**YOUR PWS NAME HERE Free and Total Chlorine Standard Operating Procedure**

**by SM 4500-CL G**

**Revision 2, DATE 08/27/2012**

1. Scope and Application
   1. This is a Residual Colorimetric DPD Method that uses a colorimeter for the determination of residual Chlorine concentration in water.
2. Summary of Method
   1. In this method the DPD Indicator reacts with available chlorine. One of the most widely used testing methods for free and total chlorine makes use of something known as ‘DPD’ which stands for N,N Diethyl-1,4 Phenylenediamine. The addition of DPD to water samples containing oxidizers such as chlorine, results in the formation of a reddish tint to the water whose intensity is directly proportional to the chlorine concentration in the water sample.
3. Sample Handling and Preservation
   1. Analyze immediately (within 15 minutes of collection). Avoid excessive light and agitation, chlorine easily disassociates from H2O.
   2. If air bubbles are present, allow them to dissipate, yet ensure the sample is analyzed within 15 minutes.
4. Interferences
   1. Color, turbidity, manganese, copper, permanganate and ozone interfere with chlorine measurements.
   2. The instrument will be zeroed out with a sample (minus DPD reagent) in order to account for these interferences.
5. Equipment and supplies
   1. **BRAND AND MODEL # OF UNIT**
   2. DPD reagents:
      1. Upon receipt write Date Received, Date Opened and Expiration Date in Sharpie on the bag.
      2. Products:
         1. **BRAND OF** DPD Total Chlorine Reagent – Part # **ENTER #**
         2. **BRAND OF** DPD Free Chlorine Reagent- Part # **ENTER #**
   3. **BRAND OF** Secondary Gel Standards
      1. Upon receipt write Expiration Date in Sharpie on box.
      2. Upon receipt of **BRAND OF** Secondary Gel Standards, review the enclosed Certificate of Analysis (COA). Ensure the Lot # on the certificate matches the box of Secondary Gel Standards you are using.
      3. Verify the values on the Certificate of Analysis with each Colorimeter and record the Known Concentrations in a location that is stored with your **BRAND OF** Secondary Gel Standards. Refer to these Known Concentration values when performing a Routine Calibration Verification Standard (see Section 7).
      4. Do not expose these standards to excessive temperature extremes. Optimal storage conditions are 50° - 77° F.
6. Initial Demonstration of Capability (IDC)
   1. A procedure to confirm the operator can properly perform a particular method. To be subsequently performed with any significant changes within the Water System (new instrument, new operator, new standards, new or revised methods).
   2. IDC Procedure: (Low Range Standards)
      1. Fill out the top portion of the Excel Spreadsheet with all applicable information (Analyst Name, SOP No. & Revision No., Matrix, Instrument Name and Serial #, Date of Analysis, 2nd Source Standard, Lot# and Expiration Date)
      2. Ensure a supervisor or 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**.
      3. Record the Known Concentration of the Secondary Gel Standards from the Instrument Reading on the IDC spreadsheet in Cells B24, B25 and B26. (Refer to Step 5.3.c.)
      4. Wipe down the Secondary Gel Standards with Kimwipes® or a microfiber cloth, or use gloves to handle them at all times.
      5. Turn the unit ON and place the colorless blank into the cell holder according to the manufacturer’s instructions (May be different for the High Range Standards). Cover the cell with the instrument cap.
      6. Press Zero (**ZEROING** button). The instrument will show 0.00.
      7. Place the standard (STD 1, STD2 or STD3) into the cell holder. Cover the cell with the instrument cap.
      8. Press Read/Enter (**READING** button). Record the concentration in Cell D24 (Read 1) on the IDC spreadsheet.
      9. Repeat steps 5 through 8 until you have obtained four readings for STD 1, zeroing the instrument with the blank between each reading of STD 1. Record the concentrations in Cells E24, F24 and G24.
      10. Return to step 5 above, choose another standard and repeat steps 7-9 until four readings have been obtained for all three standards. Record the concentrations in cells D25 through G25 for STD 2 and D26 through G26 for STD3.
      11. Ensure the Relative Standard Deviations (%RSD) in Cells L24, L25 and L26 are ≤ 15%.
      12. 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%, contact your supervisor for further technical assistance.
      13. If %RSD is ≤ 15%, sign the IDC spreadsheet along with a witness and submit it to your supervisor.

**(You may replace the words “zeroing” and “reading” with colors or text that is appropriate to your unit. Then delete this text when completed.)**

1. Calibration and routine Calibration Verification Standards (CVS)
   1. Calibration: Use factory installed calibration.
   2. Routine Calibration Verification Standards: Analyze a CVS prior to collecting chlorine residual measurement(s).
      1. Utilize the **BRAND OF** Secondary Gel Standards for this procedure. Rule of thumb is to utilize the standard that is ½ of the expected residual concentration.
      2. To limit the exposure of the **BRAND OF** Secondary Gel Standards to excessive temperature extremes the Routine CVS measurements will be collected at a **TREATMENT PLANT/OFFICE**. Routine chlorine residual samples can then be collected within approximately 1-2 hours.
      3. If numerous samples are to be collected throughout an entire day, a Routine CVS should be analyzed in the morning **and then again in the afternoon after all samples have been obtained**.
      4. If the Routine CVS does not meet the acceptance criteria of ≤15%, reanalyze the CVS. If it fails a second time, send the unit back to the manufacturer for repair and recalibration.
2. Analytical Procedure
   1. Low Range Free and Total Chlorine (Glass vials) **(Less than 2.20 mg/L)**
      1. Analyze a CVS.
      2. Add 10ml of sample to a clean glass (fingerprint free) vial.
      3. Zero the instrument with the sample, no reagent, by pressing the zeroing button.
      4. Add 1 free or total reagent powder pillow.
      5. Mix gently for 20 seconds.
      6. Free Chlorine is read within 1 minute. Total Chlorine is read between 3 and 6 minutes. Obtain sample reading by pressing the reading button.
   2. High Range Free and Total Chlorine (Plastic vials) **(Greater than 2.20 mg/L)**
      1. Analyze a CVS.
      2. Add 10ml of sample to a clean plastic (fingerprint free) vial.
      3. Zero the instrument with the sample, no reagent, by pressing the zeroing button.
      4. Add two free or total reagent powder pillows.
      5. Mix gently for 20 seconds.
      6. Free chlorine is read within 1 minute. Total Chlorine is read between 3 and 6 minutes. Obtain sample reading by pressing reading button.

**(You may replace the words “zeroing” and “reading” with colors or text that is appropriate to your unit. Then delete this text when completed.)**

1. Recordkeeping and Reporting of Results
   1. **DETAIL YOUR FACILITES’ PROCEDURE FOR RECORDKEEPING OF RESULTS**.
   2. **DETAIL YOUR FACILITES’ PROCEDURE FOR REPORTING RESULTS**.
2. Safety
   1. DPD is Toxic and flammable. Open pillows with scissors and handle with nitrile gloves or blunt tipped forceps.
3. References
   1. **INSTRUMENT NAME & MODEL #** Instruction Manual.
   2. Standard Methods (SM) 4500-Cl G 21st Edition: 2005.
4. Certification Statement
   1. Each **OPERATOR** should read and sign a copy of this Standard Operating Procedure *(*NAC 445A.54278*).*
   2. *I have read and understood the Standard Operating Procedure and will follow it as written. Furthermore, I attest to the validity and authenticity of the sample(s) I collect. I am aware that tampering with or intentionally mislabeling the sample(s) location, date or time of collection may be considered fraud and subject to legal action.*

Signature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_