GUAM ENVIRONMENTAL PROTECTION AGENCY
EMAS ANALYTICAL PROGRAM

STANDARD OPERATING PROCEDURE

Total and Free Residual Chlorine by DPD Colorimetric Method (HACH® Pocket Colorimeter™ II)

Prepared by: _____ 2-12-2016
Edelisa S. Yanit, Chemist II — Date

Peer Reviewed by: _____ 2-15-2016
Rodolfo B. Paulino, Chemist II — Date

Reviewed by: _____ 2/15/2016
Jesse T. Cruz, Administrator
EMAS Division — Date

Approved by: _____ 02/18/16
Eric M. Palacios, Administrator
Guam Environmental Protection Agency — Date

Periodic Review:

Signature	Title	Date

Revision Page

Date	Rev. No.	Summary of Changes	Sections

CONTENTS

1 SCOPE AND APPLICATION 4

2 METHOD SUMMARY 4

3 INTERFERENCES 4

4 DEFINITIONS 4

5 SAMPLE HANDLING AND PRESERVATION 5

6 EQUIPMENT AND SUPPLIES 5

7 REAGENTS AND STANDARDS 6

8 QUALITY CONTROL AND QUALITY ASSURANCE 6

9 ANALYTICAL PROCEDURES 10

10 DATA ACQUISITION, CALCULATIONS AND DATA REDUCTION... 12

11 DOCUMENTATION 12

12 REFERENCES 13

Appendix A: Initial demonstration of Capability (IDC)..... 14

Appendix B: HACH Certificate of Analysis for the Use of Pocket Color II (LR) 15

Appendix C: Chain of Custody Form..... 16

Appendix D: Total and Free Residual Chlorine Analytical Results Logbook (page) ... 17

Appendix E: Analytical Results Report (LIMS or spreadsheet) 18

Appendix F: HACH® Pocket Colorimeter™ II Analysis System Chlorine (Cl_2) Instruction Manual 19

1 SCOPE AND APPLICATION

1.1 This method is applicable to the measurement of total and free residual chlorine in any laboratory reagent water, drinking water, ground and surface water.

1.2 For wastewater analyses, only total residual chlorine is applicable.

1.3 The practical detection range of determination is from 0.02 to 2.00 mg/L Cl_2.

2 METHOD SUMMARY

2.1 Chlorine in the water sample immediately reacts with DPD (N, N diethyl-p-phenylene diamine) indicator to form a pink color whose intensity is directly proportional to the chlorine concentration.

2.2 The results are read directly as mg/L chlorine.

3 INTERFERENCES

3.1 Color, turbidity, manganese, copper, permanganate and ozone interfere with chlorine measurements. In order to account for these interferences, the instrument is zeroed out with a water sample with no DPD reagent added.

3.3 If high concentrations of monochloramine (combined chlorine) are present, they may interfere in the free chlorine determination after one minute of developing time. Therefore, it is important that the results be read within in one minute of the addition of DPD pillow. When read within one minute after reagent addition, 3.0 mg/L monochloramine causes less than 0.1 mg/L increase in the free chlorine reading.

4 DEFINITIONS

4.1 Combined chlorine residual – chlorine reacts with the organics and the ammonia, forming chloroorganics and chloramines. These two products are called combined chlorine residual. This is a chlorine residual that, because it has combined with other chemicals in the water, has lost some of its disinfecting strength.

4.2 Free available chlorine residual – the chlorine level in the water after the chlorine demand has been satisfied. "Free" in the sense that it has not reacted with anything and "available" in the sense that it can and will react if needed. In terms of

disinfecting power, the free available chlorine residual is the true measure of potential chlorine disinfection.

4.3 Total chlorine residual – includes both the combined chlorine residual and free available chlorine residual.

4.4 Chlorine demand – a measure of how much chlorine must be added to the water to achieve breakpoint chlorination or whatever free chlorine residual is desired.

5 SAMPLE HANDLING AND PRESERVATION

5.1 A grab sample is collected directly into a test kit vial from which the chlorine residual test is made. Do not use plastic containers to collect samples.

5.2 Samples must be analyzed immediately in the field (within 15 minutes of collection), and cannot be preserved for later analysis.

