*Name of Facility*

Standard Operating Procedure

for the Analysis of

Specific Conductance (Conductivity)

Method: SM 2510 B-2021

Effective Date:

Supervisor Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_

Supervisor Name (print):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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*Blue text is replaceable instructional language to be customized for your facility.*

1. Summary of Method
   1. Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current.
   2. *State what type of samples are analyzed, e.g., wastewater effluent, ground water monitoring well, etc. and the permit limits if applicable*
   3. *State what your reporting range is, i.e., minimum reporting limit and upper reporting limit*
2. Definitions
   1. Calibration standard: Potassium chloride (KCl) standard used to calibrate the meter each day of use.
   2. Calibration verification check standard: Second-source potassium chloride (KCl) standard analyzed after calibration of the meter to check the calibration acceptability. It is recommended that this standard value approximate (may be higher or lower than the calibration standard, as applicable) the expected range of sample values measured.
   3. µmhos/cm: Units for the measurement of specific conductance. 1 µmhos/cm = 1 µS/cm.
   4. NC WW/GW LCB: North Carolina Wastewater Groundwater Laboratory Certification Branch
   5. *Add any other applicable acronyms used by your facility*
3. Safety and Waste Handling
   1. *Items that would be included in this section are things such as:*

* *Precautionary measures (list here and at the critical steps in the procedure)*
* *Personal protective equipment (e.g., gloves, eye protection, lab coat, work in a hood, etc.)*
* *Hazardous chemicals/reagents*
* *Storage and disposal of samples and reagents*
* *Reference to Chemical Hygiene Plan, if applicable*
* *Location of Safety Data Sheets (SDS)*

1. Apparatus, Equipment and Reagents

*Note: Include storage conditions. It is recommended catalog numbers also be included*

* 1. *List your meter with make and model*
  2. Calibration standard(s): *state if it is purchased, the concentration, and if prepared, how it is made*

TABLE 2510:I. EQUIVALENT CONDUCTIVITY, A, AND CONDUCTIVITY, *k*, OF POTASSIUM CHLORIDE AT 25.0°C.\*2– 4

|  |  |  |
| --- | --- | --- |
| KCl Concentration | Equivalent  Conductivity, A | Conductivity, *ks* |
| *M or equivalent/L* | *mho-cm2/equivalent* | µ*mho/cm* |
| 0 | 149.9 |  |
| 0.0001 | 148.9 | 14.9 |
| 0.0005 | 147.7 | 73.9 |
| 0.001 | 146.9 | 146.9 |
| 0.005 | 143.6 | 717.5 |
| 0.01 | 141.2 | 1 412 |
| 0.02 | 138.2 | 2 765 |
| 0.05 | 133.3 | 6 667 |
| 0.1 | 128.9 | 12 890 |
| 0.2 | 124.0 | 24 800 |
| 0.5 | 117.3 | 58 670 |
| 1 | 111.9 | 111 900 |

\* Based on the absolute ohm, the 1968 temperature standard, and the dm3 volume standard.2 Values are accurate to ±0.1% or 0.1 µmho/cm, whichever is greater.

*Note: Conductivity standards may not be diluted because the effect of dilution is not linear. Standards must be purchased or prepared individually at the desired concentration according to Table 2510:I.*

* 1. Calibration verification check standard: *state if it is purchased, the concentration, and if prepared, how it is made*
  2. Lab water: *state what type of water is used e.g., purchased distilled water*
  3. *Include glassware if standards are prepared*
  4. *State sample collection container type and volume*
  5. Chemical containers are dated when received and when opened.
  6. The date received, date opened (in use), vendor, lot number and expiration date of reagents is documented *on a traceability log OR on the benchsheet.*
  7. *The analyst’s initials, date of preparation, the volume or weight of standard(s) used, the solvent and final volume of the solution are documented when any solutions are prepared.*

1. Interferences

N/A

1. Sample Collection, Preservation and Holding time.
   1. Samples must be collected in *glass, fluoropolymer or polyethylene* containers.
   2. The holding time is 28 days.
   3. If the sample is not analyzed within 15 minutes, it must be transported and stored at ≤6 °C, without freezing.
   4. *State where the sample is generally analyzed e.g., in the stream, immediately at the sampling site, in the lab within holding time, etc.*
2. Calibration

*Note: If the meter is not equipped with an Automatic Temperature Compensator (ATC) or the ATC is disabled, the standards must be analyzed at 25.0 °C.*

* 1. The conductivity meter must be calibrated daily before compliance sample analysis.
  2. The meter is calibrated using the following standard(s): *State concentration(s) here*
     1. *If not using the ATC, include this step. Bring standards to 25.0 °C.*
     2. Thoroughly rinse the conductivity cell with one or more portions of standard prior to measurement of that standard.
     3. *State the manufacturer’s instructions for completing the calibration*
  3. After calibration, a calibration verification check standard *(state the concentration here)* is analyzed and documented.

