59571-88

POCKET COLORIMETER™ II
ANALYSIS SYSTEMS
INSTRUCTION MANUAL

Bromine (Br)
Chlorine Dioxide (ClO_2)
Chlorine (Cl_2) / pH

te/dk 9/06 4ed

Important Note

This manual is intended for use with the following Pocket Colorimeter™ II instruments:

Bromine	Cat. No. 59530-01
Chlorine Dioxide	Cat. No. 59530-51
Chlorine / pH	Cat. No. 59530-12

The Pocket Colorimeter™ II instruments listed above are **not** interchangeable.

Table of Contents

Table of Contents, continued

Safety Precautions

Please read this entire manual before unpacking, setting up, or operating this instrument. Pay particular attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

Laboratory Safety

As part of good laboratory practice, please familiarize yourself with the reagents used in these procedures. Read all product labels and the material safety data sheets (MSDS) before using them. It is always good practice to wear safety glasses when handling chemicals. Follow instructions carefully. Rinse thoroughly if contact occurs. If you have questions about reagents or procedures, please contact the manufacturer or distributor.

Use of Hazard Information

If multiple hazards exist, this manual will use the signal word (Danger, Caution, Note) corresponding to the greatest hazard.

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTE
Information that requires special emphasis.

Precautionary Labels

Please pay particular attention to labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

⚠ This symbol, if noted on the instrument, references the instruction manual for operational and/or safety information.

Specifications

Lamp: Light emitting diode (LED)

Detector: Silicon photodiode

Photometric precision: ± 0.0015 Abs

Filter bandwidth: 15 nm

Wavelength: 528 nm

Absorbance range: 0–2.5 Abs

Dimensions: 3.2 x 6.1 x 15.2 cm (1.25 x 2.4 x 6 inches)

Weight: 0.2 kg (0.43 lb)

Sample cells: 25 mm (10 mL), 1 cm (10 mL), AccuVac® Ampuls

Operating conditions: 0 to 50 °C (32 to 122 °F); 0 to 90% relative humidity (noncondensing)

Power supply: Four AAA alkaline batteries; approximate life is 2000 tests*

---

* Backlight usage will decrease battery life.

OPERATION

DANGER

Handling chemical samples, standards, and reagents can be dangerous. Review the necessary Material Safety Data Sheets and become familiar with all safety procedures before handling any chemicals.

DANGER

La manipulation des échantillons chimiques, étalons et réactifs peut être dangereuse. Lire les Fiches de Données de Sécurité des Produits (FDSP) et se familiariser avec toutes les procédures de sécurité avant de manipuler tous les produits chimiques.

PELIGRO

La manipulación de muestras químicas, estándares y reactivos puede ser peligrosa. Revise las fichas de seguridad de materiales y familiarícese con los procedimientos de seguridad antes de manipular productos químicos.

GEFAHR

Das Arbeiten mit chemischen Proben, Standards und Reagenzien ist mit Gefahren verbunden. Es wird dem Benutzer dieser Produkte empfohlen, sich vor der Arbeit mit sicheren Verfahrensweisen und dem richtigen Gebrauch der Chemikalien vertraut zu machen und alle entsprechenden Materialsicherheitsdatenblätter aufmerksam zu lesen.

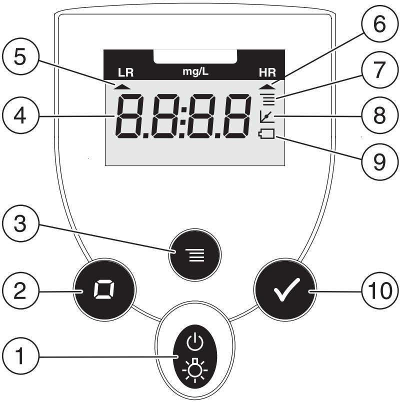
PERIGO

A manipulação de amostras, padrões e reagentes químicos pode ser perigosa. Reveja a folha dos dados de segurança do material e familiarize-se com todos os procedimentos de segurança antes de manipular quaisquer produtos químicos.

PERICOLO

La manipolazione di campioni, standard e reattivi chimici può essere pericolosa. La preghiamo di prendere conoscenza delle Schede Techniche necessarie legate alla Sicurezza dei Materiali e di abituarsi con tutte le procedure di sicurezza prima di manipolare ogni prodotto chimico.

Instrument Keys and Display



Item	Description
1	**POWER/BACKLIGHT** Key
2	**ZERO/SCROLL** Key
3	**MENU** Key
4	Numeric Display
5	Range Indicator
6	Range Indicator
7	Menu Indicator
8	Calibration Adjusted Indicator
9	Battery Low Indicator
10	**READ/ENTER** Key

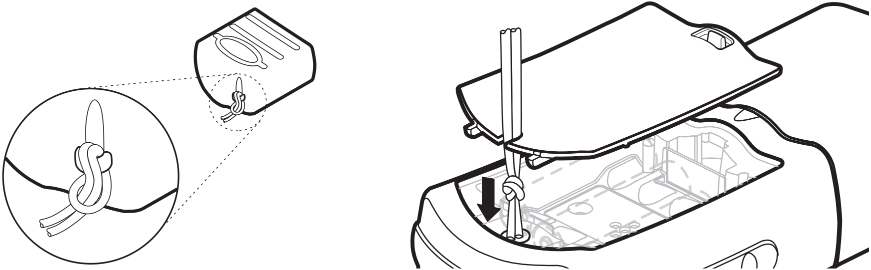
Instrument Cap Cord

The instrument cap for the Pocket Colorimeter™ II doubles as a light shield. Accurate measurements cannot be obtained unless the sample or blank is covered with the cap. Use the instrument cap cord to secure the cap to the body of the colorimeter and prevent loss of the cap. See Figure 1 on page 1—13.

1. Loop the instrument cap cord through the ring on the cap.
2. Remove the battery compartment cover. Press the knotted end of the cord into the hole indicated by the arrow.
3. Slide the cord into the slot on the battery compartment cover. Snap the cover into place.

Instrument Cap Cord, continued

Figure 1 Attaching the Instrument Cap Cord



Bromine, Total, LR (0.05 to 4.50 mg/L Br_2)

Method 8016

For water, wastewater, and seawater

DPD Method* (PermaChem® Powder Pillows or AccuVac® Ampuls)

Measuring Hints

- Analyze samples immediately. Do not use plastic containers to collect samples.

Note: *The Pocket Colorimeter™ II is designed to measure solutions contained in sample cells.* **DO NOT** *dip the meter in the sample or pour the sample directly into the cell holder.*

Note: *If the sample temporarily turns yellow after reagent addition, or if the display shows overrange (page 2—10), dilute a fresh sample and repeat the test. A slight loss of bromine may occur because of the dilution. Multiply the result by the appropriate dilution factor.*

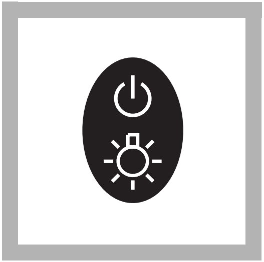
---

* Adapted from *Standard Methods for Examination of Water and Wastewater.*

Bromine, Total, Low Range (using Powder Pillows)

1. Fill a 10-mL sample cell sample (the blank). Cap.

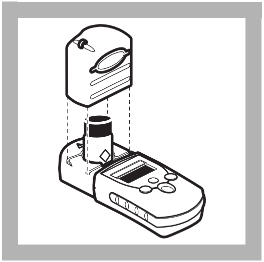
Note: *Samples must be analyzed immediately and cannot be preserved for later analysis.*



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

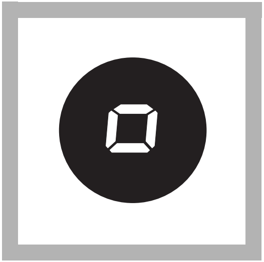
The arrow should indicate the low range channel (LR).

Note: *See page 2—4 for information on selecting the correct range channel.*



3. Remove the instrument cap. Place the blank in the cell holder. Cover the blank with the instrument cap.

Note: *Wipe excess liquid and fingerprints from the sample cells.*

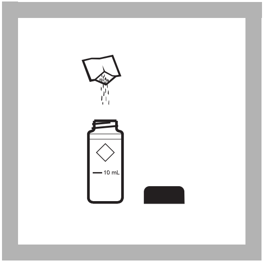


4. Press **ZERO/SCROLL**.

The display will show "- - - -" then "0.00".

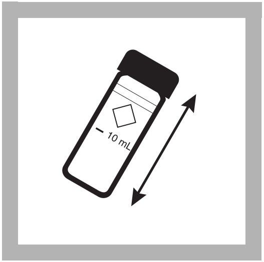
Remove the blank from the cell holder.

5. Fill a second sample cell to the 10 mL line with sample. Wipe off any liquid or fingerprints.



6. Add the contents of one DPD Total Chlorine Powder Pillow to the sample cell (the prepared sample).

Note: *The SwifTest™ Dispenser for total chlorine can be used in place of the powder pillow.*

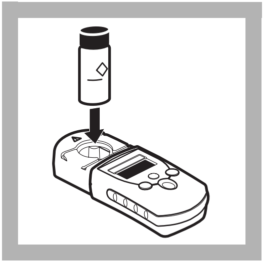


7. Cap and shake gently for 20 seconds.

Note: *Shaking dissipates bubbles that may form in samples with dissolved gases.*

Note: *A pink color will develop if bromine is present.*

Note: *Wipe liquid off sample cells.*



8. Place the prepared sample in the cell holder and cover with the instrument cap. Wait at least three but no more than six minutes after adding the DPD Total Chlorine Pillow.

Note: *Accuracy is not affected by undissolved powder.*

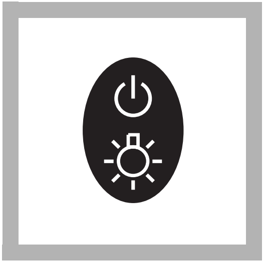
9. Press **READ/ENTER**.