5.3 Avoid excessive light and agitation, chlorine easily disassociates from water.

5.4 If air bubbles are present, allow them to dissipate, yet ensure the sample is analyzed within 15 minutes.

5.5 For best results, dedicate a set of cells to each free chlorine and total chlorine test.

6 EQUIPMENT AND SUPPLIES

6.1 Chlorine Test Kit (HACH® Pocket Colorimeter™ II, Cat. No. 58700-00). See Instruction Manual, Cat. No. 59570-88 (Appendix F)

6.2 Sample cells, 10-mL (glass cells) with screw caps (HACH # 24276-06) – dedicated for Low Range Free and Total Residual Chlorine determination

6.3 Sample cells, 1-cm/10-mL (plastic cells with caps) with 5-ml and 10-ml markings (HACH # 48643-02) – dedicated for High Range Total Residual Chlorine determination

6.4 Class "A" graduated cylinder, 25, 50 and 100 mL

6.5 Plastic or Teflon spray bottle

6.6 Pipet/pipet tips, 0.1 to 1.0 mL

7 REAGENTS AND STANDARDS

7.1 Laboratory Reagent Water –GEPA Lab uses analytical grade deionized (DI) water produced from Barnstead NANOpure™ ultrapure water system.

7.2 DPD Free Chlorine Reagent for 10-mL sample (HACH# 2105569)

7.3 DPD Total Chlorine Reagent for 10-mL sample (HACH# 2105669)

7.4 Free Chlorine Standard (HACH Voluette®, Cat No. 14268).
It is recommended that the chlorine ampules be stored under refrigeration between 35° – 45° F, (2° -10° C), immediately upon receipt. When stored under those conditions, the expected stability at the stated conditions is at least 18 months.

7.5 DPD-Chlorine Secondary Standard (HACH Spec√ Color Standard, Cat No. 2635300)
Do not expose these standards to extreme temperature conditions. Optimal storage conditions are 50° – 77° F, (10° – 25° C).

8 QUALITY CONROL AND QUALITY ASSURANCE

8.1 Initial Demonstration of Capability (IDC)

8.1.1 An IDC is a procedure to confirm that an analyst (or an operator) can properly perform a particular method. It is to be subsequently performed with any significant changes within the laboratory (or within the Water System), e.g., new instrument, new analyst or operator, new standards, new or revised methods.

8.1.2 IDC Procedure: (Low Range Standards)

a. Fill out the top portion of the IDC Spreadsheet (Excel), (Appendix A) with all applicable information (Analyst Name, SOP No. and Revision No., Matrix, Instrument Name and Serial#, Date of Analysis, 2nd Source Standard, Lot# and Expiration Date)
b. Ensure a supervisor or a fellow employee is present to witness this procedure. This person should be equally knowledgeable of the procedure and requirements as the person performing the procedure.

c. Record the known concentration of the secondary gel standards (HACH® Spec√™ DPD-Chlorine-LR) from the Certificate of Analysis for the Instrument (Pocket Color II LR (Kit PN 5870000).
d. Wipe down the secondary gel standards with Kimwipes® or a microfiber cloth, or use gloves to handle them all the times.
e. Press the **POWER** to turn the unit on. Be sure the instrument is in the low range channel (LR).
f. Place the colorless Spec√ blank into the cell holder with the alignment mark facing you. Tightly cover the cell with the instrument cap.
g. Press the **ZERO/SCROLL** key. The instrument will show "0.00".
h. Place the standard STD1 into the cell holder. Tightly cover the cell with the instrument cap.
i. Press **READ/ENTER** key). Record the concentration measurement.
j. Repeat steps **f** through **i** until you have obtained four readings for STD 1, zeroing the instrument with the blank between each reading of STD 1. Record the readings.
k. Choose another standard and repeat steps **f** through **i** until four readings have been obtained for all three standards, zeroing the instrument with the blank between each reading for each standard. Record the readings.
l. Ensure the Relative Standard Deviations (%RSD) of the concentrations for each standard are ≤ 15%.
m. If the %RSD is >15%, wipe down all standards, clean colorimeter, verify standards are not expired, etc. and perform IDC again. If IDC %RSD is still >15%, the instrument calibration must be checked using Chlorine Reference Standards (HACH® Free Chlorine - Voluette® Cat. No. 14268). See Section 8.3.
n. If the instrument calibration is within the certified range, perform IDC again using another set of secondary standards with a different lot number.
o. If %RSD is ≤ 15%, sign the IDC spreadsheet along with a witness and submit it to your supervisor or QA officer for record keeping.

