Chlorine Dioxide

★Method 10126 — DPD Method[1]

Powder Pillows and AccuVac® Ampuls — (0.04 to 5.00 mg/L)

Scope and Application: For water and wastewater. USEPA accepted for reporting for drinking water analysis.[2]

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

[2] Procedure is equivalent to *Standard Methods, 18 ed., 4500 ClO_2 D.*

Test Preparation

Before starting the test:

Analyze samples immediately because chlorine dioxide is unstable and volatile. See Sample Collection, Storage, and Preservation on page 5.
For more accurate results, determine a reagent blank value for each new lot of reagent. Follow the procedure using chlorine-free deionized water instead of the sample. Subtract the reagent blank value from the final results or perform a reagent blank adjust.
After adding the DPD Free Chlorine Powder Pillow to the sample, a pink color will develop if chlorine dioxide is present.
If the chlorine dioxide concentration in the sample exceeds the upper limit of the test, the color may fade or the sample may turn yellow. Dilute the sample with high quality water that is chlorine demand-free, and repeat the test. Some loss of chlorine dioxide may occur. Multiply the result by the appropriate dilution factor.

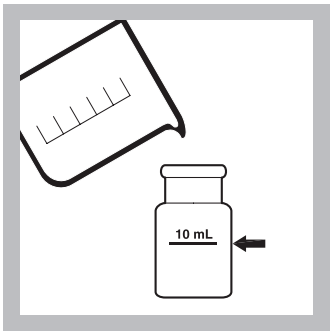
Collect the following items:	**Quantity**
Powder Pillow Test:	
DPD Free Chlorine powder pillow, 10-mL	1
Glycine Reagent	4 drops
Sample cells, 1-inch square, 10-mL	2
Stopper for 18 mm tube	2
AccuVac Test:	
DPD Free Chlorine Reagent AccuVac® Ampuls	1
Glycine Reagent	16 drops
Beaker, 50-mL	1
Sample Cell, 10-mL	1
Stopper for 18 mm tube	1

Note: *Reorder information for consumables and replacement items is on page 7.*

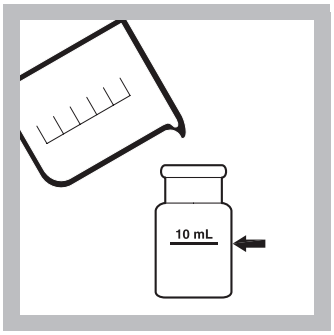
Powder Pillows — Method 10126

1. Press **STORED PROGRAMS**.

2. Select the test.

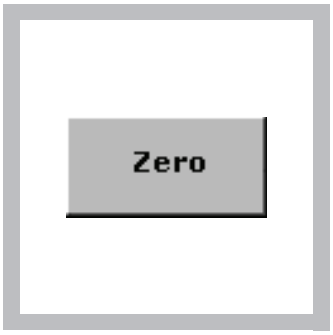


3. Blank Preparation: Fill a square sample cell with 10 mL of sample and stopper.



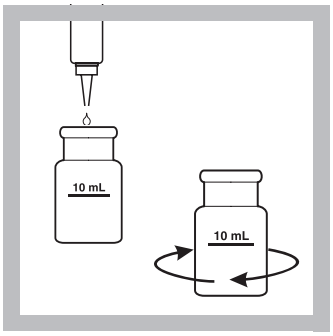
4. Prepared Sample: Fill a second square sample cell with 10 mL of sample and stopper.

5. Wipe the blank and insert it into the cell holder with the fill line facing right.

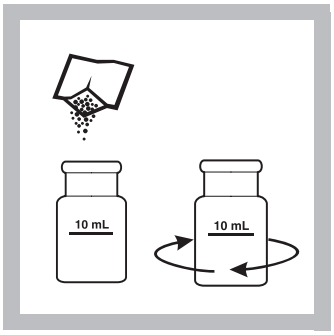


6. Press **ZERO**.

The display will show: 0.00 mg/L ClO_2



7. Add four drops of Glycine Reagent to the sample. Swirl to mix.



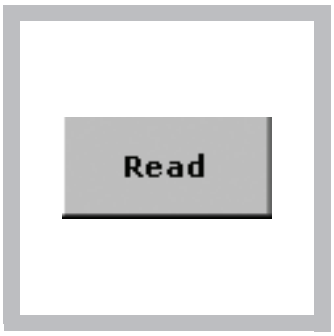
8. Add the contents of one DPD Free Chlorine Powder Pillow to the prepared sample cell.

Swirl the sample for 20 seconds to mix.

9. Wait 30 seconds for any undissolved powder to settle.

Immediately proceed to step 10.

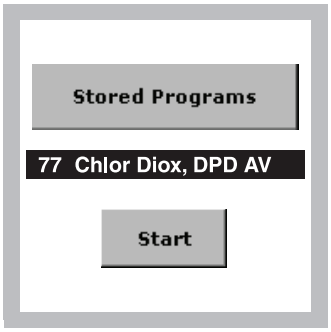
10. Within one minute of adding the DPD reagent, wipe the sample cell and insert it into the cell holder with the fill line facing right.



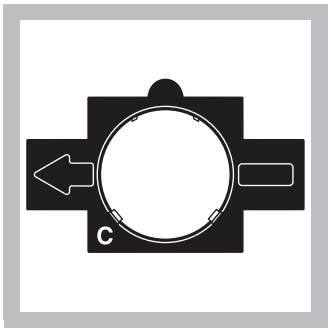
11. Press **READ**.

