



Guam EPA Laboratory  
B-15-6101 Mariner Ave.  
Tiyan, Barrigada  
Guam 96921

Title:  
Number:  
Date:  
Rev. no.

Conductivity, EPA 120.1  
CH-01-05  
06/28/07  
000

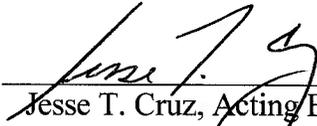
**GUAM ENVIRONMENTAL PROTECTION AGENCY  
EMAS ANALYTICAL PROGRAM**

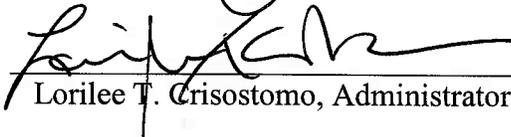
**STANDARD OPERATING PROCEDURE**

**CONDUCTIVITY by EPA 120.1**

Prepared by:  6/28/07  
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Reviewed by:  6/28/07  
Jesse T. Cruz, Acting EMAS Administrator Date

Approved by:  7-17-2007  
Lorilee T. Crisostomo, Administrator Date



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## 1 SCOPE AND APPLICATION

- 1.1 This method is applicable to drinking, surface and saline water, domestic and industrial wastewaters and acid rain (atmospheric deposition).

## 2 METHOD SUMMARY

- 2.1 Conductivity measurements are used to evaluate variations in dissolved mineral concentrations of water samples
- 2.2 The conductivity of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge-type or equivalent.
- 2.3 Samples are preferably analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C.
- 2.4 Conductivity is measured and reported as micromhos per centimeter (umhos/cm).

## 3 INTERFERENCES

- 3.1 Conductivity changes with temperature. Samples should be at room temperature before analyzed. The further away from 25°C the sample temperature is, the less accurate the results will be.
- 3.2 Oil and grease, algae, and dirt can coat instrument electrode, causing sluggish instrument response and incorrect readings.

## 4 DEFINITIONS

- 4.1 Conductivity – A measure of the ability of water to carry an electrical current, which is directly related to the concentration of dissolved ions present in the water.
- 4.2 Conductivity Cell – Any cell with electrodes used to measure conductivity of liquid.



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## **5 SAMPLE HANDLING AND PRESERVATION**

- 5.1 Samples are collected in glass or plastic bottles.
- 5.2 Analyses can be performed either in the field or laboratory.
- 5.3 If analysis is not completed within 24 hours of sample collection, sample should be filtered through a 0.45um filter and stored at 4°C. Filter and apparatus must be washed with high quality distilled water and pre-rinsed with sample before used.
- 5.4 Maximum time between sampling and analysis is 28 days.

## **6 EQUIPMENT AND SUPPLIES**

- 6.1 OAKTON PC510 conductivity meter
- 6.2 OAKTON conductivity probe with Automatic Temperature Compensation (ATC), with 1.0 cell constant.
- 6.3 Analytical Balance, capable of accurately weighing to the nearest 0.0001 g
- 6.4 Class "S" weights
- 6.5 Drying oven, capable of being controlled at  $140 \pm 5^{\circ}\text{C}$
- 6.6 Desiccator
- 6.7 Glassware – Class A volumetric flasks and pipettes or plastic containers as required.
- 6.8 250-ml Beakers

## **7 REAGENTS AND STANDARDS**

- 7.1 Reagent Water – Use ASTM Type II reagent water
- 7.2 Calibration Standards – commercially prepared:

OAKTON Conductivity Standard Solution 23 uS @ 25°C  
OAKTON Conductivity Standard Solution 1413 uS @ 25°C



OAKTON Conductivity Standard Solution 2764 uS @ 25°C  
OAKTON Conductivity Standard Solution 80 mS @ 25°C

- 7.3 Standard Potassium Chloride Solution, 0.01M: Dissolve 0.7456 g of pre-dried (2 hour at 105°C) KCl in reagent water and dilute to 1 liter at 25°C.

## 8 QUALITY CONTROL PROCEDURES

### 8.1 Conductivity Meter Calibration

- 8.1.1 The OAKTON PC510 has 5 measuring ranges. Calibrate 1 point each of the measuring ranges (up to 5 points). If measuring values in more than 1 range, make sure to calibrate for each of the sample range. All new calibration data will over-ride existing stored calibration data for each measuring range that is calibrated.
- 8.1.2 When measuring in ranges near to or greater than 20 mS, or near to or lower than 100 uS, calibrate the meter at least once a week.
- 8.1.3 When measuring in the mid-ranges and the probe is washed in de-ionized water and is stored dry, calibrate the meter at least once a month.
- 8.1.4 When taking measurements at extreme temperatures, calibrate the meter at least once a week.
- 8.1.5 For best results, select a standard value close to the sample value. For example, in the 0 to 1999 uS conductivity range, a 1413 uS solution is a good solution for calibration.
- 8.1.6 See the table below for recommended solution ranges.