8.2 Calibration and Routine Calibration Verification Standards (CVS)

8.2.1 Calibration – Use factory installed calibration.

8.2.2 Routine Calibration Verification Standards – Verify instrument performance prior to performing chlorine residual measurement(s). Utilize the HACH® Spec√™ DPD-Chlorine-LR Secondary Standards for this procedure.

a. Place the Spec√™ blank into the cell holder with the alignment mark facing you. Cover the cell with the instrument cap.
b. Press **ZERO/SCROLL** key. The display will show "0.00."
c. Place the "STD 1" cell into the cell holder. Cover the cell with the instrument cap.

d. Press **READ/ENTER** key. Record the concentration reading in the Total and Free Residual Chlorine Logbook (GEPA Log: CH-02-07). See Appendix D.
e. Repeat steps c and d with the cells labelled "STD 2" and "STD3."
f. If these are the first readings, record them as initial readings for comparison with the future readings.
g. Compare these readings with the known values on the HACH® Certificate of Analysis (COA) for using Pocket Color II (LR) (Kit PN 5870000). Ensure the Lot # on the enclosed COA matches the box of secondary standards you are using. See Appendix B.
h. The measured performance value for each standard must be within 100 ±10% of the known value to be acceptable.
i. If the performance value is outside the acceptable range, perform a calibration check of the instrument using HACH® Free Chlorine Standard (Voluette® Cat. No. 14268). Refer to Section 8.3.
j. After performing Section 8.3 **a** through **j**, and the instrument is found to be within the required calibration range, discard the Spec√ Color Standards used in section 8.2.2 **a** through **g**. Use a new set of Spec√ Color Standards for future measurements.

8.3 Calibration Check Using Primary Standards - If the Routine CVS does not meet the acceptance criteria of 100±10%, perform instrument calibration check. Utilize the HACH® Free Chlorine Analytical Standards, Voluette® Cat. No. 14268 for this procedure. If it fails, send the unit back to the manufacturer for repair and recalibration.

a. Use at least four (4) glass sample cells. Make sure sample cells are clean and dry. Add 10 mL of reagent water to the cells.
b. Add the required amount of DPD to each glass cell.
c. One glass cell will be used as a blank and should be labelled as such. Label the other cells as S1, S2 and S3.
d. Using the micro-pipettes, accurately pipette the volume of chlorine standard to each of the other cells.

Volume of Standard added:	Cell ID:
0.0 mL	Blank
0.10 mL	S1
0.20 mL	S2
0.30 mL	S3

e. Cap and swirl each one after adding the standard.

f. Place the blank into the unit – the diamond on the glass cell should face you (the user). Place the cap back on, and press **ZERO/SCROLL** key.
g. Remove the blank and place the first standard into the unit. Cap and press the **READ/ENTER** key.
h. Read the mg/L chlorine and record this value.
i. Repeat with the other standards.
j. Calculate the concentration of chlorine (expected value) added to the sample:

$$\frac{\text{mL of standard added}}{\text{mL of standard added + mL of sample}} \times \text{label Value of Voluette (mg/L)}$$

For example:
The lot being used for this example contains 63.9 mg/L chlorine.

The expected values would be:
S1: (0.10 / (0.10 + 10)) X 63.9 mg/L = 0.63 mg/L
S2: (0.20 / (0.20 + 10)) X 63.9 mg/L = 1.25 mg/L
S3: (0.30 / (0.30 + 10)) X 63.9 mg/L = 1.86 mg/L

If for example, the measured values from **g** through **i** are:

S1: 0.70 mg/L
S2: 1.20 mg/L
S3: 1.92 mg/L

Acceptance criteria:

The measured value of each standard is within 100±15% of its expected value to pass.

(Measured value / Expected value) X 100

So:
S1: (0.70mg/L / 0.63 mg/L) X 100 = 111% --- PASS
S2: (1.20 mg/L) / 1.25 mg/L) X 100 =96% --- PASS
S3: (1.92 mg/L / 1.86 mg/L) X 100 = 103% --- PASS

The unit passes calibration check.

8.4 A procedural blank (deionized water that is known to be chlorine free – GEPA Lab's analytical grade reagent water, (see Section 7.1) is analyzed once per every 20

samples or daily whichever is more frequent. If a procedural blank reads greater than 0.05 mg/L, the source of contamination must be investigated and all samples processed with the out-of-control-blank must be re-analyzed.