The display will show "- - - -", followed by results in mg/L bromine.

Bromine, Total, Low Range (using AccuVac® Ampuls)

1. Fill a 10-mL sample cell with sample (the blank). Cap. Collect at least 40 mL of sample in a 50-mL beaker.

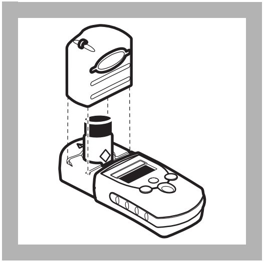
Note: *Samples must be analyzed immediately and cannot be preserved for later analysis.*



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

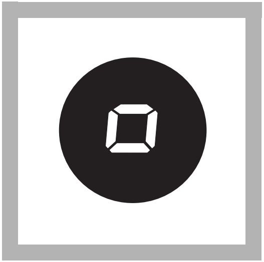
The arrow should indicate the low range channel (LR).

Note: *See page 2—4 for information on selecting the correct range channel.*



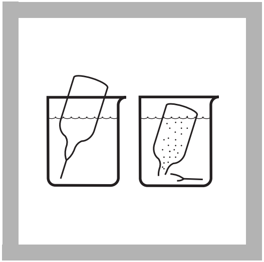
3. Remove the instrument cap. Place the blank in the cell holder. Cover the blank with the instrument cap.

Note: *Wipe excess liquid and fingerprints from the sample cells.*

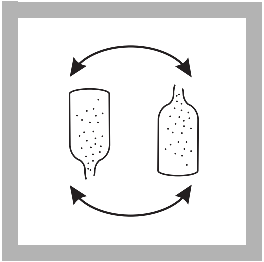


4. Press **ZERO/SCROLL**. The display will show “- - - -” then “0.00”.

Remove the blank from the cell holder.



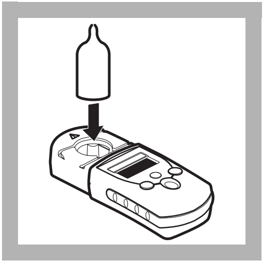
5. Fill a DPD Total Chlorine Reagent AccuVac Ampul with sample. Keep the tip of the ampule immersed until the ampule fills completely.



6. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

Note: *A pink color will form if bromine is present.*

Note: *Accuracy is not affected by undissolved powder.*



7. Place the prepared sample in the cell holder and cover with the instrument cap. Wait at least three but no more than six minutes after filling the ampule.

Note: *Wipe liquid off sample cells.*

8. Press **READ/ENTER**.

The display will show "- - - -", followed by results in mg/L bromine.

Sampling and Storage

Analyze samples immediately. Do not collect samples in plastic containers.

Accuracy Check

Standard Additions Method

1. Snap the neck off a low range Chlorine Standard Solution PourRite® Ampule, 20–30 mg/L Cl_2.
2. Use a TenSette® pipet to add 0.1, 0.2, and 0.3 mL of standard to three 10-mL samples. Swirl gently to mix. (For AccuVac Ampuls, use 0.3, 0.6, and 0.9 mL of standard and a 30-mL sample in a 50-mL beaker.)
3. Analyze each sample as described in the procedure. Each 0.1 mL of standard will cause an incremental increase in the apparent bromine concentration. The exact value depends on the concentration of the ampule standard. Check the certificate enclosed with the standard ampules for the chlorine concentration. Multiply the expected chlorine concentration by 2.25 to determine the expected increase in bromine concentration.

Standard Solution Method

Standard solutions for bromine or chlorine are difficult and time-consuming to prepare. Errors can occur if attention to detail is not addressed during preparation of the standards. Hach Company prepares the calibration curve under rigorous analytical laboratory conditions. Hach strongly recommends using the factory calibration.

A user calibration or a user-prepared bromine standard may be required by a regulatory official or agency. Two options are available on the Pocket Colorimeter™ II to meet this requirement.

A bromine standard may be prepared and used to validate the calibration curve using the Standard Calibration Adjust feature (see page 2—13 for more information.). The concentration of the prepared standard must be determined with an alternate instrument such as a spectrophotometer, colorimeter, amperometric titration, or by using another alternate method. The concentration of the bromine standard for the low range procedure must be between 2.00 and 4.00 mg/L bromine.

In addition, a user-generated calibration curve can be made and programmed into the Pocket Colorimeter™ II. See User-Entered Calibration on page 2—15.

If a chlorine standard is used, multiply its concentration by 2.25 to determine the equivalent bromine concentration.

Interferences

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. Determine amount to be added on separate 10-mL sample, then add the same amount to the sample being tested. Correct for the additional volume.
Alkalinity	Greater than 250 mg/L $CaCO_3$. May not develop full color or color may fade instantly. Neutralize to pH 6–7 with 1 N Sulfuric Acid. Determine amount to be added on separate 10-mL sample, then add the same amount to the sample being tested. Correct for the additional volume.
Chlorine, Cl_2	Interferes at all levels

Interfering Substance	Interference Levels and Treatments
Hardness	No effect at less than 1,000 mg/L as $CaCO_3$
Iodine, I_2	Interferes at all levels
Manganese, Oxidized (Mn^{4+}, Mn^{7+}) or Chromium, Oxidized (Cr^{6+})	1. Adjust sample pH to 6–7. 2. Add 3 drops Potassium Iodide (30-g/L) (Cat. No. 343-32) to a 25-mL sample. 3. Mix and wait one minute. 4. Add 3 drops Sodium Arsenite (5-g/L) (Cat. No. 1047-32) 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 result to obtain the correct chlorine concentration.
Monochloramine	Interferes at all levels.
Ozone	Interferes at all levels.

Method Performance

Estimated Detection Limit (EDL) = 0.05 mg/L Br_2

Typical Precision (95% confidence interval) = 2.25 ± 0.11 mg/L Br_2

Bromine, Total, HR (0.2 to 10.0 mg/L Br_2)

Method 8016

For water, wastewater, and seawater

DPD Method* (PermaChem® Powder Pillows)

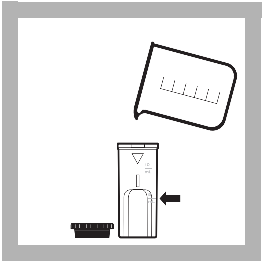
Measuring Hints

- If the bromine concentration is typically less than 4 mg/L, use the low range procedure.
- Analyze samples immediately. Do not use plastic containers to collect samples.

Note: *The Pocket Colorimeter II is designed to measure solutions contained in sample cells.* **DO NOT** *dip the meter in the sample or pour the sample directly into the cell holder.*

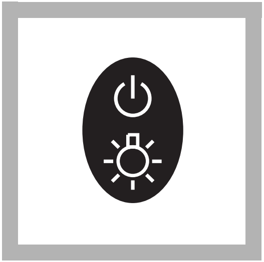
---

* Adapted from *Standard Methods for Examination of Water and Wastewater.*



1. Fill a 1-cm/10-mL sample cell with sample. Cap. This is the blank.

Note: *Samples must be analyzed immediately and cannot be preserved for later analysis.*



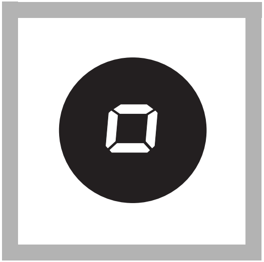
2. Press the **POWER** key to turn the meter on.

The arrow should indicate the high range channel (HR).

Note: *See page 2—4 for information on selecting the correct range channel.*

3. Remove the meter cap. Place the blank into the cell holder, with the diamond mark facing the back of the cell holder. Cover the cell with the cap.

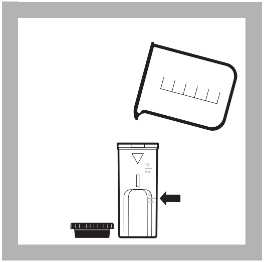
Note: *Wipe excess liquid and fingerprints from the sample cells.*



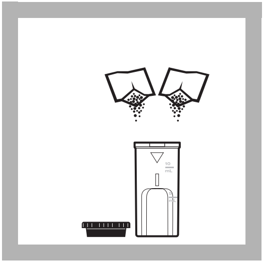
4. Press **ZERO/SCROLL**.

The display will show “- - - -” then “0.0”.

Remove the blank from the cell holder.

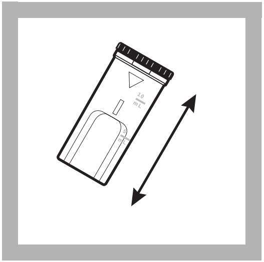


5. Fill another 1-cm/10-mL sample cell to the 5-mL line with sample.



6. Add the contents of two DPD Total Chlorine Powder Pillows to the sample cell (the prepared sample).

Note: *The SwifTest™ Dispenser for Total Chlorine can be used in place of the powder pillows. Use two dispensations from the dispenser.*

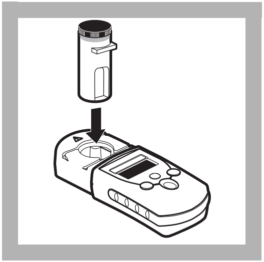


7. Cap and shake gently for 20 seconds.

Note: *Shaking dissipates bubbles that may form in samples with dissolved gases.*

Note: *A pink color will develop if bromine is present.*

Note: *Wipe liquid off sample cells.*



8. Place the prepared sample in the cell holder and cover with the instrument cap. Wait at least three but no more than six minutes after adding the DPD Total Chlorine Pillows.

Note: *Accuracy is not affected by undissolved powder.*

9. Press **READ/ENTER**.

The display will show "- - - -", followed by results in mg/L bromine.

Note: *If the sample temporarily turns yellow after reagent addition, or if the display shows overrange (page 2—12), dilute a fresh sample and repeat the test. A slight loss of bromine may occur because of the dilution. Multiply the result by the appropriate dilution factor.*

Sampling and Storage

Analyze samples immediately. Do not collect samples in plastic containers.