Range Indicator	Conductivity Range	Recommended Calibration Solution Range
R1	0.00 to 19.99 uS	6.00 to 17.00 uS
R2	0.0 to 199.9 uS	60.0 to 170.0 uS
R3	0 to 1999 uS	600 to 1700 uS
R4	0.00 to 19.99 mS	6.00 to 17.00 mS
R5	0.0 to 199.9 mS	60.0 to 170.0 mS

### 8.2 Procedure for Calibrating OAKTON PC150 Conductivity Meter



- 8.2.1 If necessary, press the MODE key to select conductivity mode.
- 8.2.2 Rinse the probe thoroughly with de-ionized water or a rinse solution; then rinse with a small amount of calibration standard.
- 8.2.3 If necessary, ensure that the probe's yellow guard is attached. Dip the probe into the calibration standard. Immerse the probe tip beyond the upper steel band. Stir the probe gently to create a homogeneous sample.
- 8.3.4 Wait for the measured conductivity value to stabilize. The READY indicator lights when the reading is stable.
- 8.2.5 Press CAL/MEAS to enter conductivity mode. The CAL indicator will appear in the upper right corner of the display.
- 8.2.6 Press the arrow up or arrow down key to change the value on the primary display to match the value of the calibration standard.
- 8.2.7 Press ENTER to confirm the calibration value. The meter returns to the MEAS (measurement) mode.
- 8.2.8 Repeat steps 1 to 7 for other measuring ranges.

NOTE: Offset the conductivity reading up to  $\pm 40\%$  from default setting. If the measured value differs by more than  $\pm 40\%$  clean or replace probe as needed, or use a calibration standard with a higher value as required.

- 8.2.9 Record calibration data in the Conductivity, EPA 120.1 Analytical Results Logbook (GEPA Log: CH-02-02). Example page is contained in Attachment B.
- 8.3 Alternatively, monthly conductivity cell calibration (determination of cell constant) should be performed if the meter cannot be calibrated as noted in section 8.1. The procedure for conductivity cell calibration is described in Attachment A.

## 9 ANALYTICAL PROCEDURES

- 9.1 Allow samples to come to room temperature (23 to 27°C), if possible.



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- 9.2 Rinse the probe with de-ionized water before use to remove any impurities adhering to the probe body. Shake or air dry. To avoid contamination or dilution of your sample, rinse probe with a small amount volume of your sample liquid.
- 9.3 Press the MODE key to select conductivity measurement mode. The MEAS indicator appears on the top center of the LCD. The ATC indicator appears in the lower right hand corner to indicate Automatic Temperature Compensation
- 9.4 If necessary, ensure that the probe's yellow guard is attached. Dip the probe into the sample. When dipping the probe into the sample, take care to ensure that the liquid level is above its upper steel band. Stir probe gently in the sample to create a homogeneous sample.
- 9.5 Allow time for the reading to stabilize. Note the reading on the display. The READY indicator lights when the reading is stable.
- 9.6 Record the result in the Analytical Results Logbook, Conductivity, EPA 120.1. (GEPA Log: CH-02-02)
- 9.7 Remove the probe from the sample solution and rinse with de-ionized water.
- 9.8 Repeat for remaining samples.

## 10 DOCUMENTATION

- 11.1 When samples are received, the laboratory personnel verify that the chain of custody is properly filled out. Laboratory personnel may then receive and sign the chain of custody. A copy of the chain of custody is included in the data package (Attachment E).
- 11.2 Sample results are recorded in the Analytical Results Logbook (GEPA Log: CH-02-02), and then entered in the Laboratory Information Management System (LIMS) and analytical results are reported. The LIMS generated report must be included in the data package (Attachment A).
- 11.3 Each standard prepared for the analysis is entered in the Inorganic Standard Preparation Logbook (Attachment D). A copy of the appropriate page is included in the data package.
- 11.4. The data package consists of the following:



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Attachment A: LIMS Analytical Results Report  
Attachment B: Analytical Results Logbook (page copy)  
Attachment C: Conductivity Cell Calibration (page copy)  
Attachment D: Inorganic Standard Preparation Logbook (page copy)  
Attachment E: Chain of Custody

## 11 REFERENCES

- 11.1 EPA Method 120.1, Approved for NPDES (Editorial Revision 1982)
- 11.2 SM 2510-B, Standard Methods for the Examination of Water and Wastewater, 20<sup>th</sup> Edition, 1998.
- 11.3 OAKTON PC 510 Bench pH/Conductivity Meter Instruction Manual