9 ANALYTICAL PROCEDURES

9.1 **Low Range Free Chlorine (0-2.0 mg/L Cl_2)** – Be sure the instrument is in the low range (LR) mode.

Note: Use the glass cells with 10-mL marking for this determination. (See section 6.2)

a. Fill a 10-mL glass cell with sample (the blank). Cap and wipe any liquid and finger prints off the sample cell.
b. Press the **POWER** key to turn the meter on. The arrow should indicate the low range channel (LR).
c. Remove the meter cap and place the blank in the cell holder with the diamond mark facing you. Tightly cover the cell with instrument cap.
d. Press **ZERO/SCROLL** key. The display will show "_ _ _ _" then "0.00".
e. Remove the blank from the cell holder.
f. Fill a second 10-mL glass cell to the 10-mL line with the sample.
g. Add the contents of one 10-mL DPD Free Chlorine powder pillow to the sample cell (the prepared sample).
h. Cap and shake gently for 20 seconds. Shaking dissipates bubbles that may form in samples with dissolved gases.
i. **Within one minute** after adding DPD to the sample, place the prepared sample in the cell holder and tightly cover with the instrument cap.
   Note: A pink color will develop if chlorine is present.
   Accuracy is not affected by undissolved powder.
   Wipe liquid off sample cells to prevent damage to the instrument.
j. Press **READ/ENTER** key. The instrument will show "_ _ _ _" followed by the results in mg/L free chlorine.
   Note: If the sample temporarily turns yellow after adding the reagent or shows over range (flashing 2.20), dilute a fresh sample and repeat the test. Multiply the result by the appropriate dilution factor.
   j. Record the results on the field data sheet/chain-of-custody form (Appendix C) for field determinations, or on the Analytical Results Logbook (GEPA Log: CH-02-07) when appropriate. See Appendix D.

9.2 Total Chlorine, Low Range (0-2.00 mg/L Cl_2)

Note: Use the glass cells with 10-ml markings for this determination (see section 6.2).

a. Fill a 10-mL glass cell with sample (the blank). Cap and wipe any liquid and finger prints off the sample cell.
b. Press the POWER key to turn the meter on. The arrow should indicate the low range channel (LR).
c. Remove the meter cap and place the blank in the cell holder with the diamond mark facing you. Tightly cover the cell with instrument cap.
d. Press **ZERO/SCROLL** key. The display will show "_ _ _ _" then "0.00".
e. Remove the blank from the cell holder.
f. Fill a second 10-mL glass cell to the 10-mL line with the sample.
g. Add the contents one 10-mL DPD Total Chlorine powder pillow to the sample cell (the prepared sample).
h. Cap and shake gently for 20 seconds. Shaking dissipates bubbles that may form in samples with dissolved gases.
i. **Wait 3 minutes**.
j. Within 3 minutes after the 3-minute reaction period, wipe any liquid off the cell. Place the prepared sample in the cell holder and tightly cover with the instrument cap.
k. Press **READ/ENTER** key. The instrument will show "_ _ _ _" followed by the results in mg/L Cl_2.
   Note: If the sample temporarily turns yellow after adding the reagent or shows over range (flashing 2.20), dilute a fresh sample and repeat the test. Multiply the result by the appropriate dilution factor.
l. Record the results on the field data sheet/chain-of-custody form (Appendix C) for field determinations, or on the Analytical Results Logbook (GEPA Log: CH-02-07) (Appendix D) when appropriate.

9.3 Total Chlorine, High Range (0-4.5 mg/L Cl_2) – Be sure the instrument is in the high range (HR) mode.

Note: Use the **plastic** sample cells with 5-ml and 10-ml markings for this determination (see section 6.3).

a. Fill a plastic sample cell to the **5-mL** line with sample. This is the blank.
b. Press the "POWER" key to turn on the instrument. The arrow should indicate the high range channel (HR).