Accuracy Check

Standard Additions Method

1. Snap the neck off a high range Chlorine Standard Solution Voluette® Ampule, 25–30 mg/L Cl_2.
2. Use a TenSette® pipet to add 0.1, 0.2, and 0.3 mL of standard to three separate 5-mL samples. Swirl gently to mix.
3. Analyze 5 mL of each sample as described in the procedure. Each 0.1 mL of standard will cause an incremental increase in bromine concentration. The exact value depends on the concentration of the ampule standard. Check the certificate enclosed with the standard ampules for the chlorine concentration. Multiply the expected chlorine concentration by 2.25 to determine the expected increase in bromine concentration.

Standard Solution Method

Standard solutions for bromine or chlorine are difficult and time-consuming to prepare. Errors can occur if attention to detail is not addressed during preparation of the standards. Hach Company prepares the calibration curve under rigorous analytical laboratory conditions. Hach strongly recommends using the factory calibration.

A user calibration or a user-prepared bromine standard may be required by a regulatory official or agency. Two options are available on the Pocket Colorimeter II to meet this requirement.

A bromine standard may be prepared and used to validate the calibration curve using the Standard Calibration Adjust feature (see page 2—13 for more information.). The concentration of the prepared standard must be determined with an alternate instrument such as a spectrophotometer, colorimeter, amperometric titration, or by using another alternate method. The concentration of the bromine standard for the low range procedure must be between 2.00 and 4.00 mg/L bromine and between 2.0 and 8.0 mg/L bromine for the high range procedure.

In addition, a user-generated calibration curve can be made and programmed into the Pocket Colorimeter™ II. See User-Entered Calibration on page 2—15.

If a chlorine standard is used, multiply its concentration by 2.25 to determine the equivalent bromine concentration.

Interferences

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. Determine amount to be added on separate 10-mL sample, then add the same amount to the sample being tested. Correct for the additional volume.
Alkalinity	Greater than 250 mg/L $CaCO_3$. May not develop full color or color may fade instantly. Neutralize to pH 6–7 with 1 N Sulfuric Acid. Determine amount to be added on separate 10-mL sample, then add the same amount to the sample being tested. Correct for the additional volume.
Chlorine, Cl_2	Interferes at all levels

Interfering Substance	Interference Levels and Treatments
Hardness	No effect at less than 1,000 mg/L as $CaCO_3$
Iodine, I_2	Interferes at all levels
Manganese, Oxidized (Mn^{4+}, Mn^{7+}) or Chromium, Oxidized (Cr^{6+})	1. Adjust sample pH to 6–7. 2. Add 3 drops Potassium Iodide (30-g/L) (Cat. No. 343-32) to a 25-mL sample. 3. Mix and wait one minute. 4. Add 3 drops Sodium Arsenite (5-g/L) (Cat. No. 1047-32) 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 result to obtain the correct chlorine concentration.
Monochloramine	Interferes at all levels.
Ozone	Interferes at all levels.

Method Performance

Estimated Detection Limit (EDL) = 0.2 mg/L Br_2

Typical Precision (95% confidence interval) = 11.3 ± 0.5 mg/L Br_2

Summary of Method

Bromine residuals react with DPD (N,N-diethyl-p-phenylenediamine) to form a pink color which is proportional to the total bromine concentration. The range of analysis is extended in the high range procedure by adding additional powder to increase the ratio of indicator to sample.

Replacement Parts (LR and HR)

Required Reagents

Description	Unit	Cat. No.
DPD Total Chlorine Reagent Powder Pillows	100/pkg	21056-69
or		
DPD Total Chlorine Reagent AccuVac® Ampuls	25/pkg	25030-25

Required Apparatus (Using AccuVac® Ampuls)

Description	Unit	Cat. No.
Beaker, 50 mL	each	500-41H

Optional Reagents

Chlorine Standard Solution, Voluette® Ampules, 50-75 mg/L, 10 mL	16/pkg	14268-10
Chlorine Standard Solution, Pour Rite Ampules, 25-30 mg/L	20/pkg	26300-20
Potassium Iodide Solution, 30 g/L	100 mL MDB	343-32
Sodium Arsenite Solution, 5 g/L	100 mL MDB	1047-32
Sodium Hydroxide Standard Solution, 1 N	100 mL MDB	1045-32
Sulfuric Acid Standard Solution, 1 N	100 mL MDB	1270-32
SwifTest™ Dispenser with DPD Total Reagent	each	28024-00
Water, deionized	4 L	272-56

Optional Apparatus

AccuVac® Snapper Kit	each	24052-00
Caps for 10-mL sample cells	12/pkg	24018-12
Caps for 1-cm/10-mL sample cells	each	52626-00

Optional Apparatus, continued

Description	Unit	Cat. No.
Cylinder, graduated, 25 mL, poly	each	1081-40
Cylinder, graduated, 100 mL, PMP	each	2172-42
sension™1 Basic Portable pH Meter, with electrode	each	51700-10
Pipet, TenSette®, 0.1 to 1.0 mL	each	19700-01
Pipet Tips, For 19700-01 TenSette®	50/pkg	21856-96
Sample Cells, 10-mL with screw caps	6/pkg	24276-06

Replacement Parts

Batteries, AAA, alkaline	4/pkg	46743-00
Instrument Cap/light shield	each	59548-00
Instruction Manual	each	59571-88
Sample Cells, 1-cm/10-mL	2/pkg	41658-02

Chlorine, Free and Total, HR (0.1 to 10.0 mg/L Cl_2)

Method 10069 (Free)

For water, treated water, estuary water, and seawater

Method 10070 (Total)

For water, treated waters, wastewater, estuary water, and seawater

DPD Method*

USEPA accepted for reporting drinking water analyses (free and total chlorine) and wastewater analyses (total chlorine)

Measuring Hints

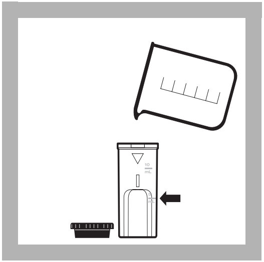
- If the chlorine concentration is typically less than 2 mg/L, use the Chlorine Pocket Colorimeter (Cat. No. 58700-00).
- Analyze samples immediately. Do not use plastic containers to collect samples. For best results, dedicate a set of cells to each test (free and total).

---

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

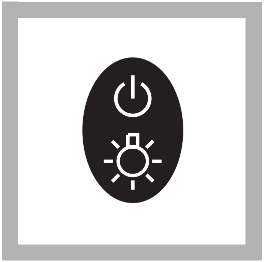
- High range free chlorine determinations are subject to variable levels of interferences from monochloramine. See Interferences on page 1—46.

Note: *The Pocket Colorimeter™ II is designed to measure solutions contained in sample cells.* ***DO NOT*** *dip the meter in the sample or pour the sample directly into the cell holder.*



1. Fill a 1-cm/10-mL cell to the 5-mL line with sample (the blank). Cap.

Note: *Samples must be analyzed immediately and cannot be preserved for later analysis.*



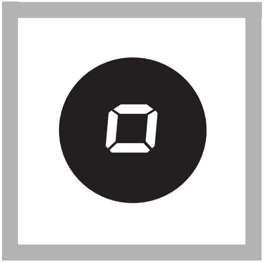
2. Press the **POWER** key to turn the meter on.

The arrow should indicate the chlorine channel (mg/L Cl_2).

Note: *See page 2—4 for information on selecting the correct range channel.*

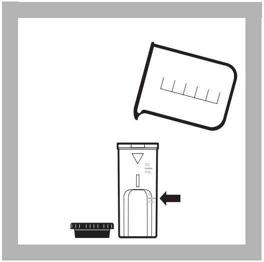
3. Remove the meter cap. Place the blank into the cell holder, with the diamond mark facing the back of the cell holder. Cover the cell with the cap.

Note: *Wipe liquid off sample cells.*



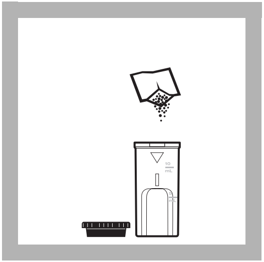
4. Press: **ZERO/SCROLL**
The display will show
“- - - -” followed by “0.0”.

Remove the blank.



5. Fill another 1-cm/10-mL sample cell to the 5-mL line with sample. Cap.

Note: *Do not use the same sample cells for free and total chlorine without thoroughly rinsing the cells between the free and total tests.*



6. Add the contents of one DPD **Free** Chlorine or one DPD **Total** Chlorine Powder Pillows to the sample cell (the prepared sample). Cap the cell and shake gently for 20 seconds.

Note: *Wipe liquid off sample cells.*

7. For **free** chlorine, place the prepared sample cell in the cell holder within **one** minute after adding the DPD Free Pillow. Cover the cell with the instrument cap. Proceed to step 9.

8. For **total** chlorine, place the prepared sample in the cell holder and cover with the instrument cap. Wait **three to six** minutes after adding the DPD Total Pillows.Proceed to step 9.

9. Press **READ/ENTER**.

The instrument will show "- - - -" followed by the results in mg/L chlorine (Cl_2).

Note: *If the sample temporarily turns yellow after reagent addition or shows overrange (page 2—12), dilute a fresh sample and repeat the test. A slight loss of chlorine may occur. Multiply the result by the dilution factor.*

Accuracy Check

Standard Additions Method

a. Snap the neck off a high range Chlorine Standard Solution Voluette® Ampule, 50–70 mg/L Cl_2.

b. Use a TenSette® pipet to add 0.1, 0.2, and 0.3 mL of standard to three separate 5-mL samples. Swirl gently to mix.

c. Analyze each sample as described in the procedure. Each 0.1 mL of standard will cause an incremental increase in chlorine. The exact value depends on the concentration of the Voluette ampule standard. Check the certificate enclosed with the Voluette ampules for calculation of the expected increase in the chlorine concentration.

