

Indophenol Method¹

Method 10171
0.04 to 4.50 mg/L Cl₂ (LR)
Powder Pillows

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

¹ U.S. Patent 6,315,950





Test preparation

Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows requirements that can change between instruments, such as adapter and sample cell requirements.

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

Table 1 Instrument-specific information

Instrument	Adapter	Sample cell orientation	Sample cell
DR6000	—	The orientation key is toward the arrow on the universal cell adapter.	4864302 
DR5000	A23618	The orientation key is toward the user.	
DR3900	LZV846 (A)	The orientation key is away from the user.	
DR1900	9609900 or 9609800 (C)	The orientation key is toward the arrow on the adapter.	
DR/850, DR/890	—	The orientation key is at the 2 o'clock position.	
DR900	—	The orientation key is toward the user.	
DR3800 DR2800 DR2700	LZV585 (B)	The 1-cm path is aligned with the arrow on the adapter.	5940506 

Before starting

Samples must be analyzed immediately after collection and cannot be preserved for later analysis.

Install the instrument cap on the DR900 and DR800 series cell holder before ZERO or READ is pushed.

In bright light conditions (e.g., direct sunlight), close the cell compartment, if applicable, with the protective cover during measurements.

To measure chloramine (mono) and free ammonia on the same sample, use Method 10200 Nitrogen, Free Ammonia and Chloramine (Mono).

For the best results, measure the reagent blank value for each new lot of reagent. Replace the sample with deionized water in the test procedure to determine the reagent blank value. Subtract the reagent blank value from the sample results automatically with the reagent blank adjust option.

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
Monochlor F reagent pillows	1
Sample cells (For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.)	2

Refer to [Consumables and replacement items](#) on page 6 for order information.

Sample collection and storage

- Analyze samples immediately after collection.
- Collect samples in clean glass bottles.
- Open the sample valve or spigot and let the water flow for a minimum of 5 minutes.
- Rinse the sample bottle several times with the sample and let the sample overflow each time, then cap the container so that there is no head space (air) above the sample.

Color development time

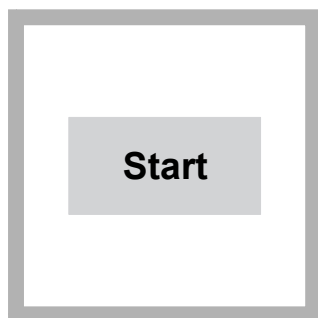
Test results are strongly influenced by the sample temperature. The reaction times in the procedure are for samples at 18–20 °C (64–68 °F). Adjust the reaction times for the sample temperature as shown in [Table 2](#). The color is stable for a maximum of 15 minutes after the specified development time.

If the sample temperature is less than 10 °C (50 °F), especially if the sample is measured outdoors in cold weather, measure the prepared sample again 5 to 10 minutes after the development time given in [Table 2](#). Measure the prepared sample again to make sure that the reaction has completed. The colorimetric reaction has completed if the results do not increase by more than 10% within 10 minutes of the development time.

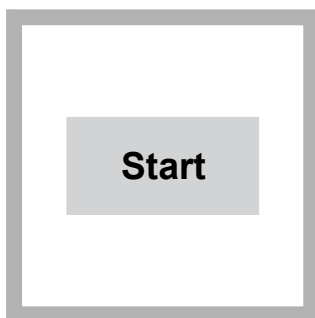
Table 2 Color development time

Sample temperature (°C)	Sample temperature (°F)	Development time (minutes)
5	41	10
7	45	9
9	47	8
10	50	8
12	54	7
14	57	7
16	61	6
18	64	5
20	68	5
23	73	2.5
25	77	2
> 25	> 77	2

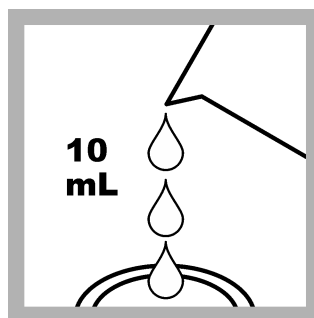
Indophenol method, powder pillows



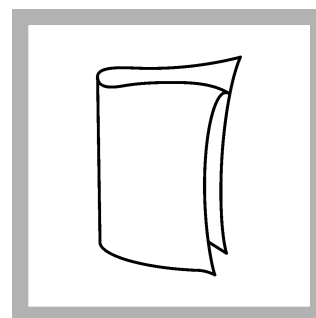
1. For the DR800 series, enter and start program **132**.



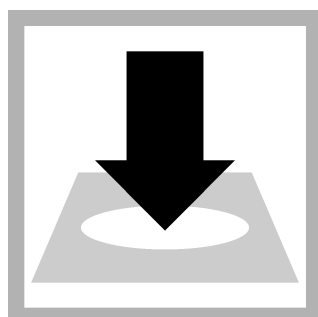
2. For other instruments, start program **66**, **Monochloramine LR**. For information about sample cells, adapters or light shields, refer to [Instrument-specific information](#) on page 1.