c. Remove the instrument cap and place the blank into the cell holder, with the triangle mark pointing away from the keypad. Tightly cover the cell with the instrument cap.
Note: The triangle mark is placed in the cell holder **not** facing you.
d. Press **ZERO/SCROLL** key. The display will show "_ _ _ _" followed by "0.0". Remove the blank.
e. Fill another plastic sample cell to the **5-mL** line with sample.
f. Add the contents of **two** 10-mL DPD Total Chlorine powder pillows to the sample cell (the prepared sample). Cap the cell and shake gently for 20 seconds. Shaking gently dissipates bubbles which may form in samples containing dissolved gases.
g. Place the prepared sample in the cell holder and cover with the instrument cap. **Wait 3 minutes** before reading the sample. The 3-minute waiting time is the reaction period.
h. Within 3 minutes after the reaction period, press **READ/ENTER**. The instrument will show "_ _ _ _" followed by the results in mg/L Cl_2.
Note: If the sample temporarily turns yellow after adding the reagent or shows over range (flashing 2.20), dilute a fresh sample and repeat the test. Multiply the result by the appropriate dilution factor.
i. Record the results on the field data sheet/chain-of-custody form (Appendix C) for field determinations, or on the Analytical Results Logbook (GEPA Log: CH-02-07) when appropriate. See Appendix D.

10 DATA ACQUISITION, CALCULATIONS AND DATA REDUCTION

10.1 Residual chlorine measurements are read from the instrument's display and documented by hand on a field data/chain-of-custody form (Appendix C).

10.2 All sample measurements which exceed 2.0 mg/L free residual chlorine, and samples exceeding 4.5 mg/L total residual chlorine are re-analyzed using a diluted aliquot, and the results multiply by the dilution factor.

10.3 Instrument calibration verification data are recorded in the same analytical log book where chlorine test results are recorded (GEPA Log: CH-02-07).

11.0 DOCUMENTATION

11.1 When samples are received, the laboratory personnel verify that the chain of custody form is properly filled out. Laboratory personnel may then receive and sign the chain

of custody. A copy of the chain of custody form (Appendix C) is included in the data package.

11.2 Sample results are recorded on the Chain-of-Custody Form (Appendix C), or in the Analytical Results Logbook (GEPA Log: CH-02-07) (Appendix D), and then entered in the Laboratory Information Management System (LIMS) and analytical results are reported. The Analytical Results Report (LIMS or spreadsheet report) (Appendix E) is included in the data package.

11.3 The data package consists of the following:
Appendix A: Initial Demonstration of Capability (IDC)
Appendix B: HACH Certificate of Analysis (COA) for using Pocket Color II (LR) (Kit PN 5870000)
Appendix C: Chain of Custody
Appendix D: Total and Free Residual Chlorine Analytical Results Logbook page
Appendix E: Analytical Results Report (LIMS or spreadsheet)
Appendix F: HACH® Pocket Colorimeter™ II Analysis System Chlorine (Cl2) Instruction Manual

12 REFERENCES

12.1 SM 4500-Cl G, Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

12.2 HACH Pocket Colorimeter II Analysis System Chlorine (Cl2) Instruction Manual, Cat. No. 59570-88

12.3 EPA Method 334.0: Determination of Residual Chlorine in Drinking Water Using An On-Line Chlorine Analyzer

Appendix A

Initial Demonstration of Capability (IDC)

Initial Demonstration of Capability (IDC)

Analyst Name: David Kautz DK Witness: E. Yanit EY Date of Analysis: 12/02/2015

SOP No. CH-01-12, Revision: Matrix: Water

Instrument Name: HACH Chlorine Pocket Colorimeter II

Secondary Standard: HACH DPD-Chlorine LR Spec Check Standards Kit Lot # A4218 Exp Date: Aug 2016

STD #	Known Values ($mg/L\ Cl_2$) **		1st Rdg. ($mg/L\ Cl_2$)	2nd Rdg. ($mg/L\ Cl_2$)	3rd Rdg. ($mg/L\ Cl_2$)	4th Rdg. ($mg/L\ Cl_2$)	Mean	STD DEV	%RSD *
1	0.22		0.21	0.21	0.21	0.21	0.21	0	0
2	0.92		0.90	0.90	0.90	0.90	0.90	0	0
3	1.63		1.64	1.64	1.63	1.64	1.64	0	0

* Criteria: %RSD (Relative Standard Deviation) $\leq$ 15%

** Refer to HACH Certificate of Analysis for using Pocket Color II (LR) - Kit PN 5870000.

Peer Reviewed By: EY
Date Reviewed: 12/02/15

Appendix B

HACH Certificate of Analysis for the Use of Pocket Color II (LR) (Kit PN 5870000)

Use of Chlorine Spec√ Standards

The Chlorine Spec√ Standards can now be used to verify instrument performance on all Hach Spectrophotometers and Colorimeters. These NIST traceable standards read directly as mg/L chlorine when used with Hach Company stored programs for Chlorine.