Results are in mg/L ClO_2.

AccuVac® Ampuls — Method 10126

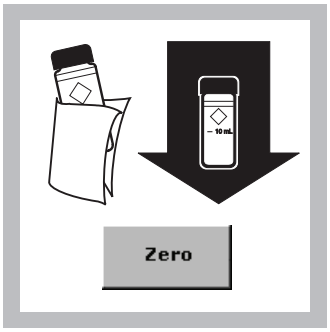


1. Select the test.



2. Insert the 1-inch round cell adapter (Adapter C).

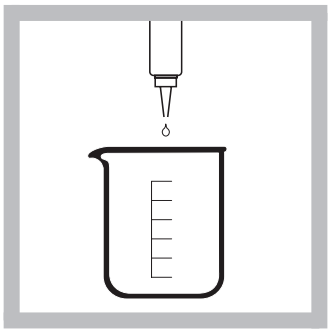
3. Blank Preparation: Fill a round sample cell with 10-mL of sample.



4. Wipe the blank and insert it into the cell holder.

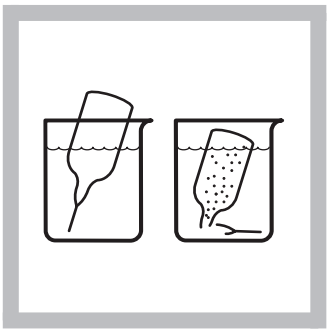
Press **ZERO**.

The display will show: 0.00 mg/L ClO_2

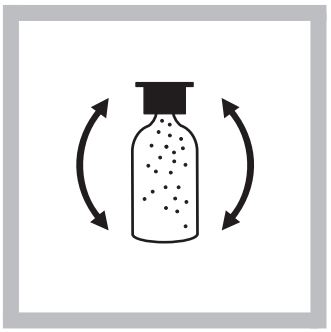


5. Prepared Sample: Fill a 50-mL beaker with 40 mL of sample.

Add 16 drops of Glycine Reagent to the sample in the beaker. Swirl gently to mix.



6. Fill a DPD Free Chlorine Reagent AccuVac Ampul with sample. Keep the tip immersed while the Ampul fills completely.



7. Quickly invert the Ampul several times to mix. Wait 30 seconds for any undissolved powder to settle.

8. Within one minute of adding the sample, wipe the Ampul and insert it into the cell holder.

Press **READ**. Results are in mg/L ClO_2.

Interferences

Table 1 Interfering Substances and Levels

Interfering Substance	Interference Levels and Treatments
Acidity	Greater than 150 mg/L $CaCO_3$. May not develop full color or color may fade instantly. Neutralize to pH 6–7 with 1 N Sodium Hydroxide[1]. Determine amount to be added on separate sample aliquot, then add the same amount to the sample being tested. Correct for volume addition.
Alkalinity	Greater than 250 mg/L $CaCO_3$. Color may not develop fully or may fade instantly. Neutralize to pH 6–7 with 1 N Sulfuric Acid[1]. Determine amount to be added on separate sample aliquot, then add the same amount to the sample being tested. Correct for the volume addition.
Bromine, Br_2	Interferes at all levels.
Chlorine, Cl_2	May interfere at levels greater than 6 mg/L. Additional glycine may be able to compensate for this interference.
Chloramines, organic	May interfere.
Flocculating agents	High levels of most flocculating agents can be tolerated. This tolerance is decreased if chlorine is present. See the information about metals in this table. In the presence of 0.6 mg/L Cl_2, $Al(SO_4)_3$ (< 500 mg/L) and $FeCl_2$ (<200 mg/L) may be tolerated.
Hardness	No effect at less than 1000 mg/L as $CaCO_3$.
Iodine, I_2	Interferes at all levels.
Manganese, oxidized (Mn^{4+}, Mn^{7+}) or Chromium, oxidized (Cr^{6+})	Oxidized manganese interferes at all levels. Oxidized chromium interferes at levels greater than 2 mg/L. To remove the interferences: **1.** Adjust sample pH to 6–7. **2.** Add 3 drops Potassium Iodide[1] (30 g/L) to a 25-mL sample. **3.** Mix and wait one minute. **4.** Add 3 drops Sodium Arsenite[1, 2] (5 g/L) and mix. **5.** Analyze 10 mL of the treated sample as described in the procedure. **6.** Subtract the result of this test from the original analysis to obtain the correct chlorine dioxide concentration.

Table 1 Interfering Substances and Levels (continued)

Interfering Substance	Interference Levels and Treatments
Metals	Various metals may interfere by combining with the glycine needed to remove the chlorine interference. Metal interference is limited except when chlorine is present. In the presence of 0.6 mg/L Cl_2, both copper (>10 mg/L) and nickel (>50 mg/L) interfere. Other metals may also interfere, depending on their ability to prevent glycine from reacting with any Cl_2 in the sample. It may be necessary to add more glycine to overcome this interference.
Monochloramine	Causes a gradual drift to higher readings. When read within 1 minute after reagent addition, 3 mg/L monochloramine causes less than a 0.1 mg/L ClO_2 increase in the reading.
Ozone	Interferes at levels greater than 1.5 mg/L.
Peroxides	May interfere.
Extreme sample pH	Adjust to pH 6–7.
Highly buffered samples	Adjust to pH 6–7.