Standard Solution Method

Standard solutions for chlorine are difficult and time-consuming to prepare. Errors can occur if attention to detail is not addressed during preparation of the standards. The calibration curve is prepared under rigorous analytical laboratory conditions. Use the factory calibration for most normal testing.

A user calibration or a user-prepared chlorine standard may be required by a regulatory official or agency. Two options are available on the Pocket Colorimeter II to meet this requirement.

A chlorine standard may be prepared and used to validate the calibration curve using the Standard Calibration Adjust feature (see page 2—13 for more information). The concentration of the prepared standard must be determined with an alternate instrument such as a spectrophotometer, colorimeter, or by using an alternate method such as amperometric titration. The concentration of the chlorine standard for the HR procedure must be between 4.5 and 7.0 mg/L chlorine.

In addition, a user-generated calibration curve can be programmed into the Pocket Colorimeter II. See User-Entered Calibration on page 2—15 for more information.

Interferences

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. Determine amount to be added on separate 5-mL sample, then add the same amount to the sample being tested. Correct for the additional volume.
Alkalinity	Greater than 250 mg/L $CaCO_3$. May not develop full color or color may fade instantly. Neutralize to pH 6–7 with 1 N Sulfuric Acid. Determine amount to be added on separate 5-mL sample, then add the same amount to the sample being tested. Correct for the additional volume.
Bromine, Br_2	Interferes at all levels
Hardness	No effect at less than 1,000 mg/L as $CaCO_3$
Iodine, I_2	Interferes at all levels

Interfering Substance	Interference Levels and Treatments
Manganese, Oxidized (Mn^{4+}, Mn^{7+}) or Chromium, Oxidized (Cr^{6+})	1. Adjust sample pH to 6–7. 2. Add 3 drops Potassium Iodide (30-g/L) (Cat. No. 343-32) to a 5-mL sample. 3. Mix and wait one minute. 4. Add 3 drops Sodium Arsenite (5-g/L) (Cat. No. 1047-32) and mix. 5. Analyze 5 mL of the treated sample as described in the procedure. 6. Subtract the result from this test from the original analysis to obtain the correct chlorine concentration.

<table>
<tr><th>Interfering Substance</th><th>Interference Levels and Treatments</th></tr>
<tr><td>Monochloramine</td><td>For conventional free chlorine disinfection (beyond the breakpoint), monochloramine concentrations are very low. If monochloramine is present in the sample, its interference in the free chlorine test varies with the temperature, the relative amount of monochloramine to free chlorine, and the time required to do the analysis. Approximate interference levels of monochloramine in the free chlorine test are listed below (as mg/L Cl_2).
<table>
<tr><th>NH_2Cl</th><th colspan="4">Sample Temperature °C (°F)</th></tr>
<tr><td>(as Cl_2)</td><td>5 (40)</td><td>10 (50)</td><td>20 (68)</td><td>30 (83)</td></tr>
<tr><td>1.2</td><td>0.2</td><td>0.2</td><td>0.3</td><td>0.3</td></tr>
<tr><td>2.5</td><td>0.4</td><td>0.5</td><td>0.6</td><td>0.6</td></tr>
<tr><td>3.5</td><td>0.5</td><td>0.6</td><td>0.7</td><td>0.8</td></tr>
</table>
</td></tr>
<tr><td>Ozone</td><td>Interferes at all levels.</td></tr>
</table>

Spec√ Secondary Standards

The DPD Chlorine Secondary Standards kit (Cat. No. 26353-00) cannot be used on the high range (HR) chlorine channel.

Method Performance

Estimated Detection Limit (EDL) = 0.1 mg/L Cl_2

Typical Precision (95% confidence interval) = 5.0 ± 0.2 mg/L Cl_2

Summary of Method

Chlorine can be present in water as free chlorine and as combined chlorine. Both forms can coexist in the same solution and can be determined together as total chlorine. Free chlorine is present as hypochlorous acid or hypochlorite ion. Combined chlorine represents a combination of chlorine-containing compounds including but not limited to monochloramine, dichloramine, nitrogen trichloride, and other chloro derivatives. The combined chlorine oxidizes triiodide ion (I_3^-) to iodine (I_2). The iodine and free chlorine reacts with DPD (N,N-diethyl-p-phenylenediamine) to form a red solution. The color intensity is proportional to the total chlorine concentration. To determine the concentration of combined chlorine, run a free chlorine test and a total chlorine test.

Subtract the results of the free chlorine test from the total chlorine test to obtain the combined chlorine concentration.

The range of analysis using the DPD method for chlorine is extended by adding more indicator in proportion to sample volume. Thus, a larger, 25-mL size powder pillow of DPD Reagent is added to a 5-mL sample.

Replacement Parts

Required Reagents

Description	Unit	Cat. No.
Free Chlorine Tests		
DPD Free Chlorine Reagent Powder Pillows for 25-mL sample	100/pkg	14070-99
Total Chlorine Tests		
DPD Total Chlorine Reagent Powder Pillows for 25-mL sample	100/pkg	14064-99

Optional Reagents

Description	Unit	Cat. No.
Chlorine Standard Solution, Voluette Ampules, 50–75 mg/L, 2-mL	20/pkg	14268-20
Potassium Iodide Solution, 30 g/L	100 mL MDB*	343-32
Sodium Arsenite Solution, 5 g/L	100 mL MDB	1047-32
Sodium Hydroxide Standard Solution, 1 N	100 mL MDB	1045-32
Sulfuric Acid Standard Solution, 1 N	100 mL MDB	1270-32
Water, deionized	4 L	272-56

Optional Apparatus

AccuVac® Snapper Kit	each	24052-00
Batteries, AAA, alkaline	4/pkg	46743-00
Caps for 10-mL sample cells	12/pkg	24018-12
Cylinder, graduated, 25 mL. glass	each	508-40
Cylinder, graduated, 100 mL, glass	each	508-42
*sens***ion**™***1*** Basic Portable pH Meter, with electrode	each	51700-10

---

* Marked Dropper Bottle

Optional Apparatus, continued

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

Replacement Parts

Cap for 1-cm/10 mL sample cell	each	52626-00
Instrument Cap/light shield	each	59548-00
Instruction Manual	each	59571-88
Sample Cells, 1-cm/10-mL	2/pkg	48643-02

Chlorine Dioxide **(0.05 to 5.00 mg/L ClO_2)**

Method 10126

For water and wastewater

DPD Method* USEPA accepted for drinking water **

Measuring Hints

- Chlorine dioxide samples cannot be stored, they must be analyzed immediately after collection to minimize loss of chlorine dioxide.
- Do not use plastic sample containers or measurement apparatus.
- If the chlorine dioxide concentration exceeds the upper limit of the test (5.00 mg/L ClO_2), the color will not develop properly. The display will show overrange (flashing **5.50**) when the concentration is 5.50 or more.
  If the reading is over 5.00, dilute the sample with high quality water that is chlorine demand-free and repeat the test. Some loss of chlorine dioxide may occur during dilution. Multiply the result by the appropriate dilution factor.

---

* Adapted from *Standard Methods for Examination of Water and Wastewater.*

** Procedure is equivalent to Standard Methods, 4500 ClO_2 D.

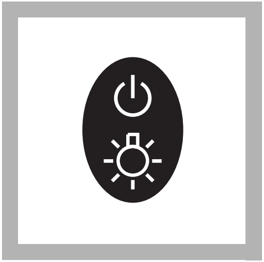
- Use a timer for reagent reaction and be consistent for all samples.
- Gently swirl samples to mix reagents. Do not shake sample cells or ampules. Do not invert sample cells. AccuVac Ampuls can be inverted as they contain little air. Vigorous agitation may cause loss of volatile chlorine dioxide before it can react.
- Allow any unreacted reagent to settle before taking readings.
- For best accuracy when using AccuVac Ampuls, draw sample into an empty AccuVac ampule (Cat. No. 26779-25) and use that for the zero instead of a 10-mL sample cell.
- Check the reagent blank for each new lot and at least every two months. Make this adjustment by using deionized water in the procedure instead of sample and subtract that reading from future test results.

Note: *The Pocket Colorimeter™ II is designed to measure solutions contained in sample cells.* ***DO NOT*** *dip the meter in the sample or pour the sample directly into the cell holder.*

Chlorine Dioxide (using Powder Pillows)

1. Fill a 10-mL sample cell with sample (the blank).

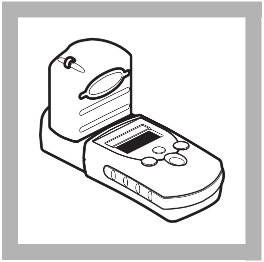
Note: *Samples must be analyzed immediately.*



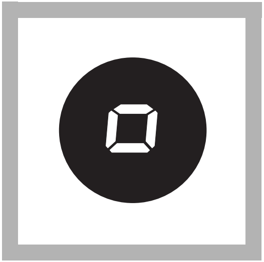
2. Press the **POWER** key to turn the meter on.

The arrow should indicate channel 1.

Note: *See page 2—4 for information on selecting the correct range channel.*

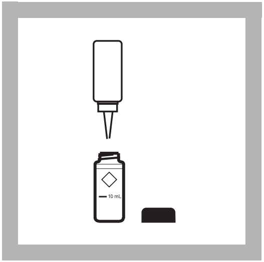


3. Place the cell into the cell holder. Cover the cell with the instrument cap.

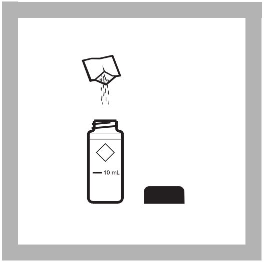


4. Press **ZERO/SCROLL**. The display will show “- - - -” then “0.00”.

Remove the blank from the cell holder.

