DOCUMENT TYPE: Standard Operating Procedure

DOCUMENT CLASS: Physical Property Procedure

TITLE: Conductivity, EPA 120.1

INSTRUMENTATON: HACH CO150 Conductivity Meter

PREPARED BY: Marshall K. Cheung, Ph.D., Laboratory Director _____

REVISED BY: Marshall K. Cheung, Ph.D., Laboratory Director _____

REVIEWED BY: Anne Cheung, Laboratory Manager _____

APPROVED BY: Marshall K. Cheung, Ph.D., Laboratory Director _____

Table of Contents

Document No.:	***PP 002 - 014***
***Copy provided to*:**	**Marshall K. Cheung**
***Title*:**	Laboratory Director
	29 Palms Laboratory
	47-250 Dillon Road
	Coachella, CA 92236
***Copy provided by*:**	**Jan Kilduff**
***Title*:**	Quality Assurance Officer
Date:	July 28, 2004

1. Scope and Application

1.1. This method is applicable to the analysis of drinking, surface and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).

2. Summary of Method

2.1. The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge-type, or equivalent.

2.2. Samples are preferably analyzed at 25°C. If not, corrections for temperature are made and result reported at 25°C.

3. Comments

3.1. Instrument must be standardized with certified calibration solutions before use daily.

3.2. Conductivity cell must be kept clean.

3.3. Temperature variations and corrections represent the largest source of potential error.

3.4. Results are reported as specific conductance, µS/cm at 25°C.

4. Sample Handling and Preservation

4.1. Analyses can be performed either in the field or laboratory.

4.2. If analysis is not completed within 24 hours of sample collection, sample should be filtered through a 0.45µm filter and stored at 4°C. Filter and apparatus must be washed with reagent water and pre-rinsed with sample before use.

5. Apparatus

5.1. *HACH* CO150 Conductivity Meter

5.2. *HACH* Model 50161 Conductivity Probe

6. Reagents/Supplies

6.1. Calibration Standards

6.1.1. VWR traceable ONE-SHOT conductivity calibration standard – 100 µmhos/cm with certificate of analysis (Cat. No. 23226-651)

6.1.2. VWR traceable ONE-SHOT conductivity calibration standard – 1000 µmhos/cm with certificate of analysis (Cat. No. 23226-652)

6.1.3. VWR traceable ONE-SHOT conductivity calibration standard – 10,000 µmhos/cm with certificate of analysis (Cat. No. 23226-653)

6.2. Continuous Calibration Check Standard (CCV)

6.2.1. VWR traceable ONE-SHOT conductivity calibration standard (second bottle different from Calibration Standard 6.1.2) – 1000 µmhos/cm with certificate of analysis (Cat. No. 23226-652)

6.3. Ricca Deionized Water (Cat. No. 9150-5)

6.4. Kimberly-Clark Kimwipes EX-L (Cat. No. 34120)

7. Procedure

7.1. *Instrument Setup* (Refer to the *HACH* CO150 Manual)

7.1.1. Power-up and Self-Diagnostics Checkout

7.1.1.1. Disconnect the conductivity probe from the meter.

7.1.1.2. Press **I/O** key to turn the meter on.

7.1.1.3. Install 9V battery when low battery indicator appears on the display.

7.1.1.4. Press **I/O** key to turn the meter off.

7.1.1.5. Press and hold the **YES** key while pressing the **I/O** key.

7.1.1.6. The instrument automatically performs electronic and hardware diagnostic tests, and a system countdown will display 1-8.

