GUAM ENVIRONMENTAL PROTECTION AGENCY
EMAS ANALYTICAL PROGRAM

STANDARD OPERATING PROCEDURE

CONDUCTIVITY by EPA 120.1

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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.

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 ± 5°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 CONROL 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 o 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 ±40% from default setting. If the measured value differs by more than ±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.

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:

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, 20th Edition, 1998.

11.3 OAKTON PC 510 Bench pH/Conductivity Meter Instruction Manual

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.

Lab Sample Number	Field Sample ID	Station Location
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**	Lab Sample Number:	**01946-005**
Submitter:	GEPA - EMAS Assessment Program (EMAP)	Date Sample Collected:	22-Jan-07
Type of Sample:	Water	Date Sample Received:	22-Jan-07

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Conductivity	**(Dilution Factor: 1)**					
Conductivity	EPA 120.1	1/22/2007	eyanit		453	umhos/cm
Total Suspended Solids (103-105 C	**(Dilution Factor: 1)**					
Total Suspended Solids (103-105 C)	SM 2540D	1/24/2007	eyanit	10	<10	mg/L
Total Dissolved Solids	**(Dilution Factor: 1)**					
Total Dissolved Solids	SM2540C	1/25/2007	eyanit	10	291	mg/L
Nitrate (as N)	**(Dilution Factor: 1)**					
Nitrate (as N)	EPA 353.2	1/23/2007	EY/RP	0.05	<0.05	mg/L
Nitrite (as N)	**(Dilution Factor: 1)**					
Nitrite (as N)	EPA 353.2	1/23/2007	EY/RP	0.01	<0.01	mg/L
Ammonia	**(Dilution Factor: 1)**					
Ammonia	EPA 350.1	2/7/2007	RP	0.01	<0.01	mg/L
Turbidity, NTU	**(Dilution Factor: 1)**					
Turbidity, NTU	EPA 180.1	1/22/2007	eyanit	0.05	0.31	NTU
Orthophosphate as P	**(Dilution Factor: 1)**					
Orthophosphate (as P)	EPA 365.1	1/23/2007	eyanit	0.005	0.040	mg/L
pH	**(Dilution Factor: 1)**					
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**	Lab Sample Number:	**01946-005**
Submitter:	GEPA - EMAS Assessment Program (EMAP)	Date Sample Collected:	22-Jan-07
Type of Sample:	Water	Date Sample Received:	22-Jan-07

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Color	**(Dilution Factor: 1)**					
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).

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

Date: 1/22/07

Conductivity Meter Calibration:*

Conductivity Standard 1413 @ 25°C

Conductivity Standard _____ @ 25°C

Conductivity Standard 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					EY 1/22/07
LAB DUP	1/22/07	01946	- LD	455	RPD = 0.44%

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.

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	Conductivity Theoretical Value*, K_s	Conductance Measured Value, G_s	Conductivity Cell Constant, C
(°C)	(umhos/cm)	(umhos/cm)	
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_s = Theoretical Conductivity value (*use table above :EPA Method 120.1)
G_s = 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)

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)	Preser-vative	Prep Date	Exp Date	Prep By (Initials)	Remarks
STD122806 -03	0.25 ppm Nitr	STD06-008	100 ppm	25 µL	100 mL	0.25 ppm	/	12/28	12/29	EY	
-04	0.10 ppm	↓	↓	10 µL	100 mL	0.10	/	↓	↓	↓	Cal Stds.
-05	0.05 ppm	↓	↓	10 µL	200 mL	0.05	/	↓	↓	↓	
-06	0.5 ppm Nitr	STD06-005	↓	25 EY ~~50~~ µL	50 EY ~~100~~ mL	0.5 ↓	/	↓	↓	↓	Second Source
STD 010807 -01	0.01M KCl	Lot# Q8163	0.745g KCl	/	1 L	0.01M	/	1/8/07	7/8/07	EY	Conductivity Cell Constant Determination
STD 012307 -01	5 ppm NO3	STD 06-002	1000 ppm	500 µL	100 mL	5 ppm	/	1/23/07	1/24/07	EY	Cal. Std
-02	2.5 ppm NO3	↓	↓	125 µL	50 mL	2.5 ppm	/	↓	↓	↓	
-03	0.25 ppm NO3	↓	↓	25 µL	100 mL	0.25 ppm	/	↓	↓	↓	
-04	2.5 ppm NO3	STD06-003	100 ppm ~~1000 ppm~~	625 µL	25 mL	25 ppm	/	↓	↓	↓	Second Source
STD 012307	1 ppm PO4	STD06-003	100 ppm	100 µL	100 mL	1 ppm	/	↓	↓	↓	
-05	0.5 ppm PO4	↓	↓	50 µL	100 mL	0.5 ppm	/	↓	↓	↓	Cal Std.
-06	0.05 ppm PO4	↓	↓	10 µL	200 mL	0.05 ppm	/	↓	↓	↓	

Attachment E: Chain of Custody

01946

GUAM ENVIRONMENTAL PROTECTION AGENCY

Phone: 475-1658
Fax: 477-9402

CHAIN OF CUSTODY RECORD

PROJ. NO.: GWSA 07

PROJECT NAME: Guam WSA

SAMPLERS: (Signature)

FIELD SAMPLE ID	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	E. Coli	NO2 + OPO4	NH4 + NO3	pH, Cond., True Color, Turbidity	TDS + TSS		REMARKS
GWSA05-033	1/22/07	1045		X	Madog River	5	X	X	X	X	X		

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
	1/22/07 2:40p				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
			1/22/07 1455		

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