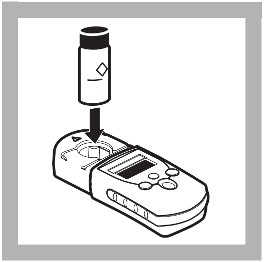


5. Fill a second sample cell with 10 mL of sample. Immediately add four drops of Glycine Reagent to the sample cell and swirl to mix.

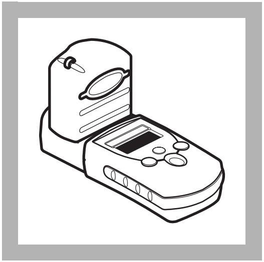


6. Immediately add the contents of one DPD Free Powder Pillow. Cap and swirl gently for 20 sec. Wait 30 sec. for undissolved powder to settle. Accuracy is not affected by undissolved powder.

Note: *A pink color will develop if* ClO_2 *is present.*



7. Within one minute of adding the DPD to the sample, place the prepared sample into the cell holder.



8. Cover the sample with the instrument cap.

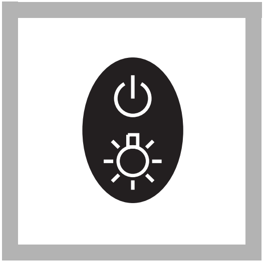
9. Press **READ/ENTER**.

The display will show “- - - -”, followed by results in mg/L ClO_2.

Chlorine Dioxide (using AccuVac® Ampuls)

1. Fill a 10-mL sample cell with sample (the blank).

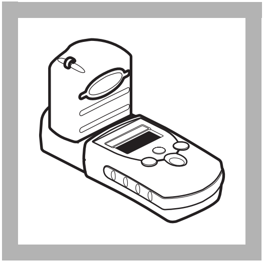
Note: *Samples must be analyzed immediately.*



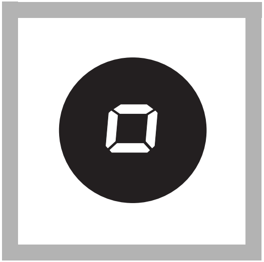
2. Press the **POWER** key to turn the meter on.

The arrow should indicate channel 2.

Note: *See page 2—4 for information on selecting the correct range channel.*



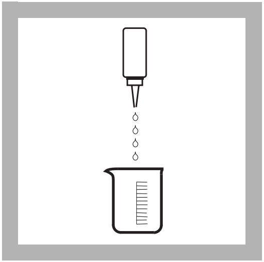
3. Place the cell into the cell holder. Cover the cell with the instrument cap.



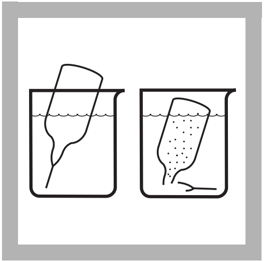
4. Press **ZERO/SCROLL**.

The display will show "- - - -" then "0.00".

Remove the blank from the cell holder.



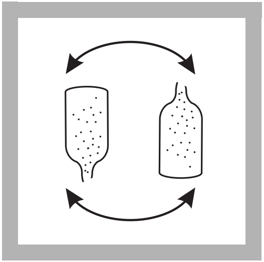
5. Collect 40 mL of sample in a 50- or 100-mL beaker. Add 16 drops of Glycine Reagent to the 40 mL of sample. Swirl gently to mix. Continue with step 6 immediately.



6. Fill a DPD Free Chlorine Reagent AccuVac Ampul with the pretreated sample in the beaker.

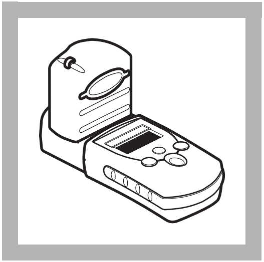
Note: *Keep the tip immersed until the ampule fills completely.*

Chlorine Dioxide, continued



7. Quickly invert the ampule several times to mix. Wait 30 seconds for any undissolved powder to settle. Accuracy is not affected by undissolved powder.

Note: *A pink color will form if chlorine dioxide is present.*



8. Within one minute after filling the ampule, place it into the cell holder. Cover the ampule with the instrument cap.

9. Press **READ/ENTER**.

The display will show "- - - -" followed by the results in mg/L chlorine dioxide.

Sampling and Storage

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.

Do not use plastic containers to collect samples for analysis since they often have a high 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 each use, only occasional pretreatment is necessary thereafter.

Failure to obtain a representative sample is a common error in testing for chlorine dioxide. 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.
    a. Obtain Free Chlorine Standards (Cat. No. 14268-10).
    b. Determine the concentration of the standard from the certificate of analysis shipped with the standard (50–75 mg/L Cl_2). 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.
2. Perform the chlorine dioxide test on the standard without adding Glycine Reagent (step 3 of the procedures).
3. The chlorine dioxide reading should be 2.4 times greater than the chlorine concentration. If so, this verifies that the DPD Reagent and the instrument are working properly.

4. Repeat the chlorine dioxide test on the chlorine standard, including the Glycine addition. The reading should be less than 0.10 mg/L ClO_2. This verifies that the Glycine is eliminating free chlorine interference.

Standard Solution Method

Standard solutions for chlorine dioxide are difficult and time-consuming to prepare. Errors can occur if attention to detail is not addressed during preparation of the standards. Hach prepares the calibration curve under rigorous analytical laboratory conditions. Hach recommends using the factory calibration.

A user calibration or a user-prepared chlorine dioxide standard may be required by a regulatory official or agency. Two options are available on the Pocket Colorimeter II to meet this requirement.

A chlorine dioxide standard may be prepared and used to validate the calibration curve using the Standard Calibration Adjust feature (see Standard Calibration Adjust on page 2—13). The concentration of the prepared standard must be determined with an alternate instrument such as a spectrophotometer, colorimeter, amperometric titration or by using another alternate method. The concentration of the chlorine dioxide standard must be between 2.00 and 4.50 mg/L chlorine dioxide.

In addition, a user-generated calibration curve can be made and programmed into the Pocket Colorimeter™ II. See User-Entered Calibration on page 2—15.

Method Performance

Typical Precision (95% confidence interval):

4.78 ± 0.22 mg/L ClO_2 (AccuVac)

2.08 ± 0.04 mg/L ClO_2 (Powder Pillows)

Estimated Detection Limit:

EDL = 0.04 mg/L ClO_2 (AccuVac and Powder Pillows)

Interferences

Samples containing more than 250 mg/L alkalinity or 150 mg/L acidity as $CaCO_3$ may inhibit full color development, or the color may fade instantly. Neutralize these samples to pH 6–7 with 1 N Sulfuric Acid Standard Solution or 1 N Sodium Hydroxide Standard Solution. Determine the amount required on a separate 10-mL sample. Add the same amount to the sample to be tested. Correct for the additional volume.

Samples containing monochloramine will cause a gradual drift to higher chlorine dioxide readings. When read within one minute of reagent addition, 3.0 mg/L monochloramine will cause an increase of less than 0.10 mg/L in the chlorine dioxide reading.

Bromine, chlorine, iodine, ozone and oxidized forms of manganese and chromium also interfere and read as chlorine dioxide.

To compensate for the effects of manganese (Mn^{4+}) or chromium (Cr^{6+}), adjust the pH to 6–7 as described above. To a 25-mL sample, add 3 drops of 30 g/L Potassium Iodide Solution, mix, and wait one minute. Add 3 drops of 5 g/L Sodium Arsenite Solution and mix. Subtract the result of this test from the original analysis to obtain the accurate chlorine dioxide concentration.

DPD Free Chlorine Reagent Powder Pillows and AccuVac Ampuls contain a buffer formulation that withstands high levels (at least 1000 mg/L) of hardness without interference.

Organic chloramines and peroxides may interfere. Various metals may interfere by combining with the Glycine Reagent needed to remove the chlorine interference. Metal interference is limited except when chlorine is present. In the presence of 0.60 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 chlorine in the sample. It may be necessary to add more Glycine to overcome this interference.

Summary of Method

Twenty percent of the chlorine in the chlorine dioxide is reduced to chlorite, which reacts with DPD (N,N-diethyl-p-phenylenediamine) indicator to form a pink color. The color intensity is proportional to the ClO_2 in the sample. Chlorine interference is eliminated by adding Glycine Reagent, which converts free chlorine to chloroaminoascorbic acid, but has no effect on chlorine dioxide at the test pH.

Reagents and Apparatus

Required Reagents (Using Powder Pillows)

Description	Units	Cat. No.
ClO_2 DPD Powder Pillow/Glycine Reagent Set (100 tests)		27709-00
Includes: (1) DPD Free Chlorine Reagent Powder Pillows, 100/pkg (1) Glycine Reagent, 29 mL		

Required Reagents (Using AccuVac Ampuls)

Description	Units	Cat. No.
ClO_2 DPD AccuVac®/Glycine Reagent Set (25 tests)		27710-00
Includes:		
(1) DPD Free Chlorine Reagent AccuVac® Ampuls, 25/pkg		
(1) Glycine Reagent, 29 mL		

Require Apparatus (Using AccuVac Ampuls)

Description	Units	Cat. No.
Beaker, 50-mL, glass	each	500-41
Beaker, 100-mL, glass	each	500-42

Optional Reagents

Description	Units	Cat. No.
AccuVac® Ampuls for Blanks	25/pkg	26779-25
Chlorine Standard Solution Voluette™ Ampules, 50–75 mg/L, 10-mL	16/pkg	14268-10
Potassium Iodide Solution, 30 g/L	100-mL MDB	343-32
Sodium Arsenite Solution, 5 g/L	100-mL MDB	1047-32

Optional Reagents, continued

Description	Units	Cat. No.
Sodium Hydroxide Standard Solution, 1 N	100-mL MDB	1045-32
Sulfuric Acid Standard Solution, 1 N	100-mL MDB	1270-32
Water, deionized	4 L	272-56

