

DPD Method¹ Method 10231 (Free Chlorine) and Method 10232 (Total Chlorine)

0.05 to 2.00 mg/L Cl₂

TNTplus™ 866/867

Scope and application: For drinking water, wastewater and pool water. This product has not been evaluated to test for chlorine and chloramines in medical applications in the United States.

¹ Adapted from Standard Methods for the Examination of Water and Wastewater.



Test preparation

Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows the adapter and light shield requirements for the applicable instruments that can use TNTplus vials.

To use the table, select an instrument, then read across to find the applicable information for this test.

Table 1 Instrument-specific information for TNTplus vials

Instrument	Adapters	Light shield
DR 6000, DR 5000	—	—
DR 3900	—	LZV849
DR 3800, DR 2800	—	LZV646
DR 1900	9609900 or 9609800 (A)	—

Before starting

DR 3900, DR 3800, DR 2800: Install the light shield in Cell Compartment #2 before this test is started.

Review the safety information and the expiration date on the package.

Analyze the samples immediately. The samples cannot be preserved for later analysis.

The recommended sample pH is 3–10.

The recommended temperature for samples and reagents is 15–25 °C (59–77 °F).

The recommended temperature for reagent storage is 2–8 °C (35–46 °F).

To sequentially measure free and total chlorine, complete the free chlorine procedure, then start the total chlorine procedure at step 2.

DR 1900: Go to All Programs>LCK or TNTplus Methods>Options to select the TNTplus number for the test. Other instruments automatically select the method from the barcode on the vial.

Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.

Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

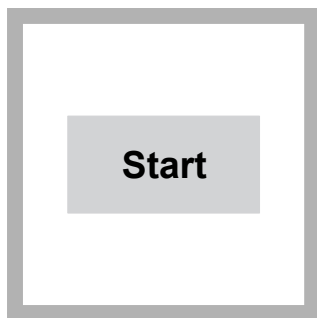
Items to collect

Description	Quantity
Chlorine Free (TNT866) or Total (TNT867) Reagent Set	1
Beaker, 50 mL	1

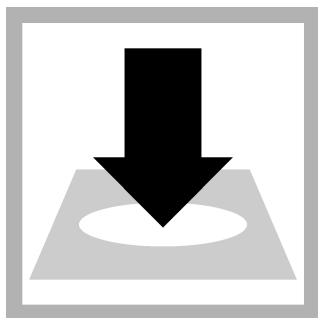
Sample collection

- Analyze the samples immediately. The samples cannot be preserved for later analysis.
- Chlorine is a strong oxidizing agent and is unstable in natural waters. Chlorine reacts quickly with various inorganic compounds and more slowly with organic compounds. Many factors, including reactant concentrations, sunlight, pH, temperature and salinity influence the decomposition of chlorine in water.
- Collect samples in clean glass bottles. Do not use plastic containers because these can have a large chlorine demand.
- Pretreat glass sample containers to remove chlorine demand. Soak the containers in a weak bleach solution (1 mL commercial bleach to 1 liter of deionized water) for at least 1 hour. Rinse fully with deionized or distilled water. If sample containers are rinsed fully with deionized or distilled water after use, only occasional pretreatment is necessary.
- Make sure to get a representative sample. If the sample is taken from a spigot or faucet, let the water flow for at least 5 minutes. Let the container overflow with the sample several times and then put the cap on the sample container so that there is no headspace (air) above the sample.

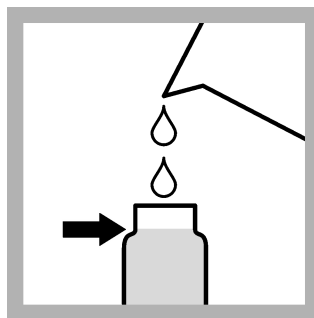
Test procedure—free chlorine



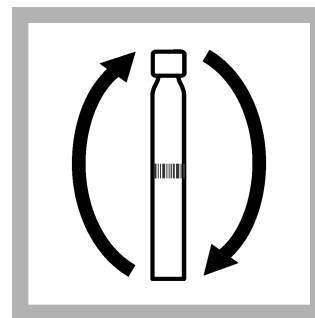
1. DR 1900 only: Select program 866. Refer to [Before starting](#) on page 1.