1. Procedure
   1. Thoroughly rinse the conductivity cell with one or more portions of sample prior to sample measurement. Samples must not be diluted.
   2. *If not using the ATC, include this step. Bring samples to 25.0 °C.*
   3. *State the steps that are in the instrument manual for analyzing the sample*
   4. *State how the data is recorded on the benchsheet, e.g., number of decimal points.*
   5. *If the meter is transported by vehicle after calibration, include 8.5, delete if not.* When the meter is transported by vehicle after calibration, a post-analysis calibration verification check standard must be analyzed at the end of the run. See Section 12 for the acceptance criterion.
   6. Keep the conductivity cell clean when not in use. *(State how the cell is stored)*
2. Documentation

The following must be documented in indelible ink whenever sample analysis is performed:

* 1. Date and time of sample collection
  2. Date of sample analysis to verify the 28-day holding time is met

* 1. Permitted facility name or permit number, and sample site (ID or location)
  2. Collector’s/analyst’s name or initials
  3. True value of the standard used for calibration
  4. True value of the calibration verification check standard
  5. Date and time of meter calibration
  6. Value obtained and recovery for the calibration verification check standard
  7. *If applicable-* Temperature of samples and standards, when not using ATC
  8. *If applicable-* True value, value obtained and recovery for the post-analysis calibration verification check standard
  9. *If applicable-* An indication of when the post-analysis verification was performed, e.g., the time of analysis or labeled as end-of-day analysis, etc.
  10. Quality control assessments (i.e., evaluation of acceptance criteria)
  11. Units of measure (μmhos/cm)
  12. Traceability for chemicals, reagents, standards and consumables
  13. Instrument identification *(serial number preferred)*
  14. Parameter analyzed
  15. Value to be reported
  16. Method reference
  17. Data qualifiers, when necessary.
  18. *Equipment maintenance (recommended)*

1. Proficiency Testing (PT) Procedure
   1. Analysis of a blind PT Sample is required at least once during every 9-month PT calendar year (January 1- September 30).
      1. A list of approved PT Sample Providers may be found on the NELAC website at <http://nelac-institute.org/content/NEPTP/ptproviders.php>. This list is checked yearly to assure the chosen vendor is still approved.
      2. A PT Sample can be analyzed as early as January 1 and the graded result must be reported to NC WW/GW LC office from the PT Sample Provider no later than September 30.

* 1. PT Samples must be analyzed in accordance with the routine testing, calibration and reporting procedures, unless otherwise specified in the instructions supplied by the PT Sample Provider.
     1. PT Samples are logged in and analyzed using the same staff, sample tracking systems, standard operating procedures including the same equipment, reagents, calibration techniques, analytical methods, and the same quality control acceptance criteria.

* + 1. PT Samples shall not be analyzed with additional quality control. They are not to be replicated beyond what is routine for Compliance Sample analysis.
    2. PT Sample analysis must be documented on the laboratory’s daily benchsheet.
  1. The PT Sample Provider’s instructions for analyzing the PT Sample must be followed and the practice documented by the analyst. The instruction sheet will be initialed and dated when the PT sample is prepared and retained for 5 years.
  2. The following information must be included with the results when reporting the PT Samples to the vendor.
     1. EPA Lab Code: *(enter here so it is easy to retrieve)*
     2. State Lab Certification number: *(enter here so it is easy to retrieve)*
     3. Method description (refer to the most recent certified parameter listing)
     4. Mailing address for NC WW/GW LC: 1623 Mail Service Center, Raleigh, NC 27699-1623

1. Calculations and Reporting
   1. Percent Recovery

% Recovery = Value Obtained x 100

True Value

* 1. All data must be reported in μmhos/cm *at 25.0 ºC or corrected to 25.0 ºC (by ATC)*
  2. *Include rounding procedure*
  3. Conductivity samples must not be diluted. Any sample greater than *(state upper reporting limit)* will be reported as > *(upper reporting limit.)* Any sample less than (*state lower reporting limit)* will be reported as < *(lower reporting limit)*