Optional Apparatus

AccuVac® Snapper Kit	each	24052-00
Caps for 10-mL sample cells	12/pkg	24018-12
Cylinder, graduated, 25-mL, glass	each	508-40
Cylinder, graduated, 100-mL, glass	each	508-42
sension™1 Basic Portable pH Meter, with electrode	each	51700-10
Pipet, TenSette®, 0.1 to 1.0 mL	each	19700-01
Pipet Tips, for 19700-01 TenSette® Pipet	50/pkg	21856-96

Replacement Parts

Batteries, AAA, alkaline	4/pkg	46743-00
Instrument Cap/light shield	each	59548-00
Instrument Manual	each	59571-88
Sample Cell, 25 x 60 mm 10 mL mark	6/pkg	24276-06

pH (6.0 to 8.5 pH units)

For water and wastewater **Method 10076**

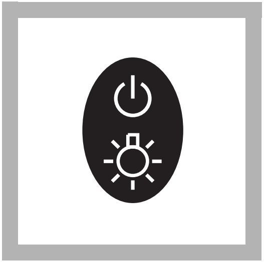
Phenol Red Method

Measuring Hints

- For greatest accuracy, use the Standard Calibration Adjust to adjust the calibration curve with each new lot of Phenol Red. Use the pH 7.00 Buffer Solution included in the kit.
- Periodically, recheck with the pH 7 Buffer to confirm the accuracy of the instrument and method. If not reading within 0.1 pH unit, recalibrate the instrument.
- The amount of indicator and sample is critical for accurate results and should be measured carefully.
- Attempting to measure a sample with a pH below 6.0 or above 8.2 will result in an inaccurate reading. Measurements outside the range can differ from the true pH reading by as much as 2 pH units.

Note: *The Pocket Colorimeter II is designed to measure solutions contained in sample cells.* ***DO NOT*** *dip the meter in the sample or pour the sample directly into the cell holder.*

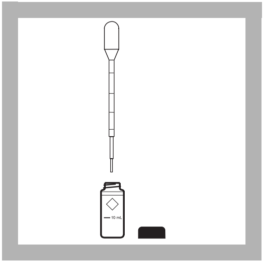
1. Collect about 50 mL of sample in a beaker and fill a 10-mL sample cell to the 10-mL mark with sample.



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

The arrow should indicate pH.

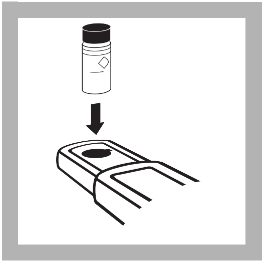
Note: *See page 2—4 for information on selecting the correct range channel.*



3. Using the calibrated dropper, add 0.5 mL of Phenol Red Solution to the cell. Cap and invert to mix.

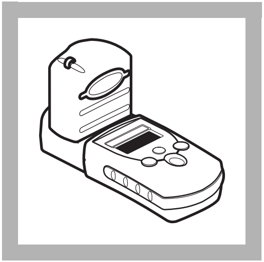
Note: *For greatest accuracy, use a clean and dry dropper.*

4. Fill a second sample cell to the 10-mL mark with the original sample. Cap the sample cell. This is the blank.

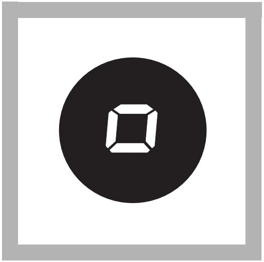


5. Place the blank into the cell holder.

Note: *Wipe liquid off sample cells or damage to the instrument may occur.*



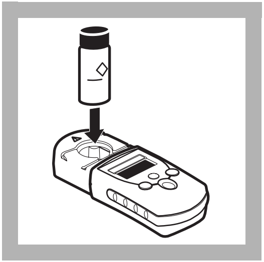
6. Cover the cell with the instrument cap.



7. Press **ZERO/SCROLL**.

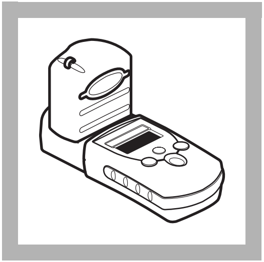
The display will show "- - - -" then "0.0".

Remove the blank from the cell holder.



8. Place the prepared sample in the cell holder.

Note: *Wipe liquid off sample cells.*



9. Cover the cell with the instrument cap.

10. Press **READ/ENTER**.
The display will show
"- - - -", followed by results
in pH units.

Accuracy Check

Preparation of pH 7.0 Standard Solution

A pH 7.00 standard solution is necessary to calibrate or check the accuracy of the pH measurement using the Standard Calibration Adjust feature (see Standard Calibration Adjust on page 2—13). Use the pH 7.00 Buffer Vial (included in this kit) or bulk buffer solution (see Optional Reagents on page 1—76). Add 0.5 mL of Phenol Red Solution to 10 mL of pH 7.00 Buffer Solution to prepare the color standard. Do not use colored buffer solutions.

For greatest accuracy, adjust the calibration curve using Standard Calibration Adjust with each new lot of Phenol Red Indicator. Periodically check the strength of the indicator by testing a pH 7.0 Buffer Solution.

Method Performance

Typical Precision (95% CI):

7.0 ± 0.1 pH

Standard Calibration Adjust

To perform a standard calibration adjustment using the pH 7.0 buffer, see Standard Calibration Adjust on page 2—13.

Summary of Method

Proper pH control in drinking water and swimming pools is necessary for many reasons. Bactericidal activity of chlorine is greatest when the pH is less than 7.4. Alum-type flocculents, important for clear water, perform best in a pH range of 7.2 to 8.0. Keeping the pH below 8.0 is important to control algae. A sudden rise in pH may signal an increase in algal growth. If the pH drops below 7.0, corrosion of pipes and metal fixtures may occur. Eye irritation is minimized when the pH is kept between 7.2 and 7.6.

Phenol Red is a phthalein indicator which has a transition window of pH 6.8 (yellow) to 8.2 (red). The pH is determined colorimetrically from the change in the absorbance of the alkaline peak.

Replacement Parts

Required Reagents

Description	Unit	Cat. No.
Buffer Solution, pH 7.0	25 mL	12222-20
Phenol Red Solution, Spec-grade	50 mL	26575-12

Required Apparatus

Sample Cells, 10 mL, with caps	6/pkg	24276-06

Optional Reagents

Buffer Solution, pH 7.0	500 mL	12222-49
Water, deionized	500 mL	272-49

Optional Apparatus

Droppers, 0.5 and 1.0 mL	pkg/20	21247-20

Replacement Parts

Batteries, AAA, alkaline	4/pkg	46743-00
Instrument Cap/light shield	each	59548-00
Instruction Manual	each	59571-88

Section 2
Instrument Manual

Instrument Operation

Key Functions

Key	Description	Function
⏻ ☼	**POWER**	On/Off/Backlight To turn on the backlight, turn on the instrument, then press and hold the power key until the backlight turns on. Press and hold again to turn off the backlight. This key functions the same in all instrument modes and ranges.
0	**ZERO/SCROLL**	In measurement mode, sets the instrument to zero. In menu mode, scrolls through menu options. Also scrolls numbers when entering or editing a value.
✓	**READ/ENTER**	In measurement mode, initiates sample measurement. In menu mode, selects a menu option. When entering numbers, moves one space to the right and executes the function when the entry is complete.

Key	Description	Function
☰	**MENU**	Enter/Exit the menu mode Press and hold for approximately 5 seconds to enter user-entered method mode.

Menu Selections

Press the **MENU** key to access the menu selections.

Switching Ranges

1. Press the **MENU** key. The display will show “SEL”. A flashing arrow indicates the current range.
2. Press the **READ/ENTER** key to toggle between ranges.
3. Press **MENU** again to accept and exit back to the measurement screen.

Setting the Time

1. Press the **MENU** key, then press the **ZERO/SCROLL** key until the display shows a time in the “00:00” format.

2. Press **READ/ENTER**. The digit to be edited will flash.
3. Use the **ZERO/SCROLL** key to change the entry, then press **READ/ENTER** to accept and advance to the next digit. The time is entered in 24-hour format.

Recalling Stored Measurements

1. Press the **MENU** key, then press the **ZERO/SCROLL** key until the display shows RCL. The instrument automatically stores the last 10 measurements.
2. In RCL, press **READ/ENTER** to recall the stored measurements, beginning with the most recent measurement taken. The meter stores the measurement number as 01 (most recent) through 10 (oldest), the time the measurement was taken, and the measurement value. The **ZERO/SCROLL** key allows for selection of a specific measurement by number. The **READ/ENTER** key scrolls through all stored data points.

Battery Installation

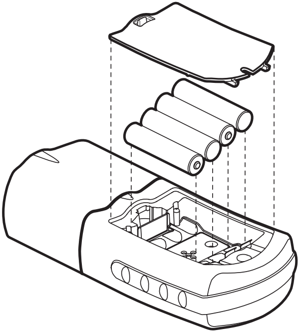
Figure 1 on page 2—7 provides an exploded view of battery installation.

1. Unhook the latch and remove the battery compartment cover. The polarities are shown on the battery holder.
2. Place the four batteries provided with the instrument in the holder as indicated and replace the battery compartment cover. The display will show the software version number (e.g., “P 1.6”) after correct battery installation.

When replacing discharged batteries, always replace the complete set of four alkaline batteries. Rechargeable batteries are not recommended and cannot be recharged in the instrument.

Note: *The Low Battery icon will appear on the display when the batteries have 10% battery life remaining. The battery icon will flash when the batteries are too low to complete measurements. See Instrument Keys and Display on page 1—11.*

Figure 1 Battery Installation



Error Codes

When the instrument cannot perform the function initiated by the operator, an error message will appear in the display. Refer to the appropriate message information below to determine what the problem is and how it can be corrected. Resolve error messages in the order that they appear on the display. Service Centers are listed in page 2—37.

Error Messages

1. E-0 No Zero (User mode)

   Error occurs when trying to read a standard in the user calibration mode before setting the meter to zero.