[1] See Optional Reagents and Apparatus on page 7.
[2] Samples treated with sodium arsenite for interferences will be hazardous waste as regulated by Federal RCRA for arsenic (D004). Refer to a current MSDS for proper disposal instructions.

Sample Collection, Storage, and Preservation

Analyze samples for chlorine dioxide immediately after collection. Chlorine dioxide is a strong oxidizing agent and is unstable in natural waters. It reacts rapidly with various inorganic compounds, but oxidizes organic compounds more slowly. Many factors, including reactant concentrations, sunlight, pH, temperature, and salinity influence decomposition of chlorine dioxide in water.

Avoid plastic containers since these may have a large chlorine dioxide demand. Pretreat glass sample containers to remove any chlorine or chlorine dioxide demand by soaking in a dilute bleach solution (1 mL commercial bleach to l liter of deionized water) for at least one hour. Rinse thoroughly with deionized or distilled water. If sample containers are rinsed thoroughly with deionized or distilled water after use, only occasional pretreatment is necessary.

A common error in testing for chlorine dioxide is not obtaining a representative sample. If sampling from a tap, let the water flow for at least 5 minutes to ensure a representative sample. Let the container overflow with the sample several times, then cap the sample containers so there is no headspace (air) above the sample. If sampling with a sample cell, rinse the cell several times with the sample, then carefully fill to the 10-mL mark. Perform the chlorine dioxide analysis immediately.

Accuracy Check

Because chlorine dioxide is difficult and hazardous to produce, check the DPD and glycine reagents by using chlorine standards. Proceed as follows:

1. Prepare a 1-mg/L free chlorine standard using Method 1 or 2, below:

Method 1

a. Use Free Chlorine Standard*.

b. Determine the concentration of the standard from the certificate of analysis shipped with the standard (50–75 mg/L). Calculate the volume of standard needed as follows:

mL standard needed = 100 ÷ standard concentration

c. Pipet the volume of standard needed into a 100-mL volumetric flask. Dilute to the line with chlorine-demand-free deionized water. Invert to mix.

Method 2

a. Dilute 1 drop of 5% chlorine bleach in 1 liter of chlorine-demand-free deionized water. Use this as the standard.

b. Verify the standard's concentration using the Free Chlorine Method 8021.

c. Perform the chlorine dioxide test on the standard **without** adding glycine.

d. For program 76, the chlorine dioxide reading should be 2.35 times greater than the chlorine result. For program 77, the chlorine dioxide reading should be 2.34 times greater than the chlorine result. If so, this verifies the DPD and the instrument are functioning properly.

e. Repeat the chlorine dioxide test on the chlorine standard, including the glycine addition. The reading should be less than 0.10 mg/L. This verifies that the glycine is eliminating free chlorine interference.

Summary of Method

Chlorine dioxide reacts with DPD (N, N-diethyl-p-phenylenediamine) to the extent of one-fifth of its total available chlorine content corresponding to reduction of chlorine dioxide to chlorite to form a pink color. The color intensity is proportional to the ClO_2 in the sample. Chlorine interference is eliminated by adding glycine, which converts free chlorine to chloroaminoacetic acid, but has no effect on chlorine dioxide at the test pH. Test results are measured at 530 nm.

* See Optional Reagents and Apparatus on page 7.

Consumables and Replacement Items

Required Reagents

Description	Quantity/Test	Unit	Cat. No.
Chlorine Dioxide DPD/Glycine Reagent Set (100 tests), includes:			27709-00
(1) DPD Free Chlorine Reagent Powder Pillows, 10-mL	1	100/pkg	21055-69
(1) Glycine Reagent	4 drops	29 mL	27621-33
OR			
Chlorine Dioxide DPD/Glycine AccuVac® Ampul Reagent Set (25 tests), includes:			27710-00
(1) DPD Free Chlorine Reagent AccuVac® Ampuls	1	25/pkg	25020-25
(1) Glycine Reagent	16 drops	29 mL	27621-33

Required Apparatus (Powder Pillows)

Description	Quantity/Test	Unit	Cat. No.
Sample Cells, 1-inch square, 10 mL, matched pair	2	2/pkg	24954-02
Stopper for 18 mm tube	2	6/pkg	1731-06

Required Apparatus (AccuVac)

Description	Quantity/Test	Unit	Cat. No.
Adapter, 1-inch round, for AccuVac Ampuls	1	each	LZV584
Beaker, 50-mL	1	each	500-41H
Sample Cell, 10-mL, with cap	1	each	21228-00
Stopper	1	6/pkg	1731-06

Recommended Standards

Description	Unit	Cat. No.
Chlorine Standard Solution, 10-mL Voluette® Ampule, 50–75 mg/L	16/pkg	14268-10
Water, deionized	4 L	272-56

Optional Reagents and Apparatus

Description		Cat. No.
Potassium Iodide, 30 g/L, 100 mL	each	343-32
Sodium Arsenite, 5 g/L, 100 mL	each	1047-32
Sodium Hydroxide, 1 N, 100 mL	each	1045-32
Stopper	25/pkg	1731-25
Sulfuric Acid, 1 N, 100 mL	each	1270-32

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Updated September 2005 Edition 1

Chlorine Dioxide

Method 8065

Chlorophenol Red Method[1]
LR (0.01 to 1.00 mg/L)

Scope and Application: For water and wastewater

[1] Adapted from Harp, Klein, and Schoonover, *Jour. Amer. Water Works Assn.*, 73 387–388 (1981).