7.1.1.6.1. If *E-3* appears in the display, check to make sure the conductivity probe is not attached.

7.1.1.7. The meter will stop on test 7.

7.1.1.7.1. When "0" is displayed, press each key (including the **I/O** key within 10 seconds to complete this test.

7.1.1.7.2. The numeric digits will change.

7.1.1.7.3. If all keys are not pressed within 10 seconds, or if a key is not responding properly, *E-7* will appear.

7.1.1.7.4. If problems are found during self-test, the meter will display the error code until YES is pressed.

7.1.1.7.5. Refer to Table 10 *Error Codes* on page 31 of the instrument manual.

7.1.1.7.6. If there is an error, begin Power-up and Self-Diagnostics Checkout (7.1.1) again.

7.1.1.8. After the keypad test (7), the meter will display test 8 and then the meter will turn off.

7.1.2. Instrument Setup

7.1.2.1. Press the **I/O** key.

7.1.2.2. Press the **SETUP** key to enter the setup menu.

7.1.2.3. Turn automatic temperature compensation (S-1) to "ON" using an **ARROW** key and then press the **YES** key.

7.1.2.4. Set the reference temperature (S-2) to 25^{o}C using an **ARROW** key and then press the **YES** key.

7.1.2.5. Set the temperature compensation (S-3) to 25^{o}C using an **ARROW** key and then press the **YES** key.

7.1.2.6. Turn automatic Auto Shutoff (S-4) to "ON" using an **ARROW** key and then press the **YES** key.

7.1.2.7. Return to measure mode by pressing **MODE** key.

7.1.3. Install conductivity probe.

7.1.4. Thoroughly rinse conductivity probe with deionized water and blot with Kimwipe.

7.1.5. Instrument is ready for calibration.

7.2. Instrument Calibration

7.2.1. Allow the 100, 1000 and 10,000 µS/cm standard solutions to come to room temperature (20 – 30^{o}C).

7.2.2. Using the **MODE** key set the meter to "Cond" mode.

7.2.3. Place the conductivity probe into the 1000 µS/cm standard solution.

7.2.3.1. Immerse the tip to or beyond the vent holes.
7.2.3.2. Agitate the probe vertically to make sure air bubbles are not entrapped.
7.2.4. If the reading differs from the certified value listed on the bottle by more than 10%, a calibration is necessary.
7.2.5. To calibrate, an adjustment value must be entered.
7.2.6. To approximate an adjustment value, subtract 40 µS from displayed value if standard temperature is below 25 ^{o}C and add 40 µS to displayed value if standard temperature is above 25 ^{o}C.
7.2.7. Press **CAL** key three (3) times to enter screen for entering adjustment value (display should read 1999).
7.2.8. Use **ARROW** keys to change digits followed by the **YES** key to enter.
7.2.9. After the last digit is entered, the meter will automatically begin calibration and display the adjusted value of the calibration standard solution at the reference temperature.
7.2.10. Continue increasing or decreasing adjustment value until displayed value is within 10% of certified value.
7.2.11. Record the temperature and the calibrated result.
7.2.12. Record the values for 100 and 10,000 µS/cm standards.
7.2.13. Prepare calibration curve (See ***8. Calibration Curve***).
7.2.14. Measure conductance of a 1000 µS/cm standard (different from standard used to calibrate) as a calibration verification standard *(initial calibration verification -ICV*) to verify validity of curve.
7.2.14.1. If the conductivity of the ICV is within 10% of the expected value based on the calibration curve, the calibration is verified. Continue with sample measurement (7.3).
7.2.14.2. If the conductivity of the ICV differs by more than 10% from the expected value, see corrective action in 8.7.

7.3. Take sample measurements.
7.3.1. Allow samples to come to room temperature (20 – 30^{o}C).
7.3.2. Thoroughly rinse conductivity probe with deionized water and dry with Kimwipe.
7.3.3. Insert rinsed and dried probe into sample.
7.3.4. Record the conductivity value and the temperature of samples.
7.3.5. Analyze the 1000 µS/cm calibration verification standard (*continuing calibration verification – CCV*) with every ten samples to re-check the validity of the calibration curve.
7.3.5.1.If the CCV is within 10% of the expected value, continue with sample analysis.
7.3.5.2.If the CCV differs by more than 10%, see corrective action in 8.7.

8. Calibration Curve

8.1. Obtain a standard curve by plotting the three calibration standard values that were run by the above procedure against expected conductivity in µS/cm.
8.2. Perform regression analysis of calibration data to evaluate correlation.
8.3. Plot best-fit line.
8.4. For the curve to be valid, the correlation of points with the residual line must meet following criteria:
8.4.1. Relative percent standard deviation of the response factor (RF) must be less than 15%.
8.4.2. R^2 must be greater than or equal to 99%.

8.4.3. If the relative percent standard deviation of the RF is greater than 15% or the R^2 value is less than 0.99, then the calibration standards must be reanalyzed to achieve an acceptable curve.

8.5. Prior to sample analysis, calibration verification (*initial calibration verification –ICV*) is performed (7.2.14).

8.6. During sample analysis, calibration verification (*continuing calibration verification-CCV*) is done at a frequency of 10% (7.3.6).

8.7. The order of corrective action for Calibration Verification Standard problems are:

8.7.1. If the Calibration Verification Standard (ICV or CCV) does not come within 10% of the expected value, then the standard should first be rerun.

8.7.2. If the repeat analysis result still differs by greater than 10%, a fresh standard should be prepared and analyzed.