   - Zero the instrument on an appropriate blank.
2. E-1 Ambient Light Error

   There is too much light present to take a valid measurement.

   - Verify instrument cap is correctly seated.
   - If the problem persists, contact a Service Center (page 2—37).

3. E-2 LED Error

   The LED (light source) is out of regulation.

   - Replace batteries.
   - Verify LED lights up (inside the cell holder) when the **READ/ENTER** or **ZERO/SCROLL** key is pressed.
   - If the problem persists, contact a Service Center (page 2—37).

Note: When an E-1 or E-2 error occurs on a measurement, the display will show "_.__". (The decimal place is determined by the chemistry.) If the E-1 or E-2 error occurs while zeroing the meter, the meter will require the user to re-zero.

4. E-3 Standard Adjust Error

   The value obtained on the prepared standard exceeds the adjustment limits allowed for the standard concentration, or the concentration of the standard is outside the concentration range allowed for standard calibration adjust.

   - Prepare the standard and rerun according to the procedure.
   - Prepare a standard at or near the recommended concentrations given in the procedure.
   - Verify that the concentration of the standard has been entered correctly.

- If the problem persists, contact a Service Center (page 2—37).

5. E-6 Abs Error (User mode)

   Indicates that the absorbance value is invalid, or indicates an attempt to make a curve with less than two points.

   - Enter or measure the absorbance value again.
   - If the problem persists, contact a Service Center (page 2—37).

6. E-7 Standard Value Error (User mode)

   Standard concentration is equal to another standard concentration that is already entered.

   - Enter the correct standard concentration.
   - If the problem persists, contact a Service Center (page 2—37).

7. E-9 Flash Error

   The meter is unable to save data.

   - If the problem persists, contact a Service Center (page 2—37).

8. Underrange—flashing number below stated test range
   - Verify instrument cap is correctly seated.
   - Check zero by measuring a blank. If error recurs, re-zero the instrument.
   - If the problem persists, contact a Service Center (page 2—37).

   Note: See Maximum/Minimum Displayed Value on page 2—26 for more information.

9. Overrange—flashing number above stated test range

   Note: Flashing value will be 10% over the upper test limit.

   - Check for light blockage.
   - Dilute and retest sample.

   Note: See Maximum/Minimum Displayed Value on page 2—26 for more information.

Standard Calibration Adjust

The Pocket Colorimeter™ II instrument is factory-calibrated and ready for use without user calibration. Use of the factory calibration is recommended unless the user is required to generate a calibration. The Standard Calibration Adjust can be used to meet regulatory requirements.

This feature allows the factory default calibration curve to be adjusted with a known standard. Use the standard described in the procedure.

1. Place a blank in the meter (in measurement mode). Press **ZERO/SCROLL**.
2. Place the reacted standard in the meter. Press **READ/ENTER**.
3. Press **MENU**, then press **ZERO/SCROLL** until the display shows “SCA”.
4. Press **READ/ENTER** to display the standard calibration adjust value.
5. Press **READ/ENTER** to adjust the curve to the displayed value. The meter will return to the measurement mode and the Calibration Adjusted icon will appear in the display window.

If an alternate concentration is used, or if a standard concentration is not given:

6. Repeat steps 1–4.

7. Press **ZERO/SCROLL** to access the Edit function, then press **READ/ENTER** to begin editing. The digit to be edited will flash. Use the **ZERO/SCROLL** key to change the entry, then press **READ/ENTER** to accept and advance to the next digit.

   When the last digit is entered, press **READ/ENTER** and the meter will adjust the curve to the value entered. The meter will return to measurement mode and the Calibration Adjusted icon will appear in the display window.

To turn off Standard Calibration Adjust (SCA):

1. Press **MENU**.
2. Press **ZERO/SCROLL** until “SCA” appears in the display.
3. Press **READ/ENTER**, then press **ZERO/SCROLL** until “Off” appears in the display.
4. Press **READ/ENTER** to turn off SCA.

   Note: Perform another standard calibration adjust to turn SCA on again.

   Note: For meters with factory-calibrated ranges or methods, Standard Calibration Adjust (SCA) will be disabled when a user-entered method is programmed into the meter. To turn SCA back on, restore the meter to factory default calibration. See Retrieving the Factory Calibration on page 2—25.

User-Entered Calibration

Overview

The Pocket Colorimeter™ II will accept a user-prepared calibration curve. The curve can extend from 0 to 2.5 absorbance. A user-prepared calibration curve may be entered into any channel that does not contain a factory-programmed curve. These channels are labeled “abs” on instruments having a single factory calibration or are labeled “1” and “2” on the uncalibrated single wavelength instruments. Any chemistry that can be run at the instrument wavelength may be user-entered in these channels.

Using prepared standard solutions that cover the range of interest, the meter generates a calibration curve by calculating the straight-line segments between each standard entered. A calibration curve may be entered using the keypad. Factory-entered calibration curves may also be recalculated or adjusted using the same procedure.

To enter the user-entered calibration mode, press the **MENU** key and hold it down until the display shows “USER” (about 5 seconds), followed by “CAL”. Press **ZERO/SCROLL** to scroll through the options.

- CAL—Used to enter and edit standard values and measure absorbance values, or review the existing calibration.
- Edit—Used to enter and edit standard values and absorbance values with the keypad or review the existing calibration. Used to enter a predetermined calibration curve.
- dFL—Used to return the instrument back to the default factory calibration. User-entered calibrations are stored upon exit from the calibration or edit modes.

Note: To return to factory settings, following the instructions in Retrieving the Factory Calibration on page 2—25.

If the instrument is shut off or loses power during data entry, all edits will be lost. Automatic shut-off in user-entered calibration entry mode is 60 minutes.

CAL and Edit Submenus

In CAL mode, standard values are entered and absorbance values are measured. In Edit mode, standard and absorbance values are entered.

- To select CAL from the User menu, press **READ/ENTER**.
- To select Edit from the User menu, press **ZERO/SCROLL** and **READ/ENTER.**

- Once in the CAL or Edit option, press the **READ/ENTER** key to navigate through each option.

  *Note: Press **ZERO/SCROLL** to quickly scroll through each option.*

Calibration Procedure Using Prepared Standards

Note: *Deionized water or a reagent blank can be used to zero during the calibration procedure. Calibrations generated with deionized water as the zero will give less accurate results if the reagent blank is significantly more turbid or colored than deionized water. Use the deionized water or the reagent blank as the zero concentration point (S0) in the following calibration procedure.*

1. Turn on the instrument and select the range to be calibrated. An arrow at the top of the display will point to the selected range. To change ranges, press the **MENU** key, then use the **READ/ENTER** key to toggle between ranges 1 and 2. Press **MENU** again to return to measurement mode.
2. Follow the procedure for the chemical method to be calibrated. Prepare a reagent blank (if needed) and a standard solution. Allow the color to develop fully.

3. Insert the reagent blank or deionized water into the meter and cover with the cap. Press the **ZERO/SCROLL** key. The meter will display "- - - -", followed by "0.000". This initializes (zeroes) the meter.
4. Press the **MENU** key and hold it down until the display shows "USER", followed by "CAL". Press **READ/ENTER** to enter the calibration mode.
5. In factory-calibrated meters, S0 will appear in the display.

Note: When recalibrating a factory-calibrated meter or range, RES (resolution) cannot be changed.

6. In uncalibrated meters or meters with ranges labeled Abs, "RES" will appear. Press **ZERO/SCROLL** to review the current resolution (decimal placement). Press **ZERO/SCROLL** again to accept the current resolution. To change the resolution, press **READ/ENTER,** then **ZERO/SCROLL** to change the resolution. Press **READ/ENTER** to accept the new resolution. "S0" will appear on the display.
7. Press the **READ/ENTER** key again, then enter the blank value.

Note: Press the **READ/ENTER** *key to move from digit to digit. Use the* **ZERO/SCROLL** *key to change the number.*

8. After completing entry of the blank value, press the **READ/ENTER** key. The display will show "A0".

9. Insert the reagent blank or deionized water into the cell holder. Cover the blank with the instrument cap.
10. Press the **READ/ENTER** key. The meter will measure and display the absorbance value for "S0".
11. Remove the sample blank. Press the **ZERO/SCROLL** key. "S1" will appear. Press the **READ/ENTER** key, then enter the first standard value.

    Note: Press the **READ/ENTER** *key to move from digit to digit. Use the* **ZERO/SCROLL** *key to change the number.*

12. After completing entry of the first standard value, press the **READ/ENTER** key. The display will show "A1".
13. Insert the first reacted standard solution into the cell holder. Cover the prepared standard with the instrument cap.
14. Press the **READ/ENTER** key. The meter will measure and display the absorbance value for S1.
15. The calibration is complete with two points. If additional standards are required, press **ZERO/SCROLL** until "Add" appears on the display. Repeat steps 11–14 to enter additional standards.

16. Press the **MENU** key twice to exit and accept the changes. The instrument will use this calibration to determine the displayed concentration of future sample measurements.

Entering a Predetermined Calibration Curve

Note: Entering a predetermined calibration curve requires at least two data pairs. Each data pair requires a concentration value and the absorbance value for the given concentration. Up to 10 data pairs may be entered. This procedure uses the Edit mode.

1. Turn on the instrument and select the range to be calibrated. An arrow at the top of the display will point to the selected range. To change ranges, press the **MENU** key, then use the **READ/ENTER** key to toggle between ranges 1 and 2. Press **MENU** again to return to measurement mode.
2. Press the **MENU** key and hold it down until the display shows “USER”, followed by “CAL”. Press **ZERO/SCROLL** to scroll to EDIT. Press **READ/ENTER.**
3. In uncalibrated meters or in Abs range, “RES” will appear. Press **ZERO/SCROLL**. To change the resolution (decimal placement), press **READ/ENTER**. Press **ZERO/SCROLL** to select the new resolution, then press **READ/ENTER** to accept. “S0” will appear on the display.