Test Preparation

Before starting the test:

Chlorine dioxide is unstable and volatile. Analyze samples immediately.
For most accurate results, analyze each portion of sample at the same temperature.
A TenSette® Pipet may be used to dispense Chlorine Dioxide Reagent 1 and Chlorine Dioxide Reagent 3

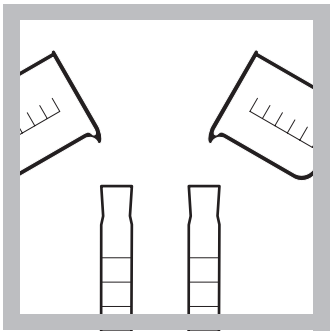
Collect the following items:	**Quantity**
Chlorine Dioxide Reagent 1	2 mL
Chlorine Dioxide Reagent 2	2 mL
Chlorine Dioxide Reagent 3	2 mL
Dechlorinating Reagent Pillows	1
Cylinder, graduated mixing, 50 mL	2
Pipet, volumetric, Class A, 1 mL	3
Pipet Filler, with safety bulb	1
Sample Cells, 1-inch square, 10-mL	2

Note: *Reorder information for consumables and replacement items is on page 4.*

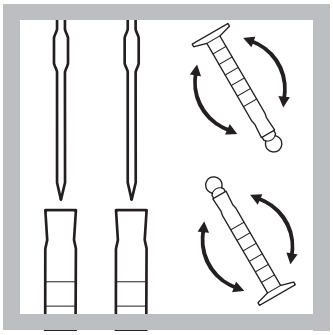
Powder Pillows — Method 8065

1. Press **Stored Programs**.

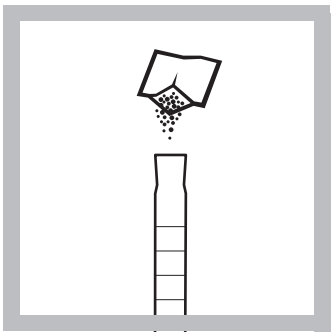
2. Select the test.



3. Fill two 50-mL mixing cylinders to the 50-mL mark with sample.



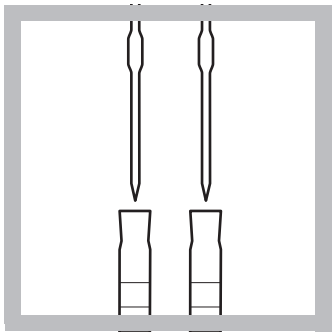
4. Use a volumetric pipet and pipet filler to add 1.0 mL of Chlorine Dioxide Reagent 1 to each cylinder. Stopper. Invert several times to mix.



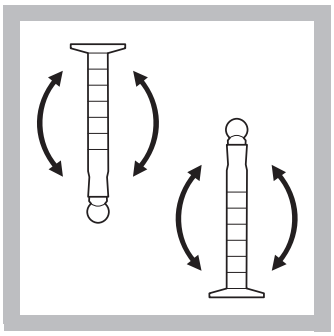
5. Blank Preparation: Add the contents of one Dechlorinating Reagent Powder Pillow to one cylinder. (This is the blank).

Stopper and invert several times until dissolved.

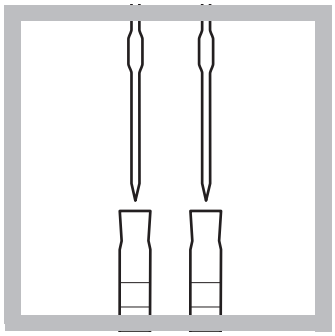
The second cylinder, which does **not** receive dechlorinating reagent, is the prepared sample.



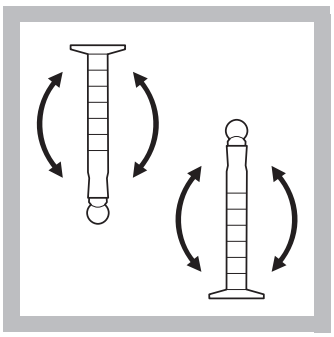
6. Use a volumetric pipet to add exactly 1.00 mL of Chlorine Dioxide Reagent 2 to each cylinder. Stopper.



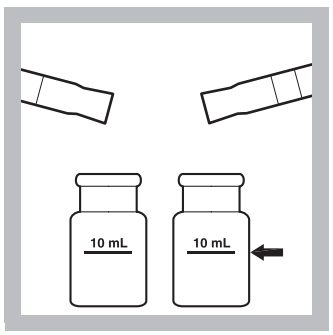
7. Invert several times to mix.



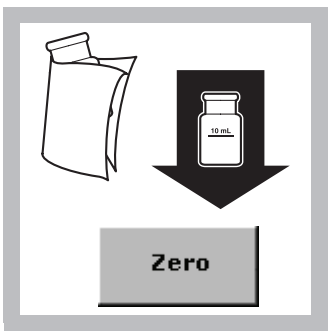
8. Use a volumetric pipet and pipet filler to add 1.0 mL of Chlorine Dioxide Reagent 3 to each cylinder. Stopper.