8.7.3. If the fresh standard does not meet the criteria, a new calibration must be performed.

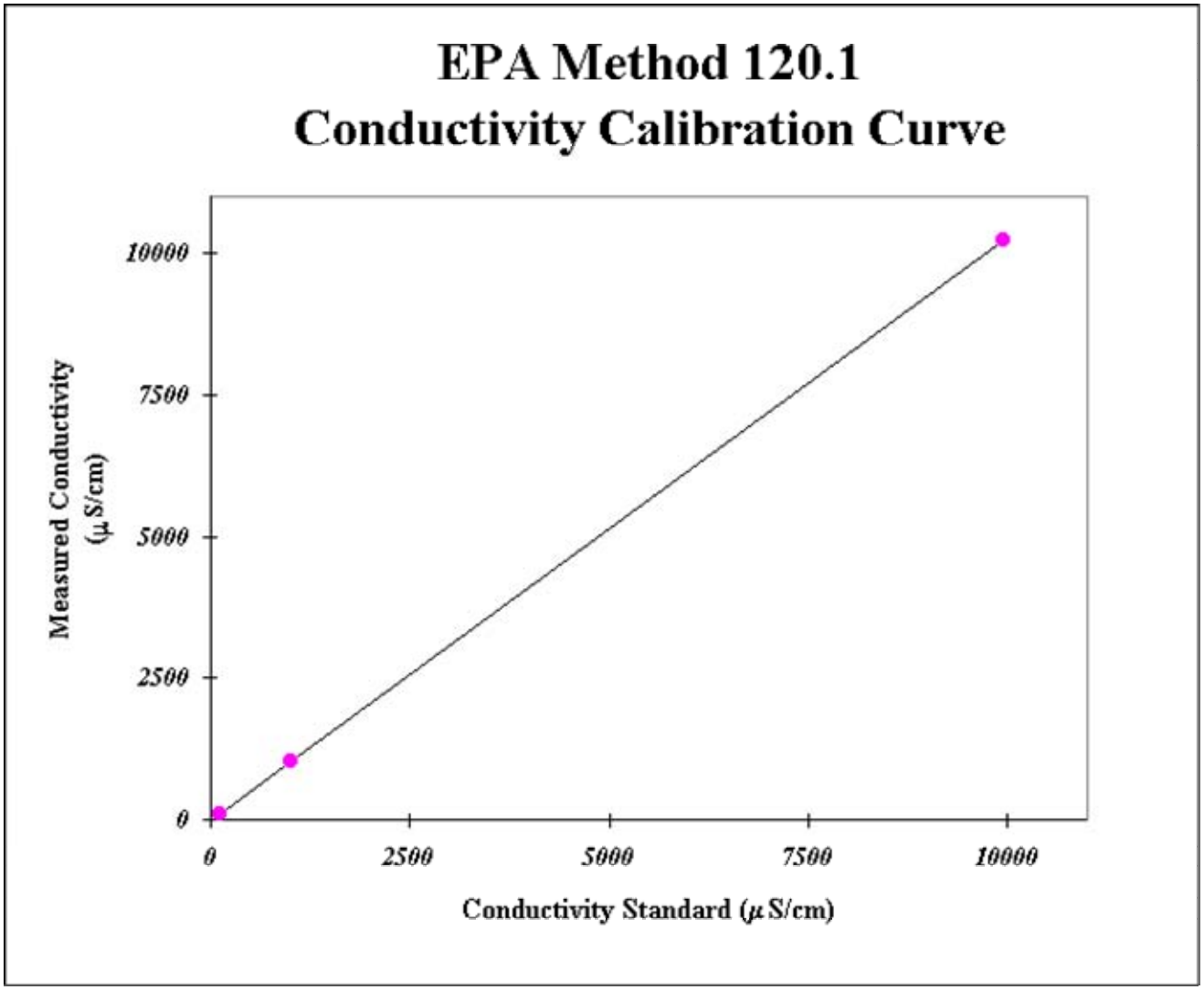
9. Bibliography

9.1. *HACH* CO150 Conductivity Meter Manual

9.2. EPA Method 120.1

9.3. Standard Methods for the Examination of Water and Wastewater, *20th Edition*, Method No. 2510, p 2-44 to 2-47, (1998).

10. Calibration Curve



Conductivity Standard *(µS/cm)*	Measured Conductivity *(µS/cm)*		Check Standard	*Date:*9/8/00
109	105			
998	1032		1009	***Std. Dev.*** =0.040
9959	10241			***Relative % Std. Dev.*** =3.92
				R^2 =1.000
				m =1.028
				y-intercept =0.000