedure for adjustment of a digital conductivity meter used for conductivity and resistivity testing. The conductivity meter may have a probe to dip into the water or may have an integrated cell to receive the sample. Note: conductivity is a relative indicator of purity and is not specific for density measurements of water. An in-line conductivity sensor with a suitable probe may be evaluated with this procedure with appropriate modifications.

1.2 Applicable References:

1.2.1 Good Laboratory Practice (GLP) 10, Purity of Water.

1.2.2 Operation manual and instructions for conductivity meter.

1.3 Prerequisites

1.3.1 Ensure staff have suitable on-the-job training and have demonstrated proficiency with this procedure.

1.3.2 Standard Reference Material (SRM) or Certified Reference Material (CRM) for conductivity or resistivity reference measurements that have suitable calibration or test certificates and that solutions are up to date (have not expired).

1.3.3 Adequate supply of distilled, deionized, or reverse-osmosis/deionized water per GLP 10.

1.3.4 Maintain environmental conditions within the limits noted in Table 1.

Table 1. Environmental limits for calibrations (as used for Gravimetric Volume Calibrations).

Temperature	Relative Humidity
18 °C to 23 °C Stable to ± 1 °C / 1 h	40 % to 60 % Stable to ± 10 % / 4 h

2 Methodology

2.1 Summary

This procedure is used as a verification step for water quality indications as a part of gravimetric volume calibrations. The procedure includes testing the digital conductivity meter, applicable adjustments based on standard/certified reference materials, and use of the conductivity meter to verify acceptable water quality per GLP 10.

2.2 Equipment / Apparatus

2.2.1 Conductivity/Resistivity meter. Conductivity units[1] are siemens, symbol S, usually represented as mS/cm or μS/cm. Resistivity is usually in Ohm-cm units, such as MΩ-cm or μΩ-cm, with ohms represented by Ω. The values are reciprocals of each other, $S = \Omega^{-1}$.

2.2.2 Calibrated thermometer with resolution and uncertainty less than 0.1 °C to determine liquid temperatures.

2.2.3 Appropriately sized beakers or flasks for pure water (distilled, deionized). E.g., 1 000 mL, 100 mL.

2.2.4 Small tools for adjusting conductivity meter (e.g., flat head screw driver).

2.3 Procedure for Conductivity Meter with Probe, Verification and Adjustment

2.3.1 Turn on the water system in the volume laboratory.

2.3.2 Retrieve the conductivity meter, a 100 mL glass flask, and an up to date SRM/CRM.

2.3.3 Connect the conductivity meter probe to the meter.

2.3.4 Rinse the 100 mL flask with pure water. Open the water system valve and let the water run for approximately 5 to 10 seconds. Rinse the 100 mL flask several times.

2.3.5 Pour approximately 30 mL of SRM/CRM into the 100 mL flask. Dip the probe into the flask so that the SRM/CRM covers the probe and then remove the probe from the flask (this is to coat and condition the probe and sensors). Rinse the probe in the SRM/CRM.

[1] The SI unit of conductivity is siemens per meter (S/m). The 14th General Conference on Weights and Measures approved the addition of the siemens as a derived unit in 1971. In the case of direct current (DC), conductance units in siemens is the reciprocal of the resistance in ohms (S = amperes per volts); in the case of alternating current (AC), it is the reciprocal of the impedance in ohms. A former term for the reciprocal of the ohm is the mho (ohm spelled backward).

2.3.6 Rinse the 100 mL flask with the SRM/CRM. Cover with a suitable lid/thumb and shake the flask so the SRM/CRM coats the inside of the flask.

2.3.7 Pour the SRM/CRM in the flask into the sink.

2.3.8 Take note of the Conductivity Reference value in μΩ-cm from the certificate or original container to use later.

2.3.9 Pour approximately 30 mL of the SRM/CRM into the 100 mL flask. Dip the probe into the flask so that the Conductivity Standard covers the probe.

2.3.10 Push the conductivity meter switch to the 0.1 μΩ to 199.9 μΩ position. Check the conductivity meter reading against the value obtained in step 2.3.8.

2.3.11 Adjust the conductivity meter if possible and needed. This may be done by turning a small screw on the conductivity meter, using a suitable tool, until the value on the conductivity meter matches the value obtained in step 2.3.8.

2.3.12 Remove the probe and place back into the solution several times verifying that the reading on the conductivity meter matches the value obtained in step 2.3.8. If it does not then repeat step 2.3.11.

2.3.13 When the readings are repeatable the meter is ready for use to evaluate water quality.

2.3.14 When finished, turn off the conductivity meter. Empty the 100 mL flask and rinse with pure water. Dry the flask. Use extreme care to dry the conductivity meter probe by gently dabbing with a paper towel. Remove the probe from the conductivity meter.

2.3.15 Turn off the pump for the water system and put all items away.

2.3.16 Make a note in the Control Chart in the "Notes" column that the reference was set and which reference standard material was used. Record this information with the Gravimetric Calibration data sheet as well.

2.4 Procedure for Verification of Conductivity Meter with Integrated Conductivity Cell

2.4.1 Turn on the water system in the volume laboratory.

2.4.2 Retrieve the conductivity meter, a small glass flask, and an up to date Conductivity Reference Standard.

2.4.3 Rinse the small flask with pure water. Open the water system valve and let the water run for approximately 5 to 10 seconds. Rinse the flask several times.