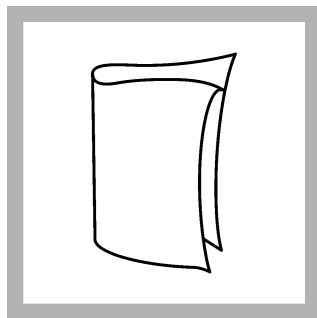
2. Insert the Zero vial into the cell holder. DR 1900 only: Push **ZERO**. The instrument zero is set.



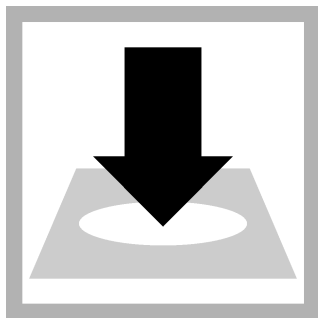
3. Complete this procedure within 1 minute: Fill the sample vial with sample to the throat of the vial.



4. Tighten the cap on the vial and invert the vial 2–3 times. Carefully rotate the vial to remove air bubbles. Do not shake.

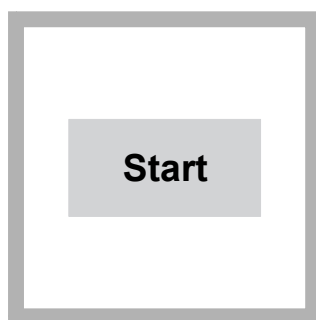


5. Clean the vial.

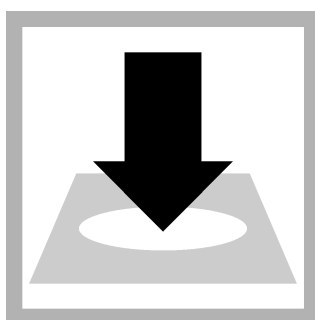


6. Insert the vial into the cell holder. DR 1900 only: Push **READ**. Results show in mg/L Cl₂.

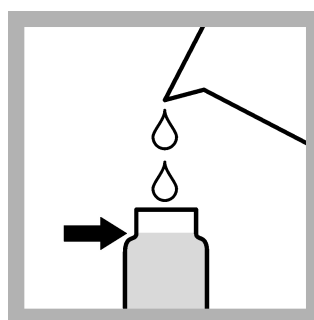
Test procedure—total chlorine



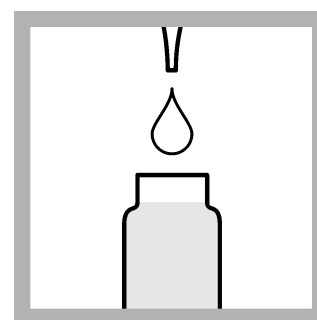
1. DR 1900 only: Select program 867. Refer to [Before starting](#) on page 1.



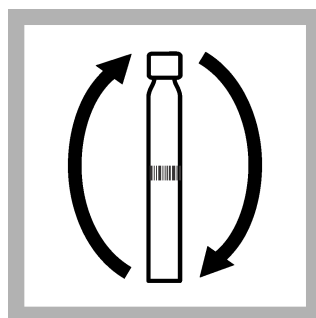
2. Insert the Zero vial into the cell holder. DR 1900 only: Push **ZERO**. The instrument zero is set.



3. Fill the sample vial with sample to the throat of the vial.



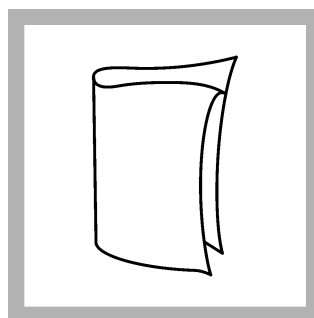
4. Immediately add 1 drop of potassium iodide Solution A.



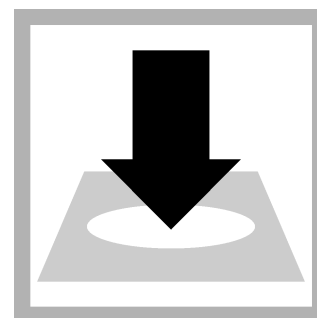
5. Tighten the cap on the vial and invert the vial 2–3 times. Carefully rotate the vial to remove air bubbles. Do not shake.