Secondary standards serve as a quality control check to verify that your instrument is operating correctly. The Spec√ standards are routinely used for two purposes. First, the standards confirm that the instrument response is within the tolerance range given on the Certificate of Analysis. Refer to the Certificate of Analysis to find the test values and the tolerance ranges that apply to the instrument model and stored program being used. The actual values determined should be recorded on the Record of Performance Verification included with the standards. These instrument performance values, when used together with results from any additional reagent and calibration verification tests required by your state or local regulatory agencies, form the basis for a thorough quality control program.

The second use of the standards is to verify that instrument performance has not changed from the initial performance evaluation. The standards are especially useful in verifying that instrument response has not changed during transportation of an instrument to the field or due to exposure of an instrument to extreme environmental conditions. The standards may also be used to confirm performance evaluations between analysts under lab and field conditions. Often times it is not feasible or practical to prepare and analyze chlorine standard solutions under these types of conditions.

The Spec√ standards are assigned chlorine equivalent test values by Hach Company at the time of manufacture. The test values are determined from the chlorine calibration curves stored in each Hach Company instrument. Test values are valid for two years from the date of manufacture.

Each instrument model responds or "sees" the gel standards differently as compared to the DPD chlorine chemistry color. Different responses from different instruments are due to differences in the optical systems, differences in the half-band width, and differences in the cell pathlength used for a specific stored program. These differences are expected. For example, we would not expect the Spec√standards to give the same value on a stored program that used a 1-inch square cell versus a stored program that was calibrated using a chlorine AccuVac; nor would we expect the response from a colorimeter to match the response from a spectrophotometer. Each test value listed is specific to the Hach Company instrument and chlorine program being used.

The Spec√ Chlorine Standards are just one part of the total testing package that Hach Company supplies for chlorine testing. Prepackaged DPD Chlorine Reagents calibrated and controlled specifically on Hach Company instruments along with simplified procedures, standard solutions and excellent technical support gives you, the customer, the best chlorine testing system available today.

2635300, 2893300, 2980500 Rev Y06-1ED AR310A

Hach Company
100 Dayton Ave.
Ames, Iowa 50010

HACH

Certificate of Analysis

Product : DPD-Chlorine LR Spec Check Secondary Standards Kit

Product Number: 2635300 Lot Number: A4218 Expiration Date: Aug 2016

Instrument (PRGM)	Blank A4212	STD 1 (mg/L) A4212	STD 2 (mg/L) A4212	STD 3 (mg/L) A4212
DR 6000 (80)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 6000 (85)	0.00	0.22 +/- 0.09	0.94 +/- 0.10	1.66 +/- 0.14
DR 5000 (80)	0.00	0.21 +/- 0.09	0.88 +/- 0.10	1.56 +/- 0.14
DR 5000 (85)	0.00	0.23 +/- 0.09	0.96 +/- 0.10	1.71 +/- 0.14
DR 4000 (1450)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 4000 (1460)	0.00	0.21 +/- 0.09	0.91 +/- 0.10	1.62 +/- 0.14
DR 3900 (80)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 3900 (85)	0.00	0.22 +/- 0.09	0.94 +/- 0.10	1.66 +/- 0.14
DR 3800 (80)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 3800 (85)	0.00	0.22 +/- 0.09	0.94 +/- 0.10	1.66 +/- 0.14
DR 2800 (80)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 2800 (85)	0.00	0.22 +/- 0.09	0.94 +/- 0.10	1.66 +/- 0.14
DR 2700 (80)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 2700 (85)	0.00	0.22 +/- 0.09	0.94 +/- 0.10	1.66 +/- 0.14
DR 2500 (80)	0.00	0.22 +/- 0.09	0.92 +/- 0.10	1.63 +/- 0.14
DR 2500 (85)	0.00	0.22 +/- 0.09	0.92 +/- 0.10	1.63 +/- 0.14
DR 2400 (80)	0.00	0.22 +/- 0.09	0.92 +/- 0.10	1.63 +/- 0.14
DR 2400 (85)	0.00	0.22 +/- 0.09	0.92 +/- 0.10	1.63 +/- 0.14
DR 1900 (80)	0.00	0.20 +/- 0.09	0.85 +/- 0.10	1.51 +/- 0.14
DR 1900 (85)	0.00	0.22 +/- 0.09	0.94 +/- 0.10	1.66 +/- 0.14
DR 900 (80)	0.00	0.21 +/- 0.09	0.88 +/- 0.10	1.56 +/- 0.14
DR 900 (85)	0.00	0.21 +/- 0.09	0.88 +/- 0.10	1.56 +/- 0.14
DR 800 (9)	0.00	0.21 +/- 0.09	0.88 +/- 0.10	1.56 +/- 0.14
DR 800 (11)	0.00	0.21 +/- 0.09	0.88 +/- 0.10	1.56 +/- 0.14
Pocket Color II (LR) (Kit PN 5870000)	0.00	0.22 +/- 0.09	0.92 +/- 0.10	1.63 +/- 0.14

