Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Field Screening of Total Residual Chlorine**

Effective Date: August 20, 2015	**Number:** SESDPROC-112-R4

Author

Name: Jairo Castillo
Title: Environmental Engineer
Signature: Jairo Castillo Date: 8/18/2015

Approvals

Name: John Deatrick
Title: Chief, Field Services Branch
Signature: John Deatrick Date: 8/18/15

Name: Hunter Johnson
Title: Field Quality Manager, Science and Ecosystem Support Division
Signature: Date: 8/18/15

Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

History	Effective Date
SESDPROC-112-R4, *Field Screening of Total Residual Chlorine,* Replaces SESDPROC-112-R3 **Cover Page:** Changes made to reflect reorganization of SESD from two field branches to one: John Deatrick listed as the Chief, Field Services Branch. The FQM was changed from Bobby Lewis to Hunter Johnson. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history. **Section 3.2:** Omitted Tolerance Range Table and referred personnel to current Certificate of Analysis for tolerance information.	August 20, 2015
SESDPROC-112-R3, *Field Screening of Total Residual Chlorine,* Replaces SESDPROC-112-R2	January 29, 2013
SESDPROC-112-R2, *Field Measurement of Total Residual Chlorine,* Replaces SESDPROC-112-R1	April 20, 2011
SESDPROC-112-R1, *Field Measurement of Total Residual Chlorine,* Replaces SESDPROC-112-R0	June 13, 2008
SESDPROC-112-R0, *Field Measurement of Total Residual Chlorine,* Original Issue	October 19, 2007

TABLE OF CONTENTS

1 General Information

1.1 Purpose

This document describes methods and considerations to be used and observed when conducting field screening of total residual chlorine in surface water and wastewater effluent.

1.2 Scope/Application

On the occasion that SESD field investigators determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another method must be used to obtain a measurement for total residual chlorine, the alternate procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products in this operating procedure does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

Code of Federal Regulations, 40 CFR Part 136, Appendix B

Hach Company Pocket Colorimeter Chlorine Manual, Hach, 2010

SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108)

SESD Safety, Health and Environmental Management Program (SHEMP) Manual, Most Recent Version

Standard Methods for the Examination of Water and Wastewater, 21th Edition, 2005

1.5 Safety Precautions

Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. When using this procedure, minimize exposure to potential health hazards through the use of protective clothing, safety glasses, and gloves. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

2 Quality Control

All total residual chlorine meters will be maintained and operated in accordance with the manufacturer's instructions and the SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108. Before a meter is taken to the field, it will be verified according to Section 3.2 of this procedure to ensure it is operating properly. Calibration verifications and maintenance procedures will be documented and maintained in a logbook.

The following are general guidelines for maintaining total residual chlorine meters:

- Each meter should be visually inspected before and after each use.
- Check the battery strength.
- Ensure that the reagents are fresh and up to date before field trips.
- Ensure that gel standards are up to date prior to use.

The ambient temperature in the immediate vicinity of the meter should be measured and recorded in the field logbook to ensure the instrument is operated within the manufacturer's specified range of operating temperatures.

If, at any time during a field investigation, it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped. This will be documented in the field logbook.

3 Field Screening of Total Residual Chlorine

3.1 General

The chlorination of water supplies and polluted water serves primarily to destroy or deactivate disease-producing microorganisms. Chlorine applied to water in its molecular or hypochlorite form initially undergoes hydrolysis to form free available chlorine. Free available chlorine reacts with ammonia and certain nitrogenous compounds to form combined chlorine. The following terms are provided to explain the disinfection process.

Chlorination: Adding chlorine or chlorine compounds to water for disinfection.

Combined Available Chlorine Residual: The residual consisting of chlorine that is combined with ammonia, nitrogen, or nitrogenous compounds (chloramines). This is the amount of chlorine that has reacted with nitrates and is unavailable for disinfection.