9. Invert several times to mix.



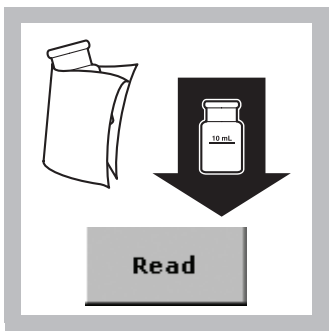
10. Pour 10 mL from each cylinder into square sample cells.



11. Wipe the blank and insert it into the cell holder with the fill line facing right.

Press **Zero**.

The display will show: 0.00 mg/L ClO_2



12. Wipe the prepared sample and insert it into the cell holder with the fill line facing right.

Press **READ**.

Results are in mg/L ClO_2.

Interferences

Table 1 Interfering Substances and Levels

Interfering Substance	Interference Levels and Treatments
Highly acidic or alkaline water	May require 2.0 mL each of Chlorine Dioxide Reagent 1 and Chlorine Dioxide Reagent 3 instead of 1.0 mL
ClO^-	Greater than 5.5 mg/L
ClO_2^-	Greater than 6 mg/L
ClO_3^-	Greater than 6 mg/L
CrO_4^{2-}	Greater than 3.6 mg/L
Fe^{3+}	Greater than 5 mg/L
Hardness	Greater than 1000 mg/L
Ozone	Greater than 0.5 mg/L
Turbidity	Greater than 1000 NTU

Sample Collection, Storage, and Preservation

Analyze samples for chlorine dioxide immediately after collection. Chlorine dioxide is a strong oxidizing agent and is unstable in natural waters. It reacts rapidly with various inorganic compounds, but oxidizes organic compounds more slowly. Many factors, including reactant concentrations, sunlight, pH, temperature, and salinity influence decomposition of chlorine dioxide in water.

Avoid plastic containers since these may have a large chlorine dioxide demand. Pretreat glass sample containers to remove any chlorine or chlorine dioxide demand by soaking in a dilute bleach solution (1 mL commercial bleach to 1 liter of deionized water) for at least one hour. Rinse thoroughly with deionized or distilled water. If sample containers are rinsed thoroughly with deionized or distilled water after use, only occasional pretreatment is necessary.

A common error in testing for chlorine dioxide is not obtaining a representative sample. If sampling from a tap, let the water flow for at least 5 minutes to ensure a representative sample. Let the container overflow with the sample several times, then cap the sample containers so there is no headspace (air) above the sample.

Accuracy Check

Standard Solution Method

Preparing chlorine dioxide standards is difficult and dangerous. In addition, these standards are both explosive and volatile! Only a trained chemist should prepare the standards using appropriate safety equipment and precautions. The Manufacturer does not recommend preparation of chlorine dioxide standards. If independent standard preparation is required, please see the instructions in *Standard Methods for the Examination of Water and Wastewater*, 20th ed., under the headings “Stock chlorine dioxide solution” and “Standard chlorine dioxide solution” (pp 4–74 and 4–75). Prepare a 0.50-mg/L chlorine dioxide standard.

Summary of Method

Chlorine Dioxide (ClO_2) is determined by its combination with chlorophenol red at pH 5.2 to form a colorless complex. The net effect is bleaching of the color in an amount proportional to the chlorine dioxide concentration. The method is specific for ClO_2 and is unreactive to other active chlorine or moderate oxidizing compounds. Test results are measured at 575 nm.

Consumables and Replacement Items

Required Reagents

Description	Quantity/Test	Unit	Cat. No.
Chlorine Dioxide Reagent Set (100 Tests), includes:	—	each	22423-00
(2) Chlorine Dioxide Reagent 1	2 mL	100 mL	20700-42
(2) Chlorine Dioxide Reagent 2	2 mL	100 mL	20701-42
(2) Chlorine Dioxide Reagent 3	2 mL	100 mL	20702-42
(1) Dechlorinating Reagent Powder Pillows	1	100/pkg	14363-69

Required Apparatus

Description	Quantity/Test	Unit	Cat. No.
Cylinder, graduated mixing, 50-mL	2	each	1896-41
Pipet, volumetric, Class A, 1.00-mL	3	each	14515-35
Pipet Filler, safety bulb	1	each	14651-00
Sample Cells, 1-inch square, 10 mL, matched pair	2	2/pkg	24954-02

Optional Reagents and Apparatus

Description	Unit	Cat. No.
Pipet, TenSette®, 0.1 to 1.0 mL	each	19700-01
Pipet Tips, for TenSette Pipet 19700-01	50/pkg	21856-96

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Updated June 05 Edition 1

Chlorine Dioxide

Method 8138

Direct Reading Method
HR (5 to 1000 mg/L)

Scope and Application: For water and wastewater

Test Preparation

Before starting the test:

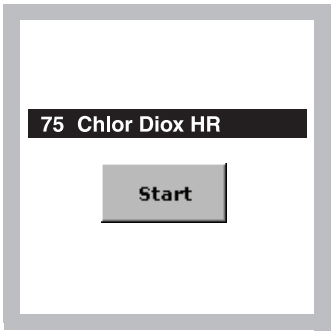
Chlorine dioxide is unstable and volatile. Analyze samples immediately.