NOTE: Choose the instrument and chlorine program being used. Transfer the control values to the enclosed certificate label and keep the label with your instrument for reference. For example, the test values for using a DR/2800 Spectrophotometer and stored program #80 would be 0.20, 0.85, and 1.51 mg/L chlorine for Standard 1, Standard 2, and Standard 3 respectively.
File this Certificate of Analysis for safe keeping. Values Traceable to NIST SRM 930

Certified by: _____ for and on the behalf of Hach Company.

Doc. Cat. No. 26353-87

Appendix C

Chain of Custody Form

GUAM ENVIRONMENTAL PROTECTION AGENCY
AHENSIAN PRUTEKSION LINA'LA GUAHAN
P.O. BOX 22
BARRIGADA, GU 969
EPA.GUAM.GO

GUAM ENVIRONMENTAL PROTECTION AGENCY 1973

Chain of Custody Record

PROJECT NAME: _____ **ASSIGNED LAB ID NUMBER** _____

SAMPLERS
(Print name and sign) _____

FIELD SAMPLE ID	DATE	TIME	COMPOSITE	GRAB	STATION LOCATION	# OF CONTAINERS						REMARKS

RELINQUISHED BY (*Print name and sign*)	DATE	TIME	RECEIVED BY (*Print name and sign*)
RELINQUISHED BY (*Print name and sign*)	DATE	TIME	RECEIVED BY (*Print name and sign*)
RELINQUISHED BY (*Print name and sign*)			RECEIVED FOR LAB by(*Print name and sign*)

REMARKS

chain of custody # _____

8/06 Rev. 2 12/27/12 - V6P GuamEPA

Appendix D

Total and Free Residual Chlorine
Analytical Results Logbook
(page)

Guam EPA Laboratory
Analytical Results Logbook
Total and Free Residual Chlorine by DPD Colorimetric Method (SM 4500-Cl G)

Instrument ID: HACH Chlorine Pocket Calorimeter II

Serial #/ ID #: _____ Analyst: _____

Date of Last Calibration Check: _____ Analysis Date: _____

Calibration Check Using Chlorine Reference Standards (HACH Voluette® Free Chlorine Standard): _____ mg/L Lot# _____ Exp. Date: _____					**Daily Performance Verification Using Secondary Standards (HACH SPEC√ DPD-Chlorine (LR)** Lot# _____ Exp. Date: _____			
Sample Size _____ml	*Expected Values	Measured Values	% Recovery[1]		Standard #	**Known Values	Measured Values	% Performance[2]
Reagent Blank	mg/L	mg/L			Std. Blank	mg/L	mg/L	
0.1mL Addition	mg/L	mg/L	%		Std. 1	mg/L	mg/L	
0.2mL Addition	mg/L	mg/L	%		Std. 2	mg/L	mg/L	
0.3mL Addition	mg/L	mg/L	%		Std. 3	mg/L	mg/L	

#	Date Sampled	Lab Sample ID #	Location	Total Residual Cl_2 (mg/L)	Free Residual Cl_2 (mg/L)	Notes
1						
2						
3						
4						
5						
Lab Dup						RPD[3] = _____
QCS						

Criteria: [1]The instrument calibration is considered valid when the (%Recovery) measured value of the standard is 100 ±15% of its expected value.
[2]The measured performance values must be within 100 ±10% of the known value.
[3]Relative Percent Difference (RPD) must be less than ±10%

* Refer to Section 8.3 j Standard Operating Procedure for Total and Free Residual Chlorine (NUMBER: CH-01-12) for the computation.