4. Enter the concentration value and absorbance value of the first data pair (S0, A0).
5. To enter the S0 value, press **READ/ENTER**. Use the **ZERO/SCROLL** key to select the numerical value, then press the **READ/ENTER** key to accept the entry and advance to the next decimal place. Repeat this sequence until the S0 concentration value is entered.
6. After editing the S0 value, press **READ/ENTER** to accept. “A0” will appear on the display.
7. To enter the absorbance value for S0, press the **READ/ENTER** key to go to entry mode. Use the **ZERO/SCROLL** key to select the numerical value, then press the **READ/ENTER** key to accept the entry and advance to the next decimal place. Repeat this sequence until the absorbance value for S0 is entered.
8. After entering A0, press **READ/ENTER** to accept. “S1” will appear on the display.
9. Repeat steps 5 through 8 for each standard value and absorbance value pair in the calibration curve

Note: After A1 is entered, Add will appear in the display. If additional data pairs are to be entered, press **READ/ENTER** *and continue with step 9.*

10. When all the calibration data has been entered, press **MENU** twice to return to the measurement mode.

Editing a User-entered or Factory Calibration Curve

1. Press the **MENU** key and hold it down until the display shows “USER”, followed by “CAL”. Press **ZERO/SCROLL** until EDIT appears.
2. Press the **READ/ENTER** key to enter Edit mode. In factory-calibrated meters, “S0” will appear in the display.

   Note: When editing a factory-calibrated meter or range, RES (resolution) cannot be changed.

   Note: When RES or S0 appears in the display, press **ZERO/SCROLL** *to quickly scroll to the data to be edited.*

3. In uncalibrated meters or in Abs range, “RES” will appear. Press **ZERO/SCROLL** to review the current resolution. Press **ZERO/SCROLL** again to accept the displayed resolution. To change the resolution (decimal placement), press **READ/ENTER**. Press **ZERO/SCROLL** to select the new resolution, then press **READ/ENTER** to accept. “S0” will appear on the display.
4. Press **READ/ENTER**. The current concentration value for S0 will appear on the display.

5. To edit the S0 value, press **READ/ENTER**. Use the **ZERO/SCROLL** key to select the numerical value, then press the **READ/ENTER** key to accept the entry and advance to the next decimal place. Repeat this sequence until the S0 concentration value is entered.
6. After editing the S0 value, press **READ/ENTER** to accept. “A0” will appear on the display.
7. To edit the absorbance value for S0, press the **READ/ENTER** key to go to entry mode. Use the **ZERO/SCROLL** key to select the numerical value, then press the **READ/ENTER** key to accept the entry and advance to the next decimal place. Repeat this sequence until the absorbance value for S0 is entered.
8. After editing A0, press **READ/ENTER** to accept. “S1” will appear on the display.
9. Repeat steps 4 through 8 for each standard value and absorbance value pair in the calibration curve.
10. When all calibration data has been reviewed or edited, “ADD” will appear in the display.
11. Press **READ/ENTER** to add more calibration points, or press **MENU** twice to return to the measurement mode.

Note: When a factory calibration curve has been edited, the "calibration adjust" icon will appear in the display.

Exiting the Calibration Routine

Exit the calibration routine by pressing the **MENU** key to return to measurement mode. The instrument uses the last completed user-entered calibration or the factory calibration if no user-entered calibration has been completed.

Deleting Calibration Points

1. Select the range containing user-entered calibration points. See Switching Ranges on page 2—4.
2. Press and hold the **MENU** key until "USER", then "CAL" appears. Press **READ/ENTER.**

   Note: Calibration points can also be deleted in Edit mode.

3. Press **ZERO/SCROLL** to select the point to delete (e.g., S0 or S1 or S2). Press **READ/ENTER.**
4. The left digit will flash. Press **ZERO/SCROLL** until "dEL" appears. ("dEL" will appear after the numeral 9.)

5. Press **READ/ENTER** to delete. Repeat for all points to be deleted.

   Note: The minimum number of valid points is two. For example, if five points have been entered, three can be deleted using this feature.

6. Press **MENU** to return to the measurement mode.

Retrieving the Factory Calibration

1. Select the range to restore factory default calibration. See Switching Ranges on page 2–4.
2. Press and hold the **MENU** key until “USER”, then “CAL” appears.
3. Press the **ZERO/SCROLL** key to find dFL.
4. Press the **READ/ENTER** key to select dFL and restore the instrument to the factory default calibration.

   Note: For meters with factory-calibrated ranges or methods, Standard Calibration Adjust (SCA) will be disabled when a user-entered method is programmed into the meter. To turn SCA back on, restore the meter to factory default calibration.

Maximum/Minimum Displayed Value

In meters with absorbance (Abs) ranges, the maximum displayed value and minimum displayed value is related to the value of the standards entered in a user calibration.

Measurements that exceed the minimum or maximum standards entered in the user calibration will return a flashing number indicating “underrange” or “overrange”. See *Error Codes* (page 2—12) for more information.

Example 1

For a calibration with the following standards:

S0=0.000
S1=1.000

Maximum Displayed Value	1.000
Minimum Displayed Value	0.000

Example 2

For a calibration with the following standards:

S0=1.00
S1=2.00
S2=4.00

Maximum Displayed Value	4.00
Minimum Displayed Value	1.00

For Hach-calibrated programs, the maximum and minimum displayed values always equal the factory-calibrated values and cannot be changed.

Certification

Hach Company certifies this instrument was tested thoroughly, inspected, and found to meet its published specifications when it was shipped from the factory.

The Pocket Colorimeter™ II instrument has been tested and is certified as indicated to the following instrumentation standards:

EMC Immunity:

Per 89/ 336/ EEC EMC: EN 61326: 1998 (Electrical Equipment for measurement, control and laboratory use—EMC requirements). Supporting test records by Hach Company, certified compliance by Hach Company.

Standard(s) include:

IEC 1000-4-2: 1995 (EN 61000-4-2: 1995) Electro-Static Discharge Immunity (Criteria B)

IEC 1000- 4- 3: 1995 (EN 61000- 4- 3: 1996) Radiated RF Electro- Magnetic Field Immunity (Criteria A)

Additional Immunity Standard(s) include:

ENV 50204: 1996 Radiated Electromagnetic Field from Digital Telephones

(Criteria A) Radio Frequency Emissions:

Per 89/ 336/ EEC EMC: EN 61326: 1998 (Electrical Equipment for measurement, control and laboratory use—EMC requirements) “Class B” emission limits. Supporting test records from Hach EMC Test Facility, certified compliance by Hach Company.

Additional Radio Frequency Emissions Standard(s) include:

EN 55022 (CISPR 22), Class B emissions limits.

Canadian Interference-causing Equipment Regulation, IECS-003, Class A: Supporting test records from Hach EMC Test Facility, certified compliance by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference-causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

FCC Part 15, Class “A” Limits: Supporting test records from Hach EMC Test Facility, certified compliance by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. The following techniques of reducing the interference problems are applied easily.

1. Remove power from the Pocket Colorimeter instrument by removing one of its batteries to verify that it is or is not the source of the interference.
2. Move the Pocket Colorimeter instrument away from the device receiving the interference.
3. Reposition the receiving antenna for the device receiving the interference.
4. Try combinations of the above.

GENERAL INFORMATION

At Hach Company, customer service is an important part of every product we make.

With that in mind, we have compiled the following information for your convenience.

How to Order

By Telephone:

6:30 a.m. to 5:00 p.m. MST
Monday through Friday
(800) 227-HACH (800-227-4224)

By FAX:

(970) 669-2932 (Hach Loveland)

By Mail:

Hach Company
P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A.

For order information by E-mail:

orders@www.hach.com

Information Required:

- Hach account number (if available)
- Billing address
- Shipping address
- Your name and phone number
- Purchase order number
- Catalog number
- Brief description or model number
- Quantity

How to Order, continued

Technical and Customer Service (USA only)

Hach Technical and Customer Service Department personnel are eager to answer questions about our products and their use and to take your orders. Specialists in analytical methods, they are happy to put their talents to work for you.
Call 1-800-227-4224 or E-mail techhelp@hach.com.

International Customers

Hach maintains a worldwide network of dealers and distributors. To locate the representative nearest you, send E-mail to intl@hach. com or call (970) 669-3050.

In Canada

Hach Instrument Service Centre, Winnipeg, Manitoba, Canada

Telephone: (204) 632-5598; (800) 665-7635

FAX: (204) 694-5134

Repair Service

Authorization must be obtained from Hach Company before sending any items for repair. Please contact the Hach Service Center serving your location.

In the United States:

Hach Company
100 Dayton Avenue
Ames, Iowa 50010
(800) 227-4224 (USA only)
FAX: (515) 232-3835

Canada:

Hach Sales & Service Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba R3H 0X4
(800) 665-7635 (Canada only)
Telephone: (204) 632-5598
FAX: (204) 694-5134
E-mail: canada@hach.com

Latin America, Caribbean, Africa, Far East, Indian Subcontinent:

Hach Company World Headquarters
P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A.
Telephone: (970) 669-3050
FAX: (970) 669-2932
E-mail: intl@hach. com.

Europe, the Middle East, or Mediterranean Africa:

HACH Company, c/o
Dr. Bruno Lange GmbH & CO. KG
Willstätterstr. 11
40549 Düsseldorf, Germany
Telephone: +49/(0)211/52 88-0
FAX: +49/(0)211/52 88-134

Warranty

Hach Company warrants this product to the original purchaser against any defects that are due to faulty material or workmanship for a period of two years from date of shipment.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price, excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from Hach Company.

Limitations

This warranty does not cover:

- damage caused by acts of God, natural disaster, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- damage caused by misuse, neglect, accident or improper application or installation
- damage caused by any repair or attempted repair not authorized by Hach Company
- any product not used in accordance with the instructions furnished by Hach Company
- freight charges to return merchandise to Hach Company
- freight charges on expedited or express shipment of warranted parts or product
- travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.