Free Available Chlorine Residual: The residual consisting of hypochlorite ions (OCl^-), hypochlorous acid (HOCl) or a combination of the two. These are the most effective in killing bacteria.

Chlorine Demand: The amount of chlorine used by reactions with substances that oxidize in the water before chlorine residual can be measured. It is the difference between the amount of chlorine added to wastewater and the amount of chlorine residual remaining after a given contact time. Chlorine demand may change with dosage, time, temperature, pH, and the type and amount of pollutants in the water.

Chlorine Dosage: The amount of chlorine which must be added to produce a desired result (disinfection of the effluent, control of filter flies, ponding, odor, etc.).

Chlorine Residual: The amount of available chlorine present in wastewater after a given contact time (20 minutes at peak flow; 30 minutes at average flow) under specific environmental conditions. Temperature and pH should be documented during testing procedures.

Total Chlorine Residual: The total amount of chlorine present in a sample. This is the sum of the free chlorine residual and the combined available chlorine residual.

Chlorination may produce adverse effects. Potentially carcinogenic chloro-organic compounds such as chloroform may be formed. To fulfill the primary purpose of chlorination and to minimize any adverse effects, it is essential that proper testing procedures be used. Several methods for measurement of total residual chlorine are available including iodometric methods, amperometric titration methods, and *N*,*N*-diethyl-

p-phenylenediamine (DPD) methods. This operating procedure will discuss a DPD Colorimetric Method.

3.2 Initial Verification Check

The pocket colorimeter shall be checked with a minimum of three gel standards and a blank. Gel standard kits are kept at the SESD Field Equipment Center (FEC) along with the Certificate of Analysis for each kit. For the specific tolerance range, refer to the current Certificate of Analysis.

When checking the instrument verification against the three gel standards, the observed values should be within the applicable tolerance range of the Certificate of Analysis for each gel standard. The tolerance ranges must be verified for each new batch of gel standards against its Certificate of Analysis and documented in a logbook prior to use in field activities.

3.3 Field Measurement Procedures for Screening Purposes

Total or free residual chlorine measurements must be conducted within 15 minutes of sample collection. When using the DPD colorimetric method for total residual chlorine, gel standards will be used for meter verification. The gel standards must be verified by the field inspector against its Certificate of Analysis to ensure accuracy prior to use and must be documented in the field logbook.

Once the meter has been verified for field screening purposes, the following steps should be followed using a 2.5 cm sample cell for total residual chlorine concentrations ranging from 0 – 1.66 mg/L.

1. Fill a clean sample cell to the 10-mL mark with a sample blank. Cap the sample cell.

2. Press the **Power** key to turn the meter on.

3. Remove the meter's cover. Wipe off any excess liquid and fingerprints from the sample cell. Place the blank in the cell holder with the diamond mark facing the keypad. Fit the meter cover over the cell compartment to completely cover the cell.

4. Press the **ZERO** button**.** The display will show "- - - -" then go to "0.00". Record the blank's value in the logbook. Remove the blank from the cell holder.

5. Fill a second 10-mL cell to the 10-mL line with the sample.

6. Open a DPD total chlorine powder packet and add the contents to the sample cell.

7. Replace the cap on the sample cell and swirl or mix for approximately 20 seconds. **Note**: Wipe off any excess liquid and fingerprints from the sample cell.

8. Wait three to six minutes after adding the DPD.

9. Press **READ/ENTER**. The instrument will show "- - - -" followed by the actual results in mg/L chlorine. Record the sample's value in the logbook.

Also for screening purposes, all of the above steps should be followed using a 1.0 cm sample cell for total residual chlorine concentrations above 1.66 mg/L.

3.4 Units

Measurements for total residual chlorine are reported in mg/L.

3.5 Limitations

Do not use with or in the presence of any oxidizing agents including bromine, iodine, permanganate, hydrogen peroxide, and ozone. Sample color and turbidity may also interfere.