** Refer to HACH Certificate of Analysis for using Pocket Color II (LR) – Kit PN5870000

Action: If instrument is out of calibration, it should be returned to the manufacturer for service. Inform supervisor.

Appendix E

Analytical Results Report (LIMS or spreadsheet)

- 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: 12-Aug-15

To: GEPA - Water Div, SDW Program
Angel Marquez

Project: Complaint (Palacios)

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

Lab Sample Number	Field Sample ID	Station Location
02836-001	1	PH (upstream)
02836-002	2	HSE # 107 (Downstream)
02836-003	3	Kitchen
02836-004	4	Outside HB
02836-005	LB	Laboratory Blank

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: 12-Aug-15

Field ID:	1	Lab Sample Number:	02836-001
Submitter:	GEPA - Water Div, SDW Program	Date Sample Collected:	11-Aug-15
Type of Sample:	water	Date Sample Received:	11-Aug-15

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Coliform, Total/E. coli	**(Dilution Factor: 1)**					
Coliform, E. coli	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Coliform, Total	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Residual Chlorine (Field Determine	**(Dilution Factor: 1)**					
Residual Chlorine	SM 4500Cl(G)	08/11/15	AP	0.02	1.60	mg/L

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: 12-Aug-15

Field ID:	2	Lab Sample Number:	02836-002
Submitter:	GEPA - Water Div, SDW Program	Date Sample Collected:	11-Aug-15
Type of Sample:	water	Date Sample Received:	11-Aug-15

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Coliform, Total/E. coli	**(Dilution Factor: 1)**					
Coliform, E. coli	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Coliform, Total	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Residual Chlorine (Field Determine	**(Dilution Factor: 1)**					
Residual Chlorine	SM 4500Cl(G)	08/11/15	AP	0.02	1.00	mg/L

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: 12-Aug-15

Field ID:	3	Lab Sample Number:	02836-003
Submitter:	GEPA - Water Div, SDW Program	Date Sample Collected:	11-Aug-15
Type of Sample:	water	Date Sample Received:	11-Aug-15

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Coliform, Total/E. coli	**(Dilution Factor: 1)**					
Coliform, E. coli	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Coliform, Total	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Residual Chlorine (Field Determine	**(Dilution Factor: 1)**					
Residual Chlorine	SM 4500Cl(G)	08/11/15	AP	0.02	2.10	mg/L

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: 12-Aug-15

Field ID:	4	Lab Sample Number:	02836-004
Submitter:	GEPA - Water Div, SDW Program	Date Sample Collected:	11-Aug-15
Type of Sample:	water	Date Sample Received:	11-Aug-15

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Coliform, Total/E. coli	**(Dilution Factor: 1)**					
Coliform, E. coli	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Coliform, Total	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Residual Chlorine (Field Determine	**(Dilution Factor: 1)**					
Residual Chlorine	SM 4500Cl(G)	08/11/15	AP	0.02	1.30	mg/L

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: 12-Aug-15

Field ID:	**LB**	Lab Sample Number:	**02836-005**
Submitter:	GEPA - Water Div, SDW Program	Date Sample Collected:	11-Aug-15
Type of Sample:	water	Date Sample Received:	11-Aug-15

Parameter Name	Analytical Method	Date Analyzed	Analyst	MDL	Result	Units
Coliform, Total/E. coli	**(Dilution Factor: 1)**					
Coliform, E. coli	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml
Coliform, Total	SM9223B	08/11/15	eyanit	1	Absence	CFU/100ml

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

Appendix F

HACH® Pocket Colorimeter™ II Analysis System

Chlorine (Cl_2)

Instruction Manual

Instrument Instruction Manual may be downloaded at:

https://ay14-15.moodle.wisc.edu/prod/mod/resource/view.php?id=7474

5957088.book Page 1 Friday, March 22, 2013 3:54 PM

59570-88

POCKET COLORIMETER™ II
ANALYSIS SYSTEMS

INSTRUCTION MANUAL

Chlorine (Cl_2)

© Hach Company, 2006–2009, 2013. All rights reserved. Printed in the U.S.A.te/jk/dk 03/13 6ed