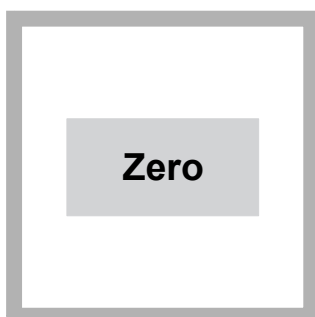
3. Fill the sample cell with 10 mL of sample.



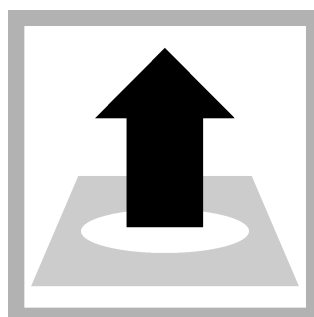
4. Clean the prepared sample cell.



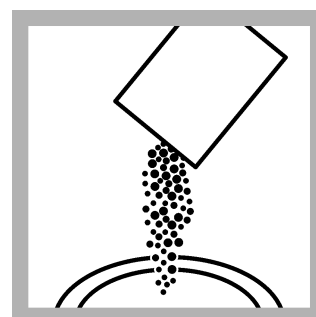
5. Insert the blank into the cell holder.



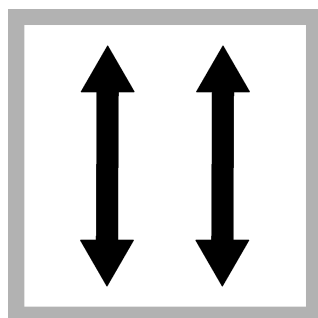
6. Push **ZERO**. The display shows 0.00 mg/L Cl₂.



7. Remove the sample cell from the cell holder.



8. Add the contents of one Monochlor F powder pillow to the sample cell.

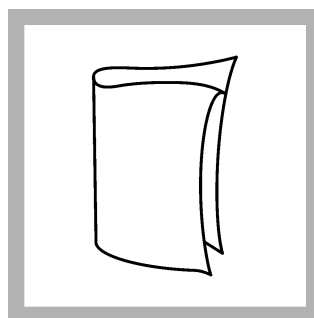


9. Put the stopper on the sample cell. Shake the sample cell for about **20 seconds** to dissolve the reagent.

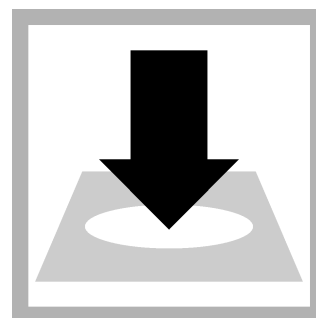


10. Start the instrument timer. A 5-minute reaction time starts.

For samples colder than 18 °C, refer to [Table 2](#) on page 2.



11. Clean the prepared sample cell.



12. When the timer expires, insert the prepared sample into the cell holder.

Read

13. Push **READ**. Results show in mg/L Cl₂.

Interferences

Table 3 shows the substances that have been tested for interference and do not interfere at or below the indicated levels. Table 4 suggests treatments for interferences.

Table 3 Non-interfering substances

Interfering substance	Interference level
Alanine	1 mg/L N
Aluminum	10 mg/L Al
Bromide	100 mg/L Br ⁻
Bromine	15 mg/L Br ₂
Calcium	1000 mg/L as CaCO ₃
Chloride	18,000 mg/L Cl ⁻
Chlorine Dioxide	5 mg/L ClO ₂
Chromium (III)	5 mg/L Cr ³⁺
Copper	10 mg/L Cu
Cyanide	10 mg/L CN ⁻
Dichloramine	10 mg/L as Cl ₂
Fluoride	5 mg/L F ⁻
Free Chlorine	10 mg/L Cl ₂
Glycine	1 mg/L N
Iron (II)	10 mg/L Fe ²⁺
Iron (III)	10 mg/L Fe ³⁺
Lead	10 mg/L Pb
Nitrate	100 mg/L N
Nitrite	50 mg/L N
Phosphate	100 mg/L PO ₄
Silica	100 mg/L SiO ₂
Sulfate	2600 mg/L SO ₄ ²⁺
Sulfite	50 mg/L SO ₃ ²⁻
Tyrosine	1 mg/L N
Urea	10 mg/L N
Zinc	5 mg/L Zn

Table 4 Interfering substances

Substance	Effect	Interference level	Recommended treatment
Magnesium	+	Above 400 mg/L CaCO ₃	Add 5 drops of Rochelle Salt Solution prior to testing. OR: use the high range (HR) test.
Manganese (+7)	-	Above 3 mg/L	Use the HR test; it will tolerate up to 10 mg/L.
Ozone	-	Above 1 mg/L	Usually does not coexist with monochloramine.
Sulfide	+	A "rust" color develops if present.	Usually does not coexist with monochloramine.
Thiocyanate	-	Above 0.5 mg/L	This method will tolerate up to 2 mg/L.