1. Quality Assurance and Quality Control
   1. The calibration verification check standard must read within ±10% of the true value to be acceptable. See Section 14.0 for corrective action
   2. *Delete this section if the post-analysis calibration verification is not needed:* The value obtained for the post-analysis calibration verification check standard must read within 10% of the standard’s true value. If the obtained value is outside of the ±10% range, corrective action must be taken. See Section 14.0.
   3. The automatic temperature compensation of the meter must be checked prior to initial use and every 12 months. *Note: Other Certified laboratories may provide assistance in meeting this ATC verification requirement. If this is done, you can state that right here and delete the rest of 12.3.1 through 12.3.4.*

*If your lab will perform the ATC check, decide whether a standard or sample is going to be used and make applicable changes below.*

* + 1. Pour an adequate amount of conductivity *standard or sample* into a beaker or other container and analyze at 25.0 °C ± 0.5 °C. Document the temperature and conductivity value.
    2. Lower the temperature of the *standard or sample* (e.g., by placing the container in a refrigerator or ice chest) to less than the lowest anticipated sample temperature and analyze. Document the temperature and conductivity value.
    3. *If compliance samples greater than 25.0 °C are analyzed during the year, perform the following additional step.* *Anticipated temperatures can be obtained from a review of the Discharge Monitoring Reports (DMRs) from the peak summer and winter months. Historical data should provide a reasonably accurate estimation of ranges that will bracket the expected sample temperatures:* Raise the temperature above 25.0 °C to greater than the highest anticipated sample temperature (e.g., by placing the container in a hot water bath) and analyze. Document the temperature and conductivity value.
    4. *If using a standard use this acceptance criterion and delete the other:* As the temperature increases or decreases, the value of the conductivity standard must be within ±10% of the true value of the standard. If not, corrective action must be taken. See Section 14.0.

*If using a sample, use this acceptance criterion and delete the other:* As the temperature increases or decreases, the value of the conductivity sample must remain within ±10% of the value observed at 25.0 °C. If not, corrective action must be taken. See Section 14.0.

* 1. *State who is transcribing the data to the DMR and whether anyone peer reviews (checks) it. Peer review is recommended, but if that is not possible, it is recommended that the analyst rechecks their own transcription for errors after a certain amount of time has passed.*
  2. All documentation errors shall be corrected by drawing a single line through the error so that the original entry remains legible. Entries shall not be obliterated by erasures or markings. Wite-Out®, correction tape, or similar products designed to obliterate documentation are not to be used; instead the correction shall be written adjacent to the error. The correction shall be initialed by the responsible individual and the date of change documented. All manual data and log entries shall be written in indelible ink.

1. Preventative Maintenance
   1. *State if a maintenance log or record is maintained and the type of maintenance that may be performed.*
   2. *State if there is any scheduled timeframe for replacing probes.*
   3. *Give instructions for platinizing the cell, as recommended by manufacturer*
   4. *State any other manufacturer recommended maintenance.*
   5. *Describe short-term and long-term storage for the probe.*
   6. *Describe how the probe is conditioned prior to use after dry storage.*
2. Troubleshooting and Corrective Action
   1. If the calibration verification check standard does not read within ±10% of the true value, the meter must be recalibrated before any samples are analyzed.
   2. *(Delete if not needed)* If the post-analysis calibration verification check standard is not within acceptance limits, recalibration is necessary. All samples analyzed since the last acceptable calibration verification must be reanalyzed, if possible. If samples cannot be reanalyzed, the data must be qualified.
   3. *State what will be done if a meter does not pass the calibration check after recalibrating*
   4. *State what will be done if the meter does not pass the ATC check*
3. Employee Training

The following employee training must be documented and kept on file.

* 1. *Include education, training, experience and/or demonstrated skills required for the position*
  2. Employee must have read and acknowledged understanding of this SOP *– may also include reading the Approved Procedure for the Analysis of Specific Conductance (Conductivity).*
  3. *Employee must demonstrate proficiency (e.g., acceptable analysis of a PT Sample, side-by-side comparison with trained analyst, etc.) before analyzing compliance samples for reporting. Specify how proficiency is demonstrated and how the results are evaluated.*

1. References
   1. Standard Methods, 2510 B-*2021*.

* 1. North Carolina Wastewater/Groundwater Laboratory Certification Approved Procedure for the Analysis of Specific Conductance (Conductivity), Revision *11/29/2023 (consult NC WW/GW LCB website for latest revision)*.
  2. 15A NCAC 02H .0800

1. Revision History

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| --- | --- | --- |
| Type: Review or Revision | Date | Summary of Changes Made if Revision |
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