Collect the following items:	**Quantity**
Water, deionized	10 mL
Sample cell, 1-inch square glass, 10-mL	2

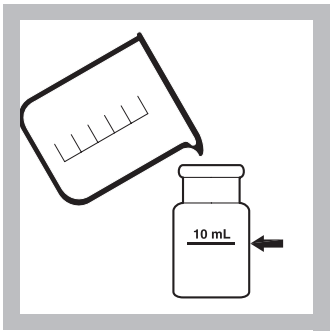
Note: *Reorder information for consumables and replacement items is on page 2.*

Direct Reading Method 8138

1. Press **STORED PROGRAM**.

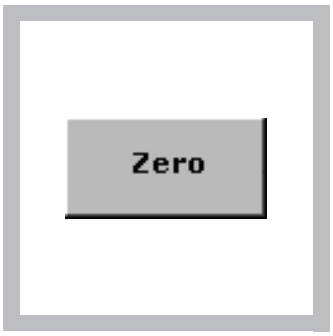


2. Select the test.



3. Blank Preparation: Fill a square sample cell to the 10-mL mark with deionized water.

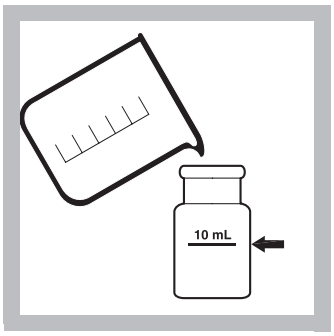
4. Wipe the blank and insert it into the cell holder with the fill line facing right.



5. Press **ZERO**.

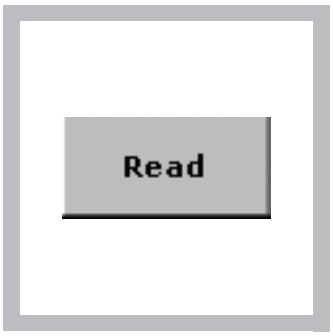
The display will show:

0 mg/L ClO_2



6. Prepared Sample: Fill a second square sample cell to the 10-mL mark with sample.

7. Wipe the prepared sample and insert it into the cell holder with the fill line facing right.



8. Press **READ**.

Results are in mg/L ClO_2.

Chlorine Dioxide

Method 8345

Direct Reading Method
MR (1-50 mg/L)

Scope and Application: For water and wastewater

Test Preparation

Before starting the test:

Chlorine dioxide is unstable and volatile. Analyze samples immediately.

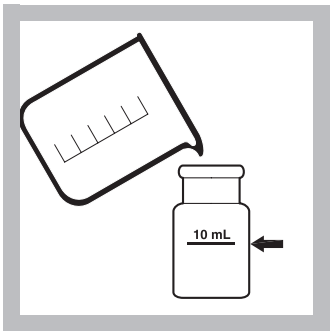
Collect the following items:	**Quantity**
Water, deionized	10 mL
Sample cell, 1-inch square glass, 10-mL	2

Note: *Reorder information for consumables and replacement items is on page 2.*

Direct Reading Method 8345

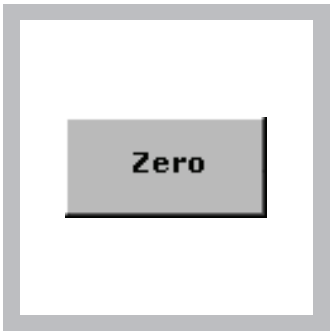
1. Press **STORED PROGRAMS**.

2. Select the test.



3. Blank Preparation: Fill a square sample cell to the 10-mL mark with deionized water.

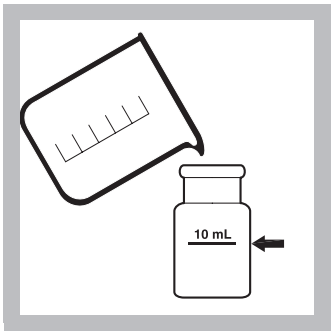
4. Wipe the blank and insert it into the cell holder with the fill line facing right.



5. Press **ZERO**.

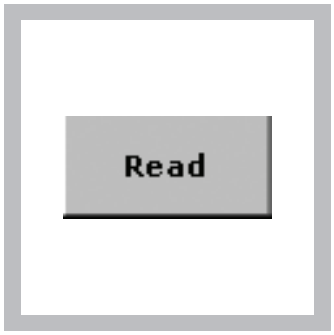
The display will show:

0.0 mg/L ClO_2



6. Prepared Sample: Fill a second square sample cell to the 10-mL mark with sample.

7. Wipe the prepared sample and insert it into the cell holder with the fill line facing right.



8. Press **READ**.

Results are in mg/L ClO_2.

Sample Collection, Storage, and Preservation

Collect samples in clean plastic or glass bottles. Samples must be analyzed immediately. Chlorine dioxide is very volatile and unstable.

Accuracy Check

Standard Solution Method

Preparing chlorine dioxide standards is difficult and dangerous. In addition, these standards are both explosive and volatile! Only a trained chemist should prepare the standards using appropriate safety equipment and precautions. The manufacturer does not recommend preparation of chlorine dioxide standards. If independent standard preparation is required, please see the instructions in *Standard Methods for the Examination of Water and Wastewater*, 20th ed., under the headings “Stock chlorine dioxide solution” and “Standard chlorine dioxide solution” (pp 4–74 and 4–75). Prepare a 25.0-mg/L chlorine dioxide standard.

Summary of Method

Chlorine dioxide, a yellow gas, can be measured directly in a water solution. Test results are measured at 360 nm.