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## **Attachment A: LIMS Analytical Results Report**



**- Guam Environmental Protection Agency -**

**EMAS Laboratory**

**P.O. Box 22439, GMF**

**Barrigada, Guam 96921**

**TEL (671) 475 - 1658, FAX (671) 477 - 9402**

**Date of Report: 08-Feb-07**

To: GEPA - EMAS Assessment Program (EMAP)  
Jesse Cruz

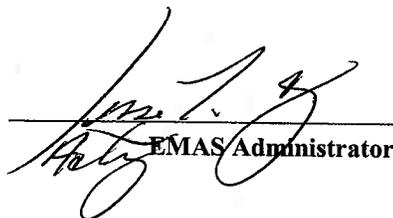
Project: Guam WSA

Attached are the analytical results for sample(s) listed below.

<u>Lab Sample Number</u>	<u>Field Sample ID</u>	<u>Station Location</u>
01946-005	GWSA05-033	Madog River

If you have any questions regarding this report, please contact the Guam EPA EMAS Administrator. When making inquiries, please reference the Lab Sample Number which appears in the upper right corner of each report page.

  
\_\_\_\_\_  
Analyst

  
\_\_\_\_\_  
EMAS Administrator

**- Guam Environmental Protection Agency -**

EMAS Laboratory

Date of Report: 08-Feb-07

Field ID: GWSA05-033  
 Submitter: GEPA - EMAS Assessment Program (EMAP)  
 Type of Sample: Water

Lab Sample Number: 01946-005  
 Date Sample Collected: 22-Jan-07  
 Date Sample Received: 22-Jan-07

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
<b>Conductivity</b>	<b>(Dilution Factor: 1 )</b>					
Conductivity	EPA 120.1	1/22/2007	eyanit		453	umhos/cm
<b>Total Suspended Solids (103-105 C)</b>	<b>(Dilution Factor: 1 )</b>					
Total Suspended Solids (103-105 C)	SM 2540D	1/24/2007	eyanit	10	<10	mg/L
<b>Total Dissolved Solids</b>	<b>(Dilution Factor: 1 )</b>					
Total Dissolved Solids	SM2540C	1/25/2007	eyanit	10	291	mg/L
<b>Nitrate (as N)</b>	<b>(Dilution Factor: 1 )</b>					
Nitrate (as N)	EPA 353.2	1/23/2007	EY/RP	0.05	<0.05	mg/L
<b>Nitrite (as N)</b>	<b>(Dilution Factor: 1 )</b>					
Nitrite (as N)	EPA 353.2	1/23/2007	EY/RP	0.01	<0.01	mg/L
<b>Ammonia</b>	<b>(Dilution Factor: 1 )</b>					
Ammonia	EPA 350.1	2/7/2007	RP	0.01	<0.01	mg/L
<b>Turbidity, NTU</b>	<b>(Dilution Factor: 1 )</b>					
Turbidity, NTU	EPA 180.1	1/22/2007	eyanit	0.05	0.31	NTU
<b>Orthophosphate as P</b>	<b>(Dilution Factor: 1 )</b>					
Orthophosphate (as P)	EPA 365.1	1/23/2007	eyanit	0.005	0.040	mg/L
<b>pH</b>	<b>(Dilution Factor: 1 )</b>					
pH	SM 4500H	1/22/2007	eyanit		7.87	std units

**Lab Qualifiers:** J = Value is greater than or equal to the method detection limit (MDL) but less than the practical quantitation limit (PQL).

**- Guam Environmental Protection Agency -**

EMAS Laboratory

Date of Report: 08-Feb-07

Field ID: GWSA05-033  
Submitter: GEPA - EMAS Assessment Program (EMAP)  
Type of Sample: Water

Lab Sample Number: 01946-005  
Date Sample Collected: 22-Jan-07  
Date Sample Received: 22-Jan-07

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Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
<b>Color</b>	<b>(Dilution Factor: 1 )</b>					
Color	SM 2120B	1/23/2007	RP		<5	std units

**Lab Qualifiers:** J = Value is greater than or equal to the method detection limit (MDL) but less than the practical quantitation limit (PQL).