6. Start the reaction time of 3 minutes.



7. When the timer expires, clean the vial.



8. Insert the vial into the cell holder. DR 1900 only: Push **READ**. Results show in mg/L Cl₂.

Interferences

Interfering substance	Interference level
Color	Can cause high results. To make a correction for the interference, measure a sample blank.
Oxidizing agents	All oxidizing agents (e.g., ozone, iodine, chlorine dioxide, manganese dioxide and chromate) react with the indicator and are included in the results. If a large number of oxidizing agents shows, some or all of the indicator changes to a colorless form. The test result will be negative or within the range of the test.
pH	The sample pH should be between pH 3 and pH 10.
Turbidity	Can cause high results. To make a correction for the interference, measure a sample blank.

Sample blanks

If the sample has color or turbidity, measure a sample blank to correct the test result for the interference.

Items to collect:

- TNTplus 919 sample blank vial
1. Do the test procedure.
 2. Put the sample in the sample blank vial. Fill to the neck of the sample blank vial.
 3. Wipe the sample blank vial clean, then put it into the cell holder. If applicable, the instrument reads the barcode of the sample blank vial and subtracts the value from the initial test result.

Accuracy check

Standard solution method

Use the standard solution method to validate the test procedure, the reagents and the instrument.

Items to collect:

- 50–75 mg/L Chlorine Standard Solution (use mg/L on label)
 - 100-mL volumetric flask, Class A
 - Ampule breaker
 - Pipet, adjustable volume, 1.0–5.0 mL and pipet tip
 - Deionized water
1. Prepare a 1.3-mg/L (approximate) chlorine standard solution as follows:
 - a. Use a pipet to add 2.0 mL of the chlorine standard solution into the volumetric flask. First add approximately 50 mL of deionized water to the flask. Multiply the concentration that is shown on the chlorine standard solution label by 0.02 to find the concentration of the prepared standard solution.
 - b. Dilute to the mark with deionized water. Mix well. Prepare this solution daily.
 2. Use the test procedure to measure the concentration of the prepared standard solution.
 3. Compare the expected result to the actual result.

Note: The factory calibration can be adjusted slightly with the standard adjust option so that the instrument shows the expected value of the standard solution. The adjusted calibration is then used for all test results. This adjustment can increase the test accuracy when there are small variations in the reagents or instruments.

Summary of Method

Chlorine can show in water as free chlorine and as combined chlorine. Both forms can exist in the same water and can be determined together as total chlorine. Free chlorine shows as hypochlorous acid and/or hypochlorite ion. Combined chlorine exists as monochloramine, dichloramine, nitrogen trichloride and other chloro derivatives. The combined chlorine oxidizes iodide in the reagent to iodine. The iodine and free chlorine react with DPD (N,N-diethyl-p-phenylenediamine) to form a pink color that is proportional to the chlorine concentration. The measurement wavelength is 515 nm.

Consumables and replacement items

Required reagents

Description	Quantity/Test	Unit	Item no.
Free Chlorine TNT 866 Reagent Set	1	24/pkg	TNT866
Free and Total Chlorine TNT 867 Reagent Set	1	24/pkg	TNT867

Required apparatus

Description	Quantity/test	Unit	Item no.
Beaker, 50 mL	1	each	50041H
Light shield, DR 3800, DR 2800, DR 2700	1	each	LZV646
Light shield, DR 3900	1	each	LZV849

Recommended standards

Description	Unit	Item no.
Chlorine Standard Solution, 2-mL PourRite® Ampules, 50–75 mg/L	20/pkg	1426820
Chlorine Standard Solution, 10-mL Voluette® Ampule, 50–75 mg/L	16/pkg	1426810
Chlorine Standard Solution, 2-mL PourRite® Ampule, 25-30 mg/L	20/pkg	2630020

Optional reagents and apparatus

Description	Unit	Item no.
Ampule Breaker, 2-mL PourRite® Ampules	each	2484600
Ampule Breaker, 10-mL Voluette® Ampules	each	2196800
Flask, volumetric, Class A, 100 mL, glass	each	1457442
Pipet, adjustable volume, 1.0–5.0 mL	each	BBP065
Pipet tips, for 1.0–5.0 mL pipet	75/pkg	BBP068
Sample blank vials for TNTplus™ methods	5/pkg	TNT919
Sampling bottle with cap, low density polyethylene, 500-mL	12/pkg	2087079
Water, deionized	4 L	27256



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