Consumables and Replacement Items

Required Reagents

Description	Quantity/Test	Unit	Cat. No.
Water, deionized	10 mL	4 L	272-56

Required Apparatus

Description	Quantity/Test	Unit	Cat. No.
Sample Cells, 1-inch square, glass,10 mL, matched pair	2	2/pkg	24954-02

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Sample Collection, Storage, and Preservation

Analyze samples for chlorine dioxide immediately after collection. Chlorine dioxide is a strong oxidizing agent and is unstable in natural waters. It reacts rapidly with various inorganic compounds, but oxidizes organic compounds more slowly. Many factors, including reactant concentrations, sunlight, pH, temperature, and salinity influence decomposition of chlorine dioxide in water.

Avoid plastic containers since these may have a large chlorine dioxide demand. Pretreat glass sample containers to remove any chlorine or chlorine dioxide demand by soaking in a dilute bleach solution (1 mL commercial bleach to l liter of deionized water) for at least one hour. Rinse thoroughly with deionized or distilled water. If sample containers are rinsed thoroughly with deionized or distilled water after use, only occasional pretreatment is necessary.

A common error in testing for chlorine dioxide is not obtaining a representative sample. If sampling from a tap, let the water flow for at least 5 minutes to ensure a representative sample. Let the container overflow with the sample several times, then cap the sample containers so there is no headspace (air) above the sample. If sampling with a sample cell, rinse the cell several times with the sample, then carefully fill to the 10-mL mark. Perform the chlorine dioxide analysis immediately.

Accuracy Check

Standard Solution Method

Preparing chlorine dioxide standards is difficult and dangerous. In addition, these standards are both explosive and volatile! Only a trained chemist should prepare the standards using appropriate safety equipment and precautions. The manufacturer does not recommend preparation of chlorine dioxide standards. If independent standard preparation is required, please see the instructions in *Standard Methods for the Examination of Water and Wastewater*, 20th ed., under the headings “Stock chlorine dioxide solution” and “Standard chlorine dioxide solution” (pp 4–74 and 4–75). Prepare a 500-mg/L chlorine dioxide standard.

Summary of Method

Chlorine dioxide, a yellow gas, can be measured directly in a water solution. Test results are measured at 445 nm.

Consumables and Replacement Items

Required Reagents

Description	Quantity/Test	Unit	Cat. No.
Water, deionized	10 mL	4 L	272-56

Required Apparatus

Description	Quantity/Test	Unit	Cat. No.
Sample Cells, 1-inch square, glass,10 mL, matched pair	2	2/pkg	24954-02

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Chlorine Dioxide

Amaranth Method[1]

(20 to 500 µg/L)

Scope and Application: For water, drinking water

[1] This method is under license of Elf Atofina. Reagent sets for this method are only available in Europe.

Test Preparation

Before starting the test:

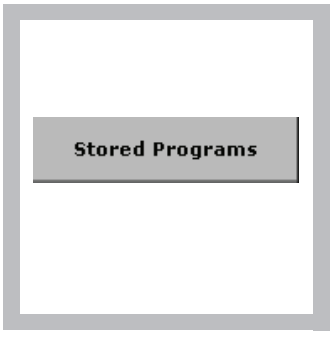
Chlorine dioxide is unstable and volatile. Analyze samples immediately. See Sample Collection, Storage, and Preservation on page 3.
For most accurate results, analyze each portion of sample at the same temperature.
A TenSette® pipet may be used to dispense Chlorine Dioxide Reagent A.

Collect the following items:	**Quantity**
Chlorine Dioxide Reagent Set	1
Volumetric Flask, 25-mL plastic	2
Syringe, 1-mL with needle	1
Sample cell, 1-inch square glass, 10-mL	2

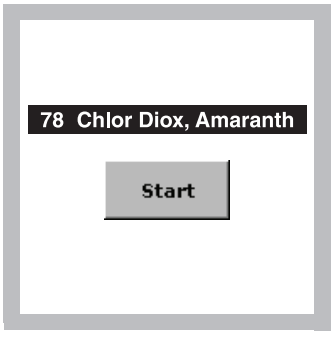
Note: *Reorder information for consumables and replacement items is on page 4.*

Note: *For best precision, measurement of the reagent with a volumetric pipet or high precision pipettor is recommended.*

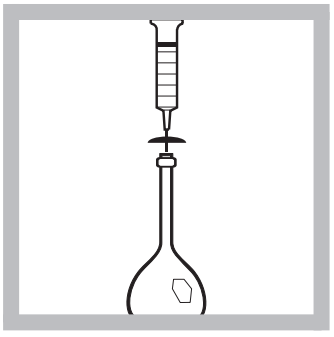
Amaranth Method



1. Press **STORED PROGRAMS**.

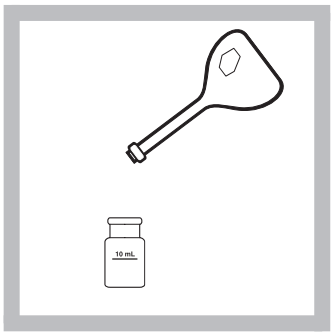


2. Select the test.

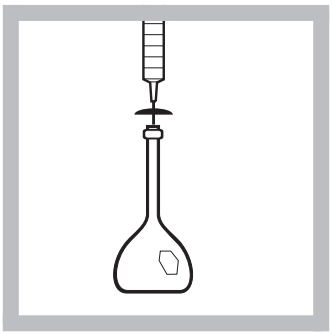


3. Blank Preparation: Using the syringe and needle provided, add 1.0 mL of Chlorine Dioxide Reagent A into a 25-mL volumetric flask.