2.4.4 Fill the receiving cell of the conductivity meter with the SRM/CRM and rinse. Repeat at least two more times, using the last fill as the reference reading. This conditions the temperature sensing network and prepares the cell.

2.4.5 Pour the SRM/CRM from the meter into the sink.

2.4.6 Take note of the Conductivity Reference value in μΩ-cm from the certificate or original container for comparison with 2.4.4. Record observations from the conductivity meter and the SRM/CRM and note any differences.

2.4.7 Adjust the conductivity meter with the SRM/CRM in the cell if the meter has an adjustment feature following the manufacturer's instructions (often using a "Cal" button to adjust the integrated electronic sensor readings).

2.4.8 When the readings are repeatable the meter is ready for use to evaluate water quality.

2.4.9 When finished, turn off the conductivity meter and rinse several times with pure water. Empty flasks and rinse with pure water. Dry the flasks. Do not scrub the integrated cell or sensors.

2.4.10 Turn off the pump for the water system and put all items away.

2.4.11 Make a note in the Control Chart in the "Notes" column that the reference was set and which reference standard material was used. Record this information with the Gravimetric Calibration data sheet as well.

2.5 Procedure for Water Quality Evaluation, Using a Meter with a Probe

2.5.1 Turn on the water system in the volume laboratory.

2.5.2 Obtain the conductivity meter, the 1 000 mL flask, and the thermometer.

2.5.3 Connect the conductivity meter probe to the meter (unless integrated in the unit) and turn on the unit.

2.5.4 Push the conductivity meter switch to the 2.00 MΩ to 19.99 MΩ position. The meter should read 1.

2.5.5 Push the conductivity meter switch to the 0.1 MΩ to 199.9 MΩ position. The meter should read 0.00.

2.5.6 Rinse the 1 000 mL flask. Open the pure water system valve and let it run for approximately 5 to 10 seconds, rinse out the 1 000 mL flask several times and then fill it to approximately 1 000 mL. Turn off the water.

2.5.7 Place the probe from the conductivity meter into the 1 000 mL flask.

2.5.8 Push the conductivity meter switch to the 0.1 MΩ to 199.9 MΩ position and record the value on the observation sheet for the calibration. Monitor water quality on a control chart as well.

2.5.9 Push the conductivity meter switch to the 2.00 MΩ to 19.99 MΩ position and record the value on the observation sheet for the calibration. Monitor water quality on a control chart as well.

2.5.10 Take the temperature of the water that was just tested using the digital thermometer and record it on the observation sheet and the control chart data sheet.

2.5.11 Enter the observations readings into the appropriate control chart.

2.5.12 Empty the flask and dry it off with a paper towel. Dry off the thermometer probe. Use extreme care to dry the conductivity meter probe by gently dabbing with a paper towel. Disconnect the probe from the conductivity meter.

2.5.13 Turn off the water system (if calibration is complete) and put all items away.

2.6 Procedure for Water Quality Evaluation, Using a Meter with Integrated Conductivity Cell

2.6.1 Turn on the water system in the volume laboratory.

2.6.2 Obtain the conductivity meter, a 1 000 mL flask, and the thermometer.

2.6.3 Rinse the 1 000 mL flask. Open the pure water system valve and let it run for approximately 5 to 10 seconds, rinse out the 1 000 mL flask several times and then fill it to approximately 1 000 mL. Turn off the water.

2.6.4 Place a sample in the conductivity meter from the flask.

2.6.5 Record the value of the conductivity meter on the observation sheet for the calibration. Monitor the water quality on a control chart as well.

2.6.6 Take the temperature of the water that was just tested using the digital thermometer and record it on the observation sheet and the control chart data sheet.

2.6.7 Enter the observations readings into the appropriate control chart.

2.6.8 Empty and dry the flask and thermometer probe.

2.6.9 Turn off the water system (if calibration is complete) and put all items away.

3 Calculations (Measurement Equations)

There are no calculations in this SOP. See GLP 10 for calculations of water density.

4 Measurement Assurance

This procedure is part of the measurement assurance required for GLP 10, Water Purity evaluation and SOP 14, Gravimetric Volume Calibrations to ensure suitable water quality for use in calibrations.

Monitor laboratory water quality over time on a control chart if desired. This will help track maintenance or service requirements for the water purification system.

5 Assignment of Uncertainty

No uncertainties are assigned for this procedure.

6 Certificate

Documentation of conductivity meter evaluation and water quality assessments are included with the recorded measurement data for volume calibrations as appropriate. No calibration or test certificates are issued. Temperature of the water at the time of verification and the relevant information from the SRM/CRM should be recorded as well (e.g., brand, serial or sample number, certificate reference, date of test/certification, and status of the laboratory providing conductivity certification).

7 Acknowledgements and Validation

The original SOP for this procedure was submitted by the State of Pennsylvania and modified by Georgia Harris to make the procedure generic, incorporate the SRM/CRM terminology, to incorporate a conductivity/resistivity meter with integrated sensor/cell that is in use within OWM, and to review the instruction manuals for the meters referenced in this SOP.