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**Attachment B: Analytical Results Logbook  
(page copy)**

**GUAM EPA LABORATORY  
ANALYTICAL RESULTS LOGBOOK  
Conductivity (EPA Method 120.1)**

Conductivity Meter ID: OAKTON pH/CON 510 Series

Analyst: EY

Conductivity Meter Calibration:\*

Date: 1/22/07

Conductivity Standard 1413 @ 25°C

Conductivity Standard Z @ 25°C

Conductivity Standard Z EY 1/22/07 @ 25°C

Calibration Date: 1/22/07

#	Date Sampled	Lab Sample ID #	Location	Conductivity (umhos/cm)	Notes
1	1/22/07	01946	GWSA05-033	453	
2	/				
3					
4					
5					
6					
7					
8					
9					
10					
LAB DUP	1/22/07	01946	- LD	455	RPD = 1.44%

NOTES: 1 uS = 1 umho

- \* If you are measuring in the low-ranges (i.e., 0 to 199.9 uS), calibrate the meter at least once a week to get specified ±1% Full Scale accuracy.
- \* If you are measuring in the mid-ranges (i.e., 200 to 1999uS) and you washed the probe in de-ionised water and stored it dry, calibrate the meter at least once a month.
- \* If you take measurements at extreme temperatures, calibrate the meter at least once a week.



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**Attachment C: Conductivity Cell Calibration**  
**(page copy)**

**GUAM EPA LABORATORY  
CALIBRATION LOGBOOK  
Conductivity (EPA Method 120.1)**

**Conductivity Cell Calibration**

Conductivity Meter ID: OAKTON PC 510 Bench pH/Conductivity Meter

Analyst: E. YANIT

Date: 1/8/07

**Preparation of Standard Reference Solution, 0.01M Potassium Chloride:**

Dissolve 0.7456 grams of pre-dried (2 hour at 105°C) KCl in reagent water and dilute to 1 liter at 25°C.

**Calibration of Conductivity Cell Constant:**

Fill four 150ml beakers with 0.01M KCl standard solution. Subsequently, place the probe into the three beakers to clean and rinse the probe.

Read and record the conductivity of the 0.01M KCl solution in the fourth beaker.

Calculate and check for the accuracy of the cell constant and conductivity bridge using the table and the formula below:

Conductivity 0.01M KCl (°C)	Conductivity Theoretical Value*, K <sub>s</sub> (umhos/cm)	Conductance Measured Value, G <sub>s</sub> (umhos/cm)	Conductivity Cell Constant, C
23	1359		
24	1386		
25	1413	1409	1.003
26	1441		
27	1468		

**Conductivity Cell Constant Calculation:**

$$C = K_s / G_s$$

Where: C = Conductivity Cell constant

K<sub>s</sub> = Theoretical Conductivity value (\*use table above :EPA Method 120.1)

G<sub>s</sub> = Conductance measured value, uS or umho (1 uS = 1 umho)

$$C = \frac{1413 \text{ umhos/cm}}{1409 \text{ umhos/cm}} = 1.0028$$

**Criteria:** Conductivity cell constant = 1 ( must be within 0.90 to 1.10)



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**Attachment D: Inorganic Standards Preparation Logbook**  
**(page copy)**

# GUAM ENVIRONMENTAL PROTECTION AGENCY - EMAS Analytical Program

## Inorganic Standard Preparation Logbook

GEPA Standard ID	Standard Description	GEPA Std Receipt Number	Initial Conc. (mg/L, ug/L)	Volume Used (mL, uL)	Final Volume (L, mL)	Final Conc. (mg/L, ug/L)	Preservative	Prep Date	Exp Date	Prep By (Initials)	Remarks
STD0206-03	6.75 ppm NH <sub>4</sub>	STD06-008	1700 ppm	75 uL	100 mL	0.25 ppm	/	1/18/07	1/22/07	EY	
-04	0.10 ppm			10 uL	100 mL	0.10	/				Cal Std.
-05	0.05 ppm			10 uL	200 mL	0.15	/				
-06	0.5 ppm NH <sub>4</sub>	STD06-005		75 uL	50 mL	0.5	/				Second Sample
STD 012367-01	0.01 M KCl	4# 08163	0.7459 KCl		1 L	0.01 M	/	1/8/07	7/2/07	EY	Conductivity cell Constant Determination
STD 012367-01	5 ppm NH <sub>4</sub>	STD 06-002	1000 ppm	50 uL	100 mL	5 ppm	/	1/23/07	1/24/07	EY	Cal Std.
-02	2.5 ppm NH <sub>4</sub>			175 uL	50 mL	2.5 ppm	/				
-03	0.75 ppm NH <sub>4</sub>			75 uL	100 mL	0.75 ppm	/				
-04	2.5 ppm NH <sub>4</sub>	STD06-013	1000 ppm	675 uL	75 mL	7.5 ppm	/				Second Sample
STD 012367	1 ppm PO <sub>4</sub>	STD06-003	1000 ppm	100 uL	100 mL	1 ppm	/				
-05	0.5 ppm PO <sub>4</sub>			50 uL	100 mL	0.5 ppm	/				Cal Std.
-06	0.05 ppm PO <sub>4</sub>			10 uL	200 mL	0.05 ppm	/				



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## **Attachment E: Chain of Custody**