4. Fill the volumetric flask to the mark with deionized water. Stopper. Invert at least 7 times to mix.

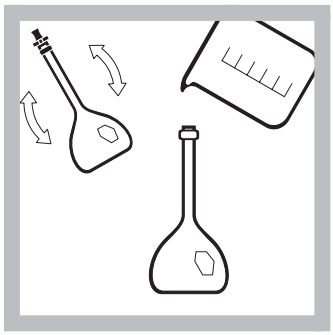


5. Pour 10 mL from the volumetric flask into a 10 mL sample cell.



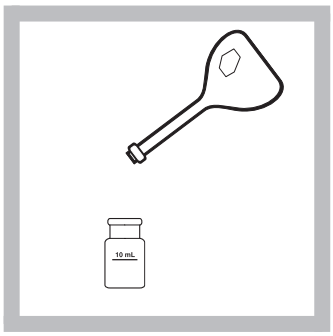
6. Prepared Sample: Add 1.0 mL of Chlorine Dioxide Reagent A into a second 25-mL volumetric flask.

Use a volumetric pipet and pipet filler or a TenSette Pipet to add this reagent.

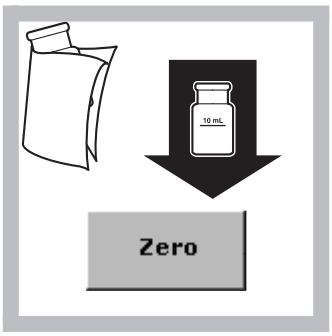


7. Fill the second volumetric flask to the mark with the sample. Stopper. Invert at least 7 times to mix.

8. Press **TIMER>OK**. A 1-minute reaction period will begin.



9. Prepared Sample: Pour 10 mL from the second volumetric flask into a second sample cell.



10. Wipe the blank and insert it into the cell holder with the fill line facing right.

Press **ZERO**.

The display will show:

0 µg/L ClO_2

11. When the timer expires, wipe the prepared sample and insert it into the cell holder with the fill line facing right.

12. Press **READ**.

Results are in µg/L ClO_2.

Interferences

Table 1 Interfering Substances and Levels

Interfering Substance	Interference Levels and Treatments
ClO^-	Greater than 2.0 mg/L
ClO_2^-	Greater than 2.0 mg/L
ClO_3^-	Greater than 2.0 mg/L
CrO_4^{2-}	Greater than 0.2 mg/L
Fe^{3+}	Greater than 0.5 mg/L
Hardness	Greater than 1000 mg/L
Ozone	Greater than 0.5 mg/L
Turbidity	Greater than 1000 NTU

Sample Collection, Storage, and Preservation

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Avoid plastic containers since these may have a large chlorine dioxide demand. Pretreat glass sample containers to remove any chlorine or chlorine dioxide demand by soaking in a dilute bleach solution (1 mL commercial bleach to 1 liter of deionized water) for at least one hour. Rinse thoroughly with deionized or distilled water. If sample containers are rinsed thoroughly with deionized or distilled water after use, only occasional pretreatment is necessary.

A common error in testing for chlorine dioxide is not obtaining a representative sample. If sampling from a tap, let the water flow for at least 5 minutes to ensure a representative sample. Let the container overflow with the sample several times, then cap the sample containers so there is no headspace (air) above the sample.

Accuracy Check

Standard Solution Method

Preparing chlorine dioxide standards is difficult and dangerous. In addition, these standards are both explosive and volatile! Only a trained chemist should prepare the standards using appropriate safety equipment and precautions. The manufacturer does not recommend preparation of chlorine dioxide standards. If independent standard preparation is required, please see the instructions in *Standard Methods for the Examination of Water and Wastewater*, 20th ed., under the headings “Stock chlorine dioxide solution” and “Standard chlorine dioxide solution” (pp 4–74 and 4–75). Prepare a 0.25-mg/L (250-µg/L) chlorine dioxide standard.

Summary of Method

Chlorine dioxide (ClO_2) is determined by its combination with Amaranth. Color intensity decreases as the level of chlorine dioxide increase. Test results are measured at 521 nm.

Consumables and Replacement Items

Required Reagents

Description	Quantity/Test	Unit	Cat. No.
Chlorine Dioxide Reagent Set (100 Tests)[1]	1	100/pkg	LYW 240

[1] Available only in Europe.

Required Apparatus

Description	Quantity/Test	Unit	Cat. No.
Chlorine Dioxide Tool Set, includes:	—	each	LZC 140
(2) Flask, volumetric, plastic, 25-mL	2	each	—
(1) Syringe, 1-mL, with needle	1	each	—
Sample Cells, 1-inch square glass, 10-mL	2	2/pkg	24954-02

Optional Reagents and Apparatus

Description	Unit	Cat. No.
Pipet, TenSette®, 0.1 to 1.0 mL	each	19700-01
Pipet Tips, for TenSette Pipet 19700-01	50/pkg	28156-96
Pipet Filler, safety bulb	each	each
Pipet, volumetric, Class A, 1.00-mL	each	each

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