Accuracy check

Standard solution method

Items to collect:

- Buffer Powder Pillow, pH 8.3
- Nitrogen, Ammonia Standard Solution, 100 mg/L as NH₃-N
- Chlorine Solution Ampules, 50–70 mg/L
- 100-mL Class A volumetric flask
- 50-mL graduated cylinder
- Pipet, TenSette®, 0.1–1.0 mL and tips
- Pipets, Volumetric, 2 mL Class A and Mohr, 5 mL
- Pipet bulb
- Organic-free water

1. Prepare a 4.5-mg/L (as Cl₂) monochloramine standard immediately before use as follows.
 - a. Add the contents of one Buffer Powder Pillow, pH 8.3 to approximately 50 mL of organic-free water in a clean 100-mL Class A volumetric flask. Swirl to dissolve the powder.
 - b. Use a Class A volumetric pipet to add 2.00 mL of Nitrogen, Ammonia Standard Solution, 100 mg/L as NH₃-N into the flask.
 - c. Dilute to the mark with organic-free water. Mix well. This is a 2.00-mg/L buffered ammonia standard.
 - d. Use a graduated cylinder to add 50.00 mL of the buffered ammonia standard into a clean 100-mL beaker. Add a stir bar.
 - e. Find the exact concentration of the Chlorine Solution Ampules, 50–70 mg/L from the label on the package.
 - f. Calculate the volume of the Chlorine Solution to add to the ammonia standard: mL chlorine solution required = 455/(free chlorine concentration).
 - g. Open an ampule and use a glass Mohr pipet to add the calculated amount of Chlorine Solution slowly to the ammonia standard in the beaker. Keep the beaker on a stir-plate at medium speed during the chlorine addition.
 - h. Stir the monochloramine solution for 1 minute after the Chlorine Solution addition is complete.
 - i. Quantitatively transfer the monochloramine solution to a clean 100-mL Class A volumetric flask. Dilute to the mark with organic-free water and mix well. This is a nominal 4.5-mg/L (as Cl₂) monochloramine standard.
2. Use this standard within 1 hour of preparation. Use the test procedure to measure the concentration of the monochloramine standard solution.
3. Compare the expected result to the actual result.

Note: The factory calibration can be adjusted slightly with the standard calibration 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.

Method performance

The method performance data that follows was derived from laboratory tests that were measured on a spectrophotometer during ideal test conditions. Users can get different results under different test conditions.

Program	Standard	Precision (95% confidence interval)	Sensitivity Concentration change per 0.010 Abs change
66	2.60 mg/L Cl ₂	2.58–2.62 mg/L Cl ₂	0.04 mg/L Cl ₂

Summary of method

In the presence of a cyanoferrate catalyst, monochloramine (NH₂Cl) in the sample reacts with a substituted phenol to form an intermediate monoimine compound. The intermediate couples with excess substituted phenol to form a green-colored indophenol, which is proportional to the amount of monochloramine present in the sample. The measurement wavelength is 655 nm for spectrophotometers or 610 nm for colorimeters.

Consumables and replacement items

Required reagents

Description	Quantity/Test	Unit	Item no.
Monochlor F Reagent Pillow	1	50/pkg	2802246

Recommended standards

Description	Unit	Item no.
Buffer Powder Pillows, pH 8.3	25/pkg	89868
Chlorine Standard Solution, 10-mL Voluette [®] Ampule, 50–75 mg/L	16/pkg	1426810
Chlorine Standard Solution, 2-mL PourRite [®] Ampules, 50–75 mg/L	20/pkg	1426820
Chlorine Standard Solution, 2-mL PourRite [®] Ampules, 25–30 mg/L	20/pkg	2630020
Nitrogen Ammonia Standard Solution, 100-mg/L as NH ₃ -N	500 mL	2406549
Nitrogen, Ammonia Standard Solution, 1000-mg/L NH ₃ -N	1 L	2354153
Water, organic-free	500 mL	2641549

Optional reagents and apparatus

Description	Unit	Item no.
Ampule Breaker, 2-mL PourRite [®] Ampules	each	2484600
Ampule Breaker, 10-mL Voluette [®] Ampules	each	2196800
Beaker, glass, 100 mL	each	50042H
Flask, volumetric, Class A, 100 mL, glass	each	1457442
Monochlor F Reagent Powder Pillows	100/pkg	2802299
Monochloramine/Free Ammonia SpecCheck [™] Kit	each	2507500
Paper, pH, 0–14 pH range	100/pkg	2601300
Pipet, Mohr, glass, 5 mL	each	2093437
Pipet filler, safety bulb	each	1465100
Pipet, TenSette [®] , 0.1–1.0 mL	each	1970001
Pipet tips for TenSette [®] Pipet, 0.1–1.0 mL	50/pkg	2185696
Pipet tips for TenSette [®] Pipet, 0.1–1.0 mL	1000/pkg	2185628

Optional reagents and apparatus (continued)

Description	Unit	Item no.
Pipet, volumetric, Class A, 2 mL	each	1451536
Pipet, volumetric, Class A, 50 mL	each	1451541
Rochelle Salt Solution	29 mL	172533
Shears	each	2369400
Stir bar, octagonal	each	2095352
Stirrer, magnetic	each	2881200
Thermometer, non-mercury, -10 to +225 °C	each	2635700



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